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EDR (Event Data Recorder) in Vehicles using IOT

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Abstract: *The increasing integration of Electronic Control Units (ECUs) in modern vehicles has paved the way for sophisticated in-vehicle monitoring and diagnostics systems, givingrise to the concept of Event-Driven Recording (EDR). EDR in vehicles involves the continuous capture and storage of critical data related to various events, such ascollisions, sudden accelerations, or system malfunctions. This data, often collected from multiple sensors and modules within the vehicle, serves as a crucial tool for post-incident analysis, aiding in the reconstruction of events leading up to and during accidents. EDR not only provides valuable insights for accident investigation but also plays a pivotal role in enhancing vehicle safety by facilitating the identification of potential design flaws and contributing to the development of more robust safety features.*

Keywords: Arduino, Black box, GPS, GSM, IoT, Vehicular Electronics, Blackbox, accident prevention, Prevention, Remedial, VANE

I. INTRODUCTION

The advent of the Internet of Things (IoT) has revolutionized various industries, and the automotive sector is no exception. One of the groundbreaking applications of IoT technology in vehicles is the implementation of Event Data Recorders (EDRs), which go beyond traditional black box functionalities. An IoT-based EDR in a vehicle leverages a network of interconnected sensors, such as accelerometers, GPS modules, and cameras, to capture a comprehensive array of real-time data. This data encompasses crucial information related to the vehicle's performance, environmental conditions, and driver behavior, providing a holistic view of events leading up to and during an incident.

In today's fast-paced world, ensuring the safety of both drivers and passengers is of paramount importance. This project presents an innovative solution aimed at enhancing road safety by incorporating multiple advanced technologies into a single integrated system. This project encompasses the development of a sophisticated model capable of assessing several critical parameters. Firstly, it evaluates the driver's alcohol status, promoting responsible and sober driving habits. Furthermore, it monitors seat belt usage, a fundamental safety practice that, when neglected, can lead to dire consequences.

To further bolster safety measures, the system incorporates a sleep detection mechanism for drivers. If the driver is detected to be in a state of drowsiness or sleep, the system takes immediateaction, immobilizing the vehicle and issuing a timely alert. Continuous speed monitoring is another pivotal aspect of our system, allowing for real-time assessment of vehicle velocity. In the unfortunate event of an accident, the integrated ADXLsensor swiftly identifies the impact, prompting the system to automatically dispatch an alert message, complete with live location information, to relevant authorities.

In addition to these crucial safety features, a high-resolution camera has been integrated into the system to provide comprehensive recording capabilities. This video documentation serves as a valuable tool for post-incident analysis and aids in the precise determination of accident scenarios. This project represents a significant leap forward in automotive safety technology, unifying various critical monitoring functions into a single, reliable unit. By seamlessly integrating these features, our system aims to minimize the occurrence of accidents, reduce injury rates, and ultimately save lives on the road.

