5845000

5845000

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SERIAL NUMBER	FILING DATE	CLASS	SUBCLASS	GROUP ART UNIT	EXAMINER
08/474,786	06/07/95	382	100	2733	COUSO

APPLICANTS

DAVID S. BREED, BOONTON TOWNSHI, NJ; WILBUR E. DUVALL, KIMBERLING CITY, MO; WENDELL C. JOHNSON, TORRANCE, CA.

CONTINUING DATA********
VERIFIED

THIS APPLN IS A CIP OF 07/878,571 05/05/92 ABN
AND A CIP OF 08/040,978 03/31/93
AND A CIP OF 08/247,760 05/23/94
AND A CIP OF 08/239,978 05/09/94

FOREIGN/PCT APPLICATIONS********
VERIFIED

NOTE-DISCLAIMER
The term of this patent shall not extend beyond the expiration date of Pat. No. 5835613.

FOREIGN FILING LICENSE GRANTED 09/07/95 ***** SMALL ENTITY *****

Foreign priority claimed / 35 USC 119 conditions met / Verified and Acknowledged	AS FILED	STATE OR COUNTRY	SHEETS DRWGS.	TOTAL CLAIMS	INDEP. CLAIMS	FILING FEE RECEIVED	ATTORNEY'S DOCKET NO.
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ADDRESS
BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

TITLE
OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

ISSUE FEE IN F

U.S. DEPT. OF COMM./ PAT. & TM—PTO-436L (Rev.12-94)

PARTS OF APPLICATION FILED SEPARATELY

NOTICE OF ALLOWANCE MAILED

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PRIMARY EXAMINER

Primary Examiner

DRAWING

Sheets Drwg.	Figs. Drwg.	Print Fig.
12	13	1B

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08/474,786

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U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/474,786	06/07/95	382	2613

APPLICANT

DAVID S. BREED, BOONTON TOWNSHI, NJ; WILBUR E. DUVALL, KIMBERLING CITY, MO; WENDELL C. JOHNSON, TORRANCE, CA.

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OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

This is to certify that annexed hereto is a true copy from the records of the United States Patent and Trademark Office of the application which is identified above.

By authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

Date Certifying Officer

PATENT APPLICATION

08474786

Date Entered or Counted

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PTO GRANT DEC 0 1 1998

(FRONT)

US005845000A

United States Patent [19]

Breed et al.

[11] **Patent Number: 5,845,000**

[45] **Date of Patent: *Dec. 1, 1998**

[54] **OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES**

[75] Inventors: **David S. Breed**, Boonton Township, N.J.; **Wilbur E. DuVall**, Kimberling City, Mo.; **Wendell C. Johnson**, Torrance, Calif.

[73] Assignee: **Automotive Technologies International, Inc.**, Denville, N.J.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,835,613.

[21] Appl. No.: **474,786**

[22] Filed: **Jun. 7, 1995**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 878,571, May 5, 1992, abandoned, Ser. No. 40,978, Mar. 31, 1993, abandoned, Ser. No. 247,760, May 23, 1994, and Ser. No. 239,978, May 9, 1994, abandoned.

[51] **Int. Cl.**[6] **G06K 9/00**

[52] **U.S. Cl.** **382/100**; 348/143

[58] **Field of Search** 340/436; 382/104, 382/103, 291, 100; 280/735; 348/143, 148

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,496,222	1/1985	Shah	350/354
4,625,329	11/1986	Ishikawa et al.	382/1
4,648,052	3/1987	Friedman et al.	364/550
4,720,189	1/1988	Heynen et al.	351/210
4,768,088	8/1988	Ando	358/93
4,836,670	6/1989	Hutchinson	351/210
4,881,270	11/1989	Knecht et al.	382/191
4,906,940	3/1990	Greene et al.	382/100
4,950,069	8/1990	Hutchinson	351/210
4,966,388	10/1990	Warner et al.	280/730.1
5,003,166	3/1991	Girod	250/201.4

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

342337	2/1991	Japan .
94/22692	10/1994	WIPO .

OTHER PUBLICATIONS

"Analysis of Hidden Units in a Layered Network Trained to Classify Sonar Targets", R. Paul Gorman, et al., Neural Networks, vol. 1, pp.75–89, 1988.

Learned Classification of Sonar Targets Using a Massively Parallel Network, R. Paul Gorman et al., IEEE Transactions on Acoustics, Speech and Signal Processing, vol. 36, No. 7, Jul., 1988, pp. 1135–1140.

"How Airbags Work", David S. Breed, Presented at the Canadian Association of Road Safety Professional, Oct. 19, 1992–Oct. 20, 1992.

Derwent Abstract of German Patent Publication No. DE 42 11 556, Oct. 7, 1993.

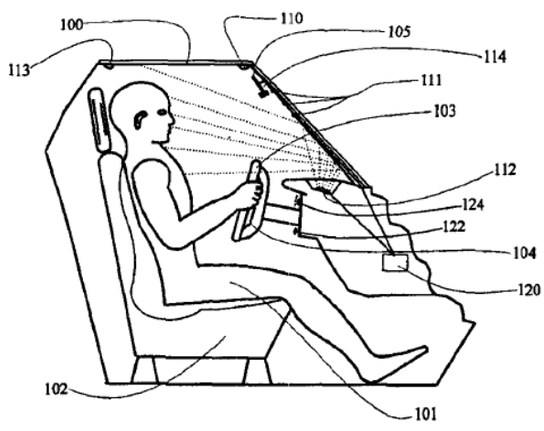
Derwent Abstract of Japanese Patent Application No. 02–051332, Nov. 13, 1991.

Primary Examiner—Yon J. Couso

[57] **ABSTRACT**

A vehicle interior monitoring system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle. When system is installed in the passenger compartment of an automotive vehicle equipped with an airbag, the system determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag.

25 Claims, 12 Drawing Sheets



U.S. PATENT DOCUMENTS

5,008,946	4/1991	Ando	382/2
5,026,153	6/1991	Suzuki et al.	356/3.16
5,064,274	11/1991	Alten	359/604
5,071,160	12/1991	White et al.	280/735
5,074,583	12/1991	Fujita et al.	280/730.1
5,118,134	6/1992	Mattes et al.	280/735
5,162,861	11/1992	Tamburino et al.	356/5
5,181,254	1/1993	Schweizer et al.	382/100
5,185,667	2/1993	Zimmermann	358/209
5,193,124	3/1993	Subbarao	382/255
5,214,744	5/1993	Schweizer et al.	395/11
5,227,784	7/1993	Masamori et al.	340/436
5,235,339	8/1993	Morrison et al.	342/159
5,249,027	9/1993	Mathur et al.	356/1
5,249,157	9/1993	Taylor	340/435
5,298,732	3/1994	Chen	250/203.4
5,305,012	4/1994	Faris	345/7
5,309,137	5/1994	Kajiwara	348/148
5,329,206	7/1994	Slotkowski et al.	315/159
5,330,226	7/1994	Gentry et al.	280/735
5,339,075	8/1994	Abst et al.	340/903
5,355,118	10/1994	Fukahara	348/148
5,390,136	2/1995	Wang	364/754
5,441,052	8/1995	Miyajima	126/661.09
5,454,591	10/1995	Mazur et al.	260/735
5,537,003	7/1996	Bechtel et al.	35/82

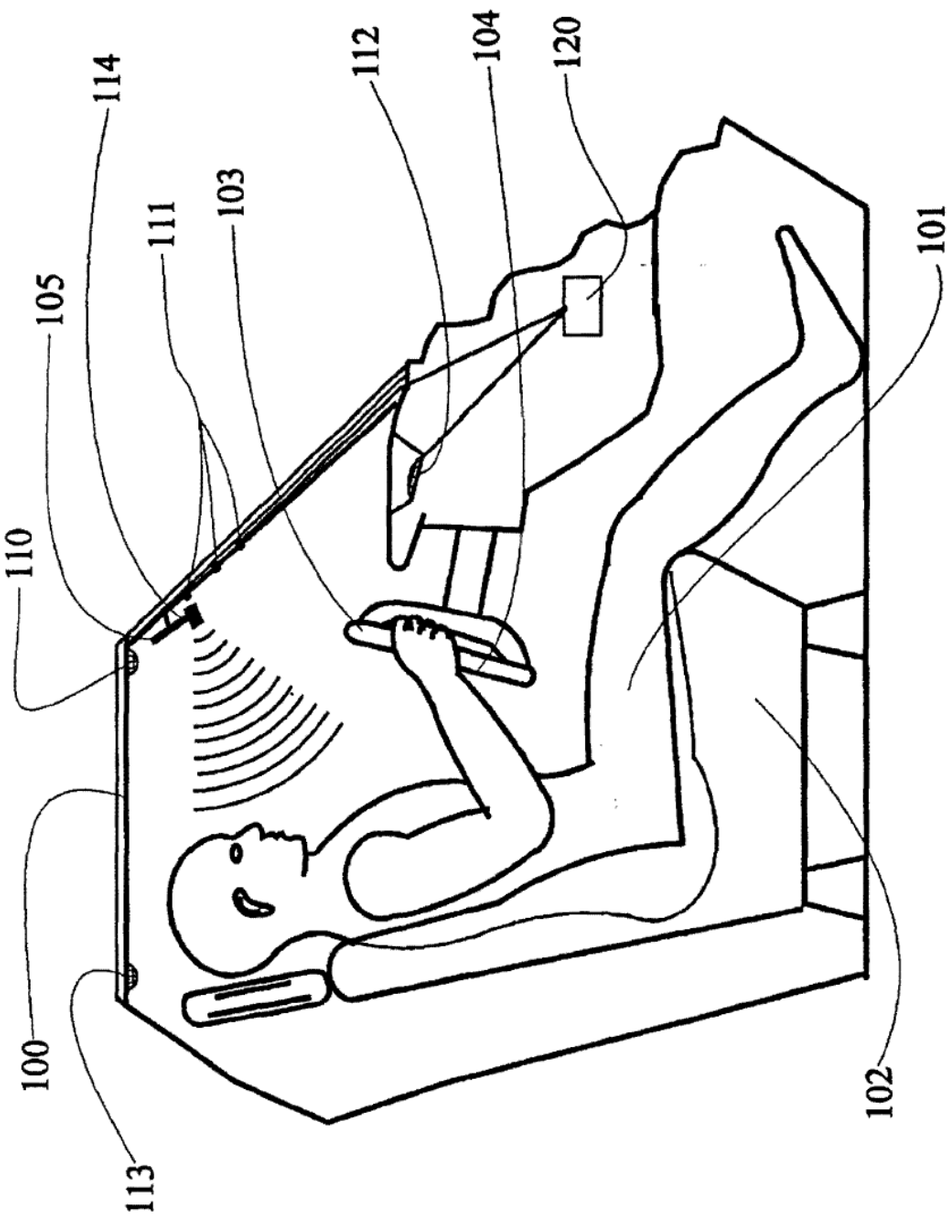


FIG. 1A

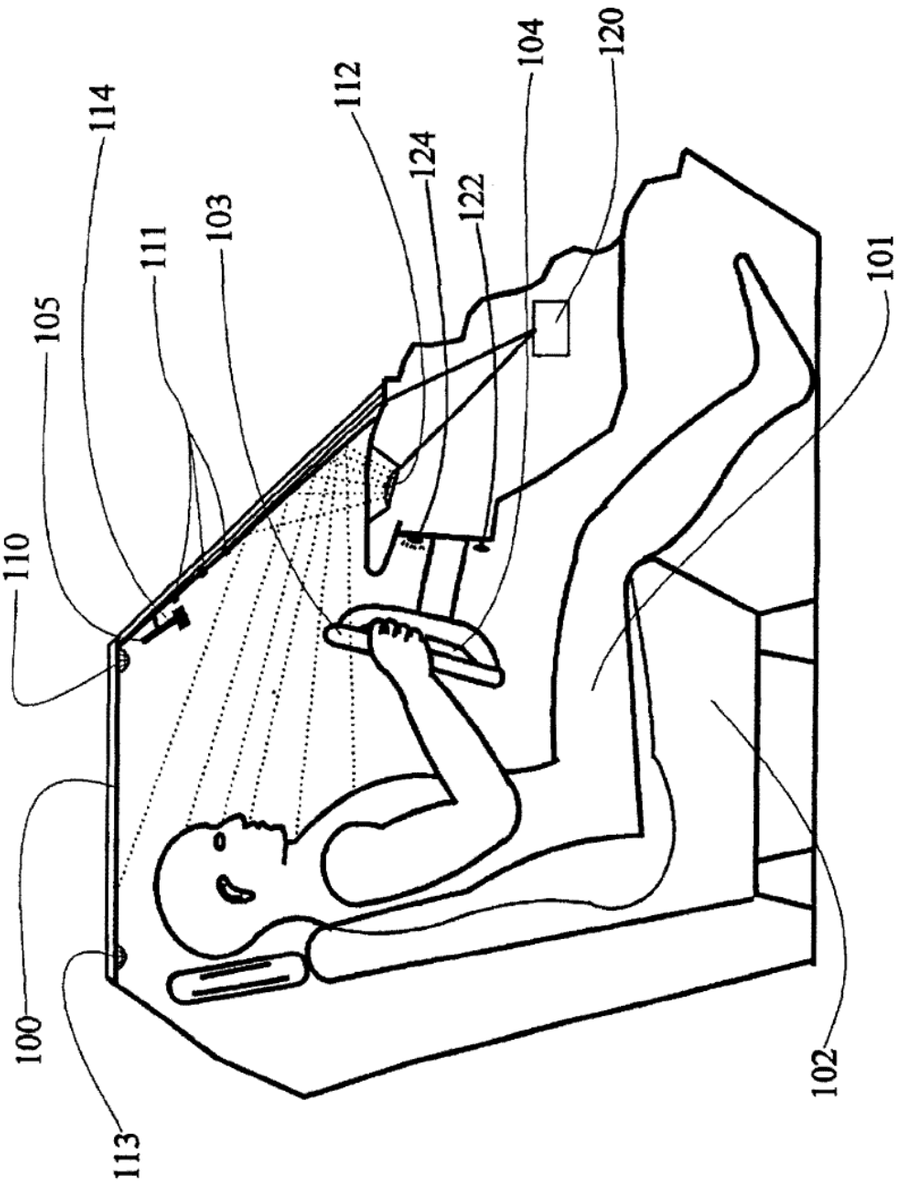


FIG. 1B

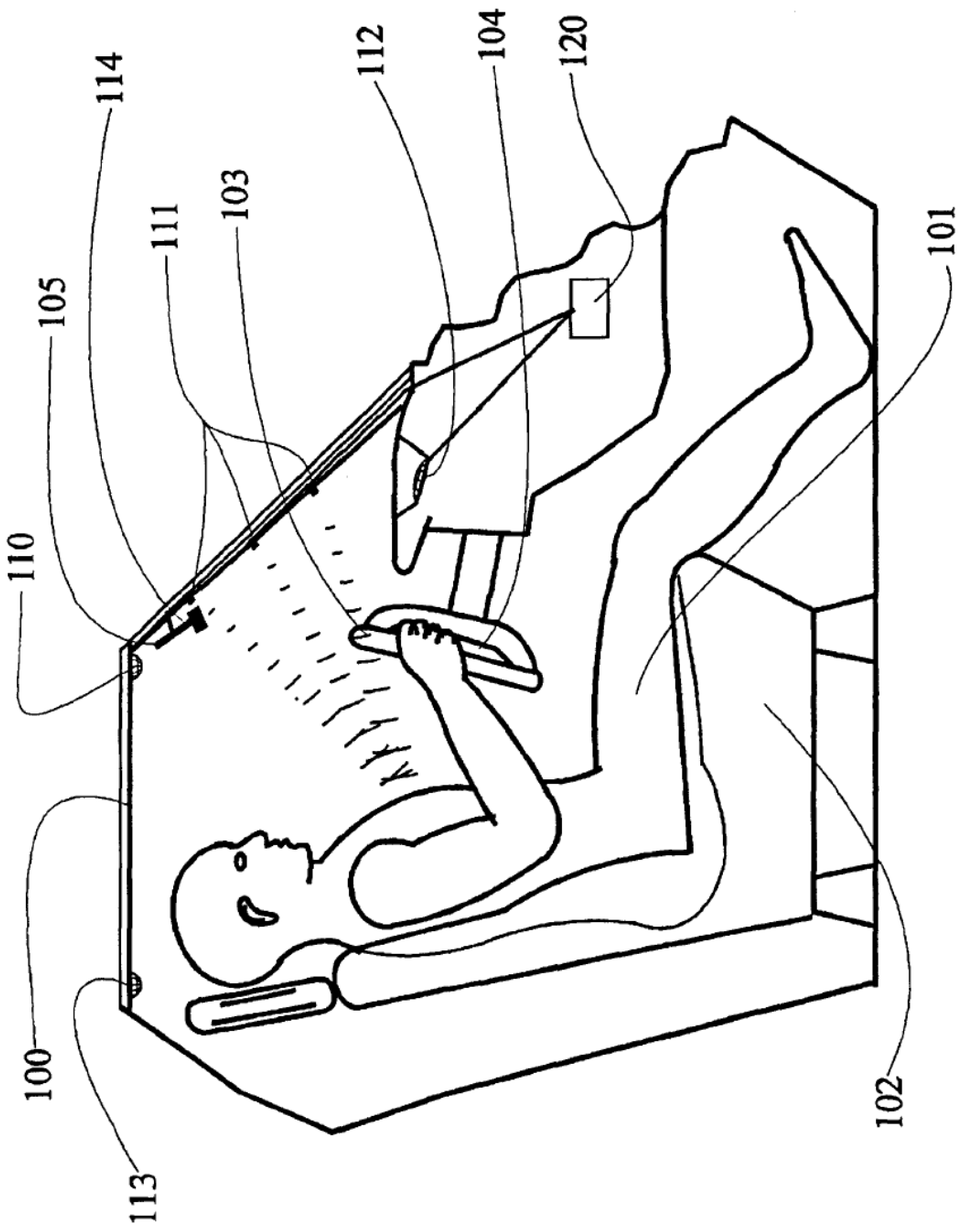


FIG. 1C

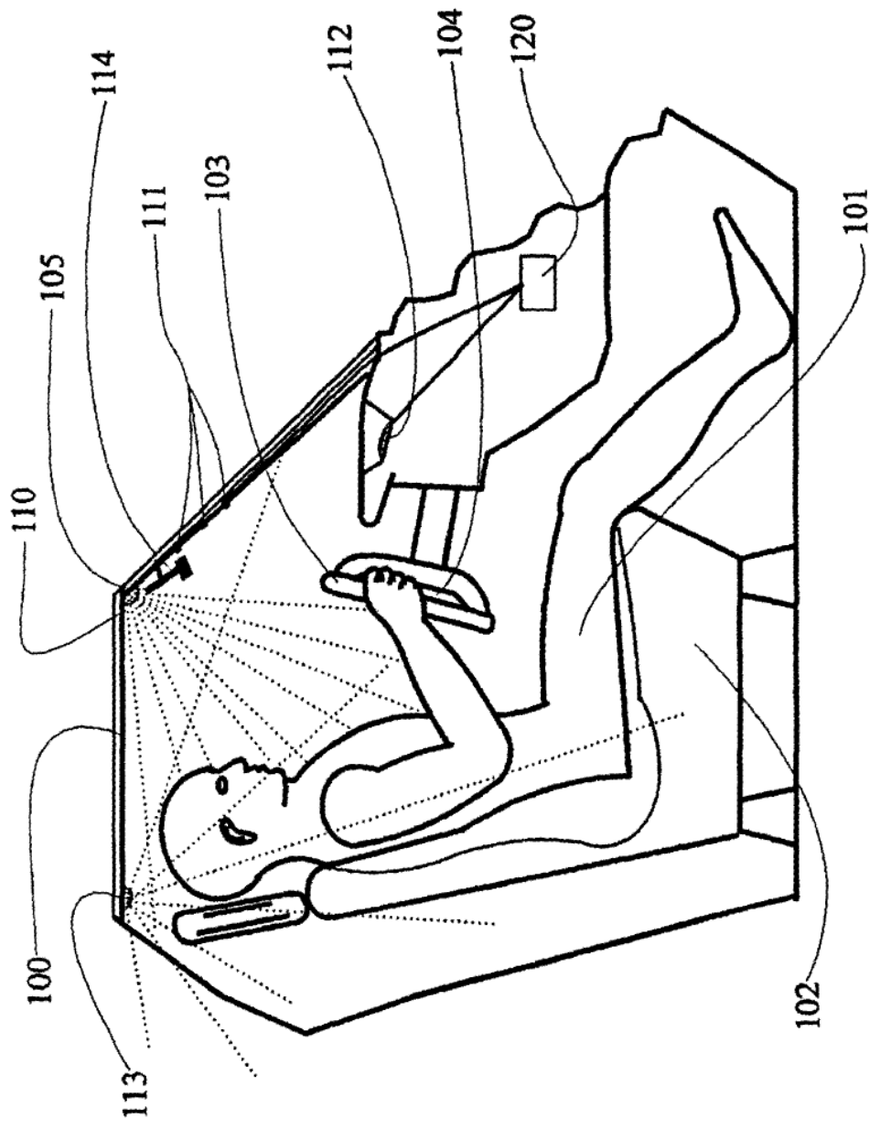


FIG. 1D

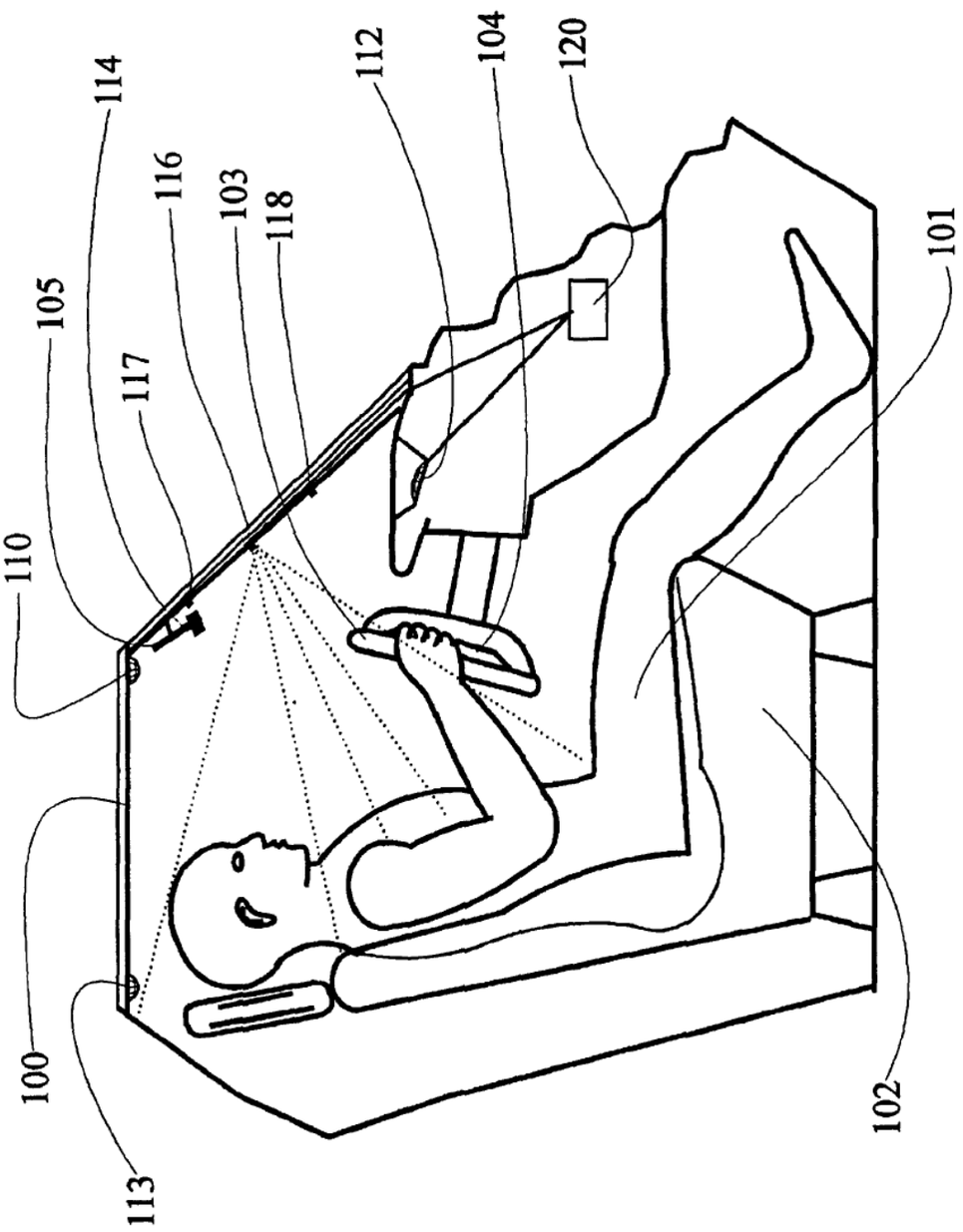


FIG. 1E

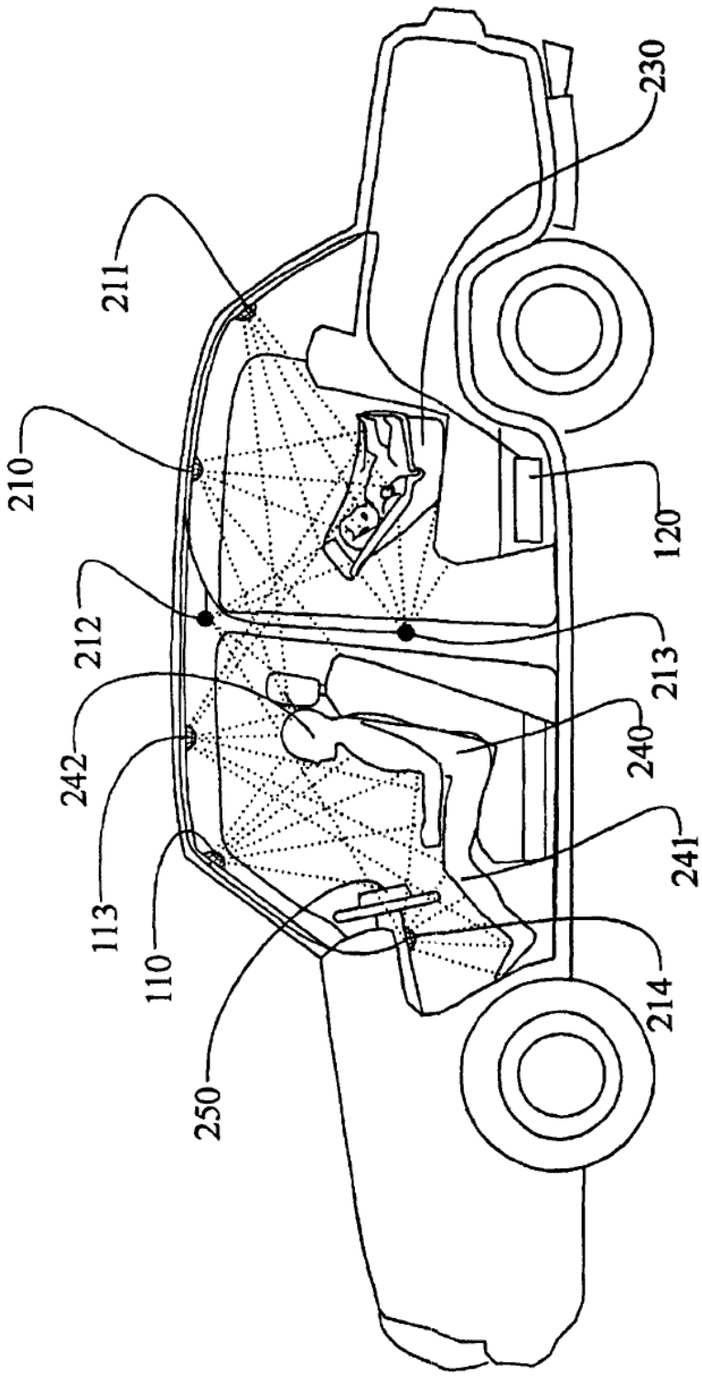


FIG. 2

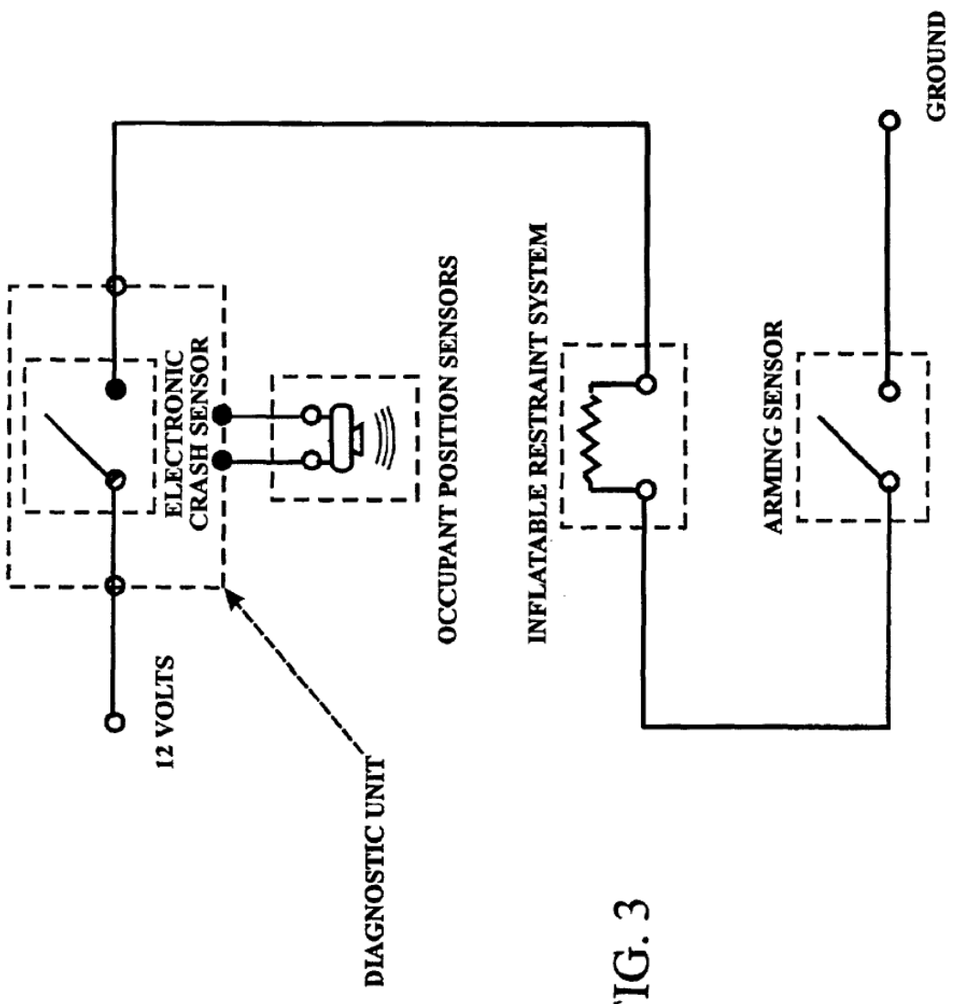

12 VOLTS
ELECTRONIC CRASH SENSOR
DIAGNOSTIC UNIT
OCCUPANT POSITION SENSORS
INFLATABLE RESTRAINT SYSTEM
ARMING SENSOR
GROUND

FIG. 3

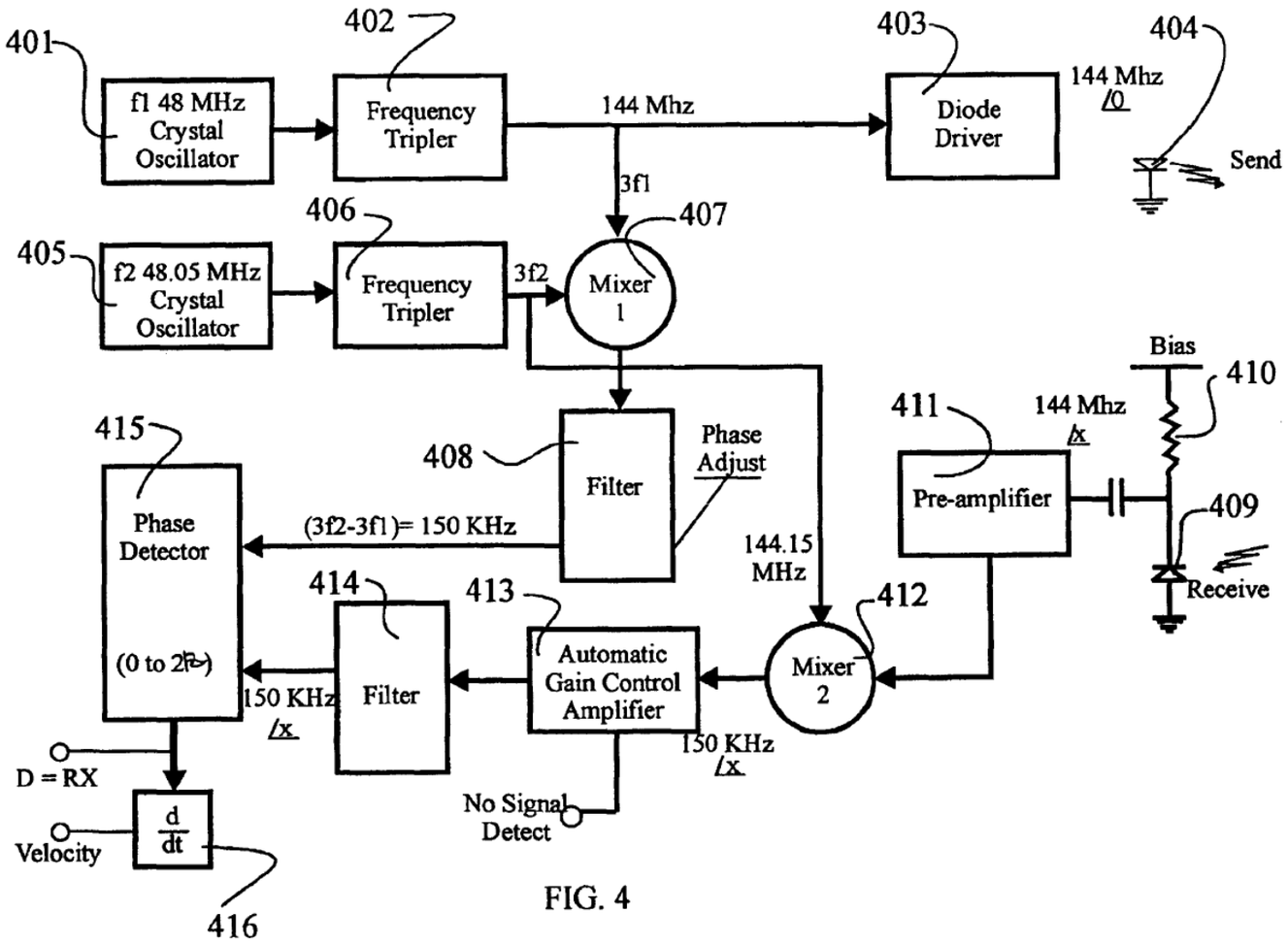

401
f1 48 MHz Crystal Oscillator
402
Frequency Tripler
144 Mhz
403
Diode Driver
144 Mhz
404
Send
3f1
405
f2 48.05 MHz Crystal Oscillator
406
Frequency Tripler
3f2
407
Mixer 1
Bias
410
411
144 Mhz
Pre-amplifier
409
Receive
408
Filter
Phase Adjust
415
Phase Detector
(3f2-3f1)= 150 KHz
144.15 MHz
414
413
412
Automatic Gain Control Amplifier
Mixer 2
(0 to 2π)
150 KHz
Filter
150 KHz
D = RX
No Signal Detect
Velocity
d/dt
416

FIG. 4

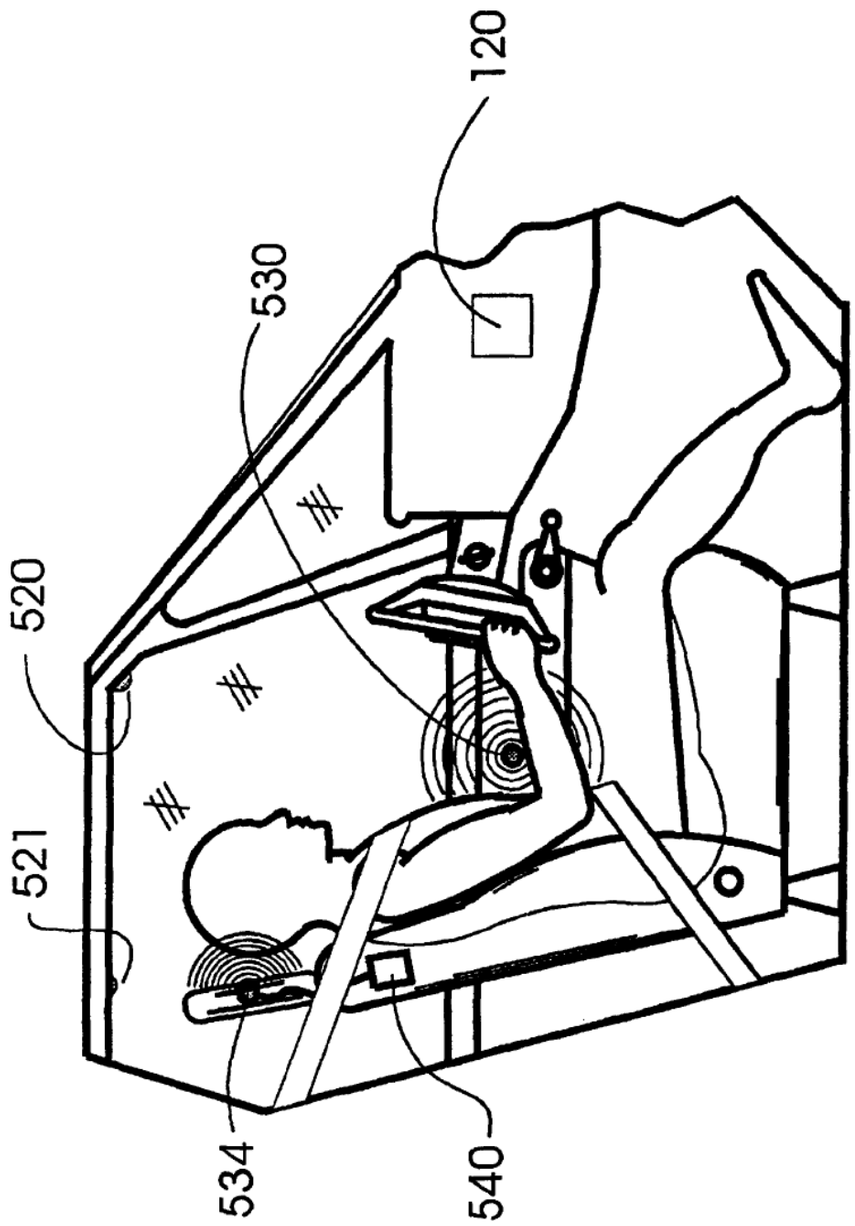


FIG. 5

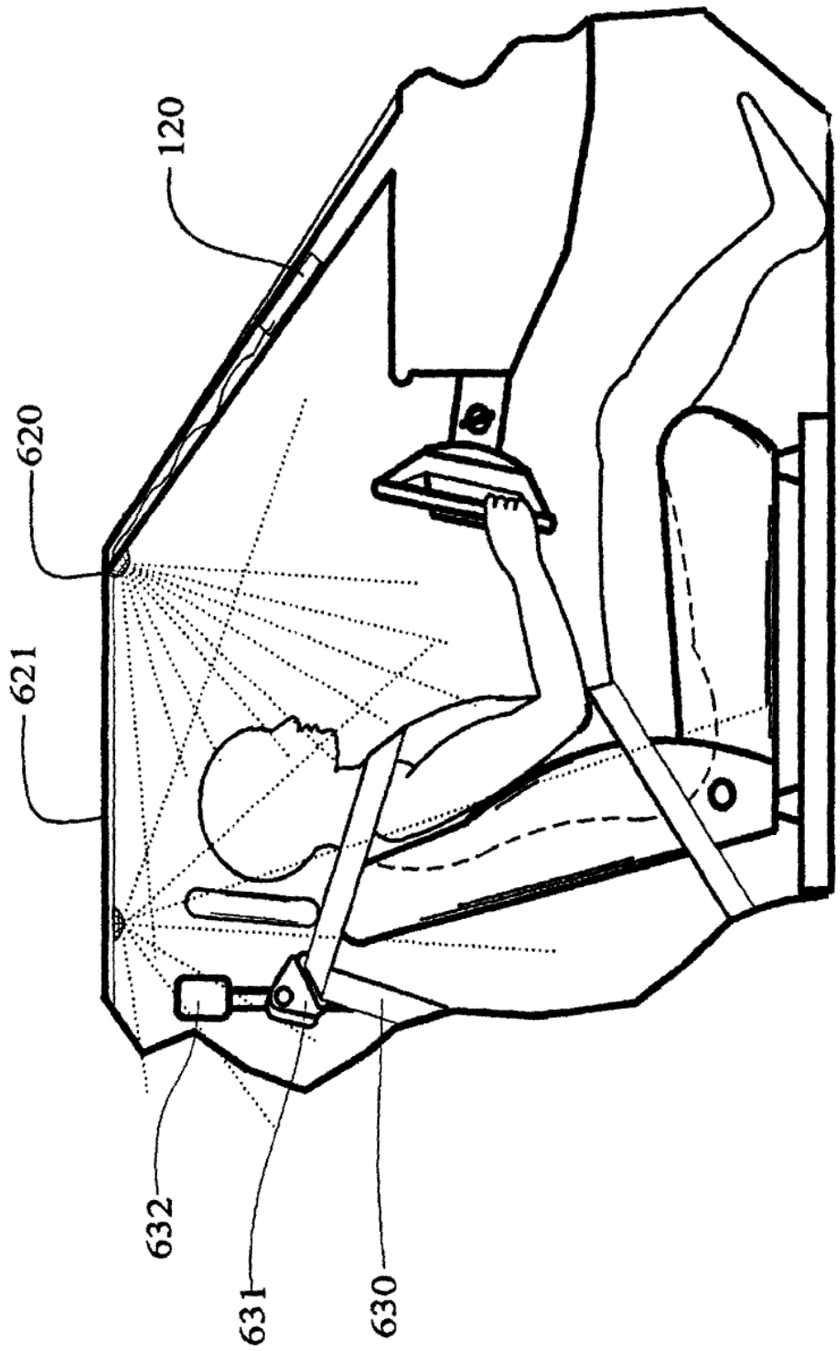


FIG. 6

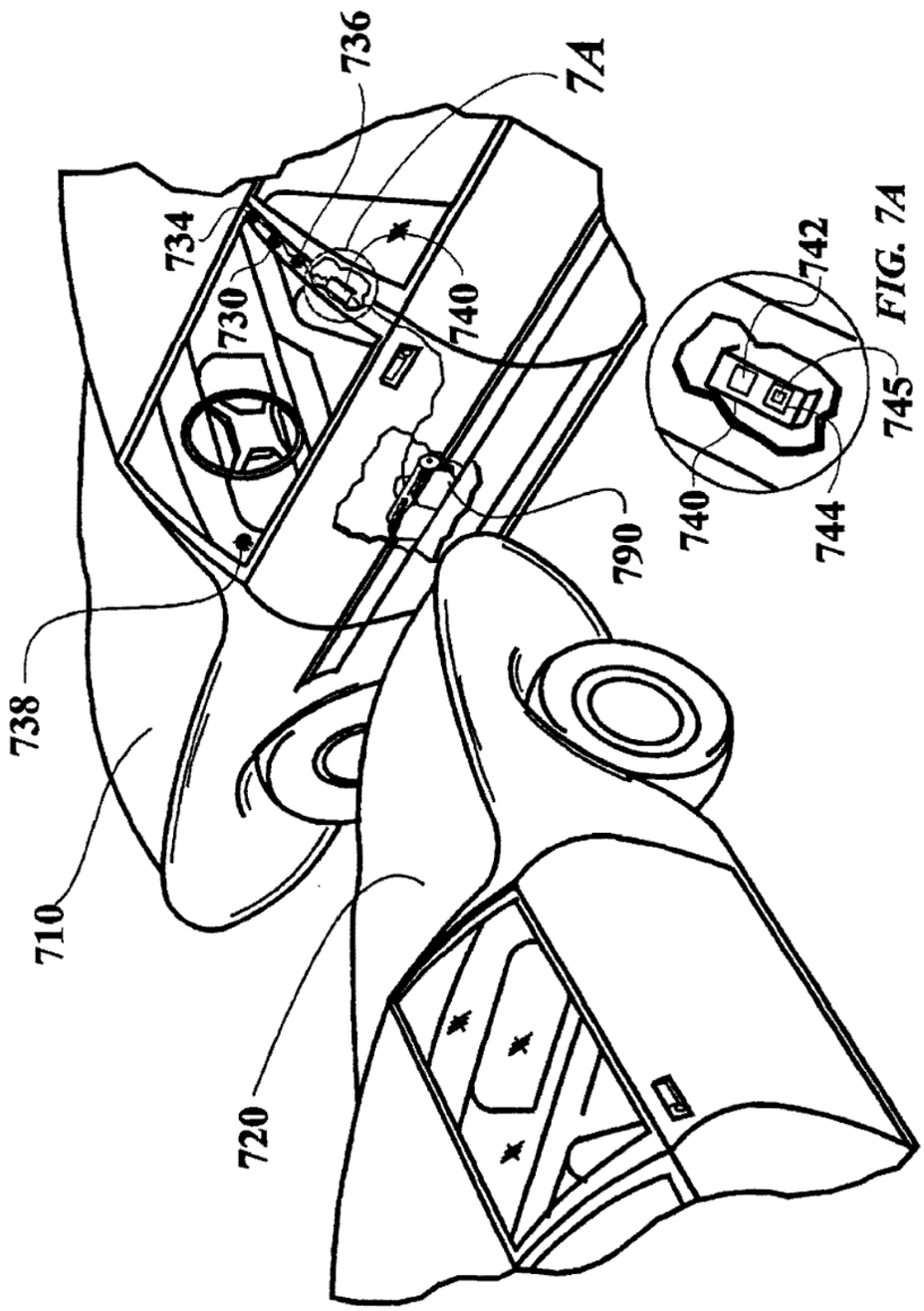


FIG. 7A

FIG. 7

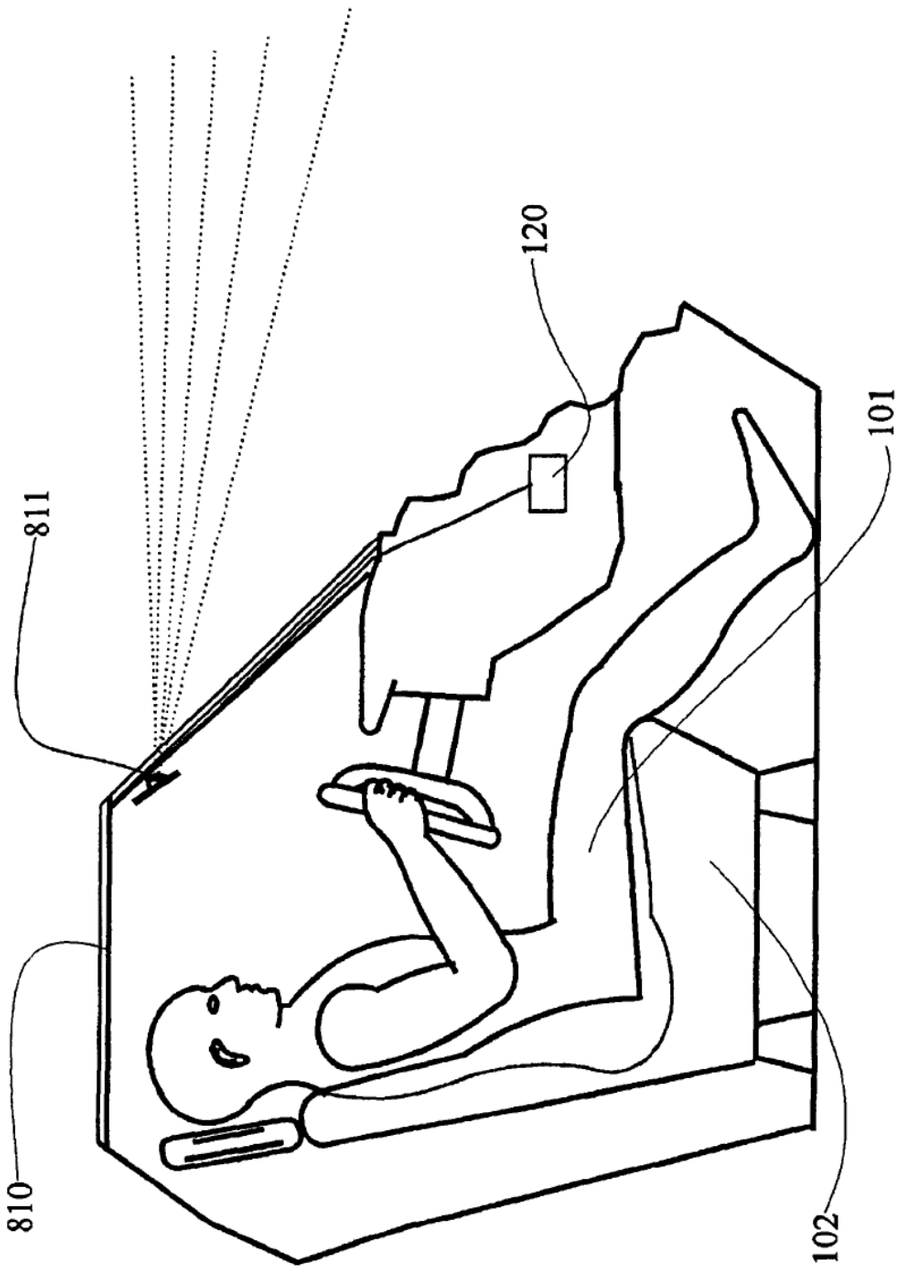


FIG. 8

OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 07/878,571 filed May 5, 1992, now abandoned, of application Ser. No. 08/040,978 filed Mar. 31, 1993 now abandoned, of copending application Ser. No. 08/247,760 filed May 23, 1994 and of application Ser. No. 08/239,978 filed May 9, 1994 now abandoned, the last three of which are included herein by reference.

