Smart Arduino Based Accident Protection System Using Multiple Sensor

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***Abstract*—Numerous people lose their lives in traffic accidents every day. In India, 4,80,652 traffic accidents resulted in a total of 1,51,113 fatalities in 2019. In terms of road accident deaths, India currently retains the top rank. Excessive speed was the primary cause of fatalities in road accidents. To save the lives of several injured accident victims, this is a serious problem that needs to be remedied. In order to address the ongoing challenges surrounding automobile accidents, various automobile companies have implemented a range of safety systems, including safety airbags, seat belts, camera sensors, and more. Despite these efforts, the root causes of accidents and their resulting effects have proven difficult to mitigate entirely. To tackle this persistent issue effectively, there is an urgent need for a comprehensive system that can automatically detect accidents as they occur. This system would play a crucial role in promptly communicating vital information about the accident and its precise location to both nearby hospitals and concerned relatives without any delays. When a car has an accident, the accelerometer immediately provides data to the Arduino, which then sends the alarm message through the GSM MODULE, including the location that is identified by the GPS MODULE, to recently saved crisis contacts.**

***Index Terms*—Arduino, Gas Sensor, Eye Blink Sensor, Accelerometer, GSM & GPS Module, Buzzer, LED**

1. INTRODUCTION

The use of vehicles has significantly increased in the modern world, which has increased traffic volume and, in turn, contributed to an increase in road accidents. Due to a lack of timely preventive and safety facilities, this damages the property and results in human life loss. The proposed embedded system takes the necessary precautions to prevent accidents from happening. As the position was provided to the emergency services' smart devices with mobile network accessibility coupled with a link to a Google Map, they could quickly locate the area. Approximately 1214 road accidents occurring every day. Major road accidents in India are caused due to the over speeding and violation of traffic rules. The road accident rates are increasing day by day due to large numbers of vehicle running on the road. In all these Vehicles, the speed control needs to be implemented. Here is the new idea of ours to install an automated speed control system in the vehicles to control the speed mainly in the restricted areas like school, college zones etc. In the event of an accident, the accelerometer picks it up, GPS is used to determine the location, and then a GSM module is used to communicate the information to the police and ambulance service.

The message received on a mobile device includes the address of the accident site in the form of a Google Maps link, which will assist emergency services like ambulance services and police stations in quickly reaching the victim and saving lives. Additionally, the information that the sensors have stored can be used later to look into the accident. Since the system is being watched over by a cloud, several criminal behaviors can be traced and observed. In the event of a chase or other emergency, the cloud service can remotely stop or lock the car.

2. PROBLEM STATEMENT

India's extensive road network poses a distinctive challenge in responding to accidents, relying on nearby individuals for emergency help. This becomes problematic if there's no one around or if they fail to make the necessary call, resulting in delays in

assistance and tragically leading to a significant number of deaths. Adding to the problem, the existing system is burdened by excessive costs, hampering the effectiveness of emergency responses. An essential aspect is the incorporation of a system that not only promptly alerts nearby police and hospitals but also does so at a lower cost. This requirement emphasizes the need for a more affordable and efficient solution to navigate the complexities of India's extensive and diverse road infrastructure while ensuring timely and cost-effective rescue operations. (7)

3. LITERATURE REVIEW

Accident Prevention and Alert System using Arduino using IoT technology which was published by Aswin, Sujitha, Archunan, Sandhya Devi R in the IRJET journal in 2021. The paper was proposed towards generation of alerts and alarms using Buzzers and LEDs in case of accidents. Arduino-Home which is available on the Arduino.cc website. The paper was published by Arduino itself and was intended towards the use of Arduino Uno R3 and circuit design. An Arduino Based Automatic Accident Detection and Location Communication System which was published by Souvik Roy, Akanksha Kumari, Pulakesh Roy, Rajib Banerjee in IEEE Xlpore in 2020. The paper was focused towards implementation of Vehicle Tracking using GSM/GPS/GPRS automatic alerts. IoT in Connected Cars: Challenges and Chances which was published by B. Lakshmipraba, V.G. Shivakumar in IJEAT in 2019. The findings of the paper are uses of IoT in vehicles and their use cases in various scenarios and challenges. Research Study on Advanced Driver-Assistance Systems (ADAS) published by J. Anand, A. Manoj Kumar, K. Naresh, G. Janakiraman on IRJETS in 2021. The paper consisted of implementation and working principle of ADAS system. Cloud Computing Arduino Cloud IoT Integration with REST API published by Nemese Kalubi, Sayeed Sajal in IEEE Xplore in 2022. The paper was intended towards to connect an Arduino to a cloud to share and monitor data.