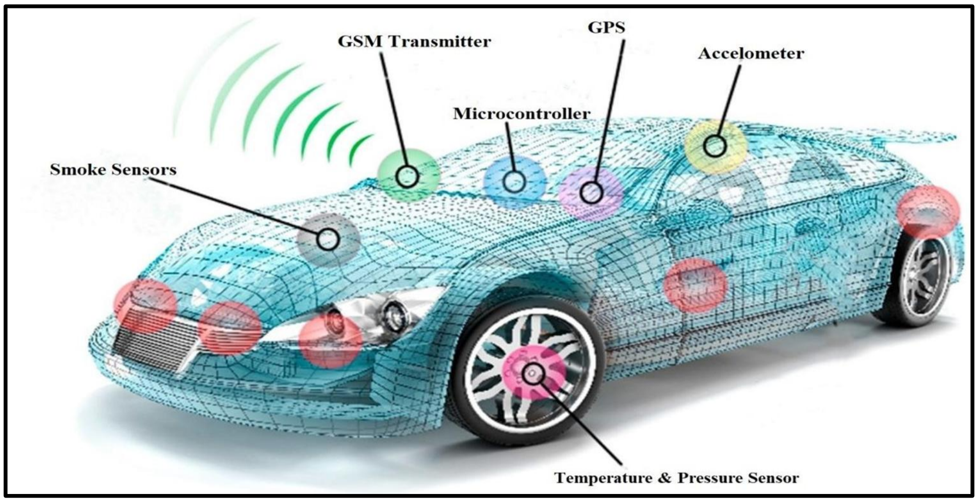

Fig. 1:Schematicof the sensing layer

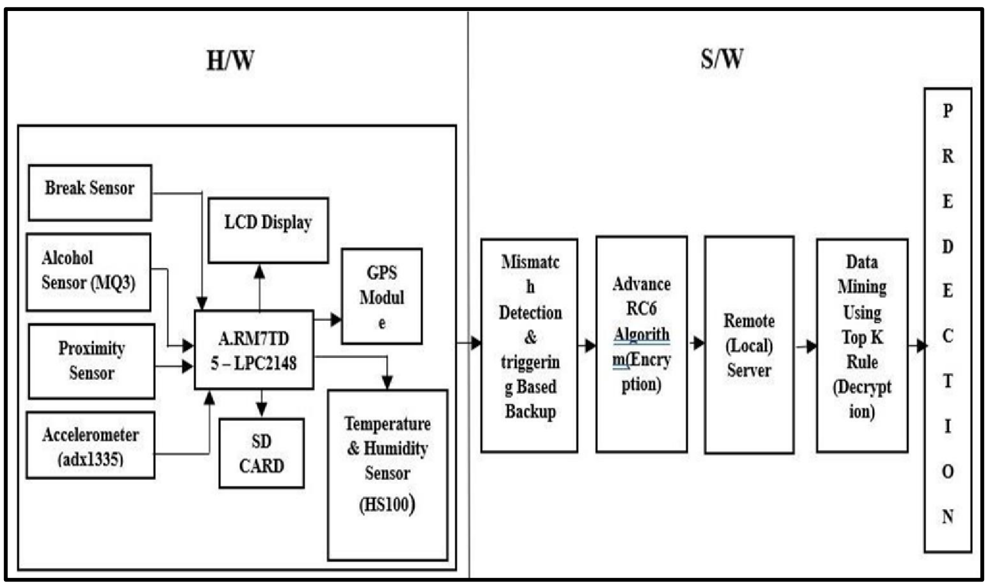

Fig. 2:Schematicof the sensing layer

The core functionality of the proposed system revolves around improving accident reconstruction, driver behavior analysis, and overall vehicle safety. By continuously monitoring and recording events, the EDR system not only provides valuable insights into the circumstances leading up to accidents but also facilitates preventive measures through the analysis of driver behavior patterns. The integration of GPS data allows for precise location tracking, aiding emergency response efforts and streamlining the post-accident investigation process. Moreover, the system can be accessed through a user interface, allowing authorized users, such as fleet managers or law enforcement, to retrieve and analysis recorded data for operational optimization and regulatory compliance.

II. LITERATURE REVIEW

This paper proposes a black box system for vehicles that can monitor the driver's alcohol status, seat belt usage, and sleepiness, and take corrective action in the event of an accident. The black box also records all events leading up to and after an accident using a camera, which can be used to investigate the cause of the accident and provide evidence in court.

This paper presents a design for a vehicle black box system that can monitor the vehicle's speed, acceleration, braking, steering angle, and engine RPM. It also uses a camera to record video footage of the events leading up to and after an accident. The black box data can be used to investigate accidents and improve vehicle safety.

This paper proposes an IoT-based black box system for vehicles that can monitor the vehicle's speed, acceleration, after an accident. The black box data is sent to a cloud server, where it can be accessed by the vehicle owner and other authorized users.

This paper presents a solution which includes both preventive as well as remedial system. VANET technology is used in the preventive system. The remedial system focuses on providing details of the location to the nearby hospitals so that immediate help can be provided, the Internet of Things (IoT) can be used to accomplish this task. The system improves road safety, security, communication medium and performance monitoring and increases productivity.

