iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.69562

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Machine Learning-Based Automatic Accident Identification, Segmentation, and Duration Forecasting

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Abstract: ***The use of automobiles has grown dramatically in the modern world. Because of the increased traffic caused by the excessive use of vehicles, there are now more accidents on the roads. This damages the property and causes fatalities since there is no quick access to safety and preventative measures. While complete accident prevention may not be achievable, the consequences can be reduced to a minimum. This embedded technology has put the right safety precautions in place and can prevent mishaps from happening. To make it easy for the police station and ambulance service's smart devices, which can access mobile networks, to find the place, they were provided with the address and a link to a Google map. An accelerometer, temperature sensor, GSM module, GPS module, alcohol sensor, and eye blink sensor are all part of the system.***
Index Terms: Automatic Segmentation, Accident Detection, Machine Learning Models, Traffic Accidents, Traffic Flow, Traffic Data, Speed Data, Multiple Segments, Traffic Prediction, Prediction Model.

I. INTRODUCTION

As is well known, the increase in traffic accidents is one of the main issues that nations are currently dealing with. This is because cars are being used to their maximum capacity and there are more accidents due to drunk driving and sleepy drivers, both of which are extremely dangerous. Implementing a suitable, workable standard solution is necessary to lower the nation's accident rate. There isn't any cutting-edge, useful technology available right now for both accident prevention and detection. Because it took longer for the ambulance to arrive at the scene of the accident and communicate the victim's status to the hospital, the likelihood of the victim dying also increases. The existing technology can identify accidents while tracking the car, which delays the victim's treatment because it takes longer to go to the hospital. With the suggested approach, the victim receives the essential medical care immediately after the accident and there is no delay between the accident and the availability of the necessary facilities. The abrupt rise in vehicles without corresponding improvements in road safety has resulted in several fatalities. The usage of automobiles has increased along with the population, which raises the risk of traffic accidents and the deaths that result from them due to a lack of emergency supplies. Accidents still occur often despite countless international efforts by governments and other groups. According to the WHO, car crashes are the leading cause of death for children and young adults aged five to twenty-nine. In several countries, car accidents cause significant losses in terms of both physical damage and fatalities, up to three. There has been a notable increase in the number of automobiles on the road due to the population growth during the past 20 years. In countries like India, where people commute daily by car, the number of accidents has significantly increased. It's critical that a car rider engaged in an accident gets medical attention as soon as possible. By offering automated alerts and real-time monitoring, the IoT-based system to which this work contributes increases road safety and the effectiveness of emergency response. Accidents are intended to be prevented, detected, and reported by the system.

II. LITERATURE REVIEW

Our lives are now easier because to the advanced facilities and technologies available. Because of the increasing traffic risks brought about by technology, there are more road accidents, which result in significant losses in terms of life and property due to inadequate emergency facilities. The creation of a transit has given humans the ability to surpass all other living things on Earth in terms of civilization. One of the most significant and fundamental danger factors when driving is speed. Accidents still occur occasionally despite the numerous initiatives implemented by governmental and non-governmental groups worldwide to raise awareness of the dangers of reckless driving. However, if the crash information had reached the rescue services sooner, the majority of the lives could have been spared. Only if emergency services had been available at the scene of the accident at the appropriate moment could accidents have been avoided.

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Therefore, in order to save valuable human life, effective automatic accident detection that notifies emergency services automatically of the accident location is essential. Around the world, traffic accidents result in a significant number of fatalities. The difference between the current system and the ideal system is that the automated system is used after an accident occurs, providing the latitude and longitude of the area where the accident occurred without delay. It also provides alert messages for drivers who consume alcohol so that the vehicle's engine can be stopped. This system has the potential to save more human lives.

