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# Vehicle Blackbox

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**ABSTRACT—**

As commercial businesses grow day by day, their need for transportation has increased rapidly too. With increased transportation, it has become the need of the hour to maintain records of the vehicles that carry such goods so that in the situations of any mishaps, the information about the vehicle can be recovered including its latest stats. This project uses ESP32 microcontroller along with SIM 800L module so as logging the vehicle information is possible. We have used a certain degree of hardware in our project to meet the requirements set by the Electronics and Telecommunications department of Pune Institute of Computer Technology. Our project caters to the need of vehicle statistics logging and maintaining that information inside a Blackbox.

Index Terms—vehicle tracking, monitoring, GPS, microcontroller, GSM.

## I. Introduction

In this fast-paced world, tracking and logging information has become the need of the time. With the introduction of internet in our day-to-day things with the help of IoT, there is a flow of countless data. Also, as the internet is becoming more and more accessible to common man, there is a boom in the smartphone industry with most of the people becoming users of a smartphone. This project aims to bring the live parameters of the vehicle right in the hands of the people with the help of Android Smartphone. The project involves creation of a Blackbox system which will contain ESP32 microcontroller, SIM 800L GSM Module, Thermocouple sensor and other devices like EPROM for storing data which will log the information. This information will then be sent on a remote server using the standard MQTT protocol and a corresponding broker via internet. In case of absence of internet, the data will get stored inside the EEPROM so that it can be uploaded once the internet connection resumes. This uploaded data can then be fetched inside an Android Application. The end user can then view the stats of the vehicle using the admin-user login system. To prevent data loss during extreme situations where the vehicle is damaged, burned or even submerged in water, the Blackbox will be covered by potting Epoxy Material. This will make the Blackbox robust and prevent shutting down even in harsh conditions. This Blackbox will be powered by lithium-ion rechargeable battery. The lithium-ion battery will be recharged from the car battery itself by introduction of a step down chopper in between to maintain and supply the correct voltage levels to the battery and the rest of the project components.

## II. LITERATURE SURVEY

### *A. Related works*

[1] The research article "Implementing Vehicle Black Box System using IoT based approach" published in the IEEE conference proceedings analyses the implementation of a vehicle black box system using an Internet of Things (IoT) based approach. The relevance of gathering and analysing information about accidents and vehicle performance is discussed in relation to the rising demand for vehicle black boxes. The authors suggest an IoT-based strategy that uses sensors to gather information on the operation of the vehicle and send the information to a cloud-based server for archiving and analysis. [2] In order to reduce the loss of life and property due to vehicle accidents, this research study suggests a prototype for an automobile black box system that may be fitted into cars. The system uses 12 sensors to track several aspects of driving behaviour, including the usage of external sensors like a camera and a Global Positioning System (GPS) to gather video and location information. For later retrieval in the event of an accident, the sensor data is stored on an SD card mounted on a Raspberry Pi controller. Data encryption is used by the system's security module to protect the data saved on the SD card. To get first assistance started as soon as possible, the suggested method uses GPS to transmit a brief message containing the location of the car to a family member, emergency services, and the closest hospital. [3] In order to gather data for more accurate accident analysis, the Vehicle Black Box System (VBBS) prototype being developed for installation in any car worldwide is described in the study. The most crucial information required following an accident is listed together with a description of the hardware and software resources devoted to VBBS. The hardware component comprises of in-vehicle sensors and a black box that collects sensor status data and stores it in the EEPROM of the microcontroller. The study also describes the several kinds of sensors utilised in VBBS, such as switches, water sensors, and speed sensors. The system's software component, which presents the user with a streamlined version of the recorded data, is discussed. The relevance of a black box system in creating safer cars, treating collision victims better, and assisting insurance companies with their vehicle crash investigations is finally covered in the report.

