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Smart Accident Detection and Alert System using Accelerometer, GPS and GSM Module with Integrated Functionality of Alcohol Detection

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Abstract: ***The Smart Accident Alert System is a comprehensive solution created to identify accidents and transmit alerts to the authorities in real-time. It uses IOT and integrates GPS, Accelerometer, GSM, and MQ3 Sensor. To enable precise and accurate accident detection and reporting, this system makes use of a number of technologies, including GPS, Accelerometer, GSM, and MQ3 Sensor. The system functions by continuously tracking a vehicle's motions and evaluating the sensor data. When an accident occurs, the system immediately alerts the emergency services and notifies the registered user to let them know. The IOT-based Smart Accident Alert System offers a trustworthy and effective means to identify accidents, shortening response times and sparing priceless lives.***

Keywords: Accident Alert System, Internet of Things (IOT), Global Positioning System (GPS), Accelerometer, MQ3 Sensor, Arduino UNO

I. INTRODUCTION

In modern times, the transportation system has become an integral aspect of our daily routine, thanks to advancements in science and technology. Nevertheless, there is a cost associated with this convenience, since vehicles - while being immensely useful - are also a major contributor to road accidents worldwide. A significant proportion of these incidents are influenced by speed. To mitigate the detrimental effects of such mishaps, an error detection and warning system supported by personal digital assistants (PDAs) can be employed. This system uses a sent effect sensor to detect malfunctions, processes information with a microcontroller unit and GPS for a smartphone application, and sends notifications to gsm to immediately inform the family of injured individuals of the incident's benefits, reducing fatalities caused by delays in medical care arriving at the accident site. [1].

One of the primary causes of accidents is speeding, but thanks to the widespread use of GPS receivers in cars, this issue can be addressed. In addition to its various functions, GPS can now monitor speed to identify errors. By using a common and economical GSM modem, it can transmit the location of the error to an Alert Service Centre. This system can also send a warning of the speed limit in advance of any potential disasters, notifying those involved. If the car's occupants can report the error status by pressing the Recovery switch, then the message will not be sent to the servers. [2].

International customers can access a GPS-based vehicle tracking and management system, which offers services at any time and from any location. This system allows individuals to track various aspects of their vehicles, such as location, speed, stops, and progress. The system has capabilities including establishing speed and location limits, getting information on the vehicle's performance, and more to ensure safe usage. Additionally, the system can help prevent theft by alerting the user automatically and providing a guide to the vehicle's location if it is suspected of being stolen. The system uses various advanced communication technologies, including GPRS, GSM, internet, and GPS, to track vehicles in the area. The system can be improved more in the future by adding more management functions to the mobile application and making new client interfaces. [4]

A vehicle positioning system has been developed using an auto-frame framework with an ARM view. The system integrates GPS LR9548 and GSM TC35 modules while using the ARM microprocessor LPC2129 as the system's control unit. The system includes location mapping, map matching, and a packet of information related to the situation, and predicts the pattern of the vehicle's spatial structure. The Capture ARM serves as a platform, and GPS and GSM function as a remote information communication platform. The resulting Vehicle Positioning System is compact, stable, and reliable, with minimal errors, which successfully overcomes past deficiencies and high operating costs in the framework. The design of the system aims to achieve a new appearance, integrate existing structures, and include a location-based management system for current customer/server. The system is anticipated to offer increased application capabilities.[3]

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II. OBJECTIVE

This research paper's goal is to design and build a smart accident alert system that incorporates GPS, an accelerometer, a GSM signal, and a MQ3 sensor.[11]

Goal of this article are as follows:

1) To Create and implement a smart accident alert system using IOT technology that combines GPS, accelerometer, GSM, and MQ3 sensor.
2) Assessing the accuracy, dependability, and response time of the proposed system.
3) To look into the viability of adding alcohol detecting capabilities to the system and evaluate how well it works to stop accidents brought on by drunk driving.
4) To evaluate the system's effectiveness in lowering accident-related fatalities and injuries as well as the financial and societal consequences of traffic accidents.
5) To look into potential enhancements and future approaches for the suggested system, including the application of machine learning and other cutting-edge methods to improve the precision and effectiveness of accident detection and alerting.[4]