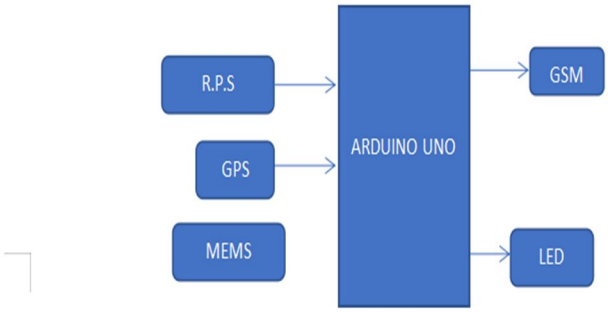
1) *Majd Khaled Almohsen, Renad khlief alonzi, Taif Hammad Alanazi, Shahad Nasser BinSaif and Maha Mohammed alujally, "Smart Car Seat Belt: Accident Detection and Emergency Services in Smart City Environment", 2021 1st International Conference on Artificial Intelligence and Data Analytics, DOI: 10.1109/CAIDA51941.2021.9425108.*

One of the primary causes of the rise in fatalities in many nations throughout the world is the delay in the rescue team's arrival following a traffic collision. Saudi Arabia is not an anomaly. This served as the primary impetus for starting this project, which aims to develop an Internet of Things product that can lessen the number of fatalities brought on by the issue of emergency personnel or ambulances arriving late. For this project, we created a seat belt with a sensor that can detect the driver's heart rate and notify the ambulance of the driver's whereabouts in the event of an accident. The raw data from the car's vibration sensor and heartbeat sensor are gathered to ascertain whether an accident has happened. The UNO microcontroller is used to process and assess if it is an accident based on the values of these two collected data. In the event of an accident, the controller notifies the pre-stored emergency contact numbers and uses the car's GPS to determine the current location. The location of the accident will be included in an alert sent by the system via GSM technology. In order to prevent errors in the sensor's heart rate tracking in the event that the driver changes, we have also included a fingerprint to verify the passenger's identification. Here, the hardware connections are implemented using the Arduino platform, and the Arduino IDE is utilized for programming.

2) *Unaiza alvi1, Moazzam a. khan Khattak, Balawal Shabir, Asad Waqar malik and Sher Ramzan Muhammad, "A Comprehensive Study on IoT Based Accident Detection Systems for Smart Vehicles", 2020, DOI: 10.1109/ACCESS.2020.3006887.*

The demand for cars has skyrocketed due to population growth, which has led to a concerning increase in traffic risks and accidents. Both the percentage of traffic accidents and the number of fatalities brought on by them are increasing dramatically. However, the delay in emergency assistance is the main reason for the higher death rate. Effective rescue services could save many lives. Traffic jams or erratic communication to the medical units are the causes of the delay. Automatic road accident detection systems must be put in place in order to deliver aid in a timely manner. In the literature, numerous approaches to automatic accident detection have been put forth.These methods include GPS/GSM-based systems, vehicle ad-hoc networks, smartphone crash prediction, and a variety of machine learning approaches. Road safety is the most important area that requires substantial research because of the high death rates linked to traffic accidents. In order to guarantee road safety and save important lives, we critically evaluate the numerous approaches now in use for anticipating and preventing traffic accidents in this paper, pointing out their advantages, disadvantages, and difficulties.

BLOCK DIAGRAM

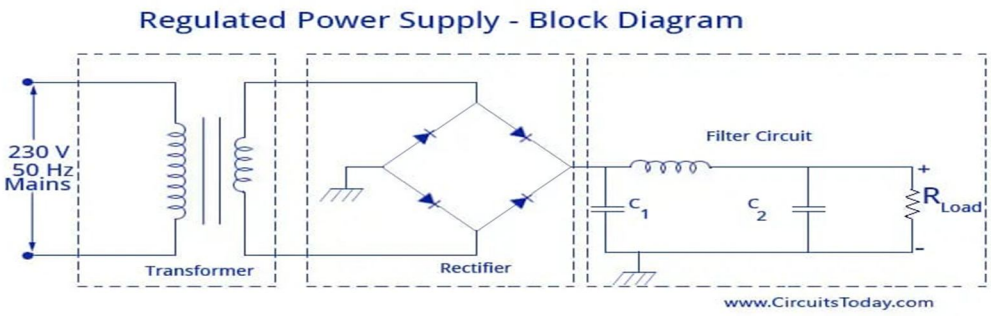


ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

III. HARDWARE COMPONENTS

A. Regulated Power Supply

A regulated power supply is an electronic device designed to provide a stable and consistent DC (Direct Current) output voltage, regardless of variations in the input voltage or changes in the load. It is widely used in electronic circuits to ensure reliable operation and protect sensitive components.



