An Arduino Based Accident Prevention And Identification System For Vehicles

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***Abstract*—In this paper an accident prevention system is being introduced with accident identification for vehicles that will give a higher probability to reduce the accidents taking place every day on roads and at the same time if accident occurs, the system will locate its place and will automatically inform those people who will be able to take immediate actions. Here, an Arduino based system has been developed by using Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technology. An accelerometer will also be used that will measure the velocity and the amount of the vehicle's tilting when it will struck over something. When the velocity of the car will be more than the defined maximum velocity for the road or it tilts, a warning will be given automatically. Also, whenever an accident will take place, the GPS will locate the geographical coordinates for that particular place, and using the GSM it will send an SMS. The system is of low-cost and is user friendly.**

Keywords—GPS; GSM; Google Map; Accelerometer; Velocity; Micro SD Card Module; Arduino; LCD.

I. INTRODUCTION

The arrival of modern technology has made our lives much easier and comfortable in comparison with the previous decades. Nowadays, people are becoming more reluctant to vehicles for travelling purpose due to its ease and reduction of time. This leads to increased usage of vehicles, which also increase traffic hazards in a proportionate rate, causing many people to die due to road accidents. Based on the line graph in Fig.1, one can observe that the number of accidents that took place from 2008 to 2016 according to Bangladesh Road Transport Authority, BRTA is decreasing [1]. But, in 2016, the number of accident was almost 2400; this is a lot in number.

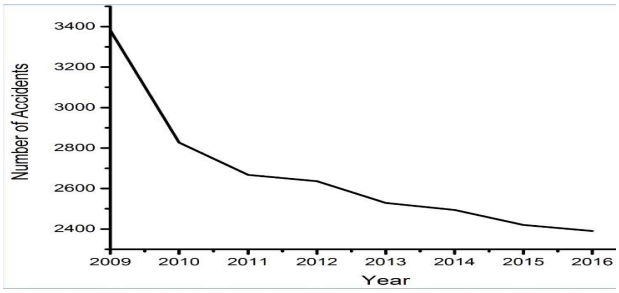

Fig. 1. Accidents per year [1]

For solving this problem, in this paper a system is introduced that is basically GPS and GSM oriented. This system will continuously measure latitude and longitude along with the velocity of the moving vehicles with respect to time. The accelerometer will allow us to detect the velocity of the vehicle and when this value will cross the defined value for that particular geographical coordinates calculated from real time Google Map, a signal will be sent as SMS with the help of Arduino and GSM module. A micro SD card module is also used to generate audio output along with LCD display to aware the people inside the vehicle about the danger. This increases the probability to reduce accidents.

II. RELATED WORKS

Many research works are going on in this topic. Md. Marufi Rahman developed a system that can locate the real time GPS coordinate which will then be sent to a cell phone [2]. Prof. Dr. Bharati Wukkadada, proposed a device that can track animals, resources, and also automobiles that are being robbed [3]. Seok Ju Lee also developed a system that is of low cost and was able to locate vehicle's position in an effective way [4].

III. MODEL OF THE SYSTEM

When the value of the velocity and tilting will exceed the range then a SMS will be sent through Arduino with real time coordinates. This will be shown on the LCD display and an audio output will also be generated through the Micro SD card module. In Fig.2 the model is shown.

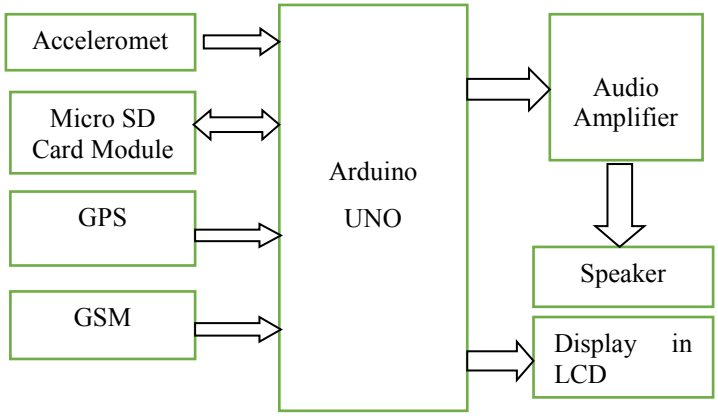

Fig. 2. Architecture of system

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IV. SYSTEM DESIGN

The total system is based of Microcontroller Arduino. Here Arduino is our main controlling unit. After receiving the data from the sensors and GPS module it first fetches the data than decode the data and finally execute its operation. Here in Fig.3 shows the simulation circuit diagram of the designed system where Arduino which is the main microcontroller unit is connected with 10 DOF IMU Sensor (accelerometer sensor), GPS module, GSM module, Micro SD card module, LCD display, and Audio amplifier with speaker.

