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VEHICLE CONDITION MONITORING SYSTEM USING GPS AND GSM MODULE

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Abstract- *Vehicle accident is the paramount thread for the people's life which causes a serious wound or even dead. The automotive companies have made lots of progress in alleviating this thread, but still the probability of detrimental effect due to an accident is not reduced. Over speed is a major factor causing road traffic accidents. Another reason is irregular movement of a vehicle. But when accident is occurred on road, there should be need emergency services. So our purpose is notifying condition about the vehicle not only to the owner but also to health center and police station nearby to the location of accident who can take necessary steps in that situation using a specified system. This system is as kwon as Vehicle Condition Monitoring System (VCMS). This system contains single-board embedded system that is equipped with accelerometer, gyroscope, magnetometer, GSM and GPS shield along with ARDUINO mega that is installed in the vehicle. The use of GPS technology allows the system to track object and provides the most up-to-date information about ongoing trips. By using these sensors, we have created a specified algorithm that allows someone to know about the different mode or situation of the vehicle. GSM technology has been used for sending information with accurate location. It is completely integrated so that once it is implement in all vehicle, then it is easy to monitor vehicles condition at any time.*

Keywords: Vehicle condition monitoring, accelerometer, gyroscope, magnetometer, GPS, emergency message.

1. INTRODUCTION

The automotive industry around the world has shown a tremendous enhancement its production over the recent years. Millions of vehicles are being produced annually. Many of motor vehicles owners give to right of their driver to drive that vehicle. So it is quite difficult to monitor their vehicle's condition. Along with these, the accident rates are also getting significantly increased. Most of the accidents occur due to human negligence, such as reckless driving, lack of good infrastructure etc. An immediate rescues process after an accident can be considered as a tightrope walk between life and death. It could be better, if we take any kind of precaution. This also is saved a life from danger.

If owners get time to time data from that vehicle, then owners can knows about vehicle condition. This can restrict some kind of accident. A study by Virtanen et al. shows that 4.6% of the fatalities in accident could have been prevented only in Finland if the emergency services could be provided at the place of the accident at the proper time [1]. As such, an efficient automatic notification system which will provide information about vehicle condition with location, that is a prime need to save the precious human life.

A vehicle monitoring system is described having an arrangement installed within a Vehicle, wherein the system includes an external data terminal for communication information to a remotely located base station. This system has also Global Position System (GPS) which will receive the co-ordinates from the satellites among other critical information. This can be useful in tracking of the theft vehicle and send the location of accident place. We use GSM module for communicating information. GSM modem, provided with a SIM card uses same communication process as we are using in regular phone. Also use sensor circuit for getting information about vehicle condition.

We have discussed on some relevant papers in section 2. In section 3 we have chronicled the system functionality with technical details. Later we have shown the implementation result with experimental data, functional and subjective evaluation of our application. In the end, we discussed about the challenges and future extension of our work.

2. LITERATURE REVIEW

VCMS is not only doing detection of road accident but also it can transmit information about vehicle condition and different mode at any time. But in recent years many researchers had made the project related on accident alarm system. This technology includes: GPS, GSM

communication and others. S. M. Tang et al research about road accident detection which is based on nonparametric regression [2]. Smartphone have been deployed as floating traffic probes and sensors in many application, both academically and commercially which had been shown by G. Rose [3]. Different types of application also had been made by different researchers like P.Mohan et al show road condition survey, traffic condition monitoring [4] and Huachun Tan shows Vehicle speed measurement for accident scene investigation [5].

The measurement technologies on vehicle speed mainly apply to simultaneously monitor vehicle speeds. The vehicle speed is one of the most important parameters that a traffic monitoring system should provide in a timely manner. It provides traffic management authorities and end users (e.g. drivers) with a rough idea of the current traffic situation, and is also crucial to estimate travel time and traffic flow. C. Saiprasert et al. propounded a reporting system in case of dangerous driving using android [6].Jung Lee described an accident detection system on a highway by tracking the vehicle [7].

3. IMPLEMENTATION and OPERATION of VCMS

VCMS can perform in three different modes. One is parking modes and another is reckless driving mode and last one is accident detection mode. By these three different modes anyone can monitor whole condition of his/her vehicles. Full implementation and operation is given below.

