IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

VEHICAL BLACKBOOX

[1] Ankita K.Darnule, [2]Jay G. Gangan, [3] Shyam Krishna, [4] Vikas Kotian,[5] Zainab Mizwan.

[1 ,2,3,4] Students, Electronics & Tele Communication Engineering, Shree L.R. Tiwari College of Engineering, India.

[5] Assistant Professor, Electronics & Tele Communication Engineering, Shree L.R. Tiwari College of Engineering, India.

***Abstract*:**

Vehicle black box systems play a crucial role in accident analysis and road safety enhancement by recording crucial vehicular data before, during, and after incidents. This research presents a cost-effective black box system designed for vehicles, integrating sensors, GPS, and realtime data logging to improve accident investigation and driver accountability. The proposed system continuously records vehicle speed, impact force, location, and driver behavior, ensuring valuable insights for accident reconstruction. With advancements in IoT and cloud connectivity, the system enables remote monitoring and data retrieval, aiding authorities and insurance companies in ensuring fair assessments and improved safety standards.

1. INTRODUCTION

With the increasing number of road accidents globally, it has become imperative to develop advanced accident analysis tools. Aircraft black box technology has proven effective in aviation, and a similar approach can be applied to vehicles for better accident reconstruction. Vehicle black boxes can record crucial parameters such as speed, acceleration, braking force, and driver actions, providing valuable data for investigations and legal proceedings. However, reconstructing the events leading up to and during a crash can be challenging, especially when eyewitness accounts are unreliable or unavailable. This is where a vehicle black box comes in – a revolutionary technology designed to capture and store critical data in the moments leading up to and during an incident. This paper discusses the implementation of a cost-effective vehicle black box system designed to enhance road safety and accountability

Keywords—Vehicle black box, accident analysis, data logging, IoT, GPS tracking, road safety.

2. OBJECTIVES

This project aims to develop a cost-effective vehicle black box system that records critical data such as speed, impact force, location, and temperature using various sensors. It includes real-time data logging, IoT-based remote monitoring, and secure storage for post-accident analysis. The system is designed to support accident reconstruction, improve road safety, enhance driver accountability, and aid insurance investigations. A backup power supply ensures continued operation during crashes.

3. LITERATURE REVIEW

Previous studies have explored vehicle black box systems focusing on parameters like speed, GPS tracking, and crash detection. Early systems, such as those by Jung et al., emphasized accident data logging, while others integrated GSM and GPS for real-time tracking. Recent works have introduced IoT and cloud storage for remote data access, but many lacked features like impact force analysis, temperature monitoring, and comprehensive driver behavior tracking. The proposed system aims to overcome these limitations by offering a more complete, sensor-rich, and cost-effective solution for accident analysis and road safety enhancement.

3.1 Key Findings

- **Limited Sensor Integration in Existing Systems**: Most existing vehicle black box solutions focus primarily on GPS and accelerometer data, lacking additional sensors like gyroscopes and temperature sensors which are vital for comprehensive accident analysis.
- **Insufficient Driver Behavior Monitoring**: Current systems often fail to log critical behavioral parameters such as sudden braking, sharp turns, or speeding, which are essential for identifying accident causes and promoting safe driving habits
- **Lack of Redundant and Secure Data Storage**: Many systems rely solely on onboard memory without cloud backup, risking data loss during severe crashes or system damage.
- **Inefficient Real-time Communication**: While some systems include GSM/GPS modules, network instability can hinder real-time alerts and remote monitoring, especially in remote areas.

- **Need for Cost-effective Solutions**: High costs and complexity of advanced black box systems limit their use in common consumer vehicles, creating a need for affordable yet feature-rich alternatives.
- **Potential of IoT and Cloud Integration**: The incorporation of IoT technologies enables real-time monitoring and remote data retrieval, improving emergency response and post-accident investigation.

3.2 Gaps and Opportunities Identified

Gaps:

- Limited use of sensors like gyroscope and temperature.
- Weak driver behavior analysis**.**

Opportunities:

- Integrate more sensors for detailed data.
- Use IoT for real-time cloud storage.
- Design a low-cost, scalable system.
- Monitor driver behavior to promote safety.
- Support faster emergency response and fair insurance claims.