Using Arduino to create a smart accident detection, reporting, and prevention system. Alcohol/gas sensors, eye- blinking sensors, and other sensors are employed since these two factors account for the majority of accidents: drunk driving and driver inattention. Following this, automatic notification of emergency contacts is made in the event of accident detection. car recovery after theft at no additional expense. Delivering emergency assistance more quickly. safety of the vehicles and efficient fleet management. decreased number of traffic collisions. Any car can easily and inexpensively have the system installed. Additionally, ADAS compatibility for autonomous steering and braking is possible. This would be useful for observing, checking, and looking into several illicit actions.

4. PROPOSED SYSTEM

When a collision occurs, the accelerometer detects it up, GPS is used to determine the location, and then a GSM module is used to communicate the information to the police and ambulance service. The message received on a mobile device includes the address of the accident site in the form of a Google Maps link, which will help rescue agencies, such as ambulance services and police stations, reach the victim swiftly and save lives.

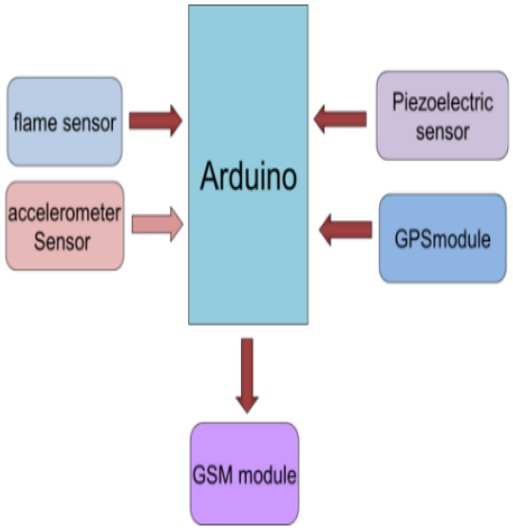

Fig.1 Block Digram of Proposed System

The sensor-based accident detection and rescue system seamlessly integrates crucial components to enhance road safety. The GPS Sim28ML module provides precise real-time location tracking, and the Arduino Uno acts as the central unit, efficiently coordinating the functionalities of various sensors. The accelerometer and piezoelectric sensors play pivotal roles in collision detection, prompting the GSM Sim800A module for immediate wireless communication. The addition of a flame sensor further

refines the system, prioritizing responses to potential fires. This well-coordinated system architecture ensures swift emergency responses, overcoming challenges through meticulous calibration and programming. Vehicle unit Transfer the information to the emergency contacts like police control room and an ambulance unit.

The system will carry out preliminary inspections to help prevent accidents, and in the event of an incident, quick reporting is carried out to help prevent loss of life. In addition, our established system will aid in the surveillance and detection of crimes involving vehicles, such as auto theft, excessive speeding, and drug trafficking.

5. SYSTEM ARCHITECTURE

5.1. Hardware Requirement Specification

5.1.1. Arduino: -

It is a board-based microcontroller called the Arduino Uno. Six analogue inputs, fourteen digital input and output pins, a reset button, a power jack, an ICSP header, a USB port, and a 16 MHz ceramic resonator are all included. Simply put in a USB cable, an AC-toDC adapter, or a battery to start using it; it already includes everything required to support the microcontroller.

Fig. 2 Arduino

The open-source Arduino platform is mostly used to develop electronic projects. UNO is the board that is used the most.