BACKGROUND OF THE INVENTION

1. Prior Art On Out Of Position Occupants And Rear Facing Child Seats

Whereas thousands of lives have been saved by airbags, a large number of people have also been injured, some seriously, by the deploying airbag, and thus significant improvements need to be made in this regard. As discussed in detail in copending patent applications Ser. Nos. 08/040,978 and 08/239,978 cross-referenced above, for a variety of reasons vehicle occupants may be too close to the airbag before it deploys and can be seriously injured or killed as a result of the deployment thereof. Also, a child in a rear facing child seat which is placed on the right front passenger seat is in danger of being seriously injured if the passenger airbag deploys. For these reasons and, as first publicly disclosed in Breed, D. S. "How Airbags Work" presented at the International Conference on Seatbelts and Airbags in 1993, in Canada, occupant position sensing and rear facing child seat detection is required.

Initially these systems will solve the out-of-position occupant and the rear facing child seat problems related to current airbag systems and prevent unneeded airbag deployments when a front seat is unoccupied. However, airbags are now under development to protect rear seat occupants in vehicle crashes and all occupants in side impacts. A system will therefore be needed to detect the presence of occupants, determine if they are out-of-position and to identify the presence of a rear facing child seat in the rear seat. Future automobiles are expected to have eight or more airbags as protection is sought for rear seat occupants and from side impacts. In addition to eliminating the disturbance and possible harm of unnecessary airbag deployments, the cost of replacing these airbags will be excessive if they all deploy in an accident needlessly.

Inflators now exist which will adjust the amount of gas flowing to the airbag to account for the size and position of the occupant and for the severity of the accident. The vehicle identification and monitoring system (VIMS) discussed in patent application Ser. No. 08/239,978 will control such inflators based on the presence and position of vehicle occupants or of a rear facing child seat. The instant invention is an improvement on that VIMS system and uses an advanced optical system comprising one or more CCD (charge coupled device) arrays and a source of illumination combined with a trained neural network pattern recognition system.

The need for an occupant out-of-position sensor has been observed by others and several methods have been disclosed in U.S. patents for determining the position of an occupant of a motor vehicle. Each of these systems, however, have significant limitations. In White et al. (U.S. Pat. No. 5,071,160), for example, a single acoustic sensor and detector is

disclosed and, as illustrated, is mounted lower than the steering wheel. White et al. correctly perceive that such a sensor could be defeated, and the airbag falsely deployed, by an occupant adjusting the control knobs on the radio and thus they suggest the use of a plurality of such sensors.

Mattes et al. (U.S. Pat. No. 5,118,134) disclose a variety of methods of measuring the change in position of an occupant including ultrasonic, active or passive infrared and microwave radar sensors, and an electric eye. Their use of these sensors is to measure the change in position of an occupant during a crash and use that information to access the severity of the crash and thereby decide whether or not to deploy the airbag. They are thus using the occupant motion as a crash sensor. No mention is made of determining the out-of-position status of the occupant or of any of the other features of occupant monitoring as disclosed in the above cross-referenced patent applications. It is interesting to note that nowhere does Mattes et al. discuss how to use active or passive infrared to determine the position of the occupant. As pointed out in the above cross-referenced patent applications, direct occupant position measurement based on passive infrared is probably not possible and, until very recently, was very difficult and expensive with active infrared requiring the modulation of an expensive GaAs infrared laser. Since there is no mention of these problems, the method of use contemplated by Mattes et al. must be similar to the electric eye concept where position is measured indirectly as the occupant passes by a plurality of longitudinally spaced-apart sensors.

The object of an occupant out-of-position sensor is to determine the location of the head and/or chest of the vehicle occupant relative to the airbag since it is the impact of either the head or chest with the deploying airbag which can result in serious injuries. Both White et al. and Mattes et al. disclose only lower mounting locations of their sensors which are mounted in front of the occupant such as on the dashboard or below the steering wheel. Both such mounting locations are particularly prone to detection errors due to positioning of the occupant's hands, arms and legs. This would require at least three, and preferably more, such sensors and detectors and an appropriate logic circuitry which ignores readings from some sensors if such readings are inconsistent with others, for the case, for example, where the driver's arms are the closest objects to two of the sensors.

White et al. also disclose the use of error correction circuitry, without defining or illustrating the circuitry, to differentiate between the velocity of one of the occupant's hands as in the case where he/she is adjusting the knob on the radio and the remainder of the occupant. Three ultrasonic sensors of the type disclosed by White et al. might, in some cases, accomplish this differentiation if two of them indicated that the occupant was not moving while the third was indicating that he or she was. Such a combination, however, would not differentiate between an occupant with both hands and arms in the path of the ultrasonic transmitter at such a location that they were blocking a substantial view of the occupant's head or chest. Since the sizes and driving positions of occupants are extremely varied, trained pattern recognition systems, such as neural networks, are required when a clear view of the occupant, unimpeded by his/her extremities, cannot be guaranteed.

Fujita et al., in U.S. Pat. No. 5,074,583, illustrate another method of determining the position of the occupant but do not use this information to suppress deployment if the occupant is out-of-position. In fact, the closer that the occupant gets to the airbag the faster the inflation rate of the airbag is according to the Fujita patent, which thereby

increases the possibility of injuring the occupant. Fujita et al. do not measure the occupant directly but instead determine his or her position indirectly from measurements of the seat position and the vertical size of the occupant relative to the seat. This occupant height is determined using an ultrasonic displacement sensor mounted directly above the occupant's head.

As discussed above, the optical systems described herein are also applicable for many other sensing applications both inside and outside of the vehicle compartment such as for sensing crashes before they occur as described in copending patent application Ser. No. 08/239,978 cross-referenced above, for a smart headlight adjustment system and for a blind spot monitor.

2. Definitions

The use of pattern recognition is central to the instant invention as well as those cross-referenced patent applications above. Nowhere in the prior art is pattern recognition which is based on training, as exemplified through the use of neural networks, mentioned for use in monitoring the interior or exterior environments of the vehicle. "Pattern recognition" as used herein will mean any system which processes a signal that is generated by an object, or is modified by interacting with an object, in order to determine which one of a set of classes that the object belongs to. Such a system might determine only that the object is or is not a member of one specified class, or it might attempt to assign the object to one of a larger set of specified classes, or find that it is not a member of any of the classes in the set. The signals processed are generally electrical signals coming from transducers which are sensitive to either acoustic or electromagnetic radiation and, if electromagnetic, they can be either visible light, infrared, ultraviolet or radar. A trainable or a trained pattern recognition system as used herein means a pattern recognition system which is taught various patterns by subjecting the system to a variety of examples. The most successful such system is the neural network.

To "identify" as used herein will mean to determine that the object belongs to a particular set or class. The class may be one containing, for example, all rear facing child seats, one containing all human occupants, or all human occupants not sitting in a rear facing child seat depending on the purpose of the system. In the case where a particular person is to be recognized, the set or class will contain only a single element, i.e., the person to be recognized.

An "occupying item" of a seat may be a living occupant such as a human being or a dog, another living organism such as a plant, or an inanimate object such as a box or bag of groceries.

In the description herein on anticipatory sensing, the term "approaching" when used in connection with the mention of an object or vehicle approaching another will mean the relative motion of the object toward the vehicle having the anticipatory sensor system. Thus, in a side impact with a tree, the tree will be considered as approaching the side of the vehicle and impacting the vehicle. In other words, the coordinate system used in general will be a coordinate system residing in the target vehicle. The "target" vehicle is the vehicle which is being impacted. This convention permits a general description to cover all of the cases such as where (i) a moving vehicle impacts into the side of a stationary vehicle, (ii) where both vehicles are moving when they impact, or (iii) where a vehicle is moving sideways into a stationary vehicle, tree or wall.

3. Pattern Recognition Prior Art

Japanese patent 3-42337 (A) to Ueno discloses a device for detecting the driving condition of a vehicle driver comprising a light emitter for irradiating the face of the driver and a means for picking up the image of the driver and storing it for later analysis. Means are provided for locating the eyes of the driver and then the irises of the eyes and then determining if the driver is looking to the side or sleeping. Ueno determines the state of the eyes of the occupant rather than determining the location of the eyes relative to the other parts of the vehicle passenger compartment. Such a system can be defeated if the driver is wearing glasses, particularly sunglasses, or another optical device which obstructs a clear view of his/her eyes. Pattern recognition technologies such as neural networks are not used.

U.S. Pat. No. 5,008,946 to Ando uses a complicated set of rules to isolate the eyes and mouth of a driver and uses this information to permit the driver to control the radio, for example, or other systems within the vehicle by moving his eyes and/or mouth. Ando uses natural light and illuminates only the head of the driver. He also makes no use of trainable pattern recognition systems such as neural networks, nor is there any attempt to identify the contents of the vehicle nor of their location relative to the vehicle passenger compartment. Rather, Ando is limited to control of vehicle devices by responding to motion of the driver's mouth and eyes.

U.S. Pat. No. 5,298,732 to Chen also concentrates in locating the eyes of the driver so as to position a light filter between a light source such as the sun or the lights of an oncoming vehicle, and the driver's eyes. Chen does not explain in detail how the eyes are located but does supply a calibration system whereby the driver can adjust the filter so that it is at the proper position relative to his or her eyes. Chen references the use of an automatic equipment for determining the location of the eyes but does not describe how this equipment works. In any event, there is no mention of monitoring the position of the occupant, other that the eyes, of determining the position of the eyes relative to the passenger compartment, or of identifying any other object in the vehicle other than the driver's eyes. Also, there is no mention of the use of a trainable pattern recognition system.

U.S. Pat. No. 5,305,012 to Faris also describes a system for reducing the glare from the headlights of an oncoming vehicle. Faris locates the eyes of the occupant by the use of two spaced apart infrared cameras using passive infrared radiation from the eyes of the driver. Again, Faris is only interested in locating the driver's eyes relative to the sun or oncoming headlights and does not identify or monitor the occupant or locate the occupant relative to the passenger compartment or the airbag. Also, Faris does not use trainable pattern recognition techniques such as neural networks. Faris, in fact, does not even say how the eyes of the occupant are located but refers the reader to a book entitled Robot Vision (1991) by Berthold Horn, published by MIT Press, Cambridge, Mass. Also, Faris uses the passive infrared radiation rather than illuminating the occupant with active infrared radiation or in general electromagnetic radiation as in the instant invention.

The use of neural networks as the pattern recognition technology is central to this invention since it makes the monitoring system robust, reliable and practical. The resulting algorithm created by the neural network program is usually only a few lines of code written in the C computer language as opposed to typically hundreds of lines when the techniques of the above patents to Ando, Chen and Faris are implemented. As a result, the resulting systems are easy to implement at a low cost making them practical for automotive applications. The cost of the CCD arrays, for example, have been prohibitively expensive until very recently rendering their use for VIMS impractical. Similarly, the imple-

mentation of the techniques of the above referenced patents requires expensive microprocessors while the implementation with neural networks and similar trainable pattern recognition technologies permits the use of low cost microprocessors typically costing less than $5.

The present invention uses sophisticated trainable pattern recognition capabilities such as neural networks. Usually the data is preprocessed, as discussed below, using various feature extraction. An example of such a pattern recognition system using neural networks on sonar signals is discussed in two papers by Gorman, R. P. and Sejnowski, T. J. "Analysis of Hidden Units in a Layered Network Trained to Classify Sonar Targets", *Neural Networks*, Vol. 1. pp. 75–89, 1988, and "Learned Classification of Sonar Targets Using a Massively Parallel Network", IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 36, No. 7, July 1988. Examples of feature extraction techniques can be found in U.S. Pat. No. 4,906,940 entitled "Process and Apparatus for the Automatic Detection and Extraction of Features in Images and Displays" to Green et al. Examples of other more advanced and efficient pattern recognition techniques can be found in U.S. Pat. No. 5,390,136 entitled "Artificial Neuron and Method of Using Same and U.S. patent application Ser. No. 08/076,601 entitled "Neural Network and Method of Using Same" to Wang, S. T. Other examples include U.S. Pat. Nos. 5,235,339 (Morrison et al.), 5,214,744 (Schweizer et al), 5,181,254 (Schweizer et al), and 4,881,270 (Knecht et al). All of the above references are included herein by reference.

4. Optics

Optics can be used in several configurations for monitoring the interior of a passenger compartment of an automobile. In one known method, a laser optical system uses a GaAs infrared laser beam to momentarily illuminate an object, occupant or child seat, in the manner as described and illustrated in FIG. 8 of the copending patent application Ser. No. 08/040,978 cross-referenced above. The receiver can be a charge coupled device or CCD, (a type of TV camera) to receive the reflected light. The laser can either be used in a scanning mode, or, through the use of a lens, a cone of light can be created which covers a large portion of the object. In these configurations, the light can be accurately controlled to only illuminate particular positions of interest within the vehicle. In the scanning mode, the receiver need only comprise a single or a few active elements while in the case of the cone of light, an array of active elements is needed. The laser system has one additional significant advantage in that the distance to the illuminated object can be determined as disclosed in the 08/040,978 patent application.

In a simpler case, light generated by a non-coherent light emitting diode device is used to illuminate the desired area. In this case, the area covered is not as accurately controlled and a larger CCD array is required. Recently, however, the cost of CCD arrays has dropped substantially with the result that this configuration is now the most cost effective system for monitoring the passenger compartment as long as the distance from the transmitter to the objects is not needed. If this distance is required, then either the laser system, a stereographic system, a focusing system, or a combined ultrasonic and optic system is required. A mechanical focusing system, such as used on some camera systems can determine the initial position of an occupant but is too slow to monitor his/her position during a crash. A distance measuring system based of focusing is described in U.S. Pat. No. 5,193,124 (Subbarao) which can either be used with a mechanical focusing system or with two cameras, the latter of which would be fast enough. Although the Subbarao patent provides a good discussion of the camera focusing art and is therefore included herein by reference, it is a more complicated system than is needed for the practicing the instant invention. In fact, a neural network can also be trained to perform the distance determination based on the two images taken with different camera settings or from two adjacent CCD's and lens having different properties as the cameras disclosed in Subbarao making this technique practical for the purposes of this instant invention. Distance can also be determined by the system disclosed in U.S. Pat. No. 5,003,166 (Girod) by the spreading or defocusing of a pattern of structured light projected onto the object of interest.

In each of these cases, regardless of the distance measurement system used, a trained pattern recognition system, as defined above, is used in the instant invention to identify and classify, and in some cases to locate, the illuminated object and its constituent parts.

5. Optics And Acoustics

The laser systems described above are expensive due to the requirement that they be modulated at a high frequency if the distance from the airbag to the occupant, for example, needs to be measured. Both laser and non-laser optical systems in general are good at determining the location of objects within the two dimensional plane of the image and the modulated laser system in the scanning mode can determine the distance of each part of the image from the receiver. It is also possible to determine distance with the non-laser system by focusing as discussed above, or stereographically if two spaced apart receivers are used and, in some cases the mere location in the field of view can be used to estimate the position relative to the airbag, for example. Finally, a recently developed pulsed quantum well diode laser does provide inexpensive distance measurements as discussed below.

Acoustic systems are also quite effective at distance measurements since the relatively low speed of sound permits simple electronic circuits to be designed and minimal microprocessor capability is required. If a coordinate system is used where the z axis is from the transducer to the occupant, acoustics are good at measuring z dimensions while simple optical systems using a single CCD are good at measuring x and y dimensions. The combination of acoustics and optics, therefore, permits all three measurements to be made with low cost components.

One example of a system using these ideas is an optical system which floods the passenger seat with infrared light coupled with a lens and CCD array which receives and displays the reflected light and an analog to digital converter (ADC) which digitizes the output of the CCD and feeds it to an Artificial Neural Network (ANN) or other pattern recognition system , for analysis. This system uses an ultrasonic transmitter and receiver for measuring the distances to the objects located in the passenger seat. The receiving transducer feeds its data into an ADC and from there into the ANN. The same ANN can be used for both systems thereby providing full three dimensional data for the ANN to analyze. This system, using low cost components, will permit accurate identification and distance measurements not possible by either system acting alone. If a phased array system is added to the acoustic part of the system as disclosed in copending patent application (ATI-102), the optical part can determine the location of the driver's ears, for example, and the phased array can direct a narrow beam to the location and determine the distance to the occupant's ears.

6. Applications

The applications for this technology are numerous as described in the copending patent applications listed above. They include: (i) the monitoring of the occupant for safety purposes to prevent airbag deployment induced injuries, (ii) the locating of the eyes of the occupant to permit automatic adjustment of the rear view mirror(s), (iii) the location of the seat to place the eyes at the proper position to eliminate the parallax in a heads-up display in night vision systems, (iv) the location of the ears of the occupant for optimum adjustment of the entertainment system, (v) the identification of the occupant for security reasons, (vi) the determination of obstructions in the path of a closing door or window, (vii) the determination of the position of the occupant's shoulder so that the seat belt anchorage point can be adjusted for the best protection of the occupant, (viii) the determination of the position of the rear of the occupants head so that the headrest can be adjusted to minimize whiplash injuries in rear impacts, (ix) anticipatory crash sensing, (x) blind spot detection, (xi) smart headlight dimmers, and many others. In fact, over forty products alone have been identified based on the ability to identify and monitor objects and parts thereof in the passenger compartment of an automobile or truck.

SUMMARY OF THE INVENTION

This invention is a system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle.

When the vehicle interior monitoring system of this invention is installed in the passenger compartment of an automotive vehicle equipped with a passenger protective device, such as an inflatable airbag, and the vehicle is subjected to a crash of sufficient severity that the crash sensor has determined that the protective device is to be deployed, the system in accordance with the invention determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag.

In some implementations of the invention, one or more ultrasonic transmitters and receivers are added to the system to provide a measurement of the distance from the transmitter/receiver to the objects of interest. In some of these implementations, a phased array system is used to permit the ultrasonic waves from the ultrasonic transmitters to be narrowly focused onto a particular location of an object. In other implementations, the source of infrared light is a modulated laser which permits an accurate measurement of the distance to the point of reflection. In still other cases, a focusing system is used to determine the distance to the object. Finally, in yet other cases a GaAs pulsed quantum well laser system is used to measure distance directly to a point of interest.

Principle objects and advantages of the optical sensing system in accordance with the invention are:

1. To recognize the presence of a human on a particular seat of a motor vehicle and to use this information to affect the operation of another vehicle system such as the airbag, heating and air conditioning, or entertainment systems, among others.
2. To recognize the presence of a human on a particular seat of a motor vehicle and then to determine his/her position and to use this position information to affect the operation of another vehicle system.
3. To determine the position, velocity or size of an occupant in a motor vehicle and to utilize this information to control the rate of gas generation, or the amount of gas generated by an airbag inflator system.
4. To determine the presence or position of rear seated occupants in the vehicle and to use this information to affect the operation of a rear seat protection airbag for frontal impacts.
5. To recognize the presence of a rear facing child seat on a particular seat of a motor vehicle and to use this information to affect the operation of another vehicle system such as the airbag system.
6. To determine the approximate location of the eyes of a driver and to use that information to control the position of the rear view mirrors of the vehicle.
7. To monitor the position of the head of the vehicle driver and determine whether the driver is falling asleep or otherwise impaired and likely to lose control of the vehicle and to use that information to affect another vehicle system.
8. To provide an occupant position sensor which reliably permits, and in a timely manner, a determination to be made that the occupant is out of position, or will become out of position, and likely to be injured by a deploying airbag and to then output a signal to suppress the deployment of the airbag.
9. To provide an anticipatory sensor which permits accurate identification of the about-to-impact object in the presence of snow and/or fog whereby the sensor is located within the vehicle.
10. To provide a smart headlight dimmer system which senses the headlights from an oncoming vehicle or the tail lights of a vehicle in front of the subject vehicle and identifies these lights differentiating them from reflections from signs or the road surface and then sends a signal to dim the headlights.
11. To provide a blind spot detector which detects and categorizes an object in the driver's blind spot and warns the driver in the event the driver begins to change lanes, for example, or continuously informs the driver of the state of occupancy of the blind spot.

These and other objects and advantages will become apparent from the following description of the preferred embodiments of the vehicle identification and monitoring system of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side planar view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing several preferred mounting locations of interior vehicle monitoring sensors shown particularly for sensing the vehicle driver illustrating the wave pattern from an ultrasonic mirror mounted position sensor.

FIG. 1B is a view as in FIG. 1A illustrating the wave pattern from an optical system using an infrared light source and a CCD array receiver using the windshield as a reflec-

tion surface and showing schematically the interface between the vehicle interior monitoring system of this invention and an instrument panel mounted inattentiveness warning light or buzzer and reset button.

FIG. 1C is a view as in FIG. 1A illustrating the wave pattern from a set of ultrasonic transmitters/receivers where the spacing of the transducers and the phase of the signals permits an accurate focusing of the ultrasonic beam and thus the accurate measurement of a particular point on the surface of the driver.

FIG. 1D is a view as in FIG. 1A illustrating the wave pattern from an optical system using an infrared light source and a CCD array receiver where the CCD array receiver is covered by a fisheye lens permitting a wide angle view of the contents of the passenger compartment.

FIG. 1E is a view as in FIG. 1A illustrating the wave pattern from a pair of small CCD array receivers and one infrared transmitter where the spacing of the CCD arrays permits an accurate measurement of the distance to features on the occupant.

FIG. 2 is a side view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing preferred mounting locations of optical interior vehicle monitoring sensors.

FIG. 3 is a circuit schematic illustrating the use of the vehicle interior monitoring sensor used as an occupant position sensor in conjunction with the remainder of the inflatable restraint system.

FIG. 4 is a schematic illustrating the circuit of an occupant position sensing device using a modulated infrared signal, beat frequency and phase detector system.

FIG. 5 is a side planer view with parts cutaway and removed of a vehicle showing the passenger compartment containing a driver and a preferred mounting location for an occupant position sensor for use in side impacts and also of a rear of occupant's head locator for use with a headrest adjustment system to reduce whiplash injuries in rear impact crashes.

FIG. 6 is a side plan view of the interior of an automobile, with portions cut away and removed, with two occupant height measuring sensors, one mounted into the headliner above the occupant's head and the other mounted onto the A-pillar and also showing a seatbelt associated with the seat where the seatbelt has an adjustable upper anchorage point which is automatically adjusted corresponding to the height of the occupant.

FIG. 7 is a perspective view of a vehicle about to impact the side of another vehicle showing the location of the various parts of the anticipatory sensor system of this invention.

FIG. 7A is a view of the section designated 7A in FIG. 7.

FIG. 8 is a side planar view, with certain portions removed or cut away, of a portion of the passenger compartment illustrating a sensor for sensing the headlights of an oncoming vehicle and/or the taillights of a leading vehicle used in conjunction with an automatic headlight dimming system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, a section of the passenger compartment of an automobile is shown generally as **100** in FIGS. 1A through 1E. A driver **101** of a vehicle sits on a seat **102** behind a steering wheel **103** which contains an airbag assembly **104**. Five transmitter and/or receiver assemblies **110, 111, 112, 113** and **114** are positioned at various places in the passenger compartment to determine the location of the head, chest and torso of the driver relative to the airbag and to otherwise monitor the interior of the passenger compartment. Control circuitry **120** is connected to the transmitter/receivers **110–114** and controls the transmission from the transmitters and captures the return signals from the receivers. Control circuitry **120** usually contains analog to digital converters (ADCs), a microprocessor containing sufficient memory and appropriate software including pattern recognition algorithms, and other appropriate drivers, signal conditioners, signal generators, etc. Usually, in any given implementation, only one or two of the transmitters and receivers would be used depending on their mounting locations as described below.

FIG. 1A illustrates a typical wave pattern of ultrasonic waves from transmitter/receiver **114**. In this embodiment, the transmitter/receiver **114** comprises an ultrasonic transducer which will generally be used in conjunction with an optical transmitter and CCD array such as shown at **110, 112** and **113**. The optical systems, i.e., the optical transmitter and CCD array, map the location of the occupant(s), objects and features thereof, in a two dimensional image by the CCD array and ultrasonic transmitter/receiver **114** determines the distance from the sensor to the occupant. When used for monitoring the passenger seat, the optical system **110** determines that the seat is occupied and identifies the occupying item and then the ultrasonic system such as **114** determines the location of the occupant relative to the airbag. The optical system identifies what it is that the ultrasonic system is measuring and determines which echo is from the occupant's head or chest as opposed to some other object. The transmitter/receiver **114** may be mounted to a rear view mirror **105**.

In the case of FIG. 1A, transmitter/receiver **114** emits ultrasonic acoustical waves which bounce off the head and chest of the driver and return thereto. Periodically, the device, as commanded by control circuit **120**, transmits a burst of ultrasonic waves at about 50 kilohertz, for example, and the reflected signal is detected by the same or a different device. An associated electronic circuit or algorithm in control circuit **120** measures the time between the transmission and the reception of the ultrasonic waves and thereby determines the distance from the transmitter/receiver to the driver, passenger or other occupying item based on the velocity of sound. This information is then sent to the crash sensor and diagnostic circuitry, which may also be resident in **120**, which determines if the occupant is close enough to the airbag that a deployment might, by itself, cause injury which exceeds that which might be caused by the accident itself In such a case, the circuit disables the airbag system and thereby prevents its deployment. In an alternate case, the sensor algorithm assesses the probability that a crash requiring an airbag is in process and waits until that probability exceeds an amount that is dependent on the position of the occupant. Thus, for example, the sensor might decide to deploy the airbag based on a need probability assessment of 50%, if the decision must be made immediately for an occupant approaching the airbag, but might wait until the probability rises to 95% for a more distant occupant. Although a driver system has been illustrated, the front and rear seat passenger systems would be similar.

In another implementation, the sensor algorithm may determine the rate that gas is generated to affect the rate that the airbag is inflated. In all of these cases, the position of the occupant is used to affect the deployment of the airbag either as to whether or not it should be deployed at all, the time of deployment or the rate of inflation.

An optical infrared transmitter and receiver assembly is shown generally at **112** in FIG. **1**B and is mounted onto the instrument panel facing the windshield. Device **112**, shown enlarged, comprises a source of infrared radiation, or another form of electromagnetic radiation, and a charge coupled device array (CCD array) of typically 160 pixels by 160 pixels. In this embodiment, the windshield is used to reflect the illumination light provided by the infrared radiation and also the light reflected back by the objects in the passenger compartment, in a manner similar to the "heads-up" display which is now being offered on several automobile models. The "heads-up" display, of course, is currently used only to display information to the driver and is not used to reflect light from the driver to a receiver. Once again, unless one of the distance measuring systems as described below is used, this system alone cannot be used to determine distances from the objects to the sensor. Its main purpose is object identification and monitoring.

Device **112** is actually about two cm. in diameter and is shown greatly enlarged in FIG. **1**B. Also, the reflection area on the windshield is considerably smaller than illustrated and special provisions are made to assure that this area of the windshield is flat and reflective as is done generally when heads-up displays are used.

The system illustrated in FIG. **1**B uses a single CCD array and thus, since this device is small, it cannot in general be used to achieve a stereographic image and thus some other method is necessary to determine the distance to the object. If two spaced apart CCD arrays are used, however, then the distance to the various objects within the passenger compartment can be found by using a simple algorithm which locates similar features on both images and determines their relative location on the images. An alternate method is to use a lens with a short focal length. In this case, the lens is mechanically focused to determine the clearest image and thereby obtain the distance to the object. This is similar to certain camera auto-focusing systems such as one manufactured by Fuji of Japan. Naturally, other methods can be used as described in the patents referenced above.

Once a vehicle interior monitoring system employing a sophisticated pattern recognition system, such as a neural network is in place, it is possible to monitor the motions of the driver over time, and his/her response to various stimuli, and determine if he is falling asleep or has otherwise become incapacitated. In such an event, the vehicle can be caused to respond in a number of different ways. One such system is illustrated in FIG. **1**B and consists of a monitoring system having transducer device **112** plus a microprocessor in control circuit **120** programmed to compare the motions of the driver over time and trained to recognize changes in behavior representative of becoming incapacitated. If the system determines that there is a reasonable probability that the driver has fallen asleep, for example, then it can turn on a warning light shown here as **124** or send a warning sound. If the driver fails to respond to the warning by pushing a button **122**, for example, then the horn and lights can be operated in a manner to warn other vehicles and the vehicle brought to a stop. Naturally other responses can also be programmed and other tests of driver attentiveness can be used without resorting to attempting to monitor the motions of the driver's eyes.

An even more sophisticated system of monitoring the behavior of the driver is to track the driver's eye motions using such techniques as are described in: Freidman et al., U.S. Pat. No. 4,648,052 entitled "Eye Tracker Communication System"; Heyner et al., U.S. Pat. No. 4,720,189 entitled "Eye Position Sensor"; Hutchinson, U.S. Pat. No. 4,836,670 entitled "Eye Movement Detector"; and Hutchinson, U.S. Pat. No. 4,950,069 entitled "Eye Movement Detector With Improved Calibration and Speed", all of which are included herein by reference as well as U.S. Pat. Nos. 5,008,946 and 5,305,012 referenced above. The detection of the impaired driver in particular can be best determined by these techniques. These systems make use of sophisticated pattern recognition techniques plus, in many cases, the transmitter and CCD receivers must be appropriately located so that the reflection off of the cornea of the driver's eyes can be detected as discussed in the above referenced patents. The size of the CCD arrays used herein permits their location, sometimes in conjunction with a reflective windshield, where this corneal reflection can be detected with some difficulty. Naturally sunglasses can interfere with this process.

The eye tracker systems discussed above are facilitated by the instant invention since one of the main purposes of determining the location of the driver's eyes either by directly locating them with trained pattern recognition technology or by inferring their location from the location of the driver's head, is so that the seat can be automatically positioned to place the driver's eyes into the "eye-ellipse". The eye-ellipse is the proper location for the driver's eyes to permit optimal operation of the vehicle and for the location of the mirrors etc. Thus, if we know where the driver's eyes are, then the driver can be positioned so that his or her eyes are precisely situated in the eye ellipse and the reflection off of the eye can be monitored with a small eye tracker system. Also, by ascertaining the location of the driver's eyes, a rear view mirror positioning device can be controlled to adjust the same to an optimal position.

A more accurate acoustic system for determining the distance to a particular object, or a part thereof, in the passenger compartment is exemplified by transducers **111** in FIG. **1**C. In this case, three ultrasonic transmitter/receivers are shown spaced apart mounted onto the A-pillar of the vehicle. The A-pillar is the forward most roof support pillar and also supports the windshield. Due to the wavelength, it is difficult to get a narrow beam using ultrasonics without either using high frequencies which have limited range or a large transducer. A commonly available 40 kHz transducer, for example, is about 1 cm. in diameter and emits a sonic wave which spreads at about a sixty degree angle. To reduce this angle requires making the transducer larger in diameter. An alternate solution is to use several transducers and to phase the transmissions so that they arrive at the intended part of the target in phase. Reflections from the selected part of the target are then reinforced whereas reflections from adjacent parts encounter interference with the result that the distance to the brightest portion within the vicinity of interest can be determined. By varying the phase of transmission from the three transducers **111**, the location of a reflection source on a curved line can be determined. In order to locate the reflection source in space, at least one additional transmitter/receiver is required which is not co-linear with the others. The accuracy of the measurement can be determined by those skilled in the art of phased array radar as the relevant equations are applicable here. The waves shown in FIG. 1C coming from the three transducers **111** are actually only the portions of the waves which arrive at the desired point in space together in phase. The effective direction of these wave streams can be varied by changing the transmission phase between the three transmitters. A determination of the approximate location of a point of interest on the occupant is accomplished by the CCD array and appropriate analysis and the phasing of the ultrasonic

transmitters is determined so that the distance to the desired point can be determined.

FIG. **1D** illustrates two optical systems each having a source of infrared radiation and a CCD array receiver. The price of CCD arrays has dropped dramatically in the last year making them practical for interior monitoring. Transducers **110** and **113** are CCD arrays having 160 by 160 pixels which is covered by an approximate spherical lens. This creates a "fisheye" effect whereby light from a wide variety of directions can be captured. One such sensor placed by the dome light or other central position in the vehicle roof such as **113**, can monitor the entire vehicle interior with sufficient resolution to determine the occupancy of the vehicle, for example. CCD's such as those used herein are available from Marshall Electronics Inc. of Culver City, Calif. A fisheye lens is ". . . a wide-angle photographic lens that covers an angle of about 180°, producing a circular image with exaggerated foreshortening in the center and increasing distortion toward the periphery". (*The American Heritage Dictionary of the English Language, Third Edition* ,1992 *by Houghton Mifflin Company*). This distortion of a fisheye lens can be substantially changed by modifying the shape of the lens to permit particular portions of the interior passenger compartment to be observed. Also, in many cases the full 180° is not desirable and a lens which captures a smaller angle may be used. Although primarily spherical lenses are illustrated herein, it is understood that the particular lens design will depend on the location in the vehicle and the purpose of the particular receiver.

CCD arrays are in common use in television cameras, for example, to convert an image into an electrical signal. For the purposes herein, a CCD will be defined to include all devices which are capable of converting light frequencies, including infrared and ultraviolet, into electrical signals. The particular CCD array used for many of the applications disclosed herein is implemented on a single chip which is less than two cm. in diameter. Data from the CCD array is digitized and sent serially to an electronic circuit **120** containing a microprocessor for analysis of the digitized data. In order to minimize the amount of data which needs to be stored, initial processing of the image data takes place as it is being received from the CCD array.

One method of determining distance to an object directly without resorting to range finders is to used a mechanical focusing system. However, the use of such an apparatus is cumbersome, expensive, slow and has questionable reliability. An alternative is to use the focusing systems described in the above referenced U.S. Pat. Nos. 5,193,124 and 5,003,166 however such systems require expensive hardware and/or elaborate algorithms. Another alternative is illustrated in FIG. 1E where transducer **116** is an infrared source having a wide transmission angle such that the entire contents of the front driver's seat is illuminated. Receiving CCD transducers **117** and **118** are shown spaced apart so that a stereographic analysis can be made by the control circuitry **120**. This circuitry **120** contains a microprocessor with appropriate pattern recognition algorithms along with other circuitry as described above. In this case, the desired feature to be located is first selected from one of the two returned images from either CCD transducer **117** or **118**. The software then determines the location of the same feature on the other image and thereby, through analysis familiar to those skilled in the art, determines the distance of the feature from the transducers.

Transducers **116–118** are illustrated mounted onto the A-pillar of the vehicle, however, since these transducers are quite small, typically approximately 2 cm. or less in diameter, they could alternately be mounted onto the windshield itself, or other convenient location which provides a clear view of the portion of the passenger compartment being monitored.

A new class of laser range finders has particular application here. This product, as manufactured by Power Spectra, Inc. of Sunnyvale, Calif., is a GaAs pulsed laser device which can measure up to 30 meters with an accuracy of <2 cm. and a resolution of <1 cm. This system is implemented in combination with transducer **116** and one of the receiving transducers **117** or **118** may thereby be eliminated. Once a particular feature of an occupying item of the passenger compartment has been located, this device is used in conjunction with an appropriate aiming mechanism to direct the laser beam to that particular feature. The distance to that feature is then known to within 2 cm, and with calibration even more accurately. Note that in addition to measurements within the passenger compartment, this device has particular applicability in anticipatory sensing and blind spot monitoring applications exterior to the vehicle.

In FIG. **2** a side view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing preferred mounting locations of optical interior vehicle monitoring sensors **110, 113, 210–214**. Each of these devices is illustrated as having a fisheye lens and is shown enlarged in size for clarity. In a typical actual device, the diameter of the lens is approximately 2 cm. and it protrudes from the mounting surface by approximately 1 cm. This small size renders these devices almost unnoticeable by vehicle occupants. Note that since these devices are optical it is important that the lens surface remains relatively clean. Control circuitry **120** contains a self-diagnostic feature where the image returned by one of the transducers is compared with a stored image and the existence of certain key features is verified. If a receiver fails this test, a warning is displayed to the driver which indicates that cleaning of the lens surface is required. The technology illustrated in FIG. **2** can be used for numerous purposes including: (i) the determination of the presence of a rear facing child seat **230**, (ii) the monitoring of the rear of an occupant's head **242**, (iii) the monitoring of the position of occupant **240**, (iv) the monitoring of the position of the occupants knees **241**, (v) the measurement of the occupant's height using transducer **113**, as well as other monitoring functions as described elsewhere in this specification.

The occupant position sensor in any of its various forms is integrated into the airbag system circuitry as shown schematically in FIG. **3**. In this example, the occupant position sensors are used as an input to a smart electronic sensor and diagnostic system. The electronic sensor determines whether the airbag should be deployed based on the vehicle acceleration crash pulse, or crush zone mounted crash sensors, and the occupant position sensor determines whether the occupant is too close to the airbag and therefore that the deployment should not take place. In FIG. **3** the electronic crash sensor located within the sensor and diagnostic unit determines whether the crash is of such severity as to require deployment of the airbag. The occupant position sensors determine the location of the vehicle occupants relative to the airbags and provide this information to the sensor and diagnostic unit which then determines whether it is safe to deploy the airbag. The arming sensor also determines whether there is a vehicle crash occurring. If the sensor and diagnostic unit and the arming sensor both determine that the vehicle is undergoing a crash requiring an airbag and the position sensors determine that the occupants are safely away from the airbags, the airbag, or inflatable restraint system, is deployed.

A particular implementation of an occupant position sensor having a range of from 0 to 2 meters (corresponding to an occupant position of from 0 to 1 meter since the signal must travel both to and from the occupant) using infrared is illustrated in the block diagram schematic of FIG. **4**. The operation is as follows. A 48 MHz signal, f1, is generated by a crystal oscillator **401** and fed into a frequency tripler **402** which produces an output signal at 144 MHz. The 144 MHz signal is then fed into an infrared diode driver **403** which drives the infrared diode **404** causing it to emit infrared light modulated at 144 MHz and a reference phase angle of zero degrees. The infrared diode **404** is directed at the vehicle occupant. A second signal f2 having a frequency of 48.05 MHz, which is slightly greater than f1, is similarly fed into a frequency tripler **406** to create a frequency of 144.15 MHz. This signal is then fed into a mixer **407** which combines it with the 144 MHz signal from frequency tripler **402**. The combined signal from the mixer **407** is then fed to filter **408** which removes all signals except for the difference, or beat frequency, between 3 times f1 and 3 times f2, of 150 kHz. The infrared signal which is reflected from the occupant is received by receiver **409** and fed into pre-amplifier **411**, a resistor **410** to bias being coupled to the connection between the receiver **409** and the pre-amplifier **411**. This signal has the same modulation frequency, 144 MHz, as the transmitted signal but now is out of phase with the transmitted signal by an angle x due to the path that the signal took from the transmitter to the occupant and back to the receiver. The output from pre-amplifier **411** is fed to a second mixer **412** along with the 144.15 MHz signal from the frequency tripler **406**. The output from mixer **412** is then amplified by an automatic gain amplifier **413** and fed into filter **414**. The filter **414** eliminates all frequencies except for the 150 kHz difference, or beat, frequency, in a similar manner as was done by filter **408**. The resulting 150 kHz frequency, however, now has a phase angle x relative to the signal from filter **408**. Both 150 kHz signals are now fed into a phase detector **415** which determines the magnitude of the phase angle x. It can be shown mathematically that, with the above values, the distance from the transmitting diode to the occupant is x/345.6 where x is measured in degrees and the distance in meters.

The applications described herein have been illustrated using the driver of the vehicle. Naturally the same systems of determining the position of the occupant relative to the airbag apply to front and rear seated passengers, sometimes requiring minor modifications. It is likely that the sensor required triggering time based on the position of the occupant will be different for the driver than for the passenger. Current systems are based primarily on the driver with the result that the probability of injury to the passenger is necessarily increased either by deploying the airbag too late or by failing to deploy the airbag when the position of the driver would not warrant it but the passenger's position would. With the use of occupant position sensors for both the passenger and driver, the airbag system can be individually optimized for each occupant and result in further significant injury reduction. In particular, either the driver or passenger system can be disabled if either the driver or passenger is out of position.

There is almost always a driver present in vehicles that are involved in accidents where an airbag is needed. Only about 30% of these vehicles, however, have a passenger. If the passenger is not present, there is usually no need to deploy the passenger side airbag. The occupant monitoring system, when used for the passenger side with proper pattern recognition circuitry, can also ascertain whether or not the seat is occupied, and if not, can disable the deployment of the passenger side airbag and thereby save the cost of its replacement. The same strategy applies also for monitoring the rear seat of the vehicle. Also, a trainable pattern recognition system, as used herein, can distinguish between an occupant and a bag of groceries, for example. Finally, there has been much written about the out of position child who is standing or otherwise positioned adjacent to the airbag, perhaps due to pre-crash braking. Naturally, the occupant position sensor described herein can prevent the deployment of the airbag in this situation as well as in the situation of a rear facing child seat as described above.

The use of trainable pattern recognition technologies such as neural networks is an important part of the instant invention. These technologies are implemented using sophisticated computer programs to analyze the patterns of examples to determine the differences between different categories of objects. These computer programs are trained using a set of representative data collected during the training phase, called the training set. After training, the computer programs output a computer algorithm containing the rules permitting classification of the objects of interest based on the data obtained after installation in the vehicle. These rules, in the form of an algorithm, are implemented in the system which is mounted onto the vehicle. The determination of these rules is central to the pattern recognition techniques used in this invention. Artificial neural networks are thus far the most successful of the rule determination approaches however research is underway to develop newer systems with many of the advantages of neural networks, such as learning by training, without the disadvantages, such as the inability to understand the network and the possibility of not converging to the best solution.

In some implementations of this invention, such as the determination that there is an object in the path of a closing window as described below, the rules are sufficiently obvious that a trained researcher can look at the returned optical or acoustic signals and devise an algorithm to make the required determinations. In others, such as the determination of the presence of a rear facing child seat or of an occupant, artificial neural networks are used to determine the rules. One such set of neural network software for determining the pattern recognition rules, is available from the NeuralWare Corporation of Pittsburgh, Pa. Another network pattern recognition technology is disclosed in the above referenced Motorola patents. Numerous articles, including more that 500 U.S. patents, describe neural networks in great detail and thus the theory and application of this technology is well known and will not be repeated here. Except in a few isolated situations where neural networks have been used to solve particular problems, they have not heretofore been applied to automobiles and trucks.