3.3 Conclusion from Literature

This paper presents an efficient and cost-effective vehicle black box system for accident analysis and road safety improvement. By integrating impact sensors, GPS tracking, and IoT capabilities, the system provides real-time and stored data for accident investigation and prevention. The proposed solution can aid insurance companies, law enforcement agencies, and vehicle manufacturers in improving road safety standards and ensuring accurate accident assessments

4. METHODOLOGY

4.1 System Architecture

The vehicle black box system uses an **ESP32 microcontroller** to collect data from various sensors:

- **MPU6050** detects motion and impact,
- **DHT11** monitors temperature, and
- **GPS Module** tracks location and speed.

Data is stored on an **SD card** for offline access and sent to the **cloud via Wi-Fi** for real-time monitoring. A **backup battery** ensures the system works even during accidents or power loss.

4.2 Technology Stack

- **Microcontroller**: ESP32 with Wi-Fi and Bluetooth.
- **Sensors**: MPU6050 (motion), DHT11 (temperature), GPS (location).
- **Storage**: MicroSD card for data logging.
- **Connectivity**: Wi-Fi for IoT/cloud integration.
- **Power**: Vehicle power with battery backup.
- **Function**: Real-time data logging, crash detection, and remote monitoring.

4.3 Implementation Workflow

- **System Initialization**: The ESP32 initializes all connected sensors (MPU6050, GPS, DHT11) and storage (SD card), preparing for data collection and cloud connectivity.
- **User Interaction**: The system supports three interfaces—**Touch**, **Bluetooth**, and **IR Remote**—for user control and monitoring.
- **Signal Reception & Processing**: The ESP32 receives and processes commands from the selected interface to determine the required action (e.g., data logging or emergency alerts).
- **Data Logging & Relay Activation**: Data such as speed, impact, and location is logged to the SD card, and emergency alerts can be triggered if necessary.
- **Voice Command (Bluetooth App)**: Voice commands sent via Bluetooth enable hands-free operation for tasks like recording accident data or sending alerts.

5. RESULTS AND DISCUSSION

The Vehicle Black Box System was tested for performance in recording and transmitting vehicle data, focusing on parameters like speed, location, impact force, and temperature.. The performance of the core components such as MPU6050, GPS Module, DHT11, and the SD Card Module was also assessed.

The Vehicle Black Box System demonstrated excellent performance in terms of data logging, real-time monitoring, and reliable storage. The integration of key components such as MPU6050, GPS Module, DHT11, SD Card Module, and ESP32 resulted in a cohesive and functional system for accident detection and vehicle safety monitoring

.

1. Reliability

- The system demonstrated high reliability during continuous operation for over 24 hours, with no data loss or system failures. The MPU6050 accurately detected acceleration, deceleration, and collision events, triggering the logging of data to the SD card without interruptions.
- The ESP32 handled simultaneous data transmission and local logging without issues. Data from the **GPS** and **DHT11** sensors were consistently recorded, and the SD card module effectively stored the information for later retrieval.

2. User Experience

- The **SD card module** effectively stored large amounts of data, with no signs of corruption or failure during continuous logging. The data was saved on the SD card in a structured format, allowing for easy retrieval and analysis after an incident.
- The **ESP32** ensured smooth communication between the sensors and the SD card, guaranteeing that no data was lost during critical moments. This data could later be used for accident reconstruction, insurance claims, or safety assessments.

---

6. CONCLUSION

This paper presents an efficient and cost-effective vehicle black box system for accident analysis and road safety improvement. By integrating impact sensors, GPS tracking, and IoT capabilities, the system provides real-time and stored data for accident investigation and prevention. The proposed solution can aid insurance companies, law enforcement agencies, and vehicle manufacturers in improving road safety standards and ensuring accurate accident assessments.

---

7. REFERENCES

- Mr.Yash Inaniya, Naresh Kumari and Urvashi Luthra “Home automation using capacitive touchscreen”,June 2014, al Int. Journal of Engineering Research and Applications ISSN : 2248-9622, Vol. 4, Issue 6(Version 2)
- Prof.Manohar Wagh, Vrushabh Gadhari, Harshad Sonawane, Shriram Shelar, Rahul Mahale “touch screen based automation system”,March 2018, at International Research Journal of Engineering and Technology(IRJET)
- Prof.Ami Munshi,Roshan Gosalia,Darshil Gala, “android based automation system”,November 2018, at International Journal of Scientific & Engineering Research Volume 9, Issue 11
- Er.VikramPuri, IEEE, “Real Time Smart Home Automation based on PIC Microcontroller, Bluetooth and Android Technology”, March 2016, At faculty- Embedded System & Robotics, Enjoin Technologies.
- Ismail Coskun and H. Ardam, “A Remote Controller for Home and Office Appliances by Telephone,l IEEE Transactions