5.1.2. GPS Module: -

Fig. 3 GPS Module

The global positioning system (GPS) is a satellitebased system that determines and records its position on Earth using both the ground and satellites. GPS receivers receive data signals from GPS satellites and learn their best practices from the satellites. By calculating the amount of time needed for the sign to travel from the satellite to the beneficiary, this is completed. The GPS beneficiary module provides output in the NMEA string format, which is the industry standard. It provides yield on the Tx pin sequentially at the standard 9600 baud rate. The NMEA string for this GPS recipient contains a number of parameters, such as longitude, range, elevation, time, and so on. Every string starts with a dollar symbol ($) and ends with a carriage return or line feed. Looking ahead, the GPS module remains instrumental in shaping the future of efficient and responsive accident detection and emergency response mechanisms. Future iterations of the smart sensorbased system may explore enhanced GPS modules with improved accuracy, faster acquisition times, and increased sensitivity. This ongoing evolution ensures that the system stays at the forefront of leveraging cutting-edge technology for improved road safety.In essence, the GPS SIM28ML module is more than a mere receiver of satellite signals; it is a key enabler of the smart sensor-based accident detection and rescue system. Its multifaceted role in providing accurate location data, seamless integration with the Arduino Uno, and active contribution to decision-making processes underscore its importance

within the broader context of intelligent transportation systems.

5.1.3 GSM Module :-

Fig. 4 Block Digram

A chip or circuit known as a GSM or GPRS module can be used by a cell phone or cash register to communicate with a GSM or GPRS framework. A GSM modem can be a standalone modem that connects via serial, USB, or Bluetooth, or it can be a cell phone with GSM modem functionality. It requires AT instructions, which are given through sequential correspondence, in order to cooperate with the processor or controller.

5.1.4. Accelerometer: -

All things considered, an accelerometer is an electromechanical device that calculates quickening powers. These forces might be either static, like the constant force that gravity has on the body, or dynamic, like any vibrations on the accelerometer.

Different mechanisms are used by accelerometers. One such method is piezoelectric impact, which uses gem-like tiny structures to generate voltages when accelerative forces strike against them.

Fig. 5 Accelerometer

5.1.5 Flame Sensor:

Fig.6 Flame Sensor Model

Central to the architecture of the Smart Sensor-Based Accident Detection and Rescue System, the Flame Sensor Module stands as a cornerstone, serving a pivotal function in specialized fire detection. Through the application of advanced infrared technology, this module excels in the rapid and accurate identification of potential fire hazards in the aftermath of vehicular accidents. Key features, including infrared detection, adjustable sensitivity settings, and a digital output signal, make the Flame Sensor Module well-suited for fire detection applications. Its ability to detect flames promptly ensures that potential fire incidents are recognized in a tailored and precise manner, minimizing false alarms and optimizing the response to genuine fire hazards. In the project, the Flame Sensor Module contributes significantly to enhancing overall functionality. Its infrared detection capability identifies potential fire hazards, and the adjustable sensitivity feature ensures accurate and customized detection, preventing false alarms. The digital output

signal from the flame sensor becomes instrumental in triggering emergency response measures within the system, including alerting authorities and emergency services. Seamless integration with the Arduino Uno enhances communication and coordination within the system. The Arduino Uno processes the digital output from the flame sensor, influencing decision-making algorithms for swift and appropriate emergency responses. The module's role extends beyond fire detection; it actively contributes to minimizing the impact of accidents by addressing potential fire incidents promptly.

Furthermore, the Flame Sensor Module's adjustable sensitivity feature allows for customization, ensuring precision in fire detection based on specific environmental conditions. This adaptability minimizes false alarms, optimizing the module's performance in diverse scenarios and enhancing its effectiveness in different operational contexts. The Flame Sensor Module emerges as a crucial element in intelligent systems, playing a vital role in fire detection technologies that contribute to the overarching goal of minimizing the impact of accidents and improving overall road safety within the Smart Sensor-Based Accident Detection and Rescue System.

