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Original Article

Smart Fuel Theft Detection and Alert System Using IoT for Augmented Consumer Protection at Gas Stations

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Abstract *- Fuel theft at gas stations has arisen as a unique and deceitful means of defrauding regular Indian consumers, with unscrupulous pump operators selling less petrol than promised at the same price. The objective of this investigation is to create a system that can detect such fraudulent activity and warn the user in a timely manner. The suggested system checks fuel levels during refilling and warns the user if any irregularities are discovered. It also has a capability that detects incoming phone calls, allowing the user to identify calls without relying on Bluetooth connectivity. The system execution is composed of combining an ultrasonic sensor to correctly detect fuel levels, a Node MCU microcontroller for data processing and wireless communication, an LCD display for visual feedback, a buzzer for aural alarms, and an LM358AN which is a low-power dual op-amp for signal conditioning. The outcome of the work uses a telegram bot to take user input, such as projected fuel volumes and uses real-time data to detect and alert users to potential fraud. Furthermore, the system regularly uploads data to the Thing Speak cloud platform, which uses powerful analytics to monitor and detect any irregularities that may occur. The device has an additional feature to improve user experience that detects any incoming calls or messages to the driver's mobile phone so that the driver does not miss any vital alerts. Overall, all this research aims to aid in detecting unethical fuel pump operators and assist regular individuals in getting the right amount of propellant they have paid for, therefore lessening the ubiquitous issue of fuel theft.*

Keywords *- Petrol pump scam, Telegram Bot, NodeMCU, Cloud, RF signal detection.*

1. Introduction

Fuel adulteration and theft at fuel pumps have emerged as important issues, raising concerns about consumer protection and ethical business practices [1]. While dispensing equipment provides precise information about the amount of petrol and its cost, unscrupulous individuals have devised cunning schemes to cheat clients [2]. Recent investigations have uncovered disturbing examples of fueling stations engaging in rampant fuel theft. Specialized task groups conducted searches and discovered a huge number of pumps engaged in such unlawful activities. The finding of electrical chip tampering at fuel distribution terminals to facilitate fuel theft is a severe issue that demands immediate attention [3]. One of the most popular techniques utilized by dishonest fuel station owners is "jump trick" fraud. In this deceptive technique, dispensing devices are programmed such that the display jumps from zero to an inflated value, usually 20 or more, as soon as fueling begins. Under normal circumstances, the first leap should not exceed five units, as industry standards require. The suggested strategy seeks to address this disparity. A telegram bot [3] is employed to notify the user if any change in the fuel level is detected at the pumps. An ultrasonic sensor should be utilized to reliably monitor fuel levels while an LCD provides visual feedback. A buzzer provides aural alarms and an LM358AN op-amp, which conditions the signal. All of these elements are integrated into the strategy. Finally, a Telegram bot [4] uses realtime data to identify and inform users of any fraudulent conduct depending on their input, such as projected fuel quantities. Furthermore, the system regularly uploads data to the ThingSpeak cloud platform, which uses powerful analytics to monitor and detect any anomalies. The process is a low-cost, low-power model due to the reduced number of sensors used and the usage of an affordable microcontroller board that uses a chip designed for low-power applications. The ease of construction and minimal hardware make it more user-friendly. Even if the user manually determines a mismatch in the fuel level, he has no real-time evidence to back up his claim. This approach shows the user real-time data and uploads sensed gasoline data to the cloud, which may be used as a justification for establishing fuel theft. Section 2 depicts the Literature survey, which was conducted to get a full overview of current knowledge and research on a topic, identify research gaps, and provide the groundwork for the suggested proposal. Section 3 provides the methodology of the Smart Fuel Theft Detection and Alert System design process, including algorithm flow and calculations. Section 4 discusses the results for different features of the proposed system. Section 5 offers further improvements that can be implemented in future. Section 6 summarizes and concludes that the suggested approach is extremely valuable for the government in maintaining transparency at the consumer level.

2. Reason for Research

To properly record the background studies, the following research paper summary can be added in accordance with the literature surveys conducted for this research. In [6], the author suggests a hybrid system to monitor fuel levels and identify fuel theft in automobiles. The LCD and buzzer will receive a command from a programmable microcontroller when the sensor detects gasoline. This type uses a microcontroller with a GSM module. By ordering the GSM, the car's owner can get an instant message with information about fuel theft, including the exact location and fuel amount. An Arduino UNO microcontroller, an IComSat v1.1 SIM900 GSM/GPRS Shield to connect to a mobile phone, a fuel level sensor to detect volume, and a push button to detect whether the fuel tank lid is open or closed are all used in the prototype of the Arduino-based vehicle fuel theft detector system proposed in [7]. This system operates based on detecting the condition of the fuel tank cover. The device will make a phone call upon opening the lid. After that, the fuel volume will be monitored by the system. If the volume drops significantly, the device will notify the car’s owner via a brief message.

To solve the problem of fuel theft from automobiles especially motorbikes and vehicles, the suggested method in [8] focuses on developing and deploying a GSM-based vehicle fuel theft detection system. The recommended approach uses a level sensor to monitor the gasoline level in the tank and a GSM modem to send an SMS to the owner in case of theft. The microcontroller combines sensor inputs and manages the communication protocol at the central processing unit. The device is activated when the ignition key is removed from the car; it only offers protection when the car is left unattended.

