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An Arduino Based Safety Alerts for Vehicle and Accident Detection System

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Abstract: ***This paper is about a system that prevents the accident of vehicles which gives more likely to lower the accidents takes place daily on roads and at the same time if any accident occurs the system will locate the vehicles location and informs to local emergency authorities automatically helps to take immediate and appropriate actions. This system is based on Arduino developed with Global Positioning System (GPS) to identify the vehicle's location and Global System for Mobile Communication (GSM) technologies. A motion sensor gyroscope with 3-axis gyroscope and 3-axis accelerometer is used that measures the vehicles velocity and tilting position when the vehicle hits by something. when the vehicle velocity is more than the defined maximum for the particular location a warning will be given automatically and if any accident occurs the geographical coordinates of place are located by GPS and sends an SMS to the authorities nearby. This system is low cost and easy to maintain.***

Keywords — GPS; GSM; Google Map; Accelerometer; Velocity; Arduino; LCD.

I. INTRODUCTION

With the advent of modern technology has made our life simple, comfortable luxurious compared to the previous years. Now a days people are more habituated to vehicles for travelling purpose because of its ease and time consumption. Thus there is increase in usage of vehicles leading to increase in traffic causing many people to die due to road accident. As per Indian road safety reports in 2013 alone over1,37,000 people died in accident which is more than that are died in a war. The statistics of road accidents in India from 2005 to 2017 are given on Table below. While the absolute numbers for road accident, fatal accident and injury are on the decline, the ratios pertaining to fatal accidents and accident severity have been consistently increasing, every year.

Year	Number of Accidents		Number of Persons		Accident Severity*
	Total	Fatal	Killed	Injured	
2005	4,39,255	83,491 (19.0)	94,968	465282	21.6
2006	4,60,920	93,917 (20.4)	105,749	496,481	22.9
2007	4,79,216	1,01,161 (21.1)	114,444	513,340	23.9
2008	4,84,704	1,06,591 (22.0)	119,860	523,193	24.7
2009	4,86,384	1,10,993 (22.8)	125,660	515,458	25.8
2010	4,99,628	1,19,558 (23.9)	134,513	527,512	26.9
2011	4,97,686	1,21,618 (24.4)	1,42,485	5,11,394	28.6
2012	4,90,383	1,23,093 (25.1)	1,38,258	5,09,667	28.2
2013	4,86,476	1,22,589 (25.2)	1,37,572	4,94,893	28.3
2014	4,89,400	1,25,828 (25.7)	1,39,671	4,93,474	28.5
2015	5,01,423	1,31,726 (26.3)	1,46,133	5,00,279	29.1
2016	4,80,652	1,36,071 (28.3)	1,50,785	4,94,624	31.4
2017	4,64,910	1,34,796 (29.0)	1,47,913	4,70,975	31.8

Fig.1:Accidents per year

Taking in consideration of this problem through this paper we would like to introduce a system-oriented with GPS and GSM. This will continuously monitor the vehicle's speed and its position along with latitude and longitude coordinates concerning time. The gyroscope having a 3-axis accelerometer will allow us to detect the speed of the vehicle and is it exceeds the defined value the particular geographical coordinates were detected and an SMS sent to the local emergency authorities. To aware of the people inside the vehicle, a message of warning will be displayed to the people inside through LCD with buzzer alarm.

II. LITERATURE REVIEW

More research is going on in this subject. A system that can locate the real time GPS coordinate which will then be sent to a cell phone was developed by Md. Marufi Rahman[2]. A device that can track animals, resources, and also automobiles that are being robbed was proposed by Prof. Dr.Bharati Wukkadada[3]. SeokJu Lee also developed a system that was able to identify vehicles position in an effective manner and is of low cost[4]. An approach for the protection of the child/elderly/disabled/pet by smart and intelligent GSM and GPS based automatic tracking and alert system was developed by Punetha[13].

III. MODEL OF THE SYSTEM

If the value of velocity and tilting exceeds the defined maximum value then an SMS to the concern authorities will sent through Arduino with real time geographical coordinates. This will be shown on LCD display and a buzzer sound is given as warning to inside people. The system model is shown in below figure

