ACCIDENT DETECTION AND ALERT SYSTEM

Prof. Kiran Khedkar[1], Kalpesh Pawar[2], Shrikant Dhumal[3], Roshan Tandalekar[4]

Prof. Kiran Khedkar, Electronics & Telecommunication & P G Moze College of Engineering, Pune
Kalpesh Pawar, Electronics & Telecommunication & P G Moze College of Engineering, Pune
Shrikant Dhumal, Electronics & Telecommunication & P G Moze College of Engineering, Pune
Roshan Tandalekar, Electronics & Telecommunication & P G Moze College of Engineering, Pune

---*---

Abstract - Speed is a fundamental factor contributing to vehicular accidents, often resulting in tragic loss of life. The prompt arrival of emergency services can significantly mitigate the consequences of such accidents. This project focuses on developing an accident detection system equipped with various components to promptly alert rescue teams when an accident occurs, thereby potentially saving precious human lives.

The proposed system is designed to efficiently detect accidents and automatically notify emergency services with the precise location of the incident. It achieves this by accurately capturing the latitude and longitude coordinates of the vehicle involved in the accident and promptly transmitting this critical information to the nearest emergency service provider.

The primary objective of this project is to detect accidents swiftly and trigger timely alerts to the rescue team. By leveraging advanced technology and real-time data acquisition, this system aims to enhance the overall effectiveness of accident response mechanisms, ultimately contributing to the preservation of human life on the roadways.

Key Words: Accident detection, Sensor network, Vehicle monitoring, Real-time monitoring, Intelligent transportation systems (ITS), Emergency response, Crash detection etc.

1. INTRODUCTION

The development of transportation systems has been instrumental in propelling human civilization to its highest echelons, distinguishing us from other creatures on Earth. Among these systems, automobiles hold significant importance in our daily lives. They serve as a means to commute to work, connect with loved ones, and facilitate the transportation of goods. However, alongside their utility, automobiles also pose significant risks, capable of causing disasters and even fatalities through accidents.

Speed stands out as one of the most critical risk factors in driving. Not only does it impact the severity of a crash, but it also amplifies the likelihood of being involved in one. Despite numerous initiatives launched by governmental and non-governmental organizations worldwide to promote safe driving practices, accidents continue to occur with alarming frequency. Sadly, many lives could have been spared if emergency services received timely crash information.

A study conducted by Virtanen et al. underscores the urgency of the matter, revealing that 4.6% of fatalities resulting from accidents could have been prevented had emergency services arrived promptly at the scene. Therefore, there exists a pressing need for an efficient automatic accident detection system capable of swiftly notifying emergency services with accurate accident locations. Such a system holds the potential to significantly mitigate the loss of precious human life on our roadways.

2. LITERATURE SURVEY

This paper proposes leveraging the capabilities of a GPS receiver to monitor vehicle speed and detect accidents based on this monitored speed. It suggests sending the accident's location and time, derived from GPS data processed by a microcontroller, via the GSM network to an Alert Service Centre.

At higher speeds, the distance required to brake and come to a complete stop increases significantly. This braking distance is directly proportional to the square of the speed, meaning that as speed increases, the likelihood of avoiding a collision decreases. To aid in accident detection, a tabular column is provided to predict the maximum allowable speed considering deceleration factors. If the vehicle's speed falls below these maximum speeds, it is assumed that some external deceleration force acted upon the vehicle, indicating an accident.

While speedometers can also be utilized to monitor speed drops in vehicles, they require an analog-to-digital converter to acquire speed data. Therefore, a GPS system is preferred to track vehicle speed continuously. The vehicle's speed is calculated at each instance by the GPS system. If there is a decrease in the newly calculated speed values, an alarm is raised for accident detection. A 5-second window is provided to abort the emergency. If no action is taken within this timeframe, the emergency signal is transmitted to the Alert Service Centre, along with the accident's location obtained through the associated GSM number. Subsequently, appropriate rescue measures can be undertaken to aid the individuals involved.

