IoT-Based System for Automated Accident Detection and Rescue

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Abstract- One of the most common causes of death is auto accidents. The worst thing that may happen to a road user is a traffic accident, despite the fact that they happen regularly. The worst part is that we fail to learn from our on-the-road errors. Most people who use roads regularly are extremely familiar with the fundamental guidelines and safety procedures that should be followed, but it is only their own negligence that results in accidents and wrecks. Accidents and crashes are primarily caused by human error. Here are some examples of normal human actions that result in accidents. 1. Driving too fast; 2. Driving while intoxicated; 3. Distracting the driver; 4. Running red lights; 5. Avoid utilizing safety equipment, such as seatbelts and helmets; 6. Driving erratically and overtaking improperly in order to save lives in a traffic collision, we're going to construct an Arduino-based car accident alert system that combines GPS, GSM, and an accelerometer. If the accelerometer detects an abrupt shift in the vehicle's axis, the GSM module alerts you and communicates the location of the accident to your cell phone. The GPS module's latitude and longitude are utilized to pinpoint the accident's location, which is provided as a Google Map link. The message also contains the vehicle's speed in knots.

Keywords: Vehicle accident alert system, Accelerometer, GSM, GPS.

1 INTRODUCTION

Every time a traffic collision happens, nearby residents must manually call the ambulance, which is a waste of time. Emergency responders must travel farther to reach the accident scene as a result [1]. We're going to create a system that will give victims access to emergency facilities as soon as is practical in order to solve the issue. It has an embedded system coupled with a GPS and GSM module on an Arduino UNO [2-3]. The front of the vehicle is where the entire setup is mounted. The location of the car is determined using the Global Positioning System (GPS). When sending an SMS to pre-coded numbers, GSM is utilized to provide the precise longitude and latitude coordinates of a vehicle's location. The GSM module uses a SIM card to enable two-way communication. Such a module functions just like a typical phone does [4] This application provides the best solution to the problem of insufficient emergency facilities for traffic accidents. Speed is one of the most important and fundamentally dangerous aspects when driving. It not only has an impact on these collisions, but it also makes them more likely [5]. Accidents still happen occasionally despite the numerous efforts made by governmental and non-governmental groups around the world through different programs to raise awareness against irresponsible driving. Many lives could have been saved if the emergency services had been able to get the crash information in time [6]. A research by Virtanen et al. found that 4.6% of accident fatalities would have been averted if emergency services had arrived at the accident scene promptly. In order to save the irreplaceable human life, effective automatic accident detection with automatic communication of the accident site to the emergency services is crucial.

2 LITERATURE REVIEW

A. Piezo Disk Based Automobile Safety System:

The automobile business is expanding steadily all around the world. In order to save lives, a car system must offer safety in dangerous situations. Although many safety precautions are used to make systems more adaptable, there is still a significant gap in emergency facilities. If the emergency services are given crash information and the right assistance is given in a timely manner, many lives can be saved. [7 -8] offers a novel solution to this problem. A standard GPS system is used to track car accidents, and a GSM modem is used to report them. To detect a collision during an accident, we have used numerous piezo disks in this system. The sensor's analog value was read by the Arduino microcontroller [9]. When a sensor's threshold value is surpassed, GSM is used to send the matching GPS coordinates of the accident location to the predetermined numbers [10]. If the driver is secure, he must manually turn off the safety switch before the counter runs out. On LCD, the counter is visible. This method will help in the production of inexpensive automotive safety systems.

B. Building intelligent transportation systems with Bluetooth and sensor networks:

If vehicles can be made to form groups for data communication, the safety of road traffic can be increased. When two or more automobiles are equipped with Bluetooth devices, they can communicate with one another using the Bluetooth protocol [11]. The principles of wireless sensor networks and the Bluetooth protocol are used in this work to provide a fresh strategy for enhancing road safety. We go through the formation of mobile ad hoc networks by cars and how they can share sensor data [12]. These data might be combined to provide a better knowledge of the traffic conditions in the area. It is assessed whether Bluetooth can be used by automobiles to communicate data. Investigating coverage area and likelihood of detection plots for isotropic and non-isotropic sensors can help us learn how to use sensors to stop potentially dangerous traffic scenarios [14]. The simulation findings demonstrate how Bluetooth and sensor networks may work together to improve road safety.