III. METHODOLOGY

A. System Block Diagram:

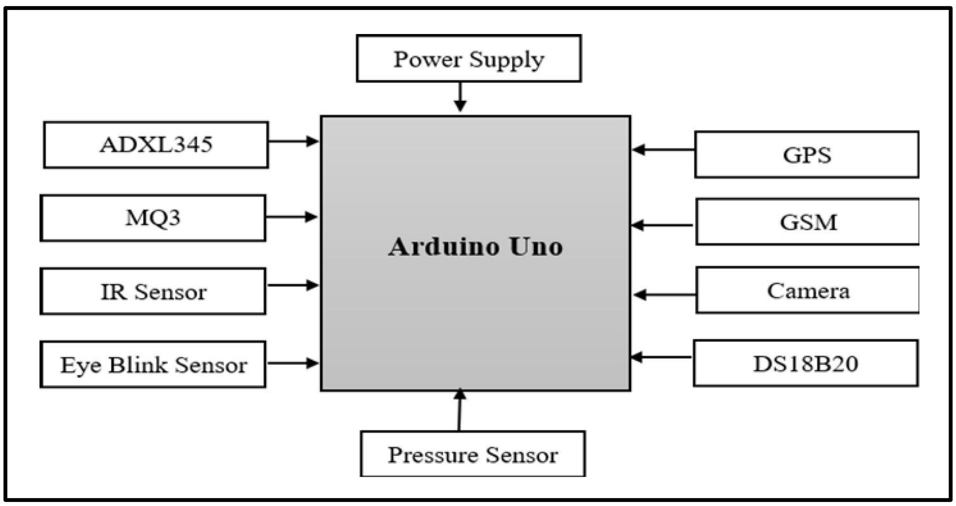

Fig. 3:Ardunio Unoblock diagram

The Event Data Recorder (EDR) project aims to enhance vehicle safety and performance monitoring by implementing a comprehensive data recording system using Arduino Uno and various sensors. The Arduino Uno will serve as the central processing unit, collecting and processing data from a set of sensors strategically placed within the vehicle.

The primary sensors for this EDR system include an accelerometer, gyroscope, GPS module, and a temperature sensor. The accelerometer and gyroscope will provide crucial information about the vehicle's acceleration, deceleration, and angular movements, helping to reconstruct the dynamics of an event accurately. The GPS module will record the vehicle's location, speed, and trajectory, offering insights into the vehicle's movement patterns. The temperature sensor will monitor the ambient temperature, providing additional environmental context.

The Arduino Uno will be programmed to continuously gather data from these sensors and store it in a secure and non-volatile memory module, such as an SD card. The recorded data will be time-stamped for accurate event reconstruction. Additionally, the system will incorporate a real-time clock (RTC) module to ensure precise time keeping. To facilitate easy retrieval of data, the EDR will be equipped with a USB interface or Bluetooth connectivity, allowing users to download recorded information to external devices for analysis. The system will also include a user-friendly interface, possibly an LCD display or LED indicators, to convey real-time information and system status. Furthermore, the EDR project will emphasize data integrity and security, implementing measures such as checksums and encryption to protect the recorded information. The Arduino Uno will be powered by the vehicle's electrical system, ensuring continuous operation.