5.1.6 Piezoelectric Sensor:

Fig. 7 Piezoelectric Sensor

The Piezoelectric Sensor holds a pivotal role within the framework of the Smart Sensor-Based Accident Detection and Rescue System, functioning as a transformative device that converts mechanical energy into actionable electrical signals. This essential sensor is adept at detecting impacts and vibrations resulting from vehicular accidents, providing crucial insights into the dynamics of the accident scenario. Operational on the principle of piezoelectricity, the sensor excels in converting mechanical stress or vibrations into electrical charges, offering an immediate and direct response to physical impacts. Its notable sensitivity to dynamic forces enables the detection of subtle vibrations and impacts, positioning it as an optimal choice for applications demanding precision. Additionally, the sensor's rapid response time ensures the delivery of instantaneous signals in response to sudden impacts, facilitating prompt decision-making within the system.In the context of the project, the Piezoelectric Sensor plays a critical role in impact detection, precisely capturing the timing and intensity of impacts resulting from vehicular accidents. Through seamless integration with the Arduino Uno, the sensor becomes a valuable source of real-time data. The electrical signals generated by the sensor are processed by the Arduino Uno, influencing decision-making algorithms to enable immediate and effective responses.

6. SOFTWARE IMPLEMENTATION

The primary objective of this system is to create an affordable solution for monitoring vehicular accidents. This proposed system operates in two distinct phases. In the initial phase, an Arduino monitors the pin connected to the impact sensor, awaiting activation. Moving to the second phase, the GPS receiver is employed to retrieve the precise location. Once the exact location is calculated, the GSM module generates an SMS containing the accident location and dispatches it to the relevant authorities and family.

7. RESULTS AND DISCUSSION

The Smart Sensor Accident Detection and Rescue System, integrating affordable fire accelerometers and piezoelectric sensors, stands out for its swift and accurate accident identification, facilitating a rapid emergency response.

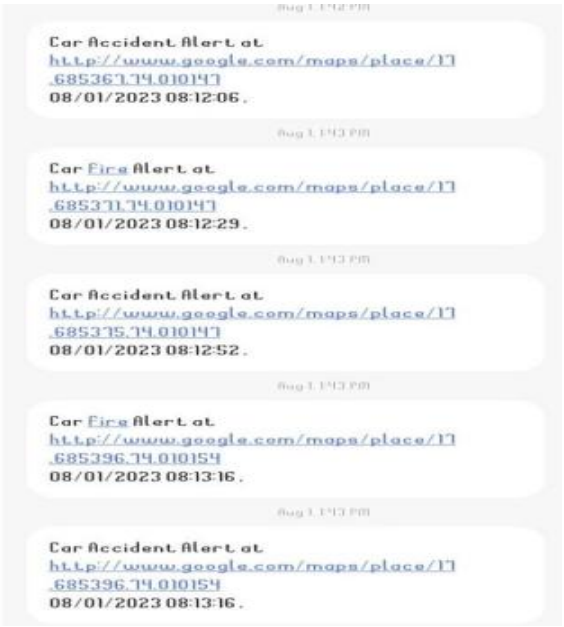

Fig. 8 Message and location URL on mobile massaging app

The system's cost-effectiveness ensures accessibility, making it a valuable solution for enhancing road safety without substantial financial burdens. This low-cost approach not only maintains efficiency but also emphasizes the project's commitment to providing practical and accessible technology. The positive reception for its innovative use of affordable sensors positions the system as a significant contribution to advancing safety technology, promising meaningful improvements in emergency response mechanisms without imposing significant financial barriers.

8. CONCLUSION

In the 21st century, the continuous advancement of science and technology has led to a heightened focus on vehicle safety. Drunk driving, drowsy driving, and engine overheating resulting in fires are significant causes of accidents. The implementation of this project aims to mitigate accidents caused by these factors. Automatic, economical, and energy- efficient technology makes for simple installation in automobiles. By integrating a GSM module and GPS, the system enables the transmission of emergency alerts to specific locations, notifying rescue units promptly. This timely alert mechanism plays a crucial role in saving numerous lives. The system is designed for regular individuals, offering affordability and simplicity of installation across all automobiles. Its versatility allows for application in various scenarios. The potential of this system extends beyond individual users, as it can be adopted on a larger scale by medical teams and law enforcement authorities. This collaborative approach enhances the efficiency of addressing and managing accident cases. By leveraging the capabilities of this system, these entities can effectively respond to emergencies, ultimately saving more lives.

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