3. SYSTEM ARCHITECTURE

The architecture of an accident detection and alert system is flexible and can vary depending on specific needs and technological choices. However, the following is a generic architecture that outlines the key components and layers:

1. Data Acquisition Layer:

Sensors: Various sensors installed in vehicles or along roadways detect accidents. These include accelerometers, gyroscopes, impact sensors, and cameras.

GPS Module: Collects location data to precisely pinpoint the accident location.

Telematics Devices: Installed in vehicles to gather and transmit vehicle performance and status data.

2. Data Processing Layer:

Data Pre-processing: Raw sensor data undergoes pre-processing to filter out noise and irrelevant information.

Accident Detection Algorithm: Utilizes machine learning or rule-based algorithms to analyze sensor data and detect potential accidents, considering factors like sudden speed changes, direction, and impact forces.

Data Fusion: Integrates data from multiple sensors and sources to enhance accuracy and reliability in accident detection.

3. Decision Making Layer:

Event Identification: Identifies the type and severity of accidents once detected.

Risk Assessment: Evaluates the risk to occupants, vehicles, and surrounding areas based on the detected event.

Emergency Protocol Activation: Triggers appropriate emergency protocols based on accident severity, including alerting emergency services, nearby vehicles, and stakeholders.

4. Communication Layer:

Wireless Communication: Utilizes cellular networks, Wi-Fi, or DSRC to transmit alerts and data to central servers, emergency services, and nearby vehicles.

Cloud Infrastructure: Stores and processes data received from vehicles and roadside infrastructure.

Mobile Applications: Interfaces for users to receive accident alerts and notifications about incidents in their vicinity.

5. User Interface Layer:

Web Interface: Provides administrators with a dashboard to monitor the system, access real-time data, and manage alerts.

Mobile Applications: Enable users to receive accident alerts, view maps showing accident locations, and access emergency services.

6. Emergency Response Layer:

Emergency Services Integration: Interfaces with emergency service providers to relay accident information and coordinate response efforts.

Automated Emergency Calls (eCall): Automatically initiates emergency calls to relevant authorities, providing them with location and event details.

7. Feedback and Improvement Layer:

Data Analytics: Analyzes historical data to identify patterns, refine accident detection algorithms, and enhance system performance over time.

User Feedback: Incorporates input from users and stakeholders to make necessary adjustments and improvements to the system.

This architecture provides a framework for developing an effective accident detection and alert system, prioritizing swift response and continuous improvement to save lives and enhance road safety.

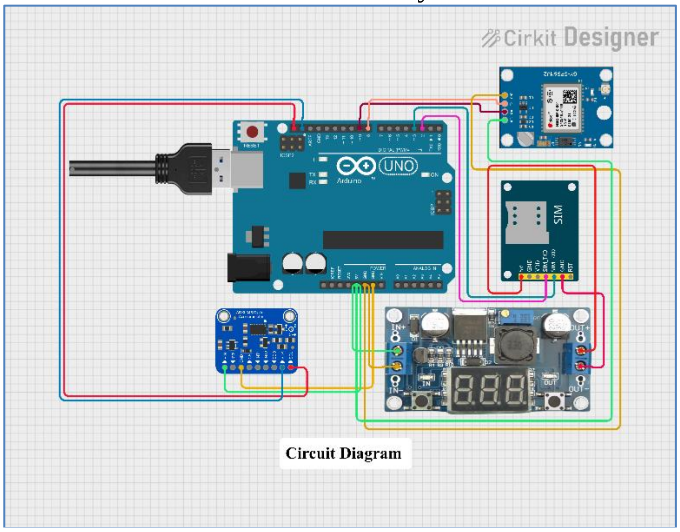

Fig. Circuit Diagram

4. Hardware Requirement

1. Arduino: Serves as the central microcontroller, orchestrating system operations, interfacing with sensors, and managing communication modules.