The method proposed in [9] suggests improving fuel monitoring in vehicle tracking systems by combining motion characteristics and microcontrollers for precise fuel level determination and theft detection[10]. The system uses a hardware module that includes vibration sensors, gyroscopes, and accelerometers, with data sent to a smartphone app for real-time monitoring. The system identifies gasoline refills, thefts, and leaks by analyzing sensor data with the goal of increasing accuracy, reducing fuel waste, and improving customer happiness. This method combines motion sensors, microcontrollers, and smartphone apps to give a full solution for fuel monitoring and theft prevention. The technique proposed in [11] is based on a fuel monitoring and tracking system that combines hardware and software components. The system checks gasoline levels using fuel level circuits, Arduino, GSM, and GPS modules and sends the information to an Android app for display. GSM and GPS modules provide real-time transfer of fuel-related data to a web server, allowing for remote monitoring and administration. Flow sensors may also monitor gasoline use at petrol pumps and send error warnings, improving fuel management efficiency across various vehicles and businesses.

The author offers an IoT-based system in [12] for monitoring and protecting gasoline tanks at petrol bunks, which consists of two primary components. The first module processes storage tank level updates and includes sensors for detecting smoke and fires, which ensures correct monitoring and security. The second module assures fuel quality compliance by analyzing fuel composition and comparing it to specified values, sending out notifications if any deviations are identified. Smart meters are used to monitor gasoline levels and provide information, automating fuel tank management while improving security and money generation.

The author’s suggested fuel theft prevention system for tanker trucks, as stated in [13], includes a complete approach to assure effective security measures throughout transportation. Key components include a keypad security system, dual-level sensors, a GPS module, a cloud platform for data storage, and mobile apps. Dual-level sensors continually monitor gasoline levels and send alarms when levels fall below predetermined limits. GPS offers real-time location tracking, allowing for pre-emptive identification of fuel theft occurrences and improving overall transportation security.

The author describes in [14] how to build a fuel theft monitoring system with an Arduino microcontroller, sensors, a GSM module, and an LCD display to provide real-time warnings and notifications. The device uses an ultrasonic sensor to accurately assess gasoline levels and a flow sensor to identify theft. An LCD panel displays real-time data, and SMS notifications are delivered to the vehicle’s owner in the event of a theft incident. The implementation procedure entails setting and integrating hardware components to establish a complete fuel theft monitoring system, which improves security and enables rapid actions.

The suggested approach in [15] uses a microcontroller to interpret the data gathered from the GPS and fuel level sensor. Then, it uses a GSM module-which is used for cellular communication-to deliver an alarm. The staff is informed of the quick change in fuel level via an integrated display and an onboard buzzer. The integrated LCD of hybrid electric cars shows the continuously monitored fuel level in the fuel containers or the SoC. The technique in [16] consists of three rounds of tests to assess the efficacy of a surveillance system in detecting manipulated fuel dispensers. In each cycle, parameters are changed to simulate alternative behaviors of tampered dispensers, and statistical analysis metrics such as sensitivity and specificity are used to assess system performance. The experiment also evaluates the efficiency of a blockchain network in sustaining the needed workload for transaction verification, proving the efficacy of the proposed solution in identifying manipulated gasoline dispensers and maintaining data integrity using blockchain.

Every author has concentrated on fuel management and theft that originates directly from the fuel tank. Not keeping an eye on the fuel level to spot any irregularities and failing to detect fuel discrepancies from the petrol pump. In this paper, this gap in research has been addressed.

The research is not only of the author's attention on fuel theft detection, but the suggested system leverages a Telegram bot to provide signs of gasoline theft on the user's phone, which could later be used to justify the theft. The method is straightforward, affordable, and easy to use. The Telegram bot assists in immediately informing users of any fraud or anomaly.

A new feature has been added that helps the user acknowledge incoming calls and sounds a buzzer to alert them. An additional feature that will enable the vehicle driver not to miss any important calls or messages using the RF signal detection technique.

3. Methodology

3.1. Design of Fuel Level Anomaly

The device consists of a NodeMCU ESP8266 (WiFi Module) and an ultrasonic sensor. Figure 3 shows the necessary connections and relevant code that needs to be uploaded into the microcontroller, assuming that the fuel tank has fixed dimensions.

The mentioned device works for a cylindrical fuel tank whose height is 55 cm, and radius is 12 cm. For the given dimensions, the maximum capacity of the fuel tank is around 24.87 Liters. Figure 1 shows the sensor deployment at the top of the fuel tank. The vehicle's Mileage is assumed to be 15 kmpl [17]. Different vehicles offer different mileages according to the Cubic Capacity (CC) of the engine being used [17].

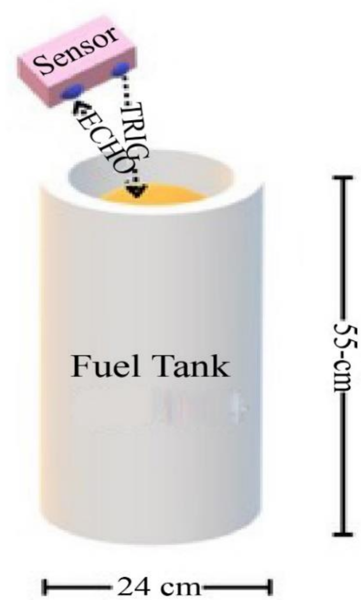

Fig. 1 Arrangement of the sensor

Refer Table 1 to distinguish the approximate Mileage a vehicle can deliver based on the cubic capacity of the engine and how much distance can it cover if the fuel tank is full. The vehicle is restricted to maintaining a constant speed of 70 kmph with no acceleration.

