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A smart vehicle accident identification and messaging system using GSM and GPS module

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***Abstract*— In most cases, it is not possible to find the accident location very quickly resulting in delaying the assistance reached to the individual. The objective of this work is to locate a traffic accident by transmitting a message through a device installed inside the vehicle. An ultrasonic sensor is used in this work in a car alarm application to identify vehicles in unsafe areas. Additionally, an accelerometer and vibration sensors are used to accurately track the accident due to the vehicle's rapid acceleration and vibration. A serious accident can be detected using signals from an accelerometer and vibration sensors. When a vehicle is involved in an accident, the vibration sensor detects the signal instantly, and if the car flips over, the accelerometer sensor identifies the indication and directs it to the microcontroller. Consequently, the microcontroller warns the nearby police station or rescue team to send an alert message through the GSM module, together with the specific location. If the accident is minor or the risk is not imminent to anyone's safety, the communication can be switched off by the car user using a switch, saving the emergency rescue team precious time.**

Keywords—Arduino, accident identification, GSM, GPS, LCD, vibration sensor

I. Introduction

Technological advancements have become instrumental in transforming key sectors such as green and renewable energy [1, 2, 3], wireless communication [4, 5, 6], localization and tracking [7, 8], and remote sensing [9, 10]. In green and renewable energy, breakthroughs in solar, wind, and hydroelectric technologies enable the generation of sustainable power, reducing dependence on fossil fuels and mitigating environmental degradation [11, 12]. Wireless communication innovations facilitate seamless connectivity, enabling global access to information and fostering collaboration across distances [13, 14]. Localization and tracking technologies optimize logistics [15, 16], enhance supply chain efficiency and improve asset management in diverse industries [17, 18]. There have been increasing traffic problems and road crashes due to increased demand for vehicles. The lives of the population are at serious risk. This is because our nation does not provide high-quality medical care. This paper outlines an alarm mechanism for an autonomous vehicle crash. This concept will classify collisions within a fraction of the time and transmit essential details, including geographical coordinates, time, and angle of the car collision, to the first-aid center within seconds. This alert message is forwarded immediately to the emergency squad, which saves precious lives. In case there is no casualty, a switch is supplied to prevent the call from being forwarded, which saves precious time for the medical rescue squad. When there is an injury, the ambulance team and the police station get a warning call automatically. The warning is sent via GSM and the direction of the crash is calculated by the GPS. The accident can be reliably detected by both a monitor of the micro-electro-mechanical device (MEMS) and a vibration sensor. You will also find the orientation of the roll-up car in the message from the MEMS sensor. This application provides the optimal solution in cases of traffic accidents to insufficient emergency services.

The internet of things (IoT) is a network of physical devices that link and share data over the internet, such as connected cars, home appliances, and other objects embedded with electronics, software sensor actuators, and other items [19-23]. Smart appliances, smart energy meters, wearable devices, transportation, and smart healthcare devices are all examples of IoT applications [24, 25]. Transportation is extremely important in our everyday lives, and its progress has greatly improved communication. According to public transport, the fourth-largest cause of death in the world is death. Almost 1.3 million people are killed per year in traffic accidents; about 20-50.000 are injured without death. If nothing is changed, 1.9 million people could be killed per year by road crashes by 2020. To provide treatment to the victims, we first need to supply medical responders with the site of the accident [26]. According to the International Road Travel Association, 1.25 million people are killed per year and 50 million are involved in road crashes worldwide (ASIRT). A big public health issue is increasingly recognized as the global crisis of traffic-related accidents and injuries [27-29].

