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Onboard Vehicle Diagnosis Fault Monitoring System Using IoT for Electric Vehicle

Ms. Sahana H S[1], Ms. Raghavi B S[2], Mr. Deshik N U[3], Mr. Krishti[4], Mr. Vasanth Kumar Reddy G [5]
[1]Ms. Sahana H S, Dept. of EEE, Rajeev Institute of Technology, Hassan, Karnataka
[2]Ms. Raghavi B S, Dept. of EEE, Rajeev Institute of Technology, Hassan, Karnataka
[3]Mr. Deshik N U, Dept. of EEE, Rajeev Institute of Technology, Hassan, Karnataka
[4]Mr. Krishti, Dept. of EEE, Rajeev Institute of Technology, Hassan, Karnataka
[5] Mr. Vasanth Kumar Reddy G, Asst. professor, Dept. of EEE, Rajeev Institute of Technology, Hassan, Karnataka

Abstract— The paper proposes a user-friendly cloud-based data acquisition and analytics system for vehicle diagnostic monitoring in real time. The vehicle's condition is assessed using the Onboard diagnostics (OBD) framework and the report is sent to the mobile of the driver via wifi on detection of unsafe and anomalous events in real time. Vehicle parameter values are instantaneously uploaded to the server. The smartphone app also visualizes data from the sensor and also generates warnings in real time.

Keywords: *Internet of Vehicles, On-board diagnostics (OBD), Vehicle self-diagnosing system, Reporting capability, Vehicle owner, Repair technician access, Vehicle subsystems, Diagnostic information, On-board vehicle computers, OBD II engine parameters.*

I. INTRODUCTION

This project demonstrates the architecture of an IOT prototype platform for On-Board Diagnostic System (OBD) and a IOT based application. Driver is also provided with a user interface through which user can read any of the sensor values by selecting on the list. Diagnosis of faults in parameters, notification of sudden changes to the driver, and indication regarding the reason for the fault are included in the system setup. The driver can find out the faults in car on the spot and this does not require any other tool for it. If in case the vehicle got struck in remote areas, the proposed OBD system inside the vehicle can be connected to the vehicle service center by providing internet facility. We are implementing this project on Arduino microcontroller. The advancement in cloud computing along with internet of things (IOT) has given a promising opportunity to resoluteness the challenges caused by the expanding transportation issues. It presents a novel multilayered vehicular data cloud platform by using cloud computing and IOT technologies.

II LITERATURE SURVEY

Mario Gerla et al. conveys the transition of the Internet of Vehicles to Vehicular Cloud, the equivalent of Internet cloud for vehicles, providing all the services required by the Autonomous Vehicles. It mentions the evolution from Intelligent

Abdul Muthalip et al. sketches Vehicle Emission Monitoring System using IoT. It narrates the sensors and circuit gathering the pollutant discharge in vehicle and how this data is used for monitoring the pollutant levels.

Mohammad Rubaiyat Tanvir Hossain et al. illustrates autonomous vehicle system. It demonstrates the video streaming technics and remote access. It also portraits the performance level of the system developed in a miniature car.

Minghe Yu et al. explains the solution to the problem of real-time vehicle monitoring and traffic management. It unravels two techniques to identification uncertainty of automobiles with the use of Radio Frequency Identification.

Sagar Sukode et al. illustrates Intelligent Transportation System with help of IR sensor, sensor array, gas sensor and temperature sensors. These will evaluate real-time traffic density. The system uses real-time of automobiles and broadcasting traffic related events. approach tracking.

Zhou et al. Proposed a cloud-based battery monitoring system using IoT, which predicts lithium-ion battery failures using machine learning.

Kumar et al Developed an IoT-enabled battery health monitoring system that tracks temperature variations and charging cycles to prevent thermal runaway.

Singh et al. Implemented a real-time fault detection system for BLDC motors using IoT sensors. The system detects anomalies in torque and vibrations.

Patel Mehta et al. Introduced a wireless sensor network (WSN) for motor fault detection that sends instant notifications to users.

Raj et al. Integrated a complete vehicle health monitoring system using IoT and AI, capable of diagnosing multiple faults in real-time.

Chen et al. Developed a digital twin model for EVs, where IoT sensors collect data and an AI model predicts possible failures before they occur.Wang, X et al. "A Comprehensive Review of IoT Applications in Electric Vehicles."IEEE Internet of Things Journal, 8(10), 7890-7905.This review paper covers various IoT applications in EVs, including fault monitoring, predictive maintenance, and remote diagnostics.

Raja,R et al. "Internet of Things for Electric Vehicles: Challenges and Opportunities."Springer.This paper provides an in-depth analysis of IoT applications in EVs, including fault monitoring and diagnostics.