III. METHODOLOGY

The following Components were used in our system

1) Arduino UNO

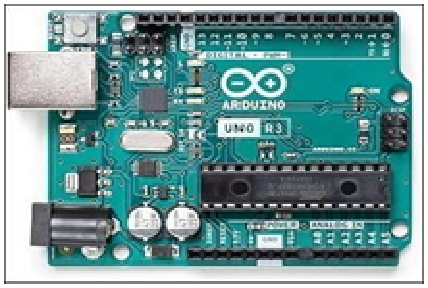


Fig.1 Arduino UNO [10]

The proposed device's decision-making will rely on the data provided by the sensors, with Arduino serving as its central processing unit. The Arduino UNO, developed by Arduino.cc, is an open-source microcontroller board that uses the Microchip ATmega328P microcontroller. It has digital and analog input/output (I/O) pins that can be connected to various expansion boards and circuits, with 14 digital pins and 6 analog pins. The board can be programmed via the Arduino IDEusing a type B USB cable and powered by either a USB cable or an external 9-volt battery, with voltage range between 7 and 20.[5]

2) GPS Module

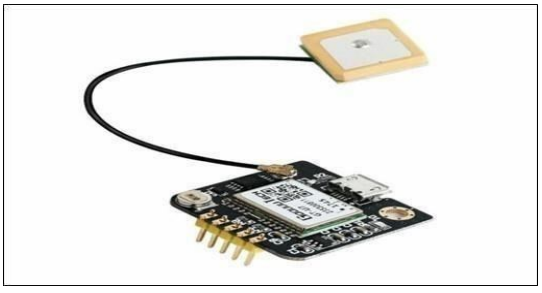


Fig.2 GPS Module [10]

The purpose of this sensor is to obtain the user's location and transmit this data to the microcontroller. The GPS, or Global Positioning System, is utilized to determine the precise latitude and longitude of any location on the planet, along with the accurate UTC time. We integrated a GPS module into our project to monitor the location of the accident. This module acquires coordinates from satellites every second, including time and date. Specifically, we used the SKG13BL GPS module, which is a high-sensitivity, low-power receiver module.[12]

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3) GSM Module



Fig.3 GPS Module [10]

The GSM/GPRS module is utilized as the primary communication method to send messages to relevant authorities. This module is responsible for establishing communication between a computer and a GSM-GPRS system, which is a widely-used mobile communication architecture inmany countries[6]

4) Accelerometer

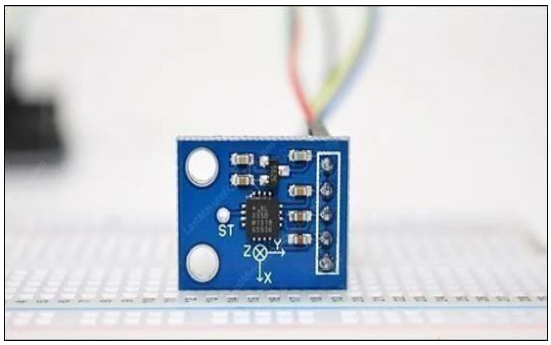


Fig.4 Accelerometer [10]

This component is responsible for detecting accidents and is the primary sensor in the system. An accelerometer is an electronic device that measures acceleration forces[7]. It specifically measures acceleration due to gravity, which is also known as g-force. Accelerometers find various applications in the biomedical field, such as step counting, activity monitoring, and motion analysis. They are used to monitor vital signals, including cases of cardiac arrest. Accelerometer sensors are easy to apply to different subjects, and their placement is not a critical factor. [8]

5) MQ3 Sensor



Fig.5 Accelerometer [10]

