VEHICLE FUEL MONITORING SYSTEM

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ABSTRACT : IoT is extensively used in everyday object and its popularity is increasing day by day. In this project it includes the design and development of an IoT and mobile-based vehicle fuel activities such as real time fuel monitoring and temperature monitoring system. The proposed IoT device measures the amount of fuel by using ultrasonic fuel sensor. When the vehicle tank of fuel reaches a certain level, driver gets notification through mobile application and also check the temperature and humidity present in the fuel tank. The proposed system used DHT11 sensor for temperature and humidity detection the fuel tank. A IOT based server called Blynk IOT Server is been used for the IOT mobile Application for monitoring and alerting purpose.Mq2 is used to detect smoke.

Keywords : NodeMCU , IOT, Ultrasonic Sensor ,DHT11.

I. INTRODUCTION

The use of motor vehicles has been greatly encouraged by India expanding economy. Consequently, there has been an increase in gasoline use as well. A sharp decline in natural resources and a steady increase in fuel costs are the results of growing demand for motor vehicles. Simultaneously, gasoline theft is growing as a simple and low-risk way to make unlawful money. Thus, it is very important that we monitor and ensure that fuel is used properly in our nation. Vehicle tracking systems (VTS) have been a welcomed trend in the nation as a remedy. With over 20 enterprises competing in the national market, this technology is booming. But at the moment, only few of them provide the fuel monitoring function.

Current car fuel level measuring methods rely on the Analog-to-Digital Converter (ADC) value that is determined using the fuel level sensor's variable resistor value[1]. But since gasoline is a liquid, it may suddenly alter suddenly in the following situations, causing the fuel level in the tank to vary significantly:

- Direction: whether to drive downhill or upwards
- Acceleration via speed bursts or harsh braking
- Vibration: potholes, uneven roads, and speed breakers

These driving circumstances may have an impact on the gasoline level sensor's float switch position and the resistor values that follow, as seen in Figure 1. As a result, the real fuel level may not be accurately shown in the ADC data that was computed. In order to solve these issues, we provide a unique method of calculating the fuel level ADC value by combining the vehicle's motion parameter value and fuel level sensor information. Our hardware module is designed with motion sensors to gather real-time vehicle data. We then analyze this data to determine how the motion factors affect the fuel status. This study attempts to accomplish the following via real-world experiments and in-depth analysis:

• Increasing fuel level measurement accuracy

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• seeing gasoline replenishment; spotting questionable activities including fuel theft and tank leaks

A. Roadmap of the Paper

We examine the literature that is pertinent to our work in part II. The system architecture of our suggested system is explained in Section III. The data and analysis from our experiments are presented in Section IV. A summary of the main conclusions and constraints of our study are given in Section V, which also looks at the direction of future research.

II. RELATED WORK

We performed a thorough background investigation on academic research as well as the VTS goods that are offered in the Bangladeshi market since VTS is a commercially produced product. This section summarizes our research and contrasts our suggested system with the current ones.

A. Academic Research

Microcontroller-based systems have been developed for the purpose of real-time gasoline data monitoring. The level sensor sends the data to a web or smartphone-based application over Bluetooth or WiFi [2] [3] [4] [5] [6] [8]. While some of these systems employ an ultrasonic sensor to measure the liquid level, others use a level sensor [2] [3] [8]. [4, 6, 7, 8]. Vehicles with gasoline tanks often have a level sensor installed to determine the fuel level. The gasoline gauge displays the ADC value that the sensor transmits, which corresponds to the fuel level [2]. The gasoline gauge displays the ADC value that the sensor transmits, which corresponds to the fuel level [2]. The installation of an extra sensor inside the tank presents additional maintenance requirements and the need for a separate power source. Furthermore, the ultrasonic sensor must always remain at least the minimum operating distance away from the fuel level in order to provide an accurate reading.

However, in their suggested protocols, Husni, Siahaan, Ciptaningtyas, Studiawan, and Aliarham [7] took into account how the fuel level measurement would be impacted by the state of the roads. Their tests show that while the sensors maintain a 99% accuracy on level roads, when the tank is tiled because to the elevation of a road, the accuracy drastically drops to 84%. The authors also devise a method for spotting gasoline leaks by tracking the drop in fuel level over time. However, they do not calculate a precise threshold that would allow one to distinguish between typical consumption and possible theft or leaks. Uddin, Sumon, Alam, and Islam [5] suggest using an RFID-based system to control gasoline use, allowing only those with the appropriate RFID card to access the fuel line and operate the vehicle. But if the driver allows illicit use or the card is taken, this method cannot guarantee fuel safety. Table I lists our methodology, sensors, and applications along with the scholarly literature that we have studied. Our research offers innovation in the fuel monitoring technique's applications as well as methodology.

