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Accident Detection and Alert System

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Abstract - Every day, a large number of people die as a result of accident injuries all over the world. The time between the occurrence of the accident and the arrival of emergency responders at the scene is an important indicator of survival rates after the accident. Reducing this time may have an impact on the number of fatalities. The main factors that cause delays in providing medical assistance are traffic congestion, a lack of ambulance services, a lack of network connectivity, and negligence.

In our project, we present an Arduino-based Accident Detection and Alert System that will minimize the time gap and ensure immediate medical assistance. The proposed system ensures that emergency services are available to accident victims as soon as possible by informing relatives, hospitals, or a rescue team of the accident spot with the help of a module embedded in the vehicle. In case of an accident, the sensors attached to the microcontroller are activated, and the GSM system sends an alert to the nearest hospital, police station, along with the location where the accident has occurred. GPS locates the location of the vehicle where the accident occurred using a space navigation system.

This will enable the response team to arrive at the accident scene and provide medical support to the victim in a timely manner. This project will help to decrease the response time and thus reduce the death toll.

Keywords - Accident Detection, Accident Prevention, Alert System, Arduino, GPS, GSM, Accelerometer.

1. INTRODUCTION

Road accidents are a major concern for individuals and societies worldwide, causing significant loss of life, property damage, and physical injuries. Unknown accident spots can also delay rescue operations, causing further loss of life and property. In order to address these problems, an accident detection and alert system has been proposed that can quickly identify accidents and inform emergency services or concerned family members of the precise location. The need for an accident detection and alert system has become increasingly important due to the rising number of road accidents. According to the World Health Organization (WHO), road accidents account for 1.35 million deaths and 50 million injuries annually, making them one of the leading causes of death worldwide. Furthermore, in many cases, people do not have access to nearby hospitals to receive medical assistance before suffering a severe loss. This highlights the urgent need for a system that can quickly detect accidents and inform emergency services or family members, ensuring that victims receive timely medical attention and reducing the quantity of traffic-related fatalities.

The proposed accident detection and alert system comprises hardware and software components. Accident identification sensors are part of the hardware unit and are managed by an Arduino board that is mounted inside the car. The sensors detect any sudden change in the vehicle's motion, indicating an accident. The software component is an Android mobile application installed on the driver's smartphone. The app receives the precise location of the accident and sends an SMS to the relevant authorities, such as emergency services or concerned family members. This ensures that emergency services can be dispatched to the accident location as quickly as possible, providing the victims with timely medical attention.

The benefits of the proposed accident detection and alert system are numerous. It is cost-effective, secure, and user-friendly. The system can play a critical role in reducing the death rate in accidents and can be a lifesaver for those concerned about road crashes. By detecting accidents and informing emergency services or family members, the system ensures that victims receive timely medical attention, reducing the number of fatalities caused by road accidents.

2. LITERATURE REVIEW

There exist several studies for vehicle accident detection and reporting systems using GSM, GPS, and other related technologies. A. S. A. Prabhu and M. K. Manikandan, 2021, presents a novel approach to detecting and reporting road accidents in real-time using Arduino microcontroller-based systems and GSM technology.

S. S. Raut and V. S. Patil, 2019, developed an Arduino-based real-time accident detection and notification system using GPS

and GSM modules. The system uses an accelerometer and GPS module to detect accidents and sends notifications to emergency contacts via SMS.
A. S. Patil, S. S. Suryavanshi, and S. V. Bachute., 2020, proposes a study to describes the development of a smart helmet that can detect accidents and send an alert using Arduino technology. It highlights the potential benefits of using microcontroller-based systems in accident detection and reporting.

A. B. Kandalkar and M. D. Pande, 2020, developed a smart vehicle accident detection and notification system using IoT. The system uses an accelerometer, GPS module, and GSM module to detect accidents and sends notifications to emergency contacts via SMS.

D. D. Durgadevi and M. Nandhini, 2018, proposed a study that emphasizes the need for a reliable and low-cost system for vehicle accident detection. The authors demonstrate a practical and efficient solution by developing a system that uses an Arduino microcontroller and various sensors to detect an accident and alert authorities via SMS through GSM communication technology.

A. M. Chandurkar, S. S. Nagdive, and R. G. Bhoyar,2018, the authors demonstrate a system that detects sudden vehicle accelerations, rapid decelerations, and collisions in real-time using an Arduino microcontroller and a GSM module.

3. PROBLEM STATEMENT

The inability to detect accidents accurately and report their location in a timely manner poses a significant challenge in accident management. This has led to a rise in the number of accidents, and the delayed arrival of emergency services has resulted in numerous fatalities. Hence, it is imperative to transport accident victims to the hospital without delay. The lack of reliable tools for swift accident detection and reporting worsens this issue, and urgent solutions are needed to address this problem.

