



Emergency Alert System

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ABSTRACT

This paper proposes a novel system to enhance the efficiency of medical emergency services during road accidents. The increasing number of accidents due to reckless driving, drunk driving, and driver negligence necessitates a more effective way to respond to these incidents promptly. The current system often faces delays in informing the ambulance and police authorities, which may lead to severe consequences for the victims.

To address this issue, the paper suggests integrating sensors in vehicles to monitor critical data like displacement, location, and chassis number using a Global Positioning System (GPS) device. This information would be shared through the Internet of Things (IoT) to a control center, allowing them to dispatch the necessary emergency response units to the accident site swiftly.

The proposed system utilizes a gyro sensor (MEMS sensor) to detect angle changes between 45° and 315° and a vibration sensor that activates at a collision impact frequency of 90 Hz or more. This system could potentially serve as a reliable addition to the safety features in vehicles manufactured in India, ensuring better accuracy in accident detection and reporting.

In conclusion, this paper presents a valuable concept to improve medical emergency services during road accidents by implementing a smart vehicle-based system. The integration of sensors and IoT technology can significantly reduce response time and save lives by providing immediate assistance to victims in need.

Keywords: IoT, Mems Sensor, GPS, Microcontroller

1 Introduction

In this paper, we will delve into the details of an "IoT-based Vehicle Accident Detection and Tracking System Using GPS Technology." The Internet of Things (IoT) is a groundbreaking concept that connects uniquely identifiable embedded computing devices to the existing Internet infrastructure. This advanced connectivity extends beyond simple sensor-to-sensor connections and encompasses a wide range of devices, including medical implants and biochips transponders.

Throughout the paper, we will discuss a practical application of IoT in the context of road safety. The primary goal of this system is to enhance the efficiency of emergency response services during vehicle accidents.

To achieve this, the paper will focus on the following key components:



1. GPS (Global Positioning System): GPS technology plays a crucial role in determining the precise location of a vehicle involved in an accident. This information is vital for emergency services to respond promptly and accurately.
2. IoT (Internet of Things): By leveraging IoT, the system can transmit real-time data about the accident location and vehicle details to a central control center. This allows for faster deployment of emergency response units and improved overall efficiency.
3. MEMS Sensor: A Micro-Electro-Mechanical System (MEMS) sensor is employed to detect significant changes in the vehicle's angle and vibrations caused by a collision. This sensor helps identify accidents and triggers the necessary response.
4. Microcontroller: The microcontroller serves as the brain of the system, processing data from the sensors and initiating the appropriate actions based on predefined algorithms.

The paper will also include illustrations, such as Fig (1.1) depicting a sample road accident and Fig (1.2) showcasing the block diagram of a MEMS sensor. By presenting these components and their interplay, the paper aims to provide a comprehensive understanding of the IoT-based vehicle accident detection and tracking system using GPS technology.

GPS (Global Positioning System)

GPS, or Global Positioning System, plays a vital role in our proposed IoT-based Vehicle Accident Detection and Tracking System. It enables the precise identification of accident locations, which is crucial for timely emergency response. GPS technology offers a fast, accurate, and cost-effective solution for locating accidents in countries with established data collection programs.

By integrating GPS with the system, motorists can easily identify the position of various features along the road network, such as service stations, maintenance facilities, and emergency services. This information is invaluable during accidents, as it helps guide rescue teams to the exact location of the incident.

In our proposed paper system, the GPS module works in conjunction with the IoT device to transmit the accident location, time, and speed data. This real-time information is essential for dispatching emergency services promptly and ensuring the best possible outcomes for those involved in accidents.

GPS sensors function as receivers equipped with antennas that utilize a network of 24 satellites orbiting Earth. These satellites provide position, velocity, and timing data, which is then processed by the system to determine the precise location of a vehicle involved in an accident. This accurate location information is a vital component of the overall system, contributing to its effectiveness in saving lives and minimizing the impact of road accidents.



MEMS (Micro-Electro-Mechanical Systems) Sensors



Figure 1: *Global Position Systems*

MEMS (Micro-Electro-Mechanical Systems) sensors are indispensable components in our IoT-based Vehicle Accident Detection and Tracking System Using GPS Technology. These tiny devices combine mechanical and electrical components to measure various physical phenomena, such as acceleration, pressure, direction, and magnetic fields. MEMS sensors are fabricated using micro-fabrication techniques similar to those employed in integrated circuit manufacturing.