C. Bluetooth Wireless Monitoring, Managing, and Control for Inter-Vehicle Vehicle Ad-Hoe Networks:

The number of accessories that car owners demand to have in their vehicles is increasing, but the available accessories must be managed manually by the driver and improperly by a smart system. These attachments can all be manually controlled by the user using various standalone controllers. Additionally, RF technology, which is not present in mobile devices, is used by the controller itself. In order to manage, operate, and monitor all the gadgets within the car using a personal mobile phone, a comprehensive and integrated system is therefore necessary [15]. Design and creation of a comprehensive system for managing and controlling all inter-vehicle accessories, enhancing the utility and effectiveness of inter-vehicle communications for drivers.

Approach**:** The suggested system was created using Java, Bluetooth, and Microcontroller technology to realize the idea of an intelligent car with the ability to use a remote mobile phone interface.

There are two steps to the development plans for this innovation: (1) smart phone and PDA application platform built on the Java programming language (2) Using monitoring and control mechanisms provided by Bluetooth media, a smart system compatible with the receiver side is designed and implemented on hardware to manage and link all interior accessories.

Results**:** The components of hardware and software systems were planned, and the finished prototype had undergone successful testing on actual automobiles. The user can monitor and manage the vehicle accessories by installing the system interface on a mobile phone during the testing stage. The system's effectiveness, adaptability, and breadth of functionality have been demonstrated with the use of various car accessories [16].

Conclusion: This project includes developing a novel technology to lower interior vehicle temperatures that are harmful to the driver's health and to enable the driver to operate some automotive accessories using a mobile phone. The car's accessories can link to the microcontroller and be controlled by a mobile application after it has a Bluetooth module and control system installed.

D. Using cellphones to identify car accidents and give first responders situational awareness:

Accident detection systems speed up the reaction time of emergency personnel, hence reducing the number of fatalities resulting from auto accidents. Smartphones and the sensors built into them, such GPS and accelerometers, are intriguing building blocks for such systems. Three new findings in the study of smartphone- based accident detection systems are presented in this publication. First, we discuss approaches to important problems in traffic accident detection, like avoiding false positives by using mobile context information and polling onboard sensors to identify significant accelerations [17].

Second, We describe layout of the prototype Smartphone-based accident detection system and conduct an empirical analysis of both its capability for accident reconstruction and its resistance to false positives [18]. The third topic we cover is how Smartphone-based accident detection might lessen general traffic congestion and improve emergency responder readiness.

E. Full Microcontroller Based Vehicle Accident Detection System with Saudi Arabia Case Study:

It was discovered that Saudi Arabia records more than 500 thousand incidents annually with up to 17 fatalities per day, making the issue of road accidents there a major and enormous concern. We were inspired to do extensive study and develop a proposal for a solution that can lessen the impact of traffic accidents because such high numbers are primarily caused by the absence or delay in responding to the wounded person's needs for assistance. In this work, we provide a sensor-based microcontroller system that identifies accidents as soon as they happen by combining a variety of sensors and modules with an Arduino microcontroller [19]. In order to enhance and deliver data more precisely, we have integrated the Airbag sensor.

3 IMPLEMENTATION OF THE SYSTEM

3.1 System Hardware & Functioning

A microcontroller, microprocessor, or DSP (Digital Signal Processor) may serve as the central processing unit (often referred to as a processor). Microcontroller is a term used to describe a low-cost processor. Its main selling point is that it will have a number of extra parts on the chip itself, including memory, a serial connection interface, and an analog-to-digital converter. A microcontroller is the greatest option for small applications as a result of the low requirement for external components. On the other hand, although they need many more components, microprocessors are more powerful.

