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Iot Based Fuel Level Monitoring System

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Abstract: In recent times, there has been a significant increase in the number of vehicles, particularly those running on fuel. Unfortunately, the rising fuel prices have led to instances where some petrol pump owners attempt to deceive their customers. They manipulate the fuel data or display incorrect information when customers request fuel filling. To address this problem, we have developed a solution called the Smart Fuel Meter, which accurately measures the amount of fuel dispensed into the vehicle's tank and calculates the corresponding cost based on the current fuel price. The Automatic Fuel Level Controller is an advanced system designed to monitor and control the fuel level in a fuel tank, typically used in vehicles or fuel storage systems. The system automatically adjusts the fuel flow based on pre-set thresholds, ensuring an optimal fuel level at all times, preventing overflows or running out of fuel. The system uses sensors and controllers to detect and maintain the fuel levels, providing alerts and controlling pumps for refilling when required. The Smart Fuel Meter incorporates Internet of Things (IoT) technology, utilizing components such as the Arduino and an embedded system to enable efficient fuel quantity measurement and fraud detection. To enhance user accessibility and transparency, we have also implemented a web-based interface that allows customers to view real-time data regarding the actual volume of fuel dispensed and the associated cost.

Keywords: Internet of Things (IoT), Fuel meter, Ultrasonic sensor.

I.INTRODUCTION

Nowadays, many vehicles are equipped with digital fuel meters. However, one significant drawback of this system is that it displays the fuel level using bars or symbols rather than showing the actual numeric value. Consequently, it becomes challenging to determine the exact amount of fuel present in the tank. Moreover, fuel fraud and tampering often occur when consumers request a specific amount of fuel based on price (e.g., Rs 50 or Rs 100) rather than specifying the volume (e.g., 1 liter). Since fuel prices fluctuate daily, consumers often opt for convenient denominations. Unfortunately, this practice creates an opportunity for unscrupulous petrol pump owners to cheat customers by dispensing less fuel than what was

paid for. Many consumers are unaware of this discrepancy, which allows pump owners to exploit the situation. To address these issues and detect fuel fraud, we have developed an IoT-based smart fuel meter. This innovative meter accurately measures the volume of fuel dispensed and transmits the data to a custom Android app. The app, in turn, updates the fuel price on a daily basis and calculates the corresponding cost based on the latest price information. It also displays the quantity of fuel dispensed along with the cost, providing users with transparency and convenience. In summary, the IoT-based smart fuel meter eliminates the ambiguity of bar-based fuel indicators by providing precise volume measurements. By integrating with an Android app, the system ensures regular price updates and empowers users to monitor fuel expenses effectively.

Due to fuel management, the fuel is monitored and expenses are controlled. Fuel monitoring systems are a crucial component of logistics and transportation businesses all over the world. The lack of fuel in the tank is indicated and this assists in managing and monitoring the car's fuel efficiency. The improvement of fuel efficiency and cost savings are two of the main objectives of fuel monitoring systems. This motivates us to develop a smart fuel monitoring system that is beneficial for transportation companies and people who own private vehicles.

In this paper, fuel monitoring system continuously monitors level of fuel in the tank. This data is stored, analyzed in the cloud and based on the analyzed data, some control actions are performed. This automated process saves on time and probable wastage of extra fuel [2]. Through the notification, the user will be able to find out how much more fuel and cost is required to fill the tank [2]. This system is efficient, accurate and simple to implement and use.

II. LITERATURE REVIEW

"In the paper titled 'Real-Time Fuel Monitoring and Theft Detection System using IoT,' the authors propose a solution for detecting fuel levels and preventing fuel theft. The system stores fuel data in a Firebase database and sends it to a dedicated Android app designed for fuel monitoring [1]. Shivashankar.S mentions the use of a flow sensor and an ultrasonic sensor to calculate fuel levels and detect potential accidents during travel [2]. Sayali A. Gayakwad describes a system called 'Fuel Level Indication and Mileage Calculation using IoT,' which utilizes an ultrasonic sensor and a YFS201 flow sensor to calculate fuel level and flow. The data is then displayed on a Blynk app [3]. Another paper titled 'Vehicle Fuel Theft Detection and Monitoring System' discusses a system that detects fuel theft using an ultrasonic sensor. When fuel theft occurs, the system generates alerts and sends a message to the registered phone number of the vehicle owner [4]. A paper titled 'Fuel Theft Detection Location Tracing using Internet of Things' presents a system that detects fuel fraud and theft, displays fuel level on a screen, and plots graphs on a mobile application [5]. The 'IoT Based Smart Fuel Monitoring System' utilizes an ATmega16 IC and an ESP8266 chip to send fuel volume data to a server, which is then displayed on an Android app [6]. Microcontroller-based systems have been designed for real-time fuel monitoring, where the level sensor transmits data over Bluetooth or WiFi to web or smartphone applications [7] [8] [12] [15] [16] [17].