[4] The article talks about how important it is to drive safely and introduces a new black box device that can be installed in any kind of car to record what happens in an accident. The concept of intelligent transportation systems (ITS) and safety applications that help prevent accidents or respond appropriately

in the case of an accident are explained in the article. The article examines the deployment of safety applications in networks of vehicles with On Board Units (OBUs) and Road Site Units (RSUs). The taxonomy of safety apps is based on communication type, and they are split into two categories: event-based applications, which rely on event recording to gather data and transmit alerts, and communication-based applications, which need a specialised infrastructure made up of OBUs and RSUs. The essay also discusses fundamental safety principles and how VANETs depend on dedicated short-range frequencies (DSR) and the global positioning system because they are latency-sensitive (GPS). The usage of specialised infrastructure or intelligent vehicles is not necessary for the new black box system described in the article.

## III. Conceptual Framework

The concept relies on the parameters taken up by the ESP32 Module and sent to the server for remote access of that data. We used SIM 800 GSM module for internet connectivity. However, in the absence of an internet connection, we are also provided a facility to store the data offline inside our Blackbox in an EEPROM. This will prevent data loss when there is no internet connectivity. We developed an Android application which will help us to see all the data which is stored on the servers.

For establishing connection of our Blackbox to the server, we have decided to go with the standard MQTT protocol. We used a free broker, EMQX, which will be helpful in testing our project and debugging the programs. If this is successful, then we will be shifting to the AWS IOT core. For supplying power to the Blackbox, we will be using a step-down chopper which will take the car battery as its input. If time permits, then we will also have a secondary source of power (like solar energy) which will keep on recharging the lithium-ion battery.

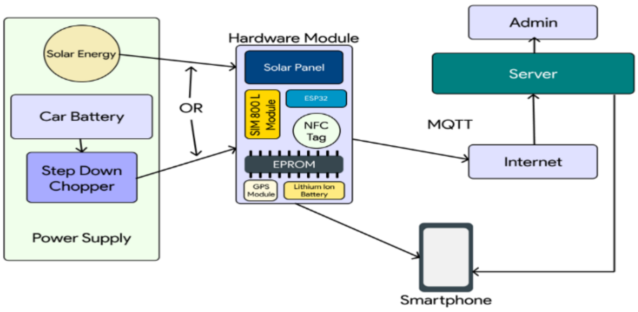


Fig 1 System Block Diagram

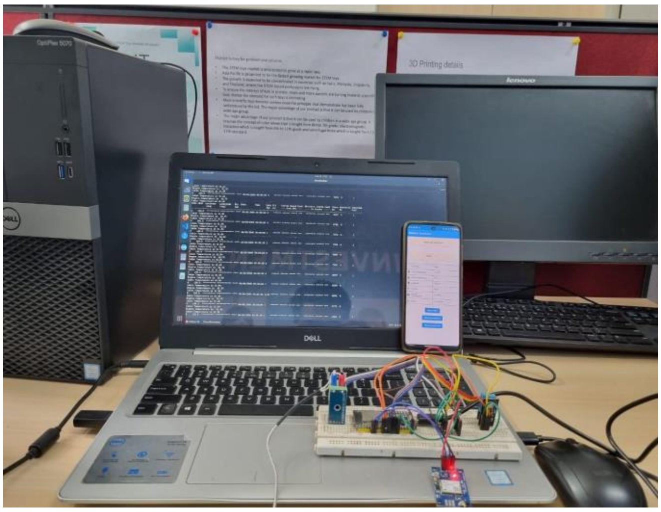

Fig 2 Breadboard Implementation of System

## IV. Working

The Blackbox system for cars is made up of a number of sensors and modules. The adaptable DHT11 sensor collects temperature and humidity and communicates over a single cable. It transmits a string of 1s and 0s for both outputs on a single pin and contains a checksum for data validation. The ESP32 microprocessor receives data from the thermocouple, which gauges the engine's temperature. While the MQ3 alcohol sensor measures alcohol content to track driver compliance, the NEO 6M GPS module gives GPS coordinates and satellite information. Every second, the microcontroller gathers data from all sensors and stores it in the blackbox for data security. The microcontroller is connected to the internet by the GSM module, which delivers data via MQTT to the EMQX Broker, who then sends it to the mobile application for display and analysis.