According to Newton's first equation of motion,

$$V = U + a \times T \quad (1)$$

V = Speed of the vehicle after each clock pulse of the microcontroller
U = Current speed of the vehicle
a = Acceleration of the vehicle
T = Delay produced due to execution of instructions by the microcontroller

Since the acceleration is assumed to be 0, V becomes independent of T. So, the equation reduces to

$V = U$, where U is 70 kmph.

Table 1. Comparisons between engine capacity and mileage

S.No	Engine Capacity	Expected Mileage (in kmpl)	Approximate Output Power (in BHP)	Expected Maximum Distance (in km)
1	Upto 120cc	More than 70	Up to 10	More than 1741
2	120cc to 150cc	55 to 75	10 to 15	1368 to 1741
3	150cc to 200cc	40 to 55	15 to 20	995 to 1368
4	200cc to 500cc	25 to 40	20 to 35	622 to 995
5	More than 500cc	Less than 25	More than 35	Less than 622

Algorithm-I

Step 1 : Initiation of microcontroller;
Connect the microcontroller to the designated WiFi source, which uses a 2.4 GHz frequency band.

Step 2 : Initializes the Telegram bot;
Send a Telegram message to the user if the user wants to fill fuel or not.

Step 3 : If the user wants to fill fuel,
The user needs to send a message saying "Y." Bot starts responding to the received message.

Step 4 : If the user sends the message that he/she wants to fill fuel,

- Bot asks what the fuel price per liter (in INR) on that particular day and how much fuel is the user wants to fill (in INR).
- The waiting time of the Bot is set to 10 seconds based on user response.
- If the Bot does not receive the data within this time, it responds that it has not received the required data.
- If the required data is received within 10 seconds, it checks whether the received data is in proper format or not.
- If it is not in proper format, it sends a message to the user that the received data is not in proper format and says in what format it expects to receive the data.
- If the data is in proper format, it will find the expected fuel volume to be received using Equation (2).

Step 5 : The device stays idle as long as the tank gets filled. On average, it found that approximately 10 seconds is required to fill one liter of petrol.

- Using this logic, how much time the device needs to stay idle is found using Equation (3).

Step 6 : After this time has elapsed,
The device computes how much fuel is filled in the tank using Equation (4).

Step 7 : Error is calculated using Equation (5);
If the error is within permissible limits, the device goes to idle mode and waits for the user to send the message that he/she wants to fill fuel again.

- If the error is not within permissible limits, the user gets a warning message that there is an anomaly in the received fuel volume.

$$eV = \frac{p}{tP} \tag{2}$$

eV = Expected fuel volume to be received
p = Amount of fuel the user is expecting (in INR)
tP = Fuel price per liter on a particular day (in INR)

$$idleTime = eV \times 10 \tag{3}$$

$$idleTime = time\ needed\ to\ fill\ fuel$$

$$aV = \frac{\pi \times tankRadius^2 \times (tankHeight - d)}{1000} \tag{4}$$

aV = Actual fuel volume received
d = Distance between the ultrasonic sensor and fuel surface
tankRadius = Radius of the fuel tank
tankHeight = Height of the fuel tank

$$err\ \% = \frac{eV - aV}{aV} \times 100 \tag{5}$$

err = Amount of deviation between expected and actual fuel volume received

3.1.1. Fuel Level Anomaly Detection

Figure 2 narrates the flow chart and how the instructions are fed to the microcontroller, which deals with Fuel Level Anomaly detection. There are a total of 9 significant functions or tasks the microcontroller has to perform, which include setting up the connections, taking inputs, processing the data after checking various conditions, and computing the output. The bot token and the Chat ID of the Telegram bot are provided to the microcontroller as inputs. This is how the NodeMCU finds the Telegram bot and communicates with the bot.

3.2. Design of Fuel Consumption Rate Anomaly

The same hardware as mentioned in Fuel Level Anomaly is used. However, the operations are performed with another NodeMCU. Two microcontrollers are used in this research to avoid the Out of Memory (OOM) error, which usually occurs when the program runs out of memory, i.e., RAM. Using two microcontrollers also reduces the delay. Only one ultrasonic sensor sends data to two microcontrollers for cost-cutting. The data can be sent to both the microcontrollers either serially or parallelly. The first method is to send the data to the first NodeMCU and from the first NodeMCU to the second NodeMCU using communication protocols such as SPI in a serial manner. This method is slower but accurate. The second method involves sending the ultrasonic data to both the microcontrollers parallel using the time multiplexing technique such that both microcontrollers cannot access the data at the same time. After every 5 milliseconds, the data path of the sensor toggles between both the NodeMCUs. This method is faster and more accurate. Figure 3 shows the reason for choosing the second method. Though the best method would be using two ultrasonic sensors, only one sensor saves cost. Additionally, a 16x2 LCD Display is used, which will show the real-time fuel level, how much distance the vehicle can travel with the remaining fuel, and the fuel consumption rate [18]. One point to be noted is that this device uses an I2C module to interface LCD and NodeMCU. It is necessary to use this module only when there is a requirement for more GPIO pins. NodeMCU has only 9 usable pins. To save the GPIO pins for further addition of features, it is always good to use as less GPIO pins as possible.

