EXHIBIT 1106

JAPANESE KOKAI APPLICATION BY YANAGAWA *ET AL.*,

NO. S62-131837 PUBLISHED JUNE 15, 1987

("YANAGAWA")

TRW Automotive U.S. LLC: EXHIBIT 1106
PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NUMBER 8,599,001

(19) Japanese Patent Office (JP) (11) Kokai Application No.

(12) Unexamined Patent Publication (A) S62-131837

(51) Int. Cl.[4] ID Symbol JPO File Number (43) Publication Date: June 15, 1987

B 60 Q1/14 A-8410-3K

G 08 G 1/16 6821-5H

Request for Examination: not yet submitted

Number of Inventions: 1 (6 pages total)

(54) Title of the Invention: Traveling Vehicle Recognition Device

(21) Application No.: S60-272478

(22) Application Date: December 5, 1985

(72) Inventor: Hirohiko Yanagawa c/o Nippon Denso Co., Ltd., 1-1 Showa-cho, Kariya-shi

(72) Inventor: Hideko Akatsuka c/o Nippon Denso Co., Ltd., 1-1 Showa-cho, Kariya-shi

(72) Inventor: Genichi Yamada c/o Nippon Denso Co., Ltd., 1-1 Showa-cho, Kariya-shi

(71) Applicant: Nippon Denso Co., Ltd. 1-1 Showa-cho, Kariya-shi

(74) Representative: Takehiko Suzue, Patent Attorney and 2 others

Specification

1. Title of the Invention

Traveling Vehicle Recognition Device

2. Claim

A traveling vehicle recognition device characterized in comprising:

color imaging means for imaging the forward direction of a traveling vehicle;

means for forming color image signals corresponding to each color based on a video signal imaged by the imaging means;

features extraction means for extracting an image signal of colors corresponding to taillights and headlights based on the color image signals obtained by said means;

means for recognizing the presence of taillights or headlights according to the image signal extracted by the features extraction means;

calculating means for computing the distance between vehicles and the speed relative to a vehicle ahead based on said recognized taillight image; and

executing means for executing headlight control based on the recognition result of said recognition means;

and controlling to switch the vehicle headlights to low beams at least when a state in which there is an oncoming vehicle in the forward direction has been recognized by said recognition of headlights.

3. Detailed description of the invention

<Industrial field of use>

The present invention relates to a recognition device for a traveling vehicle which recognizes the presence of taillights of a vehicle traveling ahead and headlights of an oncoming vehicle, especially at night, calculates and displays the interrelationship with the vehicle ahead, and is capable of controlling the device vehicle's headlights automatically.

<Prior art>

When driving an automobile at night, the headlights are lit while travelling, and in particular, the headlights are set to high beams when driving in an area with few other traveling automobiles.

However, with this type of high beam driving state, in the case that there is an oncoming vehicle or a vehicle traveling ahead is becoming close, the headlights must be switched to low beams so as not to obstruct the field of vision of the driver of the oncoming vehicle or the driver of the vehicle traveling ahead. This type of beam control of the headlights is troublesome for the driver, however, and further complicates the driving operation, especially when driving on a road with many curves. Moreover, in the case that there is a vehicle traveling ahead, the driver must accurately perceive the distance from the vehicle ahead and the speed relative to the vehicle ahead, and must control the lights in this way and accurately know the relative relationship with the vehicle ahead in order to drive safely.

<Problems that the invention is to solve>

The present invention was devised in consideration of such points, and seeks to provide a traveling vehicle recognition device capable, for example, of automatically controlling headlight beams to high and low beams according to the state of whether there is a vehicle ahead, especially when driving at night, and of issuing warnings to the driver according to the interrelationship with a vehicle traveling ahead.

<Means of solving the problems>

Specifically, the traveling vehicle recognition device of the present invention has an imaging apparatus such as a color television camera set up for imaging, for example, the forward direction of a traveling vehicle, extracts color features of headlights and taillights to form a feature extracted color image signal based on a color video signal imaged by this imaging apparatus, recognizes the headlights and taillights of a vehicle ahead, and controls the headlight beams based on this recognition result. The traveling vehicle recognition device also computes the distance from and the speed relative a vehicle traveling ahead based on the image signal of a recognized taillight.