2. GPS Module: Receives signals from satellites to accurately determine the system's geographical location.

3. GSM Module: Facilitates cellular communication, enabling the system to send SMS alerts or make calls upon detecting an accident.

4. Accelerometer and Gyroscope: Measure the system's acceleration and rotation rates, supplying data for detecting abrupt changes in motion indicative of potential accidents.

5. Vibration Sensor: Detects vehicle vibrations or impacts, triggering the system to initiate accident detection protocols.

6. Power Supply: Provides consistent electrical power to all system components, ensuring uninterrupted operation. This may involve batteries or connection to the vehicle's electrical system.

7. Connecting Wires: Enable seamless interconnection between system components, ensuring efficient data and power transmission.

8. Breadboard or PCB (Printed Circuit Board): Offers a secure platform for mounting and interconnecting electronic components, facilitating the prototyping and assembly of the system.

This setup integrates the Arduino microcontroller with GPS, GSM, accelerometer, gyroscope, and vibration sensors to detect and communicate accidents effectively. The power supply ensures continuous operation, while connecting wires and either a breadboard or a PCB streamline component assembly and connectivity, ensuring optimal system functionality.

5. Conclusion

A system designed to detect accidents has been developed, focusing on both accident detection and alerting functionalities. The system operates by accurately reading the latitude and longitude coordinates of the vehicle involved in the accident and promptly transmitting this critical information to the nearest emergency service provider. Arduino plays a crucial role in facilitating communication between various components within the system.

The system utilizes an accelerometer to monitor the direction of the accident, providing insight into the impact's trajectory. Additionally, a gyroscope is employed to detect potential vehicle rollovers, enhancing the system's ability to assess the severity of the accident accurately. Once the relevant data is collected, it is transmitted to a pre-registered phone number via the GSM module, ensuring prompt notification of the incident.

The integration of GPS technology allows for the precise determination of the accident location, enabling the tracking system to provide geographical coordinates covering the affected area. This ensures that emergency responders can swiftly navigate to the accident site, further optimizing response times and potentially saving lives.

REFERENCES

[1] T Kalyani, S Monika, B Naresh,Mahendra Vucha, Accident Detection and Alert System, IJITEE, March 2019(Base paper).

[2] Parag Parmar, Ashok M.Sapkal, Real time detection and reporting of vehicle collision, IEEE,2017.

[3] Md. Syedul Amin, Jubayer Jalil, M.B.I.Reaz, Accident Detection and Reporting System using GPS,GPRS and GSM Technology, IEEE,2012.

[4] Gowshika B, MadhuMitha, G,Jayashree,Vehicle accident detection system using GPS, GSM modem, IRJET,2019.

[5] Sayanee Nanda, Harshada Joshi, Smitha Khairnar, An IOT Based Smart System for Accident Prevention and Detection,IEEE,2018.

[6] Norsuzila Yaacob, Ainnur Eiza Azhar, Azita Laily Yusofl, Suzi Seroja Sarnin, Darmawaty Mohd Ali and Ammar Anuar, Real Time Wireless Accident Tracker using Mobile Phone,IEEE,2017.

[7] S.Sonika, Dr.K.Sathyasekhar, S.Jaishree, Intelligent accident identification system using GPS, GSM modem,DARCCE,2014.

[8] Dhruvesh H.Patel, Parth Sadatiya, Dhruvbhai K. Patel, Prasann Barot, IoT based Obligatory usage of Safety Equipment for Alcohol and Accident Detection,IEEE,2019.

[9] Ajith Kumar.A, Jaganivasan.V, Sathish.T, Mohanram.S,Accident detection and alert system using GPS&GSM,IJOPAAM,2018.

[10] Shadman Sakib, Mohammad Sayem Bin Abdullah,GPS-GSM based Inland Vessel Tracking System for Automatic Emergency Detection and Position Notification,IEEE,2016.