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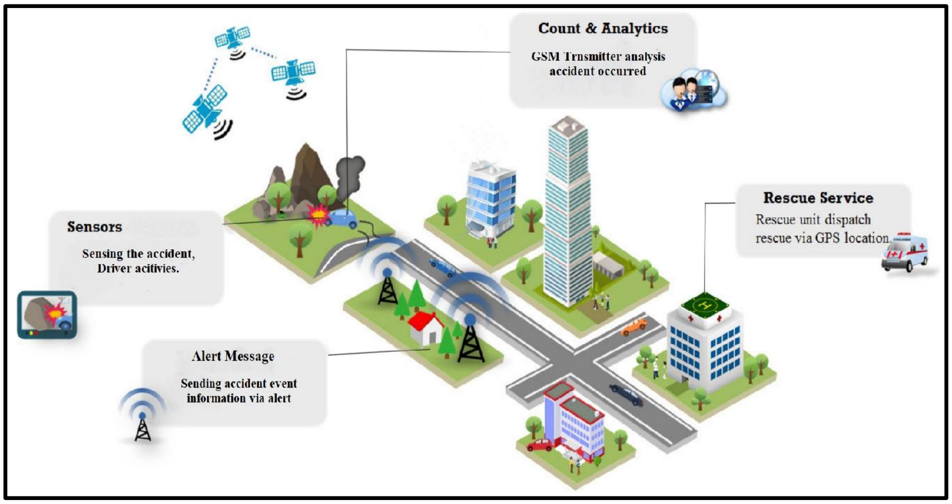

Fig.4: An example of an EDR system applied immediately to traffic accidents for detection, analysis, and emergency notification.

B. Hardware & Software Details:

Table 1: Hardware Requirements for Development of Project:

Sr. No.	Hardware	Specification
1.	Power supply	battery 12v, 1A, 7805 voltage regulators.
2.	GPS	NEO-6M GPS
3.	GSM	900A

Table 2: Software Requirements for Development of Project:

Sr. No.	Software	Specification
1.	Arduino ide	Arduino PLC IDE 1.0.3, Win 10 & newer, 64 bits
2.	EasyEDA	Easyeda-windows-x64-2.0.32
3.	Proteus	Proteus 8.16

C. ALGORITHMS:

1. Advanced RC6 Algorithm (Encryption):

In the context of Event-Driven Recording (EDR) in vehicles, this algorithm would be applied to the captured data to ensure its confidentiality and integrity during storage or transmission. These steps assume the use of a specific block size, key size, and number of rounds:

a. Key Expansion:

Derive round keys from the original symmetric key using a key expansion algorithm. This involves breaking down the key into subkeys for each round of the algorithm.

b. Initialization:

Initialize the block of data to be encrypted or decrypted. This may involve dividing the data into fixed-size blocks, typically 128 bits for RC6.

c. Data Mixing:

Perform a series of mixing operations on the data block. These operations typically involve bitwise XOR, addition, and rotation operations, creating confusion and diffusion within the data.

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d. Round Processing:
Iterate through multiple rounds (e.g., 20 rounds for RC6) of processing. Each round consists of a combination of substitution, permutation, and mixing operations on the data block using the derived round keys.

e. Key Mixing:
Introduce the round keys into the data block by XORing them with specific parts of the data. This ensures that the key is used in each round to influence the transformation.

f. Finalization:
After completing the specified number of rounds, perform a final mixing operation to produce the final encrypted or decrypted data block.

g. Output:
The final processed data block is the output of the encryption or decryption process.

Encryption Algorithm:

Input: Plain text, the number of rounds r.

Output: cipher text

Procedure:

```
B = B + S[0] D = D + S[1]
for i =1 to r do
{
        t =(B X (2B + 1))<<<lg w u =(D X (2D + 1))<<<lg w
        A = ((A X t)<<<u)+S[2i]
        C = ((C X u)<<<t)+S[2i + 1] (A;B;C;D)=(B;C;D;A)
}
A = A + S[2r + 2]
C = C + S[2r + 3]
```

2. Data Miningusing Top K Rule:

Implementing data mining with a top-K rule for Event-Driven Recording (EDR) in vehicles involves several key steps. The goal is to extract meaningful patterns and insights from the data generated by EDR systems.