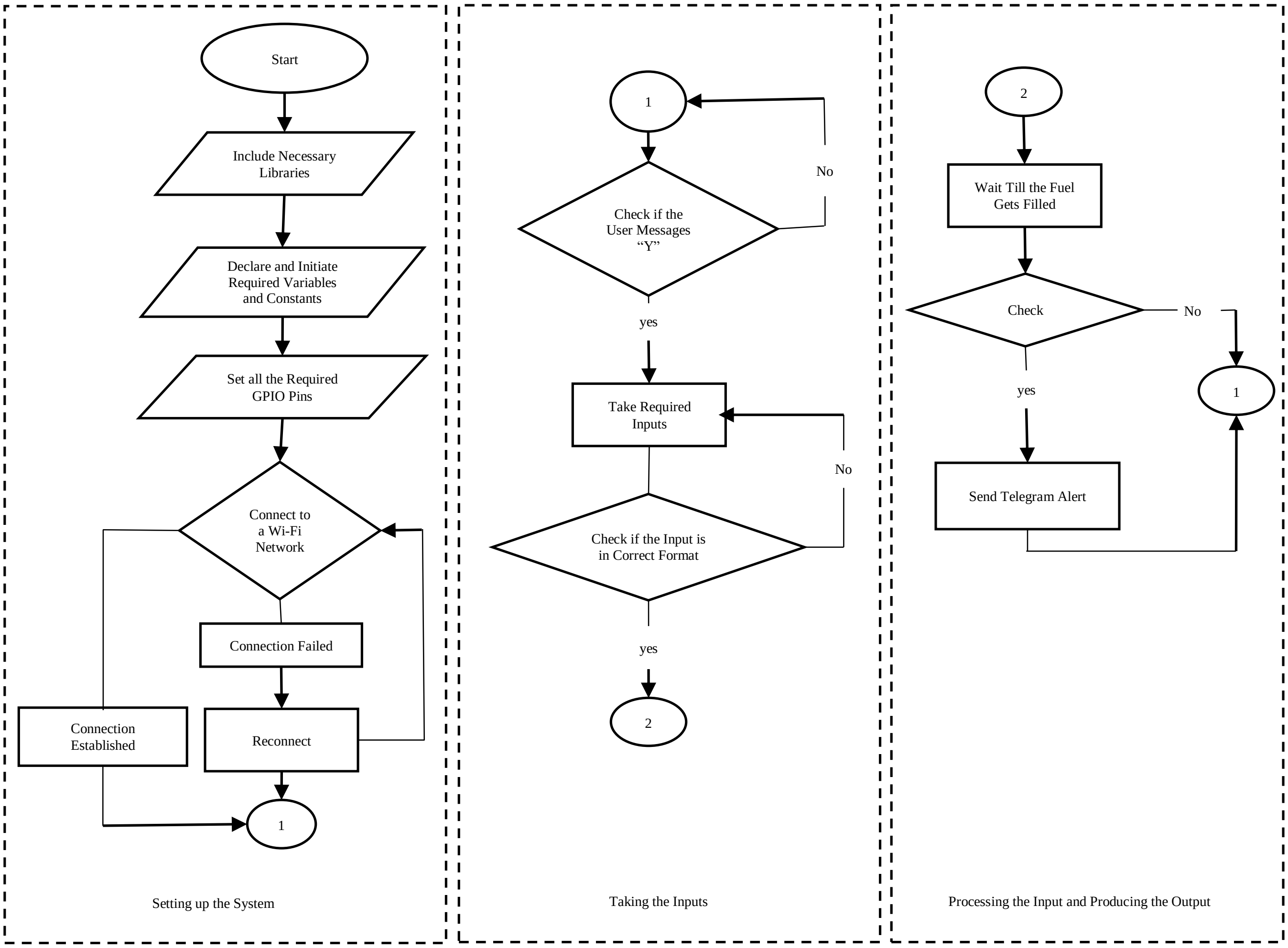

Fig. 2 A short representation of instructions given to the microcontroller, which deals with fuel level anomaly

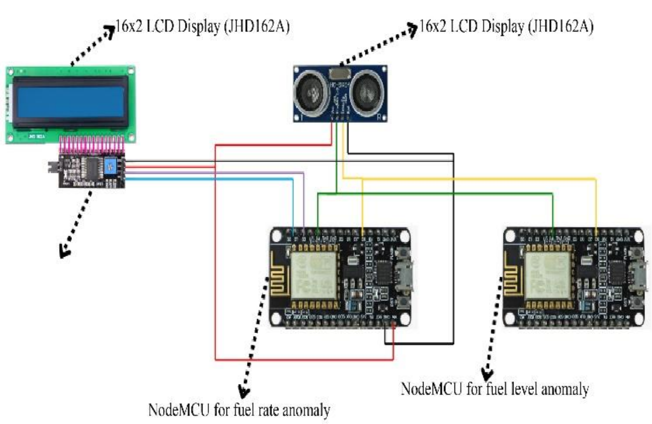

Fig. 3 circuit schematic for the proposed system

After the data is successfully received, we proceed to the further operation [19]. The device will constantly monitor the fuel level and how much fuel is consumed while the vehicle is traveling. If the rate of fuel consumption is greater than the threshold value, a telegram alert is sent to the vehicle owner. Even if the vehicle is not there with the owner, he/she can constantly monitor the fuel level by accessing the data from the cloud. This device transmits the fuel level data to ThingSpeak.

Algorithm-II

Step 1 : As mentioned in Algorithm-I, the device first tries to connect to WiFi, sets up the Telegram bot, and connects to the ThingSpeak client.

Step 2 : If any one of the processes is incomplete, the microcontroller gives a negative acknowledgement.

Step 3 : If the setup is completed, the microcontroller sends a positive acknowledgement and processes further instructions.

