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Vehicle Black Box System using IOT

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ABSTRACT: Nowadays automobiles technologies are rapidly increase every year and also every second number of accidents also increase. So, while using some technologies like black box placed in the automobile means creating a new level of data service in vehicle. The automobile black box has functions similar to an airplane black box. It is very useful to analyze the cause of accidents while driving and prevent the loss of life and property arising from vehicle accident. These paper shows the prototype automobile black box system. It is having some sensors and also the black box sends an alert message to pre stored mobile number in the way of SMS. The vehicle accident is a major public problem across world-wide. This problem is still increasing due to driver's rash driving and drunk and drive. This problem can be solved by using Black Box system analysis. Latest technologies in automobile are creating a new level of data service in vehicles.

The integration of Internet of Things (IoT) technology into vehicle black box systems has changed the landscape of transportation safety and efficiency. This abstract explains the core functionalities, architecture, and advantages of IoT powered black box systems. IoT enabled black box systems serve as good data recorders installed within vehicles, capturing and transmitting real-time information that are important for monitoring vehicle performance and ensuring driver safety. This systems consists a network of sensors that are placed throughout the vehicle to gather data on speed, acceleration, braking patterns, GPS location, and engine diagnostics. The architecture in this system consists of components including sensors, microcontrollers, communication modules, and backend servers. By continuously collecting and analyzing data, these systems enable timely detection of abnormal situations and trigger alerts in the event of accidents or deviations from safety parameters.

Moreover, the data collected by IoT-enabled black box systems provides invaluable insights for post-incident analysis, aiding in understanding the causes of accidents and informing future safety measures. Additionally, this data provides proactive maintenance scheduling, reducing downtime and optimizing vehicle performance. Furthermore, vehicle owners can leverage dedicated mobile applications or web interfaces to monitor real-time data, enabling informed decision-making regarding driving behavior and route optimization. In conclusion, the integration of IoT technology into vehicle black box systems enhances safety, efficiency, and transparency in transportation, marking a significant advancement in modern vehicle monitoring and management.

KEYWORDS: GPS, GSM, MEMS sensor, Internet of Things (IoT), SMS, Potentiometer.

I. INTRODUCTION

The Vehicle Black Box System Using IoT project is at the forefront of innovation in automotive safety and efficiency. Leveraging the capabilities of Internet of Things (IoT) technology, the project aims to develop a sophisticated black box system that can seamlessly integrate into vehicles to capture, transmit, and analyze real-time data. Through a network of sensors strategically placed within the vehicle, critical parameters such as speed, acceleration, braking patterns, and GPS location will be continuously monitored. This wealth of data will not only enable immediate alerts in the event of accidents or safety breaches but also provide valuable insights into driving behavior, vehicle performance, and road conditions. With a robust architecture comprising advanced communication modules and backend servers, the IoT-enabled black box system will facilitate seamless data transmission and analysis. Stakeholders, including vehicle owners, fleet managers, and law enforcement agencies, will benefit from access to real- time information through intuitive interfaces accessible via mobile applications or web platforms. This empowerment enables proactive decision-making regarding maintenance scheduling, route optimization, and adherence to safety protocols. Moreover, the project's emphasis on post-incident analysis aims to enhance understanding of accident causation factors, contributing to the development of targeted interventions to improve overall road safety.

The Vehicle Black Box System Using IoT project is not merely confined to individual vehicle monitoring but also has broader implications for transportation infrastructure and policy. By providing comprehensive data on traffic patterns,

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driving behaviors, and road conditions, the system can inform urban planning initiatives, traffic management strategies, and regulatory frameworks. Collaborative efforts with industry stakeholders and rigorous testing will ensure the reliability, scalability, and effectiveness of the IoT-powered black box system. Ultimately, this project endeavors to lay the groundwork for a future where IoT technology plays a pivotal role in creating safer, more efficient, and smarter transportation ecosystems.