This sensor detects the presence of alcohol in a user and sends the collected data to the Arduino. The MQ3 sensor is a commonly used MOS (Metal Oxide Semiconductor) sensor from the MQ sensor series.[13] These sensors are also known as Chemiresistors, as they detect changes in resistance of the sensing material when exposed to alcohol. The MQ3 sensor is powered by 5V DC and consumes around 800mW of power. It is capable of detecting alcohol concentrations between 25 to 500 parts per million (ppm).[9]

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IV. PROPOSED FLOW

A. *Approach*

Our research adopted a qualitative approach as we were focused on improving an existing concept. We reviewed a range of papers to identify areas for improvement and potential flaws in the existing projects. We analysed 26 research papers published from 2005 to 2022 to gain insights and perspectives on the issue. Our review revealed that most accident report systems were designed for high-end vehicles, making them inaccessible to the majority of the population due to the high cost. As a result, we aimed to develop a less costly system that could offer similar features and could be used by a wider population without the need for an expensive vehicle.

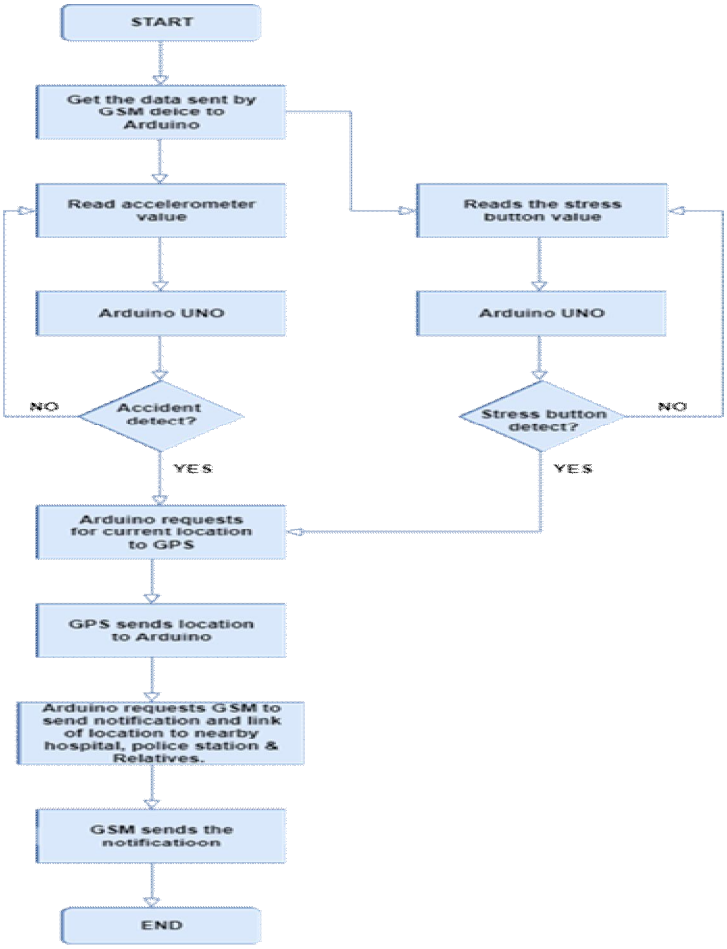


Fig.6 Proposed Flow of the System

B. *Working*

As automobiles have become an integral part of our daily routines, speeding has become a common occurrence leading to road accidents. These accidents can lead to fatal consequences if not addressed promptly with proper medical attention. To mitigate this issue, we propose a system that can detect road accidents and determine their location using GPS. The system will then notify the nearest emergency care unit via the GSM interface to ensure the victim receives timely medical attention.

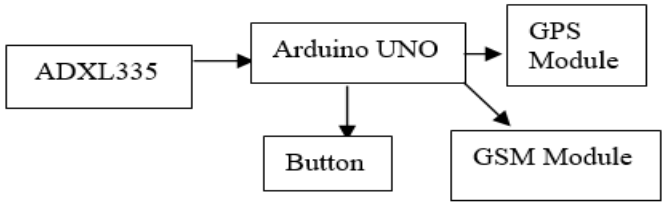


Fig.6.1 Hardware Connection

C. Phases of Accident Alert System

1) Phase I

First, a driver takes the driver's seat. The system checks on the off chance that the driver has worn the seat belt or not. If not, it shows a message, "Wear seat belt". If the driver wears the seat belt, the automobile's motor begins and displays the message "Seatbelt Detected".