At the core of their functionality, MEMS sensors convert physical stimuli or signals into electrical ones, which can then be processed and analyzed by electronic devices. Some common types of MEMS sensors include accelerometers, gyroscopes, pressure sensors, and directional sensors.

MEMS sensors have widespread applications across various industries, such as automotive, consumer electronics, aerospace, and medical devices. For instance, MEMS accelerometers are utilized in airbag systems to detect sudden changes in velocity and activate the airbag, while MEMS gyroscopes are employed in navigation systems to measure changes in orientation.

In our proposed system, MEMS sensors play a crucial role in detecting vehicle accidents. They can identify significant changes in a vehicle's angle and vibrations caused by a collision, thus triggering the necessary response from the system. By integrating MEMS sensors with GPS, IoT, and microcontrollers, our paper system aims to provide an efficient and effective solution for enhancing road safety and emergency response during vehicle accidents.

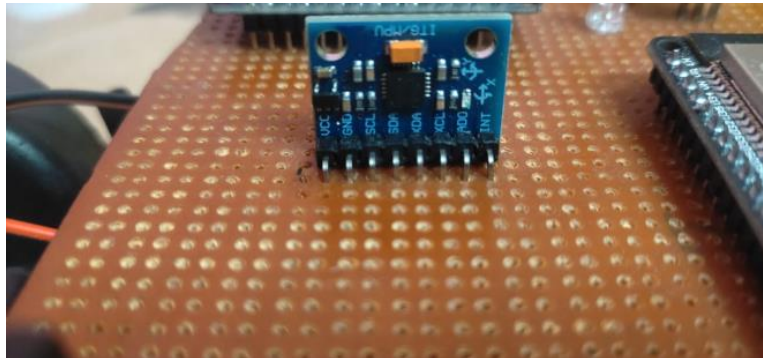


Figure 2: *MEMS Sensor*

IoT, or the Internet of Things

IoT, or the Internet of Things, is a transformative technology that enables the connection of various devices and sensors to the internet, allowing them to communicate and exchange data. This revolutionary approach has significantly enhanced the capabilities of GPS-based applications and devices. By integrating IoT with GPS technology, we can create more efficient and effective systems that provide real-time information and seamless connectivity.

IoT is essentially a vast network of interconnected devices and physical objects that collect and share data with other devices and systems across the internet. These devices, which include sensors, actuators, gadgets, and machines, are programmed for specific applications and can transmit data over networks.

C language remains a crucial programming language for IoT development due to its efficiency, simplicity, and widespread adoption in embedded systems. In our proposed paper system, we utilized the ESP32, a low-cost, low-power microcontroller that integrates Wi-Fi and includes a built-in antenna switch. Manufactured by TSMC using a 40nm process, the ESP32 is advancement over the ESP8266, a low-cost Wi-Fi microchip with built-in TCP/IP networking software and a microcontroller.

By leveraging the capabilities of IoT devices like ESP32, our system can efficiently collect, process, and transmit data related to vehicle accidents, including location, time, and speed. This information is vital for prompt emergency response and saving lives on the road. The integration of GPS, IoT, and MEMS sensors in our proposed system demonstrates the potential of these technologies to revolutionize road safety and emergency management.

Microcontroller

A microcontroller is a miniaturized computer system integrated into a single chip, specifically designed to control and manage various devices and systems. It consists of a processor, memory, and input/output peripherals, making it a self-contained, efficient solution for handling specific tasks. Microcontrollers are widely employed in numerous electronic devices due to their affordability, low power consumption, and high reliability.



These compact computer systems are tailored to perform specialized functions and are commonly used in embedded systems that require dedicated controllers. Their key advantage lies in their ability to be customized according to the unique demands of a particular application. Microcontrollers can be programmed to react to specific sensor inputs, control motors, manage other devices, and perform a multitude of other tasks.