Step 4 : The device starts calculating the fuel level (in liters) using Equation (6) with all the constants such as fuel tank height, fuel tank radius, SSID and password of WiFi, ThingSpeak channel number, and Write API key, Telegram bot token and chat ID predefined.

$$fuelLev = \frac{\pi \times tankRadius^2 \times (tankHeight - d)}{1000} \quad (6)$$

$fuelLev$ = Instantaneous level of the fuel tank

Step 5 : After calculating the instantaneous fuel level, the device finds how much more distance the vehicle can travel with the remaining fuel using Equation (7).

$$remDist = fuelLev \times vehMil \quad (7)$$

remDist = distance the vehicle can cover with the current fuel level
vehMil = Mileage of the vehicle

Step 6 : Upon calculating the fuel level and the remaining distance, the device attempts to compute the instantaneous fuel consumption rate using Equation (8), Equation (9) and Equation (10). These equations help to find the Change in fuel rate between each current fuel level and the previous fuel value.

$$consRate = \frac{\Delta L \times S}{vehMil \times 1000} \quad (8)$$

consRate = Instantaneous fuel consumption rate
ΔL = Change in vehicle fuel level
S = Speed with which vehicle is travelling

$$\Delta L = curLev - preLev \quad (9)$$
$$preLev = curLev \quad (10)$$

curLev = Current fuel level sample
preLev = Previous fuel level sample

Step 7 : After finding all the required parameters, all these parameters are sent to the 16x2 LCD as well as to the designated ThingSpeak channel.
Step 8 : Then, the device checks if the fuel rate is high. If the fuel consumption rate is higher than the threshold value, a Telegram alert is sent.
Step 9 : This process repeats continuously.

3.2.1. Flow Chart-2 for Fuel Rate Anomaly Detection

Figure 4 is flow chart 2 to depict how the program flow happens inside the NodeMCU, which deals with Fuel Rate Anomaly detection. There are a total of 8 significant functions or tasks the microcontroller has to perform, which include setting up the connections, including relevant libraries, taking inputs, processing the data after checking various conditions, and making necessary decisions. The ThingSpeak channel number and the write API Key are given to the microcontroller as inputs. Using this data, the NodeMCU uploads the data to ThingSpeak.

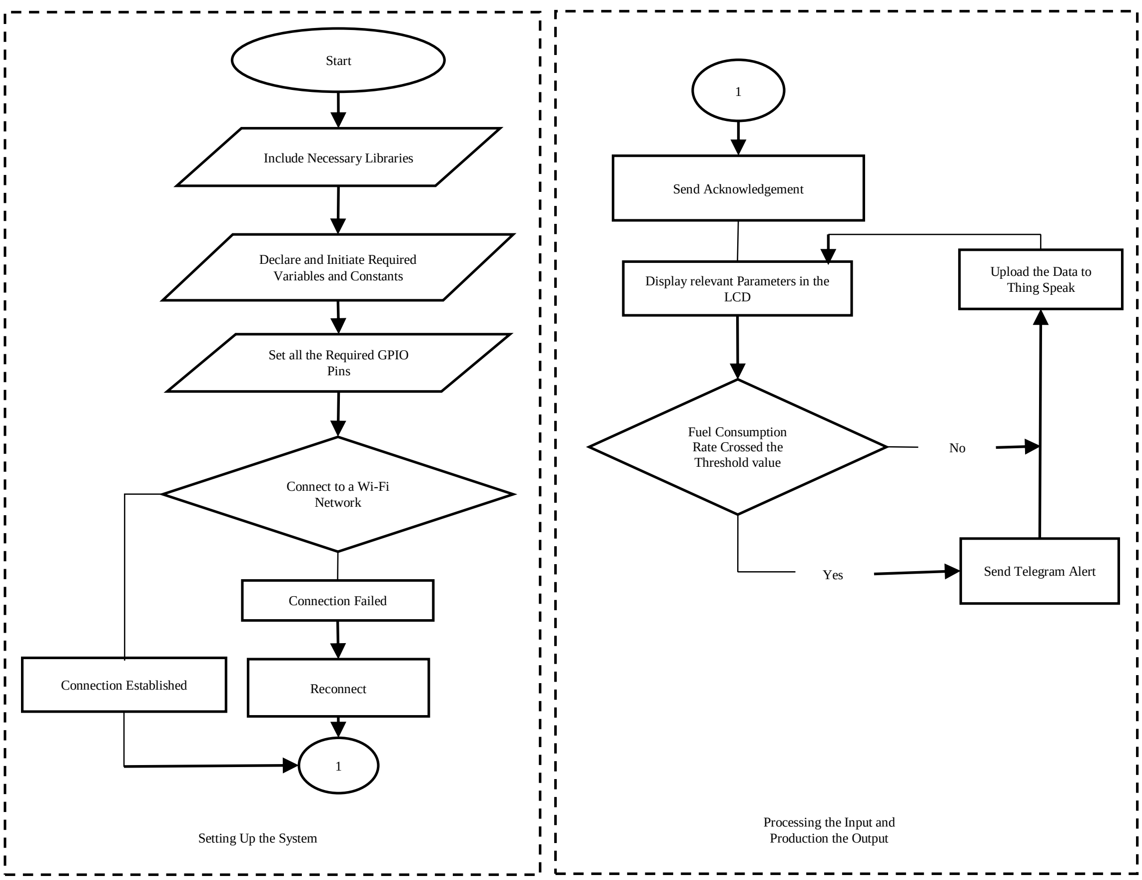

Fig. 4 A short representation of instructions given to the microcontroller, which deals with the fuel rate anomaly

3.3. Design of Low-Cost and Low-Power RF Signal Detector

A mobile phone uses a frequency range of 0.9 GHz to 3 GHz for communication. Mobile phone communication can happen either via call or SMS. When the mobile phone starts communication via call or SMS, it transmits or receives the RF signal along with some noise due to the channel. Figure 5 shows the working block diagram of the proposed device.