The paper 'Model Based Design of Digital Fuel Indication System' proposes a system that calculates fuel level using an ultrasonic sensor and displays the value on a 16x2 LCD display [9]. In the 'Fuel Theft

Detection System,' based on a PIC 16F877A microcontroller, an IR sensor detects changes in fuel level and generates a sound from a buzzer [10]. The 'IoT based Smart Vehicles for Fuel Consumption' system incorporates a load cell, GPS module, and GSM module to calculate the weight of fuel and send the values to a database using the GSM module [11]. Installing additional sensors inside the fuel tank can pose challenges such as separate power supply and maintenance, as well as maintaining the minimum operating distance for accurate measurement [12]. In the 'Embedded System Based Intelligent Digital Fuel Gauge,' the system calculates the amount of fuel filled into the tank, displays it on an LCD, and sends a message to the registered mobile number of the consumer, including the amount, cost, location, and time of refueling [13]. The 'Digital Fuel Measuring System with Distance to Zero and Fuel Fraud Indicator' measures fuel levels using an ultrasonic sensor, allowing consumers to detect fuel fraud by comparing the actual fuel amount with the one displayed by the system [14]. Our project aims to digitize conventional fuel level to display the fuel value digitally, such as 1 liter, 1.5 liters, 2 liters, and so on [18]."

III. COMPONENTS

The Fuel Monitoring System comprises several components, namely sensors, a microcontroller, and a Wi-Fi module. Here's a breakdown of each element:

A. Microcontroller Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328P. Arduino is a company that designs and sells circuit boards for microcontrollers, making them easy to use. They offer various Arduino boards with different functionalities for different applications. The Arduino Uno is a popular board that is economical and suitable for many projects. It can be used to control motors, cameras, lighting, or even build simple robotic systems. Arduino boards come with a programming language that allows users to configure the hardware easily. The Arduino Uno consists of two main microcontrollers. The first one is the ATmega328, which is the heart of the board. The second one is the ATmega16U2, which acts as a USB controller and allows the board to connect to a computer. The ATmega328 microcontroller operates at a frequency of 16MHz. Unlike the 8051 microcontroller, it doesn't have a fixed frequency level. It has an inbuilt RC phase shift oscillator that can generate frequencies ranging from 2MHz to 8MHz. The ATmega328 is an 8-bit microcontroller, meaning it can process 8 bits of data in a single clock pulse. It has built-in 32 kilobits of memory. The ATmega328 features a voltage regulator and is a RISC (Reduced Instruction Set Computer) based microcontroller. It is known for its power efficiency and optimal set of instructions. The board includes various pins, including PWM outputs, I2C connectors, SPI ports, a power jack, an ICSP header, and a reset pin. In summary, the Arduino Uno is a versatile microcontroller board that offers an easy-to-use platform for various projects. It is based on the ATmega328P microcontroller and comes with a range of pins and features that make it suitable for different applications.

Fig 1: Microcontroller Arduino Uno

B, *Ultrasonic Sensor*

The Ultrasonic Sensor is a commonly used component in robotics projects that utilizes ultrasonic sound to measure distances between itself and nearby solid objects. It consists of two ultrasonic transducers: one acts as a transmitter, and the other functions as a receiver. The transmitter emits a series of ultrasonic pulses, which are highly directional and not directly received by the receiver transducer. When an electric pulse of high voltage is sent to the ultrasonic transducer, it vibrates within a specific range of frequencies, generating a burst wave of ultrasonic sound. When an obstacle is present in front of the ultrasonic sensor, these sound waves are reflected back, resulting in the production of an electric pulse. The time delay between the transmission and reception of the signal is then used to calculate the distance. A longer time delay indicates a greater distance, while a shorter time delay signifies a shorter distance.

Figure 2: Ultrasonic sensor

C. Mini push buttons

In a fuel level monitoring system, a mini push button can serve several important purposes. Here are some common uses:

Manual Reset or Calibration: A mini push button can be used to reset or calibrate the system. After maintenance or when the system is powered on for the first time, thebutton may allow the user to reset the fuel sensor, ensuring that the fuel readings are accurate.

System On/Off: The push button may act as a power switch, allowing the user to turn the fuel monitoring system on or off. This can be especially useful in systems that require manual control or deactivation during maintenance or troubleshooting.

Fuel Level Checking: In some systems, pressing the push button may trigger a reading or display of the current fuel level. This could be connected to a display or an alarm system to inform the operator of the fuel level status.

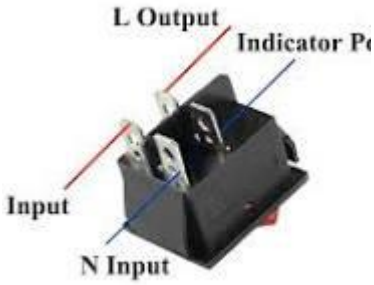

Figure 3: push bottons

IV.METHODOLOGY

The fuel monitoring and analysis system uses ATmega328 microcontroller. The Ultrasonic sensor is placed on the surface of the fuel tank. The distance of fuel level is then calculated by ultrasonic sensor using their waves. The load cell is placed at the bottom of the Fuel tank that measures the weight of the fuel to check the quality of the fuel within fuel tank. Moisture Sensor is deeped into fuel tank to measure the level of moisture in fuel. The LCD display is of 16*2 size and it displays all the measurements done by the sensors that are fuel level, fuel quality and moisture level in fuel tank in a digital format. The relay module used in system to send all the measurements including fuel level, fuel quality, moisture level and also alert for low fuel level.