GPS Booths for "Global Positioning System". It is an object's ground location satellite navigation device. The GPS consists of 24 satellites, which are located approximately 19,300 kilo-meters above the surface of the earth. Orbit the earth at a quite high speed of nearly 7,000 miles/h (11,200 km/h) per twelve hours only. The satellites are evenly distributed so that four satellites are accessible from anywhere in the world via direct view. That GPS satellite transmits a message containing the actual position, orbit, and time of the satellite. A GPS receiver uses the process called triangulation to integrate signals from different satellites to determine the exact position. To determine the location of a receiver there are three satellites needed, but a connection to four satellites is preferable because it offers more precision. To make a GPS device work properly, a connection with the required number of satellites must be established first.

The pressure sensor is a pressure-sensitive device to calculate the real sensor pressure (using different working principles) and certain components to transform this input into an output signal. Here Tekscan's piezoresistive intensity sensor is used. The more you drive, the lower the sensor's resistance. The power ranges from limitless to ~50k when pressed hard. The sensor itself is small and lightweight, but when it is flexed, the resistance does not shift. Resistance just adjusts when the circular region at the end of the sensor is under attack. The overall length is roughly 2.25. "The unit comes with a 0.1" spaced, breadboard-friendly socket, a weight sensor, pressurization sensor, etc. was supported. The pressure range is between 0 and 25 lbs. A gas sensor is a tool that senses air emission or gas concentration. The sensor generates an effective potential difference depending on the concentration of the gas, by adjusting the material resistance within the sensor, which can be determined as the output voltage. The form and composition of the gas can be calculated based on this voltage value. The form of gas that can be measured by the sensor depends on the sensor content. Typically, the sensors with comparators as shown above are accessible as modules. Such comparators can be specified for a particular gas concentration threshold value. The optical pin goes high when the gas content reaches this level. To measure the gas concentration.

MEMS Inclinometers are designed to measure a corner of an object concerning gravity power, often referred to as the tilt sensor, clinometer, or sloping sensor. Such incline or level meters assess the pitch and/or roll angle and dispose of these values via the electric interface. Inclinometers calculate an object's inclination angle due to gravitational force. This is achieved using an accelerometer that measures the gravitational influence of a specific mass held in an elastic frame of support. Its mass moves slightly when the system tilts creating a capacitance shift between the mass and the supporting framework. The angle of tilt is determined by the capacities assessed

Vehicle Black Box System using IoT represents a significant advancement in vehicle monitoring and safety. By integrating Internet of Things (IoT) technology, this project aims to create a comprehensive solution for real-time data collection, analysis, and transmission within vehicles. At the core of this project lies the development of a sophisticated black box system that utilizes sensors, microcontrollers, communication modules, and backend servers to capture and process critical vehicle parameters such as speed, acceleration, braking patterns, GPS location, and engine diagnostics.
The integration of IoT capabilities enables the black box system to provide continuous monitoring and immediate detection of abnormalities or safety breaches. Through seamless communication with centralized servers or cloud platforms, stakeholders such as vehicle owners, fleet managers, and emergency responders can receive timely alerts and notifications in the event of accidents or deviations from predefined safety parameters. This facilitates prompt intervention and response, potentially mitigating the severity of accidents and improving overall road safety. Moreover, the project focuses on enhancing user accessibility and decision-making through the development of user-friendly interfaces. Mobile applications or web portals allow stakeholders to access real-time data, analytics, and insights regarding vehicle performance, driving behavior, and maintenance needs. This empowerment enables informed decision-making regarding route optimization, maintenance scheduling, and adherence to safety protocols. Through rigorous testing, validation, and deployment procedures, the Vehicle Black Box System using IoT project aims to revolutionize vehicle monitoring and management, fostering safer, more efficient transportation systems for communities worldwide.