II. Related works

To make smart car modelling possible through the integration of smartphones in cars, the developers of [23] created the car accident detection/warning framework using the second-generation OBD-II GUI. The authors developed an Android program when an accident happens that sends SMS to a predetermined format with the appropriate data and will instantly render an emergency request. In the United States since 2001, the OBD-II format has been obligatory and a European edition is also available. This policy, therefore, extends to all trucks, but not to all cars in other nations, in the United States and Europe. Besides, repairing or upgrading the machine is an expensive operation. In [24], a prototype was developed of a Smartphone-based client/server application called Wreck Watch, using embedded smartphone sensors and communication interfaces, that implemented an accident detection and notification mechanism, thus shutting the detection process off at a low-speed rate and thus avoiding accident detections. However, it is necessary to remember that when travelling at low speed, the car is always prone to an accident.

In the E-call system, an Automatic Clash Identification and Alert Service may be introduced on mobile devices and smartphones [22]. This method also utilized the wireless network to connect between the mobile unit and the data center. The biggest drawback of the E-Call device is that it utilizes the built-in accelerometer sensor of the mobile as a crash sensor, leading to a great deal of displacement when the user is outside the vehicle. The writers of [30] have created a system for the detection of injuries at the University of Baghdad in Iraq using an accelerometer, GPS, and microphones. If an accident occurs, the website and an SMS are transmitted to the 911 contacts and emergency service providers must reach the server to find out more about the accident. Except for a few characteristics their computer uses the same sensors and hardware as this research report. The key concern is that alerts are submitted to a database server and respondents search the webserver for accidents. However, there is no mechanism in place for specific first personnel to trace the victim's place, even where there are multiple emergency services, the system has not been able to transmit urgency alerts to the closest emergency facility.

Wreck Watch, a gadget that uses accelerometer and microphone acoustic data to diagnose collisions, has been created by authors from [28]. When an event takes place, the app alerts nearby emergency responders and provides the crash site with GPS coordinates. The developers have developed an app that uses an accelerometer sensor to identify accidents [23]. When you see a crash, it sends a voice call to the 108 Ambulance Response Service in India automatically. The concern is that this scheme is used only in India and is only available for fundamental emergency management systems. Furthermore, as the mobile error is not filtered, the device is susceptible to increasing the false positives. As a result of dropping the smartphone, etc.

III. System Analysis and Description

A. System requirement

The basic requirements of the system can be divided into two types (i) Software requirements, and (ii) Hardware requirements The main two software requirements of the proposed system are Arduino and Language C++. The major hardware requirements of the system are Arduino Uno, GPS SIM-900A, GSM Module, LCD Display, Vero Board, Transformer, Accelerometer ADXL335, LED Bulb, Resistor, Ultrasonic sensor, Vibrator sensor, etc.

B. System description

This subsection includes the block diagram, circuit diagram, and flow chart of the system.

1) Block diagram: A general block diagram of the system is shown in Fig. 1.

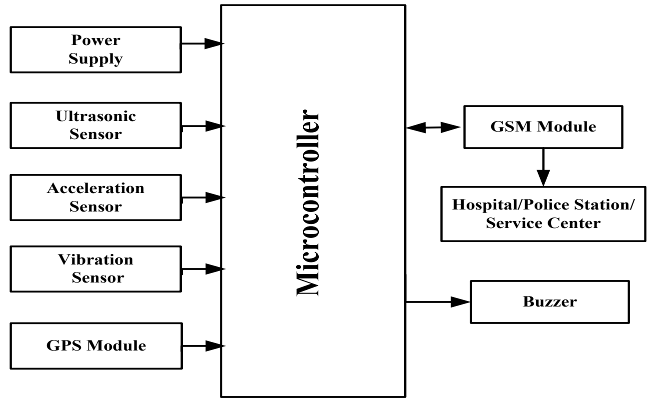

Fig. 1 Block diagram of the system.

The project is branched into three parts presented below:

Accident identification: A sensor called an accelerometer will feel distracted from an accident whether the x, y or z-axis orientation of a car is to be detected. At the start, the vehicle's location is zero grades. Due to dangers, up to 360 degrees in the direction of any axis can be expanded at any moment. Still, if the adjustment goes outside our importance limit, the accelerometer is considered to be an error by the state of affairs. We took the threshold 310 and the threshold 340 respectively for the X and Y axes. The sensor sends the signal to the microcontroller. In both the front and rear of the car, two ultrasonic sensors were included.