2) Phase II

Now the system will detect whether alcohol's present in the air and if it's detected the automobile's motor won't start. If there is no presence of alcohol in the environment then the automobile will start.

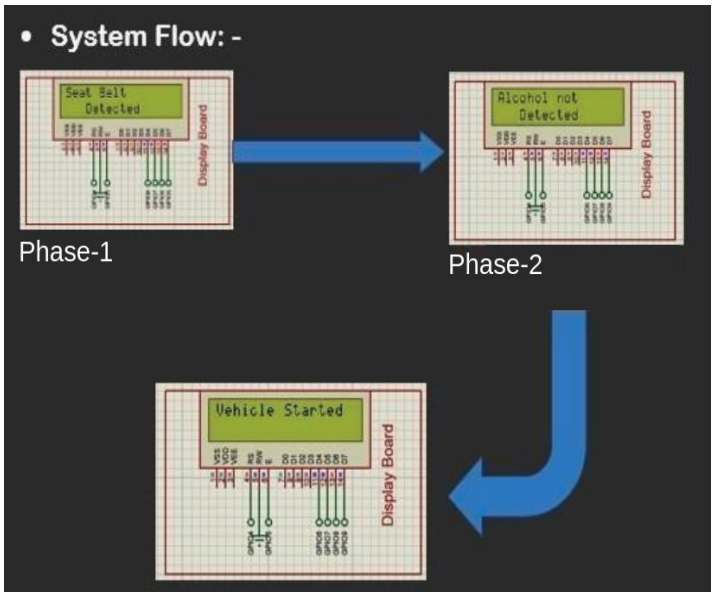


Fig.6.2 System Flow of Phase I and Phase II

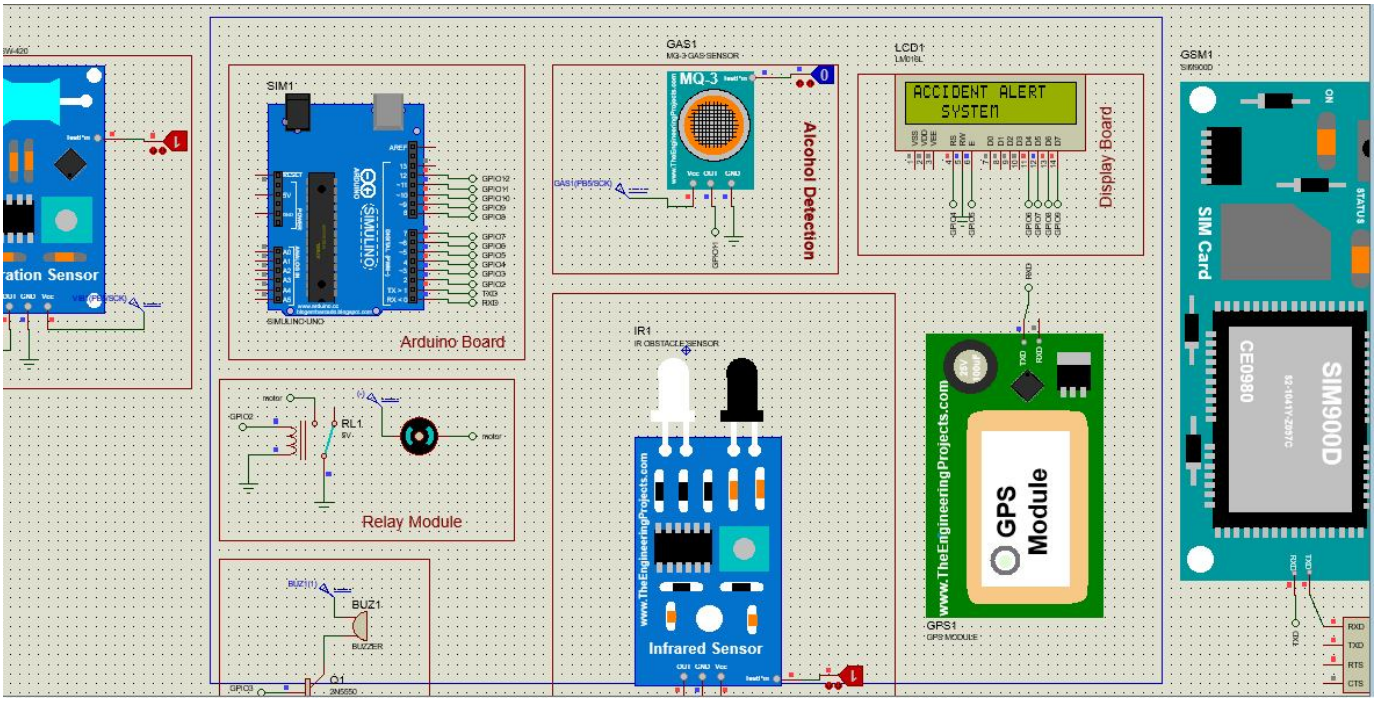


Fig.6.3 Accident Alert System Circuit overview

3) Phase III

If a vehicle meets with an accident the accelerometer will detect the occurrence of the casualty and will actuate the GPS to locate the accident area and it will start