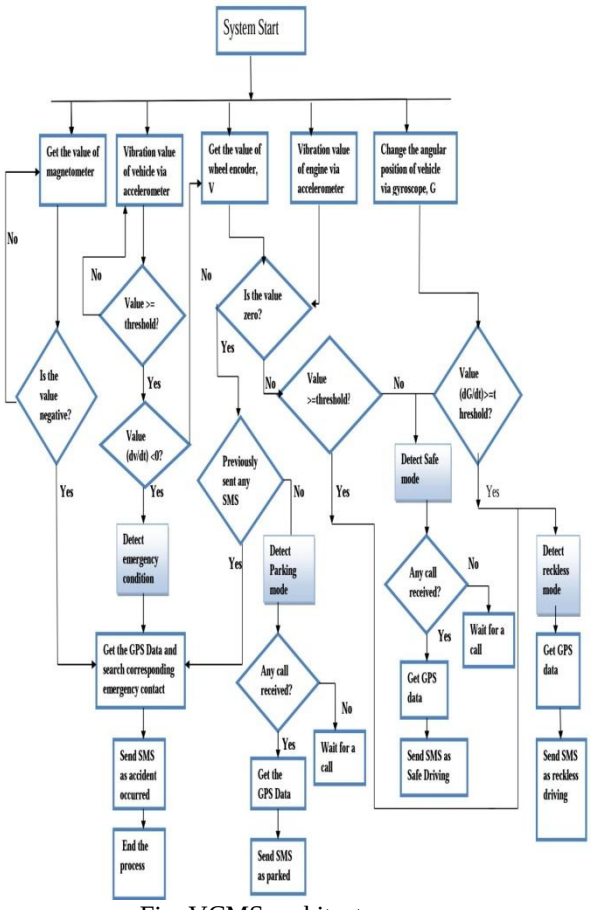

Fig: VCMS architecture

How the VCMS works that's represent above figure. This figure shows the whole operation of VCMS. That's will be describe in parameter manner. To monitor vehicle condition we set some parameters which are Speed of vehicle, Vibration of vehicle, irregular movement of vehicle, overturn of vehicle and location of the vehicle. How the sensors and encoder gets that's value of that parameters that will be discussed below.

3.1 Speed of the vehicle

Wheel encoder has been used for speed determination of the vehicle. In this system, three types of value are taken to know the vehicle condition. The first of which is zero value of speed. By this we check the parking condition. The second type of the value is threshold value. We have been set a maximum value to determine the reckless driving. Finally the derivative value of speed with respect to time has been taken by using starling formula. The negative slop of that derivative needs to check accident occurrence.

3.2 Vibration of the vehicle

It is known that force is created by the acceleration. And vibration will be started by reason of force. So we can consider acceleration as shape of vibration. For this reason accelerometer has been used to determine vibration. Two accelerometers have been used for two different conditions. One is used at the engine which only checks the zero value of vibration. It is used to decide parking mode of the vehicle. Another is used at front position of the vehicle. For this accelerometer has a threshold value which will decide the accident occurrence.

3.3 Angle between vehicle and road line

Gyroscope has been used to measure angle between vehicle and road line. The derivative value of the gyroscope with respect to time has been taken to determine reckless driving mood. We use starling's formula for determination of derivative value. If X is the value of time (t) and Y is the value of gyroscope(G), then starling's formula will be:

$$y(x) = y_0 + s\left(\frac{\Delta y_o + \Delta y_{-1}}{2}\right) + \frac{1}{2}s^2\Delta^2 y_{-1} + \frac{1}{6}(s^3 - s)\left(\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right) + \frac{1}{24}(4s^3 - 2s)\Delta^4 y_{-2} + \cdots\cdots$$

With derivatives

$$y'(x) = \frac{1}{h}\left[\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) + s\Delta^2 y_{-1} + \frac{1}{6}(3s^2 - 1)\left(\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right) + \frac{1}{24}(4s^3 - 2s)\Delta^4 y_{-2} + \cdots\cdots\right]$$

Where $s = \frac{x - x_o}{h}$ and x_0 =is the value of time at which derivative value will be found, h is the time interval between to two gyroscope value.

At $x = x_0$, then $s = 0$ hence the derivative will be

$$y'(x) = \frac{1}{h}\left[\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) - \frac{1}{6}\left(\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right)\right]$$

Finally we get the value of $\left(\frac{dG}{dt}\right)$ at any time instant. If the vehicle goes in without irregular movement then this value will be nearly zero. So we set a threshold value, after reached that value or crossed the value, system can decide about reckless driving condition.