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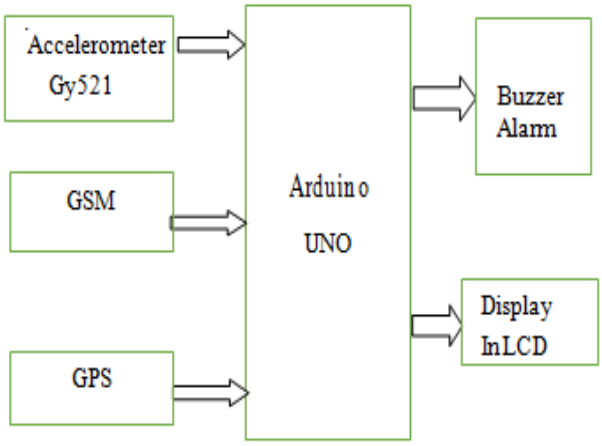


Fig.2:Architecture of the system

IV. SYSTEM DESIGN

The system design is totally based on Microcontroller Arduino. Here the Arduino acts as a main controlling unit. As we continuously monitor the data will received by Arduino from sensors and GPS it first decodes, fetches and will execute its operation finally. Here the simulation circuit of system design is shown below. we can see Arduino as main controlling unit in this connected with Global Positioning System (GPS),Global System for Mobile Communication (GSM), LCD Display Buzzer, Gyroscope.

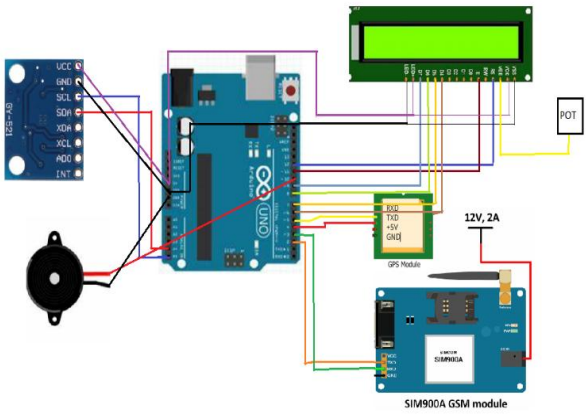


Fig. 3: Simulated circuit diagram

A. Gyroscope and Accelerometer (6-axis)

It belongs to a family of motion sensors having 3-axis of both Gyroscope and Accelerometer on the same side of the silicon die are the highest performance sensors in the market having less noise and more stability. The 3-axis Gyroscope measures the tilting value of the vehicle. If the vehicle strikes anything there will be a change in its stable values x, y, z-axis respectively. This change tells an accident has occurred. Now To prevent the accident the velocity must be taken into consideration and we know that from formula

$$V = u+at$$

Where a is said to acceleration (m/s2),t is considered as time (seconds) , u is initial velocity (m/s) and velocity v(m/s).

B.Arduino Uno:

An Arduino is an ATMEGA328P based microcontroller board which receives the values of both acceleration and tilting position and compares with the predefined values and continues with its further operations and proceedings.

C.GPS Module:

In this, a Global Positioning System is used to locate the values of geographical coordinates of the vehicle in terms of latitudes and longitudes when the values of both velocity and titling are above predefined values.

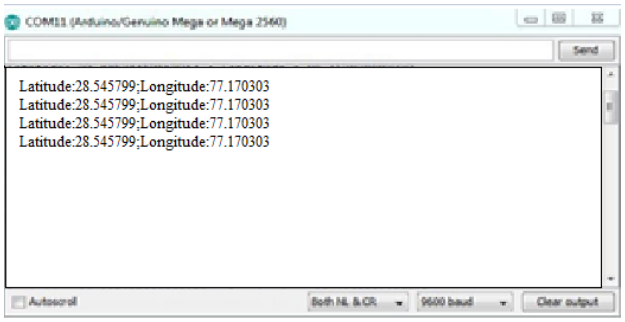


Fig. 4:Coordinates from a GPS module

D.SIM900A GSM Module:

The main purpose of GSM is for long distance communication and is used in devices like mobile phones. It transmits and receives data over GPRS. In this project SIM900A GSM module is used for sending SMS alert. When the velocity will exceed the maximum value for the given location coordinates or when the sensor tilted implies that an accident occurred, GSM will send SMS to some selected numbers. The SMS received by the cell phone consists of location coordinates and the speed of the vehicle is shown in Fig.5

Fig. 5:SMS sent from the GSM module

V. HARDWARE CIRCUIT

The implemented hardware circuit is shown in Fig. 6. I2C protocol is used to connect the IMU sensor and LCD display. SIM900A GSM Module and GPS Module are connected via serial communication with Arduino UNO. For powering the GPS and GSM modules we used a 12v and 2A power supply.

