Vehicle collision detection and reporting

Gurmanpreet Kaur Grewal[1], Meenu Lochan[2]
[1,2] *Bhutta College of Engineering and Technology, Ludhiana, Punjab*

Abstract- **Since the technology has been ruling the roost, people are provided with multifarious facilities. One of them is automobile service, which has been evolved over the years. Nowadays, increase in vehicle population leads to road accidents, which is a grave issue to be dealt with utmost care by taking measures to save the lives of victims. Many a time when the accident is happened, people usually do not bother to help the victim because of police inquiry and in case victim is conscious, is unable to inform anyone because of either trauma or not being known the location. Here, is a system with which victim will not have to depend on other people for help. This system incorporates gyroscope, accelerometer, GPS (Global Positioning System), GSM (Global System for Mobile Communications), auto dialer and MPU6050 MEMS sensor. GPS detects the location of accident and auto dialer informs the victim's family about the mishap on the pre-defined numbers as well as reports to the nearest hospital to get medical aid. MPU6050 is a motion-tracking device that contains MEMS accelerometer and MEMS gyro in a single chip helps in detecting the vehicle collision. This system would become a savior for a victim.**

Index Terms- vehicle collision, GPS, GSM, auto dialer, MPU6050.

I. INTRODUCTION

The number of vehicles has increased with the demand of population over the years, thereby has caused congestion on roads. It has resulted in increased requirement for a driver to be alert while driving. Because of such congested roads, the possibility of road accidents has also increased. There are various reasons of these accidents are over speeding, not obeying traffic rules, not wearing helmet or seatbelt. However, in order to help the victim, an automated system has introduced, that aims to detect the accident and informs family. It also detects the location of nearby hospital and then sends notification to avail medical help for a victim, in this way it can reduce the time of seeking help.

II.LITERATURE SURVEY

Kim *et al* (2011) developed the vehicle collision warning system that detects car crash and warns the danger to drivers in advance. This vehicle collision warning system is implemented by using sensors and GPS system. Collision detection algorithm, vehicle identification module and management of collision warning system are implemented. With simulation, this system could help to reduce traffic accidents of tourists and enable drivers to predict possible accidents as well as to prepare for them.

Wang *et al* (2011) proposed the system based on Vehicle Infrastructure Integration (VII) system in order to improve the traffic safety. After analyzing the system function, physical and logical framework of the system has been designed in detail. The trajectory prediction method is based on vehicle to vehicle (V2V) wireless communication and vehicle collision can be detected in real time by the collision detection algorithm. Furthermore, time to collision (TTC) as collision risk indicator is calculated to judge the vehicular collision, and the system is able to make a warning to driver according to the value of TTC.

Manoharan *et al* (2012) proposed a system, which can report automatically about the crash to the emergency help, is implemented in vehicles so that the valuable lives are saved. The earlier approach is about implementing such a facility in vehicles with SOS support, which had normal cameras, produced unclear view. This system improves the efficiency of accident report with the help of fisheye lens camera, which produces more detailed view inside the vehicle. Using fisheye lens camera, Sensors and SIM908-C the emergency helpers will get the detailed report about the accident immediately.

Ali and Alwan (2015) proposed mechanism that distinguishes between the speed variation of low speed vehicle and walking or slowly running person. The proposed system consists of two phases; the

detection phase which is used to detect car accident in low and high speeds. The notification phase, and immediately after an accident is indicated, is used to send detailed information such as images, video, accident location, etc. to the emergency responder for fast recovery. The system was practically tested in real simulated environment and achieved quite very good performance results.

Sreevishakh and Dhanure (2015) explained the technologies proposed to predict the collision between vehicles, before the collision happens itself and smart activation of safety systems like air bag deployment, seat belt tightening. He also covered in paper the review on the accident notification schemes proposed once the accident is predicted. An isotropic magneto-resistive (AMR)and sonar/ultrasonic sensors are adopted for development of the proposed sensor system. AMR sensors are used to measure the magnetic field and to get the relative position of vehicles. The main aim of the object is to develop a unique sensor system which can be used to estimate the planer position and orientation of vehicles to avoid vehicle collision by effectively predicting the possibility for collision. Once the accident is predicted, the camera system embedded in the vehicle will get activated and will capture snaps to gather information of the vehicles near tithe host vehicle. Once accident happens intimation in the form of alert message including accident location long with the snap information will be send to nearby hospitals or police station using GSM module.

III.PROPOSED SYSTEM

The proposed idea makes the automatic notification of road accidents possible; in turn, it will decrease the fatality repercussions. Although major automobile companies provide best of the safety services in their vehicles as to save the lives of customers, the proposed automated system of vehicle collision detection and reporting would come up with advanced features. This will detect the vehicle crash occurrence and will notify the family members of injured person as well as will get him opt for quick medical help from nearby hospital. This system is based on a microcontroller named MPU6050 that contains MEMS (Micro Electro Mechanical Systems) sensor. MEMS sensor has two components one is accelerometer and the other is gyroscope along with GSM and GPS. Accelerometer measures the rate of change of velocity along 3- axis in meters per second squared (m/s^2) or in G-forces (g). Whereas gyroscope senses angular velocity and specifically a yaw rate gyroscope can be used in cars for computation of rotation angles, which probably can be affected by vehicle rollover. The combination of values from an accelerometer and gyroscope will detect the occurrence of accident. There are the phases of proposed automated system.