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II. LITERATURE SURVEY

The paper [1] presents an innovative and comprehensive approach to enhancing road safety through advanced monitoring systems. The system integrates various technologies such as sensors, GPS, and intelligent algorithms to detect abnormal vehicle behaviors indicative of potential accidents. By continuously monitoring parameters like acceleration, deceleration, and vehicle trajectory, the system can preemptively identify hazardous situations and alert drivers and authorities in real-time. This proactive approach not only helps in preventing accidents but also facilitates quick intervention, potentially reducing the severity of accidents. Furthermore, the inclusion of location monitoring functionality enhances emergency response capabilities, enabling authorities to swiftly reach accident sites and provide assistance. The system's ability to reconstruct accident scenarios based on real-time data further aids in understanding the causes and consequences of accidents, paving the way for improved safety measures. Overall, the paper underscores the importance of leveraging technology to address road safety challenges effectively. The proposed system offers a promising solution to mitigate accidents frequency and severity, contributing significantly to the broader goal of creating safer transportation systems. The paper [2] presents a comprehensive exploration into the design and functionality of a car black box system, offering valuable insights into automotive safety and data analysis. The authors meticulously outline the requisite components and sensors crucial for the system's operation, emphasizing the significance of real-time data acquisition and storage capabilities. By integrating sensors such as accelerometers, gyroscopes, and GPS modules, the proposed system efficiently captures and records essential vehicle parameters, enabling comprehensive monitoring of driving behavior and environmental conditions. This meticulous attention to detail underscores the paper's contribution to advancing vehicle safety technologies and lays a solid foundation for future research and development in the field. Moreover, the paper delves into the intricacies of the software architecture necessary for data analysis and anomaly detection, demonstrating the system's ability to provide actionable insights for accident reconstruction and preventive maintenance. Through a systematic exploration of the 7 challenges associated with implementing a car black box system, including considerations of data security and regulatory compliance, the authors showcase a holistic understanding of the technology's implications and applications. Overall, the paper's rigorous approach, coupled with its clear articulation of concepts and solutions, positions it as a significant contribution to the automotive industry, offering valuable guidance for researchers, engineers, and policy makers seeking to enhance vehicle safety through data-driven solutions.

The paper [3] presents a compelling exploration into the integration of Internet of Things (IoT) technology to develop an intelligent vehicle black box system. By leveraging IoT sensors and communication capabilities, the authors propose a sophisticated solution aimed at enhancing vehicle monitoring, safety, and data analysis. The paper meticulously outlines the design and implementation of the intelligent black box, emphasizing its ability to capture real-time data on various vehicle parameters such as speed, acceleration, location, and engine performance. This comprehensive data acquisition facilitates proactive monitoring of driving behavior and enables timely detection of abnormalities or potential accidents, thus contributing to improved road safety and accident prevention strategies. Kumar et al.'s work underscores the transformative potential of IoT in revolutionizing traditional vehicle black box systems, offering a scalable and efficient solution to address contemporary challenges in transportation safety and management. Furthermore, the paper delves into the system's architecture and functionality, elucidating the role of cloud computing and data analytics in processing and analyzing the collected vehicle data. By harnessing the power of cloud-based platforms and advanced analytics techniques, the proposed intelligent black box system can generate actionable insights for vehicle diagnostics, predictive maintenance, and optimization of fleet operations. Moreover, the integration of IoT enables seamless communication between vehicles and centralized monitoring systems, facilitating efficient emergency response and remote vehicle management capabilities. Overall, Kumar et al.'s research represents a significant advancement in the field of automotive technology, offering a holistic approach to enhancing vehicle safety, performance, and operational efficiency through the intelligent utilization of IoT.

The paper [7] offers a comprehensive exploration of a smart black box system tailored for gathering crucial safety information in vehicles. The authors delve into the intricate design 8 aspects and technical implementation of the system, emphasizing its role in enhancing road safety and accident analysis. Through meticulous attention to detail, the paper outlines the components and sensors essential for effective data collection, including accelerometers, GPS modules, and data storage units. By integrating these elements, the smart black box system can accurately capture and record critical vehicle parameters, providing valuable insights into driving behavior and environmental conditions. Moreover, the authors present a detailed discussion on the software architecture and algorithms necessary for data analysis and anomaly detection, underscoring the system's capability to generate actionable insights for accident reconstruction and preventive measures. Through a systematic approach, the paper addresses challenges associated with implementing such a system, including considerations of data privacy and regulatory compliance. Overall, the thorough

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exploration of both hardware and software aspects, coupled with practical insights in to real- world applications, positions the paper as a significant contribution to the domain of automotive safety, offering valuable guidance for researchers, engineers, and policymakers striving to improve road safety through innovative technologies.