Here are the execution steps:

a. Data Collection:

- Gather relevant EDR data from vehicles. This may include information from various sensors, control units, and modules within the vehicle.
- Ensure that the data collected is representative of different driving scenarios, including normal driving, accidents, sudden accelerations, and system malfunctions.

b. Data Pre-processing:

- Clean the collected data by handling missing values, outliers, and inconsistencies.
- Normalize or standardize the data to ensure that different types of variables are on a similar scale.
- Convert raw data into a suitable format for analysis.

c. Feature Selection:

- Identify and select relevant features from the EDR data. This step is crucial for reducing dimensionality and focusing on the most informative attributes.
- Consider factors such as speed, acceleration, braking patterns, and sensor readings as potential features.

d. Top-K Rule Mining:

- Apply data mining techniques, such as association rule mining, to discover patterns and relationships within the EDR data.
- Use the top-K rule mining approach to prioritize and extract the most significant rules based on certain criteria (e.g., support, confidence, lift).
- Define what constitutes a "top" rule based on the specific objectives of the analysis.

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e. Rule Evaluation and Validation:

- Evaluate the extracted rules to ensure they are meaningful and align with the objectives of EDR analysis.
- Validate the rules using additional datasets or domain knowledge to confirm their relevance and reliability.

f. Rule Interpretation:

- Interpret the top-K rules in the context of EDR for vehicles. Understand the implications of these rules on driving behaviour, safety, and potential system malfunctions.

g. Implementation of Rules in EDR System:

- Integrate the identified rules into the EDR system to enable real-time monitoring or post- incident analysis.
- Ensure that the implemented rules contribute to enhancing the capabilities of the EDR system for identifying critical events and improving vehicle safety.

h. Continuous Monitoring and Improvement:

- Regularly monitor the EDR system's performance with the integrated rules.
- Fine-tune and update rules based on new data and insights, ensuring the system remains effective in detecting relevant events and patterns.

Decryption Algorithm:

Input: Cipher text and w-bit round keys

Output: Plain Text

Procedure:

C = C - S[2r + 3] A = A - S[2r + 2]
for i = r down to 1 do
{
    (A;B;C;D)=(D;A;B;C) u =(D X (2D + 1))<<<lg w t =(B X (2B + 1))<<<lg w
    C = ((C - S[2i + 1])>>>t) $\oplus$ u
    A = ((A S[2i])>>>u) $\oplus$ t
}
D = D - S[1]
B = B - S[0]