Moreover, microcontrollers are engineered to operate effectively in challenging environments and can be employed in applications where traditional computing devices would be unsuitable. In our proposed Vehicle Accident Detection and Tracking System Using GPS Technology and IoT, we utilize microcontrollers to process data from MEMS sensors, manage communication with other devices, and execute necessary actions in response to detected accidents. This integration of advanced technologies, including microcontrollers, demonstrates the potential to revolutionize road safety and emergency response management.

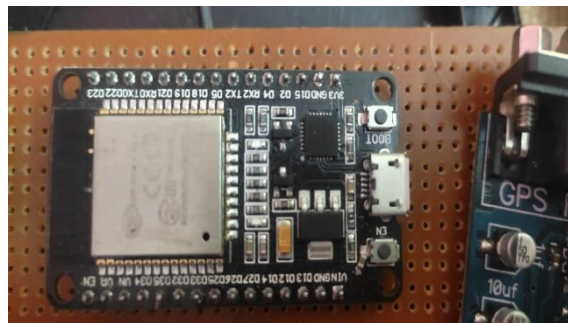


Figure 3: *Microcontrollers*

2 Experimental Result

The experimental results of our proposed paper demonstrate the effectiveness of utilizing IoT, MEMS sensors, and GPS technology in detecting and responding to road accidents promptly. This innovative system allows for the rapid collection and transmission of critical information about the accident, ultimately enabling faster emergency response and potentially saving lives. In our study, the MEMS sensor plays a crucial role in detecting the vehicle's direction and status, then transmitting this data to the IoT device. The IoT device, in turn, utilizes GPS technology to pinpoint the exact location of the accident. This information is then relayed to a specifically developed software application, which processes and presents the data in a user-friendly manner.

The rapid response and data transmission capabilities of this system are vital in emergency situations. By obtaining information about the accident within seconds, we can alert nearby hospitals or emergency services to provide essential first aid as quickly as possible. This timely intervention can significantly improve the chances of survival and recovery for those involved in road accidents.

In conclusion, the experimental results of our study highlight the potential of IoT, MEMS sensors, and GPS technology in revolutionizing road safety and emergency response management. By integrating these advanced technologies, we can create a more secure and



responsive environment for road users, ultimately saving lives and reducing the impact of accidents on our society.

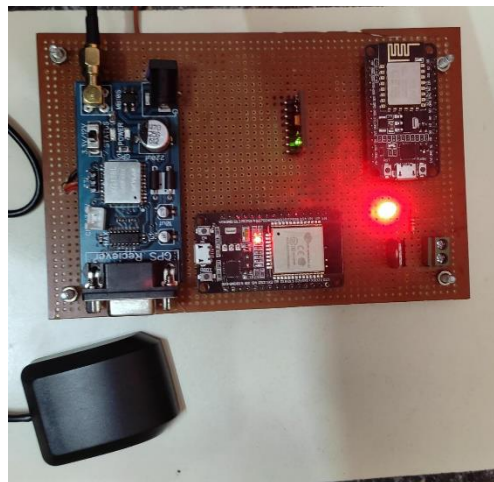


Figure 4 : Working Model

The provided figure represents the working model of the proposed paper, which utilizes MEMS sensors, IoT devices (ESP32), GPS (Skylab), and a microcontroller (ESP8266) to detect and respond to road accidents promptly. The model's components are interconnected, allowing for seamless data exchange and processing.

The programming language used in this model is C, with the code snippet provided demonstrating the setup and loop functions. The code initializes the necessary connections, configures the display, and begins the Wi-Fi and GPS communication. It also includes the Blynk library for interacting with the software application.

The code snippet retrieves GPS data from the SerialGPS object and encodes it using the TinyGPSPlus library. If the location data is valid, it extracts the latitude and longitude values, which are then displayed on the SH1106 display and sent to the Blynk application.

In summary, this working model showcases the integration of MEMS sensors, IoT devices, GPS technology, and a microcontroller to create an efficient, real-time road accident detection and response system. By leveraging the power of these technologies and the provided C programming code, the system can help save lives and improve overall road safety.