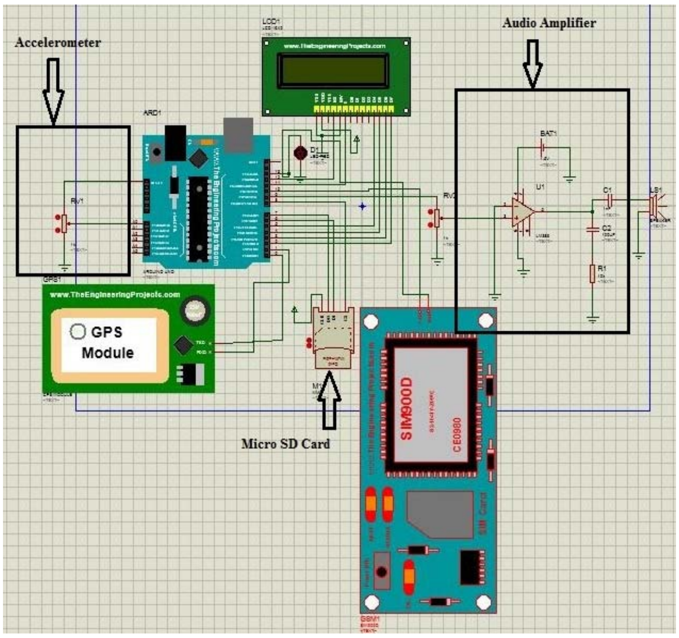


Fig. 3. Simulated circuit diagram

A. *IMU Sensor (Accelerometer):*

An accelerometer is a transducer that is used to measure the physical or measurable acceleration that is made by an object [5].In this paper we used 10 DOF IMU Sensor. This sensor can measure 3-axis accelerometer. As the car tilts, its stable value changes according to the normal 3-axis (x, y, z axis) value. This change is detected as an accident. Now, to prevent the accident the velocity is needed to be calculated. We already know a formula which states that

$$V = at \quad (1)$$

Where, 'a' is acceleration unit: m/s^2, 't' is time unit: s, 'V' is the velocity unit: m/s

Now, when a vehicle starts to travel from its stationary state and continues travelling with an increasing constant speed, the car is said to accelerate in both the x and y axis direction from which it started to travel. So in this way we can calculate the acceleration with respect to time. With these two values and eq 1 the velocity of the vehicle can be calculated. By this method the velocity can be measured and the requirements can be fulfilled.

B. *Arduino Uno:*

Arduino Uno is a microcontroller board based on the ATmega328P [6]. It receives the value of the velocity and the tilting from the accelerometer and checks whether it matches with the defined condition and continues with further proceeding

C. *GPS Module:*

Global Positioning System (GPS) is mainly a satellite oriented system that uses 24 or more satellites. It uses a process called trilateration to find out the exact location of the user. With the amount of time taken for a particular signal to be received the longitude and latitude can be calculated from each satellite [7]. In this project GPS module is used, which

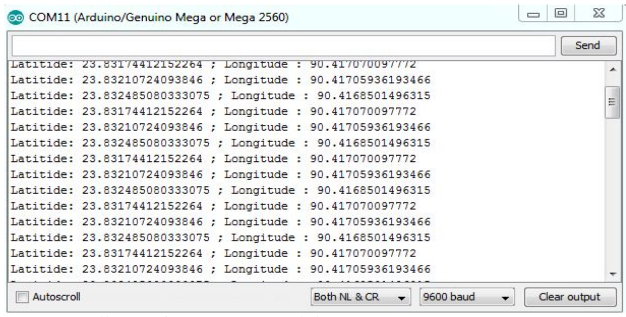


Fig. 4. Coordinates from a GPS module

continuously gives real time GPS coordinates of the current location to Arduino which shown in the Fig.4. A velocity range for the vehicle is specified to Arduino. Then Arduino will compare the velocity with respect to latitude and longitude value.

D. *SIM900A GSM Module:*

GSM is mainly used in devices like mobile phones as well as for long distance communication. It transmits and receives data over GPRS, making video calls and SMS [8]. In this project SIM900A GSM module is used for sending SMS. When the velocity will exceed the range for the given coordinate or when the car tilts implying that an accident occurred, GSM will send SMS to some selected numbers in Fig.5 which shows the SMS received by the cell phone and consists of location and the speed of the vehicle.