The system used in the instant invention, therefore, for the determination of the presence of a rear facing child seat, of an occupant, or of an empty seat is the artificial neural network. In this case, the network operates on the returned signals from the CCD array as sensed by transducers **521** and **522** in FIG. **5**, for example. For the case of the front passenger seat, for example, through a training session, the system is taught to differentiate between the three cases. This is done by conducting a large number of experiments where available child seats are placed in numerous positions and orientations on the front passenger seat of the vehicle. Similarly, a sufficiently large number of experiments are run with human occupants and with boxes, bags of groceries and other objects. As many as 1000 such experiments are run before the neural network is sufficiently trained so that it can

differentiate among the three cases and output the correct decision with a very high probability.

Once the network is determined, it is possible to examine the result using tools supplied by NeuralWare, for example, to determine the rules which were finally arrived at by the trial and error techniques. In that case, the rules can then be programmed into a microprocessor. Alternately, a neural computer can be used to implement the net directly. In either case, the implementation can be carried out by those skilled in the art of pattern recognition using neural networks. If a microprocessor is used, a memory device is also required to store the data from the analog to digital converters which digitize the data from the receiving transducers. On the other hand, if a neural network computer is used, the analog signal can be fed directly from the transducers to the neural network input nodes and an intermediate memory is not required. Memory of some type is needed to store the computer programs in the case of the microprocessor system and if the neural computer is used for more than one task, a memory is needed to store the network specific values associated with each task.

There are several methods measuring the height of the driver for use in automatically adjusting the seat or for adjusting the seatbelt anchorage point. Some alternatives are shown in FIG. **5** which is a side plan view where two height measuring sensors, one **521** mounted into the headliner above the occupant's head and the other **520** mounted onto the A-pillar are shown. These transducers may already be present because of other implementations of the vehicle interior identification and monitoring system described herein.

In the above cross-referenced patent applications, ultrasonics was the main technology for determining occupant height. This generally required at least two transducers since by using transducer **521** alone, for example, the exact position of the head is ambiguous since the transducer measures the distance to the head regardless of what direction the head is. By knowing the distance from the head to transducer **520**, the ambiguity is substantially reduced.

Optical transducers using CCD arrays are now becoming price competitive and, as mentioned above, will soon be the technology of choice for interior vehicle monitoring. A single CCD array of 160 by 160 pixels, for example, coupled with the appropriate trained pattern recognition software, can be used to form an image of the head of an occupant and accurately locate the head for the purposes of this invention.

A rear-of-head detector **534** is also illustrated in FIG. **5**. This detector is used to determine the distance from the headrest to the rear most position of the occupant's head and to control the position of the headrest so that it is properly positioned behind the occupant's head to offer optimum support in the event of a rear impact. Although the headrest of most vehicles is adjustable, it is rare for an occupant to position it properly, if at all. Each year there are in excess of 400,000 whiplash injuries in vehicle impacts approximately 90,000 of which are from rear impacts (source: National Highway Traffic Safety Administration, (NHTSA)). A properly positioned head rest could substantially reduce the frequency of such injuries which can be accomplished by the head detector of this invention. The head detector **534** is shown connected schematically to the headrest control mechanism and circuitry **540**. This mechanism is capable of moving the headrest up and down and, in some cases, rotating it fore and aft. An occupant position sensor for side impacts used with a door mounted airbag system is illustrated at **530** in FIG. **5**.

Seatbelts are most effective when the upper attachment point to the vehicle is positioned vertically close to the shoulder of the occupant being restrained. If the attachment point is too low, the occupant experiences discomfort from the rubbing of the belt on his or her shoulder. If it is too high the occupant may experience discomfort due to the rubbing of the belt against his or her neck and the occupant will move forward by a greater amount during a crash which may result in his or her head striking the steering wheel. For these reasons, it is desirable to have the upper seatbelt attachment point located slightly above the occupant's shoulder. To accomplish this for various sized occupants, the location of the occupant's shoulder must be known which can be accomplished by the vehicle interior monitoring system described herein.

Such a system is illustrated in FIG. **6** which is a side planer view of a seatbelt anchorage adjustment system. In this system, an infrared transmitter and CCD array receiver **620** is positioned in a convenient location such as the headliner located above and to the outside of the occupant's shoulder. An appropriate pattern recognition system as described above is then used to determine the location and position of the shoulder. This information is fed to the seatbelt anchorage height adjustment system **632**, shown schematically, which moves the attachment point **631** to the optimum vertical location for the proper placement of the seatbelt **630**.

FIG. **7** is an angular perspective overhead view of a vehicle **710** about to be impacted in the side by an approaching vehicle **720**, where vehicle **710** is equipped with an anticipatory sensor system showing a transmitter **730** transmitting infrared waves toward vehicle **720**. The transmitter **730** is connected to an electronic module **740**. Module **740** contains circuitry **742** to drive transmitter **730** and circuitry **744** to process the returned signals from receivers **734** and **736** (FIG. 7A). Circuitry **744** contains a neural computer **745** which performs the pattern recognition determination based on signals from receivers **734** and **736**. Receivers **734** and **736** are mounted onto the B-Pillar of the vehicle and are covered with a protective transparent cover. An alternate mounting location is shown as **738** which is in the door window trim panel where the rear view mirror (not shown) is frequently attached. One additional advantage of this system is the ability of infrared to penetrate fog and snow which makes this technology particularly applicable for anticipatory sensing applications.

The same system can also be used for the detection of objects in the blind spot of the vehicle and the image displayed for the operator to see, or a warning system activated, if the operator attempts to change lanes, for example. In this case, the mounting location must be chosen to provide a good view along the side of the vehicle in order to pickup vehicles which are about to pass vehicle **710**. Each of the locations **734**, **736** and **730** provide sufficient field of view for this application although the space immediately adjacent to the vehicle could be missed. Alternate locations include mounting onto the outside rear view mirror or the addition of a unit in the rear window or C-Pillar. The mirror location, however, does leave the device vulnerable to being covered with ice, snow and dirt.

In both cases of the anticipatory sensor and blind spot detector, the infrared transmitter and CCD array system provides mainly image information to permit recognition of the object in the vicinity of vehicle **710**. To complete the process, distance information is also require as well as velocity information, which can in general be obtained by differentiating the position data. This can be accomplished

by any one of the several methods discussed above as well as with a radar system. Radar systems, which would not be acceptable for use in the interior of the vehicle, are now commonly used in sensing applications exterior to the vehicle, police radar being one well known example. Miniature radar systems are now available which are inexpensive and fit within the available space. Another advantage of radar in this application is that it is easy to get a transmitter with a desirable divergence angle so that the device does not have to be aimed. The best mode of practicing the invention for these cases is to use radar and the second best is the pulsed GaAs laser system, along with a CCD array, although the use of two CCD arrays or the acoustical systems are also good choices. Both the acoustical and the stenographic system using the two CCD arrays have the disadvantage of being slower than the GaAs device and the acoustical system in addition must be mounted outside of the vehicle where it may be affected by the accumulation of deposits onto the active surface.

In a preferred implementation, transmitter **730** is an infrared transmitter and receivers **734, 736** and **738** are CCD transducers which receive the reflected infrared waves from vehicle **720**. In the implementation shown in FIG. **7**, an exterior airbag **790** is shown which deploys in the event that a side impact is about to occur as described in copending application Ser. No. 08/247,760 cross referenced above.

FIG. **8** illustrates the exterior monitoring system for use in detecting the headlights of an oncoming vehicle or the tail lights of a vehicle in front of vehicle **810**. In this embodiment, the CCD array is designed to be sensitive to visible light and a separate source of illumination is not used. Once again, the key to this technology is the use of trained pattern recognition algorithms and particularly of the artificial neural network. Here as in the other cases above and in the co-pending patent applications referenced above, the pattern recognition system is trained to recognize the pattern of the headlights of an oncoming vehicle or the tail lights of a vehicle in front of vehicle **810** and to then dim the headlights when either of these conditions is sensed. It is also trained to not dim the lights from other reflections such as off of a sign post or the roadway. One problem is to differentiate taillights where dimming is desired from distant headlights where dimming is not desired. Three techniques are used: (i) measurement of the spacing of the light sources, (ii) determination of the location of the light sources relative to the vehicle, and (iii) use of a red filter where the brightness of the light source through the filter is compared with the brightness of the unfiltered light. In the case of the taillight, the brightness of the red filtered and unfiltered light is nearly the same while there is a significant difference for the headlight case. In this situation, either two CCD arrays are used, one with a filter, or a filter which can be removed either electrically, such as with a liquid crystal, or mechanically.

There has thus been shown and described a monitoring system for monitoring both the interior and the exterior of the vehicle using an optical system with one or more CCD arrays and other associated equipment which fulfills all the objects and advantages sought after. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and the accompanying drawings which disclose the preferred embodiments thereof All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention which is limited only by the following claims.

What is claimed is:

1. In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for processing said electronic signal based on said received illumination from said at least one occupying item to provide an identification of said at least one occupying item based thereon, said pattern recognition means being structured and arranged to apply a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item.

2. The system in accordance with claim **1**, wherein said another system comprises an inflatable airbag and said at least one occupying item is an occupant, said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a positional categorization of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions, said output means comprising means for modifying the time at which inflation of said inflatable airbag is initiated in response to the position of the occupant.

3. The system in accordance with claim **1**, wherein said another system comprises an inflatable airbag and said at least one occupying item is an occupant, said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said surfaces of the occupant into a positional categorization of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions, said output means comprising means for modifying the rate at which said inflatable airbag is inflated in response to the position of the occupant.

4. The system in accordance with claim **1**, wherein said another system comprises an inflatable airbag and said at least one occupying item is an occupant, said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a categorization of said signal characteristic of the presence of the occupant based on data

corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the presence and absence of the occupant of the vehicle, said output means comprising means for suppressing deployment of said inflatable in response to the absence of the occupant.

5. The system in accordance with claim **1**, wherein said at least one occupying item is on an occupant, said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a head-positional categorization of said signal characteristic of the position of the occupant's head based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the head of occupants of the vehicle in different positions, said trained pattern recognition means comprises means to categorize the motion of the occupant's head over time, and said output means coupled to said pattern recognition means responds to the category of motion of the occupant's head over time to affect said another system in said vehicle.

6. The sensor in accordance with claim **5**, wherein said another system comprises an alarm.

7. The sensor in accordance with claim **5**, wherein said another system comprises limiting means for limiting the speed of said vehicle.

8. The system in accordance with claim **1** wherein said trained pattern recognition means comprises a neural network.

9. The system in accordance with claim **1** wherein said vehicle further comprises a seat and said at least one occupying item is a rear facing child seat positioned on said seat of said vehicle, and said another vehicle system comprises an airbag.

10. In a motor vehicle having an interior and an exterior, a monitoring system for monitoring at least one object exterior to said vehicle comprising:

a) transmitter means for transmitting electromagnetic waves to illuminate the at least one exterior object;

b) reception means for receiving reflected electromagnetic illumination from the at least one exterior object;

c) processor means coupled to said reception means for processing said received illumination and creating an electronic signal characteristic of said exterior object based thereon;

d) categorization means coupled to said processor means for categorizing said electronic signal to identify said exterior object, said categorization means comprising trained pattern recognition means for processing said electronic signal based on said received illumination from said exterior object to provide an identification of said exterior object based thereon, said pattern recognition means being structured and arranged to apply a pattern recognition algorithm generated from data of possible exterior objects and patterns of received electromagnetic illumination from the possible exterior objects; and

e) output means coupled to said categorization means for affecting another system in the vehicle in response to the identification of said exterior object.

11. The system in accordance with claim **10**, further comprising measurement means for measuring the distance from the at least one exterior object to said vehicle, said measurement means comprising radar.

12. The system in accordance with claim **10**, further comprising measurement means for measuring the distance from the at least one exterior object to said vehicle, said measurement means comprising a pulsed laser.

13. The system in accordance with claim **10**, wherein said another system is a warning system which is activated when the at least one exterior object is within a specified range of said vehicle and said vehicle driver begins to execute an action which increases the probability of a collision with the at least one exterior object.

14. The system in accordance with claim **10**, wherein said another system is a side impact airbag system which is activated when the at least one exterior object is within a specified range of said vehicle and said processor means determines that there is a high probability of a collision with the at least one exterior object.

15. The system in accordance with claim **10** wherein said processor means comprises a neural network algorithm.

16. In a motor vehicle having an interior and an exterior, an automatic headlight dimming system comprising:

a) reception means for receiving electromagnetic radiation from the exterior of the vehicle;

b) processor means coupled to said reception means for processing the received radiation and creating an electronic signal characteristic of the received radiation;

c) categorization means coupled to said processor means for categorizing said electronic signal to identify a source of the radiation, said categorization means comprising trained pattern recognition means for processing said electronic signal based on said received radiation to provide an identification of the source of the radiation based thereon, said pattern recognition means being structured and arranged to apply a pattern recognition algorithm generated from data of possible sources of radiation including lights of vehicles and patterns of received radiation from the possible sources; and

d) output means coupled to said categorization means for dimming the headlights in said vehicle in response to the identification of the source of the radiation.

17. The invention in accordance with claim **16** wherein said categories further comprise radiation from taillights of a vehicle-in-front.

18. The invention in accordance with claim **16** wherein said trained pattern recognition algorithm comprises a neural network.

19. The system of claim **10**, wherein said reception means comprise a CCD array.

20. The invention in accordance with claim **16**, wherein said reception means comprise a CCD array.

21. In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of the form of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item

based on the form of said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for applying a pattern recognition algorithm; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item based on the form of said at least one occupying item.

22. The system of claim **21**, wherein said trained pattern recognition means are structured and arranged to process said electronic signal based on said received illumination from said at least one occupying item to provide an identification of said at least one occupying item based thereon by applying a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items.

23. A method for affecting a system in a vehicle based on an object exterior of the vehicle, comprising the steps of:

a) transmitting electromagnetic waves to illuminate the exterior object;

b) receiving reflected electromagnetic illumination from the object on an array;

c) processing the received illumination and creating an electronic signal characteristic of the exterior object based thereon;

d) processing the electronic signal based on the received illumination from the exterior object to identify the exterior object, said processing step comprising the steps of generating a pattern recognition algorithm from data of possible exterior objects and patterns of received electromagnetic illumination from the possible exterior objects, storing the algorithm within a pattern recognition system and applying the pattern recognition algorithm using the electronic signal as input to obtain the identification of the exterior object; and

e) affecting the system in the vehicle in response to the identification of the exterior object.

24. A method for monitoring an interior of a motor vehicle having an interior passenger compartment containing at least one occupying item, comprising the steps of:

a) illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment on an array;

c) processing said received illumination and generating an electronic signal characteristic of said at least one occupying item in said passenger compartment based thereon;

d) processing the electronic signal based on the received illumination from said at least one occupying item to provide an identification of said at least one occupying item, said processing step comprising the steps of generating a pattern recognition algorithm from data of possible occupying items and patterns of received electromagnetic illumination from the possible occupying items, storing the algorithm within a pattern recognition system and applying the pattern recognition algorithm using the electronic signal as input to obtain the identification of the at least one occupying item; and

e) affecting another system in said vehicle in response to the identification of said at least one occupying item.

25. The system of claim **1**, wherein said receiver means comprise a CCD array.

* * * * *

08/474786

PATENT APPLICATION TRANSMITTAL LETTER	Docket Number (Optional) ATI-95

To the Commissioner of Patents and Trademarks:
Transmitted herewith for filing under 35 U.S.C. 111 and 37 CFR 1.53 is the patent application of
INITIAL Wilbur E. DuVall, Wendell C. Johnson and David S. Breed
entitled Optical Identification and Monitoring System Using Pattern Recognition for Use with Vehicles

Enclosed are:

- [x] 43 pages of written description, claims and abstract.
- [x] 12 sheets of drawings.
- [ ] 1 (copy) an assignment of the invention to Automotive Technologies Intl., Inc.
- [ ] executed declaration of the inventors. (faxed copy- D. S. Breed)
- [ ] a certified copy of a _____ application.
- [ ] associate power of attorney. (faxed copy)
- [ ] a verified statement to establish small entity status under 37 CFR 1.9 and 1.27 (faxed copy)
- [ ] information disclosure statement
- [ ] preliminary amendment
- [X] other: Submission of Application for filing date without signed declaration and without fee.

CLAIMS AS FILED

	NUMBER FILED	NUMBER EXTRA	RATE	FEE
BASIC FEE				$730
TOTAL CLAIMS	18 - 20 =	0 *	X $22	$ 0
INDEPENDENT CLAIMS	3 - 3 =	0 *	X $76	$ 0
MULTIPLE DEPENDENT CLAIM PRESENT			$ 230	
*NUMBER EXTRA MUST BE ZERO OR LARGER		TOTAL		$730
If applicant has small entity status under 37 CFR 1.9 and 1.27, then divide total fee by 2, and enter amount here		SMALL ENTITY TOTAL		$365

- [ ] Two checks for the amount of $_____ to cover the filing fee is enclosed.
- [ ] The Commissioner is hereby authorized to charge and credit Deposit Account No. _____ as described below. I have enclosed a duplicate copy of this sheet.
  - [ ] Charge the amount of $_____ as filing fee.
  - [ ] Credit any overpayment.
  - [ ] Charge any additional filing fees required under 37 CFR 1.16 and 1.17.
  - [ ] Charge the issue fee set in 37 CFR 1.18 at the mailing of the Notice of
  - [ ] Allowance, pursuant to 37 CFR 1.311(b).

June 7, 1995
Date

Signature
Brian Roffe, Esq.
376 Yale Avenue
Woodmere, New York, 11598

Express Mail Mailing Label No. EG 522 388 625 US Date of Deposit: June 7, 1995
I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addresse" service under 37 CFR 1.10 on the date indicated above, in an envelope addressed to the "Commissioner of Patents and Trademarks, Washington, D.C. 20231" Brian Roffe
By:

08/474786

Docket Number ATI-95

UNITED STATES PATENT AND TRADEMARK OFFICE

Re: Application of David S. Breed et al.

Serial No.: Not yet known

Filed: Simultaneously

For: Optical Identification and Monitoring System Using Pattern Recognition For Use With Vehicles

SUBMISSION OF APPLICATION FOR FILING DATE WITHOUT SIGNED DECLARATION AND WITHOUT FEE

Hon. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

June 7, 1995

Sir:

In accordance with 37 C.F.R. 1.53, there is submitted herewith for filing in connection with the above application, and in accordance with 37 CFR 1.53(b) for assignment of a serial number and filing date, the following:

1) Specification containing a description pursuant to 37 CFR 1.71 and at least one claim pursuant to 37 CFR 1.75.
2) Twelve (12) sheets of drawings.
3) The appropriate filing fee is not enclosed herewith. However, the filing fee will be submitted at a late date.
4) This application is not accompanied by a signed Declaration or Oath and Power of Attorney. However, a Declaration will be submitted. The Declaration will set forth the name, address, residence and citizenship of the inventors as follows:

David S. Breed, Citizen of the United States, 48 Hillcrest Road, Boonton Township, NJ 07005
Wilbur E. DuVall, Citizen of the United States, 57 Northwoods Drive, Kimberling City, MO 65686
Wendel C. Johnson, Citizen of the United States, 3165 Fugita Street, Torrance, CA 90505

The Declaration will appoint the undersigned as attorney. Please note the correspondence address: Brian Roffe, Esq., 376 Yale Avenue, Woodmere, New York 11598 (516) 569-3664. According to the provisions of 37 CFR 1.53, a filing date should now e accorded this application.

Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Express Mail Mailing Label No. EG 522 388 625 US
Date of Deposit: June 7, 1995
I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addresse" service under 37 CFR 1.10 on the date indicated above, in an envelope addressed to the "Commissioner of Patents and Trademarks, Washington, D.C. 20231" Brian Roffe

By:

08/474786

Lisa Williams 6/7/95

OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Serial Number 07/878,571 filed 5/5/92, now abandoned, of copending application Serial Number 08/040,978 filed 3/31/93, now abandon, of copending application Serial Number 08/247,760 filed 5/23/94 and of copending application Serial Number 08/239,978 filed 5/9/94, now abandoned, the last three of which are included herein by reference.

BACKGROUND OF THE INVENTION

1. Prior Art on Out of position occupants and rear facing child seats

Whereas thousands of lives have been saved by airbags, a large number of people have also been injured, some seriously, by the deploying airbag, and thus significant improvements need to be made in this regard. As discussed in detail in copending patent applications 08/040,978 and 08/239,978 cross-referenced above, for a variety of reasons vehicle occupants may be too close to the airbag before it deploys and can be seriously injured or killed as a result of the deployment thereof. Also, a child in a rear facing child seat which is placed on the right front passenger seat is in danger of being seriously injured if the passenger airbag deploys. For these reasons and, as first publicly disclosed in Breed, D. S. "How Airbags Work" presented at the International Conference on Seatbelts and Airbags in 1993, in Canada, occupant position sensing and rear facing child seat detection is required.

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By:

Initially these systems will solve the out-of-position occupant and the rear facing child seat problems related to current airbag systems and prevent unneeded airbag deployments when a front seat is unoccupied. However, airbags are now under development to protect rear seat occupants in vehicle crashes and all occupants in side impacts. A system will therefore be needed to detect the presence of occupants, determine if they are out-of-position and to identify the presence of a rear facing child seat in the rear seat. Future automobiles are expected to have eight or more airbags as protection is sought for rear seat occupants and from side impacts. In addition to eliminating the disturbance and possible harm of unnecessary airbag deployments, the cost of replacing these airbags will be excessive if they all deploy in an accident needlessly.

Inflators now exist which will adjust the amount of gas flowing to the airbag to account for the size and position of the occupant and for the severity of the accident. The vehicle identification and monitoring system (VIMS) discussed in patent application Serial No. 08/239,978 will control such inflators based on the presence and position of vehicle occupants or of a rear facing child seat. The instant invention is an improvement on that VIMS system and uses an advanced optical system comprising one or more CCD (charge coupled device) arrays and a source of illumination combined with a trained neural network pattern recognition system.

The need for an occupant out-of-position sensor has been observed by others and several methods have been disclosed in U.S. patents for determining the position of an occupant of a motor vehicle. Each of these systems, however, have significant limitations. In White et al. (U.S. Patent No. 5,071,160), for example, a single acoustic sensor and detector is disclosed and, as illustrated, is mounted lower than the steering wheel. White et al. correctly perceive that such a

sensor could be defeated, and the airbag falsely deployed, by an occupant adjusting the control knobs on the radio and thus they suggest the use of a plurality of such sensors.

Mattes et al. (U.S. Patent No. 5,118,134) disclose a variety of methods of measuring the change in position of an occupant including ultrasonic, active or passive infrared and microwave radar sensors, and an electric eye. Their use of these sensors is to measure the change in position of an occupant during a crash and use that information to access the severity of the crash and thereby decide whether or not to deploy the airbag. They are thus using the occupant motion as a crash sensor. No mention is made of determining the out-of-position status of the occupant or of any of the other features of occupant monitoring as disclosed in the above cross-referenced patent applications. It is interesting to note that nowhere does Mattes et al. discuss how to use active or passive infrared to determine the position of the occupant. As pointed out in the above cross-referenced patent applications, direct occupant position measurement based on passive infrared is probably not possible and, until very recently, was very difficult and expensive with active infrared requiring the modulation of an expensive GaAs infrared laser. Since there is no mention of these problems, the method of use contemplated by Mattes et al. must be similar to the electric eye concept where position is measured indirectly as the occupant passes by a plurality of longitudinally spaced-apart sensors.

The object of an occupant out-of-position sensor is to determine the location of the head and/or chest of the vehicle occupant relative to the airbag since it is the impact of either the head or chest with the deploying airbag which can result in serious injuries. Both White et al. and Mattes et al. disclose only lower mounting locations of their sensors which are mounted in front of the occupant such as on the dashboard or below the steering wheel. Both such mounting

locations are particularly prone to detection errors due to positioning of the occupant's hands, arms and legs. This would require at least three, and preferably more, such sensors and detectors and an appropriate logic circuitry which ignores readings from some sensors if such readings are inconsistent with others, for the case, for example, where the driver's arms are the closest objects to two of the sensors.

White et al. also disclose the use of error correction circuitry, without defining or illustrating the circuitry, to differentiate between the velocity of one of the occupant's hands as in the case where he/she is adjusting the knob on the radio and the remainder of the occupant. Three ultrasonic sensors of the type disclosed by White et al. might, in some cases, accomplish this differentiation if two of them indicated that the occupant was not moving while the third was indicating that he or she was. Such a combination, however, would not differentiate between an occupant with both hands and arms in the path of the ultrasonic transmitter at such a location that they were blocking a substantial view of the occupant's head or chest. Since the sizes and driving positions of occupants are extremely varied, trained pattern recognition systems, such as neural networks, are required when a clear view of the occupant, unimpeded by his/her extremities, cannot be guaranteed.

Fujita et al., in U.S. Patent No. 5,074,583, illustrate another method of determining the position of the occupant but do not use this information to suppress deployment if the occupant is out-of-position. In fact, the closer that the occupant gets to the airbag the faster the inflation rate of the airbag is according to the Fujita patent, which thereby increases the possibility of injuring the occupant. Fujita et al. do not measure the occupant directly but instead determine his or her position indirectly from measurements of the seat position and the vertical size of the occupant

relative to the seat. This occupant height is determined using an ultrasonic displacement sensor mounted directly above the occupant's head.

As discussed above, the optical systems described herein are also applicable for many other sensing applications both inside and outside of the vehicle compartment such as for sensing crashes before they occur as described in copending patent application Serial No. 08/239,978 cross-referenced above, for a smart headlight adjustment system and for a blind spot monitor.

2. Definitions

The use of pattern recognition is central to the instant invention as well as those cross-referenced patent applications above. Nowhere in the prior art is pattern recognition which is based on training, as exemplified through the use of neural networks, mentioned for use in monitoring the interior or exterior environments of the vehicle. "Pattern recognition" as used herein will mean any system which processes a signal that is generated by an object, or is modified by interacting with an object, in order to determine which one of a set of classes that the object belongs to. Such a system might determine only that the object is or is not a member of one specified class, or it might attempt to assign the object to one of a larger set of specified classes, or find that it is not a member of any of the classes in the set. The signals processed are generally electrical signals coming from transducers which are sensitive to either acoustic or electromagnetic radiation and, if electromagnetic, they can be either visible light, infrared, ultraviolet or radar. A trainable or a trained pattern recognition system as used herein means a pattern recognition system which is taught various patterns by subjecting the system to a variety of examples. The most successful such system is the neural network.

To "identify" as used herein will mean to determine that the object belongs to a particular set or class. The class may be one containing, for example, all rear facing child seats, one containing all human occupants, or all human occupants not sitting in a rear facing child seat depending on the purpose of the system. In the case where a particular person is to be recognized, the set or class will contain only a single element, i.e., the person to be recognized.

An "occupying item" of a seat may be a living occupant such as a human being or a dog, another living organism such as a plant, or an inanimate object such as a box or bag of groceries.

In the description herein on anticipatory sensing, the term "approaching" when used in connection with the mention of an object or vehicle approaching another will mean the relative motion of the object toward the vehicle having the anticipatory sensor system. Thus, in a side impact with a tree, the tree will be considered as approaching the side of the vehicle and impacting the vehicle. In other words, the coordinate system used in general will be a coordinate system residing in the target vehicle. The "target" vehicle is the vehicle which is being impacted. This convention permits a general description to cover all of the cases such as where (i) a moving vehicle impacts into the side of a stationary vehicle, (ii) where both vehicles are moving when they impact, or (iii) where a vehicle is moving sideways into a stationary vehicle, tree or wall.

*3. **Pattern recognition prior art***

Japanese patent 3-42337 (A) to Ueno discloses a device for detecting the driving condition of a vehicle driver comprising a light emitter for irradiating the face of the driver and a means for picking up the image of the driver and storing it for later analysis. Means are provided for locating the eyes of the driver and then the irises of the eyes and then determining if the driver is looking to the side or sleeping. Ueno determines the state of the eyes of the occupant rather

than determining the location of the eyes relative to the other parts of the vehicle passenger compartment. Such a system can be defeated if the driver is wearing glasses, particularly sunglasses, or another optical device which obstructs a clear view of his/her eyes. Pattern recognition technologies such as neural networks are not used.

U.S. Patent No. 5,008,946 to Ando uses a complicated set of rules to isolate the eyes and mouth of a driver and uses this information to permit the driver to control the radio, for example, or other systems within the vehicle by moving his eyes and/or mouth. Ando uses natural light and illuminates only the head of the driver. He also makes no use of trainable pattern recognition systems such as neural networks, nor is there any attempt to identify the contents of the vehicle nor of their location relative to the vehicle passenger compartment. Rather, Ando is limited to control of vehicle devices by responding to motion of the driver's mouth and eyes.

U.S. Patent No. 5,298,732 to Chen also concentrates in locating the eyes of the driver so as to position a light filter between a light source such as the sun or the lights of an oncoming vehicle, and the driver's eyes. Chen does not explain in detail how the eyes are located but does supply a calibration system whereby the driver can adjust the filter so that it is at the proper position relative to his or her eyes. Chen references the use of an automatic equipment for determining the location of the eyes but does not describe how this equipment works. In any event, there is no mention of monitoring the position of the occupant, other that the eyes, of determining the position of the eyes relative to the passenger compartment, or of identifying any other object in the vehicle other than the driver's eyes. Also, there is no mention of the use of a trainable pattern recognition system.

U.S. Patent No. 5,305,012 to Faris also describes a system for reducing the glare from the headlights of an oncoming vehicle. Faris locates the eyes of the occupant by the use of two spaced apart infrared cameras using passive infrared radiation from the eyes of the driver. Again, Faris is only interested in locating the driver's eyes relative to the sun or oncoming headlights and does not identify or monitor the occupant or locate the occupant relative to the passenger compartment or the airbag. Also, Faris does not use trainable pattern recognition techniques such as neural networks. Faris, in fact, does not even say how the eyes of the occupant are located but refers the reader to a book entitled Robot Vision (1991) by Berthold Horn, published by MIT Press, Cambridge, Mass. Also, Faris uses the passive infrared radiation rather than illuminating the occupant with active infrared radiation or in general electromagnetic radiation as in the instant invention.

The use of neural networks as the pattern recognition technology is central to this invention since it makes the monitoring system robust, reliable and practical. The resulting algorithm created by the neural network program is usually only a few lines of code written in the C computer language as opposed to typically hundreds of lines when the techniques of the above patents to Ando, Chen and Faris are implemented. As a result, the resulting systems are easy to implement at a low cost making them practical for automotive applications. The cost of the CCD arrays, for example, have been prohibitively expensive until very recently rendering their use for VIMS impractical. Similarly, the implementation of the techniques of the above referenced patents requires expensive microprocessors while the implementation with neural networks and similar trainable pattern recognition technologies permits the use of low cost microprocessors typically costing less than $5.

The present invention uses sophisticated trainable pattern recognition capabilities such as neural networks. Usually the data is preprocessed, as discussed below, using various feature extraction. An example of such a pattern recognition system using neural networks on sonar signals is discussed in two papers by Gorman, R. P. and Sejnowski, T. J. "Analysis of Hidden Units in a Layered Network Trained to Classify Sonar Targets", *Neural Networks*, Vol. 1. pp. 75-89, 1988, and "Learned Classification of Sonar Targets Using a Massively Parallel Network", IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 36, No. 7, July 1988. Examples of feature extraction techniques can be found in U.S. Patent No. 4,906,940 entitled "Process and Apparatus for the Automatic Detection and Extraction of Features in Images and Displays" to Green et al. Examples of other more advanced and efficient pattern recognition techniques can be found in U.S. Patent No. 5,390,136 entitled "Artificial Neuron and Method of Using Same and U.S. patent application Serial Number 08/076,601 entitled "Neural Network and Method of Using Same" to Wang, S. T.. Other examples include U.S. Patent Nos. 5,235,339 (Morrison et al.), 5,214,744 (Schweizer et al), 5,181,254 (Schweizer et al), and 4,881,270 (Knecht et al). All of the above references are included herein by reference.

4. Optics

Optics can be used in several configurations for monitoring the interior of a passenger compartment of an automobile. In one known method, a laser optical system uses a GaAs infrared laser beam to momentarily illuminate an object, occupant or child seat, in the manner as described and illustrated in FIG. 8 of the copending patent application Serial No. 08/040,978 cross-referenced above. The receiver can be a charge coupled device or CCD, (a type of TV camera) to receive the reflected light. The laser can either be used in a scanning mode, or,

through the use of a lens, a cone of light can be created which covers a large portion of the object. In these configurations, the light can be accurately controlled to only illuminate particular positions of interest within the vehicle. In the scanning mode, the receiver need only comprise a single or a few active elements while in the case of the cone of light, an array of active elements is needed. The laser system has one additional significant advantage in that the distance to the illuminated object can be determined as disclosed in the 08/040,978 patent application.

In a simpler case, light generated by a non-coherent light emitting diode device is used to illuminate the desired area. In this case, the area covered is not as accurately controlled and a larger CCD array is required. Recently, however, the cost of CCD arrays has dropped substantially with the result that this configuration is now the most cost effective system for monitoring the passenger compartment as long as the distance from the transmitter to the objects is not needed. If this distance is required, then either the laser system, a stereographic system, a focusing system, or a combined ultrasonic and optic system is required. A mechanical focusing system, such as used on some camera systems can determine the initial position of an occupant but is too slow to monitor his/her position during a crash. A distance measuring system based of focusing is described in U.S. Patent No. 5,193,124 (Subbarao) which can either be used with a mechanical focusing system or with two cameras, the latter of which would be fast enough. Although the Subbarao patent provides a good discussion of the camera focusing art and is therefore included herein by reference, it is a more complicated system than is needed for the practicing the instant invention. In fact, a neural network can also be trained to perform the distance determination based on the two images taken with different camera settings or from two adjacent CCD's and lens having different properties as the cameras disclosed in Subbarao making

this technique practical for the purposes of this instant invention. Distance can also be determined by the system disclosed in U.S. Patent No. 5,003,166 (Girod) by the spreading or defocusing of a pattern of structured light projected onto the object of interest.

In each of these cases, regardless of the distance measurement system used, a trained pattern recognition system, as defined above, is used in the instant invention to identify and classify, and in some cases to locate, the illuminated object and its constituent parts.

5. Optics and acoustics

The laser systems described above are expensive due to the requirement that they be modulated at a high frequency if the distance from the airbag to the occupant, for example, needs to be measured. Both laser and non-laser optical systems in general are good at determining the location of objects within the two dimensional plane of the image and the modulated laser system in the scanning mode can determine the distance of each part of the image from the receiver. It is also possible to determine distance with the non-laser system by focusing as discussed above, or stereographically if two spaced apart receivers are used and, in some cases the mere location in the field of view can be used to estimate the position relative to the airbag, for example. Finally, a recently developed pulsed quantum well diode laser does provide inexpensive distance measurements as discussed below.

Acoustic systems are also quite effective at distance measurements since the relatively low speed of sound permits simple electronic circuits to be designed and minimal microprocessor capability is required. If a coordinate system is used where the z axis is from the transducer to the occupant, acoustics are good at measuring z dimensions while simple optical systems using a

single CCD are good at measuring x and y dimensions. The combination of acoustics and optics, therefore, permits all three measurements to be made with low cost components.

One example of a system using these ideas is an optical system which floods the passenger seat with infrared light coupled with a lens and CCD array which receives and displays the reflected light and an analog to digital converter (ADC) which digitizes the output of the CCD and feeds it to an Artificial Neural Network (ANN) or other pattern recognition system , for analysis. This system uses an ultrasonic transmitter and receiver for measuring the distances to the objects located in the passenger seat. The receiving transducer feeds its data into an ADC and from there into the ANN. The same ANN can be used for both systems thereby providing full three dimensional data for the ANN to analyze. This system, using low cost components, will permit accurate identification and distance measurements not possible by either system acting alone. If a phased array system is added to the acoustic part of the system as disclosed in copending patent application (ATI-102), the optical part can determine the location of the driver's ears, for example, and the phased array can direct a narrow beam to the location and determine the distance to the occupant's ears.

6. Applications

The applications for this technology are numerous as described in the copending patent applications listed above. They include: (i) the monitoring of the occupant for safety purposes to prevent airbag deployment induced injuries, (ii) the locating of the eyes of the occupant to permit automatic adjustment of the rear view mirror(s), (iii) the location of the seat to place the eyes at the proper position to eliminate the parallax in a heads-up display in night vision systems, (iv) the location of the ears of the occupant for optimum adjustment of the entertainment system, (v) the

identification of the occupant for security reasons, (vi) the determination of obstructions in the path of a closing door or window, (vii) the determination of the position of the occupant's shoulder so that the seat belt anchorage point can be adjusted for the best protection of the occupant, (viii) the determination of the position of the rear of the occupants head so that the headrest can be adjusted to minimize whiplash injuries in rear impacts, (ix) anticipatory crash sensing, (x) blind spot detection, (xi) smart headlight dimmers, and many others. In fact, over forty products alone have been identified based on the ability to identify and monitor objects and parts thereof in the passenger compartment of an automobile or truck.

SUMMARY OF THE INVENTION

This invention is a system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle.

When the vehicle interior monitoring system of this invention is installed in the passenger compartment of an automotive vehicle equipped with a passenger protective device, such as an inflatable airbag, and the vehicle is subjected to a crash of sufficient severity that the crash sensor

has determined that the protective device is to be deployed, the system in accordance with the invention determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag.

In some implementations of the invention, one or more ultrasonic transmitters and receivers are added to the system to provide a measurement of the distance from the transmitter/receiver to the objects of interest. In some of these implementations, a phased array system is used to permit the ultrasonic waves from the ultrasonic transmitters to be narrowly focused onto a particular location of an object. In other implementations, the source of infrared light is a modulated laser which permits an accurate measurement of the distance to the point of reflection. In still other cases, a focusing system is used to determine the distance to the object. Finally, in yet other cases a GaAs pulsed quantum well laser system is used to measure distance directly to a point of interest.

Principle objects and advantages of the optical sensing system in accordance with the invention are:

1. To recognize the presence of a human on a particular seat of a motor vehicle and to use this information to affect the operation of another vehicle system such as the airbag, heating and air conditioning, or entertainment systems, among others.

2. To recognize the presence of a human on a particular seat of a motor vehicle and then to determine his/her position and to use this position information to affect the operation of another vehicle system.

3. To determine the position, velocity or size of an occupant in a motor vehicle and to utilize this information to control the rate of gas generation, or the amount of gas generated by an airbag inflator system.

4. To determine the presence or position of rear seated occupants in the vehicle and to use this information to affect the operation of a rear seat protection airbag for frontal impacts.

5. To recognize the presence of a rear facing child seat on a particular seat of a motor vehicle and to use this information to affect the operation of another vehicle system such as the airbag system.

6. To determine the approximate location of the eyes of a driver and to use that information to control the position of the rear view mirrors of the vehicle.

7. To monitor the position of the head of the vehicle driver and determine whether the driver is falling asleep or otherwise impaired and likely to lose control of the vehicle and to use that information to affect another vehicle system.

8. To provide an occupant position sensor which reliably permits, and in a timely manner, a determination to be made that the occupant is out of position, or will become out of position, and likely to be injured by a deploying airbag and to then output a signal to suppress the deployment of the airbag.

9. To provide an anticipatory sensor which permits accurate identification of the about-to-impact object in the presence of snow and / or fog whereby the sensor is located within the vehicle.

10. To provide a smart headlight dimmer system which senses the headlights from an oncoming vehicle or the tail lights of a vehicle in front of the subject vehicle and identifies these

lights differentiating them from reflections from signs or the road surface and then sends a signal to dim the headlights.

11. To provide a blind spot detector which detects and categorizes an object in the driver's blind spot and warns the driver in the event the driver begins to change lanes, for example, or continuously informs the driver of the state of occupancy of the blind spot.

These and other objects and advantages will become apparent from the following description of the preferred embodiments of the vehicle identification and monitoring system of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side planar view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing several preferred mounting locations of interior vehicle monitoring sensors shown particularly for sensing the vehicle driver illustrating the wave pattern from an ultrasonic mirror mounted position sensor.

FIG. 1B is a view as in FIG. 1A illustrating the wave pattern from an optical system using an infrared light source and a CCD array receiver using the windshield as a reflection surface and showing schematically the interface between the vehicle interior monitoring system of this invention and an instrument panel mounted inattentiveness warning light or buzzer and reset button.

FIG. 1C is a view as in FIG. 1A illustrating the wave pattern from a set of ultrasonic transmitters/receivers where the spacing of the transducers and the phase of the signals permits an

accurate focusing of the ultrasonic beam and thus the accurate measurement of a particular point on the surface of the driver.

FIG. 1D is a view as in FIG. 1A illustrating the wave pattern from an optical system using an infrared light source and a CCD array receiver where the CCD array receiver is covered by a fisheye lens permitting a wide angle view of the contents of the passenger compartment.

FIG. 1E is a view as in FIG. 1A illustrating the wave pattern from a pair of small CCD array receivers and one infrared transmitter where the spacing of the CCD arrays permits an accurate measurement of the distance to features on the occupant.

FIG. 2 is a side view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing preferred mounting locations of optical interior vehicle monitoring sensors.

FIG. 3 is a circuit schematic illustrating the use of the vehicle interior monitoring sensor used as an occupant position sensor in conjunction with the remainder of the inflatable restraint system.

FIG. 4 is a schematic illustrating the circuit of an occupant position sensing device using a modulated infrared signal, beat frequency and phase detector system.

FIG. 5 is a side planer view with parts cutaway and removed of a vehicle showing the passenger compartment containing a driver and a preferred mounting location for an occupant position sensor for use in side impacts and also of a rear of occupant's head locator for use with a headrest adjustment system to reduce whiplash injuries in rear impact crashes.

FIG. 6 is a side plan view of the interior of an automobile, with portions cut away and removed, with two occupant height measuring sensors, one mounted into the headliner above the

occupant's head and the other mounted onto the A-pillar and also showing a seatbelt associated with the seat where the seatbelt has an adjustable upper anchorage point which is automatically adjusted corresponding to the height of the occupant.

FIG. 7 is a perspective view of a vehicle about to impact the side of another vehicle showing the location of the various parts of the anticipatory sensor system of this invention.

FIG. 7A is a view of the section designated 7A in FIG. 7.

FIG. 8 is a side planar view, with certain portions removed or cut away, of a portion of the passenger compartment illustrating a sensor for sensing the headlights of an oncoming vehicle and/or the taillights of a leading vehicle used in conjunction with an automatic headlight dimming system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, a section of the passenger compartment of an automobile is shown generally as 100 in FIGS. 1A through 1E. A driver 101 of a vehicle sits on a seat 102 behind a steering wheel 103 which contains an airbag assembly 104. Five transmitter and/or receiver assemblies 110, 111, 112, 113 and 114 are positioned at various places in the passenger compartment to determine the location of the head, chest and torso of the driver relative to the airbag and to otherwise monitor the interior of the passenger compartment. Control circuitry 120 is connected to the transmitter/receivers 110-114 and controls the transmission from the transmitters and captures the return signals from the receivers. Control circuitry 120 usually contains analog to digital converters (ADCs), a microprocessor containing sufficient memory and appropriate software including pattern recognition algorithms, and other appropriate drivers, signal conditioners, signal generators, etc.. Usually, in any given implementation, only one or two

of the transmitters and receivers would be used depending on their mounting locations as described below.

FIG. 1A illustrates a typical wave pattern of ultrasonic waves from transmitter/receiver 114. In this embodiment, the transmitter/receiver 114 comprises an ultrasonic transducer which will generally be used in conjunction with an optical transmitter and CCD array such as shown at 110, 112 and 113. The optical systems, i.e., the optical transmitter and CCD array, map the location of the occupant(s), objects and features thereof, in a two dimensional image by the CCD array and ultrasonic transmitter/receiver 114 determines the distance from the sensor to the occupant. When used for monitoring the passenger seat, the optical system 110 determines that the seat is occupied and identifies the occupying item and then the ultrasonic system such as 114 determines the location of the occupant relative to the airbag. The optical system identifies what it is that the ultrasonic system is measuring and determines which echo is from the occupant's head or chest as opposed to some other object. The transmitter/receiver 114 may be mounted to a rear view mirror 105.

In the case of FIG. 1A, transmitter/receiver 114 emits ultrasonic acoustical waves which bounce off the head and chest of the driver and return thereto. Periodically, the device, as commanded by control circuit 120, transmits a burst of ultrasonic waves at about 50 kilohertz, for example, and the reflected signal is detected by the same or a different device. An associated electronic circuit or algorithm in control circuit 120 measures the time between the transmission and the reception of the ultrasonic waves and thereby determines the distance from the transmitter/receiver to the driver, passenger or other occupying item based on the velocity of sound. This information is then sent to the crash sensor and diagnostic circuitry, which may also

be resident in 120, which determines if the occupant is close enough to the airbag that a deployment might, by itself, cause injury which exceeds that which might be caused by the accident itself. In such a case, the circuit disables the airbag system and thereby prevents its deployment. In an alternate case, the sensor algorithm assesses the probability that a crash requiring an airbag is in process and waits until that probability exceeds an amount that is dependent on the position of the occupant. Thus, for example, the sensor might decide to deploy the airbag based on a need probability assessment of 50%, if the decision must be made immediately for an occupant approaching the airbag, but might wait until the probability rises to 95% for a more distant occupant. Although a driver system has been illustrated, the front and rear seat passenger systems would be similar.

In another implementation, the sensor algorithm may determine the rate that gas is generated to affect the rate that the airbag is inflated. In all of these cases, the position of the occupant is used to affect the deployment of the airbag either as to whether or not it should be deployed at all, the time of deployment or the rate of inflation.

An optical infrared transmitter and receiver assembly is shown generally at 112 in FIG. 1B and is mounted onto the instrument panel facing the windshield. Device 112, shown enlarged, comprises a source of infrared radiation, or another form of electromagnetic radiation, and a charge coupled device array (CCD array) of typically 160 pixels by 160 pixels. In this embodiment, the windshield is used to reflect the illumination light provided by the infrared radiation and also the light reflected back by the objects in the passenger compartment, in a manner similar to the "heads-up" display which is now being offered on several automobile models. The "heads-up" display, of course, is currently used only to display information to the

driver and is not used to reflect light from the driver to a receiver. Once again, unless one of the distance measuring systems as described below is used, this system alone cannot be used to determine distances from the objects to the sensor. Its main purpose is object identification and monitoring.

Device 112 is actually about two cm. in diameter and is shown greatly enlarged in FIG. 1B. Also, the reflection area on the windshield is considerably smaller than illustrated and special provisions are made to assure that this area of the windshield is flat and reflective as is done generally when heads-up displays are used.

