

**Raw Data Elements:**

## Power train sensors

5 RPM,  
transmission setting (Park, Drive, Gear, Neutral),  
throttle position,  
engine coolant temperature,  
intake air temperature,  
barometric pressure;

## Electrical sensors

10 brake light on,  
turn signal indicator,  
headlamps on,  
hazard lights on,  
back-up lights on,  
15 parking lights on,  
wipers on,  
doors locked,  
key in ignition,  
key in door lock,  
20 horn applied;

## Body sensors

airbag deployment,  
ABS application,  
level of fuel in tank,  
25 brakes applied,  
radio station tuned in,  
seat belt on,  
door open,  
tail gate open,

odometer reading,  
cruise control engaged,  
anti-theft disable;

Other sensors

5                    vehicle speed,  
                     vehicle location,  
                     date,  
                     time,  
                     vehicle direction,  
10                   IVHS data sources.

**Calculated Data Elements:**

                     rapid deceleration;  
                     rapid acceleration;  
                     vehicle in skid;  
15                   wheels in spin;  
                     closing speed on vehicle in front;  
                     closing speed of vehicle in rear;  
                     closing speed of vehicle to side (right or left);  
                     space to side of vehicle occupied;  
20                   space to rear of vehicle occupied;  
                     space to front of vehicle occupied;  
                     lateral acceleration;  
                     sudden rotation of vehicle;  
                     sudden loss of tire pressure;  
25                   driver identification (through voice recognition or code or fingerprint  
                     recognition);  
                     distance travelled; and  
                     environmental hazard conditions (e.g. icing, etc.).

**Derived Data Elements:**

- vehicle speed in excess of speed limit;
- observation of traffic signals and signs;
- road conditions;
- 5 traffic conditions; and
- vehicle position.

This list includes many, but not all, potential data elements.

With particular reference to **FIGURE 1**, a flowchart generally illustrating the data gathering process of the subject invention is illustrated.

10 Such a process can be implemented with conventional computer programming in the real time operating kernel **408** of the computer **300**. The process is identified with initially a begin step **100** (key in ignition?) and a check of whether the vehicle is operating at step **102**. If the vehicle is not operating a reverification occurs every two (2) minutes as shown at step **104**. It should be

15 noted that the computer is continually powered by at least the vehicle battery **310** (**FIGURE 3**), but it can be appreciated that during operation the generator (not shown) will supply the energy. If the vehicle is operating, then there is a step of recording sensor information **106**. The recording comprises monitoring a plurality of raw data elements, calculated data elements and derived data

20 elements as identified above. Each of these is representative of an operating state of the vehicle or an action of the operator. Select ones of the plurality of data elements are recorded when the ones are determined to have an identified relationship to the safety standards. For example, vehicle speed in excess of a predetermined speed limit will need to be recorded but speeds below the limit

25 need only be monitored and stored on a periodic basis. The recording may be made in combination with date, time and location. Other examples of data needed to be recorded are excessive rates of acceleration or frequent hard braking.

The recording process would be practically implemented by monitoring and storing the data in a buffer for a selected period of time, e.g., thirty seconds. Periodically, such as every two minutes, the status of all monitored sensors for the data elements is written to a file which is stored in the vehicle data storage 402. The raw, calculated and derived data elements listed above comprise some of the data elements to be so stored.

Certain of the recorded sensor information may comprise a trigger event of which inquiry is identified at step 108. "Trigger events" are defined as a combination of sensor data requiring additional action or which may result in a surcharge or discount during the insurance billing process. Certain trigger events may require immediate upload 110 to a central control which will then be required to take appropriate action. For example, a trigger event would be rapid deceleration in combination with airbag deployment indicating a collision, in which case the system could notify the central control of the vehicle location. Alternatively, if the operator were to trigger on an emergency light, similarly the system could notify the central control of the vehicle location indicating that an emergency is occurring. The trigger information is recorded, as at step 116, and whatever response is taken by the central control is also recorded at step 118. The trigger information recording step 116 and the recording sensor information step 106 may impart recording of information in the on-board data storage device 402 or memory 406. The event response information recording at step 118 will usually occur in the central control station. Such response information could be the dispatch of an emergency vehicle, or the telephoning of police or an EMS unit.

Trigger events are divided into two groups: those requiring immediate action and those not requiring immediate action, but necessary for proper billing of insurance. Those required for proper billing of insurance will be recorded in the same file with all the other recorded vehicle sensor information. Those trigger events requiring action will be uploaded to a central

control center which can take action depending on the trigger event. Some trigger events will require dispatch of emergency services, such as police or EMS, and others will require the dispatch of claims representatives from the insurance company.

5                   The following comprises an exemplary of some, but not all, trigger events:

**Need for Assistance:**

These events would require immediate notification of the central control center.

- 10           1.    Accident Occurrence. An accident could be determined through the use of a single sensor, such as the deployment of an airbag. It could also be determined through the combination of sensors, such as a sudden deceleration of the vehicle without the application of the brakes.
- 15           2.    Roadside assistance needed. This could be through the pressing of a "panic button" in the vehicle or through the reading of a sensor, such as the level of fuel in the tank. Another example would be loss of tire pressure, signifying a flat tire.
- 20           3.    Lock-out assistance needed. The reading of a combination of sensors would indicate that the doors are locked but the keys are in the ignition and the driver has exited the vehicle.
- 25           4.    Driving restrictions. The insured can identify circumstances in which he/she wants to be notified of driving within restricted areas, and warned when he/she is entering a dangerous area. This could be applied to youthful drivers where the parent wants to restrict time or place of driving, and have a record thereof.

**Unsafe Operation of the Vehicle**

These events would be recorded in the in-vehicle recording device for future upload. Constant trigger events would result in notification of the driver of the exceptions.

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