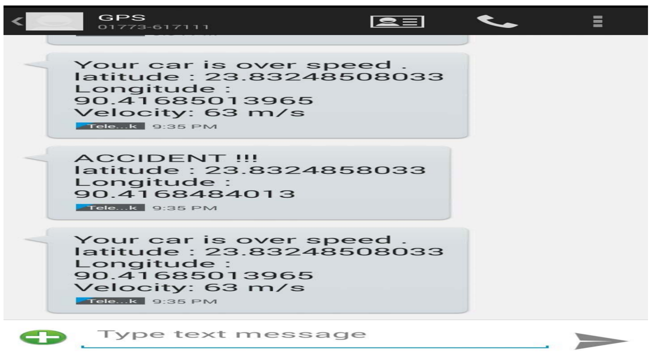


Fig. 5. SMS sent from the GSM module

E. Micro SD Card Module:

The micro SD card module transfers data from a SD card. It can also increase the capability of an Arduino. The Arduino is connected with the SD card through the breakout board and audio commands were saved in this SD card [9]. The connection of the module with Arduino is shown in Fig.3 When the velocity crosses the range for the given coordinates an audio output will be generated to make the people aware about the danger. When the audio commands are played form the micro SD card the audio volume is relatively low. So to make it hearable an audio amplifier was used. A 16*2 LCD display will show the current status of the system. In table 1 the result is shown.

V. HARDWARE CIRCUIT

Here in Fig. 6 the implemented hardware circuit is shown. I2C protocol is used to connect the IMU sensor and Micro SD card module and LCD display [10]. SIM900A GSM Module and GPS Module are connected through the serial communication with Arduino. For driving all the circuit we used a 9v and 2A power supply.

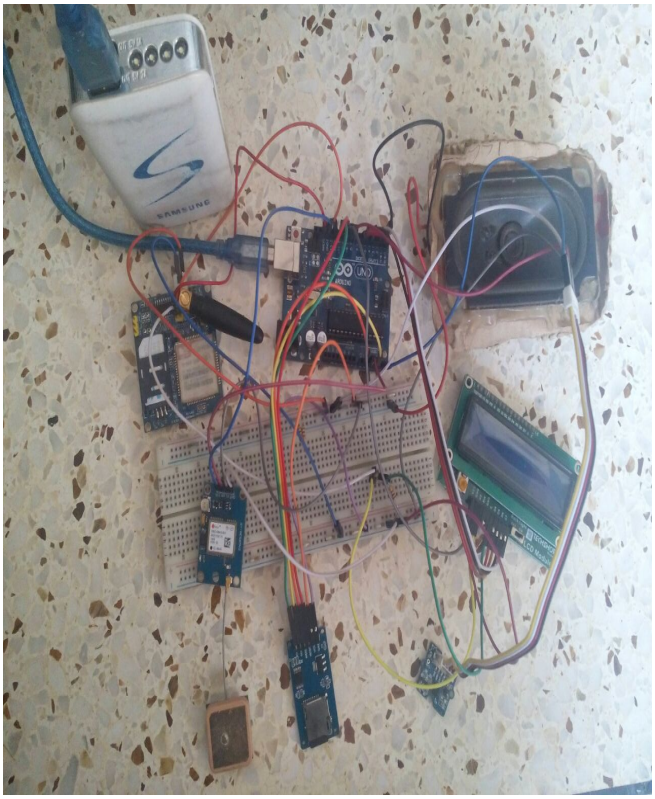


Fig. 6. Implemented Hardware circuit

VI. RESULTS ANALYSIS

TABLE I. LOCATION WITH GPS COORDINATE

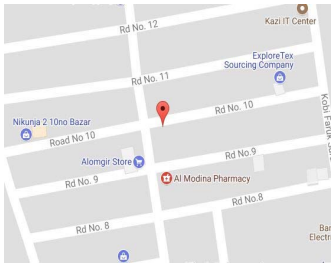
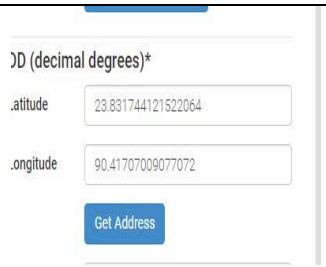
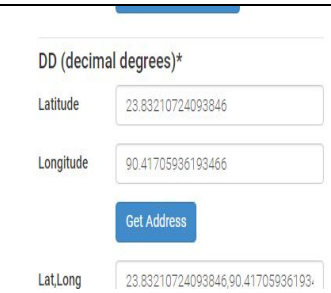
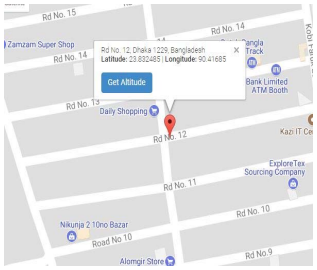
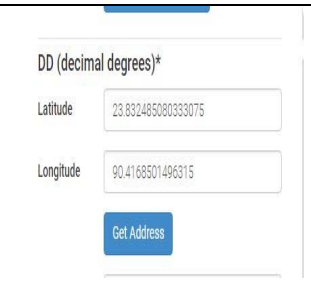
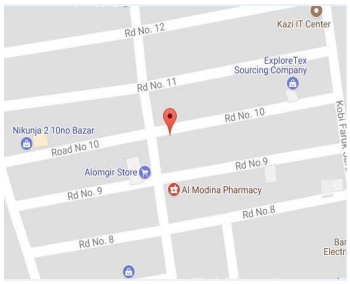
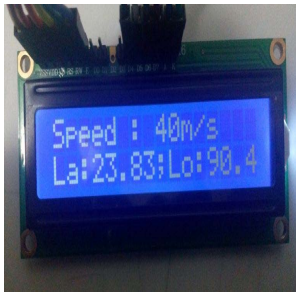
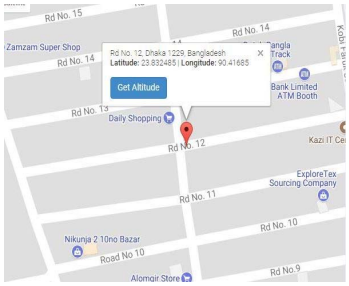
Location on Google map	Corresponding Latitude and longitude value
	