<Operation>

With the traveling vehicle recognition device configured as above, the headlights and taillights of a vehicle ahead can be recognized from color features, and the driver can be notified that there is an oncoming vehicle and there is a vehicle traveling ahead based on this recognition., Conditions that arise when the headlights must be switched from high beams to low beams are also detected based on this recognition result, and the headlight beams can be controlled automatically once detection conditions have been set. The distance from and the speed relative to a vehicle traveling ahead can also be calculated based on taillight recognition, and a warning can therefore be issued to the driver in states such as when there is risk of a rear-end collision.

<Working examples of the invention>

A working example of the present invention will be described hereinafter with reference to the appended drawings. Fig. 1 shows the configuration of this working example, which is provided with a color television camera 11. The television camera 11 is mounted and set up in the front of a vehicle 12 as shown in Fig. 2, for example, and is set so as to be able to image the forward direction of the vehicle 12, especially a vehicle 121 traveling ahead and a vehicle 122 traveling in the oncoming lane. By setting up in this way, the red taillights of the vehicle 121 and the white headlights of the vehicle 122 may be imaged accurately, especially at night.

A video signal of images imaged by the television camera 11 is supplied to a decoder 13. The decoder 13 forms R (red), G (green) and B (blue) color image signals based on the video signal, and supplies the R, B and B color image signals to an image signal processor 14.

The image signal processor 14 extracts the features of red, which is the color of taillights, and of white, which is the color of headlights, from the R, G, B color image signals, extracting, for example, a binary image signal, and causes the presence of taillights or headlights within the

the imaged video to be recognized based on this extracted image signal. The recognition results are then sent to an executing part 15.

The executing part 15 is also supplied a detection signal corresponding to the vehicle speed from a vehicle speed sensor 16 and a signal from a headlight switch 17 indicating the state of whether the headlights are set to a high or low beam . The executing part 15 then executes tasks for controlling the headlight beams or issuing a warning to the driver based on the recognition information, vehicle speed information and headlight information.

Fig. 3 shows the flow of operating states of the device described above, which starts when the ignition switch of the vehicle is turned on. In step 101, whether it is nighttime is determined according to whether the headlights are lit, and in the case that it is determined to be nighttime, the operation advances to step 102. Settings are initialized instep 122 [Translator's note: error for 102]. In this initializing step 102, the scanning area of the screen to be imaged is set and feature extraction conditions for recognizing taillights and headlights are set.

Once the settings have been initialized in this way, the operation advances to step 103, in which the color image signal from the decoder 13 formed based on the video signal from the color television camera 11 is captured and inputted to the image signal processor 14. The operation then advances to a 104. In step 104 features are extracted by the image signal processor 14 from the color image signal, and the luminescent colors of white and red are emphasized.

This image signal processor 14 is configured as shown in Fig. 4, for example, and is provided with a features extraction unit 141. The R, G and B color image signals from the decoder 13 are supplied to the features extraction unit 141. "Extracting features by the features extraction unit 141" means that the inputted image signals are binarized to capture only information relating to headlights and taillights, which are to be recognized. In this example, color image signals corresponding to the luminescent colors of headlights and taillights are extracted. Conditional expressions for the features extraction are then set, and the image signals are extracted in accordance with the conditional expressions.

For example, with white luminescence such as when a headlight is lit, the R, G and B values are large and there is little difference between the values. The conditional expressions for white luminescence are as follows.

$$|R - G| < \varepsilon / 10$$
$$|G - B| < \varepsilon / 10$$
$$|B - R| < \varepsilon / 10$$
$$4\varepsilon / 5 < R, G, B \text{ ... ... } (1)$$

The potential values that R, G and B may assume range from 0 to ε.

With red luminescence when a taillight is lit, the value of R (red) is at least twice that of G (green) and B (blue). Therefore, the extraction conditional expression for the red luminescence of taillights is as follows.

$$R > 2B, \text{ and } R > 2G \text{ ... ... } (2)$$

The image data of features extracted in step 104 in this way are stored in a memory 142 in step 105. Image data are stored every 0.05 second, for example. Next, In step 106, the image data stored in the memory 142 are sent to a recognition unit 143, which determines whether the image from which features have been extracted is a taillight.