B. Market Research

To learn more about the fuel monitoring services offered by the VTS devices that are currently on the market in Bangladesh, we carried out extensive market research. Only a small percentage of VTS suppliers provide the fuel monitoring capability, according to the results of our analysis. Instead of monitoring fuel use in real time, almost all of these devices report fuel consumption based on the average distance driven over the course of a day. None of them now provide incident reports for gasoline leaks, refills, or thefts.

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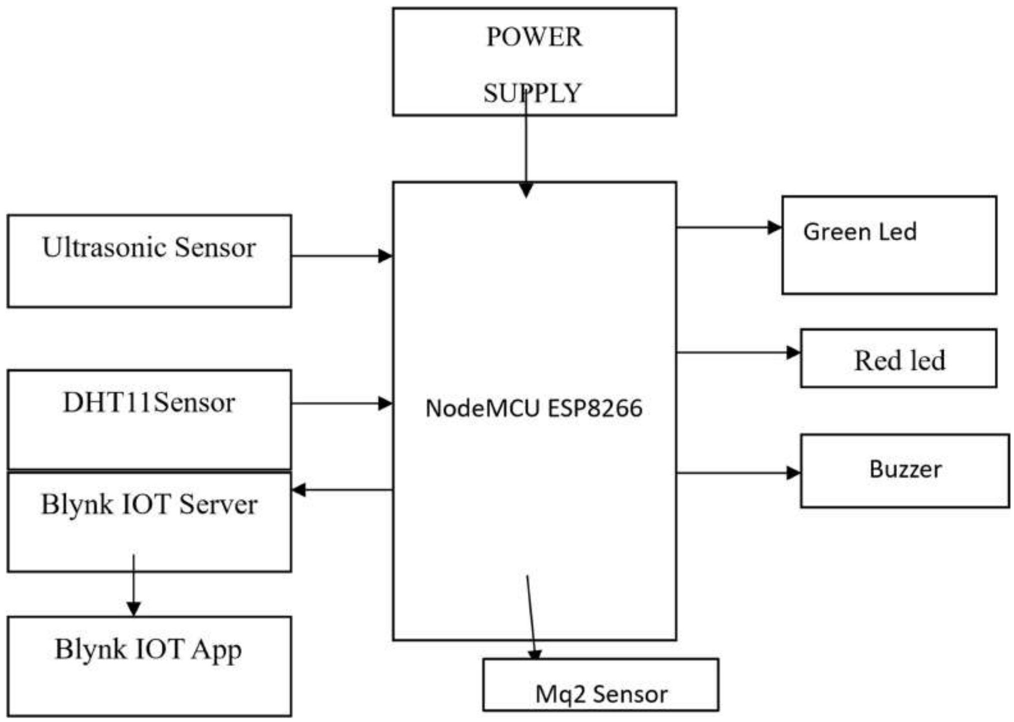
III. Block Diagram



IV. SYSTEM ARCHITECTURE

The proposed system, presented in Figure, consists of a hardware module, hardware interfacing program, data analysis program and a smartphone application. The subsequent sections discuss them respectively.

A. Hardware Module

An MPU 6050 6 Axis Gyroscope, an Accelerometer Sensor with an SD card module, an HC-05 Bluetooth communication module, a DS3231 real-time clock module, an Arduino Mega microcontroller board, and a power bank make up the hardware module, which is shown in Figure. The Arduino Mega is linked to the sensors, Bluetooth, SD card, and RTC modules, all of which supply the corresponding vehicle status data. The data is sent to the smartphone for run-time observation via the Bluetooth module and stored on the SD Card by the microcontroller.