The system illustrated in FIG. 1B uses a single CCD array and thus, since this device is small, it cannot in general be used to achieve a stereographic image and thus some other method is necessary to determine the distance to the object. If two spaced apart CCD arrays are used, however, then the distance to the various objects within the passenger compartment can be found by using a simple algorithm which locates similar features on both images and determines their relative location on the images. An alternate method is to use a lens with a short focal length. In this case, the lens is mechanically focused to determine the clearest image and thereby obtain the distance to the object. This is similar to certain camera auto-focusing systems such as one manufactured by Fuji of Japan. Naturally, other methods can be used as described in the patents referenced above.

Once a vehicle interior monitoring system employing a sophisticated pattern recognition system, such as a neural network is in place, it is possible to monitor the motions of the driver over time, and his/her response to various stimuli, and determine if he is falling asleep or has otherwise become incapacitated. In such an event, the vehicle can be caused to respond in a

number of different ways. One such system is illustrated in FIG. 1B and consists of a monitoring system having transducer device 112 plus a microprocessor in control circuit 120 programmed to compare the motions of the driver over time and trained to recognize changes in behavior representative of becoming incapacitated. If the system determines that there is a reasonable probability that the driver has fallen asleep, for example, then it can turn on a warning light shown here as 124 or send a warning sound. If the driver fails to respond to the warning by pushing a button 122, for example, then the horn and lights can be operated in a manner to warn other vehicles and the vehicle brought to a stop. Naturally other responses can also be programmed and other tests of driver attentiveness can be used without resorting to attempting to monitor the motions of the driver's eyes.

An even more sophisticated system of monitoring the behavior of the driver is to track the driver's eye motions using such techniques as are described in: Freidman et al., U.S. Patent No. 4,648,052 entitled "Eye Tracker Communication System"; Heyner et al., U.S. Patent No. 4,720,189 entitled "Eye Position Sensor"; Hutchinson, U.S. Patent No. 4,836,670 entitled "Eye Movement Detector"; and Hutchinson, U.S. Patent No. 4,950,069 entitled "Eye Movement Detector With Improved Calibration and Speed", all of which are included herein by reference as well as U.S. Patent Nos. 5,008,946 and 5,305,012 referenced above. The detection of the impaired driver in particular can be best determined by these techniques. These systems make use of sophisticated pattern recognition techniques plus, in many cases, the transmitter and CCD receivers must be appropriately located so that the reflection off of the cornea of the driver's eyes can be detected as discussed in the above referenced patents. The size of the CCD arrays used herein permits their location, sometimes in conjunction with a reflective windshield, where this

corneal reflection can be detected with some difficulty. Naturally sunglasses can interfere with this process.

The eye tracker systems discussed above are facilitated by the instant invention since one of the main purposes of determining the location of the driver's eyes either by directly locating them with trained pattern recognition technology or by inferring their location from the location of the driver's head, is so that the seat can be automatically positioned to place the driver's eyes into the "eye-ellipse". The eye-ellipse is the proper location for the driver's eyes to permit optimal operation of the vehicle and for the location of the mirrors etc. Thus, if we know where the driver's eyes are, then the driver can be positioned so that his or her eyes are precisely situated in the eye ellipse and the reflection off of the eye can be monitored with a small eye tracker system. Also, by ascertaining the location of the driver's eyes, a rear view mirror positioning device can be controlled to adjust the same to an optimal position.

A more accurate acoustic system for determining the distance to a particular object, or a part thereof, in the passenger compartment is exemplified by transducers 111 in FIG. 1C. In this case, three ultrasonic transmitter/receivers are shown spaced apart mounted onto the A-pillar of the vehicle. The A-pillar is the forward most roof support pillar and also supports the windshield. Due to the wavelength, it is difficult to get a narrow beam using ultrasonics without either using high frequencies which have limited range or a large transducer. A commonly available 40 kHz transducer, for example, is about 1 cm. in diameter and emits a sonic wave which spreads at about a sixty degree angle. To reduce this angle requires making the transducer larger in diameter. An alternate solution is to use several transducers and to phase the transmissions so that they arrive at the intended part of the target in phase. Reflections from the selected part of the target are then

reinforced whereas reflections from adjacent parts encounter interference with the result that the distance to the brightest portion within the vicinity of interest can be determined. By varying the phase of transmission from the three transducers 111, the location of a reflection source on a curved line can be determined. In order to locate the reflection source in space, at least one additional transmitter/receiver is required which is not co-linear with the others. The accuracy of the measurement can be determined by those skilled in the art of phased array radar as the relevant equations are applicable here. The waves shown in FIG. 1C coming from the three transducers 111 are actually only the portions of the waves which arrive at the desired point in space together in phase. The effective direction of these wave streams can be varied by changing the transmission phase between the three transmitters. A determination of the approximate location of a point of interest on the occupant is accomplished by the CCD array and appropriate analysis and the phasing of the ultrasonic transmitters is determined so that the distance to the desired point can be determined.

FIG. 1D illustrates two optical systems each having a source of infrared radiation and a CCD array receiver. The price of CCD arrays has dropped dramatically in the last year making them practical for interior monitoring. Transducers 110 and 113 are CCD arrays having 160 by 160 pixels which is covered by an approximate spherical lens. This creates a "fisheye" effect whereby light from a wide variety of directions can be captured. One such sensor placed by the dome light or other central position in the vehicle roof such as 113, can monitor the entire vehicle interior with sufficient resolution to determine the occupancy of the vehicle, for example. CCD's such as those used herein are available from Marshall Electronics Inc. of Culver City, CA. A fisheye lens is ".... a wide-angle photographic lens that covers an angle of about 180°, producing a

circular image with exaggerated foreshortening in the center and increasing distortion toward the periphery". (*The American Heritage Dictionary of the English Language, Third Edition ,1992 by Houghton Mifflin Company)*. This distortion of a fisheye lens can be substantially changed by modifying the shape of the lens to permit particular portions of the interior passenger compartment to be observed. Also, in many cases the full 180° is not desirable and a lens which captures a smaller angle may be used. Although primarily spherical lenses are illustrated herein, it is understood that the particular lens design will depend on the location in the vehicle and the purpose of the particular receiver.

CCD arrays are in common use in television cameras, for example, to convert an image into an electrical signal. For the purposes herein, a CCD will be defined to include all devices which are capable of converting light frequencies, including infrared and ultraviolet, into electrical signals. The particular CCD array used for many of the applications disclosed herein is implemented on a single chip which is less than two cm. in diameter. Data from the CCD array is digitized and sent serially to an electronic circuit 120 containing a microprocessor for analysis of the digitized data. In order to minimize the amount of data which needs to be stored, initial processing of the image data takes place as it is being received from the CCD array.

One method of determining distance to an object directly without resorting to range finders is to used a mechanical focusing system. However, the use of such an apparatus is cumbersome, expensive, slow and has questionable reliability. An alternative is to use the focusing systems described in the above referenced U.S. Patent Nos. 5,193,124 and 5,003,166 however such systems require expensive hardware and/or elaborate algorithms. Another alternative is illustrated in FIG. 1E where transducer 116 is an infrared source having a wide

transmission angle such that the entire contents of the front driver's seat is illuminated. Receiving CCD transducers 117 and 118 are shown spaced apart so that a stereographic analysis can be made by the control circuitry 120. This circuitry 120 contains a microprocessor with appropriate pattern recognition algorithms along with other circuitry as described above. In this case, the desired feature to be located is first selected from one of the two returned images from either CCD transducer 117 or 118. The software then determines the location of the same feature on the other image and thereby, through analysis familiar to those skilled in the art, determines the distance of the feature from the transducers.

Transducers 116-118 are illustrated mounted onto the A-pillar of the vehicle, however, since these transducers are quite small, typically approximately 2 cm. or less in diameter, they could alternately be mounted onto the windshield itself, or other convenient location which provides a clear view of the portion of the passenger compartment being monitored.

A new class of laser range finders has particular application here. This product, as manufactured by Power Spectra, Inc. of Sunnyvale, California, is a GaAs pulsed laser device which can measure up to 30 meters with an accuracy of < 2 cm. and a resolution of < 1 cm. This system is implemented in combination with transducer 116 and one of the receiving transducers 117 or 118 may thereby be eliminated. Once a particular feature of an occupying item of the passenger compartment has been located, this device is used in conjunction with an appropriate aiming mechanism to direct the laser beam to that particular feature. The distance to that feature is then known to within 2 cm, and with calibration even more accurately. Note that in addition to measurements within the passenger compartment, this device has particular applicability in anticipatory sensing and blind spot monitoring applications exterior to the vehicle.

In FIG. 2 a side view, with certain portions removed or cut away, of a portion of the passenger compartment of a vehicle showing preferred mounting locations of optical interior vehicle monitoring sensors 110, 113, 210-214. Each of these devices is illustrated as having a fisheye lens and is shown enlarged in size for clarity. In a typical actual device, the diameter of the lens is approximately 2 cm. and it protrudes from the mounting surface by approximately 1 cm. This small size renders these devices almost unnoticeable by vehicle occupants. Note that since these devices are optical it is important that the lens surface remains relatively clean. Control circuitry 120 contains a self-diagnostic feature where the image returned by one of the transducers is compared with a stored image and the existence of certain key features is verified. If a receiver fails this test, a warning is displayed to the driver which indicates that cleaning of the lens surface is required. The technology illustrated in FIG. 2 can be used for numerous purposes including: (i) the determination of the presence of a rear facing child seat 230, (ii) the monitoring of the rear of an occupant's head 242, (iii) the monitoring of the position of occupant 240, (iv) the monitoring of the position of the occupants knees 241, (v) the measurement of the occupant's height using transducer 113, as well as other monitoring functions as described elsewhere in this specification.

The occupant position sensor in any of its various forms is integrated into the airbag system circuitry as shown schematically in FIG. 3. In this example, the occupant position sensors are used as an input to a smart electronic sensor and diagnostic system. The electronic sensor determines whether the airbag should be deployed based on the vehicle acceleration crash pulse, or crush zone mounted crash sensors, and the occupant position sensor determines whether the occupant is too close to the airbag and therefore that the deployment should not take place. In

FIG. 3 the electronic crash sensor located within the sensor and diagnostic unit determines whether the crash is of such severity as to require deployment of the airbag. The occupant position sensors determine the location of the vehicle occupants relative to the airbags and provide this information to the sensor and diagnostic unit which then determines whether it is safe to deploy the airbag. The arming sensor also determines whether there is a vehicle crash occurring. If the sensor and diagnostic unit and the arming sensor both determine that the vehicle is undergoing a crash requiring an airbag and the position sensors determine that the occupants are safely away from the airbags, the airbag, or inflatable restraint system, is deployed.

A particular implementation of an occupant position sensor having a range of from 0 to 2 meters (corresponding to an occupant position of from 0 to 1 meter since the signal must travel both to and from the occupant) using infrared is illustrated in the block diagram schematic of FIG. 4. The operation is as follows. A 48 MHz signal, f1, is generated by a crystal oscillator 401 and fed into a frequency tripler 402 which produces an output signal at 144 MHz. The 144 MHz signal is then fed into an infrared diode driver 403 which drives the infrared diode 404 causing it to emit infrared light modulated at 144 MHz and a reference phase angle of zero degrees. The infrared diode 404 is directed at the vehicle occupant. A second signal f2 having a frequency of 48.05 MHz, which is slightly greater than f1, is similarly fed into a frequency tripler 406 to create a frequency of 144.15 MHz. This signal is then fed into a mixer 407 which combines it with the 144 MHz signal from frequency tripler 402. The combined signal from the mixer 407 is then fed to filter 408 which removes all signals except for the difference, or beat frequency, between 3 times f1 and 3 times f2, of 150 kHz. The infrared signal which is reflected from the occupant is received by receiver 409 and fed into pre-amplifier 411, a resistor 410 to bias being coupled to the

connection between the receiver 409 and the pre-amplifier 411. This signal has the same modulation frequency, 144 MHz, as the transmitted signal but now is out of phase with the transmitted signal by an angle x due to the path that the signal took from the transmitter to the occupant and back to the receiver. The output from pre-amplifier 411 is fed to a second mixer 412 along with the 144.15 MHz signal from the frequency tripler 406. The output from mixer 412 is then amplified by an automatic gain amplifier 413 and fed into filter 414. The filter 414 eliminates all frequencies except for the 150 kHz difference, or beat, frequency, in a similar manner as was done by filter 408. The resulting 150 kHz frequency, however, now has a phase angle x relative to the signal from filter 408. Both 150 kHz signals are now fed into a phase detector 415 which determines the magnitude of the phase angle x. It can be shown mathematically that, with the above values, the distance from the transmitting diode to the occupant is x/345.6 where x is measured in degrees and the distance in meters.

The applications described herein have been illustrated using the driver of the vehicle. Naturally the same systems of determining the position of the occupant relative to the airbag apply to front and rear seated passengers, sometimes requiring minor modifications. It is likely that the sensor required triggering time based on the position of the occupant will be different for the driver than for the passenger. Current systems are based primarily on the driver with the result that the probability of injury to the passenger is necessarily increased either by deploying the airbag too late or by failing to deploy the airbag when the position of the driver would not warrant it but the passenger's position would. With the use of occupant position sensors for both the passenger and driver, the airbag system can be individually optimized for each occupant and result

in further significant injury reduction. In particular, either the driver or passenger system can be disabled if either the driver or passenger is out of position.

There is almost always a driver present in vehicles that are involved in accidents where an airbag is needed. Only about 30% of these vehicles, however, have a passenger. If the passenger is not present, there is usually no need to deploy the passenger side airbag. The occupant monitoring system, when used for the passenger side with proper pattern recognition circuitry, can also ascertain whether or not the seat is occupied, and if not, can disable the deployment of the passenger side airbag and thereby save the cost of its replacement. The same strategy applies also for monitoring the rear seat of the vehicle. Also, a trainable pattern recognition system, as used herein, can distinguish between an occupant and a bag of groceries, for example. Finally, there has been much written about the out of position child who is standing or otherwise positioned adjacent to the airbag, perhaps due to pre-crash braking. Naturally, the occupant position sensor described herein can prevent the deployment of the airbag in this situation as well as in the situation of a rear facing child seat as described above.

The use of trainable pattern recognition technologies such as neural networks is an important part of the instant invention. These technologies are implemented using sophisticated computer programs to analyze the patterns of examples to determine the differences between different categories of objects. These computer programs are trained using a set of representative data collected during the training phase, called the training set. After training, the computer programs output a computer algorithm containing the rules permitting classification of the objects of interest based on the data obtained after installation in the vehicle. These rules, in the form of an algorithm, are implemented in the system which is mounted onto the vehicle. The

determination of these rules is central to the pattern recognition techniques used in this invention. Artificial neural networks are thus far the most successful of the rule determination approaches however research is underway to develop newer systems with many of the advantages of neural networks, such as learning by training, without the disadvantages, such as the inability to understand the network and the possibility of not converging to the best solution.

In some implementations of this invention, such as the determination that there is an object in the path of a closing window as described below, the rules are sufficiently obvious that a trained researcher can look at the returned optical or acoustic signals and devise an algorithm to make the required determinations. In others, such as the determination of the presence of a rear facing child seat or of an occupant, artificial neural networks are used to determine the rules. One such set of neural network software for determining the pattern recognition rules, is available from the NeuralWare Corporation of Pittsburgh, Pennsylvania. Another network pattern recognition technology is disclosed in the above referenced Motorola patents. Numerous articles, including more that 500 U.S. patents, describe neural networks in great detail and thus the theory and application of this technology is well known and will not be repeated here. Except in a few isolated situations where neural networks have been used to solve particular problems, they have not heretofore been applied to automobiles and trucks.

The system used in the instant invention, therefore, for the determination of the presence of a rear facing child seat, of an occupant, or of an empty seat is the artificial neural network. In this case, the network operates on the returned signals from the CCD array as sensed by transducers 521 and 522 in FIG. 5, for example. For the case of the front passenger seat, for example, through a training session, the system is taught to differentiate between the three cases.

This is done by conducting a large number of experiments where available child seats are placed in numerous positions and orientations on the front passenger seat of the vehicle. Similarly, a sufficiently large number of experiments are run with human occupants and with boxes, bags of groceries and other objects. As many as 1000 such experiments are run before the neural network is sufficiently trained so that it can differentiate among the three cases and output the correct decision with a very high probability.

Once the network is determined, it is possible to examine the result using tools supplied by NeuralWare, for example, to determine the rules which were finally arrived at by the trial and error techniques. In that case, the rules can then be programmed into a microprocessor. Alternately, a neural computer can be used to implement the net directly. In either case, the implementation can be carried out by those skilled in the art of pattern recognition using neural networks. If a microprocessor is used, a memory device is also required to store the data from the analog to digital converters which digitize the data from the receiving transducers. On the other hand, if a neural network computer is used, the analog signal can be fed directly from the transducers to the neural network input nodes and an intermediate memory is not required. Memory of some type is needed to store the computer programs in the case of the microprocessor system and if the neural computer is used for more than one task, a memory is needed to store the network specific values associated with each task.

There are several methods measuring the height of the driver for use in automatically adjusting the seat or for adjusting the seatbelt anchorage point. Some alternatives are shown in FIG. 5 which is a side plan view where two height measuring sensors, one 521 mounted into the headliner above the occupant's head and the other 520 mounted onto the A-pillar are shown.

These transducers may already be present because of other implementations of the vehicle interior identification and monitoring system described herein.

In the above cross-referenced patent applications, ultrasonics was the main technology for determining occupant height. This generally required at least two transducers since by using transducer 521 alone, for example, the exact position of the head is ambiguous since the transducer measures the distance to the head regardless of what direction the head is. By knowing the distance from the head to transducer 520, the ambiguity is substantially reduced.

Optical transducers using CCD arrays are now becoming price competitive and, as mentioned above, will soon be the technology of choice for interior vehicle monitoring. A single CCD array of 160 by 160 pixels, for example, coupled with the appropriate trained pattern recognition software, can be used to form an image of the head of an occupant and accurately locate the head for the purposes of this invention.

A rear-of-head detector 534 is also illustrated in FIG 5. This detector is used to determine the distance from the headrest to the rear most position of the occupant's head and to control the position of the headrest so that it is properly positioned behind the occupant's head to offer optimum support in the event of a rear impact. Although the headrest of most vehicles is adjustable, it is rare for an occupant to position it properly, if at all. Each year there are in excess of 400,000 whiplash injuries in vehicle impacts approximately 90,000 of which are from rear impacts (source: National Highway Traffic Safety Administration, (NHTSA)). A properly positioned head rest could substantially reduce the frequency of such injuries which can be accomplished by the head detector of this invention. The head detector 534 is shown connected schematically to the headrest control mechanism and circuitry 540. This mechanism is capable of

moving the headrest up and down and, in some cases, rotating it fore and aft. An occupant position sensor for side impacts used with a door mounted airbag system is illustrated at 530 in FIG. 5.

Seatbelts are most effective when the upper attachment point to the vehicle is positioned vertically close to the shoulder of the occupant being restrained. If the attachment point is too low, the occupant experiences discomfort from the rubbing of the belt on his or her shoulder. If it is too high the occupant may experience discomfort due to the rubbing of the belt against his or her neck and the occupant will move forward by a greater amount during a crash which may result in his or her head striking the steering wheel. For these reasons, it is desirable to have the upper seatbelt attachment point located slightly above the occupant's shoulder. To accomplish this for various sized occupants, the location of the occupant's shoulder must be known which can be accomplished by the vehicle interior monitoring system described herein.

Such a system is illustrated in FIG. 6 which is a side planer view of a seatbelt anchorage adjustment system. In this system, an infrared transmitter and CCD array receiver 620 is positioned in a convenient location such as the headliner located above and to the outside of the occupant's shoulder. An appropriate pattern recognition system as described above is then used to determine the location and position of the shoulder. This information is fed to the seatbelt anchorage height adjustment system 632, shown schematically, which moves the attachment point 631 to the optimum vertical location for the proper placement of the seatbelt 630.

FIG. 7 is an angular perspective overhead view of a vehicle 710 about to be impacted in the side by an approaching vehicle 720, where vehicle 710 is equipped with an anticipatory sensor system showing a transmitter 730 transmitting infrared waves toward vehicle 720. The

transmitter 730 is connected to an electronic module 740. Module 740 contains circuitry 742 to drive transmitter 730 and circuitry 744 to process the returned signals from receivers 734 and 736. (FIG. 7A) Circuitry 744 contains a neural computer 745 which performs the pattern recognition determination based on signals from receivers 734 and 736. Receivers 734 and 736 are mounted onto the B-Pillar of the vehicle and are covered with a protective transparent cover. An alternate mounting location is shown as 738 which is in the door window trim panel where the rear view mirror (not shown) is frequently attached. One additional advantage of this system is the ability of infrared to penetrate fog and snow which makes this technology particularly applicable for anticipatory sensing applications.

The same system can also be used for the detection of objects in the blind spot of the vehicle and the image displayed for the operator to see, or a warning system activated, if the operator attempts to change lanes, for example. In this case, the mounting location must be chosen to provide a good view along the side of the vehicle in order to pickup vehicles which are about to pass vehicle 710. Each of the locations 734, 736 and 730 provide sufficient field of view for this application although the space immediately adjacent to the vehicle could be missed. Alternate locations include mounting onto the outside rear view mirror or the addition of a unit in the rear window or C-Pillar. The mirror location, however, does leave the device vulnerable to being covered with ice, snow and dirt.

In both cases of the anticipatory sensor and blind spot detector, the infrared transmitter and CCD array system provides mainly image information to permit recognition of the object in the vicinity of vehicle 710. To complete the process, distance information is also require as well as velocity information, which can in general be obtained by differentiating the position data. This

can be accomplished by any one of the several methods discussed above as well as with a radar system. Radar systems, which would not be acceptable for use in the interior of the vehicle, are now commonly used in sensing applications exterior to the vehicle, police radar being one well known example. Miniature radar systems are now available which are inexpensive and fit within the available space. Another advantage of radar in this application is that it is easy to get a transmitter with a desirable divergence angle so that the device does not have to be aimed. The best mode of practicing the invention for these cases is to use radar and the second best is the pulsed GaAs laser system, along with a CCD array, although the use of two CCD arrays or the acoustical systems are also good choices. Both the acoustical and the stenographic system using the two CCD arrays have the disadvantage of being slower than the GaAs device and the acoustical system in addition must be mounted outside of the vehicle where it may be affected by the accumulation of deposits onto the active surface.

In a preferred implementation, transmitter 730 is an infrared transmitter and receivers 734, 736 and 738 are CCD transducers which receive the reflected infrared waves from vehicle 720. In the implementation shown in FIG. 7, an exterior airbag 790 is shown which deploys in the event that a side impact is about to occur as described in copending application Serial No. 08/247,760 cross referenced above.

FIG. 8 illustrates the exterior monitoring system for use in detecting the headlights of an oncoming vehicle or the tail lights of a vehicle in front of vehicle 810. In this embodiment, the CCD array is designed to be sensitive to visible light and a separate source of illumination is not used. Once again, the key to this technology is the use of trained pattern recognition algorithms and particularly of the artificial neural network. Here as in the other cases above and in the co-

pending patent applications referenced above, the pattern recognition system is trained to recognize the pattern of the headlights of an oncoming vehicle or the tail lights of a vehicle in front of vehicle 810 and to then dim the headlights when either of these conditions is sensed. It is also trained to not dim the lights from other reflections such as off of a sign post or the roadway. One problem is to differentiate taillights where dimming is desired from distant headlights where dimming is not desired. Three techniques are used: (i) measurement of the spacing of the light sources, (ii) determination of the location of the light sources relative to the vehicle, and (iii) use of a red filter where the brightness of the light source through the filter is compared with the brightness of the unfiltered light. In the case of the taillight, the brightness of the red filtered and unfiltered light is nearly the same while there is a significant difference for the headlight case. In this situation, either two CCD arrays are used, one with a filter, or a filter which can be removed either electrically, such as with a liquid crystal, or mechanically.

There has thus been shown and described a monitoring system for monitoring both the interior and the exterior of the vehicle using an optical system with one or more CCD arrays and other associated equipment which fulfills all the objects and advantages sought after. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and the accompanying drawings which disclose the preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention which is limited only by the following claims.

What is claimed is:

1. In a motor vehicle having an interior passenger compartment containing a passive restraint system and at least one occupying item having surfaces, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said surfaces of said at least one occupying item within said vehicle interior passenger compartment, said receiver means comprising a CCD array;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of said surfaces of said at least one occupying item in said passenger compartment based thereon;

d) categorization means coupled to said processor means for categorizing said electronic signal in order to identify said at least one occupying item, said categorization means comprising a trained pattern recognition algorithm; and

e) output means coupled to said categorization means for affecting another system in said vehicle in response to said identification of said at least one occupying item.

2. The system in accordance with claim 1, wherein the passive restraint comprises an inflatable airbag and said at least one occupying item is an occupant, said electronic signal being characteristic of the position of the occupant of the vehicle determined from said surfaces thereof, said output means comprising means for modifying the time that inflation of said inflatable airbag is initiated in response to the position of said occupant.

3. The system in accordance with claim 1, wherein the passive restraint comprises an inflatable airbag and said at least one occupying item is an occupant, said electronic signal being characteristic of the position of the occupant of the vehicle determined from said surfaces thereof, said output means comprising means for modifying the rate at which said inflatable airbag is inflated in response to the position of said occupant.

4. The system in accordance with claim 1, wherein the passive restraint comprises an inflatable airbag and said at least one occupying item is an occupant, said electronic signal being characteristic of the presence of the occupant of the vehicle determined from said surfaces thereof, said output means comprising means for suppressing deployment of said inflatable in response to the absence of said occupant.

5. The system in accordance with claim 1, wherein said at least one occupying item is the head of an occupant, said electronic signal being characteristic of the position of the occupant's head determined from said surfaces thereof, said trained pattern recognition means comprises means to categorize the motion of the occupant's head over time, and said response means coupled to said pattern recognition means responds to the category of motion of the occupant's head over time to affect another system in said vehicle.

6. The sensor in accordance with claim 5, wherein said another system comprises an alarm.

7. The sensor in accordance with claim 5, wherein said another system comprises limiting means for limiting the speed of said vehicle.

8. The system in accordance with claim 1 wherein said trained pattern recognition means comprises a neural network.

9. The system in accordance with claim 1 wherein said vehicle further comprises a seat and said at least one occupying item is a rear facing child seat positioned on said seat of said vehicle, and said another vehicle system comprises an airbag.

10. In a motor vehicle having an interior and an exterior, a monitoring system for monitoring at least one object exterior to said vehicle comprising:

a) transmitter means for transmitting electromagnetic waves to illuminate said exterior object;

b) reception means for receiving reflected electromagnetic illumination from said exterior object, said reception means comprising a CCD array;

c) processor means coupled to said reception means for processing said received illumination and creating an electronic signal characteristic of said exterior object based thereon;

d) categorization means coupled to said processor means for categorizing said electronic signal, said categorization means comprising a pattern recognition algorithm; and

e) output means coupled to said categorization means for affecting another system in the vehicle in response to said categorization.

11. The system in accordance with claim 10, further comprising measurement means for measuring the distance from said exterior object to said vehicle, said measurement means comprising radar.

12. The system in accordance with claim 10, further comprising measurement means for measuring the distance from said exterior object to said vehicle, said measurement means comprising a pulsed laser.

13. The system in accordance with claim 10, wherein said another system is a warning system which is activated when said exterior object is within a specified range of said vehicle and said vehicle driver begins to execute an action which increases the probability of a collision with said exterior object.

14. The system in accordance with claim 10, wherein said another system is a side impact airbag system which is activated when said exterior object is within a specified range of said vehicle and said processor means determines that there is a high probability of a collision with said exterior object.

15. The system in accordance with claim 10 wherein said processor means comprises a neural network algorithm.

16. In a motor vehicle having an interior and an exterior, an automatic headlight dimming system comprising:

a) reception means for receiving electromagnetic radiation from an exterior object, said reception means comprising a CCD array;

b) processor means coupled to said reception means for processing said received illumination and creating an electronic signal characteristic of received illumination;

c) categorization means coupled to said processor means for categorizing said electronic signal into categories comprising radiation from the headlights of an

oncoming-vehicle and other radiation, said categorization means comprising a trained pattern recognition algorithm; and

e) output means coupled to said categorization means for dimming the headlights in said vehicle in response to said categorization.

17. The invention in accordance with claim 16 wherein said categories further comprise radiation from taillights of a vehicle-in-front.

18. The invention in accordance with claim 16 wherein said trained pattern recognition algorithm comprises a neural network.

08/474786

ABSTRACT OF THE DISCLOSURE

A vehicle interior monitoring system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle. When system is installed in the passenger compartment of an automotive vehicle equipped with an airbag, the system determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag.

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Applicant or Patentee: Wilbur E. DuVall, Wendell C. Johnson and David S. Breed
Serial or Patent No.: 08/474,786
Filed or Issued: June 7, 1995
For: OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN Automotive Technologies International, Inc.
ADDRESS OF CONCERN P.O. Box 1028
Denville, New Jersey, 07834

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed, to and remain with the small business concern identified above with regard to the invention, entitled
OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES
by inventor(s) David S. Breed , Wilbur E. DuVall, and Wendell C. Johnson

described in

☐ the specification filed herewith
☒ application serial no. 08/474,786 , filed June 7, 1995
☐ patent no. _____, issued _____

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

**NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entitles. (37CFR 1.27).*

NAME _____

ADDRESS _____

_____

☐ INDIVIDUAL ☒ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

NAME _____

ADDRESS _____

_____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING DAVID S. BREED

TITLE OF PERSON IF OTHER THAN OWNER PRESIDENT

ADDRESS OF PERSON SIGNING 48 Hillcrest Rd.

Boonton Township, NJ 07005

SIGNATURE _____ Jan 2, 1995
Date

08/474.