3.4 Overturned of vehicle

Magnetometer has been use to know whether the vehicle has been flipped or not. This value of this parameter can only be determined, when it comes to vehicle accidents. By negative value of the magnetometer, system can decide that vehicle has been flipped.

3.5 Location of the vehicle

GPS module has been used to know the vehicle location. Location will be provided with any sending information.

3.6 Quarry message and emergency message

When a call receives from owner's number, and then only two conditions has been checked. One is parking mode and another is safe driving mode. If any one condition matched that time, a message will be sent about corresponding condition from the system. Otherwise it will send a emergency message. Furthermore emergency message will be sent automatically, when the system detects any critical condition. We classify critical condition in two steps. One is reckless driving and another is accident occurrence. Using database store coding, we make list of whole Chittagong police station and health care centre corresponding between two latitude and longitude. If a location falls in this list, then message will sent to number according to the list. Example: if the location is 22.4618835N and 91.9694505E, then message will be sent to Roazan Police Station and Rangunia Health Centre.

4. EXPECTED RESULT

To observe all the conditions, a prototype vehicle has been made. The value of angle between road line and vehicle has been changed by rotating sometimes because of checking the gyroscope value. Speed values by hard break, turning a curve road and slope road also have been cheeked. Changing the pressure value manually by physical force has been in that prototype vehicle because of checking the accelerometer value. Finally that vehicle has been flipped over a sometimes manually to see the magnetometer value. The experimental results of the entire situation are shown in table.

Table 1: Determination of different types of condition

Experiment No.	Change of speed (m/h)	Value of $\frac{dG}{dt}$	Pressure value	Vibration value of engine	Magnetometer value	Satisfied condition
1.	2.3	0.348	89	23	Positive	Safely driving
2.	4.5	0.523	74	34	Positive	Reckless driving
3.	3.6	0.436	108	40	Positive	Emergency mode
4.	4.2	0.785	305	37	Negative	Emergency mode
5.	0	0	0	0	Positive	Parking mode

In exp 1 all value are perfect so no message sent. In exp 2 changes of speed and angle increased so message sent. Exp 3 change in angle and pressure value is increased. In exp 4 all value crossed the limit and exp 5 all value are unchanged so message will be sent automatically.

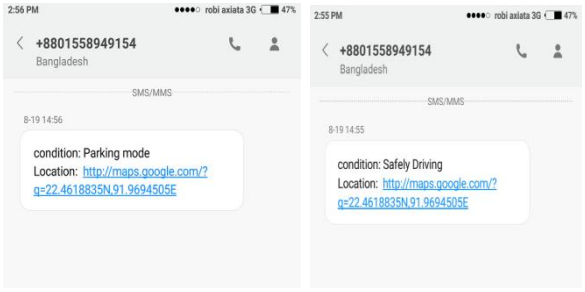

Fig2: Quarry message send from system

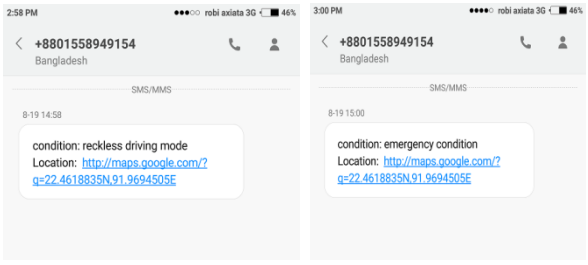

Fig 3: Emergency message send from the system

5. CONCLUSION

Nowadays road accident is a vital of the world and also as in Bangladesh. To reduce this fact some road safety measurements and some vehicle system is needed. But in this paper a vehicle monitoring system has been proposed. Our proposed approach capable of deciding whether a situation is an accident or not and if so, then

immediately traces nearest police station as well as hospital and send emergency alert message for help. Besides, we have demonstrated the reduction of false alarm in a greater extent compared to other previous works. Though the system requires a continuous GSM connection, but this it is very much cost effective and can be applied significantly in the practical world. In the future, we have a plan to consider more parameters for detecting accident and developing the application in a single device. Hence, the application would play a crucial role in post-accident services and could mitigate the effect due to accident remarkably.

7. REFERENCES

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