III. PROPOSED METHODOLOGY

This paper focuses primarily on the hunt for burglary by using car fixed cameras. Whenever the vehicle gets on, give the driver's picture for warning the owner and also focuses on accident using sensor data. If the threshold amount reaches a certain level of any sensor, all the sensor data and images will be submitted to the owner.

BLOCK DIAGRAM:

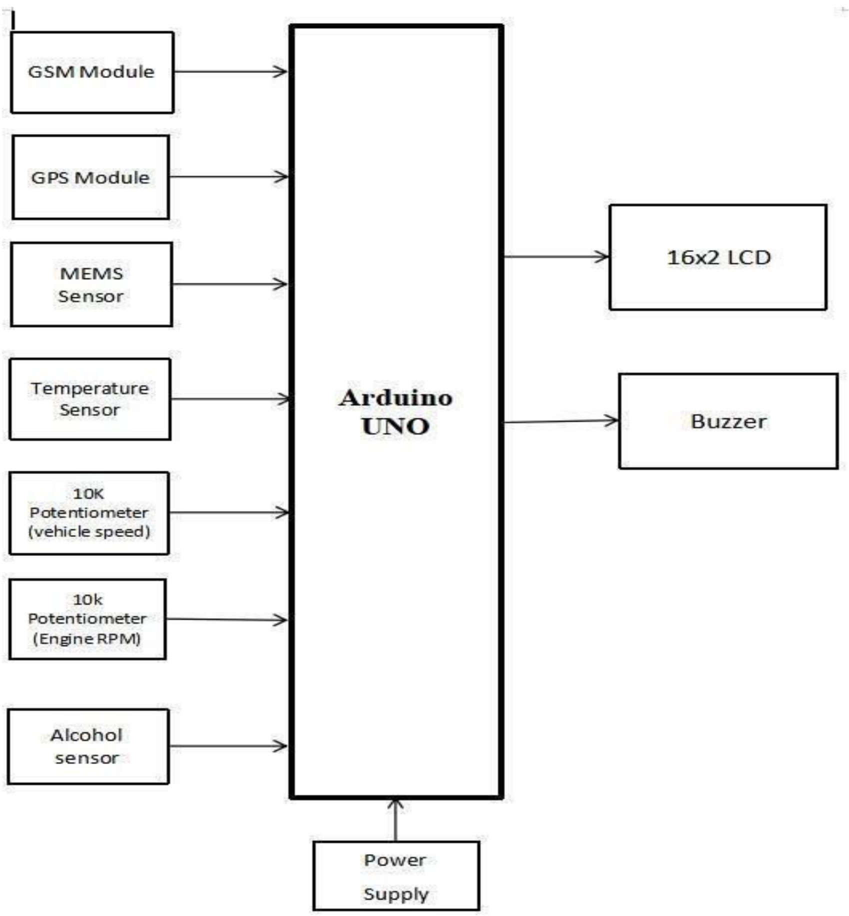

Fig.1. Block diagram of the system

Fig. 1, describes a black box system where all sensors have been linked with a Arduino UNO that sends warning messages to the different applications. It gives a brief description of the architecture that is going to be presented in this paper.

Upon powering on, the Vehicle black box system undergoes an initialization process to prepare for operation. This includes various startup procedures such as initializing internal components, setting default parameters, and establishing basic connections.

All input and output devices, including sensors and communication channels, are initialized for operation. Sensors such as MEMS sensor, Temperature sensor, alcohol sensor and potentiometers are calibrated and

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activated to monitor the vehicle environment. Communication channels, including GSM for SMS alerts, are configured for effective response. Additionally, the LCD display is initialized to provide a user interface for interaction.