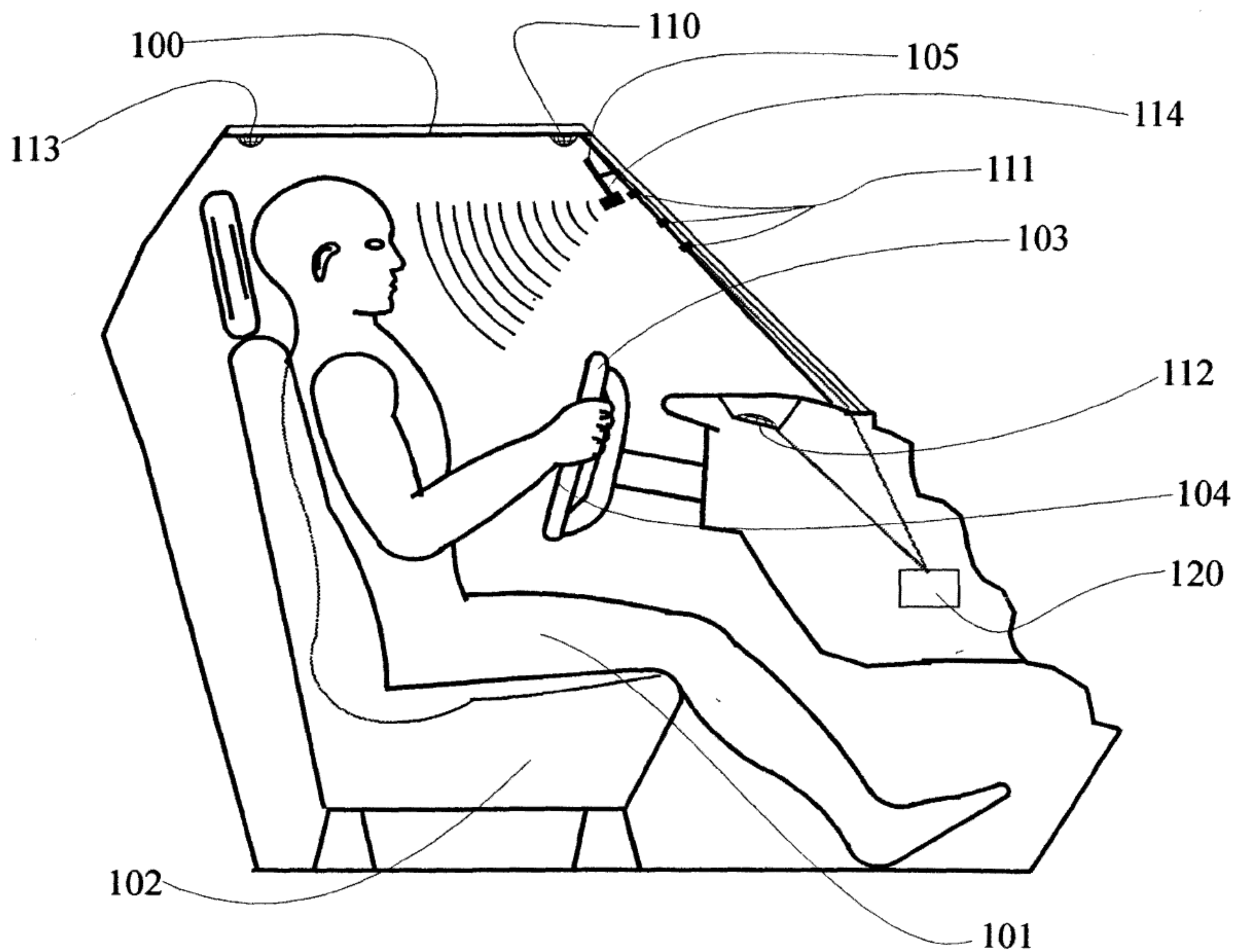

FIG. 1A

PRINT OF DRAWINGS
AS ORIGINALLY FILED

08/474786

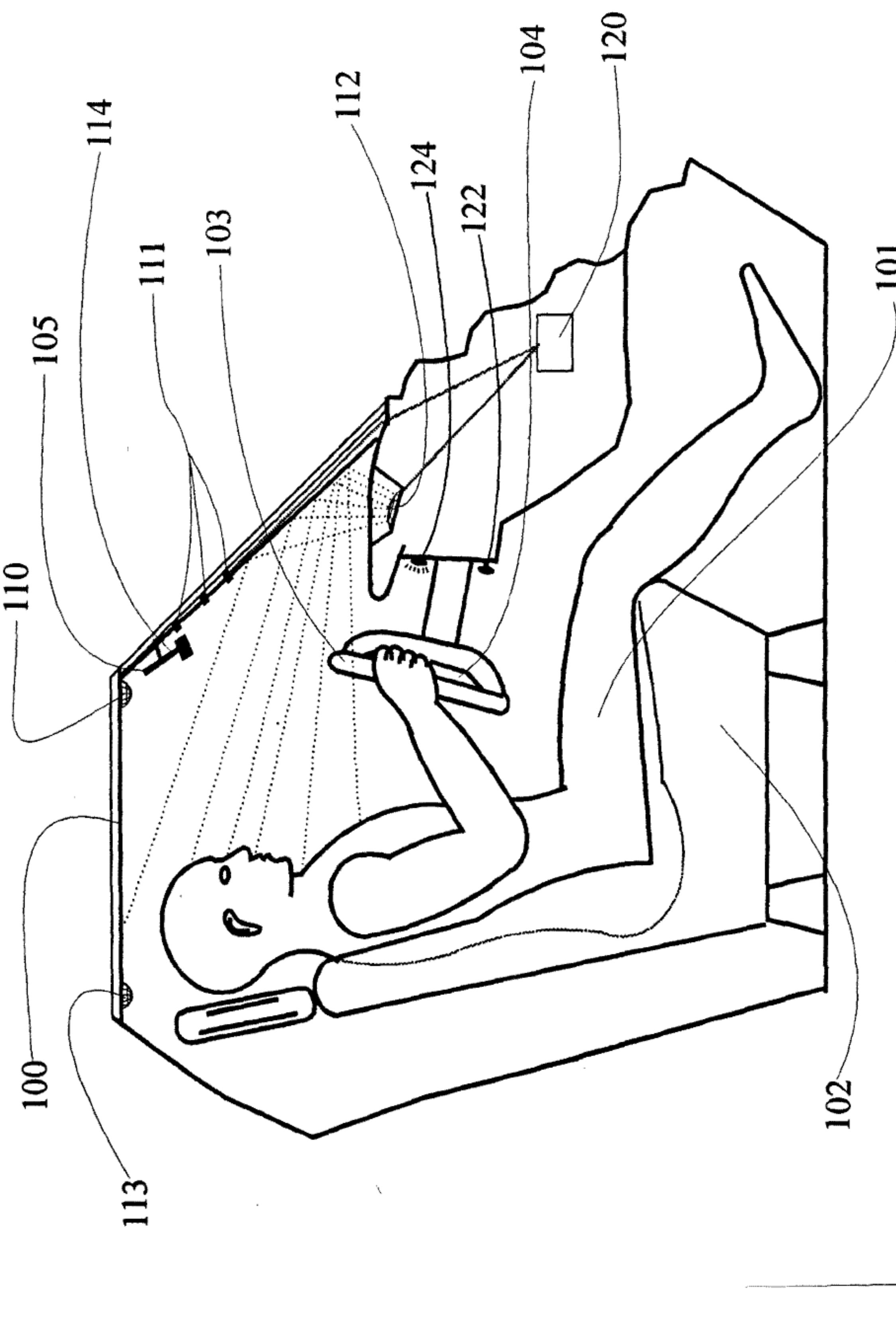

FIG. 1B

C:\AALEGAL\PATENTS\INPROCESS\ATI-95\FIG-1.CDR

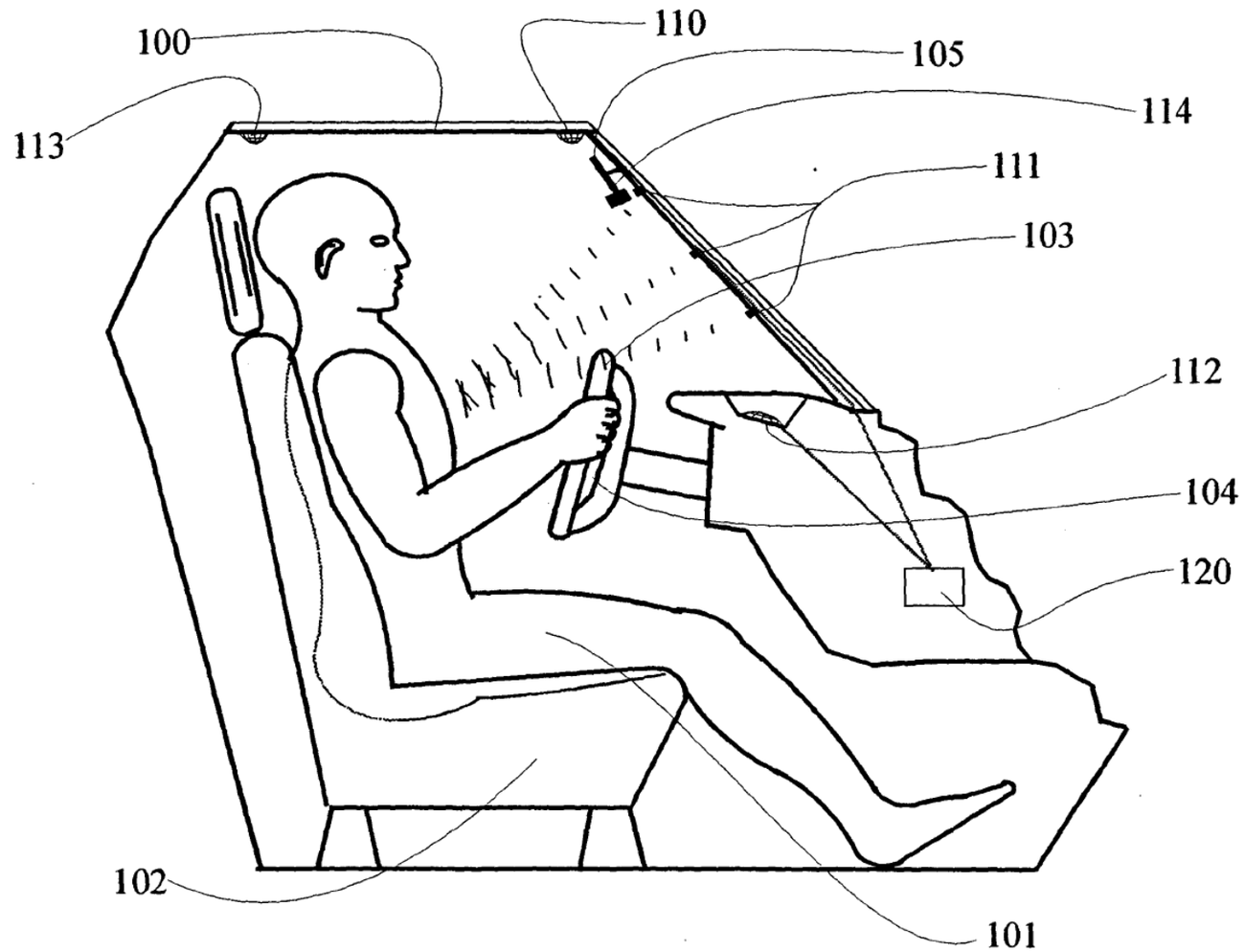

FIG. 1C

C:\AA\LEGAL\PATENTS\INPROCES\ATI-95\FIG-1.CDR

PRINT OF DRAWINGS
AS ORIGINALLY FILED

08/474786

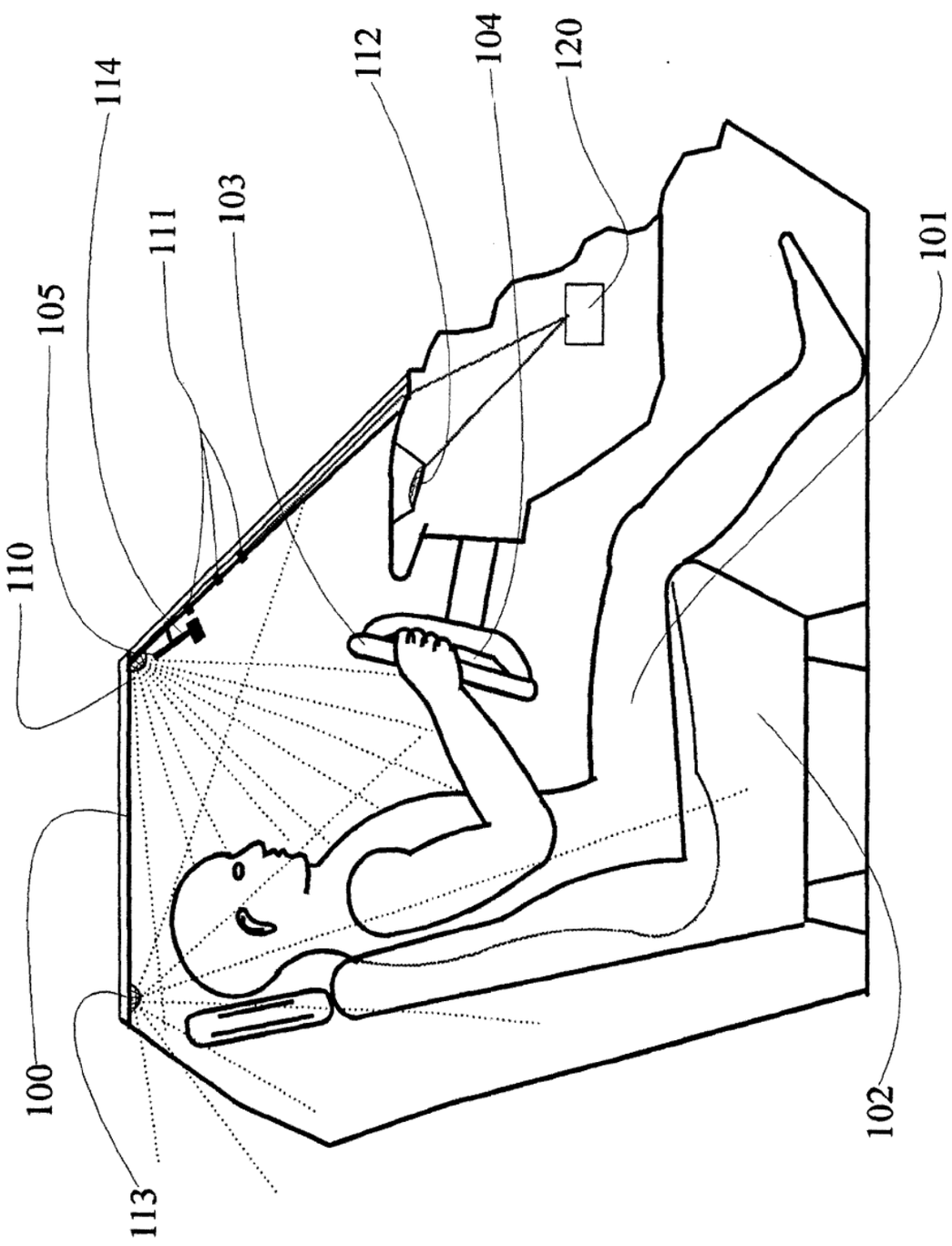

FIG. 1D

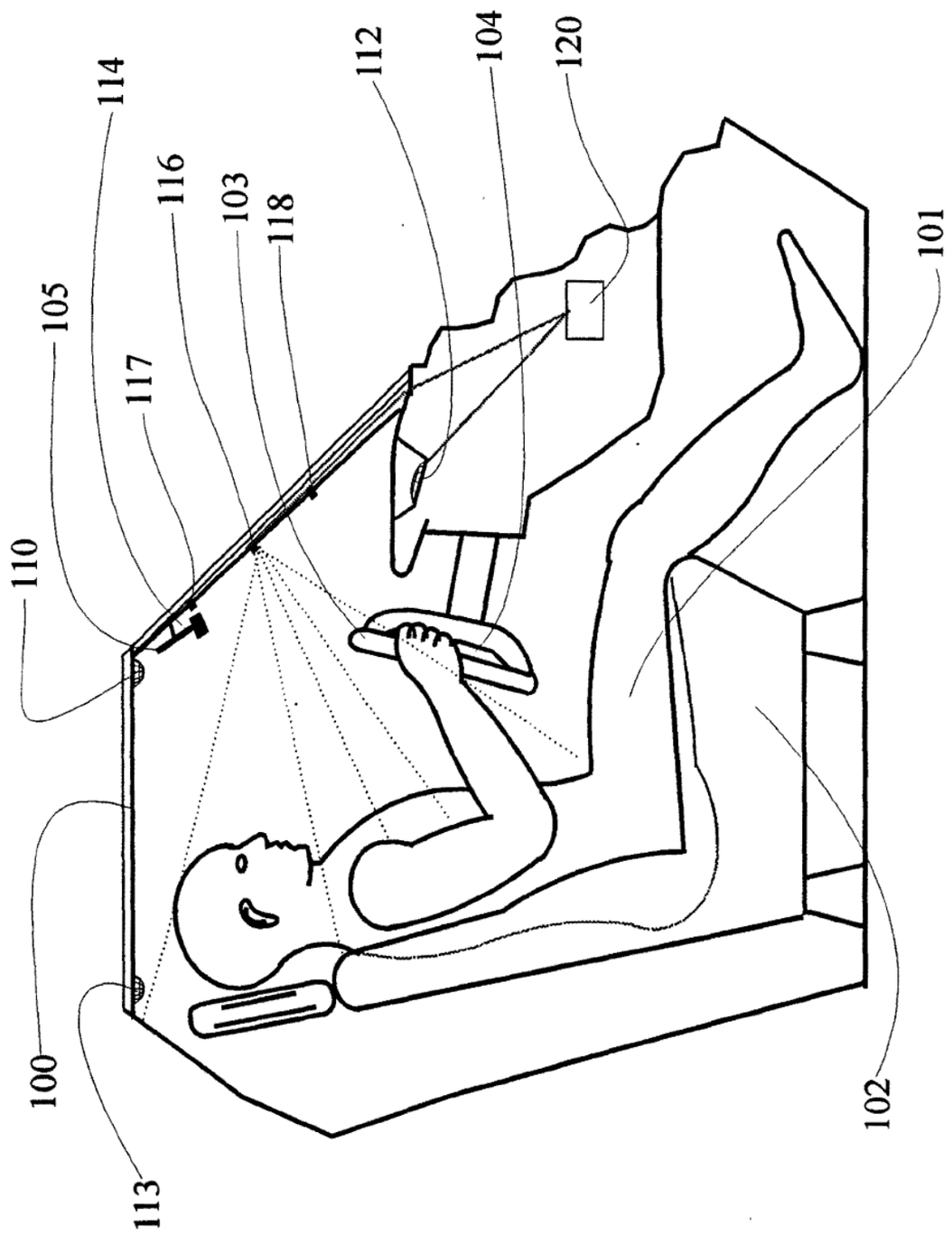

FIG. 1E

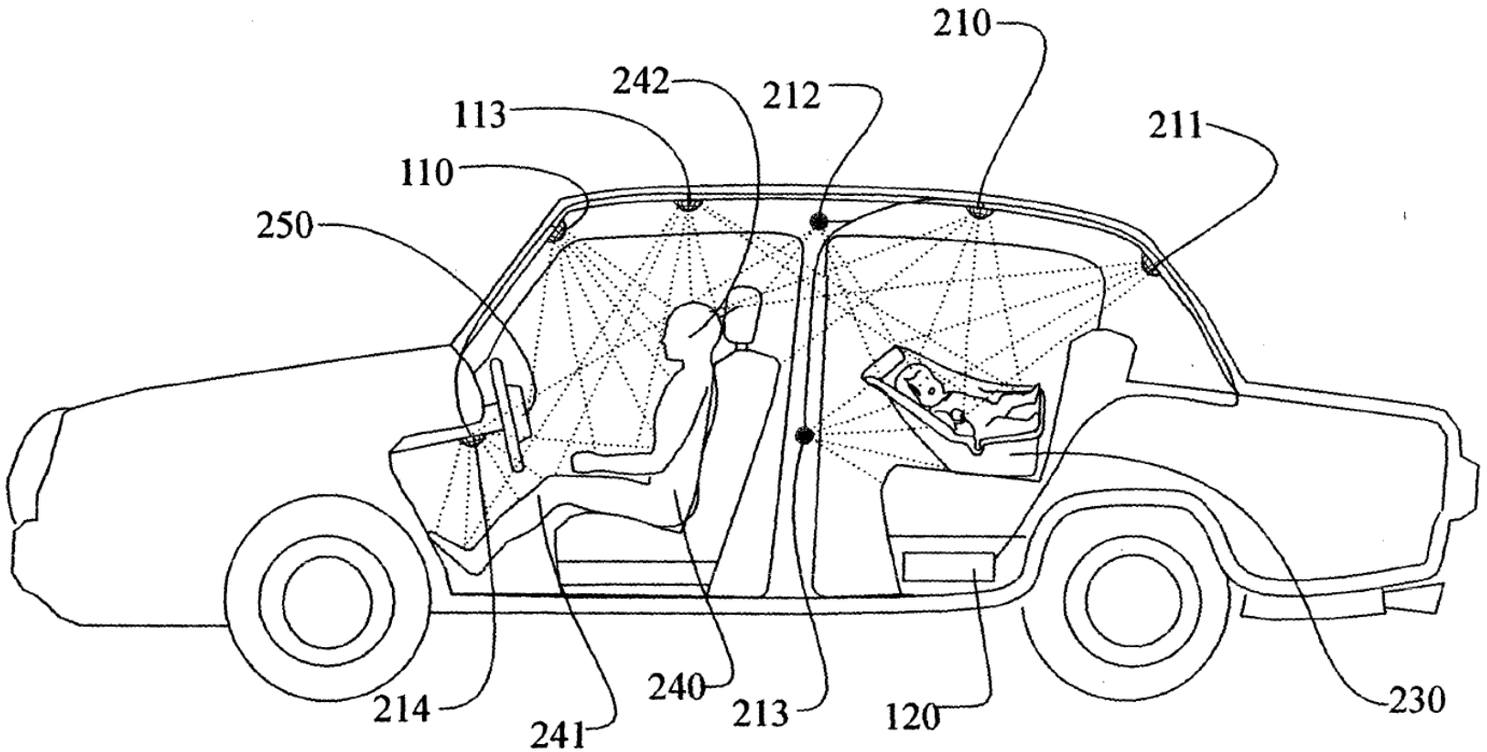

FIG. 2

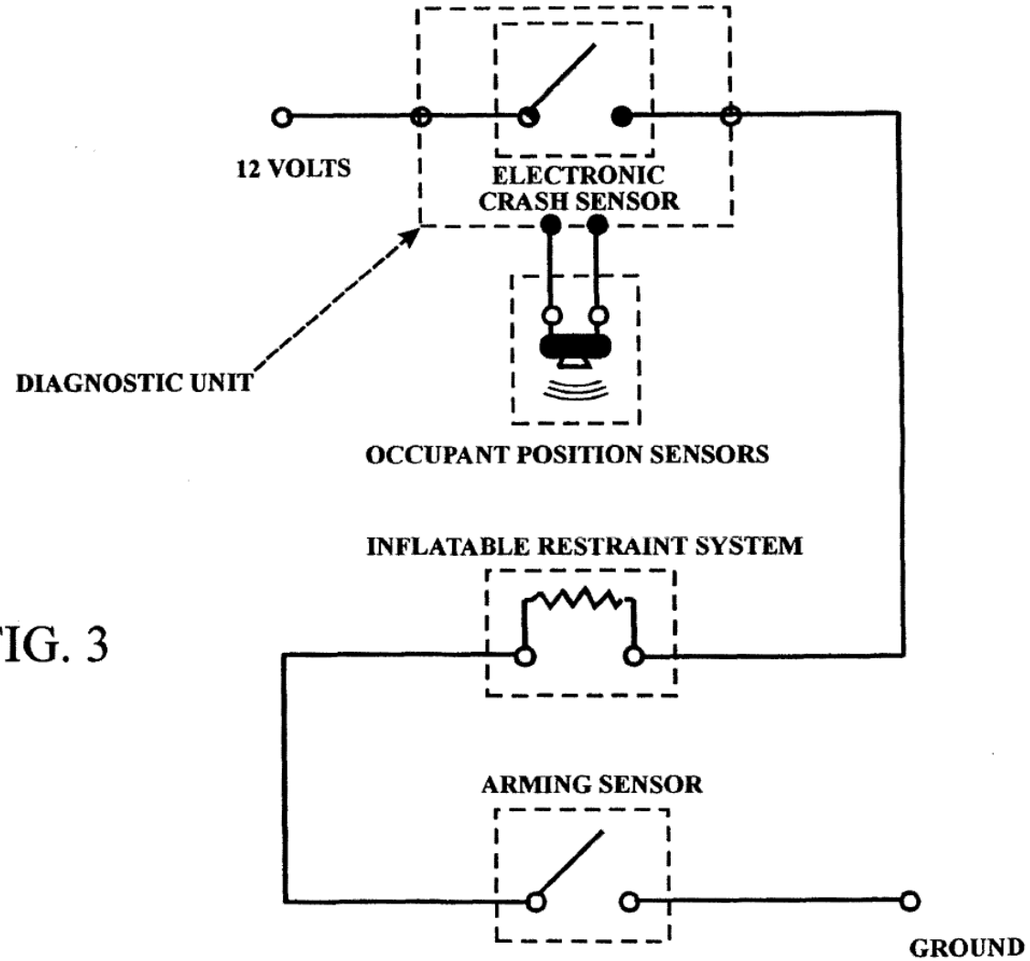

FIG. 3

C:\AA\LEGAL\PATENTS\INPROCES\AIT-95\FIG-5.CDR

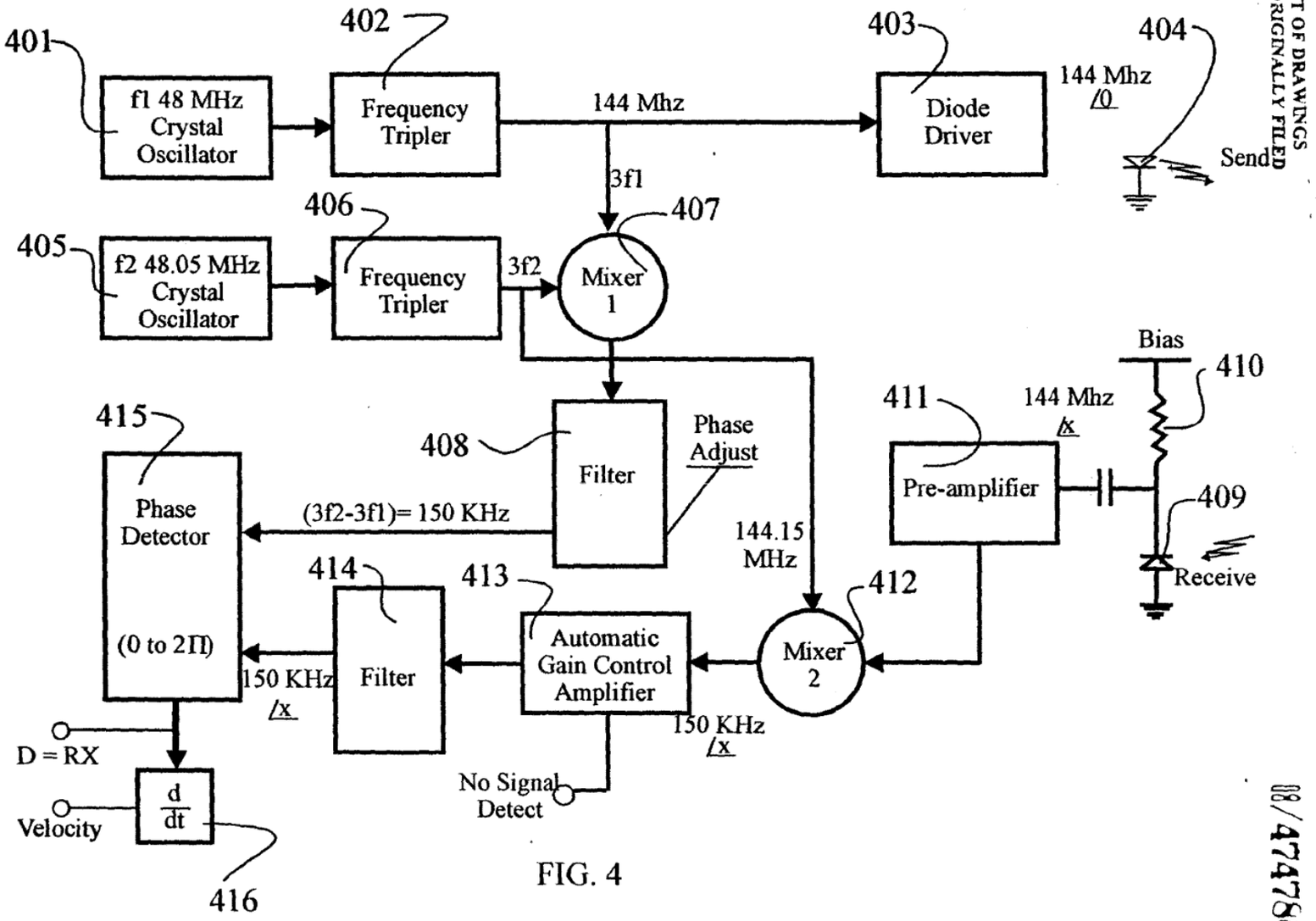

FIG. 4

C:\AA\LEGAL\PATENTS\INPROCES\A11--95\FIG--6.CDR

PRINT OF DRAWINGS AS ORIGINALLY FILED

08/474786

PRINT OF DRAWINGS
AS ORIGINALLY FILED

08/474786

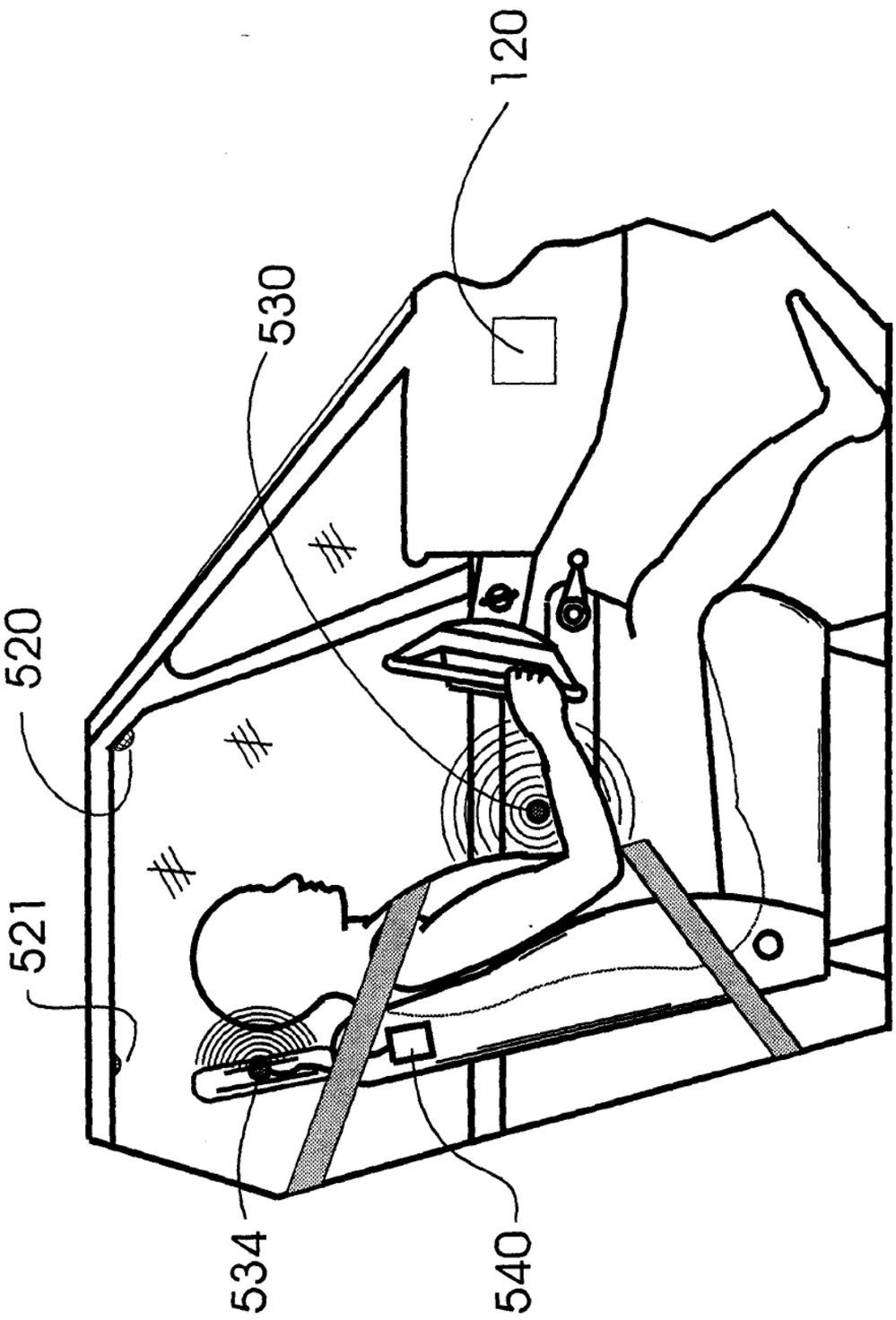

FIG. 5

PRINT OF DRAWINGS
AS ORIGINALLY FILED

08/474786

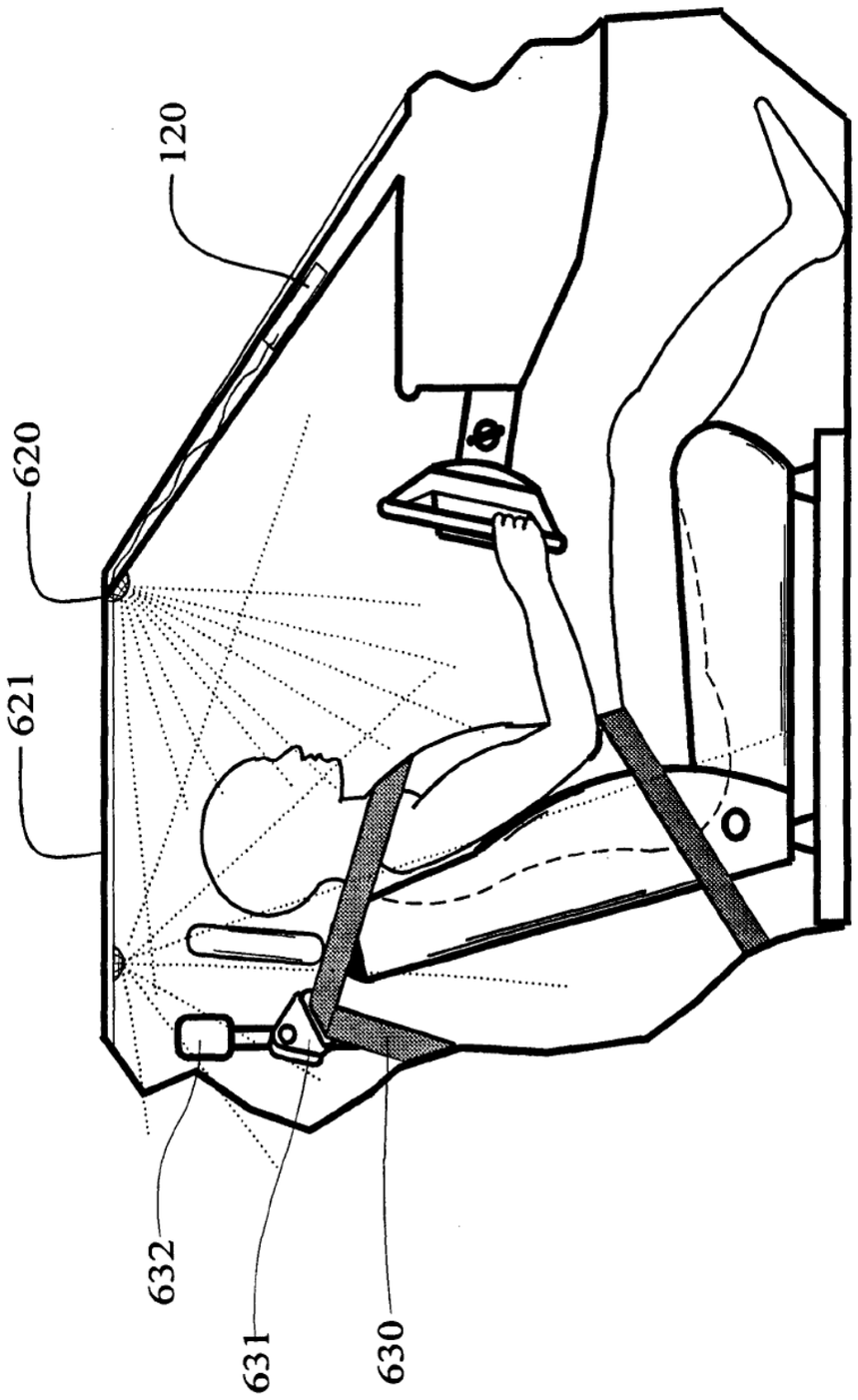

FIG. 6

PRINT OF DRAWINGS
AS ORIGINALLY FILED

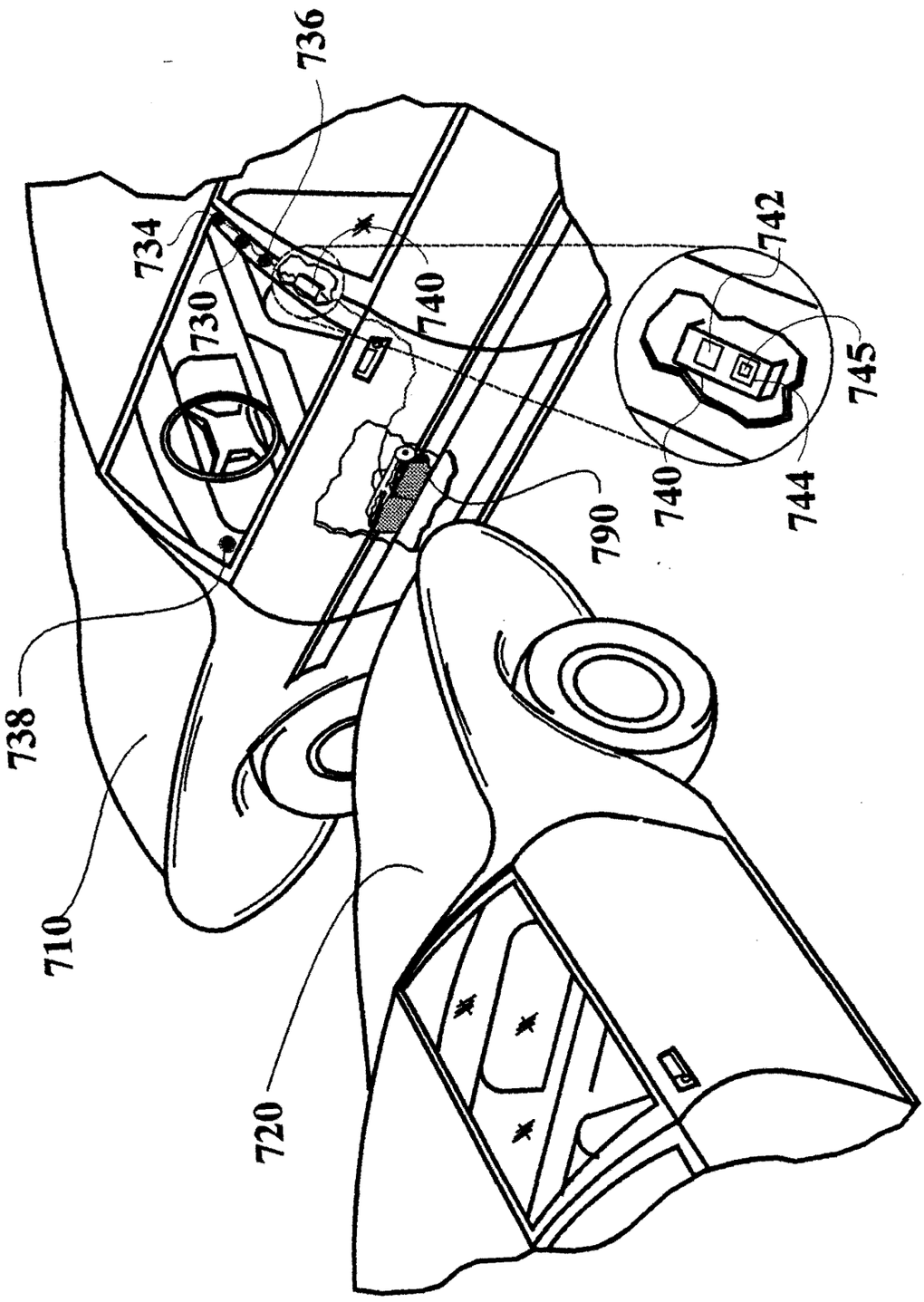

FIG. 7

PRINT OF DRAWINGS
AS ORIGINALLY FILED

08/474786

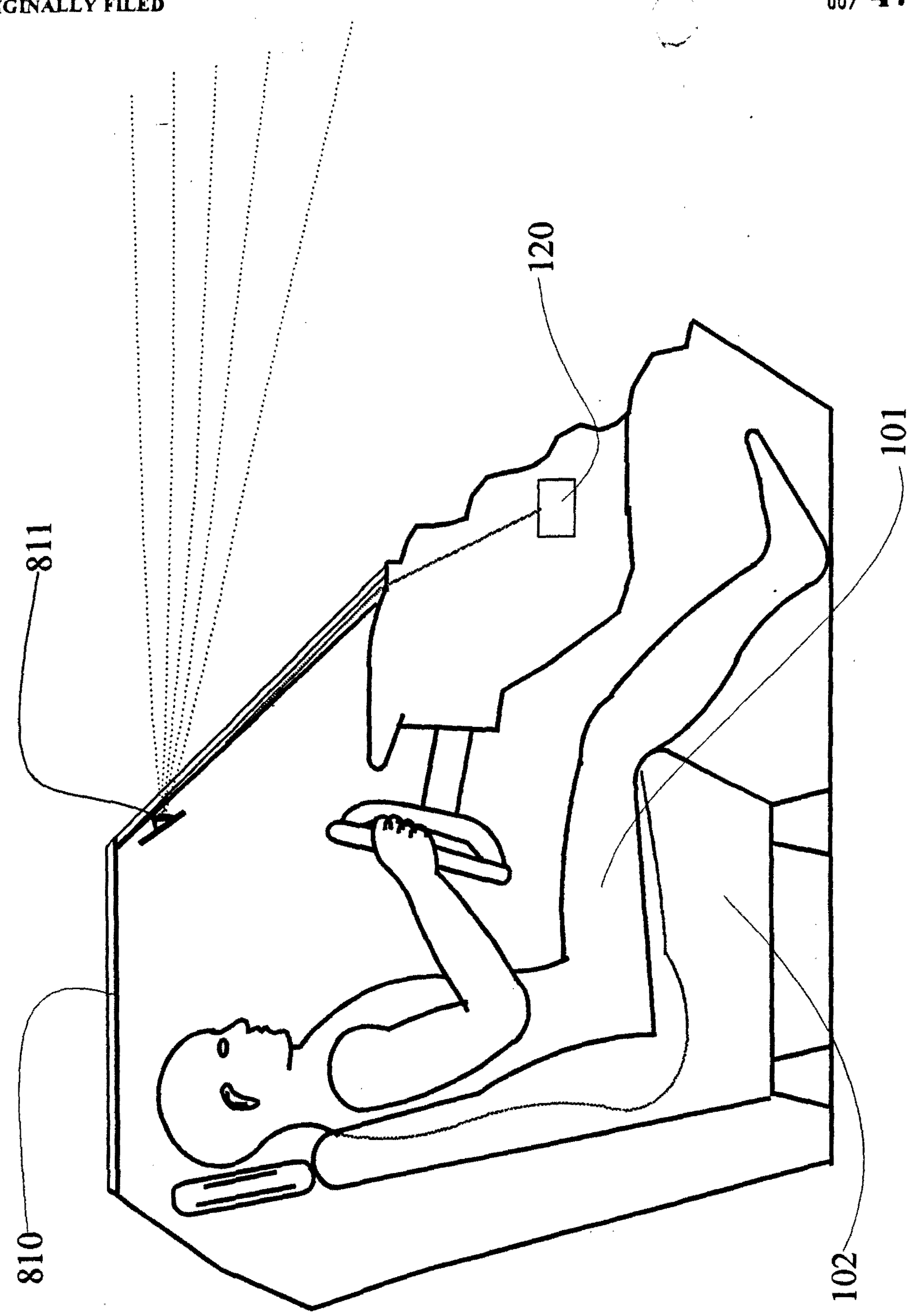

FIG. 8

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/474,786	06/07/95	DUVALL W	ATI-95

0222/0718

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598

0000

DATE MAILED: 07/13/95

NOTICE TO FILE MISSING PARTS OF APPLICATION
FILING DATE GRANTED

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130.00 for large entities or $ 65.00 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applicant as a ☒ large entity, ☐ small entity (verified statement filed), is $ 860.00.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER,** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☒ The statutory basic filing fee is: ☒ missing ☐ insufficient. Applicant as a ☒ large entity ☐ small entity, must submit $ 730.00 to complete the basic filing fee.

2. ☐ Additional claim fees of $_____ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☒ The oath or declaration:
   ☒ is missing.
   ☐ does not cover the newly submitted items.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☐ The signature(s) to the oath or declaration is/are: ☐ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   _____ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☐ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $_____ under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $_____ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other.

Direct the response to Box Missing Part and refer any questions to the Customer Service Center at (703) 308-1202.

A copy of this notice MUST be returned with the response. PHH

365.00 201
65.00 205 A/N

UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	DAVID S. BREED ET AL.
Serial No.:	08/474,786
Filed:	June 7, 1995
Title:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

RESPONSE TO NOTICE TO FILE MISSING PARTS

Hon. Commissioner of
Patents and Trademarks
Washington, D.C. 20231

August 17, 1995

Dear Sir:

In response to the Notice to File Missing Parts dated July 18, 1995, submitted herewith is a copy of the Notice to File Missing Parts and a Declaration signed by the inventors (2 pages) and a Power of Attorney form. It is noted that the first named inventor is David S. Breed. A Verified Statement Claiming Small Entity Status (2 pages) is also submitted herewith for this application.

Lastly, enclosed is a check in the amount of $430.00 to cover the filing fee for a small entity ($365.00) and the surcharge fee for a small entity ($65.00).

Respectfully submitted,

Brian Roffe

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Commissioner of Patents and Trademarks, Washington, D.C. 20231" on August 17, 1995.
Brian Roffe, Esq.

By: _____

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/473,786	06/07/95	DUVALL	

0223/0715

BRIAN BOFFE
376 YALE AVENUE
HOHOKUS NJ 11593

DATE MAILED: 8/00

NOTICE TO FILE MISSING PARTS OF APPLICATION FILING DATE GRANTED

07/18/95

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130 for large entities or $ 65 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applicant as a ☒ large entity, ☐ small entity (verified statement filed), is $ 130.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER,** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☒ The statutory basic filing fee is: ☒ missing ☐ insufficient. Applicant as a ☒ large entity ☐ small entity, must submit $ 730 to complete the basic filing fee.

2. ☐ Additional claim fees of $_____ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☒ The oath or declaration:
   ☒ is missing.
   ☐ does not cover the newly submitted items.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☐ The signature(s) to the oath or declaration is/are: ☐ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   _____ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☐ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $_____ under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $_____ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other.

Direct the response to Box Missing Part and refer any questions to the Customer Service Center at (703) 308-1202.

A copy of this notice MUST be returned with the response.

DECLARATION FOR PATENT APPLICATION

Docket Number (optional)
ATI -95

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

the specification of which is attached hereto unless the following box is checked:

[X] was filed on June 7, 1995 as United States Application Number or PCT International Application Number 08/474,786 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes [ ] No
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes [ ] No
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes [ ] No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112,I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

07/878,571 (Application Serial No.)	May 5, 1992 (Filing Date)	Abandoned (Status - patented, pending, abandoned)
08/247,760 (Application Serial No.)	May 23, 1994 (Filing Date)	Pending (Status - patented, pending, abandoned)

08/239,978 May 9, 1994 Pending 08/040,978 March 31, 1993 Pending

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Address all telephone calls to ~~SAMUEL SHIPKOVITZ~~ BRIAN ROFFE (516) 569-3664
Address all telephone calls to ~~HIM~~ at telephone number ~~(703) 521-2345 ; (412) 521-3234~~
Address all correspondence to ~~SAMUEL SHIPKOVITZ (3829 NICHOLSON, PGH., PA 15217)~~ BRIAN ROFFE
MAILING ADDRESS: ~~P.O. BOX 2961 ARLINGTON, VA 22202~~ 376 Yale Ave.
Woodmere, NY 11598-2051

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

Full name of sole or first inventor (given name, family name) David S. Breed

Inventor's signature _____ Date June 2, 1995
Residence 48 Hillcrest Rd Citizenship U S A
Post Office Address Boonton Township, NJ 07005
NJ

2-00

Full name of second joint inventor, if any (given name, family name) Wilbur H. DuVall

Inventor's signature _____ Date June 6, 1995
Residence 57 Northwoods Drive Citizenship U S A
Post Office Address Kimberling City, MO 65686 MO

Full name of third joint inventor, if any (given name, family name) Wendell C. Johnson

Inventor's signature _____ Date _____
Residence 3165 Fugita St. Citizenship U S A
Post Office Address Torrance, CA 90505

[ ] Additional inventors are being named on separately numbered sheets attached hereto.

DECL. .ATION FOR PATE. .PLICA. .ON

Docket Number (optional)
ATI -95

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

the specification of which is attached hereto unless the following box is checked:

[X] was filed on June 7, 1995 as United States Application Number or PCT International Application Number 08/474,786 amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, _1.56(a).

I hereby claim the benefit under Title 35, United States Code, _120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, _112,1 acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, _1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status - patented, pending, abandoned)
07/878,571	May 5, 1992	Abandoned
08/247,760	May 23, 1994	Pending
08/239,978	May 9, 1994	Pending
08/040,978	March 31, 1993	Pending

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Brian Roffe

Address all telephone calls to Brian Roffe Telephone number (516)569-3664
Address all correspondence to Brian Roffe, Esq. 376 Yale Avenue, Woodmere, New York 11598-2051

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) David S. Breed

Inventor's signature _____ Date _____
Residence 48 Hillcrest Rd Citizenship USA
Post Office Address Boonton Township, NJ 07005

Full name of second joint inventor, if any (given name, family name) Wilbur E. DuVall

Inventor's signature _____ Date _____
Residence 57 Northwoods Drive Citizenship USA
Post Office Address Kimberling City, MO 65686

Full name of third joint inventor, if any (given name, family name) Wendell C. Johnson

Inventor's signature Wendell C. Johnson Date 7-30-95
Residence 3165 Fugita St. Citizenship USA
Post Office Address Torrance, CA 90505 CA

[ ] Additional inventors are being named on separately numbered sheets attached hereto.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant David S. Breed et al. : Automotive Technologies International, Inc.
PO Box 1028
Denville, NJ 07834

U.S. Serial No. 08/474,786

filed June 7, 1995

For: **OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES**

Hon. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

POWER OF ATTORNEY

SIR:

The undersigned applicant hereby appoints Brian Roffe, PTO Reg. No. 35,336, as agent to act on its behalf before the competent authorities in connection with a Patent Application:

U.S. Serial No. 08/474,786 filed June 7, 1995

entitled **OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES**

(Attorney docket: ATI-95),

to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

It is hereby requested that all correspondence be directed to Brian Roffe, 376 Yale Ave. Woodmere, Ny 11598

Please direct all telephone calls to Brian Roffe: Tel. (516) 569-3664.

Automotive Technologies International, Inc.

Dated: June 2, 1995

by: _____
David S. Breed, PhD.
President

4/6

GP 2613

ATI-95

UNITED STATES PATENT AND TRADEMARK OFFICE

Re: Application of: David S. Breed et al.

Serial No.: 08/474,786

Filed: June 7, 1995

For: OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

INFORMATION DISCLOSURE STATEMENT

Hon. Commissioner of
Patents and Trademarks
Washington, D.C. 20231

October 13, 1995

Sir:

Applicants herewith submit form PTO-1449 which lists references cited in the specification of the present application. A copy of each of the references is enclosed.

An Office Action has not been received to date.. Therefore, no fee is due under 37 C.F.R. §1.17(p).

It is respectfully requested that these references be considered and made of record.

Respectfully submitted,

By: Brian Roffe

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598
(516) 569-3664

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Commissioner of Patents and Trademarks, Washington, DC 20231" on October 13, 1995
Brian Roffe

BY: Brian Roffe

Docket No. ATI-95

UNITED STATES PATENT AND TRADEMARK OFFICE

Re:	Application of:	DAVID S. BREED ET AL.
	Serial No.:	08/474,786
	Filed:	June 7, 1995
	Title:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

STATUS INQUIRY

Hon. Commissioner of
Patents and Trademarks
Washington, D.C. 20231

June 10, 1996

Dear Sir:

Please advise as to the current status of the above-identified application, no office action having been received to date..

Respectfully submitted,

Brian Roffe

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Commissioner of Patents and Trademarks, Washington, D.C. 20231" on June 10, 1996

Brian Roffe, Esq.

By: _____

Expected date for Action on this application 5/30/97

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/474,786	06/07/95	BREED	

EXAMINER
D [illegible] ART-26

ART UNIT [illegible] | PAPER NUMBER
6

E6M1/1001

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

DATE MAILED:
2616

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

10/01/96

OFFICE ACTION SUMMARY

☐ Responsive to communication(s) filed on _____.

☐ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 D.C. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1 - 18 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1 - 18 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of Reference Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

-- SEE OFFICE ACTION ON THE FOLLOWING PAGES --

1. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

2. Claim 16 objected to because of the following informalities:

Element b) recites "said received illumination". It should be changed to "said received radiation"

Element e) is after element c). The designation should be changed to d).

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes, reference AAE of Form PTO-1449, in view of Ando, reference AAC of Form PTO-1449.

As to claim 1, Mattes discloses an interior passenger compartment containing a passive restraint system and at least one occupying item having surfaces in a motor vehicle, (lines 6-10 and 18-20 of column 1 and item 35 in Fig.2 shows an occupying item having surfaces) . The monitoring system comprises:

a) illumination means for illuminating a portion of the vehicle interior with electromagnetic radiation in which the occupying item is likely situated, (lines 13-42 of column 4, and Fig. 2);

b) receiver means to receive the electromagnetic illumination reflected from the surfaces, (lines 13-42 of column 4);

c) processor means to generate an electronic signal characteristic of the surfaces, (lines 13-16 of column 4, determining a position is within the meaning of determining characteristics); and

e) output means to affect another system in the vehicle in response to the identification of the occupying item, (lines 17-26 of column 1).

However, Mattes does not show the receiver means having a CCD array and a categorization means comprising a pattern recognition algorithm. Ando discloses an image processing system in a passenger vehicle to control various parts of the vehicle, (lines 5-15 of column 1). Ando shows the receiver means comprising a CCD array, (lines 60-61 of column 6), and the categorization means comprising a pattern recognition algorithm, (lines 15-41 of column 2).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include the receiver means to have a CCD array and a categorization means to have a pattern recognition algorithm because a CCD array would be an obvious design choice and would have a shorter response time than a regular video camera, and a pattern recognition algorithms would distinguish a movement by the occupying object rather than by other small objects. Using sensors having a short response time is one of the goals of Mattes,

(lines 38-42 of column 4). In addition, both Mattes' and Ando's invention deal with systems of using a sensor or sensors in a passenger vehicle to control other parts of vehicles.

As to claim 2, Mattes shows the other system being controlled is an inflatable passive restraint apparatus, (lines 15-20 of column 1, control includes disabling or enabling the deployment of the inflatable passive restraint apparatus).

As to claim 5, Matt shows a step of calculating acceleration of the occupant of vehicle, (lines 61-63 of column 4). In order to calculate the acceleration, the sensor needs to determine the positions of the object over time. For the other elements, refer to claim 1 rejection.

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando as applied to claim 1 above, and further in view of Fujita, reference AAD of Form PTO-1449.

Mattes in view of Ando do not show the output means to comprising means for modifying the rate at which the inflatable airbag is inflated. Fujita shows controlling means to control a time period between a collision and a finish of an inflation, (referred as the rate at which the airbag is inflated in instant application), of an airbag, (lines 28-40 of column 2), using inputs from various sensors (lines 37-41 of column 5).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Mattes invention to include a controlling means to control the rate at which the airbag is inflated because applying different rate of inflation to different situations

may protect the occupant of the vehicle more effectively. In addition, both Mattes's and Fujita's inventions deal with deploying airbags controlled by sensors located within the vehicles in order to protect the occupants of vehicles.

6. Claim 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando as applied to claim 1 above, and further in view of White, reference AAF of Form PTO-1449.

Mattes in view of Ando do not show the output means to comprising means for suppressing deployment of the airbag in response to the absence of the occupant, (claim 4), and an alarm (claim 6). White shows an airbag deployment system in a vehicle with sensor(s) to detect presence of the occupant(s) (lines 35-54 of column 4), with a warning signal lamp, (lines 17-20 of column 7). The control means would inhibit operation of the airbag if the passenger is absent from certain locations, (lines 1-7 of column 3).

It would have been obvious to a person of ordinary skill in the art at the time of when the invention was made to include controlling mean to inhibit operation of the airbag if the passenger is absent from certain locations and to include a warning signal lamp because the overall goal of Mattes is to protect the occupant of the vehicle and by inhibiting operation of the airbag if the passenger is absent from certain locations would limit unnecessary injuries to the occupant and the warning signal lamp would warn the occupant the status of the airbag control system. In addition both Mattes' and White's inventions deal with deployment of airbag in vehicles using location sensors to locate the occupants of the vehicles.

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando as applied to claim 5 above, and further in view of Taylor, reference D of Form PTO-892.

Mattes in view of Ando do not show the another system comprises limiting means for limiting the speed of the vehicle. Taylor discloses a collision avoidance system comprising of a range finder and vehicle control unit to control the speed of the vehicle, (refer to Fig. 1 and the abstract).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include limiting means for limiting the speed of the vehicle controlled by the controlling means because in order to protect the occupants of the vehicle the speed of the vehicle may need to be automatically controlled. The goal of Mattes' invention is to protect the occupants of vehicles. In addition, both Mattes' and Taylor's inventions deal with protecting the occupants of vehicles by controlling various devices within the vehicle and using sensors to determine and characterize situations when the various devices should be activated or deactivated.

8. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando as applied to claim 1 above, and further in view of Gorman, reference AAR of Form PTO-1449.

Mattes and Ando do not show the trained pattern recognition means as comprising a neural network. However, the applicant disclosed that neural networks are commonly used and that software tools are also commercially available for creating neural networks and fuzzy logic

systems capable of recognizing pattern, (page 9, first full paragraph and page 13, second full paragraph in application number 08/247,760, one of the parent cases of instant application). Furthermore, Gorman shows a method to use neural networks in object recognition system using a sonic sensor, (refer to page 76).

It would have been obvious to person of ordinary skill in the art at the time the invention was made to modify the system of Mattes such that it comprised the neural networks because including such algorithm may reduce the algorithm implementation complications by using the commercially available software packages. In addition, both Mattes' and Gorman's disclosures deal with object recognition using sonic sensors.

9. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando as applied to claim 1 above, and further in view of Mazur, reference I of Form PTO-892.

Mattes and Ando do not show the occupying item as a rear facing child seat positioned on the vehicle. Mazur shows an airbag deployment system in a vehicle with a rear facing child positioned on the seat of the vehicle, (Fig. 1 and lines 1-23 of column 4).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to consider situations when there is a rear facing child seat positioned on a seat of a vehicle because consideration of a rear facing child seat positioned on a seat of a vehicle should be included for an airbag deployment system designed to protect the occupant by deploying or not deploying depending upon situation in order to protect the occupants. In

addition, both Mattes' and Masur's inventions deal with an airbag deployment system in vehicles using sensors and control systems to determine if the airbag should be deployed.

10. Claims 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori, reference C of Form PTO-892, in view of Suzuki, reference B of Form PTO-892.

As to claim 10, Masmori discloses a vehicle having a monitoring system for monitoring at least one object exterior to the vehicle, (Fig. 1 and lines 7-13 of column 1). Masomori also shows the systems comprising:

a) transmitter means for transmitting electromagnetic waves to illuminate the exterior object, (lines 30-35 of column 2);

b) reception means for receiving reflected electromagnetic illumination from the exterior object, (lines 37-47 of column 2);

c) processor means coupled to the reception means for processing the received illumination and creating an electronic signal characteristic of the exterior object based thereon, (lines 37047 of column 2);

d) categorization means coupled to the process means for categorizing the electronic signal, the categorization means comprising a pattern recognition algorithm, (lines 48-65 of column 2, a target detecting and range determining systems represents a pattern recognition system); and

e) output mean coupled to the categorization means for affecting another systems in the vehicle in response to the categorization, (lines 35-42 of column 1).

However, Masamori does not show the reception means comprising a CCD array. Suzuki discloses an automobile radar apparatus to detect the distance and angle to the preceding vehicle, (Fig. 3 and lines 10-17 of column 1).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include a CCD array in Masamori's invention because the CCD array will have additional capability of efficiently generating images. In addition, both Masamori's and Suzuki's inventions deal with sensors mounted in vehicles to determine distances to the preceding vehicles.

As to claim 11, Masamori shows the measurement means comprising radar, (lines 45-46 of column 1).

As to claim 12, Masamori shows the measurement means comprising a pulsed laser, (lines 65-69 of column 4, laser diodes exited by pulse signals).

As to claim 13, Masamori shows the another system is a warning system, (lines 27-42 of column 1).

11. Claim 14 rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki as applied to claim 10 above, and further in view of Warner, reference A of Form PTO-892.

Masamoris in view of Suzuki do not show the another system is a side impact airbag system. Warner discloses a side impact airbag deployment system, (lines 7-15 of column 1), controlled by sensors, (lines 57-62 of column 5).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Masamori's invention to include a control systems to control deployment of a side impact airbag because the airbag would protect the occupant of the vehicle and the one of the goals of Masamori's invention is to protect the occupant of the vehicle. In addition, both Masamori's and Warner's inventions deal with protection systems to protect occupants of vehicles by using sensor to sense proximity of dangers.

12. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki as applied to claim 10 above, and further in view of Morrison, reference AJ of Form PTO-1449.

Masamori in view of Suzuki do not show the processor means as comprising a neural network. However, the applicant disclosed that neural networks are commonly used and that software tools are also commercially available for creating neural networks and fuzzy logic systems capable of recognizing pattern, (refer to claim 8 rejection). Furthermore, Morrison shows a method to use neural networks in object recognition system using a radar sensor, (refer to the abstract).