Location Tracking: A GPS sensor will easily sense the current position of a car. In this job, this technology was used. Once an accident signal is received by the microcontroller, the current location at the GPS accident point is demanded. GPS complies with [31-34] specifications.

Sending Notification: GSM sends a text note with a link to the nearest hospital and police department from the crash site. As a consequence, the fastest way to save the victim would be really quick to send an ambulance [35-37].

2) Circuit diagram: The basic circuit diagram of the system is shown in Fig. 2.

The proposed car warning system's circuit diagram is quite basic. The GPS module's Tx pin is directly attached to the Arduino Uno RX (RX0) pin in the link diagram. We provided serial communications with pins RX0 and TX0 using the software serial library, making Rx and Tx and leaving the GPS module Rx to pin accessible. Pins 0 and 1 of Arduino are used by default for serial communication, but serial communication with other Arduino digital pins is possible by utilizing the Software Serial library. The GPS module is powered by a 5-volt supply. The Tx and Rx pins of the GSM module are attached directly to Arduino pins D8 and D7. We have used device serial libraries here for GSM interfacing. A 5V supply is also supplied with the GSM module. An Arduino pin 12, 11, 6, and 5 are paired with optional LCD data pins D4, D5, D6, and D7. The RS and EN command pins of LCD are directly attached to the ground with Arduino pins 4 and 3, and RW pins. Often used for contrast setting or LCD brightness is a potentiometer.

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This device is supplemented with an accelerometer to identify an injury, and it is attached to Arduino ADC pins A0, A1, and A2 directly through its x,y, and z-axle ADC output pins

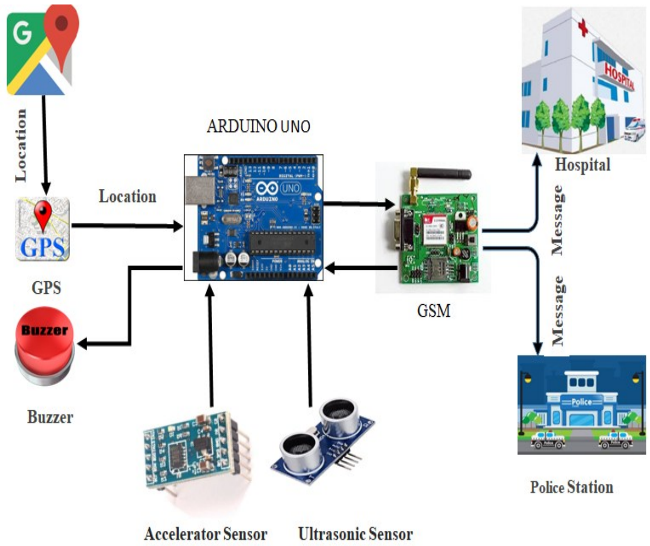
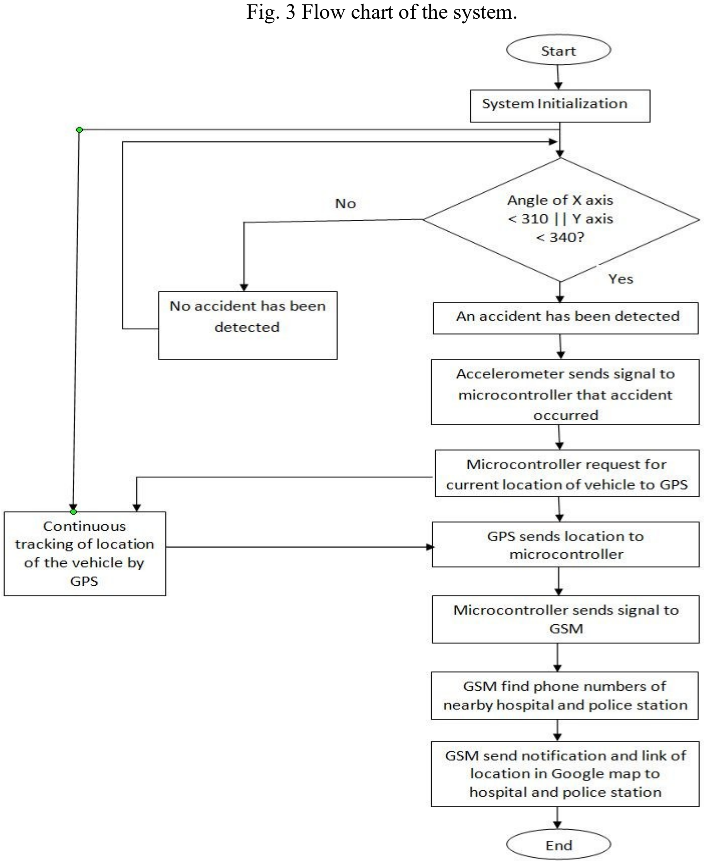