The GPS module is initialized to determine the location of the vehicle. This involves establishing communication with the GPS module and configuring settings for accurate positioning. Once initialized, the GPS module continuously updates the system with location data for monitoring and reporting purposes. Initialization of the GSM module is crucial for establishing communication with external devices or servers. The system configures GSM module settings, including network parameters and communication protocols. Upon successful initialization, the GSM module is ready to send and receive messages, enabling remote monitoring and control.

The system undergoes a meticulous assessment of the MEMS, alcohol and temperature sensors and potentiometers to ensure optimal functionality and sensitivity. This thorough examination encompasses various aspects, including the verification of sensor connections, evaluation of signal quality, and execution of self-diagnostic procedures. Special attention is given to guaranteeing that sensors are appropriately calibrated and responsive to environmental stimuli. The system proceeds to analyze the sensors data for any anomalies or deviations. Anomalies may manifest as unexpected fluctuations in sensor output, irregular patterns of movement or any other atypical sensor behavior. In the absence of predefined thresholds, the system relies on its ability to recognize deviations from baseline readings as potential indicators of security breaches. If the data from sensor confirms any abnormalities like tilt from MEMS sensor or engine temperature more than 60 degrees or if speed exceeds 100kmph then SMS alert is sent to the registered mobile number of designated authorities or stakeholders. The alert message contains relevant details such as the nature of the detected anomaly, timestamp, and vehicle location. This enables prompt response and intervention to mitigate potential security risks.

If no abnormal activity is detected, the system proceeds with normal operation. This includes completing the initialization process for the GSM module and transitioning to standby mode for continuous monitoring. With normal operation confirmed and no anomalies detected, the system finalizes initialization of the GSM module. This ensures seamless connectivity for ongoing monitoring, communication, and security management tasks.

IV. RESULT

Prior to connecting the components, the code was successfully uploaded into the Arduino microcontroller. Upon connecting the components according to the provided circuit diagram and switching on the power supply, the LCD display on the Arduino promptly exhibited the message "Vehicle Black Box System" and proceeded to display the coordinates obtained from the GPS module. This confirmed the correct integration and operation of the GSM and GPS modules with the system of a registered mobile number. Upon receiving the registered mobile number preceded by "*", the GSM module successfully registered the number and sent an SMS confirmation to the registered mobile number.

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Fig 2: LCD Prompt: Project title