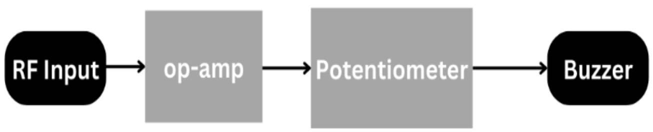

Fig. 5 Block Diagram of the proposed system

According to the block diagram above, when the circuit is charged by a 9-volt direct current battery and the RF antenna detects a wireless signal, the operational amplifier LM358AN amplifies the signal, which in turn activates the buzzer and causes the LED to blink [20].

Figure 6 shows the working of the circuit. All the components used to develop the system are described below.

3.3.1. Ceramic Disk Capacitor

A ceramic disk capacitor is used to capture any RF signal present around its surroundings and store that energy in the form of an electric field. After the capacitor is fully charged, it discharges by sending that energy through the IC.

3.3.2. LMC358AN

The IC LM358AN consists of two high gain and an independent operational amplifier (op-amp). This capacitor is placed between the inverting and non-inverting terminals of any one op-amp present in the IC.

Since the capacitor is connected to the input terminals of an op-amp present in the IC, the given signal is amplified and is available at the output terminal.

3.3.3. RC Network

An RC network consisting of a bypass capacitor in parallel with a resistor offering high resistance is connected to the non-inverting terminal so that the non-inverting input voltage stays constant, i.e., any extra DC signal is drained out from the resistor and AC noise is bypassed through the bypass capacitor.

3.3.4. Buzzer

The output of the second op-amp present in the IC is fed to a buzzer or an LED. In this case, a buzzer is used so that whenever a call or text message is received, the buzzer starts to flicker.

3.3.5. Feedback Resistor and Potentiometer

A feedback resistor is connected to the op-amp's inverting terminal. The op-amp's output is supplied to the IC's second non-inverting terminal, while the inverting terminal is adjusted with a 470KΩ potentiometer and connected to a 9V power source.

As a result, the device's sensitivity can be modified. A buzzer or an LED receives the output of the second op-amp inside the IC [21]. In this instance, a buzzer is there that responds to any calls or text messages that are received.

3.3.6. Circuit

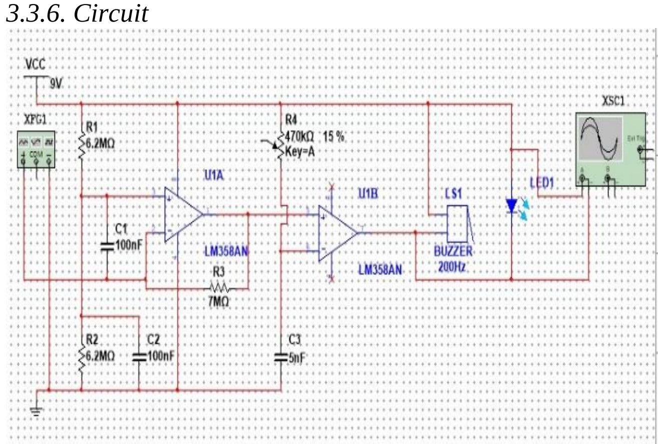

Fig. 6 Working of circuit schematic

4. Result and Output Analysis

4.1. Fuel Level Anomaly

Figure 7 depicts the ability of the device to communicate with users with the help of the created Telegram bot. When the user says "Y", the device is ready to receive how much fuel the user wants and today's fuel price. As soon as it gets the data, it waits for a certain amount of time, which is calculated using Equation (3).

If the received data is in the wrong format, the device attempts to fetch the data again from the user. Then, it finds the error and sends an alert to the user if there is any anomaly. After this operation is done, the device again waits for the user to send "Y" so that it will start working again. This process is done continuously. Table 2 represents the data on the engagement of the alert system.

The permissible error value can be subjective to every user depending on the fuel efficiency of their vehicles. If the expected volume of fuel to be received is 4 liters and the actual volume received is 3.9 liters, the users having a high mileage vehicle might not notice this difference.

However, a user with a low-mileage vehicle will notice the difference. So, the permissible error is inversely proportional to the vehicle mileage.

Table 2. The engagement of the alert system

Fuel Wanted by User (INR)	Fuel Price on a Day Per Liter (INR)	Expected Fuel Volume (Liters)	Actual Volume Received (Liters)	Anomaly Detected (Assuming Permissible Error is 10%)
200	98	2.04	1.50	Yes
300	100	3.00	2.99	No
500	95	5.26	4.00	Yes
600	100	6.00	5.51	No
900	104	8.65	7.82	Yes