Applications:

- Used in electronic devices like radios, TVs, and computers.
- Essential in laboratory equipment and testing instruments.
- Powers microcontrollers and other sensitive electronic components.

B. GSM Module

A GSM module is a device that allows electronic devices to communicate with each other over the GSM network. GSM is a standard for digital cellular communications, which means that it provides a platform for mobile devices to communicate with each other wirelessly. The GSM module is a specialized device that enables a device to send and receive data over the GSM network.

Function:-



A GSM module works by connecting to the GSM network through a SIM card. The SIM card provides the module with a unique identification number, which is used to identify the device on the network. The GSM module then communicates with the network using a set of protocols, which allows it to send and receive data.

The GSM network is a digital cellular network that uses a set of protocols to enable communication between devices. The network is divided into cells, which are each serviced by a base station. The base station communicates with the devices in its cell, and the cells are interconnected to form a network.

The GSM module plays a crucial role in the communication between devices and the GSM network. It is responsible for establishing and maintaining the communication link between the device and the network. The module also handles the encryption and decryption of data, which ensures the security of the communication.

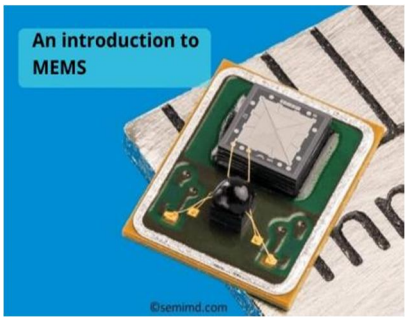
There are different types of GSM modules, each with its own functionalities. Some modules are designed to handle voice communication, while others are designed for data communication. Some modules also have built-in GPS, which allows them to provide location information.

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C. MEMS

MEMS stands for Micro-Electro-Mechanical Systems. These are miniature devices that combine mechanical and electrical components and are fabricated using semiconductor processes. They can act as sensors, actuators, or both, and are used in a wide variety of applications, from smartphones to medical devices.



D. LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown below.

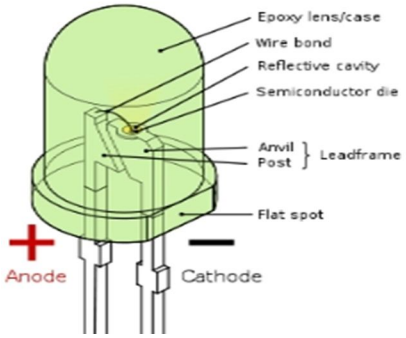


Fig : LED

E. Working

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light-emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode. When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor.

IV. OPERATIVE BENEFITS

By leveraging real-time data from sensors, cameras, and other IoT devices, the system can automatically detect road accidents as they happen, enabling immediate alerts to emergency services and traffic management authorities. This leads to quicker emergency response times, potentially saving lives and minimizing road congestion. The segmentation component helps classify and analyze different types of accidents, assessing their severity and isolating key visual or sensor data for further analysis. Additionally, machine learning models can predict the likely duration of an incident's impact on traffic flow, allowing for better resource allocation and traffic rerouting. These capabilities not only enhance road safety but also provide valuable insights for city planners, insurance companies, and legal investigators. The system aids in the prevention of future accidents through trend analysis and supports smart city initiatives by integrating with existing infrastructure, leading to more efficient and intelligent urban traffic management.

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V. RESULTS



Fig 6. Results display

VI. CONCLUSION

To sum up, the suggested An ML-based accident avoidance, detection, and evaluation system offers a viable way to improve Rescue interventions and road security. The system shows its potential to reduce accidents and lessen their effects on people and infrastructure by integrating sensor networks and ML technology. Sustained research and development endeavors are important in order to enhance the system's functionalities, tackle novel obstacles, and adjust to changing road safety requirements. We can work to make roads safer and lessen the toll that traffic accidents have on society by utilizing innovation and teamwork.