IV. RESULTS

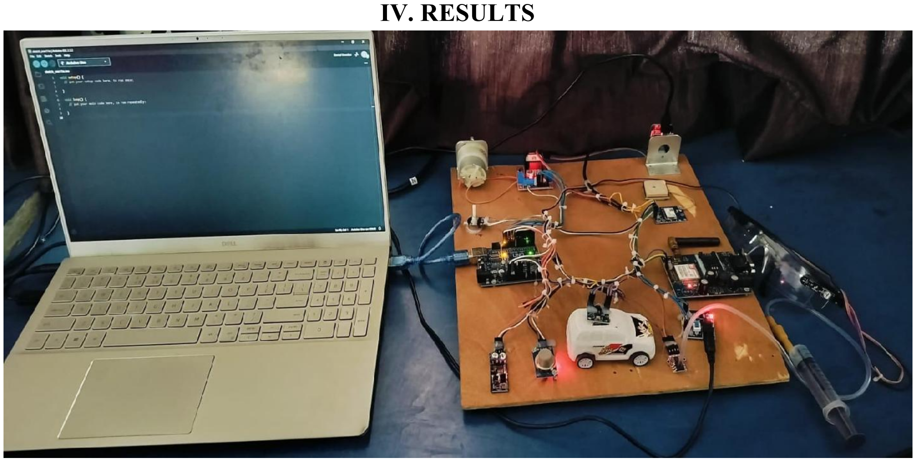

Fig. 5: EDR with all connections

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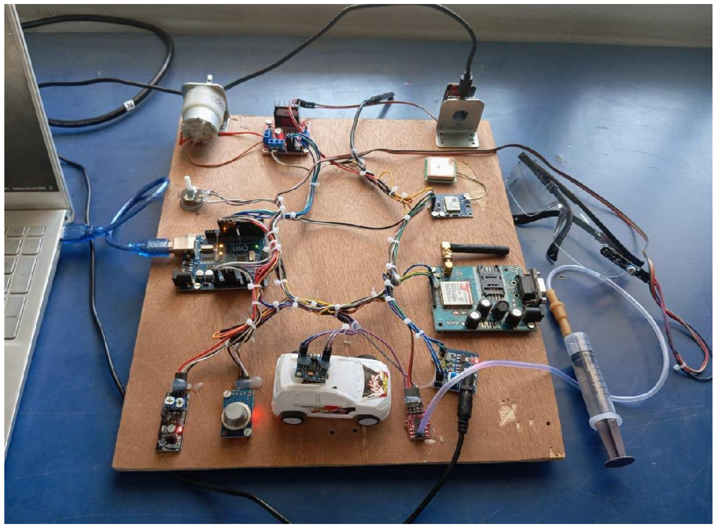

Fig. 6

V. CONCLUSION

The Event Data Recorder (EDR) for vehicles represents a critical advancement in automotive safety and forensic analysis. This module, akin to the black box in aircraft, is designed to capture and store essential data surrounding vehicular events, such as accidents or unusual incidents. By integrating a range of sensors, including accelerometers, gyroscopes, and GPS modules, the EDR records crucial information such as vehicle speed, brake usage, and airbag deployment. The meticulous design considerations, encompassing microcontroller selection, data storage systems, event-triggering mechanisms, and communication interfaces, collectively contribute to the EDR's ability to provide a comprehensive and accurate account of events. With a focus on compliance with industry standards and legal requirements, the EDR serves not only as a tool for post-incident analysis but also as a proactive measure for enhancing vehicle safety and informing future design improvements. As the automotive industry continues to evolve, the EDR stands as a pivotal component in advancing both safety research and the overall understanding of vehicular dynamics.

Moreover, the EDR contributes significantly to the improvement of vehicle safety standards by providing empirical data that can be used to enhance vehicle design and engineering. The insights derived from EDR data can lead to the development of advanced safety features, contributing to the overall reduction of accidents and fatalities on the roads. As the automotive industry continues to evolve, the EDR stands as a testament to the commitment to not only address incidents reactively but also proactively contribute to the advancement of vehicle safety technologies.

In the regulatory landscape, the EDR plays a crucial role in compliance with industry standards and legal requirements. Governments and regulatory bodies often mandate the inclusion of EDRs in vehicles to ensure transparency and accountability in the event of accidents. As the automotive industry continues to embrace technology, the EDR remains a fundamental tool for fostering a safer and more accountable driving environment, ultimately striving towards the vision of reducing the impact and severity of vehicular incidents.

REFERENCES

[1]. Blackbox and Accident Prevention System in Automobiles, Kannan S, Kadar A A, Divya D S, 2020
[2]. Vehicle Black Box System, Abhirup Das, Abhisek Ray, Abhisek Ghosh, Swarasree Bhattacharyya, Debaleena Mukherjee, T. K. Rana, 2019.
[3]. IoT Based Automative Drive Recorder as Black Box, A. Ponmalar, B. Chandra, S Aarthi, Gomathi Sun, 2022.
[4]. A Novel Accident Prevention System using VANET and Remedial System using IoT, Prabhakar Manage, Vaishnavi Patil, Shrusti Aribenchi, Sahana Navalgatti, Pranali Gomanache, 2020.
[5]. Embedded Controllers Using C and Arduino, James Flore, Mohawk Valley Community College

[6]. INTORDUCTION TO IoT, Sudip Misra, Cambridge University Press; First Editon (31 January 2022); Cambridge University Press, Splendour Forum, Jasola District Centre, New Delhi 110025
[7]. Black box data from Accident Vehicles, William Rosenbluth, ASTM
[8]. https://ieeexplore.ieee.org/document/9214296
[9]. https://www.researchgate.net/publication/344135466_Blackbox_And_Accident_Prevention_Systemin_Automobiles
[10]. https://ieeexplore.ieee.org/document/10072081
[11]. https://ieeexplore.ieee.org/document/4519050