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Survey Paper on IoT-Enabled Vehicle Telemetry System

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Abstract:
Road accidents cause millions of deaths and injuries annually, making them a serious worldwide health concern. IoT-based black boxes for car accidents have the potential to significantly increase traffic safety by offering precise and trustworthy accident data. This project suggests utilizing an ESP32 microcontroller to create an Internet of Things black box for car accidents. A number of sensors are used by the black box to gather data, such as a gas sensor to identify hazardous substances, an accelerometer to measure acceleration, a GPS sensor to monitor location, and a piezoelectric sensor to measure impact force and take pictures of the accident scene. The sensor data is sent to a cloud server by the black box, which also encrypts and compresses it. The information is kept on the cloud server and is accessible to authorized users, including the owner of the vehicle, insurance providers, and emergency responders.

Keywords: IoT-based black box, car accident black box, ESP32, road safety, accident investigation, emergency response, insurance, fleet management.

I. INTRODUCTION:

Road accidents are a major global health problem, resulting in millions of deaths and injuries each year. As per the World Health Organization, the primary cause of death for children and young adults between the ages of 5 and 29 is road traffic injuries. Lack of precise and trustworthy accident data is one of the obstacles to increasing traffic safety. Investigation of accidents, emergency response, insurance, and fleet management all depend on this data.

Current accident data collection techniques, like police reports and witness interviews, are frequently imprecise and lacking in detail. This makes it challenging to pinpoint the reasons behind accidents and create practical safety precautions. The primary purpose of an automobile's black box system is to gather, process, and store data while the car is moving. Although this technique is commonly utilized in airplanes, automobiles can also benefit from it.

II. LITERATURE REVIEW:

Abel Garcia-Barrientos, David Torres-Uresti, Francisco R. Castillo-Soria published paper in 2022 [1]. In this study, an Internet of things module and a Raspberry Pi microcomputer were used in the design and implementation of a car's black box system. A Raspberry Pi microcontroller, along with several sensors such a GPS, camera, audio, and alcohol sensor modules, as well as signals from the electronic control unit, were used to build this system.

Dr. C. K. Gomathy, K Rohan, Bandi Mani Kiran Reddy, Dr. V Geetha [2] proposed a model in which the major goal of this work is to develop an application that uses the accelerometer and GPS sensors found in mobile phones to identify collisions when there is an sudden decrease in speed from the outside using a Sensor Fusion Based Algorithm.

Sharvin Pingulkar1, Haroondeep Singh Sandhu2, Jayant. R. Mahajan [3] published a paper in that the primary goal of the article is to create a Black Box prototype that can be fitted in any kind of car to facilitate vehicle diagnostics. Similar to flight data recorders

in airplanes, "Black Box" technology is essential to the investigation of car crashes. It is possible to design this prototype with the fewest possible circuits. In order to lower the death rate, this can help build safer cars, enhance the care given to collision victims, assist insurance companies with their vehicle crash investigations, and improve road conditions.

A system that uses GPS and Android applications to provide travelers with safe and secure travel was proposed by R Dimple and Nanda B S [4]. For this, the incorrect route alert approach is applied. It is useful to determine the vehicle's present location. Additionally, temperature, ultrasonic, smoke, and accelerometer sensors are used to give a travelers safety mechanism. In response to concerns raised by travelers over their safety, the planned system also sends alert messages to authorized mobile devices, letting them know about the whereabouts of their fellow travelers.

Abhishek M D, Eshwari, Praveen M J, Sneha B M [5] proposed an article which is to design and create a Black Box messaging system for vehicle tracking and monitoring that uses GPS and GSM modules. Understanding how GPS and GSM technology function is crucial to finishing the entire paper in order to have a complete understanding of both technologies.