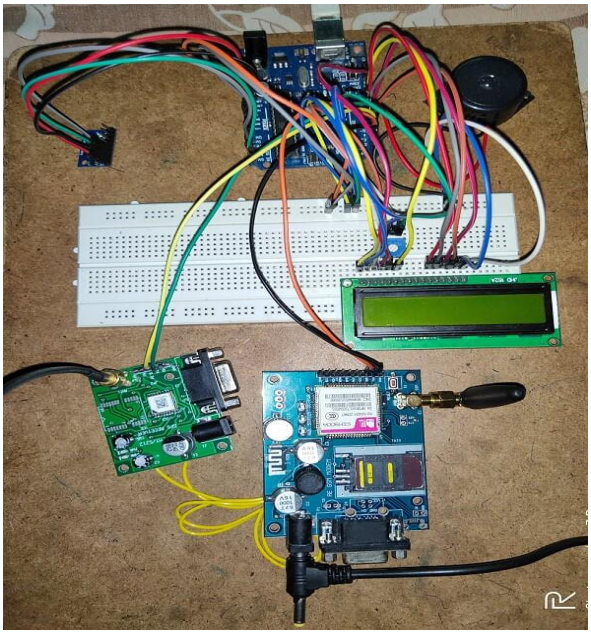


Fig. 6:Implemented Hardware circuit

VI. RESULTS ANALYSIS

Table I shows the coordinate values corresponding to its position in google maps. Here various areas are selected and by using internet, the geographical location of this range is found out. Now in Arduino, a predefined velocity is set for a particular range of areas. Suppose, the street3 road is not good and the probability of accident occuring is the most. So now the appropriate velocity of running vehicles without causing any accidents on this particular road is fixed. If a vehicle crosses that velocity, a Message is displayed in LCD indicating the warning and buzzer alarms. There can be different velocity ranges for different coordinates based on the consideration of real time parameters such as Quality of the road,the probability of accident occurring and number of accidents occurred in that place in the previous years.

TABLE I .OUTPUT COORDINATES AND VELOCITY

Real time position of the vehicles	Output shown is LCD
	
	

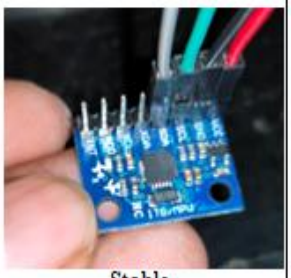
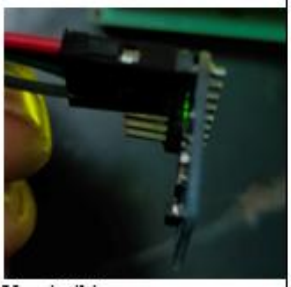
Table I consists of output result in will be displayed on LCD with real time geographical coordinates and velocity. As the predefined velocity of the area is fixed.If the vehicle crosses the predefined velocity in that area then the warning will be displayed on LCD.

TABLE II.DEFINED RANGES FOR PARTICULAR ROADS

Latitude and longitude	Velocity	Warning
Street1 Latitude: 23.83174412152264 to 23.83210724093840 Longitude: 90.417070097772 to 90.41705936193400	10 m/s	No Warning
Street2 Latitude: 23.83210724093846 to 23.832485080333068 Longitude: 90.417059361934 66 to 90.4168501496303	15 m/s	No Warning
Street3 Latitude: 23.832485080333075 to 23.832485630589712 Longitude: 90.4168501496315 to 90.416859657819	20 m/s	Warning Shown In LCD and Buzzer Sounds
Street3 Latitude: 23.832485080333075 to 23.832485630589712 Longitude: 90.4168501496315 to 90.416859657819	If it velocity <17 m/s	No Warning

In table II the velocity ranges for different roads with latitudes and longitudes are shown. Testing the hardware if the vehicle is traveling in road 12 with 50 m/s but the predefined value is less than that of the value. As it exceeds the limit a warning will be displayed on the LCD with buzzer telling to slow down and an immediate SMS will be send to the owner or to whom ever monitoring the vehicle status.

TABLE III. OUTPUT CORRESPONDING TO TILT OF THE VEHICLE

Tilting	Output result
 Stable	
 X axis tilting	
 Y axis tilting	
 -ve Y axis tilting	

In table III the output result in showing the tilt of Gyroscope (IMU sensor). If the vehicle exceeds the limit of the axis predefined then a SMS will be send to the nearby emergency authorities through GSM Module.

VII. CONCLUSION

This paper offers a system that will save the life of many people on roads due to over speed of vehicle. The device was successfully implemented and tested with real time GPS coordinates, but the main drawback for this system is that the velocity is not detected automatically, it is needed to be predefined. In future, further research can be carried out to improve the algorithm for this system and make the system fully operated for accident prevention.

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AUTHORS PROFILE

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