It would have been obvious to person of ordinary skill in the art at the time the invention was made to modify the system of Masomori's invention such that it comprised the neural networks because including such algorithm may reduce the algorithm implementation complications by using the commercially available software packages. In addition, both Masomori's and Morrison's inventions deal with object recognition using radar sensors.

13. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel, reference J of Form PTO-892, in view of Suzuki, reference B of Form PTO-892.

As to claim 16, Bechtel discloses a vehicle having an automatic headlight dimming system, (refer to the abstract). Bechtel also shows the systems comprising:

a) reception means for receiving electromagnetic radiation from the exterior object, (refer to the abstract);

b) processor means coupled to the reception means for processing the received radiation and creating an electronic signal characteristic of received radiation, (lines 49-55 of column 8, detecting the red color of the trail lamps of a leading vehicle is withing the meaning of processing the received radiation and creating an electronic signal characteristic of received radiation);

c) categorization means coupled to the process means for categorizing the electronic signal, the categories comprising radiation from the headlights of an oncoming-vehicle and other radiation, the categorization means, (lines 12-16 of column 1); and

d) output mean coupled to the categorization means for dimming the headlights in the vehicle in response to the categorization, (lines 12-16 of column 1).

However, Bechtel does not show the reception means comprising a CCD array. Suzuki discloses an automobile radar apparatus to detect the distance and angle to the preceding vehicle, (Fig. 3 and lines 10-17 of column 1).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include a CCD array in Bechtel's invention because the CCD array will have additional capability of efficiently generating images. In addition, both Masamori's and Suzuki's inventions deal with sensors mounted in vehicles to determine external conditions of the vehicles.

As to claim 17, Bechtel shows the categories further comprising radiation form taillights of a vehicle-in-front, (lines 49-55 of column 8).

14. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki as applied to claim 16 above, and further in view of Morrison.

Masamori in view of Suzuki do not show the processor means as comprising a neural net. However, the applicant disclosed that neural networks are commonly used and that software tools are also commercially available for creating neural networks and fuzzy logic systems capable of recognizing pattern, (refer to claim 8 rejection). Furthermore, Morrison shows a method to use neural networks in object recognition system detect another vehicle as an exterior condition, (refer to the abstract).

It would have been obvious to person of ordinary skill in the art at the time the invention was made to modify the system of Bechtel's invention such that it comprised the neural networks because including such algorithm may reduce the algorithm implementation complications by using the commercially available software packages. In addition, both Bechtel's and Morrison's

inventions deal with object recognition using sensors to determine exterior conditions of vehicles.

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Reference E and H are included as an example of a motor vehicle speed control system.

Reference F is included as an example of a motor vehicle head light dimming control system.

Reference G is included as an example of a motor vehicle driver alert system.

16. Any inquiry concerning this communication should be directed to Anthony Kahng at telephone number (703) 305-4022.

AK

9-26-96

TO SEPARATE, HOLD TOP AND BOTTOM EDGES, SNAP–APART AND DISCARD CARBON

FORM PTO-892 (REV. 2-92)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	SERIAL NO.	GROUP ART UNIT	ATTACHMENT TO PAPER NUMBER
NOTICE OF REFERENCES CITED		08/474,786	2616	6
		APPLICANT(S) Breed et al.		

U.S. PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
	A	4966388	10/'90	Warner et al.	280	730.1	
	B	5026153	6/'91	Suzuki et al.	356	3.16	
	C	5227784	7/'93	Masamori et al.	340	436	12/'91
	D	5249157	9/'93	Taylor	340	435	8/'90
	E	5309137	5/'94	Kajiwara	348	148	2/'92
	F	5329206	7/'94	Slotkowski et al.	315	159	5/'91
	G	5339075	8/'94	Abst et al.	340	903	11/'92
	H	5355118	10/'94	Fukuhara	348	148	7/'92
	I	5454591	10/'95	Mazur et al.	280	735	3/'93
	J	5537003	7/'96	Bechtel et al	315	82	4/'94
	K						

FOREIGN PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUB-CLASS	PERTINENT SHTS. DWG	PERTINENT PP. SPEC.
	L								
	M								
	N								
	O								
	P								
	Q								

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

	R	
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EXAMINER	DATE
A. Kahng	9-26-96

A copy of this reference is not being furnished with this office action.
(See Manual of Patent Examining Procedure, section 707.05 (a).)

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Sheet 1 of 3

FORM PTO-1449 (REV. 7-80) — U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

LIST OF PRIOR ART CITED BY APPLICANT
(Use several sheets if necessary)

ATTY. DOCKET NO.: ~~ATT-0950~~ | SERIAL NO.: 08/474,786
APPLICANT: David S. Breed et al.
FILING DATE: 6/7/95 | GROUP: 2613

U.S. PATENT DOCUMENTS Part of Paper #4

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
AK	AA	4 836 670	6/89	Hutchinson	351	210	
AK	AB	4 906 940	3/90	Greene et al.	382	~~55~~ 100	
AK	AC	4 720 189	1/88	Heynen et al.	351	210	
AK	AD	4 648 052	3/87	Friedman et al.	364	550	
AK	AE	5 003 166	3/91	Girod.	250	~~201~~ 201.4	
AK	AF	5 193 124	3/93	Subbarao	382	~~44~~ 255	
AK	AG	4 881 270	11/89	Knecht et al.	382	~~47~~ 191	
AK	AH	5 181 254	1/93	Schweizer et al.	382	± 100	
AK	AI	5 214 744	5/93	Schweizer et al.	395	~~21~~ 11	
AK	AJ	5 235 339	8/93	Morrison et al.	342	159	
AK	AK	5 390 136	2/95	Wang	364	754	

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
AK	AL	3 423 37	2/91	Japan (Abstract)	—	—	X	
	AM							
	AN							
	AO							
	AP							

OTHER PRIOR ART *(Including Author, Title, Date, Pertinent Pages, Etc.)*

	AR		
	AS		
	AT		

EXAMINER: A. Kahng | DATE CONSIDERED: 9-25-96

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

USCOMM-DC 80-3985

Sheet 2 of 3

FORM PTO-1449 (REV. 7-80) — U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

LIST OF PRIOR ART CITED BY APPLICANT
(Use several sheets if necessary)

ATTY. DOCKET NO.	SERIAL NO.
MM-95	08/474,786
APPLICANT	
David S. Broed et al.	
FILING DATE	**GROUP**
6/7/95	2013

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
AK	AA	5305012	4/94	Faris	345	7	
AK	AB	5298732	3/94	Chen	250	203.4	
AK	AC	5008946	4/91	Ando	382	2	
AK	AD	5074583	12/91	Fujita et al.	780	~~735~~	730.1
AK	AE	5118134	6/92	Mattes et al.	280	735	
AK	AF	5071160	12/91	White et al.	280	735	
AK	AG	4950069	8/90	Hutchinson	351	210	
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER PRIOR ART *(Including Author, Title, Date, Pertinent Pages, Etc.)*

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	AS		
	AT		

EXAMINER	DATE CONSIDERED
A. Kalmy	9-25-96

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

USCOMM-DC 80-3985

PTO-1449 Continued

Page 3 of 3

AR "Analysis of Hidden Units in a Layered Network Trained to Classify Sonar Targets", R. Paul Gorman, et al., Neural Networks, Vol. 1, pp.75-89, 1988.

AS "Learned Classification of Sonar Targets Using a Massively Parallel Network, R. Paul Gorman et al., IEEE Transactions on Acoustics, Speech and Signal Processing, Vol. 36, No. 7, July, 1988, pp1135-1140.

AT "How Airbags Work", David S. Breed, Presented at the Canadian Association of Road Safety Professionals, 10/19/92-10/20/92.

2-24-98

Form PTO 948 (Rev. 10-94) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office Application No. 474786

NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

PTO Draftpersons review all originally filed drawings regardless of whether they are designated as formal or informal. Additionally, patent Examiners will review the drawings for compliance with the regulations. Direct telephone inquiries concerning this review to the Drawing Review Branch, 703-305-8404.

The drawings filed (insert date) 6/7/95, are
A. ___ not objected to by the Draftsperson under 37 CFR 1.84 or 1.152.
B. X objected to by the Draftsperson under 37 CFR 1.84 or 1.152 as indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawings must be submitted according to the instructions on the back of this Notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings:
Black ink. Color.
___ Mixed media (Fig(s). ___)
Color drawings are not acceptable until petition is granted.
Fig(s) ___

2. PHOTOGRAPHS. 37 CFR 1.84(b)
___ Photographs are not acceptable until petition is granted.
Fig(s) ___
___ Photographs not properly mounted (must use brystol board or photographic double-weight paper). Fig(s) ___
___ Poor quality (half-tone). Fig(s) ___

3. GRAPHIC FORMS. 37 CFR 1.84 (d)
___ Chemical or mathematical formula not labeled as separate figure. Fig(s) ___
___ Group of waveforms not presented as a single figure, using common vertical axis with time extending along horizontal axis. Fig(s) ___
___ Individuals waveform not identified with a separate letter designation adjacent to the vertical axis. Fig(s) ___

4. TYPE OF PAPER. 37 CFR 1.84(c)
___ Paper not flexible, strong, white, smooth, nonshiny, and durable. Sheet(s) ___
Erasures, alterations, overwritings, interlineations, cracks, creases, and folds copy machine marks not acceptable. Fig(s) ___
Mylar, vellum paper is not acceptable (too thin). Fig(s) ___

5. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:
21.6 cm. by 35.6 cm. (8 1/2 by 14 inches)
21.6 cm. by 33.1 cm. (8 1/2 by 13 inches)
21.6 cm. by 27.9 cm. (8 1/2 by 11 inches)
21.0 cm. by 29.7 cm. (DIN size A4)
All drawing sheets not the same size. Sheet(s) ___
Drawing sheet not an acceptable size. Sheet(s) ___

6. MARGINS. 37 CFR 1.84(g): Acceptable margins:

Paper size

21.6 cm. X 35.6 cm. (8 1/2 X 14 inches)	21.6 cm. X 33.1 cm. (8 1/2 X 13 inches)	21.6 cm. X 27.9 cm. (8 1/2 X 11 inches)	21.0 cm. X 29.7 cm. (DIN Size A4)
T 5.1 cm. (2")	2.5 cm. (1")	2.5 cm. (1")	2.5cm.
L .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	2.5 cm.
R .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.5 cm.
B .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.0 cm.

Margins do not conform to chart above. 6,8,11,12
Sheet(s) ___
___ Top (T) ___ Left (L) ___ Right (R) ___ Bottom (B)

7. VIEWS. 37 CFR 1.84(h)
REMINDER: Specification may require revision to correspond to drawing changes.
___ All views not grouped together. Fig(s) ___
___ Views connected by projection lines or lead lines. Fig(s) ___
Partial views. 37 CFR 1.84(h) 2
X ___ View and enlarged view not labled separatly or properly. Fig(s) 7
Sectional views. 37 CFR 1.84 (h) 3
___ Hatching not indicated for sectional portions of an object. Fig(s) ___
___ Cross section not drawn same as view with parts in cross section with regularly spaced parallel oblique strokes. Fig(s) ___

8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)
___ Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s) ___

9. SCALE. 37 CFR 1.84(k)
___ Scale not large enough to show mechanism with crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s) ___
___ Indication such as "actual size" or scale 1/2" not permitted. Fig(s) ___

10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(l)
___ Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (except for color drawings). Fig(s) ___

11. SHADING. 37 CFR 1.84(m)
___ Solid black shading areas not permitted. Fig(s) 5-7
___ Shade lines, pale, rough and blurred. Fig(s) ___

12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)
___ Numbers and reference characters not plain and legible. 37 CFR 1.84(p)(1) Fig(s) ___
___ Numbers and reference characters not oriented in same direction as the view. 37 CFR 1.84(p)(1) Fig(s) ___
___ English alphabet not used. 37 CFR 1.84(p)(2) Fig(s) ___
___ Numbers, letters, and reference characters do not measure at least .32 cm. (1/8 inch) in height. 37 CFR(p)(3) Fig(s) ___

13. LEAD LINES. 37 CFR 1.84(q)
___ Lead lines cross each other. Fig(s) ___
___ Lead lines missing. Fig(s) ___

14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)
___ Sheets not numbered consecutively, and in Arabic numerals, beginning with number 1. Sheet(s) ___

15. NUMBER OF VIEWS. 37 CFR 1.84(u)
___ Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s) ___
___ View numbers not preceded by the abbreviation Fig. Fig(s) ___

16. CORRECTIONS. 37 CFR 1.84(w)
___ Corrections not made from prior PTO-948. Fig(s) ___

17. DESIGN DRAWING. 37 CFR 1.152
___ Surface shading shown not appropriate. Fig(s) ___
___ Solid black shading not used for color contrast. Fig(s) ___

COMMENTS:

9/7/95

ATI-95

#1-7
S. Cotton
11-19-96

UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: A. Kahng Art Unit:2616

Re: Application of: David S. Breed et al.

Serial No.: 08/474,786

Filed: June 7, 1995

For: OPTICAL IDENTIFICATION AND MONITORING SYSTEM

INFORMATION DISCLOSURE STATEMENT

Hon. Commissioner of
Patents and Trademarks
Washington, D.C. 20231

October 18, 1996

Sir:

Applicants herewith submit a list of references cited during the prosecution of a corresponding patent application in the British Patent Office (References AA, AL, AR and AS) and during the prosecution of a related application in the U.S. Patent and Trademark Office (U.S. patent application Serial No. 08/474,782 handled by the same Examiner-References AB-AI). A copy of each of the references is enclosed.

A copy of the British Search Report is also enclosed. It is pointed out that reference AL corresponds to U.S. Patent Application Serial No. 08/505,036 and that Great Britain Patent

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Commissioner of Patents and Trademarks, Washington, DC 20231" on OCTOBER 18, 1996

BRIAN ROFFE

BY: Brian Roffe

Application No. 2,289,332, listed in the British Search Report, corresponds to U.S. Patent Application Serial No. 08/640,068. A copy of GB '332 is not submitted since it published on or about November, 1995, after the filing date of this application.

The undersigned hereby certifies that items AA, AL, AR and AS in this Information Disclosure Statement were cited in a communication from the British Patent Office in a counterpart foreign application therein not more than three months prior to the filing of this Information Disclosure Statement.

Further, the undersigned hereby certifies that items AB-AI in this Information Disclosure Statement were cited in a communication from the United States Patent and Trademark in the related application not more than three months prior to the filing of this Information Disclosure Statement .

Therefore, no fee is due under 37 C.F.R. §1.17(p).

This submission does not represent that a search has been made or that no better prior art exists. While the term "reference" is used in citing the publications called to the Examiner's attention herein, applicants do not make any admission that each or all of them are "prior art" references within the meaning of the statutory and case law.

Applicants reserve the right to contend, where appropriate, that a reference asserted against any claim of the present application is not prior art under the facts and the law.

Applicants also reserve the right to present appropriate arguments and/or evidence to establish patentability over the references, should one or more of the references be applied against the claims of the present application.

Applicants request the Examiner independently determine those items which the Examiner would consider the most pertinent of all the references cited herein.

It is respectfully requested that these references be considered and made of record.

Respectfully submitted,

By:_____
Brian Roffe
Attorney for Applicants
Reg. No. 35,336

Enclosures

12 References
British Search Report

ATI-95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Ex.: A. Kahng	Art Unit 2616
In re Application of:	David S. Breed et al.
For:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM:
Filed:	June 7, 1995
Serial No.:	08/474,786

AMENDMENT

Hon. Commissioner of Patents and Trademarks
Assistant Commissioner of Patents
Washington, D.C. 20231

January 2, 1997

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Assistant Commissioner of Patents, Commissioner of Patents and Trademarks, Washington, D.C. 20231" on JANUARY 2,1997.
Brian Roffe, Esq.

IN THE CLAIMS:

Please amend the claims as follows.

1. (Amended) In a motor vehicle having an interior passenger compartment containing [a passive restraint system and] at least one occupying item [having surfaces], an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from [said surfaces of] said at least one occupying item [within] in said vehicle interior passenger compartment, said receiver means comprising a CCD array;

c) processor means coupled to said [receiver means] CCD array for processing said received illumination and generating an electronic signal characteristic and representative of [said surfaces of] said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal [in order] to thereby identify said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for applying a [trained] pattern recognition algorithm; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to [said] the identification of said at least one occupying item.

2. (Amended) The system in accordance with claim 1, wherein [the passive restraint] said another system comprises an inflatable airbag and said at least one occupying item is an occupant, [said electronic signal being characteristic of the position of the occupant of the vehicle determined from said surfaces thereof,] said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a positional categorization of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions, said output means comprising means for modifying the time [that] at which inflation of said inflatable airbag is initiated in response to the position of [said] the occupant.

3. (Amended) The system in accordance with claim 1, wherein [the passive restraint] said another system comprises an inflatable airbag and said at least one occupying item is an occupant, [said electronic signal being characteristic of the position of the occupant of the vehicle determined from said surfaces thereof,] said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said surfaces of the occupant into a positional categorization of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic

illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions, said output means comprising means for modifying the rate at which said inflatable airbag is inflated in response to the position of [said] the occupant.

4. (Amended) The system in accordance with claim 1, wherein [the passive restraint] said another system comprises an inflatable airbag and said at least one occupying item is an occupant, [said electronic signal being characteristic of the presence of the occupant of the vehicle determined from said surfaces thereof,] said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a categorization of said signal characteristic of the presence of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the presence and absence of the occupant of the vehicle, said output means comprising means for suppressing deployment of said inflatable in response to the absence of [said] the occupant.

5. (Amended) The system in accordance with claim 1, wherein said at least one occupying item is [the head of] an occupant, [said electronic signal being characteristic of the position of the occupant's head determined from said surfaces thereof,] said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from said occupant into a head-positional categorization of said signal characteristic of the position of the occupant's head based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the

head of occupants of the vehicle in different positions, said trained pattern recognition means comprises means to categorize the motion of the occupant's head over time, and said [response] output means coupled to said pattern recognition means responds to the category of motion of the occupant's head over time to affect said another system in said vehicle.

10. (Amended) In a motor vehicle having an interior and an exterior, a monitoring system for monitoring at least one object exterior to said vehicle comprising:

a) transmitter means for transmitting electromagnetic waves to illuminate [said] the at least one exterior object;

b) reception means for receiving reflected electromagnetic illumination from [said] the at least one exterior object, said reception means comprising a CCD array;

c) processor means coupled to said [reception means] CCD array for processing said received illumination and creating an electronic signal characteristic of said exterior object based thereon;

d) categorization means coupled to said processor means for categorizing said electronic signal, said categorization means comprising trained pattern recognition means for applying a pattern recognition algorithm; and

e) output means coupled to said categorization means for affecting another system in the vehicle in response to said categorization.

11. (Amended) The system in accordance with claim 10, further comprising measurement means for measuring the distance from [said] the at least one exterior object to said vehicle, said measurement means comprising radar.

12. (Amended) The system in accordance with claim 10, further comprising measurement means for measuring the distance from [said] the at least one exterior object to said vehicle, said measurement means comprising a pulsed laser.

13. (Amended) The system in accordance with claim 10, wherein said another system is a warning system which is activated when [said] the at least one exterior object is within a specified range of said vehicle and said vehicle driver begins to execute an action which increases the probability of a collision with [said] the at least one exterior object.

14. (Amended) The system in accordance with claim 10, wherein said another system is a side impact airbag system which is activated when [said] the at least one exterior object is within a specified range of said vehicle and said processor means determines that there is a high probability of a collision with [said] the at least one exterior object.

16. (Amended) In a motor vehicle having an interior and an exterior, an automatic headlight dimming system comprising:

a) reception means for receiving electromagnetic radiation from an exterior object, said reception means comprising a CCD array;

b) processor means coupled to said [reception means] CCD array for processing [said] the received [illumination] radiation and creating an electronic signal characteristic of the received [illumination] radiation;

c) categorization means coupled to said processor means for categorizing said electronic signal into categories comprising radiation from the headlights of an oncoming-vehicle and other radiation, said categorization means comprising trained pattern recognition means for applying a [trained] pattern recognition algorithm; and

[e)] d) output means coupled to said categorization means for dimming the headlights in said vehicle in response to said categorization.

Please add the following new claims.

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19. The system in accordance with claim 1, wherein said pattern recognition means are structured and arranged to process said electronic signal based on said received illumination from said at least one occupying item into a categorization of said signal characteristic of said at least one occupying item based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated within possible classes of occupying items of the vehicle, said output means being structured and arranged to affect said another system in the vehicle in response to said identification.

20. The system in accordance with claim 10, wherein said categorization means constitute identification means for identifying the at least one exterior object by categorizing said

electronic signal, said pattern recognition means being structured and arranged to process said electronic signal based on said received illumination from the at least one exterior object into a categorization of said signal characteristic of the at least one exterior object based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated within possible classes of exterior objects of the vehicle, said output means being structured and arranged to affect said another system in the vehicle in response to said identification.

REMARKS

Reconsideration of the present application, as amended, is respectfully requested.

Claims 1-18 and new claims 19 and 20 are presently active in this application.

Claim 16 has been amended to overcome the Examiner's formal rejection.

I. Rejection of Claims 1-9

Prior to discussing the rejections of claims 1-9 on the merits, a brief review of the claimed inventions is in order.

These embodiments of the invention relate to a vehicular interior monitoring system which is designed to control reactions of vehicular components depending on the status of the passenger compartment or the contents therein. Specifically, to obtain information from the passenger compartment, the system includes illumination means which illuminate at least a portion of the passenger compartment with electromagnetic radiation and receiver means for receiving electromagnetic illumination reflected from surfaces of one or more occupying items within the passenger compartment. To receive the electromagnetic illumination, and for other purposes

discussed below, a CCD (charge coupled device) array is used in the invention. Processor means are coupled to the CCD array for processing the received electromagnetic illumination and generating an electronic signal characteristic and representative of the occupying item(s) in the passenger compartment based thereon. Lastly, the most basic embodiment of the invention includes output means coupled to the processor means for affecting another system in the vehicle in response to the identification of the occupying item (s). For example, the another system may be a passive restraint device such as an inflatable airbag and the occupying item is an occupant, whereby the electronic signal is characteristic of the position of the occupant of the vehicle determined from the surfaces thereof and the output means comprising means for modifying the time the inflation of the airbag is initiated or the rate of inflation in response to the position of the occupant.

It is an important aspect of the invention that the system includes categorization and identification means coupled to the processor means for categorizing the electronic signal to thereby identify the occupying item(s). The categorization and identification means comprise a trained pattern recognition means for applying a pattern recognition algorithm.

The novel use of the CCD array as the illumination receiving means enables the processor means to generate an electronic signal **characteristic and representative** of the occupying item(s) in the passenger compartment based thereon (as now set forth in amended independent claim 1). In this regard, it is emphasized that the electronic signal varies depending on the specific occupying item(s), i.e., each occupying item will essentially have a different electronic signal generated based thereon whether it is a person, bag of groceries, etc. In this manner, it is possible

to identify the occupying item(s) with specificity, by the application of the pattern recognition algorithm, and thus affect another vehicle system based on this identification.

Another important aspect of the invention is that the pattern recognition means is structured and arranged to process the electronic signal based on the received illumination from the occupying item(s) into the categorization of the signal characteristic and representative thereof "based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated within possible classes of occupying items of the vehicle" (claim 19). The categorization and identification means are thus pre-loaded with data of patterns of electromagnetic illumination corresponding to possible occupying items of the vehicle and then applied during practice to provide the identity of the occupying item(s) upon receipt of an electronic signal generated by the processor means from the pattern of electromagnetic illumination received by the CC array. This aspect is described in the specification, e.g., at page 30, line 15 to page 31, line 17.

In view of the foregoing, the occupying items or contents of the passenger compartment can be identified within certain limits as imposed solely by the training of the pattern recognition algorithm. At a minimum, in certain embodiments of the invention, the pattern recognition algorithm is trained on different occupying items (claim 19), different positions of an occupant in the passenger compartment (claims 2 and 3), the presence or absence of an occupant in the passenger compartment (claim 4), the presence of a rear-facing child seat and the motion of an occupant head (claim 5).

None of the prior art references cited by the Examiner teach or suggest receiving illumination from an object by means of a CCD array and then based on the image on the CCD

array, generating an electronic signal characteristic and representative of an occupying item in the passenger compartment and **identifying** the occupying item in the passenger compartment of a vehicle through the application of trained pattern recognition means including data representative of possible occupying items of the passenger compartment.

Claims 1, 2 and 5 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando.

Mattes describes a system including transmitters and receivers for determining the presence, position and/or velocity of an occupant relative to the passenger compartment.

Ando describes a system which recognizes an image and specifically ascertains the position of the pupils and mouth of the occupant to enable movement of the pupils and mouth to control electrical devices installed in the automobile (Abstract). The system includes a camera 3 which takes a picture of the occupant and applies algorithms based on pattern recognition techniques to analyze the picture, converted into an electrical signal, to determine the position of certain portions of the image, namely the pupils and mouth (Col. 1, line 64 to Col. 2, line 4).

The Examiner took the position that the determination of the position of an occupying item in the passenger compartment, as in Mattes, is within the meaning of determining a characteristic thereof. The Examiner's position is respectfully traversed.

It is noted that in accordance with common dictionary definitions, the "position" of an object is defined as the place occupied by a person or thing, its situation or location whereas a "characteristic" of an object is defined as a distinguishing trait, feature or quality, that which characterizes the object. In view of these definitions, it is respectfully submitted that the determination of the position of an object in the vehicle's passenger compartment as in Mattes

does not constitute a characteristic of the object since the object's position is not a distinguishing trait, feature or quality, i.e., all objects can be in the same position and thus the determination of one object's position does not reveal anything with regard to what that object is (a person, bag of groceries, rear-facing child seat, dog, box, etc.). Thus, if the system of Mattes determines that an object is, e.g., 10 cm from the receiver, it has not revealed anything with regard to a characteristic (trait, feature or quality) of that object.

In view of the foregoing, it is respectfully submitted that Mattes does not disclose processor means for generating an electronic signal characteristic of the occupying item of the passenger compartment. To emphasize this distinction, claim 1 has been amended to recite that the electronic signal is not only characteristic of the occupying item but is also representative of the occupying item, i.e., it is unique to that and only that occupying item and other occupying items will have their own representative electronic signals. Of course, the pattern recognition means may be trained to provide an identification of a person from any number of different electronic signals, depending on the training data.

Moreover, it is pointed out that Mattes cannot disclose processor means for generating a signal characteristic and representative of the occupying item since the system of Mattes is based on an ultrasonic signal, and thus the ultrasonic receiver simply receives a signal from which the position of the occupying item can be determined. This signal does not represent the occupying item nor it is characteristic of the occupying item. Rather, it is merely a function of the location of the occupying item.

By contrast, the use of the CCD array in the claimed invention enables a complete electronic signal to be generated characteristic and representative of the occupying item since

each occupying item will essentially have a different image on the CCD array and thus a different electronic signal.

Although Ando shows the use of a CCD array, it does not teach or suggest that the image displayed on the CCD array can be processed to generate a signal characteristic and representative of the occupying item. Thus, Ando does not disclose the synergy of the use of a CCD array in order to enable the processing of the image to obtain an electronic signal characteristic and representative of the occupying item. Furthermore, Ando does not teach or suggest categorization and identification means which categorize an electronic signal characteristic and representative of the occupying item(s) to thereby identify the occupying item(s).

In view of the absence of the disclosure of all of the features of independent claim 1 in Ando and Mattes, one could not combine these references and arrive at the claimed invention. Therefore, claim 1 should be allowable over the prior art of record.

Claims 2 and 5 includes all of the features of independent claim 1 and for the same reasons that claim 1 is allowable over the prior art of record, claims 2 and 5 should also be allowable.

With particular respect to claim 2, the pattern recognition means of Ando are not structured and arranged to process the electronic signal "into a positional categorization of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions." It is thus pointed out that the position of the occupant is not determined so much as from the electronic signal directly, as in Mattes, but indirectly through the pattern recognition means trained to detect occupants in different positions (See page 32, lines 1-4 of the specification).

With respect to claim 5, the pattern recognition means of Ando are not structured and arranged to process the electronic signal "into a head-positional categorization of said signal characteristic of the position of the occupant's head based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the head of occupants of the vehicle in different positions" whereby the trained pattern recognition means comprises means to categorize the motion of the occupant's head over time.

Claim 3 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and further in view of Fujita. Claims 4 and 6 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and further in view of White. Claim 7 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and further in view of Taylor. Claim 8 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and further in view of Gorman. Claim 9 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and further in view of Mazur.

Claims 3, 4 and 6-9 include all of the features of claim 1 and for the same reasons that claim 1 is allowable over the prior art of record, these claims should also be allowable. In any event, none of these secondary references, viz., Fujita, White, Taylor, Gorman and Mazur, disclose generating an electronic signal characteristic and representative of an occupying item based on an image obtained on a CCD array and therefore do not overcome the deficiencies of the combination of Ando and Mattes.

With respect to new claim 19, in contrast to the claimed invention, neither Mattes nor Ando teach or suggest identification means which include stored data corresponding to patterns of received electromagnetic illumination and associated within possible classes of occupying items

of the vehicle, i.e., the pattern recognition means are trained by generating data representative of return signals from each possible class of occupying items such that the electronic signal representative of the surfaces of the occupying item obtained during operation can be analyzed in view of this data and the identification of the class of occupying item established with near certainty. Mattes does not mention anything about the storage of such data and its later use to identify occupying items of the vehicle whereas Ando merely stores an image obtained each time and analyzes that image to ascertain the location of the pupils and/or mouth. Ando does not contain trained pattern recognition means which include data representative of possible classes of occupying items.

2. Rejection of Claims 10-15

These embodiments are directed to a monitoring system for monitoring at least one object exterior to the vehicle which includes transmitter means for transmitting electromagnetic waves to illuminate the exterior object(s), reception means, namely a CCD array, for receiving reflected electromagnetic illumination from the exterior object(s), processor means coupled to the CCD array for processing the received illumination and creating an electronic signal characteristic of the exterior object(s) based thereon, categorization means coupled to the processor means for categorizing the electronic signal, which comprise trained pattern recognition means for applying a pattern recognition algorithm, and output means coupled to the categorization means for affecting another system in the vehicle in response to the categorization.

None of the prior art references teach or suggest a CCD array for receiving an image of an exterior object and processor means for generating an electronic signal characteristic of that

object. As explained above, the determination of the position of an object is not a characteristic of that object as used in this application.

Claims 10-13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki.

Masamori describes a system which is based on radar, specifically it is a collision avoidance system aimed at detecting vehicles which are at some distance from the vehicle.

Suzuki describes a vehicle tracking control for continuously detecting the distance and direction to a preceding vehicle irrespective of background dark/light distribution. In this system, every vehicle must have a light on its rear that emits a constant or time varying signal and the invention then uses two photoelectric sensors that zero in on the light emitted from the preceding vehicle and thereby determine both the distance and angular position of the preceding vehicle.

It is respectfully submitted that Masamori does not disclose processor means for generating an electronic signal characteristic of the exterior object (see the explanation above with respect to Mattes). Rather, Masamori simply discloses a distance measurement system based on radar waves. The radar waves can be reflected off of any object and thus a trait, feature or quality of the object (a characteristic of the object) is not obtained by means of the reflected radar waves.

By contrast, the use of the CCD array in the claimed invention enables a complete electronic signal to be generated characteristic of the occupying item since each exterior object will essentially have a different image on the CCD array and thus a different electronic signal.

Although Suzuki shows the use of a CCD array, it does not teach or suggest that the image displayed on the CCD array can be processed to generate a signal characteristic of the exterior object. Thus, Suzuki does not disclose the synergy of the use of a CCD array in order to

enable the processing of the image to obtain an electronic signal characteristic of the exterior object.

Furthermore, Masamori does not teach or suggest that the categorization means categorize an electronic signal which is characteristic of the exterior object.

In view of the absence of the disclosure of all of the features in independent claim 10 in Masamori and Suzuki, one could not combine these references and arrive at the claimed invention. Therefore, claim 10 should be allowable over the prior art of record.

Claims 11-13 includes all of the features of independent claim 10 and for the same reasons that claim 10 is allowable over the prior art of record, claims 11-13 should also be allowable.

Claim 14 was rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki and further in view of Warner. Claim 15 was rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki and further in view of Morrison.

Claims 14 and 15 include all of the features of claim 10 and for the same reasons that claim 10 is allowable over the prior art of record, these claims should also be allowable. In any event, Warner and Morrison do not disclose generating an electronic signal characteristic of an exterior object item based on an image obtained on a CCD array and therefore do not overcome the deficiencies of the combination of Masamori and Suzuki.

With respect to new claim 20, in contrast to the claimed invention, neither Masamori nor Suzuki teach or suggest identification means which include stored data corresponding to patterns of received electromagnetic illumination and associated within possible classes of exterior objects, i.e., the pattern recognition means are trained by generating data representative of return signals from each possible class of exterior objects such that the electronic signal representative of the

exterior objects obtained during operation can be analyzed in view of this data and the identification of the class of the exterior object established with near certainty.

3. **Rejection of Claims 16-18**

These claims are directed to embodiments of an automatic headlight dimming system which comprises reception means, a CCD array, for receiving electromagnetic radiation from an exterior object, processor means coupled to the CCD array for processing the received radiation and creating an electronic signal characteristic of the received radiation, categorization means coupled to the processor means for categorizing the electronic signal into categories comprising radiation from the headlights of an oncoming-vehicle and other radiation, the categorization means comprising trained pattern recognition means for applying a pattern recognition algorithm, and output means coupled to the categorization means for dimming the headlights in the vehicle in response to the categorization.

None of the prior art references teach or suggest a CCD array for receiving electromagnetic illumination from an exterior object and processor means for generating an electronic signal characteristic of that object based on the reception of the CCD array.

Claims 16 and 17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki.

Bechtel describes a system which uses colored mirrors to separate colors. Suzuki is described above.

It is respectfully submitted that Bechtel does not disclose processor means for generating an electronic signal characteristic of the received illumination as used herein, which is achieved by means of the CCD array. The use of the CCD array in the claimed invention enables a complete

electronic signal to be generated characteristic of the exterior object since each exterior object will essentially have a different image on the CCD array and thus a different electronic signal.

Although Suzuki shows the use of a CCD array, it does not teach or suggest that the image displayed on the CCD array can be processed to generate a signal characteristic of the exterior object. Thus, Suzuki does not disclose the synergy of the use of a CCD array in order to enable the processing of the image to obtain an electronic signal characteristic of the exterior object.

In view of the absence of the disclosure of all of the features in independent claim 16 in Bechtel and Suzuki, one could not combine these references and arrive at the claimed invention. Therefore, claim 16 should be allowable over the prior art of record.

Claim 17 includes all of the features of independent claim 16 and for the same reasons that claim 16 is allowable over the prior art of record, claim 17 should also be allowable.

Claim 18 was rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki and further in view of Morrison.

Claim 18 includes all of the features of claim 16 and for the same reasons that claim 16 is allowable over the prior art of record, claim 18 should also be allowable. In any event, Morrison do not disclose generating an electronic signal characteristic of an exterior object item based on an image obtained on a CCD array and therefore does not overcome the deficiencies of the combination of Bechtel and Suzuki.

In view of the changes made to the claims and the arguments presented above, it is respectfully submitted that the Examiner's rejections have been overcome and that the present application is now in condition for allowance.

Lastly, it is pointed out that a continuation application of U.S. patent application Serial No. 08/239,978, one of the parent applications of this application, has been filed (USSN 08/640,068). The Examiner's attention is directed to the references cited therein.

An early and favorable action on the merits is earnestly solicited.

FOR THE APPLICANT

Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598

UNITED STATES PARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
08/474,786	06/07/95	BREED D	ATI-95

EXAMINER

26M2/0317

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

KAHNG,A

ART UNIT	PAPER NUMBER
2616	9

DATE MAILED: 03/17/97

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

OFFICE ACTION SUMMARY

☒ Responsive to communication(s) filed on 1/2/97.

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 D.C. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1-20 is/are pending in the application.
Of the above, claim(s) _____ is/are withdrawn from consideration.
☐ Claim(s) _____ is/are allowed.
☒ Claim(s) 1-20 is/are rejected.
☐ Claim(s) _____ is/are objected to.
☐ Claim(s) _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.
☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.
☐ The specification is objected to by the Examiner.
☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.
☐ received in Application No. (Series Code/Serial Number) _____.
☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of Reference Cited, PTO-892
☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____
☐ Interview Summary, PTO-413
☐ Notice of Draftperson's Patent Drawing Review, PTO-948
☐ Notice of Informal Patent Application, PTO-152

--SEE OFFICE ACTION ON THE FOLLOWING PAGES--

1. Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection. However, the objections to claim 16, (refer to paragraph 2 of the Office Action mailed on 10/1/96), are withdrawn in view of the amendment.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa, reference AC of Form 1449 filed on 10/21/96. The statements advanced in paragraph 4 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes and Ando are incorporated by reference herein.

Mattes does not explicitly show an identification means comprising trained pattern recognition means for applying a pattern recognition algorithm. Ishikawa discloses an image analyzer inside of a vehicle, (refer to the abstract). Ishikawa shows an identification means comprising a trained pattern recognition means for applying a pattern recognition algorithm, (refer to Fig. 9).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include an identification means comprising trained pattern recognition means for applying a pattern recognition algorithm in the invention of Mattes because the identification

means could help accurately determine where the person is in the vehicle. In addition, both the inventions of Mattes and Ishikawa deal with sensors inside vehicles.

As to claim 19, refer to claim 1 rejection.

4. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa as applied to claim 1 above, and further in view of Fujita. The statements advanced in paragraph 5 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes, Ando and Fujita are incorporated by reference herein.

5. Claim 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa as applied to claim 1 above, and further in view of White. The statements advanced in paragraph 6 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes, Ando and White are incorporated by reference herein.

6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa as applied to claim 5 above, and further in view of Taylor. The statements advanced in paragraph 7 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes, Ando and Taylor are incorporated by reference herein.

7. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa as applied to claim 1 above, and further in view of Gorman. The statements advanced in paragraph 8 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes, Ando and Gorman are incorporated by reference herein.

8. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa as applied to claim 1 above, and further in view of Mazur. The statements advanced in paragraph 9 of the Office Action mailed on 10/1/96, (paper 6), as to the applicability and disclosure of Mattes, Ando and Mazur are incorporated by reference herein.

9. Claims 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki. The grounds for rejections stated in paragraph 10 of the Office Action mailed on 10/1/96 are incorporated by reference herein.

The applicant alleges "Masamori does not disclose processor means for generating an electronic signal characteristic of the exterior object" because "Masamori simply discloses a distance measurement system based on radar waves," (the fourth full paragraph of page 16 of the amendment). The Examiner is interpreting the phrase "characteristic of" and object to be length, width, depth, distance and/or shape of an object among many other possible characteristics of an object.

10. Claim 14 rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki as applied to claim 10 above, and further in view of Warner. The grounds for rejections stated in paragraph 11 of the Office Action mailed on 10/1/96 are incorporated by reference herein.

11. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki as applied to claim 10 above, and further in view of Morrison. The grounds for

rejections stated in paragraph 12 of the Office Action mailed on 10/1/96 are incorporated by reference herein.

As to claim 20, refer to claim 15 rejection.

12. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki. The grounds for rejections stated in paragraph 13 of the Office Action mailed on 10/1/96 are incorporated by reference herein.

The Examiner is interpreting the meaning of phrase "characteristic of the received illumination" to include the meaning of the intensity level of the beam of lights emanating from a second vehicle as shown in Bechtel.

13. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki as applied to claim 16 above, and further in view of Morrison. The grounds for rejections stated in paragraph 14 of the Office Action mailed on 10/1/96 are incorporated by reference herein.

14. Any inquiry concerning this communication should be directed to Anthony Kahng at telephone number (703) 305-4022.

AK

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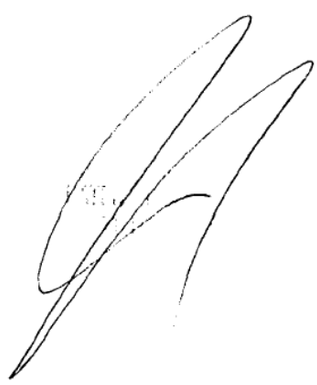
3/10/97



44= U.S. PTO

Docket No. ATI-95
U.S. Serial No. 08/474,786
Inventors David S. Breed et al.
Filed June 7, 1995

-LIST OF REFERENCES CITED

U.S. PATENT DOCUMENTS

Check		Patent No.	Date	Name	Class	Subclass
AK	AA	4,768,088	8/30/1988	Ando	358	93
AK	AB	4,496,222	1/29/1985	Shah	350	354
AK	AC	4,625,329	11/25/1986	Ishikawa et al.	382	1
AK	AD	5,064,274	11/12/1991	Alten	359	604
AK	AE	5,162,861	11/10/1992	Tamburino et al.	356	5
AK	AF	5,185,667	2/9/1993	Zimmermann	358	209
AK	AG	5,249,027	9/28/1993	Mathur et al.	356	1
AK	AH	5,330,226	7/19/1994	Gentry et al.	280	735
AK	AI	5,441,052	8/15/1995	Miyajima	126	661.09
	AJ					
	AK					

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OCT 30 96
GROUP 2600

FOREIGN DOCUMENTS

		Number	Date	Country	Class/ Subclass	Translation
AK	AL	94/22693	10/13/1994	W.I.P.O.	— —	Yes
	AM					
	AN					
	AO					
	AP					
	AQ					

PUBLICATIONS

AK	AR	Derwent Abstract of German Patent Publication No. DE 42 11 556, October 7, 1993.
AK	AS	Derwent Abstract of Japanese Patent Application No. 02-051332, November 13, 1991
	AT	
	AU	

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120 - 202 2616

ATI-95 A1/C/B 10/1 1-31-97

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Ex.: A. Kahng	Art Unit 2616
In re Application of:	David S. Breed et al.
For:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM:
Filed:	June 7, 1995
Serial No.:	08/474,786

AMENDMENT

Hon. Commissioner of Patents and Trademarks
Assistant Commissioner of Patents
Washington, D.C. 20231

June 17, 1997

In response to the Office Action dated March 17, 1997, please amend the above-identified application as follows.

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Assistant Commissioner of Patents, Washington, D.C. 20231" on JUNE 17,1997.
Brian Roffe, Esq.

07/18/1997 MVILLARI 00000005 08474786
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02 FC:203 55.00 OP

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IN THE CLAIMS:

Please cancel claims 19 and 20 without prejudice.

Please amend the claims as follows.

1. (Twice Amended) In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment [, said receiver means comprising a CCD array];

c) processor means coupled to said [CCD array] receiver means for processing said received illumination and generating an electronic signal characteristic [and representative] of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for [applying a pattern recognition algorithm] processing said electronic signal based on said received illumination from said at least one occupying item to provide an identification of said at least one occupying item based thereon, said pattern recognition means being structured and arranged to

apply a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item.

10. (Twice Amended) In a motor vehicle having an interior and an exterior, a monitoring system for monitoring at least one object exterior to said vehicle comprising:

a) transmitter means for transmitting electromagnetic waves to illuminate the at least one exterior object;

b) reception means for receiving reflected electromagnetic illumination from the at least one exterior object [, said reception means comprising a CCD array];

c) processor means coupled to said [CCD array] reception means for processing said received illumination and creating an electronic signal characteristic of said exterior object based thereon;

d) categorization means coupled to said processor means for categorizing said electronic signal to identify said exterior object, said categorization means comprising trained pattern recognition means for [applying a pattern recognition algorithm] processing said electronic signal based on said received illumination from said exterior object to provide an identification of said exterior object based thereon, said pattern recognition means being structured and arranged to apply a

pattern recognition algorithm generated from data of possible exterior objects and patterns of received electromagnetic illumination from the possible exterior objects; and

e) output means coupled to said categorization means for affecting another system in the vehicle in response to [said categorization] the identification of said exterior object.

16. (Twice Amended) In a motor vehicle having an interior and an exterior, an automatic headlight dimming system comprising:

a) reception means for receiving electromagnetic radiation from [an] the exterior [object] of the vehicle [, said reception means comprising a CCD array];

b) processor means coupled to said [CCD array] reception means for processing the received radiation and creating an electronic signal characteristic of the received radiation;

c) categorization means coupled to said processor means for categorizing said electronic signal [into categories comprising radiation from the headlights of an oncoming-vehicle and other radiation] to identify a source of the radiation, said categorization means comprising trained pattern recognition means for [applying a pattern recognition algorithm] processing said electronic signal based on said received radiation to provide an identification of the source of the radiation based thereon, said pattern recognition means being structured and arranged to apply a pattern recognition algorithm generated from data of possible sources of radiation

including lights of vehicles and patterns of received radiation from the possible sources; and

d) output means coupled to said categorization means for dimming the headlights in said vehicle in response to [said categorization] the identification of the source of the radiation.

Please add the following new claims.

21. In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of the form of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for applying a pattern recognition algorithm; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item.

22. The system of claim 21, wherein said trained pattern recognition means are structured and arranged to process said electronic signal based on said received illumination from said at least one occupying item to provide an identification of said at least one occupying item based thereon by applying a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items.

23. A method for affecting a system in a vehicle based on an object exterior of the vehicle, comprising the steps of:

a) transmitting electromagnetic waves to illuminate the exterior object;

b) receiving reflected electromagnetic illumination from the object on an array;

c) processing the received illumination and creating an electronic signal characteristic of the exterior object based thereon;

d) processing the electronic signal based on the received illumination from the exterior object to identify the exterior object, said processing step comprising the steps of generating a pattern recognition algorithm from data of possible exterior objects and patterns of received electromagnetic illumination from the possible exterior objects, storing the algorithm within a pattern recognition system and

applying the pattern recognition algorithm using the electronic signal as input to obtain the identification of the exterior object; and

e) affecting the system in the vehicle in response to the identification of the exterior object.

24. A method for monitoring an interior of a motor vehicle having an interior passenger compartment containing at least one occupying item, comprising the steps of:

a) illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment on an array;

c) processing said received illumination and generating an electronic signal characteristic of said at least one occupying item in said passenger compartment based thereon;

d) processing the electronic signal based on the received illumination from said at least one occupying item to provide an identification of said at least one occupying item, said processing step comprising the steps of generating a pattern recognition algorithm from data of possible occupying items and patterns of received electromagnetic illumination from the possible occupying items, storing the algorithm within a pattern recognition system and applying the pattern recognition

algorithm using the electronic signal as input to obtain the identification of the at least one occupying item; and

e) affecting another system in said vehicle in response to the identification of said at least one occupying item.