III. PROPOSED SYSTEM:

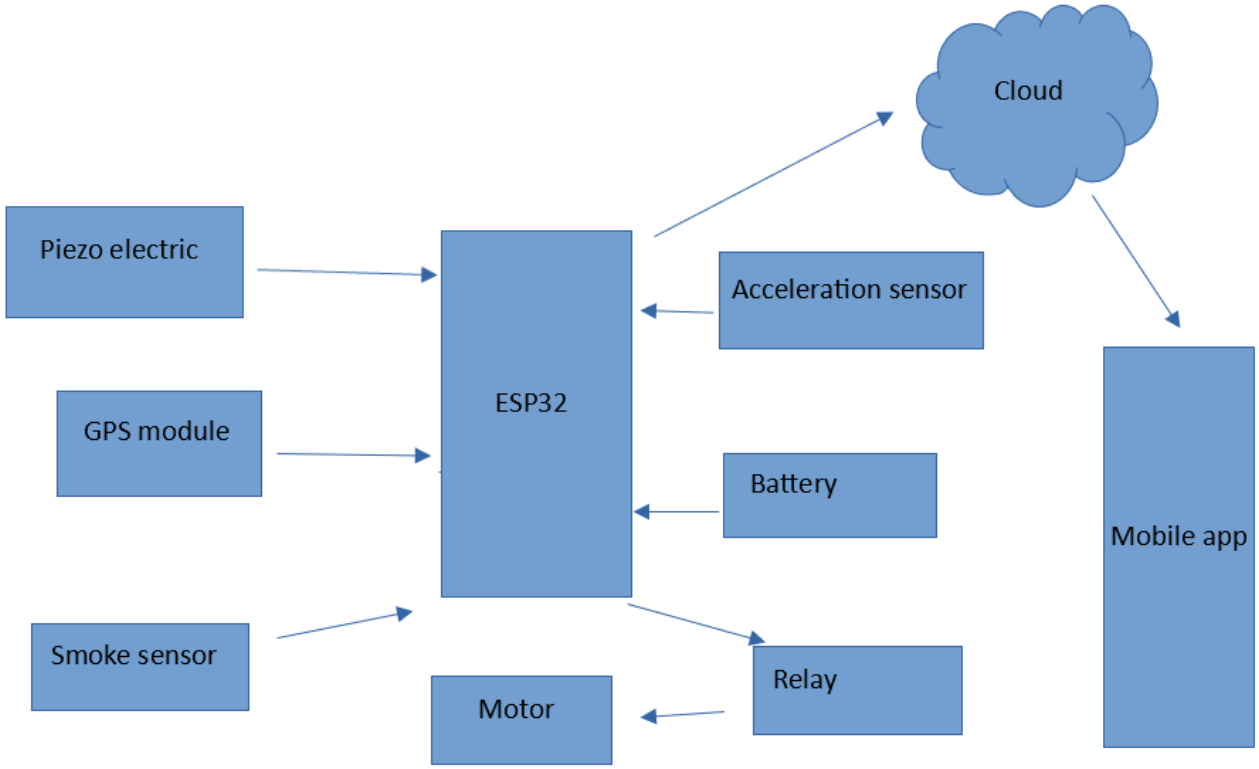
Following a survey of several literatures, we have chosen to suggest an Internet of Things-enabled telemetry system. The concept of the IoT-based black box for car accidents using ESP32 is to provide a low-cost and reliable solution for collecting and transmitting data about car accidents to a cloud server. The black box would be equipped with a variety of sensors, including:

- Piezoelectric sensor: to measure impact force
- Accelerometer sensor: to measure acceleration
- GPS sensor: to track location
- Gas sensor: to detect harmful gases
- Camera: to take photos of the accident scene

An ESP32 microcontroller, which is inexpensive, low-power, and ideal for Internet of Things applications, would also be included in the black box. Data collection from the sensors, data compression and encryption, and data transmission to the cloud server would all fall under the control of the ESP32.
The information would be kept on the cloud server and accessible to authorized users, including the owner of the vehicle, insurance providers, and emergency responders. The information may be utilized to lower insurance costs, improve emergency response times, enhance fleet management, and enhance accident investigation.

The IoT-based black box for car accidents can be used for a variety of applications, including:

- **Accident analysis:** The information gathered by the black box can be utilized to determine the reason behind the incident and to find solutions to stop it from happening again.
- **Insurance claims:** The data collected by the black box can be used to support insurance claims, which can help to speed up the claims process and to ensure that the insured receives a fair settlement.
- **Emergency response:** The data collected by the black box can be used to direct emergency responders to the scene of the accident quickly and efficiently.
- **Vehicle safety:** The data collected by the black box can be used to develop new safety features for vehicles.
- **Improved fleet management**: Fleet managers can use the black box data to monitor driver's behavior and vehicle performance. This can help to identify and address potential safety hazards, improve fuel efficiency, and reduce maintenance costs.



IV. **Conclusion:**

Thus, this project suggests utilizing an ESP32 microcontroller to create an Internet of Things black box for car accidents. A number of sensors are used by the black box to gather data, such as a gas sensor to identify hazardous substances, an accelerometer to measure acceleration, a GPS sensor to monitor location, and a piezoelectric sensor to measure impact force and take pictures of the accident scene. The sensor data is sent to a cloud server by the black box, which also encrypts and compresses it.

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