D5P is mostly used in signal processing applications like audio and video processing.

Two types of memory : random access memory (RAM) and read-only memory (ROM). The RAM contents are lost if the chip's power is turned off, however the ROM contents are kept even if the power is turned off. The firmware is therefore retained in the ROM. The CPU reads the ROM and starts the software when the power is turned on. input gadgets The capabilities of an embedded system's input devices are much more constrained than those of desktop computers. It will be challenging to connect to the embedded system because there won't be a keyboard or mouse. Many embedded devices come with a tiny keypad where you can type a

single key to send a specific command. Using a keypad, only the digits may be entered. Many embedded systems used in process control don't have a way for people to interact with them; instead, they gather data from sensors or other transducers and turn it into electrical impulses that are delivered to other systems.

The capabilities of embedded systems' output devices are also rather constrained. Some embedded systems will use a few Light Emitting Diodes (LEDs) to show the state of the system's components' health or to visually communicate alerts. A tiny Liquid Crystal Display (LCD) may also be used to display some crucial parameters.

Fig.1. Block diagram of Arduino UNO

3.2 Hardware and Software Requirements

Vibration Sensor:

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LCD:

An LCD (Liquid Crystal Display), an electronic display module, is shown in Figure. A 16x2 LCD display is a widely used, reasonably basic component that is utilized in numerous different types of devices and circuits. Above seven-segment and other multi- segment LEDs, these modules are advised.

GSM:

GSM modems are a specific type of modem that function over wireless networks with subscription-based service in a way like to a mobile phone. By utilizing a Subscriber Identity Module (SIM) card, a GSM modem functions on a computer similarly to a mobile phone. Such a modem can even be a dedicated mobile phone that the computer uses for GSM network functionality. For dial-up connectivity to other computers, PCs are linked to conventional modems. Similar functions are carried out by a GSM modem, however instead of using a phone line, it transmits and receives data via radio waves. A USB cable or a serial cable can be used to connect this type of modem to an external device. It is frequently a small gadget that simply slips into a USB port or card slot on a desktop or laptop. The world

uses this mobile technology for communication on a large scale. GSM, an open, digital cellular technology, uses the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands to deliver mobile voice and data services.

Features :

International roaming with improved spectrum efficiency ISDN (Integration Services Digital Network) compatibility support for new services. Administration of the SIM phonebook through a set calling number Timer in real-time with alarm control.

GPS:

The Global Positioning System (GPS), a satellite-based navigation system, can be used to find positions on the earth. The US Department of Defense designed and maintains it; it consists of satellites, control and monitoring stations, and receivers. Using information gathered from the satellites, triangulation is a technique used by GPS receivers to pinpoint a user's exact location. There are numerous scenarios in which GPS can be used.

Power Supply:

The H-bridge idea underlies how it works. Voltage can go in either direction thanks to an H-bridge circuit. Because a DC motor requires that the voltage change its direction in order to revolve either clockwise or anticlockwise, H-bridge IC are ideal for driving DC motors.

ESP32 CAM:

The ESP32-CAM is a tiny camera module with an ESP32-S microcontroller that costs about $10. In addition to the OV2640

camera, it contains a microSD card port and other GPIOs for attaching external devices.