Fig. 2 Circuit diagram of the system.

3) Flow chart: The basic working principle of the proposed system can be represented by the flow chart shown in Fig. 3.

Fig. 3 Flow chart of the system.



IV. Result and Discussions

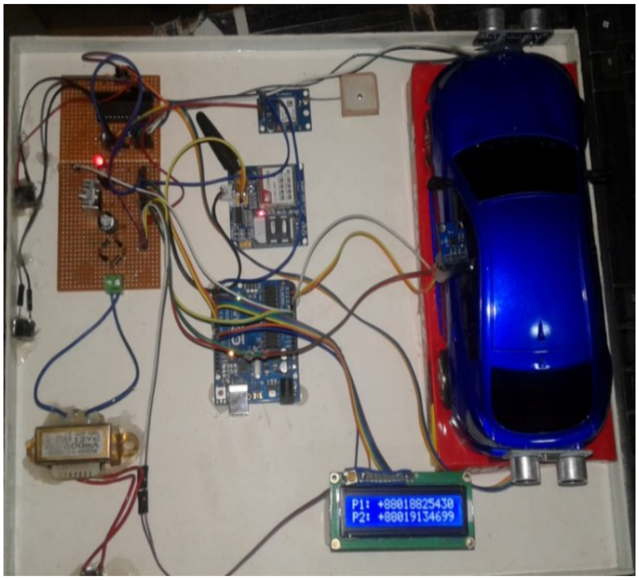


Fig. 4 Real image of the prototype system.

The findings include the efficient operation of automated warning and injury reporting systems. This device will identify an accident and notify an accident survivor to a nearby Police Department and Medical Assistance Centre.

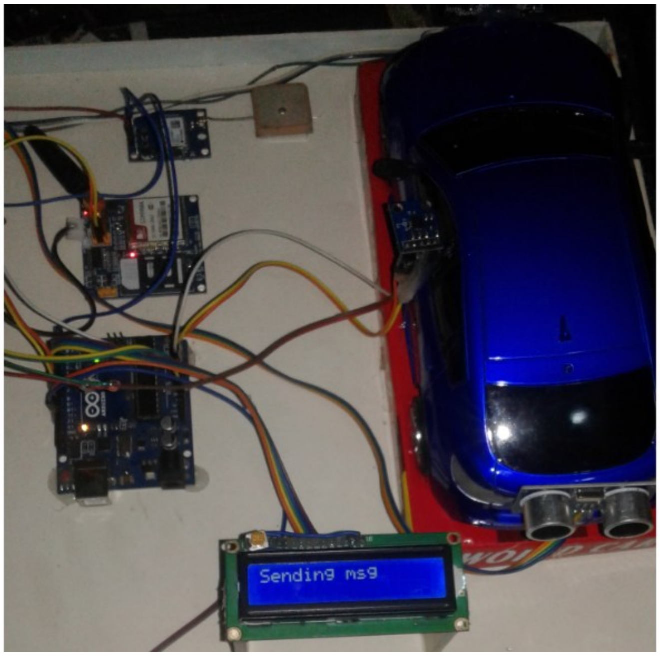


Fig. 5 Real image of the system while sending the message.