4. OBJECTIVE OF THE PROJECT

The objective of the project is to design and develop a system that can detect accidents in real-time and alert the relevant authorities or emergency services. The system should be able to detect accidents accurately and quickly, so that timely assistance can be provided to the people involved in the accident.

5. PROPOSED METHODOLOGY

5.1 HARDWARE REQUIREMENTS:

- Arduino Uno
- GPS module (Ublox NEO-6M)
- GSM module (SIM900A)
- Accelerometer
- Collision Sensor Module
- Battery or power supply
- Connecting Wires
- LED and buzzer for alert notifications
- USB Cable
- Soldering Kit

5.2 SOFTWARE REQUIREMENTS:

- Software - Arduino IDE

5.3 IMPLEMENTATION:

5.3.1 Setting up the Hardware Components

The first step in implementing the system is to set up the hardware. We will connect the GPS module to the Arduino board using jumper wires, with the GPS RX connected to Arduino TX, GPS TX connected to Arduino RX, GPS VCC connected to Arduino 5V, and GPS GND connected to Arduino GND. Next, we will connect the GSM module to the Arduino board using jumper wires, with the GSM RX connected to Arduino TX, GSM TX connected to Arduino RX, GSM VCC connected to Arduino 5V, and GSM GND connected to Arduino GND. We will then connect the accelerometer to the Arduino board using jumper wires, with the X, Y, and Z pins of the accelerometer connected to Arduino A0, A1, and A2, respectively. The VCC pin of the accelerometer will be connected to Arduino 3.3V, and the GND pin will be connected to Arduino GND. If we are using an LCD panel, we will connect it to the Arduino board using jumper wires as well.

5.3.2 Writing the Code

Once the hardware is set up, we will move on to writing the software for the project. We will first install the required libraries, including the TinyGPS++, Adafruit ADXL335, and SIM900A libraries, in the Arduino IDE. We will then write the code to read data from the GPS module using the TinyGPS++ library. This code will continuously read the GPS data and extract the GPGGA string to get the current location coordinates. We will then write the code to read data from the accelerometer using the Adafruit ADXL335 library. This code will continuously read the accelerometer data and check for sudden changes in any axis. If a sudden change is detected, we will use the GPS data to determine the current location of the vehicle and send an SMS message using the SIM900A library. The SMS message will contain the current location coordinates and the speed of the vehicle, and it will be sent to a pre-defined number using the GSM module. If we are using an LCD panel, we will also write the code to display the speed of the vehicle on the panel.

5.3.3 Integration and Testing

Once we have written all the code snippets, we will combine them and test the system using a power source, such as a 9V battery. We will verify that the system is functioning correctly by tilting the board to simulate an accident and checking if an SMS message is sent to the pre-defined number. We will also verify that the LCD panel displays the speed of the vehicle correctly.

5.3.4 Working Explanation

When we are ready with our hardware after programming, we can install it in our vehicle and power it up. Now, whenever there is an accident, the car gets tilt and accelerometer changes his axis values. These values read by Arduino and checks if any change occurs in any axis. If any change occurs then Arduino reads coordinates by extracting $GPGGA String from GPS module data (GPS working explained above) and send SMS to the predefined number to the police or ambulance or family member with the location coordinates of accident place. The message also contains a Google Map link to the accident location, so that location can be easily tracked. When we receive the message then we only need to click the link and we will redirect to the Google map and then we can see the exact location of the vehicle. Speed of Vehicle, in knots (1.852 KPH), is also sent in the SMS and displayed on the LCD panel.

