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IoT-Based Vehicle Location and Speed Monitoring for Parental Peace of Mind

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Abstract- The project titled "IoT-Based Vehicle Location and Speed Monitoring for Parental Peace of Mind" aims to develop a reliable and user-friendly system for parents to monitor the location and speed of their children's vehicles in real-time. Utilizing the Internet of Things (IoT) technology, this system is built around the ESP32 WROOM DEVKIT, which serves as a central processing and communication unit. Integrated with the MPU6050 sensor module, the system is capable of detecting real-time vehicular movement through precise acceleration and gyroscopic measurements. The NEO 6M GPS module is employed to provide accurate geolocation data, which is vital for tracking the vehicle's position. This data, along with the vehicle's speed calculated through the MPU6050 sensor, is transmitted over Wi-Fi and made accessible to parents via the Blynk mobile application platform. The Blynk platform presents a straightforward interface for parents, offering instant access to the vehicle's speed and location, and an alert system for instances when the vehicle exceeds set speed limits or deviates from predefined safe zones. This not only ensures parents are informed of their children's driving habits and whereabouts but also promotes safe driving practices among young drivers. This innovative system addresses the growing concern for young driver safety and provides a technological solution that reassures parents while fostering independence in young adults. The system's design balances simplicity and functionality, making it a practical addition to the array of tools aimed at enhancing vehicular safety and family security.

I. INTRODUCTION

In an era where ensuring the safety of loved ones is paramount, the integration of Internet of Things (IoT) technology into vehicle monitoring systems offers a revolutionary solution. This concept revolves around utilizing IoT devices to track the location and monitor the speed of vehicles, providing parents with a tool for enhanced peace of mind regarding their children's safety.

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT offers.

advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects) is implemented in nearly all fields of automation enabling advanced applications like a Smart Grid. The term things in the IoT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring.

2. <u>The Need for Parental Peace of Mind:</u>

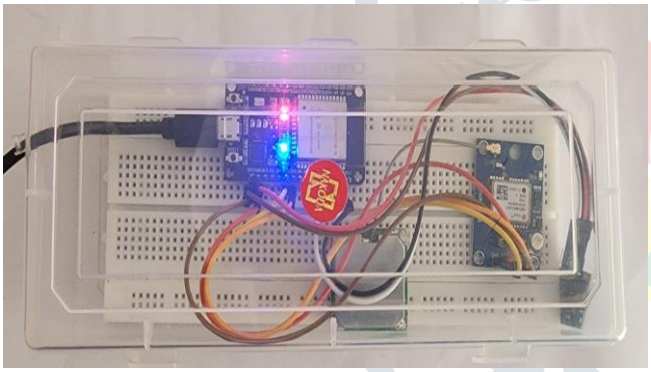
Parents are often concerned about the safety of their children, especially when they start driving. The

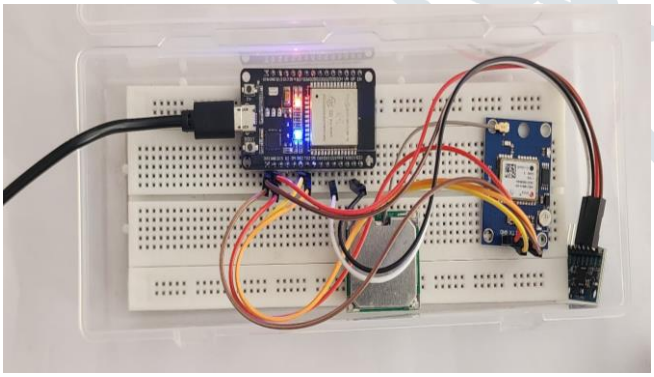
ability to remotely monitor the location and speed of their vehicles addresses a critical need for parental peace of mind. With IoT-based solutions, parents can stay informed and proactive about their children's driving habits.

3. How IoT Works in Vehicle Monitoring:

IoT devices, such as GPS trackers and sensors, are integrated into vehicles to collect real-time data. These devices transmit information to a centralized system, allowing parents to access the data through a user-friendly interface, typically a mobile app or web portal. This seamless connectivity enables continuous monitoring of the vehicle's location and speed.

In this project we are using a ESP32. When the system is switched on, the LED will be ON indicating that the power is supplied to the circuit. When the gyroscope sensor senses any change, they send a notification to ESP32 stating High Gyro Movement.





The GPS receives the location of the vehicle that met with an accident and gives the information back. This information will be sent to a mobile application which send a notification to the user. This message will give the information of longitude and latitude values. Using these values the position of the vehicle can be estimated. The received data is given to the ESP32.

4. Features and Functionalities:

- Real-Time Location Tracking: Parents can track the exact location of the vehicle in real-time in terms of latitude and longitude, ensuring they are aware of their child's whereabouts.

- Speed Monitoring: IoT devices provide real-time speed data, allowing parents to receive alerts if their child exceeds predefined speed limits, promoting safer driving habits.