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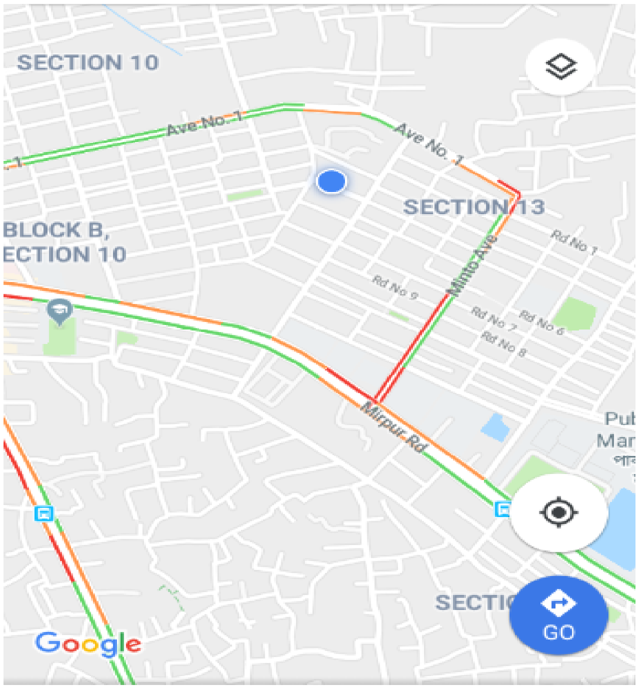

Fig. 6 Location tracking by the proposed system.

Fig. 4 shows the actual picture of the device. In Fig. 4, Fig. 5, and 6, the actual image, position monitoring, and machine message during the accident are seen. The device senses automobile collisions and communicates through the GSM module. Another GSM module will receive the post. The module of Google Maps shows a Google map of the precise size and specifics of the crash. Detailed SMSs are sent from the scene of the crash. Therefore, the coordinates have a slight deviation, the original magnitude of latitude and longitude remains the same, but the fractional meaning varies with a small variance.

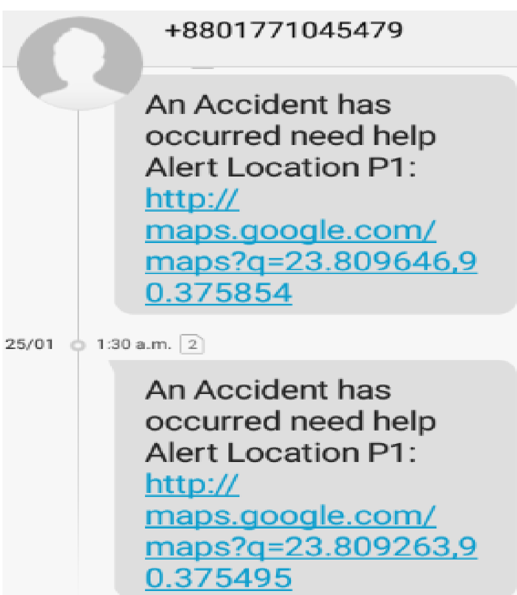

Fig. 6 Sending message during the accident.

V. CONCLUSIONS

The main objective of this article is to present a vehicle accident detection and alert system with SMS to user-defined mobile numbers. This system is the best possible response to inadequate emergency services given to victims of traffic accidents. If an accident happens, this technology allows for quick action to be taken by sending a message to the appropriate people. The GPS tracking and GSM alert-based algorithm is designed and implemented. The proposed vehicle accident detection system can track geographical information automatically and send an alert SMS regarding an accident. The system is successfully implemented and tested. After the detailed experiment, it is observed that this system is efficient and reliable.

However, connectivity can be challenging in some areas where GSM networks are unavailable.

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