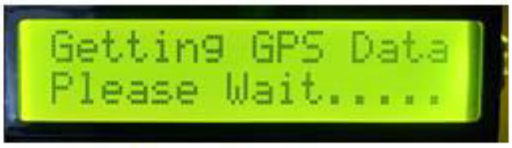

Fig 3: LCD Prompt: GPS getting Data

Fig 4: LCD Prompt: GPS Data

Fig 5: LCD Prompt: GSM Initilisation

Fig 6: LCD Prompt: Send Message to GSM Module SIM Number for Number

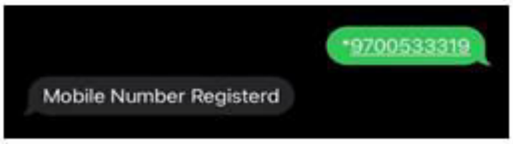

Fig 7: Verification of Registered Mobile Number via GSM Module

Fig 8: LCD Prompt: Showing the stored mobile number

Fig 9: At Stable conditions of temperature, Alcohol, MEMS sensor, speed and RPM

Fig 10: MEMS sensor at tilt position and High engine emperature detected

Fig 11: Vehicle Speed exceeding 100kmph

Fig 12: Detected alcohol from sensor

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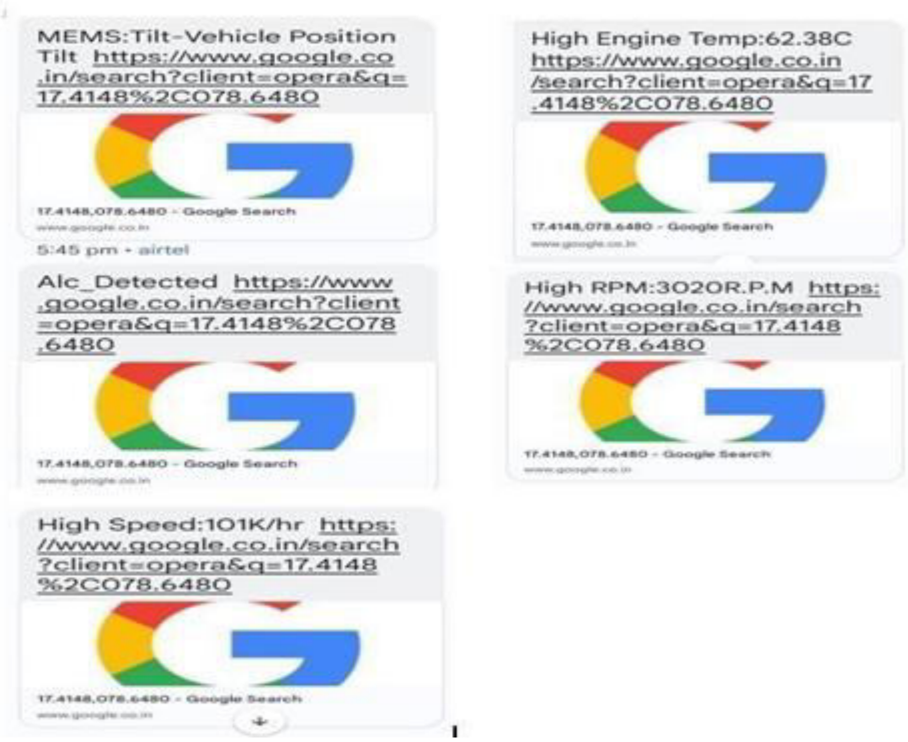

Fig 13: MEMS Sensor Triggered Buzzer Alarm and Sent SMS Alert with Live Location Link; High engine temperature Detected and Sent Prompt SMS; Alcohol detected and sent SMS alert with live location; High RPM detected and sent SMS alert; High speed detected and sent SMS alert with live location to the registered mobile number.

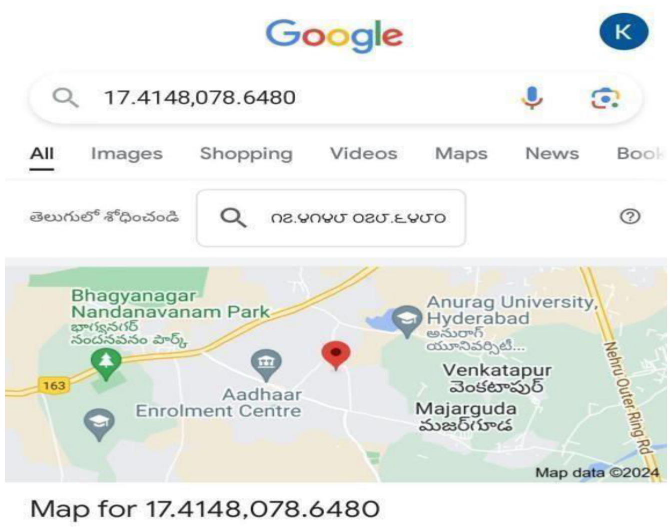

Fig 14: SMS Location Sharing: Viewing on Google

V. CONCLUSION

In this article, a working model of a Black Box with SMS alert for road vehicles has been developed for vehicle accident detection and reporting. In this modern era, IoT Technology is improving rapidly to help the issues mostly concern the world. This paper mainly focuses on alerting the driver from the Collision situations and using Cloud Computing Services, the location can be easily traced. It provides crucial information to emergency responders in the earliest possible time. The crucial time between the accident and getting victim medical attention can often be the difference between life and death. This system provides better safety rather than no safety.

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