VII. FUTURE SCOPE

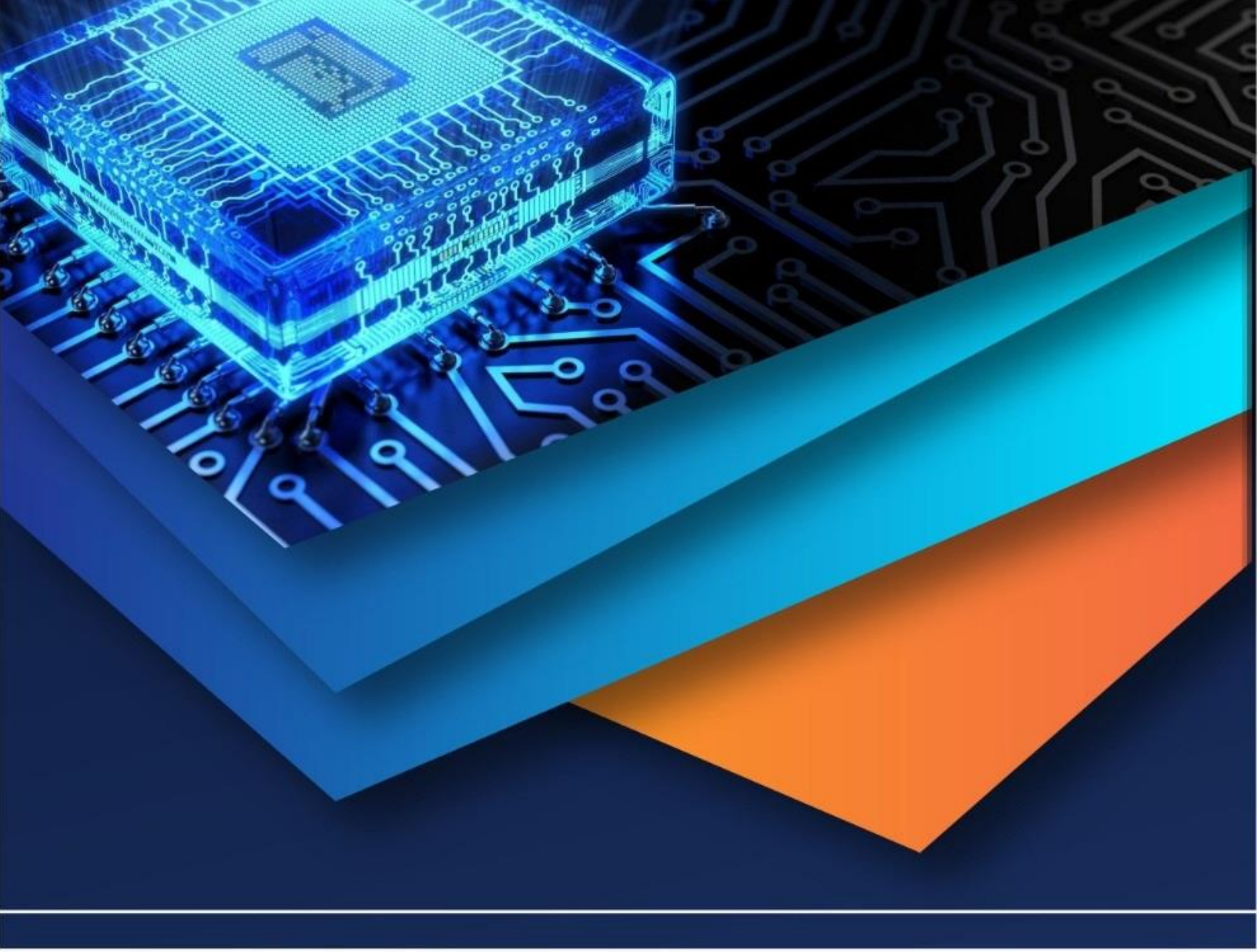
The future scope o this paper is vast and promising, with the potential to transform traffic safety and urban mobility. As advancements in artificial intelligence, computer vision, and Internet of Things (IoT) continue, the system can be further enhanced to achieve even greater accuracy and efficiency. In the future, integration with autonomous vehicles could enable real-time accident detection and prevention directly from within smart vehicles. Enhanced deep learning models may allow for more precise segmentation of accident scenes, identifying not only vehicle damage but also injured individuals and hazardous materials. The duration prediction models can evolve to consider environmental factors like weather, road type, and traffic density for more reliable estimations. On a larger scale, such systems could be embedded into nationwide smart transportation networks, enabling predictive analytics that help reduce accident rates and optimize emergency response strategies.

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