25. The system of claim 1, wherein said receiver means comprise a CCD array.

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~~26~~. The system of claim 10, wherein said reception means comprise a CCD array.

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~~27~~. The invention in accordance with claim 16, wherein said reception means comprise a CCD array.

REMARKS

Reconsideration of the present application, as amended, is respectfully requested.

Claims 1-18 and new claims 21-27 are presently active in this application, claims 19 and 20 having been canceled.

I. Rejection of Claims 1-9

A description of the embodiments set forth in claims 1-9 is provided in the amendment dated January 2, 1997.

Independent claim 1 has now been amended to include subject matter previously set forth in claim 19. As such, claim 1 specifies that the categorization and identification means comprise **trained** pattern recognition means for processing the electronic signal based on the received illumination from the occupying item to provide an identification of the occupying item based

thereon and that the pattern recognition means are structured and arranged to "apply a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items." The data of possible occupying items and patterns of receiving illumination therefrom constitute a training set for the algorithm and which is created and stored within the pattern recognition means.

This aspect is described in detail in the specification, e.g., at page 5, lines 19-21, "A trained pattern recognition system as used herein means a pattern recognition system which is taught various patterns by subjecting the system to a variety of examples." Also, at page 30, a description of the training of the computer programs used in the trained pattern recognition means is provided, i.e., the computer programs are trained using a set of representative data collected during a training phase. Reference is also made to the definition of "identify" in this application which is set forth on page 6, lines 1-5.

Thus, by describing the pattern recognition means as "trained" and the specification of the algorithm as being generated from data of possible occupying items and patterns of received illumination therefrom, applicants are expressly intending a system which is based on pre-obtained data relating to possible electronic signals (representative of the received illumination) and possible objects in the passenger compartment. The categorization and identification means are thus provided prior to installation with data of patterns of electromagnetic illumination corresponding to possible occupying items of the vehicle and then applied during practice to provide the identity of the occupying item(s) upon receipt of an electronic signal generated by the processor means from the pattern of electromagnetic illumination received by the receiver means. The receiver means preferably comprise a CCD array (new claim 25).

None of the prior art references expressly teach or suggest this feature and do not even remotely allude to the possibility of creating an algorithm from data of possible occupying items in the passenger compartment and patterns of received illumination therefrom.

Claims 1, 2 and 5 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando and Ishikawa (note that it appears that claim 19 was also rejected on this ground although not explicitly stated). The Examiner takes the position that Ishikawa shows an identification means comprising a trained pattern recognition means for applying a pattern recognition algorithm.

The Examiner's rejection is respectfully traversed in view of amended claim 1.

Mattes describes a system including transmitters and receivers for determining the presence, position and/or velocity of an occupant relative to the passenger compartment.

Ando describes a system which recognizes an image and specifically ascertains the position of the pupils and mouth of the occupant to enable movement of the pupils and mouth to control electrical devices installed in the automobile. The system includes a camera 3 which takes a picture of the occupant and applies algorithms based on pattern recognition techniques to analyze the picture, converted into an electrical signal, to determine the position of certain portions of the image, namely the pupils and mouth (Col. 1, line 64 to Col. 2, line 4).

Ishikawa describes an image analyzer which analyzes the position of driver. An infrared light source illuminates the driver's face, an image detector receives light from the face and then determines the position of facial feature, e.g., the eyes in three dimensions, and thus determines the position of driver in three dimensions. To this end, Ishikawa uses a pattern recognition process which begins by converting pixels to either black or white based on intensity, conducting

an analysis based on white area in order to find the largest contiguous white area and then the center point of the maximum contiguous white area. In this manner, the driver's height can be readily derived and a heads up display is adjusted so information is within driver's field of view without blocking view. Also, the pattern recognition process can be applied to detect the eyes, mouth, or nose of the driver based on the differentiation between the white and black areas.

In contrast to the claimed invention, Ishikawa does not use a "trained" pattern recognition system in the sense that there is no training of the system using data relating to possible occupying items of the passenger compartment and storing this data in the form, e.g., of an algorithm, in association with the pattern of received illumination therefrom to enable the system to subsequently identify occupying items based on the received illumination therefrom. Rather, Ishikawa functions so that each time the analyzer operates it simply performs a rote pattern recognition computer program based on the image received of the contents of the passenger compartment at that instant and does not "apply a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items" as now set forth in claim 1.

In view of the absence of the disclosure of all of the features of independent claim 1 as amended in Ando, Mattes and Ishikawa, one could not combine these references and arrive at the claimed invention. Therefore, claim 1 should be allowable over the prior art of record.

Claims 2 and 5 includes all of the features of independent claim 1 and for the same reasons that claim 1 is allowable over the prior art of record, claims 2 and 5 should also be allowable.

With particular respect to claim 2, the pattern recognition means of Ishikawa and Ando are not structured and arranged to process the electronic signal "into a positional categorization

of said signal characteristic of the position of the occupant based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with occupants of the vehicle in different positions." It is thus pointed out that the position of the occupant is not determined so much as from the electronic signal directly, as in Mattes, but indirectly through the pattern recognition means trained to detect occupants in different positions (See page 32, lines 1-4 of the specification).

With respect to claim 5, the pattern recognition means of Ishikawa and Ando are not structured and arranged to process the electronic signal "into a head-positional categorization of said signal characteristic of the position of the occupant's head based on data corresponding to patterns of received electromagnetic illumination stored within said pattern recognition means and associated with the head of occupants of the vehicle in different positions" whereby the trained pattern recognition means comprises means to categorize the motion of the occupant's head over time.

Claim 3 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando, Ishikawa and Fujita. Claims 4 and 6 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando, Ishikawa and White. Claim 7 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando, Ishikawa and Taylor. Claim 8 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando, Ishikawa and Gorman. Claim 9 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ando, Ishikawa and Mazur.

Claims 3, 4 and 6-9 include all of the features of claim 1 and for the same reasons that claim 1 is allowable over the prior art of record, these claims should also be allowable. In any

event, none of these secondary references, viz., Fujita, White, Taylor, Gorman and Mazur, disclose categorization and identification means which comprise trained pattern recognition means which "apply a pattern recognition algorithm generated from data of possible occupying items of the vehicle and patterns of received electromagnetic illumination from the possible occupying items" as now set forth in claim 1 and therefore do not overcome the deficiencies of the combination of Ando, Mattes and Ishikawa.

2. **Rejection of Claims 10-15**

A description of the embodiments set forth in claims 10-15 is provided in the amendment dated January 2, 1997.

Independent claim 10 has now been amended to include subject matter previously set forth in claim 20. As such, claim 10 specifies that the categorization means comprise **trained** pattern recognition means for processing the electronic signal based on the received illumination from the exterior object to provide an identification of the exterior object based thereon and that the pattern recognition means are structured and arranged to "apply a pattern recognition algorithm generated from data of possible exterior objects and patterns of received electromagnetic illumination from the possible exterior objects." Further, the output means affect another system in the vehicle in response to the identification of the exterior object. The data of possible exterior objects and patterns of receiving illumination therefrom constitute a training set for the algorithm and which is created and stored within the pattern recognition means. This aspect is described in the specification, e.g., at page 35, lines 19-21.

None of the prior art references expressly teach or suggest this feature and do not even remotely allude to the possibility of creating an algorithm from data of possible exterior objects of the vehicle and patterns of received illumination therefrom.

Claims 10-13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki.

The Examiner's rejection is respectfully traversed in view of amended claim 10.

Masamori describes a system which is based on radar, specifically it is a collision avoidance system aimed at detecting vehicles which are at some distance from the vehicle.

Suzuki describes a vehicle tracking control for continuously detecting the distance and direction to a preceding vehicle irrespective of background dark/light distribution. In this system, every vehicle must have a light on its rear that emits a constant or time varying signal and the invention then uses two photoelectric sensors that zero in on the light emitted from the preceding vehicle and thereby determine both the distance and angular position of the preceding vehicle.

In contrast to the claimed invention, Masamori and Suzuki do not use a "trained" pattern recognition system in the sense that there is no training of the system using data relating to possible exterior objects relative to the vehicle and storing this data in the form, e.g., of an algorithm, in association with the pattern of received illumination therefrom to enable the system to subsequently identify the object based on the received illumination. As such, Masamori and Suzuki do not disclose structure which applies a pattern recognition algorithm generated from data of possible objects exterior of the vehicle and patterns of received electromagnetic illumination from the possible exterior objects as now set forth in claim 10.

In view of the absence of the disclosure of all of the features in independent claim 10 in Masamori and Suzuki, one could not combine these references and arrive at the claimed invention. Therefore, claim 10 should be allowable over the prior art of record.

Claims 11-13 includes all of the features of independent claim 10 and for the same reasons that claim 10 is allowable over the prior art of record, claims 11-13 should also be allowable.

Claim 14 was rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki and Warner. Claim 15 was rejected under 35 U.S.C. 103(a) as being unpatentable over Masamori in view of Suzuki and Morrison (note that it appears that claim 20 was also rejected on this ground although not explicitly stated).

Claims 14 and 15 include all of the features of claim 10 and for the same reasons that claim 10 is allowable over the prior art of record, these claims should also be allowable. In any event, Warner and Morrison do not disclose structure which applies a pattern recognition algorithm generated from data of possible objects exterior of the vehicle and patterns of received electromagnetic illumination from the possible exterior objects and therefore do not overcome the deficiencies of the combination of Masamori and Suzuki.

3. Rejection of Claims 16-18

A description of the embodiments set forth in claims 16-18 is provided in the amendment dated January 2, 1997.

Independent claim 16 has now been amended to recite that the categorization means comprise **trained** pattern recognition means for processing an electronic signal based on received radiation to provide an identification of the source of the radiation based thereon and that the pattern recognition means are structured and arranged to "apply a pattern recognition algorithm

generated from data of possible sources of radiation including lights of vehicles and patterns of received radiation from the possible sources." Further, the output means dim the headlights in the vehicle in response to the identification of the source of the radiation. This aspect is described in the specification, e.g., at page 36, line 18 to page 37, line 12 with reference to Fig. 8.

None of the prior art references expressly teach or suggest this feature and do not even remotely disclose the possibility of creating an algorithm from data of possible sources of radiation exterior of the vehicle and patterns of received radiation therefrom.

Claims 16 and 17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki.

The Examiner's rejection is respectfully traversed in view of amended claim 16.

Bechtel describes a system which uses colored mirrors to separate colors. Suzuki is described above.

In contrast to the claimed invention, Bechtel and Suzuki do not use a "trained" pattern recognition system in the sense that there is no training of the system using data relating to possible sources of radiation from the exterior of the vehicle and storing this data in the form, e.g., of an algorithm, in association with the pattern of received radiation therefrom to enable the system to subsequently identify the source of the radiation based on the received radiation. As such, Bechtel and Suzuki do not disclose structure which applies a pattern recognition algorithm generated from data of possible sources of radiation and patterns of received electromagnetic radiation therefrom as now set forth in claim 16.

In view of the absence of the disclosure of all of the features in independent claim 16 in Bechtel and Suzuki, one could not combine these references and arrive at the claimed invention. Therefore, claim 16 should be allowable over the prior art of record.

Claim 17 includes all of the features of independent claim 16 and for the same reasons that claim 16 is allowable over the prior art of record, claim 17 should also be allowable.

Claim 18 was rejected under 35 U.S.C. 103(a) as being unpatentable over Bechtel in view of Suzuki and Morrison.

Claim 18 includes all of the features of claim 16 and for the same reasons that claim 16 is allowable over the prior art of record, claim 18 should also be allowable. In any event, Morrison do not disclose structure which applies a pattern recognition algorithm generated from data of possible sources of radiation and patterns of received electromagnetic radiation therefrom and therefore does not overcome the deficiencies of the combination of Bechtel and Suzuki.

In view of the changes made to the claims and the arguments presented above, it is respectfully submitted that the Examiner's rejections have been overcome and that the present application is now in condition for allowance.

4. <u>New Claims 21-24</u>

Claims 21 and 22 are directed to an embodiment of the interior monitoring system wherein the processor means coupled to the receiver means process the received illumination therefrom and generate an electronic signal characteristic of the "form of said at least one occupying item in said passenger compartment based thereon". This aspect is disclosed in the specification by way of reference to using the pattern recognition techniques to determine whether the object in the passenger compartment is an occupant or a bag of groceries (page 30, lines 9-10).

Claim 23 is directed to a method for affecting a system in a vehicle based on an object exterior of the vehicle and is comparable to the subject matter of claim 10. As such, claim 23 should be considered in this application.

Claim 24 is directed to a method for monitoring an interior of a motor vehicle having an interior passenger compartment containing at least one occupying item comparable to the subject matter of claim 1. As such, claim 24 should be considered in this application.

Claims 25-27 are directed to the feature of the receiver means (claim 25) or reception means (claims 26 and 27) comprising a CCD array, which was removed from the independent claims.

An early and favorable action on the merits is earnestly solicited.

FOR THE APPLICANT

Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598

Enc.
Check for $175.00

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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CRUZ, Y.	
ART UNIT	**PAPER NUMBER**
2616	11

26M2/0929

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

DATE MAILED: 09/29/97

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

☐ This application has been examined ☒ Responsive to communication filed on 6/20/97 ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), — days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892.
2. ☐ Notice of Draftsman's Patent Drawing Review, PTO-948.
3. ☐ Notice of Art Cited by Applicant, PTO-1449.
4. ☐ Notice of Informal Patent Application, PTO-152.
5. ☐ Information on How to Effect Drawing Changes, PTO-1474.
6. ☐ _____.

Part II SUMMARY OF ACTION

1. ☒ Claims 1-18, 21-27 are pending in the application.

Of the above, claims _____ are withdrawn from consideration.

2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 1-18, 21-27 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice of Draftsman's Patent Drawing Review, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____. has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☐ Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☐ not been received ☐ been filed in parent application, serial no. _____ ; filed on _____.
13. ☐ Since this application apppears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

1. This office action is in response to the amendment filed June 20, 1997.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes in view of Ishikawa.

Mattes discloses an interior passenger compartment containing a passive restraint system and at least one occupying item having surfaces in a motor vehicle, (lines 6-10 and 18-20 of column 1 and item 35 in Fig.2 shows an occupying item having surfaces) . The monitoring system comprises: illumination means for illuminating a portion of the vehicle interior with electromagnetic radiation in which the occupying item is likely situated, (lines 13-42 of column 4, and Fig. 2); receiver means to receive the electromagnetic illumination reflected from the surfaces, (lines 13-42 of column 4); processor means to generate an electronic signal characteristic of the surfaces, (lines 13-16 of column 4, determining a position is within the meaning of determining characteristics); and output means to affect another system in the vehicle in response to the identification of the occupying item, (lines 17-26 of column 1).

Mattes does not explicitly show an identification means comprising trained pattern recognition means for applying a pattern recognition algorithm. Ishikawa discloses an image analyzer inside of a vehicle, (refer to the abstract). Ishikawa shows an identification means comprising a trained pattern recognition means for applying a pattern recognition algorithm, (refer to Fig. 9).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to include an identification means comprising trained pattern recognition means for applying a pattern recognition algorithm in the invention of Mattes because the identification means could help accurately determine where the person is in the vehicle. In addition, both the inventions of Mattes and Ishikawa deal with sensors inside vehicles.

4. The non-statutory double patenting rejection, whether of the obviousness-type or non-obviousness-type, is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent. *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969); *In re Vogel,* 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Van Ornum,* 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Longi,* 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); and *In re Goodman,* 29 USPQ2d 2010 (Fed. Cir. 1993).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(b) and © may be used to overcome an actual or provisional rejection based on a non-statutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.78(d).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-18 and 21-27 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4, 7-17, 21 and 22 of copending Application No. 08/474,782. Although the conflicting claims are not identical, they are not patentably distinct from each other because only difference between the claimed invention and the 08/474,782 is that 08/474,782 recites means for measuring the distance of at least one occupying item from the receiver means wherein the present invention recites means for measuring the distance from the exterior object to the vehicle. Both application claims means for

means for measuring, whether the actual measurement is from A to B or C to D is deemed to be a matter of design choice and they are deemed to be patentably distinctive.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yon J Couso whose telephone number is (703) 305-4779. The examiner can normally be reached on Monday-Thursday from 8:30am to 6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mike Razavi, can be reached on (703) 305-4713. The fax phone number for this Group is (703) 308-5397.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 305-3900.

YON COUSO
PRIMARY EXAMINER
GROUP 2600

yjc
September 24, 1997

GP 2714

Please type a plus sign (+) inside this box [+]

PTO/SB/21 (10-96)
Approved for use through 10/31/99. OMB 0651-0031
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

U. ... Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	08/474,786
Filing Date	June 7, 1995
First Named Inventor	D. BREED
Group Art Unit	2714
Examiner Name	Y. COUSO
Attorney Docket Number	AMI-95

Total Number of Pages in This Submission: 9

ENCLOSURES *(check all that apply)*

- [X] Fee Transmittal Form
- [ ] Fee Attached
- [X] Amendment / Response
- [ ] After Final
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
- [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Assignment Papers *(for an Application)*
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition Checklist and Accompanying Petition
- [ ] To Convert a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [X] Terminal Disclaimer
- [ ] After Allowance Communication to Group
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to Group *(Appeal Notice, Brief, Reply Brief)*
- [ ] Proprietary Information
- [ ] Status Letter
- [ ] Additional Enclosure(s) *(please identify below)*:

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	BRIAN ROFFE
Signature	Brian Roffe
Date	12/22/97

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 12/22/97

Typed or printed name	Brian Roffe		
Signature	Brian Roffe	Date	12/22/97

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be send to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

ATI-95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Ex.: Y. Couso	Art Unit 2616
In re Application of:	David S. Breed et al.
For:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM:
Filed:	June 7, 1995
Serial No.:	08/474,786

TERMINAL DISCLAIMER

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

The undersigned is an attorney of record for the above-referenced application.

The owner, Automotive Technologies International, Inc. of 100% percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173, as presently shortened by any terminal disclaimer, of any patent granted on U.S. patent application Serial No. 08./474,782, which application is also owned in its entirety by Automotive Technologies International, Inc.

The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on U.S. patent application Serial No. 08/474,782 are commonly owned.

This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 to 156 and 173 of any patent granted on U.S. patent application Serial No. 08/474,782, as presently shortened by any terminal disclaimer, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims cancelled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

The fee of $55.00 for submission of a Terminal Disclaimer, applicants having qualified for small entity status, should be charged to Deposit Account No. 50=-0266. A duplicate copy of these sheets is enclosed.

By: Brian Roffe

Signature

12/20/97
Date

PTO/SB/17 (10-96)
Appr ...or use through 9/30/98. OMB 0651-0032
Patent and Trademark ...ice: U.S. DEPARTMENT OF COMMERCE
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FEE TRANSMITTAL

TOTAL AMOUNT OF PAYMENT ($) 55.00

Complete if Known	
Application Number	08/474,786
Filing Date	June 7, 1995
First Named Inventor	D. BLEED
Group Art Unit	274
Examiner Name	Y. COUSO
Attorney Docket Number	ATT-45

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 50-0266
Deposit Account Name: Automotive Technologies Int'l

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 ☐ Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance, 37 CFR 1.311(b)

2. ☐ Payment Enclosed: ☐ Check ☐ Money Order ☐ Other

FEE CALCULATION (fees effective 10/01/96)

1. FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	770	201	385	Utility filing fee	
106	320	206	160	Design filing fee	
107	530	207	265	Plant filing fee	
108	770	208	385	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($)

2. CLAIMS

		Extra		Fee from below		Fee Paid
Total Claims	-20 =		X		=	
Independent Claims	- 3 =		X		=	
Multiple Dependent Claims			X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	22	203	11	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim
109	80	209	40	Reissue independent claims over original patent
110	22	210	11	Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,460	147	2,460	For filing a request for reexamination	
112	900*	112	900*	Requesting publication of SIR prior to Examiner action	
113	1,790*	113	1,790*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	390	216	195	Extension for response within second month	
117	930	217	465	Extension for response within third month	
118	1,470	218	735	Extension for response within fourth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,470	138	1,470	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,290	241	645	Petition to revive unintentionally abandoned application	
142	1,290	242	645	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	650	244	325	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	230	126	230	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	770	246	385	Filing a submission after final rejection (37 CFR 1.129(a))	
149	770	249	385	For each additional invention to be examined (37 CFR 1.129(b))	
Other fee (specify) Terminal Disclaimer (Small Entity)					55.00
Other fee (specify)					

SUBTOTAL (3) ($) 55.00

* Reduced by Basic Filing Fee Paid

SUBMITTED BY				Complete (if applicable)	
Typed or Printed Name	BRIAN ROFFE			Reg. Number	35,336
Signature	Brian Roffe	Date	12/22/97	Deposit Account User ID	50-0266

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

#13/C
TOM
2-24-98

ATI-95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Ex.: Y. Couso	Art Unit 2616
In re Application of:	David S. Breed et al.
For:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM:
Filed:	June 7, 1995
Serial No.:	08/474,786

AMENDMENT

Assistant Commissioner of Patents
Washington, D.C. 20231

December 22, 1997

In response to the Office Action dated September 29, 1997, please amend the above-identified application as follows.

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Assistant Commissioner of Patents, Washington, D.C. 20231" on DECEMBER 22, 1997.
Brian Roffe, Esq.

IN THE CLAIMS:

Please amend claim 21 as follows.

21. (Amended) In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of the form of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item based on the form of said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for applying a pattern recognition algorithm; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item based on the form of said at least one occupying item.

REMARKS

Reconsideration of the present application, as amended, is respectfully requested.

Initially, reference is made to a telephone conference with Examiner Couso on December 18, 1997 in which the Examiner advised the undersigned to submit a formal amendment and that thereafter, the Examiner would contact the undersigned to discuss the case. Accordingly, upon the Examiner's review of this amendment, the Examiner is respectfully requested to contact the undersigned to discuss the same.

Claims 1-18 and 21-27 are presently active in this application, claims 19 and 20 having been canceled.

Claims 1-18 and 21-27 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4, 7-17, 21 and 22 of co-pending U.S. patent application Serial No. 08/474,782.

Although applicants do not agree with the grounds for the obviousness-type double patenting rejection, submitted herewith is a Terminal Disclaimer disclaiming the terminal part of any patent granted on this application which would extend beyond the term of any patent granted on co-pending U.S. patent application Serial No. 08/474,782, along with the appropriate fee for submission of a Terminal Disclaimer. In view of the submission of the Terminal Disclaimer, and the absence of any prior art rejection of claims 1-18 and 22-27, these claims should now be allowable. Confirmation of the allowability of claims 1-18 and 22-27 is respectfully requested.

Claim 21 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes et al. in view of Ishikawa et al.

Claim 21 is directed to an embodiment of an interior monitoring system for one or more occupying items in accordance with the invention which includes processor means coupled to receiver means for processing received illumination therefrom and generating an electronic signal characteristic of the "*form of said at least one occupying item* in said passenger compartment based thereon" (emphasis added). This aspect is disclosed in the specification with reference to using the pattern recognition techniques to determine whether the occupying item in the passenger compartment is an occupant or a bag of groceries (page 30, lines 9-10). The interior monitoring system also includes categorization and identification means coupled to the processor means for "categorizing said electronic signal to thereby identify said at least one occupying item *based on the form of said at least one occupying item*" (emphasis added). The electronic signal will depend on the exact form of the occupying item, and since, e.g., a bag of groceries will undoubtedly have a different form than an occupant, a different electronic signal will be generated for the occupant than for the bag of groceries. This difference in the electronic signal enables the categorization and identification means to identify the occupying item based on the form thereof.

It is essential to appreciate the fact that the applicants' invention entails utilizing processor means for processing electromagnetic radiation received by receiver means into an electronic signal characteristic of the form of an occupying item in order to enable another system in the vehicle to be affected by the identification of the occupying item based on its particular form. In other words, the system in the vehicle will be directed to operate differently depending on the form of the occupying item which is reflected in different patterns of illumination received by the receiver means, i.e., the illumination received by the receiver means will be different for occupying items having different forms. For example, if the occupying item is an adult occupant, the system

in the vehicle may be an airbag which will be enabled to deploy in the event of a crash, whereas if the occupying item is a rear-facing child seat, the airbag will be prevented from deploying in the event of a crash. Thus, in this claimed embodiment, the form of the occupying item is integrated into the interior monitoring system by means of the processor means which process the received electromagnetic radiation into the electronic signal characteristic of the form of the occupying item. The "form" of the occupying item is defined in its usual dictionary definition as the "shape or outline of anything".

None of the prior art references cited by the Examiner teach or suggest the claimed invention.

The Examiner stated that Mattes et al. discloses an interior passenger monitoring system including "processor means to generate an electronic signal characteristic of the surfaces, (lines 13-16 of column 4, determining a position is within the meaning of determining characteristics)".

Mattes et al. describes an apparatus for determining the presence, position and/or velocity of an occupant of a motor vehicle and actuating a safety device to protect the occupant based on the measured acceleration of the vehicle and the determined position and/or velocity of the occupant. To this end, the apparatus of Mattes et al. includes sensors S2, 32, 33 which, e.g., transmit and receive ultrasonic waves, and based on the received ultrasonic waves, is able to determine the position and/or velocity of the occupant ("The position sensor S2 serves to determine the position of the motor vehicle occupant 35 and/or to determine the velocity of the motor vehicle occupant 35 relative to the passenger cabin of the vehicle..." (col. 3, lines 52-55); "With these types of sensors, the presence, the position, and/or the velocity of motion of the motor vehicle occupant 35 relative to the passenger cabin can be quickly determined." (col. 4,

lines 38-41)). Thus, based on the received ultrasonic waves, Mattes et al. at most only determines the position and velocity of the occupant.

In contrast to the claimed invention, Mattes et al. does not utilize the form of an occupying item of the passenger compartment of the vehicle as reflected in the waves received by the sensors S2, which may or may not be a human occupant, in any manner whatsoever. Rather, only the position and velocity of the occupant are determined from the waves received by the sensor S2 and utilized in the system described therein. Accordingly, Mattes et al. does not include processor means for processing the received illumination and generating an electronic signal characteristic of the form of the occupying item, and categorization and identification means for categorizing the electronic signal to thereby identify the occupying item based on the form thereof, as set forth in claim 21.

Ishikawa et al also does not base the system described therein on the form of the occupying item of the passenger compartment.

In view of the absence of the all of the features of independent claim 21, as amended, in Mattes et al. and Ishikawa et al., one could not combine these references and arrive at the claimed invention. Therefore, claim 21 should be allowable over the prior art of record.

Lastly, it is pointed out that although a CCD array is included as an element in some of the claims in this application, other devices which perform substantially the same function may also be used in accordance with the invention without deviating from the scope and spirit thereof. For example, a recently developed CMOS device performs nearly the same as a CCD and for the purposes of this patent application, it is equivalent thereto.

An early and favorable action on the merits is earnestly solicited.

FOR THE APPLICANTS
Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598
(516) 569-3664/(516) 569-2788

DRAFT

BRIAN ROFFE, ESQ.
376 YALE AVENUE
WOODMERE, NEW YORK 11598-2051

Fax Cover Sheet

DATE:	December 13, 1997	**TIME:**	
TO:	Examiner Y. Couso	**PHONE:**	(703) 305-4779
	USPTO	**FAX:**	(703) 308-5397
FROM:	Brian Roffe	**PHONE:**	(516) 569-3664
		FAX:	(516) 569-2788

RE: U.S. Patent Application

Serial No. 08/474,786

David S. Breed et al.

OPTICAL IDENTIFICATION AND MONITORING SYSTEM

CC:

Number of pages including cover sheet: [7]

Message

DO NOT ENTER-DO NOT ENTER-PROPOSED AMENDMENT

AS PER MY MESSAGE, ATTACHED HERETO IS A PROPOSED AMENDMENT FOR THE ABOVE-REFERENCED APPLICATION. I WILL CALL ON MONDAY, DECEMBER 15, 1997 TO ARRANGE A SUITABLE TIME TO DISCUSS THIS CASE.

BRIAN ROFFE.

DO NOT ENTER-DO NOT ENTER-PROPOSED AMENDMENT

Brian Roffe

DRAFT

ATI-95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Ex.: Y. Couso	Art Unit 2616
In re Application of:	David S. Breed et al.
For:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM:
Filed:	June 7, 1995
Serial No.:	08/474,786

AMENDMENT

Assistant Commissioner of Patents
Washington, D.C. 20231

December , 1997

In response to the Office Action dated September 29, 1997, please amend the above-identified application as follows.

IN THE CLAIMS:

Please amend claim 21 as follows.

21. (Amended) In a motor vehicle having an interior passenger compartment containing at least one occupying item, an interior monitoring system comprising:

a) illumination means for illuminating a portion of said vehicle interior passenger compartment with electromagnetic radiation in which said at least one occupying item is likely situated;

b) receiver means for receiving electromagnetic illumination reflected from said at least one occupying item in said vehicle interior passenger compartment;

c) processor means coupled to said receiver means for processing said received illumination and generating an electronic signal characteristic of the form of said at least one occupying item in said passenger compartment based thereon;

d) categorization and identification means coupled to said processor means for categorizing said electronic signal to thereby identify said at least one occupying item based on the form of said at least one occupying item, said categorization and identification means comprising trained pattern recognition means for applying a pattern recognition algorithm; and

e) output means coupled to said categorization and identification means for affecting another system in said vehicle in response to the identification of said at least one occupying item based on the form of said at least one occupying item.

REMARKS

Reconsideration of the present application, as amended, is respectfully requested.

Claims 1-18 and 21-27 are presently active in this application, claims 19 and 20 having been canceled.

Claims 1-18 and 21-27 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4, 7-17, 21 and 22 of co-pending U.S. patent application Serial No. 08/474,782.

Although applicants do not agree with the grounds for the obviousness-type double patenting rejection, submitted herewith is a Terminal Disclaimer disclaiming the terminal part of any patent granted on this application which would extend beyond the term of any patent granted on co-pending U.S. patent application Serial No. 08/474,782, along with the appropriate fee for submission of a Terminal Disclaimer. In view of the submission of the Terminal Disclaimer, and the absence of any prior art rejection of claims 1-18 and 22-27, these claims should now be allowable. Confirmation of the allowability of claims 1-18 and 22-27 is respectfully requested.

Claim 21 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mattes et al. in view of Ishikawa et al.

Claim 21 is directed to an embodiment of an interior monitoring system for one or more occupying items in accordance with the invention which includes processor means coupled to receiver means for processing received illumination therefrom and generating an electronic signal characteristic of the "*form of said at least one occupying item* in said passenger compartment based thereon" (emphasis added). This aspect is disclosed in the specification with reference to using the pattern recognition techniques to determine whether the occupying item in the passenger

compartment is an occupant or a bag of groceries (page 30, lines 9-10). The interior monitoring system also includes categorization and identification means coupled to the processor means for "categorizing said electronic signal to thereby identify said at least one occupying item *based on the form of said at least one occupying item*" (emphasis added). The electronic signal will depend on the exact form of the occupying item, and since, e.g., a bag of groceries will undoubtedly have a different form than an occupant, a different electronic signal will be generated for the occupant than for the bag of groceries. This difference in the electronic signal enables the categorization and identification means to identify the occupying item based on the form thereof.

It is essential to appreciate the fact that the applicants' invention entails utilizing processor means for processing electromagnetic radiation received by receiver means into an electronic signal characteristic of the form of an occupying item in order to enable another system in the vehicle to be affected by the identification of the occupying item based on its particular form. In other words, the system in the vehicle will be directed to operate differently depending on the form of the occupying item which is reflected in different patterns of illumination received by the receiver means, i.e., the illumination received by the receiver means will be different for occupying items having different forms. For example, if the occupying item is an adult occupant, the system in the vehicle may be an airbag which will be enabled to deploy in the event of a crash, whereas if the occupying item is a rear-facing child seat, the airbag will be prevented from deploying in the event of a crash. Thus, in this claimed embodiment, the form of the occupying item is integrated into the interior monitoring system by means of the processor means which process the received electromagnetic radiation into the electronic signal characteristic of the form of the occupying

item. The "form" of the occupying item is defined in its usual dictionary definition as the "shape or outline of anything".

None of the prior art references cited by the Examiner teach or suggest the claimed invention.

The Examiner stated that Mattes et al. discloses an interior passenger monitoring system including "processor means to generate an electronic signal characteristic of the surfaces, (lines 13-16 of column 4, determining a position is within the meaning of determining characteristics)".

Mattes et al. describes an apparatus for determining the presence, position and/or velocity of an occupant of a motor vehicle and actuating a safety device to protect the occupant based on the measured acceleration of the vehicle and the determined position and/or velocity of the occupant. To this end, the apparatus of Mattes et al. includes sensors S2, 32, 33 which, e.g., transmit and receive ultrasonic waves, and based on the received ultrasonic waves, is able to determine the position and/or velocity of the occupant ("The position sensor S2 serves to determine the position of the motor vehicle occupant 35 and/or to determine the velocity of the motor vehicle occupant 35 relative to the passenger cabin of the vehicle..." (col. 3, lines 52-55); "With these types of sensors, the presence, the position, and/or the velocity of motion of the motor vehicle occupant 35 relative to the passenger cabin can be quickly determined." (col. 4, lines 38-41)). Thus, based on the received ultrasonic waves, Mattes et al. at most only determines the position and velocity of the occupant.

In contrast to the claimed invention, Mattes et al. does not utilize the form of an occupying item of the passenger compartment of the vehicle as reflected in the waves received by the sensors S2, which may or may not be a human occupant, in any manner whatsoever. Rather,

only the position and velocity of the occupant are determined from the waves received by the sensor S2 and utilized in the system described therein. Accordingly, Mattes et al. does not include processor means for processing the received illumination and generating an electronic signal characteristic of the form of the occupying item, and categorization and identification means for categorizing the electronic signal to thereby identify the occupying item based on the form thereof, as set forth in claim 21.

Ishikawa et al also does not base the system described therein on the form of the occupying item of the passenger compartment.

In view of the absence of the all of the features of independent claim 21, as amended, in Mattes et al. and Ishikawa et al., one could not combine these references and arrive at the claimed invention. Therefore, claim 21 should be allowable over the prior art of record.

Lastly, it is pointed out that although a CCD array is included as an element in some of the claims in this application, other devices which perform substantially the same function may also be used in accordance with the invention without deviating from the scope and spirit thereof. For example, a recently developed CMOS device performs nearly the same as a CCD and for the purposes of this patent application, it is equivalent thereto.

An early and favorable action on the merits is earnestly solicited.

FOR THE APPLICANTS
Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598
(516) 569-3664/(516) 569-2788

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO
08/474,786	06/07/95	BREED D	ATI-95

LM32/0227

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

EXAMINER	
COUSO, Y	
ART UNIT	PAPER NUMBER
2723	14

DATE MAILED: 02/27/98

NOTICE OF ALLOWABILITY

PART I.

1. [X] This communication is responsive to 12-24-97.
2. [X] All the claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice Of Allowance And Issue Fee Due or other appropriate communication will be sent in due course.
3. [X] The allowed claims are 1-18, 21-27.
4. [ ] The drawings filed on _____ are acceptable.
5. [ ] Acknowledgment is made of the claim for priority under 35 U.S.C. 119. The certified copy has [_] been received. [_] not been received. [ ] been filed in parent application Serial No. _____, filed on _____.
6. [ ] Note the attached Examiner's Amendment.
7. [ ] Note the attached Examiner Interview Summary Record, PTOL-413.
8. [ ] Note the attached Examiner's Statement of Reasons for Allowance.
9. [ ] Note the attached NOTICE OF REFERENCES CITED, PTO-892.
10. [ ] Note the attached INFORMATION DISCLOSURE CITATION, PTO-1449.

PART II.

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" indicated on this form. Failure to timely comply will result in the ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

1. [ ] Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.
2. [X] APPLICANT MUST MAKE THE DRAWING CHANGES INDICATED BELOW IN THE MANNER SET FORTH ON THE REVERSE SIDE OF THIS PAPER.
   a. [X] Drawing informalities are indicated on the NOTICE RE PATENT DRAWINGS, PTO-948, attached hereto or to Paper No. 6. CORRECTION IS REQUIRED.
   b. [ ] The proposed drawing correction filed on _____ has been approved by the examiner. CORRECTION IS REQUIRED.
   c. [ ] Approved drawing corrections are described by the examiner in the attached EXAMINER'S AMENDMENT. CORRECTION IS REQUIRED.
   d. [X] Formal drawings are now REQUIRED.

Any response to this letter should include in the upper right hand corner, the following information from the NOTICE OF ALLOWANCE AND ISSUE FEE DUE: ISSUE BATCH NUMBER, DATE OF THE NOTICE OF ALLOWANCE, AND SERIAL NUMBER.

Attachments:

- _ Examiner's Amendment
- _ Examiner Interview Summary Record, PTOL-413
- _ Reasons for Allowance
- _ Notice of References Cited, PTO-892
- _ Information Disclosure Citation, PTO-1449
- _ Notice of Informal Application, PTO-152
- _ Notice re Patent Drawings, PTO-948
- _ Listing of Bonded Draftsmen
- _ Other

YON J. COUSO
PRIMARY EXAMINER

PTOL-37 (REV. 4-89) ★

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

LM33/0227

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
08/474,786	06/07/95	026	COLSON, Y	2223 02/27/98

First Named Applicant	BREED,	DAVID S.

TITLE OF INVENTION: OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
[illegible]	382/100	007	UTILITY	YES	$620.00	05/27/98

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.
If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

A. Pay FEE DUE shown above, or

B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B-Issue Fee Transmittal should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B Issue Fee Transmittal should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "4b" of Part B-Issue Fee Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give application number and batch number.
Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PATENT AND TRADEMARK OFFICE COPY

PTOL-85 (REV. 10-96) Approved for use through 06/30/99. (0651-0033)
☆U.S.GOVERNMENT PRINTING OFFICE 1997-433-221/62716

HW

PART B—ISSUE FEE TRANSMITTAL

Complete and mail this form, together with ap ible fees, to: **Box ISSUE FEE**
Assistant Commissioner for Patents
Washington, D.C. 20231

MAILING INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE. Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1):

PTO/SB/33/0227

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

MAY 21 1998

Note: The certificate of mailing below can only be used for domestic mailings of the Issue Fee Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing.

Certificate of Mailing

I hereby certify that this Issue Fee Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above on the date indicated below.

Brian Roffe (Depositor's name)

Brian Roffe (Signature)

May 19, 1998 (Date)

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT		DATE MAILED
08/474,786	06/07/95	025	COUSO, Y	2723	02/27/98

First Named Applicant: BREED, DAVID S.

TITLE OF INVENTION: OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
2 ATI-95	382-100.000	B01	UTILITY	YES	$660.00	05/27/98

1. Change of correspondence address or indication of " Fee Address" (37 CFR 1.363). Use of PTO form(s) and Customer Number are recommended, but not required.

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47) attached.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropiate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a subsititue for filing an assignment.

(A) NAME OF ASSIGNEE: Automotive Technologies International, Inc.

(B) RESIDENCE: (CITY & STATE OR COUNTRY): Denville, New Jersey

Please check the appropriate assignee category indicated below (will not be printed on the patent)

☐ individual ☒ corporation or other private group entity ☐ government

4a. The following fees are enclosed (make check payable to Commissioner of Patents and Trademarks):

☐ Issue Fee

☐ Advance Order - # of Copies _____

4b. The following fees or deficiency in these fees should be charged to:

DEPOSIT ACCOUNT NUMBER 50-0266

(ENCLOSE AN EXTRA COPY OF THIS FORM)

☒ Issue Fee

☒ Advance Order - # of Copies 1

The COMMISSIONER OF PATENTS AND TRADEMARKS IS requested to apply the Issue Fee to the application identified above.

(Authorized Signature) Brian Roffe (Date) 5/19/98

NOTE; The Issue Fee will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending on the needs of the individual case. Any comments on the amount of time required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND FEES AND THIS FORM TO: Box Issue Fee, Assistant Commissioner for Patents, Washington D.C. 20231

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

05/26/1998 LBERGER 00000200 500266 08474786

01 FC:242 660.00 CH
02 FC:561 3.00 CH

TRANSMIT THIS FORM WITH FEE

NOTICE OF ALLOWANCE
DATED FEBRUARY 27, 1998
BATCH NO. B01
ATI-95

UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Y. Couso Art Unit: 2723

#15 6m 7-7-98

Re: Application of: David S. BREED et al.

Serial No: 08/474,786

Filed: June 7, 1995

Title: OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

SUBMISSION OF FORMAL DRAWINGS

Assistant Commissioner for Patents
Washington, D.C. 20231

April 22, 1998

Sir:

Submitted herewith are twelve (12) pages of formal drawings for the above-referenced application.

If this submission is untimely, then this should be considered a petition for extension under 37 CFR 1.116(a) and the requisite petition fee should be charged to Deposit Account No. 50-0266.

Respectfully submitted,

Brian Roffe
Reg. No. 35,336

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Assistant Commissioner for Patents, Washington, D.C. 20231" on April 22, 1998.
Brian Roffe, Esq.