III PROPOSED SYSTEM

With the growing adoption of Electric Vehicles (EVs), the need for reliable, real-time monitoring of vehicle health and fault detection is becoming increasingly important. The proposed system leverages Internet of Things (IoT) technology to design an Onboard Vehicle Diagnosis (OBD) and Fault Monitoring System tailored specifically for EVs.

1. System Overview

The system consists of multiple embedded sensors installed across key vehicle components such as the battery pack, motor, inverter, and thermal management systems..

2. Core Components

- **Sensors:** Monitor temperature, voltage, current, vibration, and fault codes (DTCs).
- **Microcontroller/Gateway:** Collects sensor data and ensures secure transmission to the cloud.

3. Key Features

- **Real-Time Fault Detection:** Immediate notification of abnormalities such as over-temperature, low voltage, or motor malfunction.
- **Predictive Maintenance:** AI/ML algorithms analyze trends to predict and prevent future failures.

4. Working Mechanism

1. Sensors continuously monitor parameters from EV subsystems.
2. Data is transmitted to the microcontroller, which preprocesses and sends it to the cloud.

Communication Protocols for Real-Time Data Transmission and Remote Access. To facilitate real- time data transmission, the system employs TCP and
UDP.

IV METHODOLOGY

The replacement of the demonstrative instrument kit with Automotive IoT runs less time for updating ECM information. It is conceivable to utilize Wi-Fi for organizing other regions of the vehicle. The recommended strategy for diagnosing the vehicle is not at all like the existing OBD prototypes. All sensors are associated with the vehicle collects the data of every individual part and justifies the normal and abnormal conditions. So, the user can know the status of the required parameter through the utilization of cellular phone. So, the client knows the condition and working of the vehicle when driving. The prototype is pre-installed with high and low values of every parameter. The prototype shows an abnormal condition of vehicle in the display.

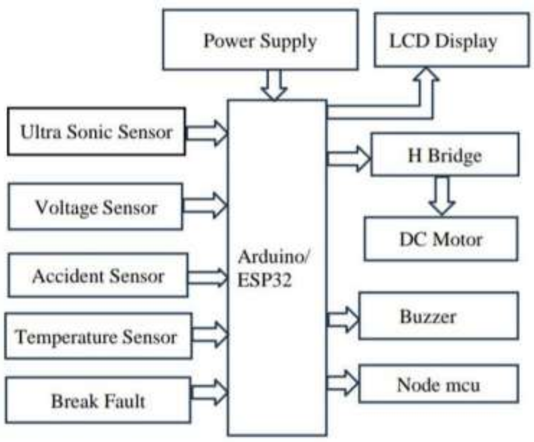

Figure 1: Block diagram of Onboard vehicle diagnosis fault monitoring system using IoT for Electric vehicles

The block diagram for an onboard vehicle diagnosis fault monitoring system for an electric vehicle. It appears to be centered around an Arduino microcontroller and incorporates various sensors and output devices. Here's a breakdown of the information, organized and clarified: Central Processing Unit:

- Arduino: This is the heart of the system. It's a microcontroller that reads sensor inputs, processes the data, and controls the outputs. The specific model isn't mentioned but appears to be an Arduino Uno or Nano based on the pin labels. Sensors:
- Temperature Sensor: Reads the temperature of a critical component (likely the motor, battery, or power electronics). The label "Temp Sensor" and connections to pins 2 and 9 suggest an analog sensor
- Ultrasonic Sensor: Likely used for distance measurement, possibly for obstacle detection or parking assistance. Connections are on pins 6 and 7
- Vibration Sensor: Detects vibrations, potentially indicating a mechanical fault (e.g., in the motor or drivetrain). Connected to pin 5.
- Brake Sensor: Indicates the status of the brakes (applied or released). Connected to pin 3.
- Voltage Check: Monitors the voltage of a specific point in the electrical system (likely the battery or DC bus). Connected to pin A5.
- Alcohol Sensor: Potentially for detecting driver alcohol impairment, which could be a safety feature. Connected to pin A4 LCD (Liquid Crystal Display): Displays diagnostic information, fault codes, sensor readings, etc. Connected to digital pins D2-D7 and potentially others for control signals (EN, RS).
- Buzzer: Provides an audible alert for warnings or faults. Connected to pin 4.
- H-Bridge Motor Driver: Controls a DC motor, likely for a cooling fan or a small auxiliary pump. Controlled by the Arduino via pins A0 and A1.
- GSM Module: (SIM800L or similar) Enables communication over the cellular network. This is crucial for remote monitoring, sending alerts to a driver or service center, and potentially for over the-air updates. Connected to TX and RX pins (likely using software serial). Power Supply:
- 12V GOD / 5V Reg: Indicates the system is powered by a 12V supply, which is then regulated to 5V for the Arduino and other components