	
	

Table I shows the Google Map position corresponding to its coordinate value. Here a small range of area in Nikunjo-2, Dhaka between road-10, road-11 and road-12 is selected. By using internet [11], the geographical location of this range is found out. Now in Arduino, a predefined velocity is set for a particular range of areas. Suppose, in road-12 the probability of accident that occurs 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, an audio command will be played and a SMS will be send through GSM. There can be different velocity ranges for different coordinates or different latitude and longitude range.

TABLE II. OUTPUT RESULTS CORRESPONDING TO GPS COORDINATES

Real time position of the vehicles	Output shown is LCD
	
	
	
	

Here in Table II the output result in LCD display corresponding with the real time coordinates value is shown.

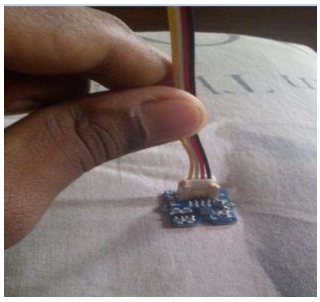
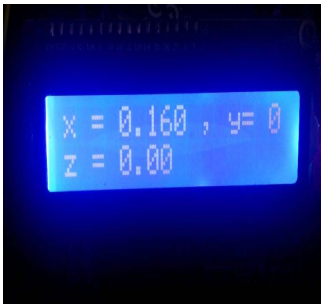
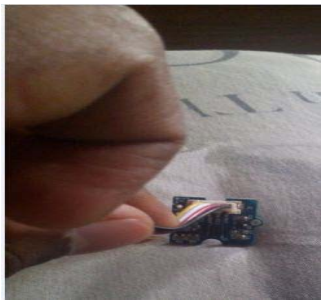
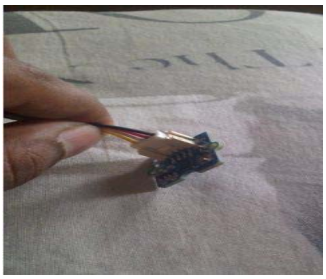
For defined coordinates range a velocity range is also fixed. If the velocity range exceeds the fixed range notification will be shown on LCD.

TABLE III. DEFINED RANGES FOR PARTICULAR ROADS

Latitude and longitude value	Velocity	Audio states
Road- 10 Latitude: 23.83174412152264 to 23.83210724093840 Longitude: 90.417070097772 to 90.41705936193400	>40 m/s	No Audio
Road- 11 Latitude: 23.83210724093846 to 23.832485080333068 Longitude: 90.41705936193466 to 90.4168501496303	40~45 m/s	No Audio
Road- 12 Latitude: 23.832485080333075 to 23.832485630589712 Longitude: 90.4168501496315 to 90.416859657819	>50 m/s	No Audio
Road – 12 Latitude: 23.832485080333075 to 23.832485630589712 Longitude: 90.4168501496315 to 90.416859657819	If it velocity < 50 m/s	Audio will be played

In Table III the velocity ranges and the latitudes and longitudes for different roads are shown. While testing the result the velocity for the road 12 is increased over 50m/s. But the predefined velocity is less than 50m/s, so it exceeds the range of velocity. Therefore, an audio output is played inside the vehicle to aware the people to decrease the velocity since it's over speed, and also a SMS will be sent to owner or the person who can take necessary step.

TABLE IV. OUTPUT RESULT CORRESPONDING TO TILTING

Tilting	Output result
 Stable	
 X axis tilting	
 Y axis tilting	
 Z axis tilting	

In Table IV LCD output result is shown with corresponding tilting of IUM sensor. If any of this tilt happen that's mean an accident accord and a SMS will send to Arduino and SIM900A 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 and the latitude and longitude is not detected automatically, they are 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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