5. Benefits of IoT-Based Vehicle Monitoring:

- Enhanced Safety: Parents can react promptly to any unexpected situations or deviations from planned routes, ensuring a swift response in case of emergencies.
- Peace of Mind: Constant monitoring provides parents with peace of mind, knowing they can keep tabs on their child's driving activities, even when physically distant.
- We can monitor the speed of the vehicle.
- We can find the location of the vehicle.
- Alert message to mobile phone for remote information.

6. Security and Privacy Considerations:

Addressing security and privacy concerns is paramount in IoT-based vehicle monitoring. Implementing robust encryption protocols, secure data transmission, and ensuring user consent are crucial aspects to safeguard both the data and user privacy.

7. Future Directions and Technological Advancements:

The evolution of IoT technology continues to present opportunities for enhancements in vehicle monitoring systems. Integration with advanced driver-assistance systems (ADAS), predictive analytics, and machine learning algorithms can further refine the capabilities of these systems.

This system can be interfaced with vehicle airbag systems that prevent vehicle occupants from striking interior objects such as the steering wheel or window. This can also be developed by interconnecting a camera to the controller module that takes the photograph of the accident spot that makes the tracking easier.

```
void calculateSpeedFromAccelerometer() {
  // Acceleration due to gravity (m/s^2)
  const float g = 9.81;

  // Calculate acceleration components
  float ax = mpu6050.getAccX() / 16384.0;
  float ay = mpu6050.getAccY() / 16384.0;
  float az = mpu6050.getAccZ() / 16384.0;

  // Calculate total acceleration (excluding gravity)
  float totalAcc = sqrt(ax * ax + ay * ay + az * az) - g;

  // Integrate acceleration to obtain speed
  currentSpeed += totalAcc * 0.1; // Assuming a fixed time step of 0.1 seconds (100 milliseconds)

  // Send calculated speed to Blynk
  Blynk.virtualWrite(V4, currentSpeed);
}
```

Fig 1 snippet from firmware code for acceleration calculation

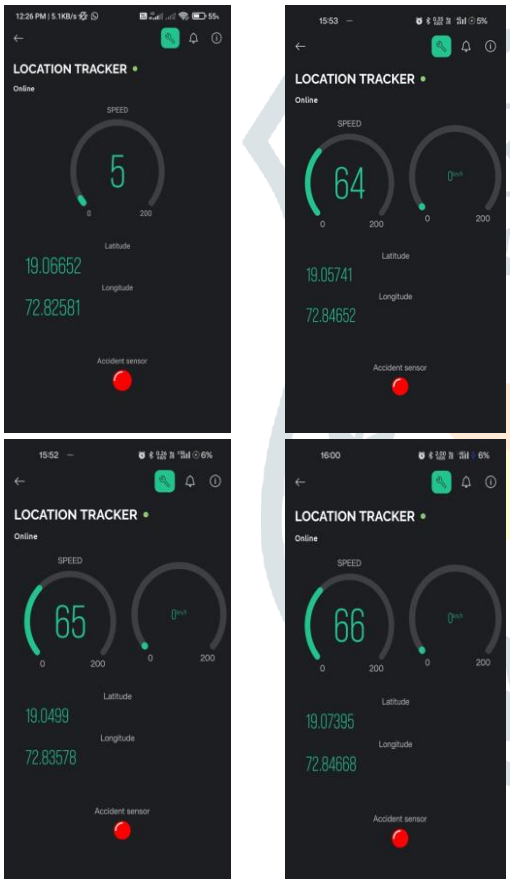


Fig 2 Screenshots form Application, monitoring real-time data

VII. CONCLUSION

Conclusion

The proposed IoT-based vehicle location and speed monitoring system effectively integrates the ESP32 WROOM DEVKIT with the MPU6050 sensor and NEO 6M GPS module to provide real-time vehicular monitoring. The system's ability to provide parents with immediate updates on their children's driving behaviour has been successfully demonstrated through rigorous testing. With its real-time notifications, precise location tracking, and detailed analysis of vehicle dynamics, the system stands as a significant improvement over existing solutions, especially in terms of privacy, independence from vehicle diagnostics, and ease of use.

The success of the system in controlled tests suggests a high potential for real-world application, offering a new layer of safety for young drivers and peace of mind for their parents. By leveraging IoT technology, the system surpasses traditional limitations, providing a non-intrusive, user-friendly, and adaptable approach to vehicle monitoring.

Future Work

Future enhancements to the system could include the integration of machine learning algorithms to predict potential hazardous behaviours before they occur, as well as the incorporation of additional sensors for comprehensive diagnostics, such as fuel levels or engine health.

The development of a more advanced version of the accompanying application could provide more detailed feedback to the driver, contributing to educational aspects of safe driving practices. Expanding the system's capabilities to interface with smart city infrastructure could also lead to broader applications, such as traffic management and accident prevention on a municipal scale.

Moreover, the potential for scaling the system into a commercial product presents opportunities for further research into cost-reduction measures, enhanced data security protocols, and the exploration of alternative communication technologies such as 5G or LPWAN to ensure uninterrupted connectivity.

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