B. Hardware Interfacing Program

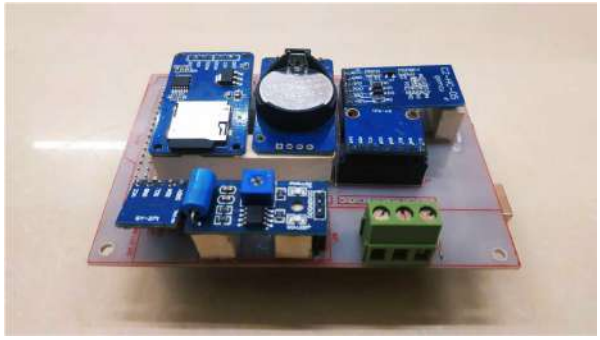
Proteus was used to mimic the hardware's whole circuit architecture. The hardware configuration's circuit schematic. The Arduino IDE was used to program each hardware module. The procedure for hardware interface.

C. Data Analysis Program

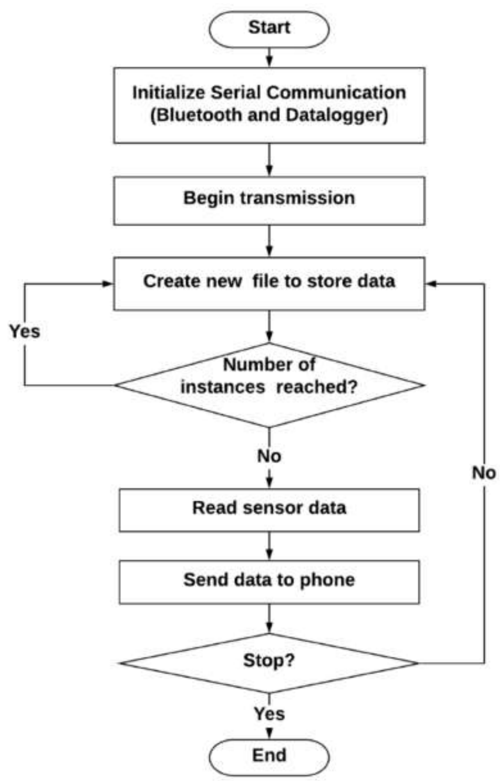
MATLAB was used to visualize and filter the raw datasets. In order to identify refill and suspicious behavior, the findings were further examined in order to investigate the impact of mobility characteristics on fuel sensor data.

D. Run-Time Data Observation Mobile Application

We created an Android application to track sensor data in real time while the car is being driven. Through the Bluetooth module, the microcontroller board communicates the sensor data to the app.



Model



Work Flow

V. EXPERIMENTAL ANALYSIS AND RESULTS

A. Attributes and Instances

The datasets' properties and instances are given. GyroX, GyroY, GyroZ, AccX, AccY, AccZ, Vibration, and Fuel Data were some of the parameters that were employed in the study.

B. Data Filtering

High-frequency variations in datasets may be smoothed using filters, a data processing technique. On the raw data, we applied three different kinds of filters:

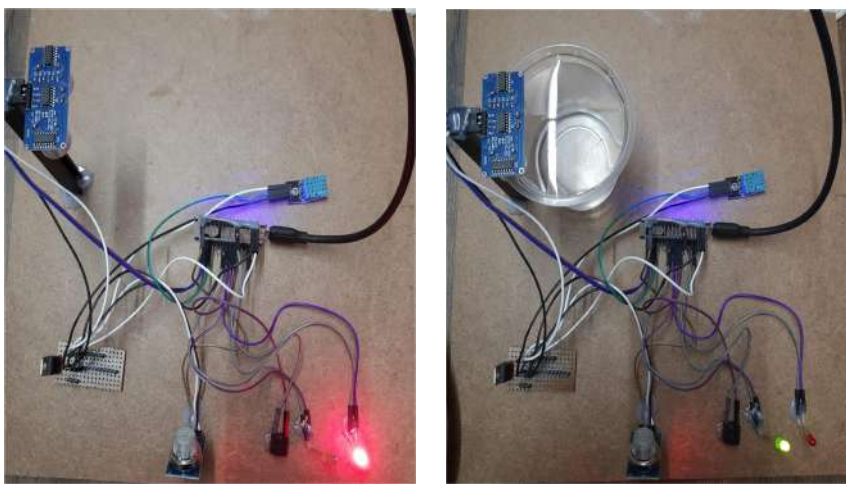
- Moving Average filtering; Savitzky-Golay filtering
- Smoothing of Linear Regressions

The best and most comparable results were obtained using the Locally Estimated Scatterplot Smoothing (LOESS) and Locally Weighted Scatterplot Smoothing (LOWESS) techniques of Linear Regression Smoothing (shown in Figures). To smooth the data points in a dataset, the first approach utilized a weighted linear polynomial, while the second one used a weighted quadratic polynomial.