By: _____

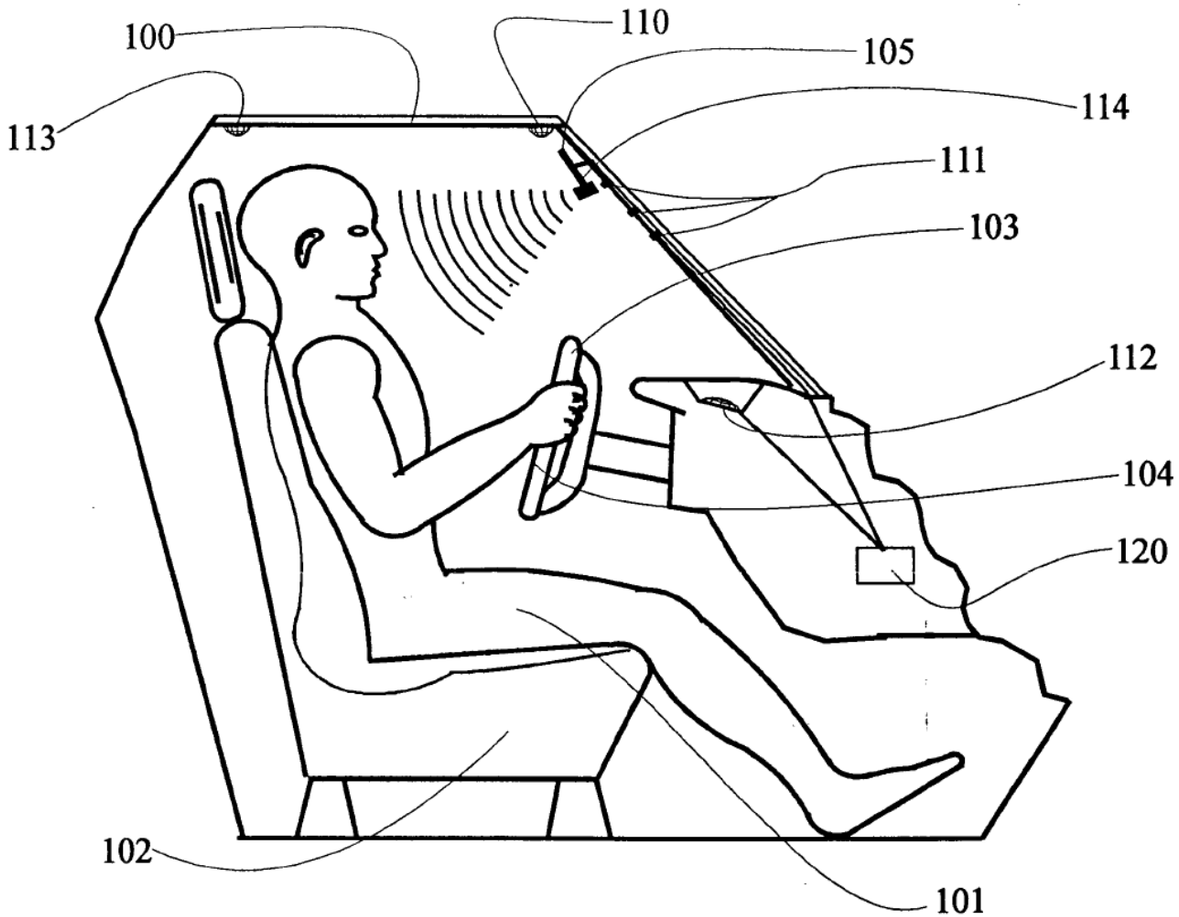

FIG. 1A

5845000

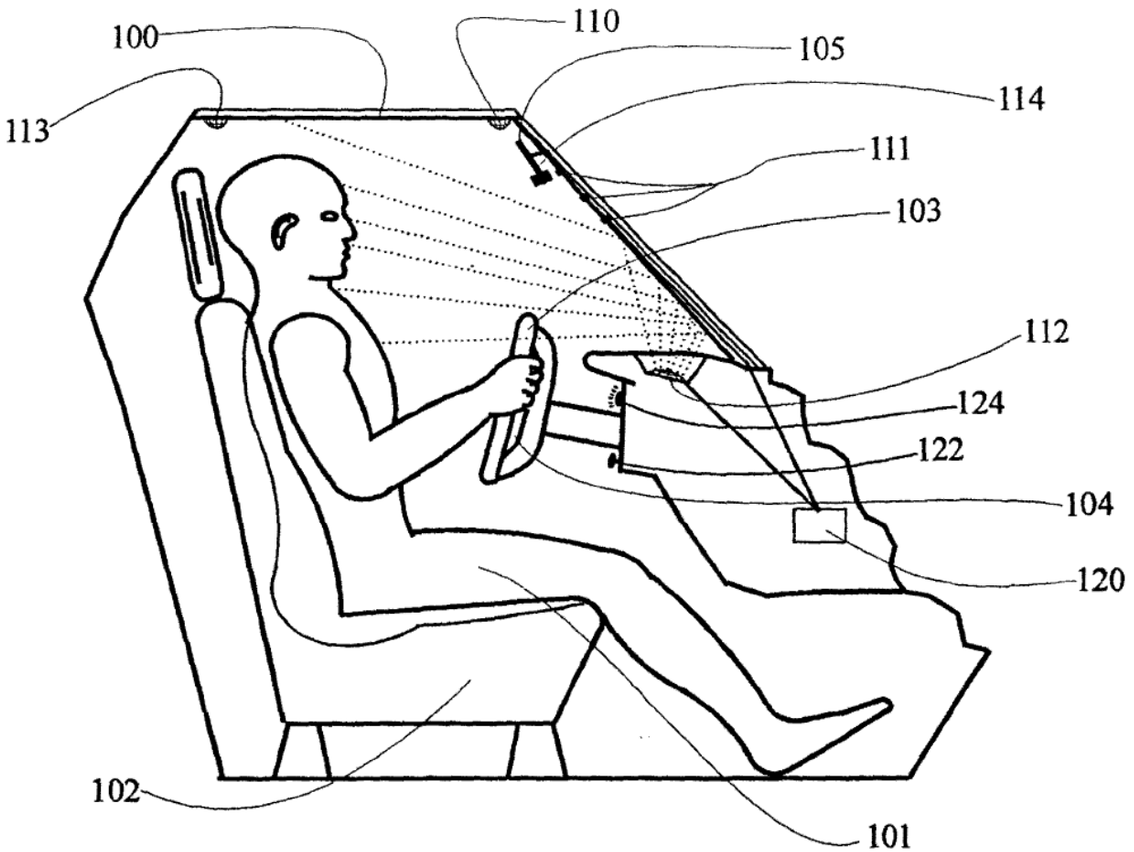

FIG. 1B

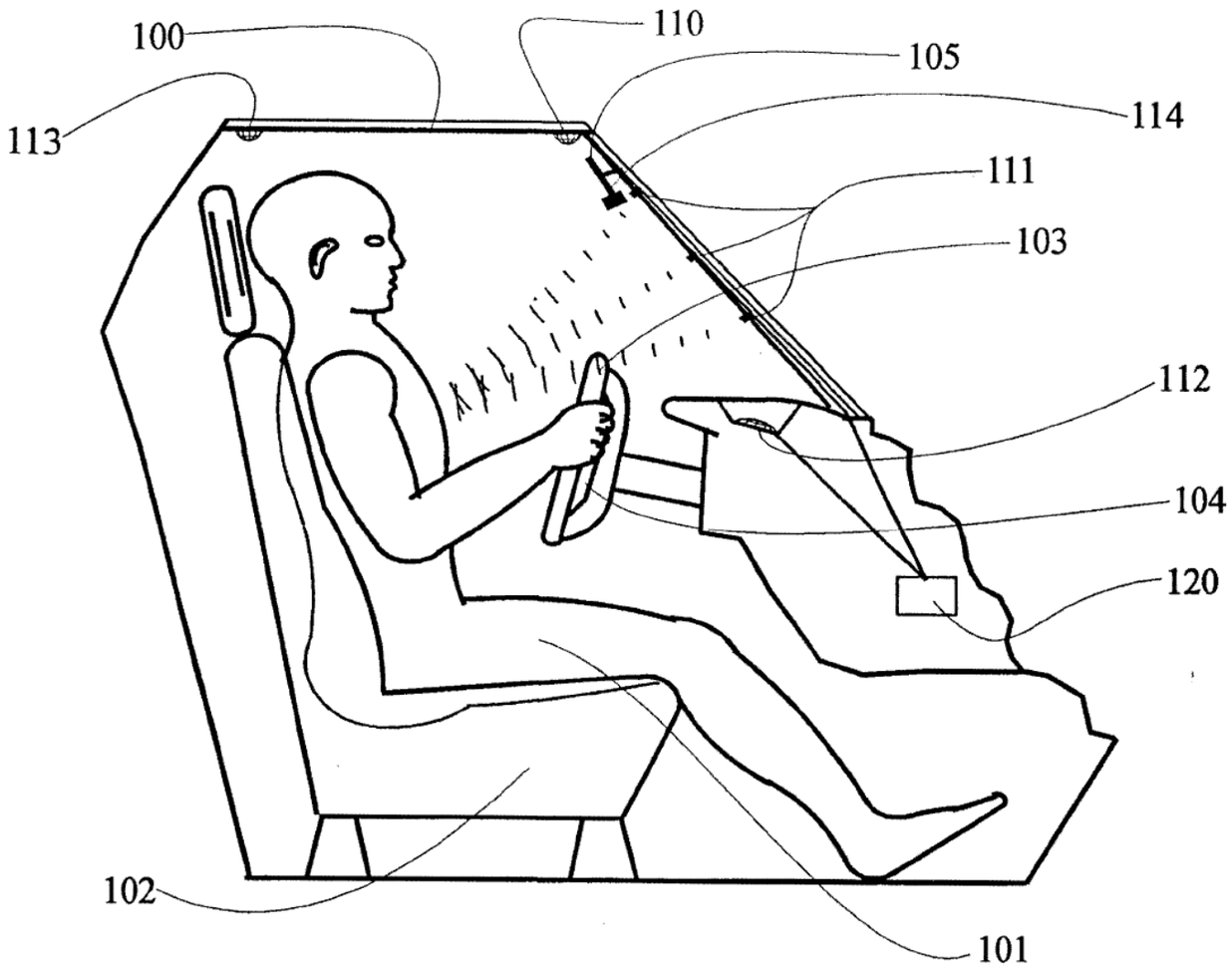

FIG. 1C

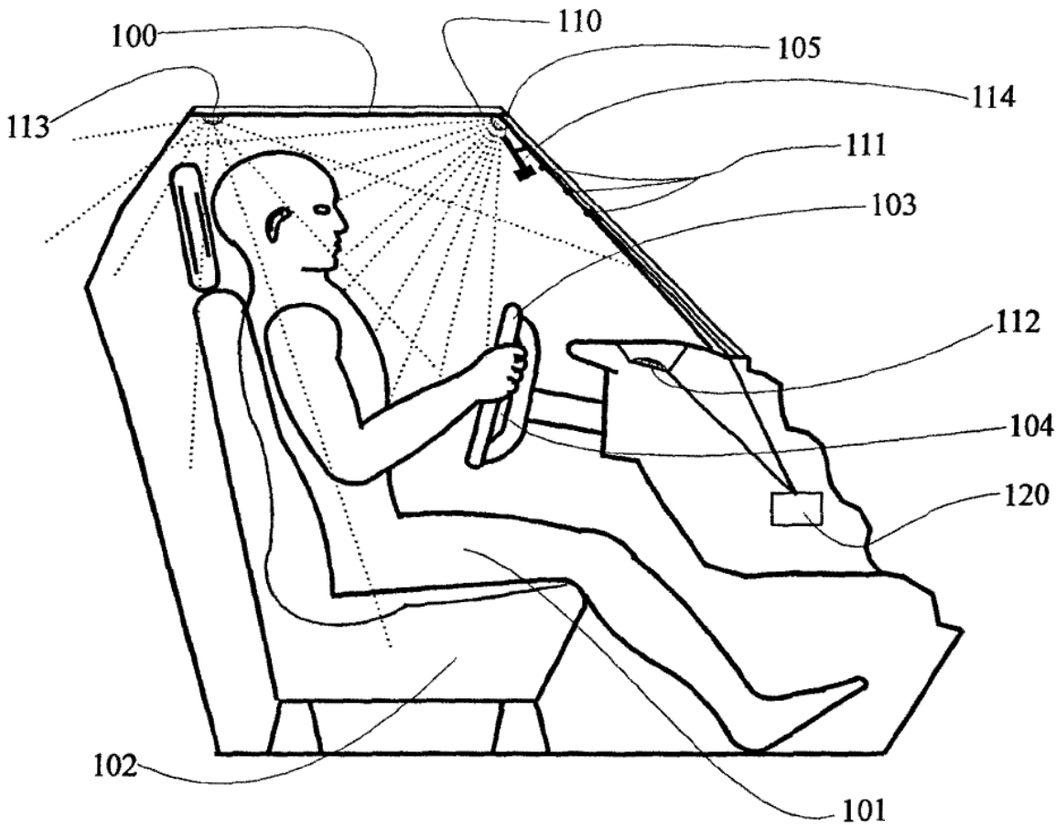

FIG. 1D

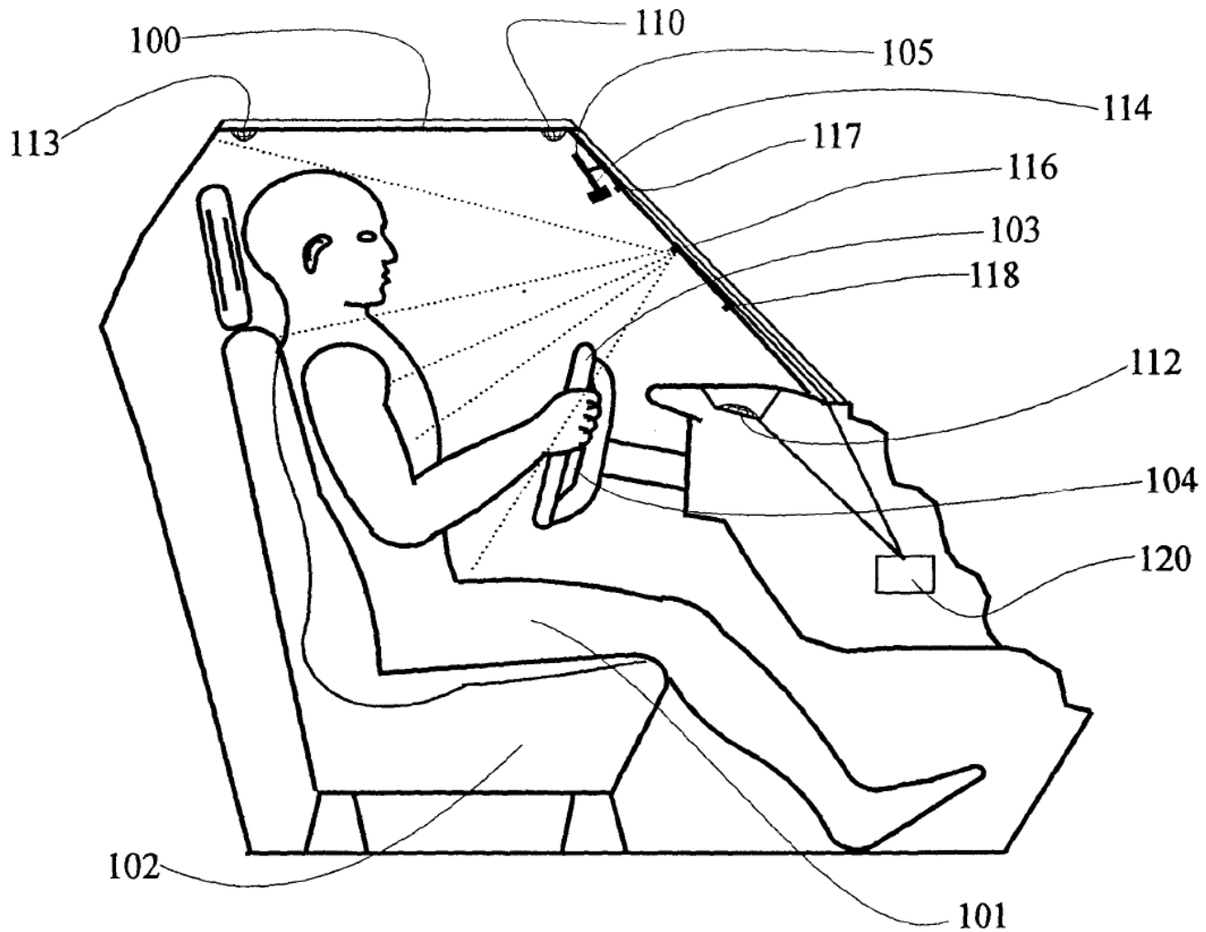

FIG. 1E

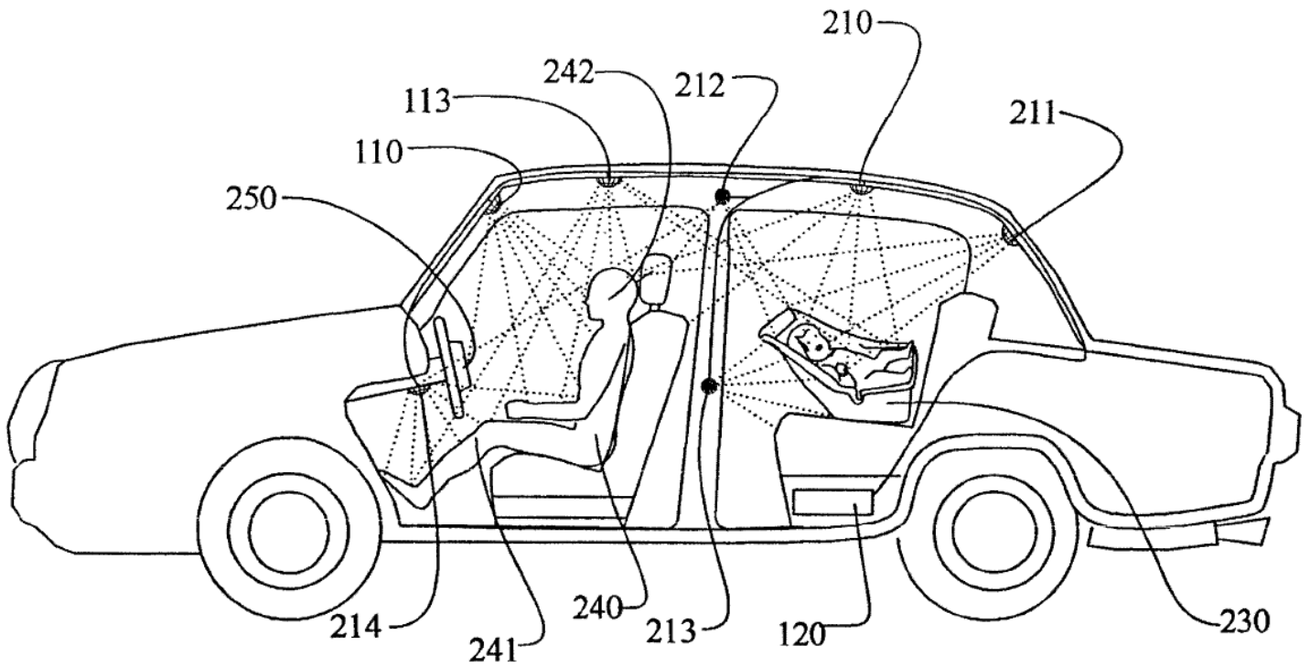

FIG. 2

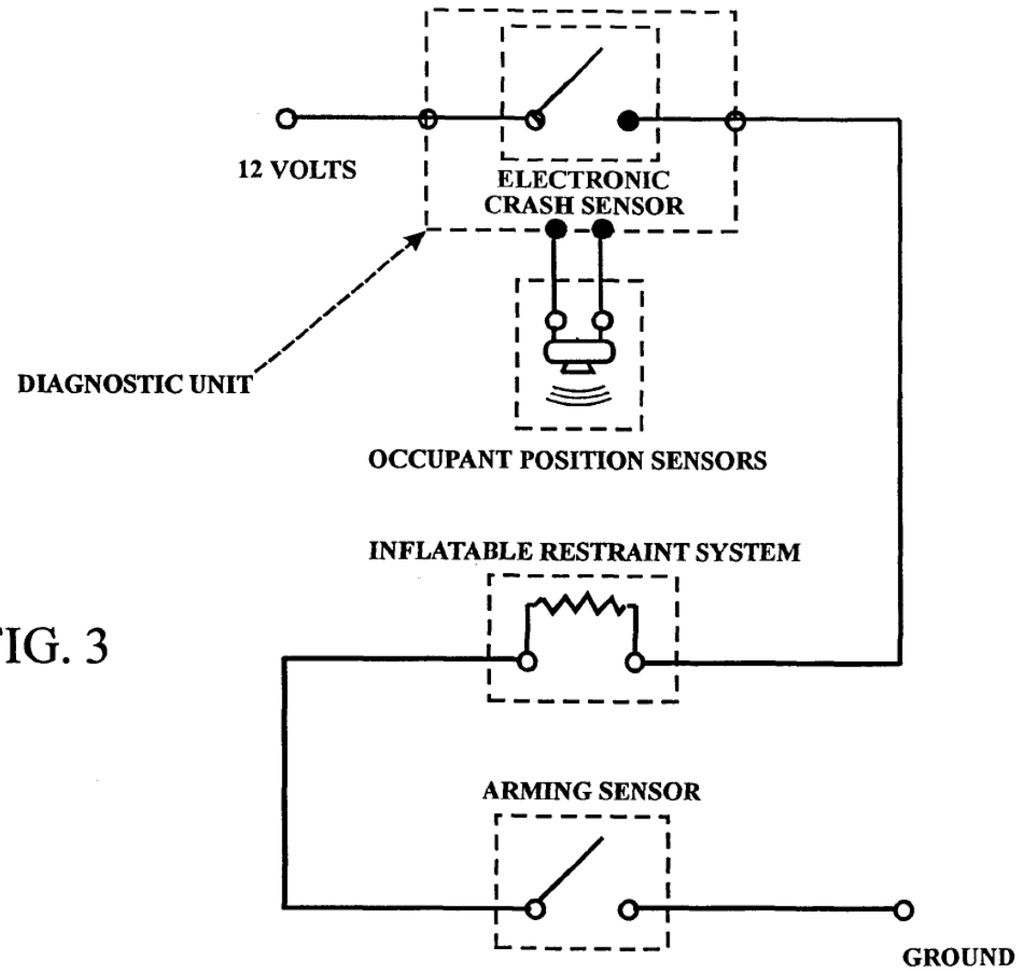
12 VOLTS
ELECTRONIC
CRASH SENSOR
DIAGNOSTIC UNIT
OCCUPANT POSITION SENSORS
INFLATABLE RESTRAINT SYSTEM
ARMING SENSOR
GROUND

FIG. 3

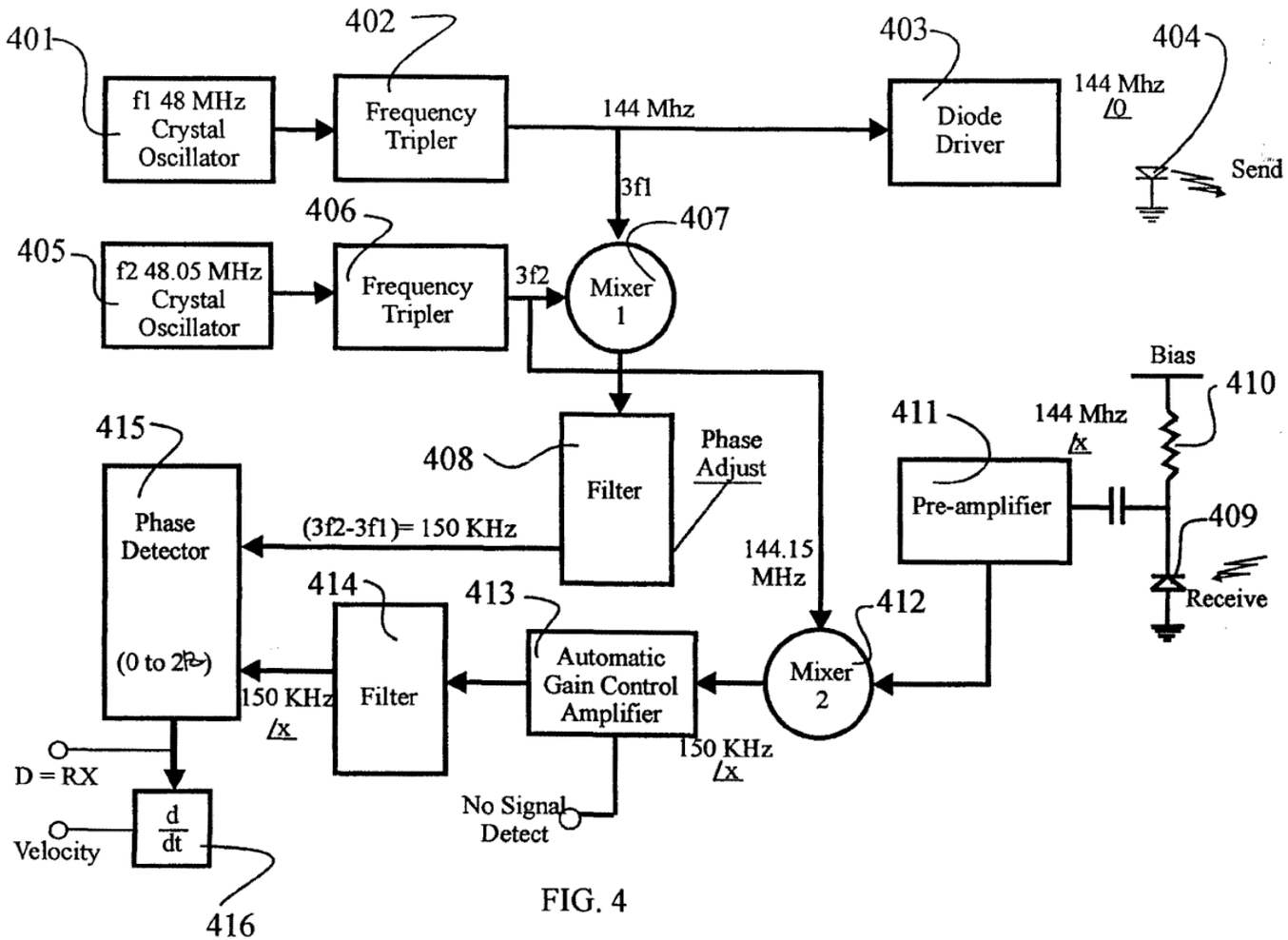
401
f1 48 MHz Crystal Oscillator
402
Frequency Tripler
144 Mhz
403
Diode Driver
404
144 Mhz
/0
Send
3f1
406
405
f2 48.05 MHz Crystal Oscillator
Frequency Tripler
3f2
Mixer 1
407
Bias
410
411
144 Mhz
/x
Pre-amplifier
409
Receive
415
408
Filter
Phase Adjust
Phase Detector
(3f2-3f1)= 150 KHz
144.15 MHz
414
413
412
(0 to 2π)
150 KHz
/x
Filter
Automatic Gain Control Amplifier
Mixer 2
150 KHz
/x
D = RX
No Signal Detect
Velocity
d/dt
416

FIG. 4

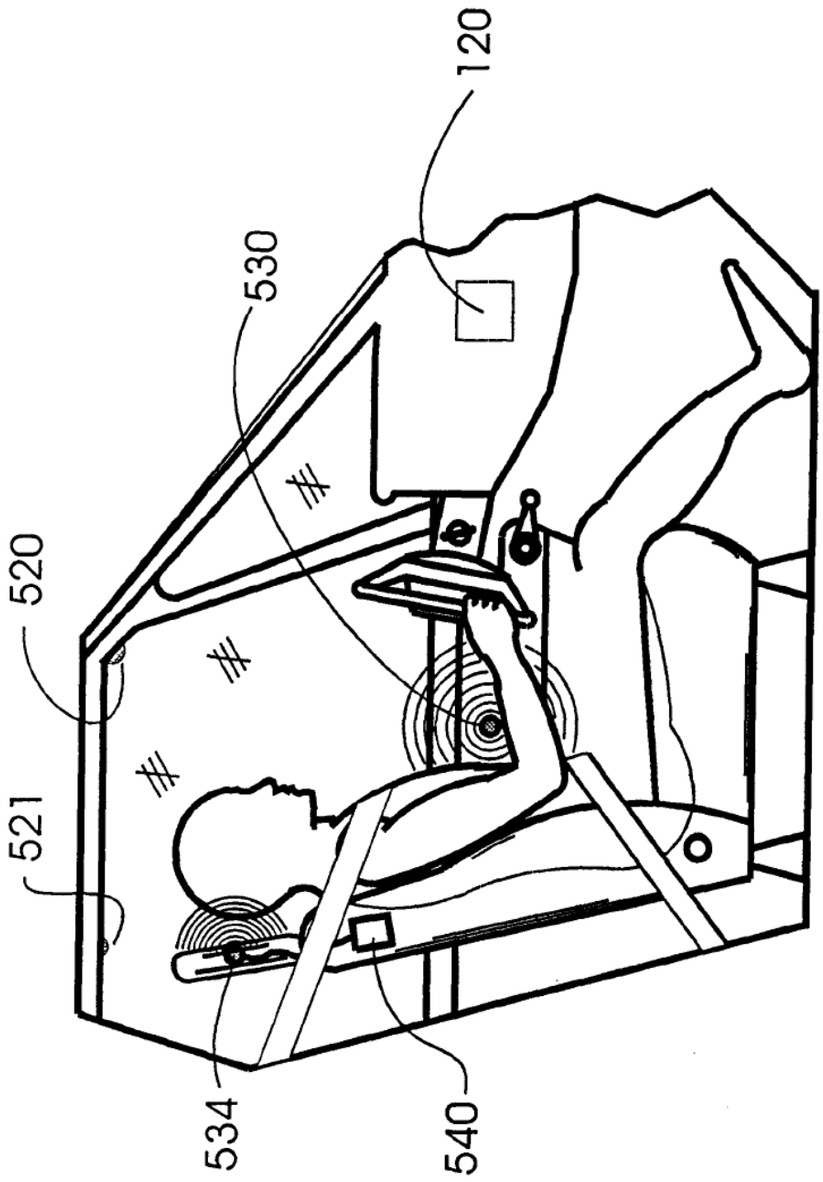

FIG. 5

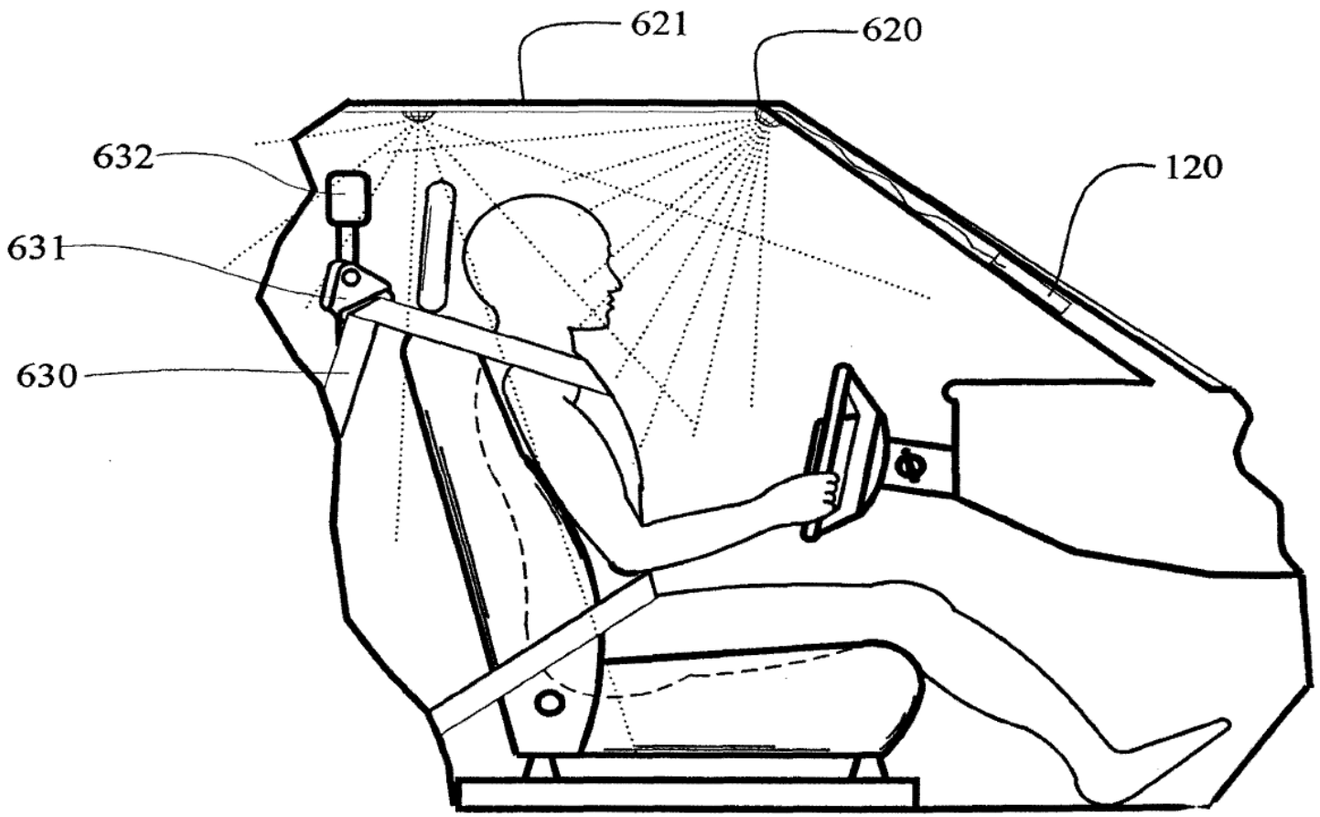

FIG. 6

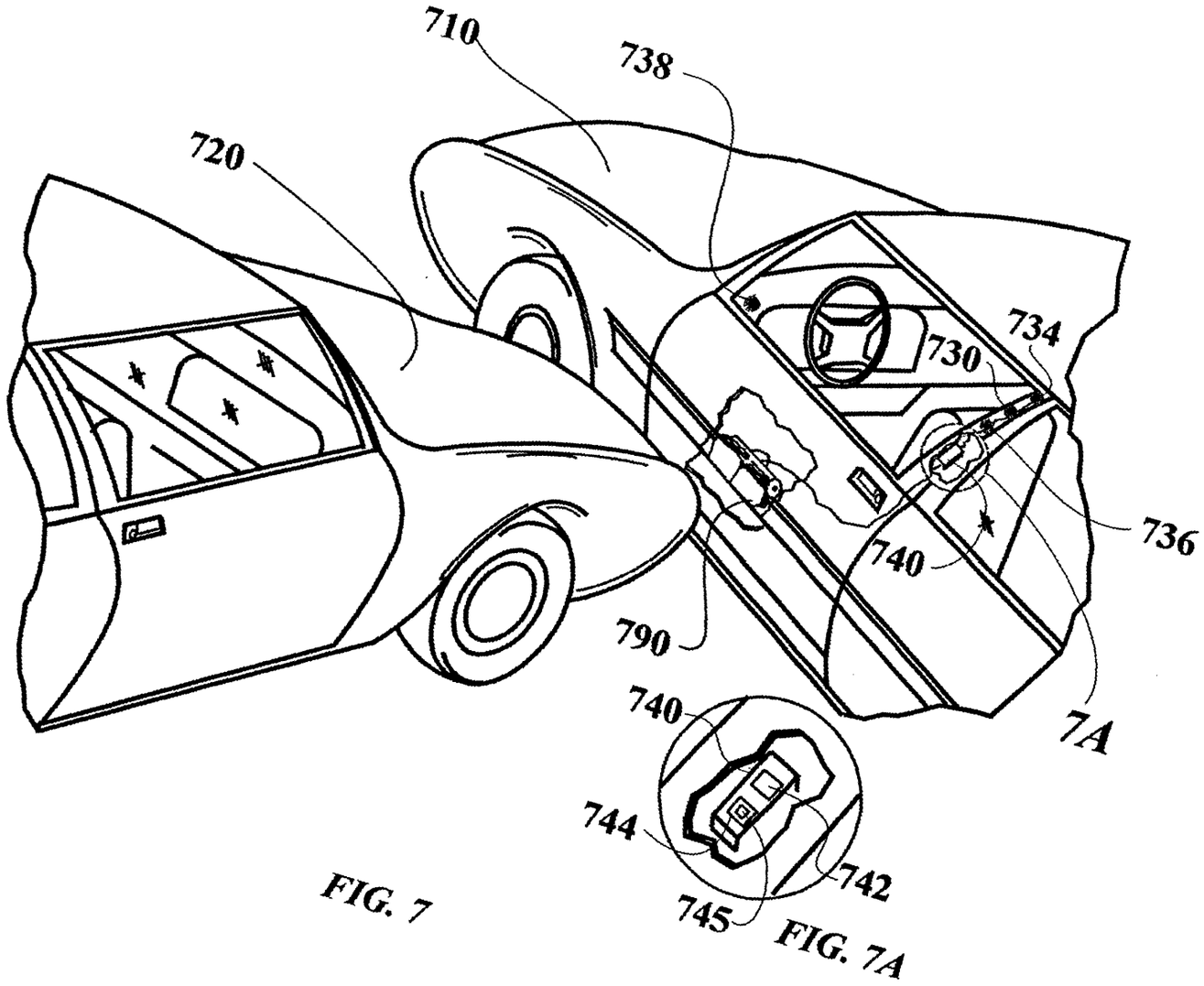

FIG. 7

FIG. 7A

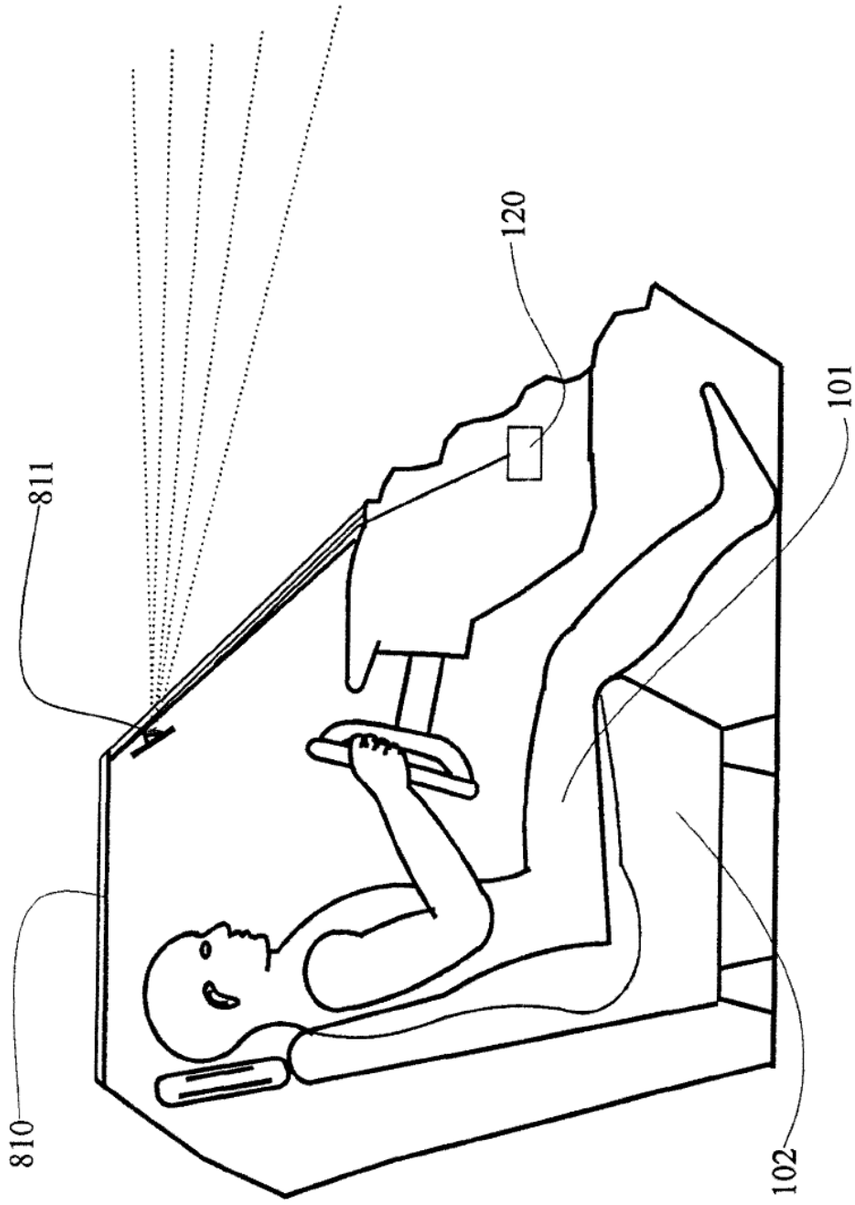

FIG. 8

NOTICE OF ALLOWANCE
DATED FEBRUARY 27, 1998
BATCH NO. B01
ATI-95

UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Y. Couso Art Unit: 2723

Re:	Application of:	David S. BREED et al.
	Serial No:	08/474,786
	Filed:	June 7, 1995
	Title:	OPTICAL IDENTIFICATION AND MONITORING SYSTEM USING PATTERN RECOGNITION FOR USE WITH VEHICLES

AMENDMENT PURSUANT TO 37 C.F.R. 1.312(a)

Assistant Commissioner for Patents
Washington, D.C. 20231

April 22, 1998

Sir:

Please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows.

In the "Brief Description of the Drawings" section of the specification at page 18, between lines 5 and 6, insert --FIG. 7A is a view of the section designated 7A in FIG. 7.--.

Page 35, lines 2-3, after "receivers 734 and 736", insert --(FIG. 7A)--.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to "Assistant Commissioner for Patents, Washington, D.C. 20231" on April 22, 1998.
Brian Roffe, Esq.

By: _____

REMARKS

A Notice of Allowance has been received in connection with the above-referenced application and the issue fee has not yet been paid. The Notice of Allowance is dated February 27, 1998, Batch No. B01.

Entry of this amendment is respectfully requested under 37 C.F.R. 1.312.

The specification has been amended to refer to a new Fig. 7A, which is the enlarged view shown in Fig. 7, in view of the fact that FIG. 7 as originally filed included two separate views. A copy of FIGS. 7 and 7A is also submitted herewith.

Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe
376 Yale Avenue
Woodmere, New York 11598-2051
(516) 569-3664

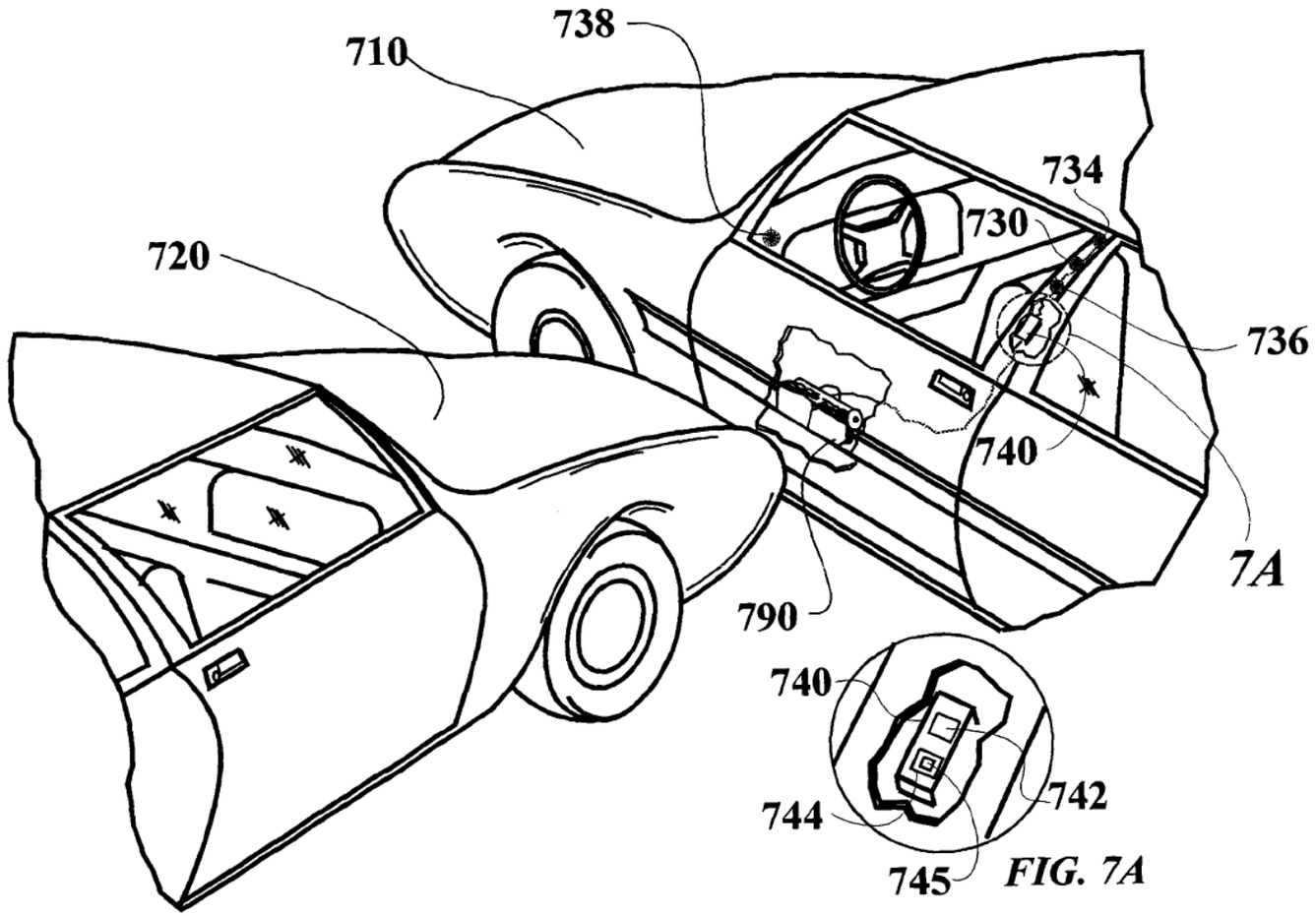

FIG. 7A

FIG. 7

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/474,786	06/07/95	BREED	D ATI 95

LM32/0714

BRIAN ROFFE
376 YALE AVENUE
WOODMERE NY 11598-2051

COUSO, Y
EXAMINER

ART UNIT	PAPER NUMBER
2723	

07/14/98
DATE MAILED:

Response to Rule 312 Communication

☐ The petition filed on _____ under 37 CFR 1.312(b) is granted. The paper has been forwarded to the examiner for consideration on the merits.

_____

_____
Director,
Patent Examining Group _____

☒ The amendment filed on 4-24-98 under 37 CFR 1.312 has been considered, and has been:

☒ entered.

☐ entered as directed to matters of form not affecting the scope of the invention (Order 3311).

☐ disapproved. See explanation below.

☐ entered in part. See explanation below.

Yon J. Couso

YON COUSO
PRIMARY EXAMINER

FORM PTOL-271 (REV. 1-96)

PTO UTILITY GRANT

Paper Number 18

The United States of America

The Commissioner of Patents and Trademarks

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.

If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to an statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extension.

Bruce Lehman

Commissioner of Patents and Trademarks

Attest Marjorie V. Turner

Form PTO-1584 (Rev. 2/95)

FPI-LOM

(RIGHT INSIDE)

PATENT APPLICATION SERIAL NO. 08/474786

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

PTO-1556
(5/87)

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 1994

Application or Docket Number: 08/474,786

CLAIMS AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA
BASIC FEE		
TOTAL CLAIMS	17 minus 20 =	*
INDEPENDENT CLAIMS	3 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		

SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
	365.00	OR		730.00
x$11=		OR	x$22=	
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL		OR	TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 20	Minus	** 20	=
Independent	* 3	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=		OR	x$22=	
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 25	Minus	** 20	= 5
Independent	* 6	Minus	*** 3	= 3
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=	55	OR	x$22=	
~~x38~~ 40=	120	OR	x76=	
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=		OR	x$22=	
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 10/94)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

Form PTO 1130
REV 2-94)

1ST EXAMINER P HUCKLEY | DATE 7-17-95
2ND EXAMINER [illegible] | DATE 9-6-95

APPLICATION NUMBER: 08/474786

TYPE: 1

FILING DATE: MONTH 06 DAY 07 YEAR 95

SPECIAL HANDLING: 0

GROUP ART UNIT: 2613

CLASS: 382

SHEETS OF DRAWING: 12

TOTAL CLAIMS: 18

INDEPENDENT CLAIMS: 3

SMALL ENTITY?: 2

FILING FEE: 430

FOREIGN FILING LICENSE: 4

ATTORNEY DOCKET NUMBER: ATI-95

CONTINUITY DATA

CONT CODE	STATUS CODE	PARENT APPLICATION SERIAL NUMBER	PCT APPLICATION SERIAL NUMBER	PARENT PATENT NUMBER	PARENT FILING DATE MONTH	DAY	YEAR
03	3	07878571	PCT/		05	05	92
03	2	08047978	PCT/		03	31	93
03	2	08247766	PCT/		05	23	94
03	2	08239978	PCT/		05	09	94
			PCT/				

PCT/FOREIGN APPLICATION DATA

FOREIGN PRIORITY CLAIMED	PRIORITY CODE	PCT/FOREIGN APPLICATION SERIAL NUMBER	FOREIGN FILING DATE MONTH	DAY	YEAR

U.S.G.P.O.: 1994-364-021

MULTIPLE DEPENDENT CLAIM
FEE CALCULATION SHEET
(FOR USE WITH FORM PTO-875)

SERIAL NO 474786

FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND	DEP	IND	DEP	IND	DEP
1	/					
2						
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TOTAL IND	3					
TOTAL DEP	15					
TOTAL						

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TOTAL IND.						
TOTAL DEP.						
TOTAL CLAIMS						

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POSITION		ID NO.	DATE
CLASSIFIER		18	7/6/95
EXAMINER		340	7.17.95
TYPIST		559	7-27-95
VERIFIER	BWM	09-[illegible]G	9-1-95
CORPS CORR.			
SPEC. HAND		440	9-6-95
FILE MAINT.		442	9/11/95
DRAFTING			

INDEX OF CLAIMS

Claim Final	Claim Original	Date								
		9/26/95	3/14/97	9/24/97	12/24/98					
1	1	✓	✓	4	4					
2	2	✓	✓							
3	3	✓	✓							
4	4	✓	✓							
5	5	✓	-							
6	6	✓	-							
7	7	✓	✓							
8	8	✓	✓							
9	9	✓	✓							
10	10	✓	✓							
11	11	✓	x							
12	12	✓	✓							
13	13	✓	✓							
14	14	✓	✓							
15	15	✓	✓							
16	16	✓	✓							
17	17	✓	✓							
18	18	✓	-	✓	=					
	19		✓							
	20		✓							
21	21			4	4					
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19	26			✓	=					
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SYMBOLS

- ✓ ..... Rejected
- = ... Allowed
- - (Through numberal) Canceled
- + ... Restricted
- N ..... Non-elected
- I ..... Interference
- A ..... Appeal
- O ..... Objected

Claim Final	Claim Original	Date							
	51								
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	99								
	100								

(LEFT INSIDE)

[redacted]

SEARCHED

Class	Sub.	Date	Exmr.
340	436	9-24-96	AK
382	104		
↓	103		
	294		
280	135		
348	143		
↓	148		
updated		3/10/97	AK
search updated		9-24-97	[illegible]
382	100		
search updated		2-24-98	[illegible]

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
382	100	2-24-98	[illegible]
348	143		

SEARCH NOTES

	Date
head light dimmer, vehicle, CCD, distance,	9-25-97
08/474782	9-24-97

(RIGHT OUTSIDE)