Fig.2. ESP 32 CAM

4 Visualisation and Analysis

Fig.4. GSM Module

Fig.5. GSM Module

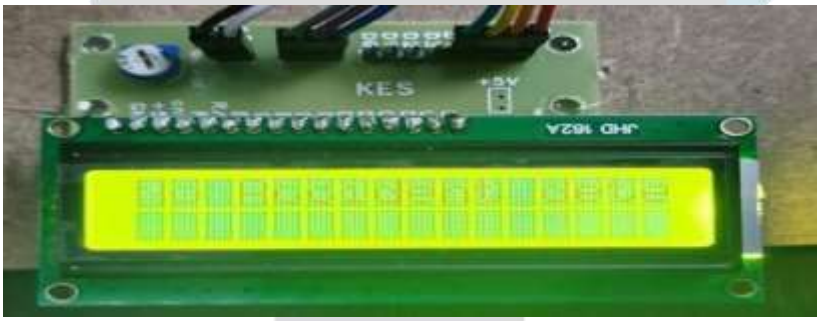

Fig 6. LCD

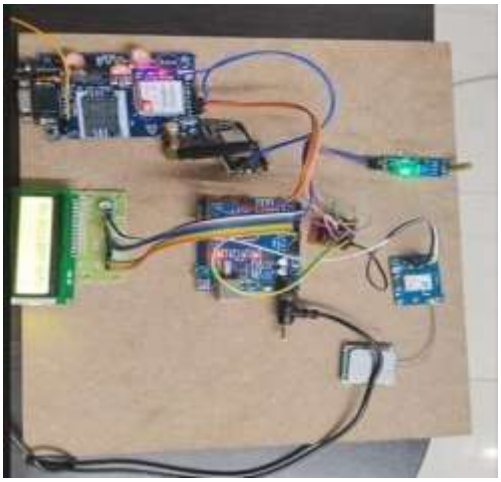

Fig.7. Accident Detection

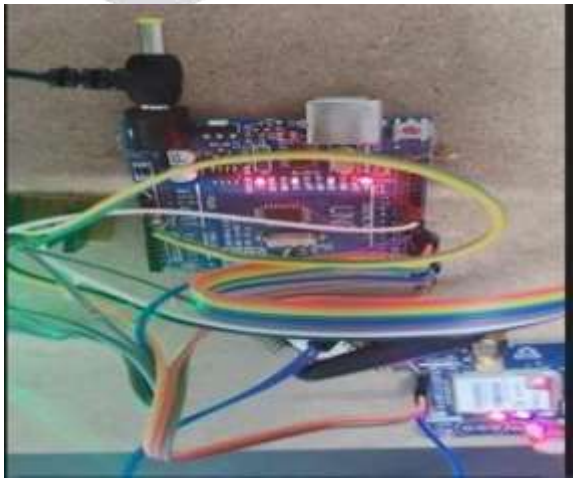

Fig. 8. Vibration Sensor

Fig. 9.GPS

Fig.10. SMS alert

5 RESULT

We have successfully developed an IoT device that possesses the capabilities of detecting , monitoring, and communicating accident detection . The integration of the webcam with this model will help people with real situation of the victim the monitoring system will help to detect any collision happened in the vehicle and by using alert system it is going to access all the contacts and share information about the accident to nearby police stations and rescue system's and even for victim relatives in this way our device helps to detect accidents happened in a vehicle and save user from accident

6 CONCLUSION

We have success fully developed an IoT accident detection device for detecting accident happened in the respective vehicle The suggested system is designed to offer information on how and where an accident happens. It is beneficial to be able to quickly offer assistance and support to the accident victim. The GPS module in this system is used to find the car. GSM is used to disseminate accident information. The proposed systems' outcomes are satisfactory. This suggested model does not require several crash sensors, saving both money and the hassle of

interface design. When an accident occurs, the crash sensor needs to activate. Overall, accident detection and rescue systems have the capacity to substantially reduce the impact of accidents, enhance public safety, and save lives. Continued advancements in technology and collaborative efforts will shape the future of these systems, making our roads and public spaces safer for everyone.

7 Future Scope

In the future, we will be able to interact with many sensors, including those that detect alcohol, fatigue, and heart rate. We can actually avoid accidents in this regard and save lives. Another way to do this is to link to a controller module that takes pictures of the accident scene to facilitate tracking. Additionally, we can use machine learning techniques to recognize the victim's facial expressions.

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