## V. Results and Discussion

Impressive findings from the Vehicle Blackbox project have made it possible to measure and save moving vehicle parameters without having to directly connect with the Engine Control Unit (ECU). This cutting-edge system provides several advantages to car owners, manufacturers, and the general public by gathering and analysing crucial data like GPS coordinates, speed, attitude, cabin temperature, and engine temperature. The cost-effectiveness of the Vehicle Blackbox is one of its main benefits. This idea offers an economical option for tracking and monitoring automobiles in real-time, with a production cost of only 1500 rupees. Due of its low cost, a wider range of people and organisations can use it, including small-scale transportation businesses, logistics corporations, and individual car owners. Vehicle movements may be precisely tracked and observed thanks to the combination of GPS coordinates and speed measurements. This function is especially useful for fleet management because it enables businesses to optimise routes, track driver behaviour, and boost overall operational effectiveness. Fleet managers can spot trends, minimise fuel usage, save maintenance costs, and increase customer satisfaction through timely and correct delivery by analysing the data they have acquired. Additionally, the Vehicle Blackbox can record engine and cabin temperatures without requiring direct access to the ECU. With the help of this capabilities, prospective problems can be identified, allowing for proactive maintenance and prompt fixes. Vehicle owners can avert expensive breakdowns and increase the longevity of their cars by taking preventive action when they see odd temperature readings. Additionally, the information gathered by the Vehicle Blackbox can help with accident investigation and enhancing traffic safety. The parameters that are captured after a collision or other incident are essential for recreating the incident and identifying its causes. In their efforts to comprehend accident trends, enhance car safety requirements, and create efficient preventive measures, insurance firms, law enforcement organisations, and researchers can benefit from this data.


Fig 3 Display Screen of application showing various parameters

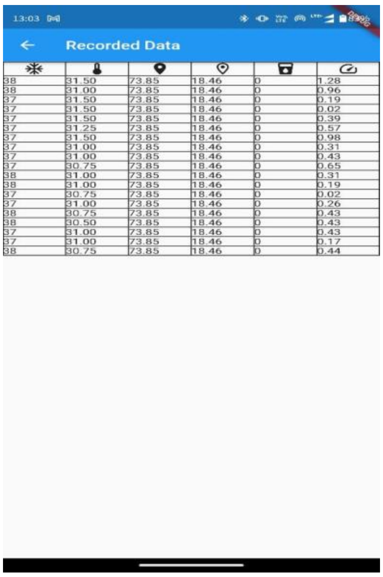


Fig 4 App screen showing previous data on clicking show previous data.

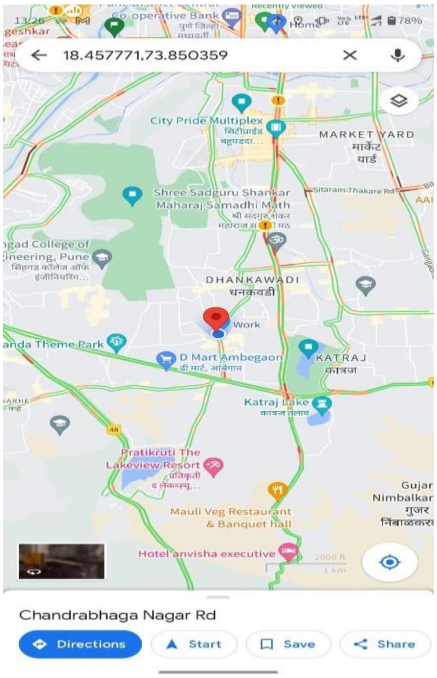


Fig 5 App screen showing live location of vehicle on clicking open in maps

Refer Fig3,4,5 which displays mobile app for the purpose of sending real-time data to the application's home screen, the ESP32 microcontroller establishes a MQTT connection with the EMQX broker. The vehicle's registration number is shown on the main page, which also offers a status card view for checking the broker connection status. The home screen allows users to examine real-time position data on Google Maps as well as other current data and pertinent information. While the "Clear Recorded Data" button enables the eradication of saved data, the "Show Recorded Data" option organises and exposes previously recorded sensor information for study. These features improve usability and offer insightful data about the behaviour and operation of the vehicle.

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