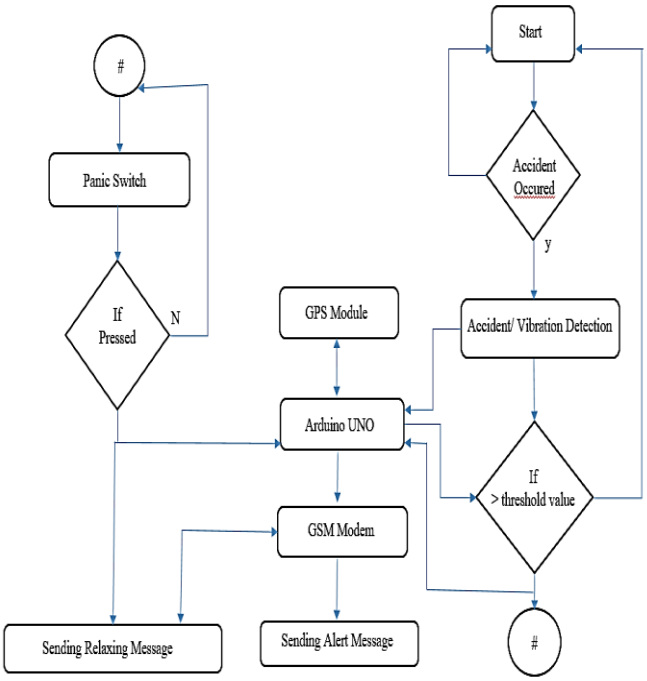

Fig 1: Flowchart of Accident Detection and Alert System

6. EXPERIMENTAL RESULT

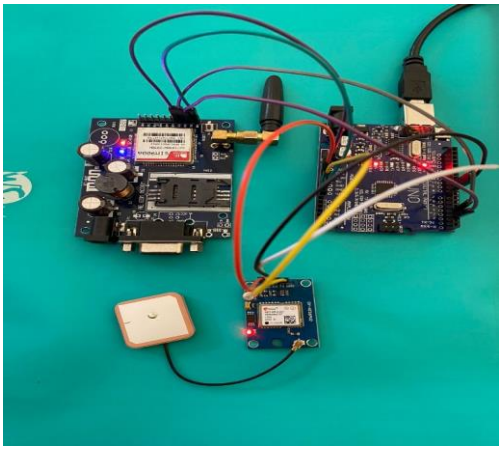

Fig 2: Interfacing Arduino UNO with all other modules

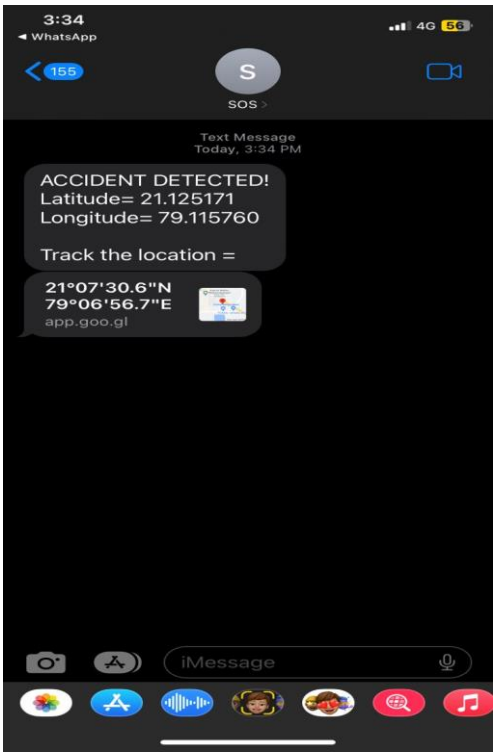

Fig 3: Alert Message

7. CONCLUSIONS

The Arduino-based accident detection and alert system project is an incredibly valuable and potentially life-saving application. By integrating various sensors, such as accelerometers, GPS, and GSM modules, the project successfully detects and communicates the location and severity of accidents, with the Arduino microcontroller board acting as the central processing unit.

In real-time, the system can detect accidents and report them quickly, leading to faster emergency response times, which can significantly reduce the chances of severe injuries or fatalities. Moreover, the project's potential economic benefits and the valuable data it can provide for road safety research and policymaking demonstrate its importance.

Overall, this accident detection and alert system project is an innovative and critical solution that addresses significant societal issues, underscoring the importance of incorporating technology to enhance people's lives.

8. FUTURE SCOPE

Accident detection and alert systems can be improved and expanded in several ways to reduce response times and save lives in emergency situations such as-

Real-time monitoring: Real-time monitoring using sensors, cameras, and GPS technology can detect accidents as soon as they occur and alert emergency services immediately.

Advanced analytics: Advanced analytics using machine learning algorithms can predict potential accidents and help authorities take proactive measures to reduce the risk of accidents.

Integration with smart city: The integration of accident detection systems with smart city infrastructure can improve traffic flow, reduce congestion, and make roads safer.

Mobile apps: Mobile apps can provide real-time alerts to users, enabling them to take alternative routes and avoid accident-prone areas.

Vehicle-to-vehicle communication: Future vehicles may be equipped with communication technology that enables them to communicate with other vehicles on the road. This can help prevent accidents by alerting drivers to potential hazards and providing real-time traffic updates.

In conclusion, accident detection and alert systems hold significant potential to save countless lives and reduce the economic impact of accidents. As technology continues to advance, we can expect to see even more innovative solutions to this critical issue.

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