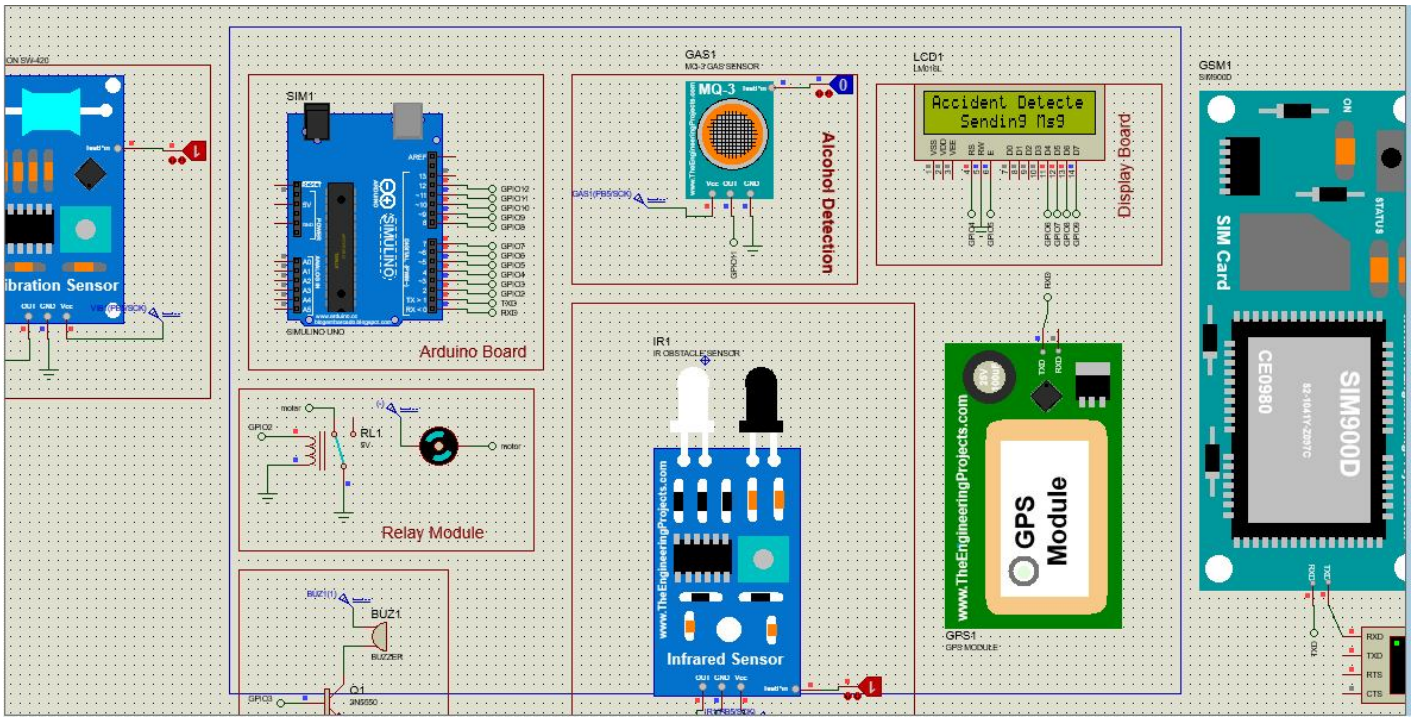


Fig.6.4 Phase III Accident Detected

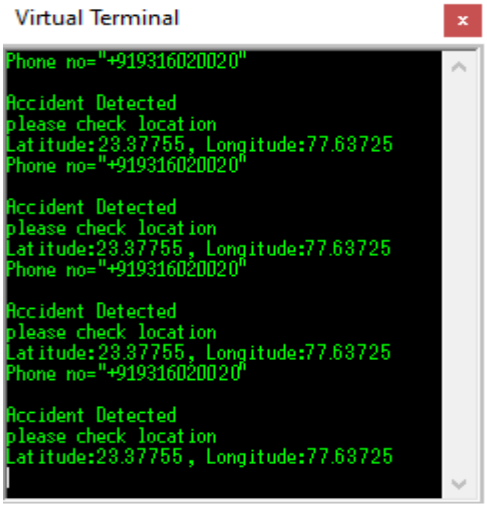


Fig.6.5 Result on Virtual Terminal

V. CONCLUSIONS AND FUTURE SCOPE

The highly unique and cutting-edge smart accident warning system, which combines GPS, GSM, accelerometer, MQ3 sensor, and IoT, has been developed to improve road safety by detecting and reporting accidents in real-time. The system makes use of different sensors to track the direction, speed, and other characteristics of the vehicle, and when an accident is found, it alerts the appropriate authorities and pre-specified contacts. The system can give emergency services access to real-time data by utilising IoT technology, enabling them to react to catastrophes rapidly and possibly save lives. The system can provide precise position information thanks to the incorporation of GPS technology, making it simpler for emergency responders to get to the accident scene.

Additionally, by using a MQ3 sensor, the system is able to identify the presence of alcohol in the driver's breath, which can be a key indicator of what caused the accident. The accelerometer is used to identify sudden movements or impacts that can point to a collision. The smart accident alarm system is a prime illustration of how technology may be applied to improve societal safety and prevent fatalities. The system offers a sophisticated and trustworthy way of identifying and reporting accidents through the integration of multiple sensors and IoT technology, which can aid emergency services in responding swiftly and effectively to potentially life-threatening circumstances.