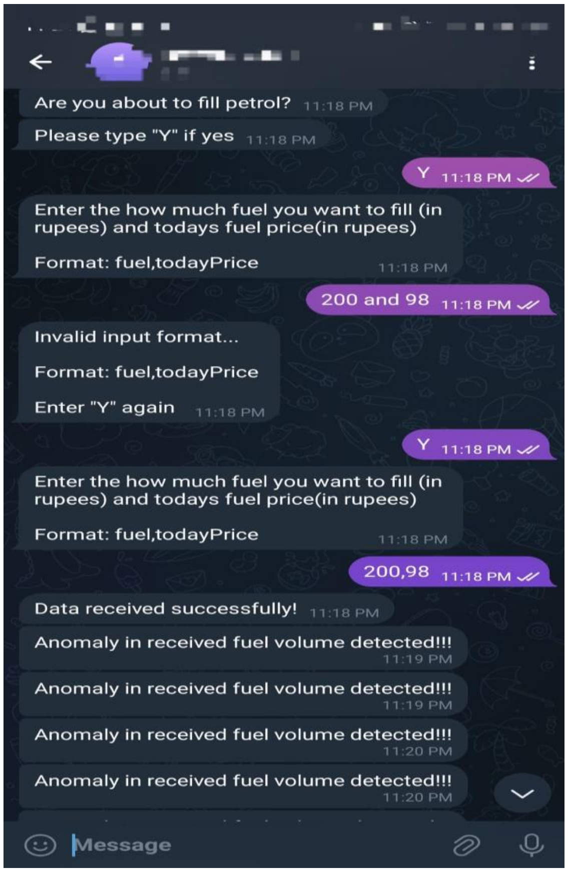

Fig. 7 Telegram chat for level anomaly

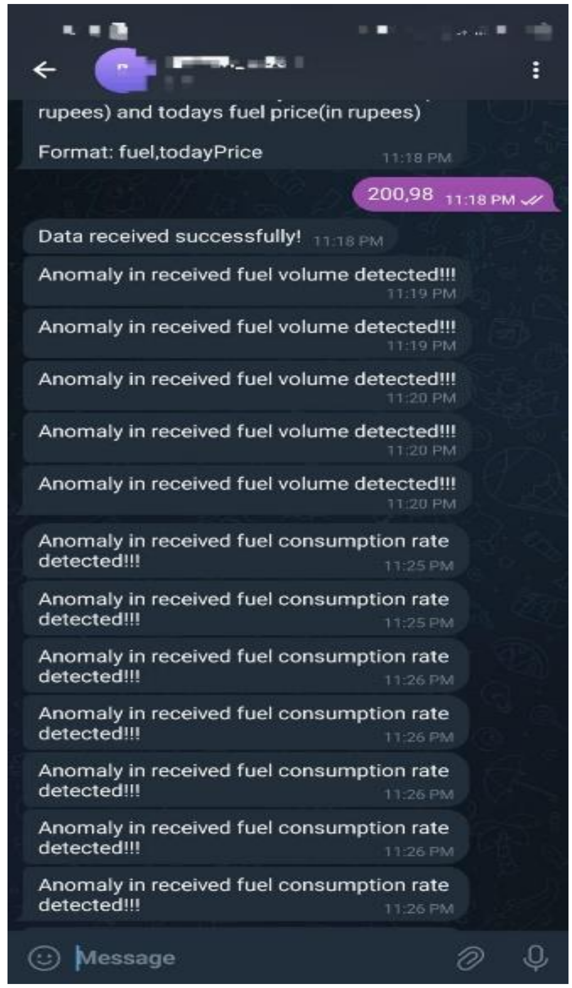

Fig. 8 Telegram chat for consumption rate anomaly

4.2. Fuel Consumption Rate Anomaly

In this part, the device has to send a Telegram alert if any anomaly is detected, and it also sends real-time fuel level and rate of fuel consumption values to ThingSpeak. As expected, the device can send a Telegram alert when the fuel consumption rate exceeds the threshold value, as shown in Figure 8.

The device is also successful in sending the fuel level and fuel consumption rate values to ThingSpeak, as shown in Figure 9 and Figure 10.With keen observation, at 12:35 PM, the fuel level has dropped drastically. That means there is either a leakage in the fuel tank or the fuel has been stolen. The same thing is reflected in Figure 10 as well. The fuel consumption rate has increased drastically, which means the same thing again.

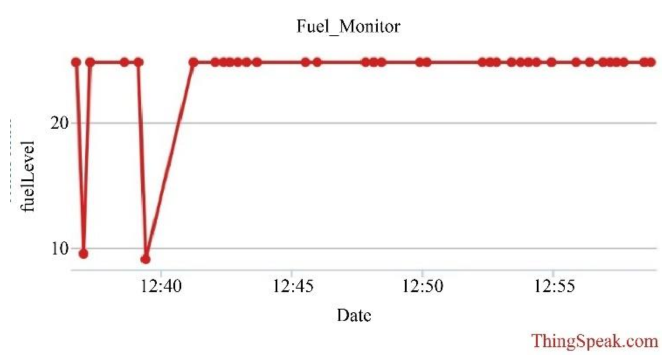

Fig. 9 Instantaneous fuel level (in liters)

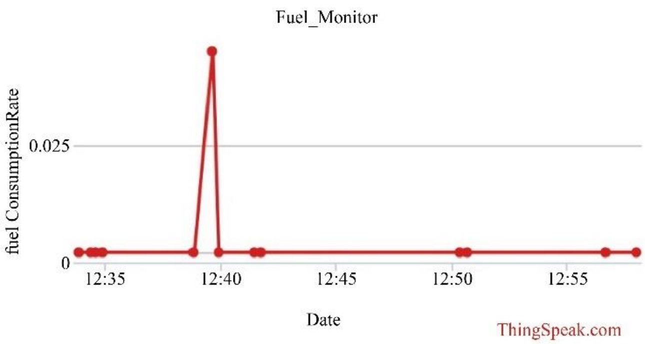

Fig. 10 Instantaneous rate of fuel consumption (in liters/km)

4.3. RF Signal Detector

A scenario similar to the hardware has been created in this simulation platform. It will help us to better understand the output. In the function generator, a signal of 2.5GHz is generated, which mimics the RF signal, which can be observed in Figure 11. The antenna detects the signal, and upon further amplification, it can be clearly observed that the LED is turned on. Similarly, Figure 12 shows that if a signal is generated out of the frequency range of the mobile signal, the LED and the buzzer remain off.