As determination criteria, the determination is made according to whether there are two red images 52 and 53 at the same height within a setting range 51 on a screen corresponding to the range of the traffic lane in which the device vehicle is traveling, as shown in Fig. 5(A). In the case that taillights are recognized in step 106, the operation advances to step 107, in which whether the headlights are in a high beam state is determined from the state of a headlight high/low-beam switch. In the case that the headlights are in a high beam state in this step 107, in the next step 108, the headlights are controlled to switch the headlights to low beams, and the operation advances to step 109. In this case, that the headlights have been switched from high to low beams is stored in a memory. This storage is erased in the case that the headlights are returned to high beams or the ignition switch is disengaged, but is retained in the meantime. Alternatively, in the case that the headlights are determined to be low beams in step 107, the operation advances directly to step 109.

In step 109, the image data stored every 0.05 second in the memory 142 are inputted to a computation unit 144, and in the next step 110, the distance Z from a vehicle traveling ahead and the speed relative to the vehicle traveling ahead are calculated.

This distance Z from a vehicle traveling ahead is calculated based, for example, on a distance r1 between the recognized taillights 52 and 53 Specifically, the distance r1 is obtained by a calculation such as the following:

If the focal length of the television camera 11 is f, the distance from the lens of the camera 11 to the vehicle is Z, and the magnification of the camera 11 is β, the following equation holds true.

$$\beta = f / Z \; \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \; (3)$$

If the distance between taillights is R when β is "1", the following equation then holds true.

$$\beta = r / R \; \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \; (4)$$

From equations (3) and (4), the distance Z between vehicles is obtained by the following equation.

$$Z = f R / r \; \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \; (5)$$

The distance between vehicles is calculated in this way every 0.05 second as the image data are stored, and the speed of the device vehicle relative to a vehicle traveling ahead is calculated from the distance between vehicles obtained every 0.05 second. Specifically, 0.05 second after a taillight image such as shown in Fig. 5(A) has been obtained, the same taillight image is as shown in Fig. 5(B), and the distance between taillights 52 and 53 changes from r1 to r2. If Z1 is the distance between vehicles calculated using the distance r2, the speed V relative to the vehicle ahead can be obtained by the following equation.

$$V = (Z - Z1) / 0.05 \; \ldots \ldots \; (6)$$

The distance Z from and the speed V relative to a vehicle ahead are obtained by such a calculation in step 110, and the results of this calculation are displayed in step 111.

A numerical display on a panel meter of the vehicle, for example, may be used as a display means in the step 111.

In the case that a taillight was not recognized in step 106, the operation advances to step 112. In this step 112, headlights are recognized by determining whether there are two white luminescent colors 62 and 63 at the same height in a setting range 61 corresponding to an oncoming traffic lane on a screen as shown in Fig. 6, and recognizing the headlights of an oncoming vehicle according to whether there are these two white luminescent colors 62 and 63.

In the case that headlights have been recognized in this step 112, the operation advances to step 113, and the state of the headlights of the device vehicle is determined in the same manner as in step 107, and in the case that they are high beams, the headlights are switched to low beams in step 114.

In the case that headlights were not recognized in step 112, it is determined that there is neither a car traveling ahead nor an oncoming car, in which case, the operation advances to step 115. In step 115, the past headlight setting status is determined from the contents stored in memory, and in the case that a state of high beams has been stored in memory, the operation advances to step 116 to switch the headlights to high beams. For example, in the case that the headlights have been switched to low beams in step 108 or 114 from a state of traveling with high beams on and the previous high beam state has been stored in memory, the headlights are switched to high beams in step 116after passing the vehicle ahead or being passed by the oncoming vehicle.

In other words, with the device, in the case that there is a vehicle ahead or an oncoming vehicle while traveling at night and the headlights are in the high beam state, for example, the headlights are automatically switched to low beams, thus

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | **sales@docketalarm.com** | **1-866-77-FASTCASE**

fastcase®
Smarter legal research.