A. Data Acquisition

ATmega328 8-bit RISC based microcontroller is interfaced with MEMS sensor to get real time values. MPU6050 sensor along with 3-axis accelerometer and 3-axis gyroscope are integrated in a single chip. For better accuracy analog to digital convertor is also used. The microcontroller processes the complex algorithms based on current sensor readings and according to that, it will detect the vehicle collision or crash.

The process of data collection can be described as follows:

1. The algorithm begins with initialization of microcontroller along with MPU6050, GPS and GSM module.
2. The MPU6050 communicates with the microcontroller using inter-integrated circuit (I2C) communication protocol, which is efficient, flexible and powerful. It is the combination of best features of SPI and UARTs. With I2C, multiple slaves can be connected to a single master (like SPI) and multiple masters can be connected to single or multiple slaves. This is useful when one microcontroller inserts data to a single memory card.
3. The initial value of accelerometer is ±8g while initial range of gyroscope is ±500 degree/second.
4. Microcontroller communicates with GPS and GSM module using serial port.

B. Data Filtration and Analysis

The values of accelerometer and gyroscope are used to determine the vehicle collision or rollover. In accelerometer, it is pertinent to know the action of constant gravitational force of 1g to determine the orientation angle. Accelerometer consist static and dynamic force, static force represents the gravitational force and dynamic force represents the

external force. When gravitational force acts on accelerometer, it provides accurate orientation angle. External force brings fluctuation in readings.

In gyroscope, calculation of orientation is quite different as it measures angular velocity. External forces do not influence gyroscope readings. To obtain the best from both accelerometer and gyroscope, filter is applied. Digital high pass filter is applied on gyroscope and digital low pass filter is applied on accelerometer. There is an equation for this calculation.

$$Angle = \alpha * (Angle_{Gyro} * dt) + (1 - \alpha) * Angle_{Accl}$$

where,

α – floating-point value ranging from 0.9 to almost 1, depending on the efficiency of gyroscope and accelerometer and the required filter.

$Angle_{Gyro}$ is the angle computed from gyroscope data

$Angle_{Accl}$ is the angle computed from accelerometer data

Vehicle collision or rollover depends on the angle measured using filter and vehicle speed. Both cases are described below:

1. Vehicle collision

Vehicle collision causes drastic change in speed and shows a direct impact on acceleration force along the axis. Z-axis is oriented along the gravitational force direction; exclusively x- and y-axis are required to detect the collision.

2. Vehicle rollover

Vehicle rollover is based on angle computed from filter. Technically, if angle is greater than 46 degrees and less than -46 degrees, then vehicle rollover is occurred. On reaching threshold point, notification system will be enabled to inform family and nearby hospital about the mishap.

C. Notification System

The notification system aims at informing the victim's family and the hospital in the vicinity so that quick medical aid can be provided to save the life. GPS module detects the location of incident and GSM sends the text message to victim's family. GPS computes the latitude and longitude and sends it to mobile server; thereby server determines the nearest hospital by using the formula haversine formula.

$$a = \sin^2\left(\frac{\Delta lat}{2}\right) + \cos(lat1) * \cos(lat2) * \sin^2\left(\frac{\Delta lon}{2}\right)$$

$$c = 2 * \operatorname{atan}(\sqrt{a}, \sqrt{(1-a)})$$

$$d = R * c$$

where,

Δlat is difference of latitude

Δlon is difference of longitude

a is square of half of the chord between the points

c is angular distance in radians

d is distance between the points

Using the above stated formula nearest hospital will be searched and reported about the accident and its location.

IV.CONCLUSION

This automated system can mitigate the accident fatalities by saving the valuable human life. It detects the accident occurrence and location of that incident, and then informs the family of victim. It also determines the location of nearby hospital by computing latitude and longitude. Using GSM, reports the hospital about the accident and makes it possible to avail medical aid in time. It eradicates the dependency on others to get help. Moreover, this feature may increase the automobile companies' revenues and make their market position reach to towering heights.

REFRENCES

[1] Ali H.M and Alwan Z.S (2015) Car Accident Detection and Notification System Using Smartphone. Int J Comput. Sci. and Mobile Comput. 4(4):620-635.

[2] Kim S, Lee S, Yoon I, YoonM and KimD (2011) The Vehicle Collision Warning System based on GPS. First ACIS/JNU International Conference on Computers, Networks, Systems, and Industrial Engineering.Pp 263-264.

[3] Manoharan R, Balamurugan G and Rajmohan B (2012) Enhanced Automated Crash Reporting System in Vehicles Based on SMS & MMS with Fish Eye CAM Camera. ICRCC.Pp 307-311.

[4] Sreevishakh K.P and Dhanure S.P (2015) A Review paper on Automotive Crash Prediction and Notification Technologies. International Conference on Computing Communication Control and Automation. Pp 999-1002.

[5] Wang Y, Wenjuan E, Tian D, Lu G, Yu G and Wang Y (2011) Vehicle collision warning system and collision detection algorithm based on vehicle infrastructure integration.AFTC. Pp 216-220.