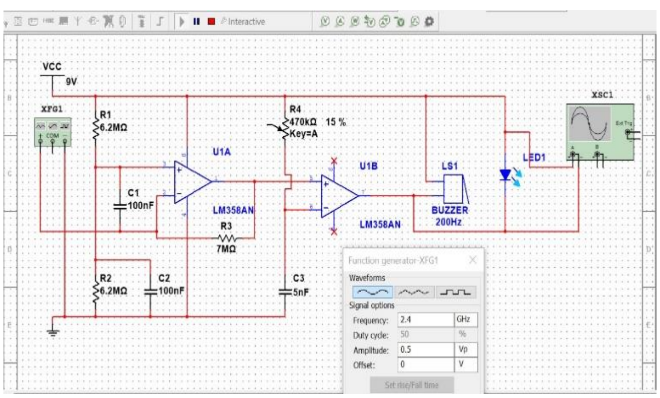

Fig. 11 Call or SMS is detected

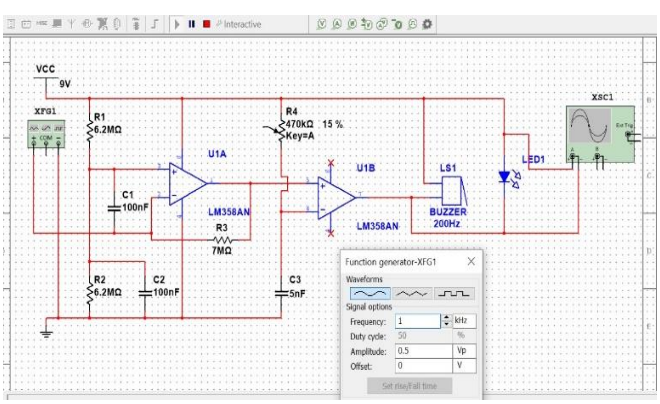

Fig. 12 No Call / SMS is detected

Table 3 gives information about input signals with different frequency ranges as well as the response of the proposed circuit for these signals.

Table 3. Response of the circuit for various frequencies

Sl. No.	Frequency of Input Signal	Within RF Range	Output
1	2.4 GHz	YES	HIGH
2	1KHz	NO	FLICKERS
3	900MHz	YES	HIGH
4	20KHz	NO	FLICKERS

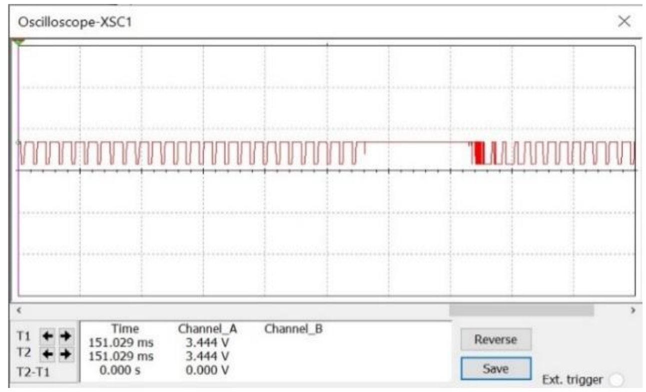

Fig. 13 Oscilloscope output

Figure 13 shows the waveform received when the output terminal of the circuit is connected to an oscilloscope. When there is an RF signal present around the circuit, the output should be high. Otherwise, it flickers. From the waveform shown, the output flickers for some time, then becomes constantly high, and then it again starts to flicker, which means there has been an RF signal near the device for some time, and then it disappears.

5. Future Scope

In the proposed methodology, a cylindrical fuel tank is assumed. However, for commercial vehicles, that is not the case. This methodology can be taken to a further level by including the procedure to measure the volume of fuel on irregularly shaped fuel tanks [22]. This part can be further explored to make an accurate and robust technique. One such technique might include using sensors that measure the weight of fuel instead of measuring fuel level. This method can apply to fuel tanks with irregular shapes.

6. Conclusion

This proposed research represents an innovative solution to detect anomalies while receiving the requested amount of petrol from the petrol pump. The methodology uses simple IoT devices and basic arithmetic concepts to resolve real-time problems. The procedure to implement the hardware and how to program it is also mentioned. The model is more advantageous for its simplicity and low-power concept. This methodology can be applied not only to detect jump tricks but also to various other real-time problems, as described below.

Furthermore, in the context of government operations, where accountability and transparency are vital, a cloud-based rate anomaly detection system has been established as an innovative solution for monitoring the use of free petrol supplied to staff and detecting possible cases of misuse or theft.

This method collects real-time data from the sensor, builds baselines for expected consumption patterns, and detects deviations that may signal abnormal behaviour. By continually analyzing petrol usage and comparing it to predefined criteria, the system can quickly discover inconsistencies and offer intuitive dashboards and reports to authorised people via cloud-based interfaces. This transparent and easily accessible information enables government organisations to take proactive steps, investigate inappropriate behaviour, and implement remedial measures, ultimately promoting accountability, responsible resource utilisation, and efficient operation while discouraging potential abuse.

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