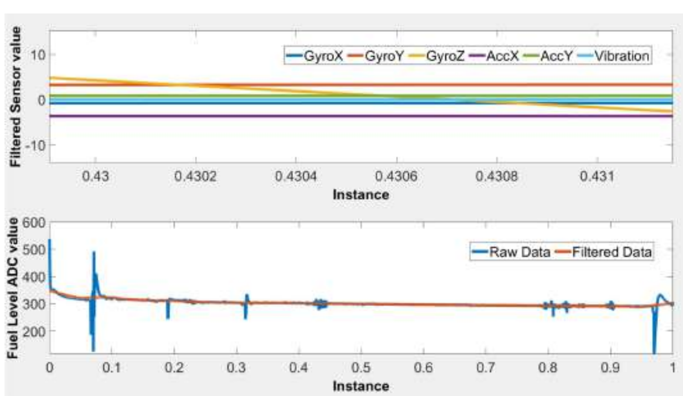
C. Correlation Observation

Plotting of the fuel data against each of the GyroX, GyroY, GyroZ, AccX, AccY, AccZ, and Vibration data was done using the 300,000 instances of data that were gathered. The following is a list of the observed effects of various motion characteristics on the Fuel data:

- There was little impact from vibration, accX, accY, and accZ.
- GyroX and GyroZ had relatively little of an impact; GyroY had a very big one.



Working Model



LOWESS Filtering- Fuel, Gyroscope, Accelerometer, Vibration Data

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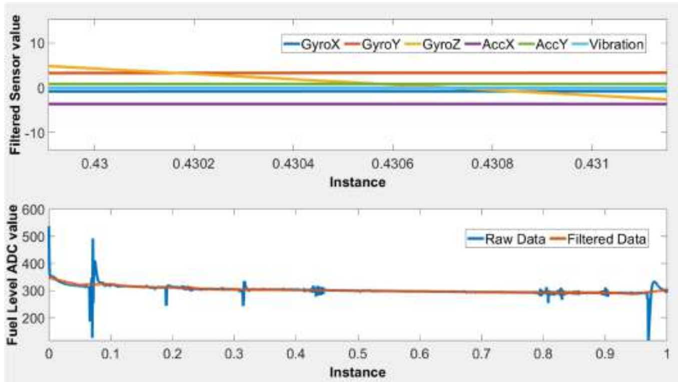

LOESS Filtering- Fuel, Gyroscope, Accelerometer, Vibration Data

H. Success Rate

Twelve of the fifteen datasets had successful computations of the fuel level's proper ADC value. The estimated ADC values varied by up to 30 points from the actual value in the remaining datasets. In all relevant datasets, the identification of suspicious conduct and refill events was effective. As a result, we were able to complete the first case with an 80% success rate and the next two with 100% success rates.

VI. CONCLUSION

This study introduces a new method for real-time vehicle fuel condition monitoring. We investigate the relationship between fuel data and a vehicle's orientation, acceleration, and vibration. For real-time monitoring, we create a small hardware module that sends sensor data to a smartphone app. Our analysis of the motion sensor data reveals a substantial correlation between the vehicle's direction and the ADC value of the fuel level. Furthermore, we create an equation to calculate a fuel ADC value that is more precise based on experimental data. An inventive technique for identifying fuel refills and questionable occurrences like fuel stealth and leaks was discovered by further examination of the ADC value. The method has a large potential influence on business models. This method may enhance accuracy metrics while also preventing fuel resource waste and stealth, which will raise customer happiness and boost business profitability overall.

Even if the trials' replenishment or suspicious event detection rates were 100%, it's probable that the sample size was limited, which led to overfitting in the detection algorithm. Moreover, when working with smaller samples, the outcome may not always converge. To combat this, a more expansive experimental configuration might be beneficial for assessing the system's resilience. Furthermore, during the trials, the error rates for the various smoothing techniques were not noted. More real-world trials might be conducted in the future to better analyze the existing model qualitatively.

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