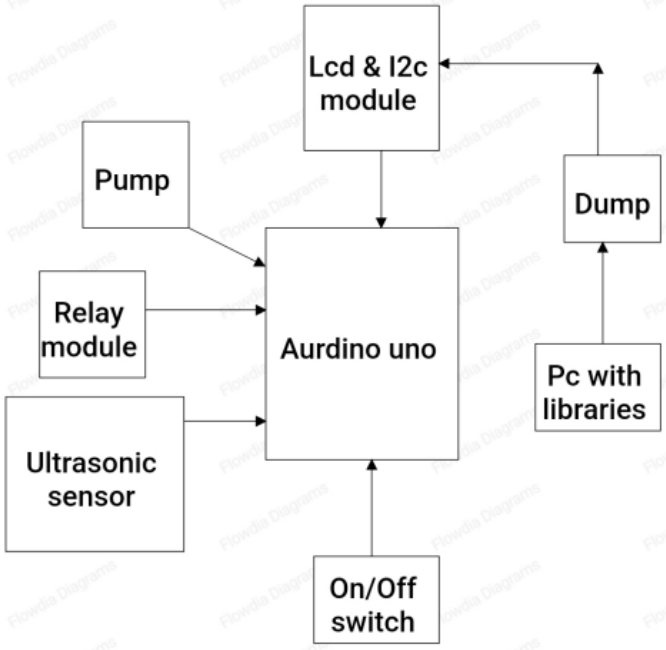

Figure 4: Block diagram

V. RESULT

Continuous tracking of fuel levels in tanks or reservoirs to ensure that the amount of fuel is consistent with expected values. Automated systems may detect any discrepancies such as low fuel levels, overfilling, or potential leaks. Real-time data may be collected and displayed on dashboards for operators to monitor and take corrective actions if needed. Alerts or alarms may be triggered if fuel levels fall below a specified threshold, prompting immediate refueling or other actions. Fuel is pumped from storage tanks to vehicles or other machinery as required, ensuring that fuel transfer rates are optimal. Monitoring ensures that pumping does not exceed capacity or cause spillage. The system may automatically adjust the flow rate depending on demand or fuel level status to prevent overflows or interruptions. Ensures that fuel is used efficiently and accurately measured. Helps in preventing overfills or leaks, maintaining safety standards for both equipment and personnel. Accurate tracking can help reduce fuel wastage, leading to better cost control. Proper fuel monitoring ensures that systems stay operational without unnecessary interruptions. The ultrasonic sensor is placed on it, moisture senor is deep into it and load cell of 10 kg is placed at the bottom of tank. All the values calculated by above mention sensors are displayed on LCD. The buzzer button gets red on thinks speak when fuel in the tank is less than 10 percentage as well as all other details displayed on LCD are shown in graph format on think speak. The load cell first minimizes the weight of tank and then based on the weight measured of the fuel purity of the fuel is measured.

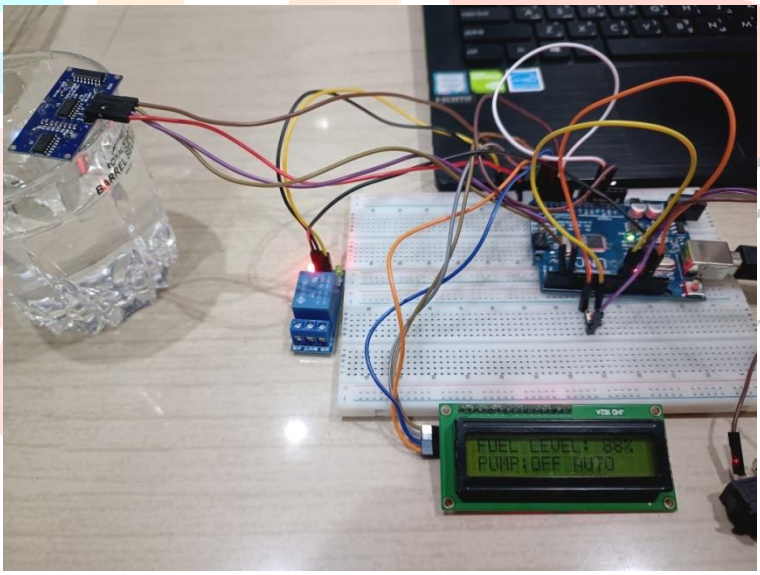

Figure 5: Prototype of proposed project

VI. CONCLUSION

The integration of fuel level monitoring and pumping systems plays a critical role in maintaining the efficiency, safety, and reliability of fuel storage and distribution operations. By implementing advanced monitoring technologies, such as real-time sensors and automated pumps, businesses can ensure accurate fuel level tracking, prevent overflows or shortages, and optimize fuel usage.

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