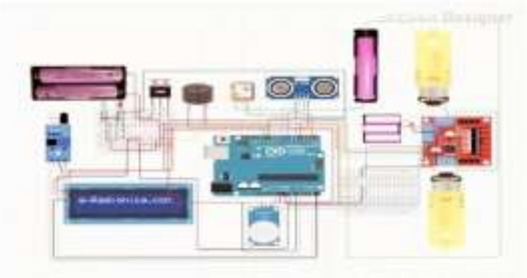

Figure 2: Circuit diagram of Onboard vehicle diagnosis fault monitoring system using IoT for Electric vehicles

I. COMPONENTS REQUIRED

A. SOFTWARE COMPONENTS

- Embedded C
- Arduino Ide

B. HARDWARE COMPONENTS

- Microcontroller Arduino
- LCD
- Temperature Sensor
- Alcohol Sensor
- Ultrasonic Sensor
- Break Sensor
- Voltage Sensor
- Accident Sensor

- Connecting Wires
- Buzzer
- H-Bridge
- GSM
- DC Motor

II. ADVANTAGES & APPLICATIONS

A. ADVANTAGES

- Real-time Monitoring: IoT enables continuous real-time monitoring of vehicle systems, providing immediate detection of faults and performance issues.
- Eco-friendly Operation: Proper vehicle diagnostics help maintain engine efficiency, reduce emissions, and ensure fuel-efficient operations, contributing to environmental sustainability.
- Integration with Smart Systems: IoT based systems can be integrated with smart traffic management systems, insurance monitoring, and other connected services, offering a holistic vehicle management solution

B. APPLICATIONS

- Fleet Management
- Public Transportation o Logistics and Delivery Services Automotive Industry
- Rental and Ride-sharing Services

V RESULT & DISCUSSION

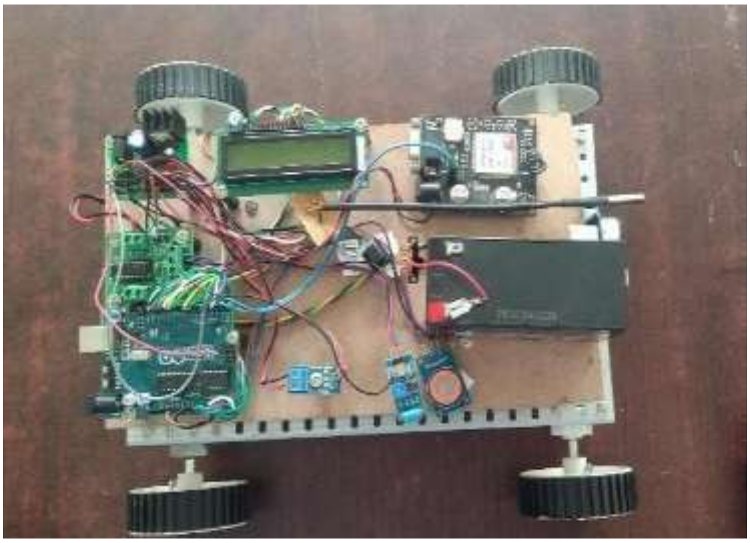

Figure 3: IMPLEMENTED RESULT

- The results and potential discussion points for a simplified onboard vehicle diagnosis fault monitoring system using an Arduino. Remember, these are general ideas based on the simplified examples we've discussed before (temperature, voltage, vibration, etc.). A real OBD-II system is vastly more complex.
- Expected Results (Simplified Examples)

- **Temperature Sensor:** You would expect to see temperature readings from the sensor displayed on the Serial Monitor. If the temperature goes above a pre- defined high threshold or below a low threshold, the Arduino would indicate a "fault" (e.g., turn on an LED, print a message).

- **Voltage Sensor:** Similarly, you'd see voltage readings. If the voltage is outside the acceptable range, a fault would be indicated.

- **Vibration Sensor:** You'd observe vibration readings. If the vibration level exceeds a threshold, a fault would be flagged.

- **Other Sensors (Alcohol, Brake, etc.):** The results would depend on the specific sensor and how you've configured the Arduino to interpret the data. For example, with an alcohol sensor, you might see a reading related to alcohol concentration, and a fault would be triggered if it exceeds a threshold. With a brake sensor (simple switch), you'd primarily see the state of the brakes (pressed or released).

CONCLUSION

In order to understand various complex problems arising in the vehicle the need of multiple ECUs are needed, which brings the requirement of a sophisticated on-board diagnostic strategies as a result increase in the amount of computer hardware and software implementations has been observed. This paper offers improved vehicle stage method for problem processes strategies, whereby any consolidated bright Entry Module will be suggested within the vehicle circle structure which is likely to the problem processes from the finish vehicle inside a sequential run. This precise Entry Module will thus have the likelihood in order to collect any bunch comprising faults raised by unique ECUs in addition to connect these meaningfully to steer the user in the direction of real cause of the problem. The work will offer how this kind of brilliant entry component will seizure, classify it as well to correlate the problem facts in the spread.

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