Coding Used(C Program)

```
#include <TinyGPS++.h>
#include <HardwareSerial.h>
#include <WiFi.h>
#include <Wire.h> // Only needed for Arduino 1.6.5 and earlier
#include <SH1106.h>
```



```
#include <BlynkSimpleEsp32.h>
float latitude, longitude;
String lat_str , lng_str;
char auth[] = "i0dTPFQeTxIJRvO5byOuL8f2Wj9hs6x4";    // You should get Auth Token
in the Blynk App.
char ssid[] = "sachin"; // Your WiFi credentials.
char pass[] = "1234567890";
WidgetMapmyMap(V0);
SH1106 display(0x3c, 21, 22);
WiFiClient client;
TinyGPSPlus GPS;
HardwareSerialSerialGPS(1);
void setup()
{
  Serial.begin(115200);
  Serial.println("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, pass);
  while (WiFi.status() != WL_CONNECTED){
    delay(500);
    Serial.print(".");          // print ... till not connected
  }
  Serial.println("");
  Serial.println("WiFi connected");
  display.init();
  display.flipScreenVertically();
  display.setFont(ArialMT_Plain_10);
  SerialGPS.begin(9600, SERIAL_8N1, 16, 17);
  Blynk.begin(auth, ssid, pass);
  Blynk.virtualWrite(V0, "clr");
}
void loop()
{
  while (SerialGPS.available() > 0) {
    if (gps.encode(SerialGPS.read()))
    {
      if (GPS.location.isValid())
      {
        latitude = gps.location.lat();
        lat_str = String(latitude , 6);
```



```

longitude = gps.location.lng();
lng_str = String(longitude , 6);
Serial.print("Latitude = ");
Serial.println(lat_str);
Serial.print("Longitude = ");
Serial.println(lng_str);
display.clear();
display.setTextAlignment(TEXT_ALIGN_LEFT);
display.setFont(ArialMT_Plain_16);
display.drawString(0, 23, "Lat:");
display.drawString(45, 23, lat_str);
display.drawString(0, 38, "Lng:");
display.drawString(45, 38, lng_str);
Blynk.virtualWrite(V0, 1, latitude, longitude, "Location");
display.display();
}
delay(1000);
Serial.println();
}
}
Blynk.run();
}

```

3 Existing Systems

In current systems, MEMS sensors play a significant role in various automotive applications. Accelerometers in MEMS sensors are utilized in airbag systems to detect sudden changes in velocity and activate the airbags during car crashes. Similarly, MEMS gyroscopes are employed in navigation systems to measure changes in orientation.

The proposed paper's model builds upon these existing systems by integrating MEMS sensors, IoT devices, GPS technology, and microcontrollers. The MEMS sensor is used to detect the impact of a car crash, which triggers the GPS to find the exact location of the accident. This location data is then transmitted through IoT and microcontroller networks to a specific software application.

Applications

1. Exact Location Finding: The primary application of this paper is to determine the precise location of the accident scene, enabling quick response and assistance for those involved.
2. Medical Emergency Services: By providing the exact location of the accident, this system can facilitate the immediate dispatch of medical emergency services, potentially saving lives and reducing the severity of injuries.



3. **Vehicle Information:** In addition to locating the accident and providing emergency services, the system can also offer information about the involved vehicle, such as its chassis number and registration number. This data can aid in identifying the vehicle and its owner, which may be crucial for insurance claims or further investigations.

Advantages

- We can save humans' life upto 80% of people. Who was impacted by the accident?
- The accident's location is detected as soon as possible within a fraction of a second.
- It is efficient and low-cost.
- It requires less space.

4 Conclusion

The primary objective of the accident alert system presented in this paper is to minimize the risk of fatalities in accidents that cannot always be prevented. By rapidly detecting and responding to accidents, this system aims to increase the chances of saving lives and providing essential medical assistance.

The invention of such a device holds immense value, particularly for accidents occurring in remote or secluded areas, as well as during nighttime when help may be scarce. As technology continues to advance, the integration of vehicle tracking and accident alert features is expected to play a crucial role in enhancing public safety and improving our day-to-day lives.

In the coming years, the widespread adoption of these accident alert systems can significantly contribute to reducing accident-related casualties, making our roads and transportation networks safer for everyone. This innovative approach to accident detection and response showcases the potential of modern technology to transform our lives and create a more secure environment for all.

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