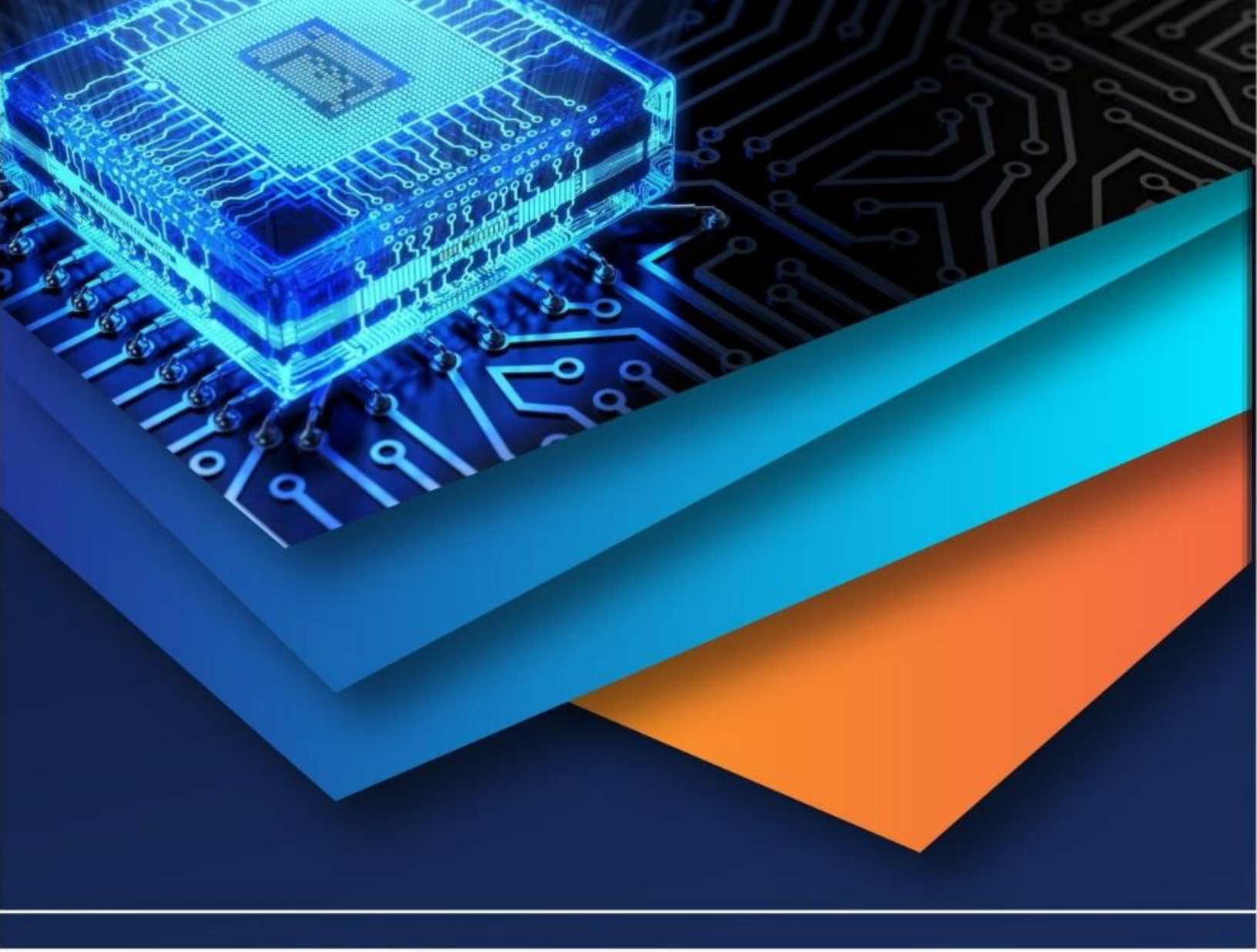
A. Future Scope

1) *AI Integration:* By integrating AI, the system might examine the information gathered by multiple sensors to find trends and abnormalities that might be signs that an accident is going to happen. This might aid the system in identifying and averting incidents before they occur.
2) *Integration of other Sensors:* The system could be improved even more by using extra sensors like a camera, LIDAR, or RADAR. As a result, the technology would be able to identify a greater variety of probable incidents and give emergency personnel more precise information.
3) *Real-time Traffic Updates:* To give up-to-date information on traffic conditions, the system could be coupled with traffic updates. As a result, the system would be able to recognise possible road dangers and modify the vehicle's course to prevent accidents.
4) *Integration with Driverless Vehicles:* As autonomous vehicles proliferate; the system might be improved to symbiotically function with them. In the event of an accident, this would allow the system to take over automatically, possibly lessening the severity of the collision and limiting damage.
5) *Voice Activation:* The system could be improved to allow users to activate the alert system using voice commands, such as drivers or passengers. In an emergency, this would make it simpler to turn on the system.

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