Petrol Pump Blacklisting Using Blockchain Technology and IoT

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Abstract— This paper proposes a method to check whether the fuel filled into the vehicle's petrol tank is appropriate to the given price or not. Based on that, the corresponding petrol pump is blacklisted. We provide an application that can be used by both the customer and dealer in the petrol pump. The customer and the dealer enter the data about the fuel being filled into the tank through the application. A sensor placed in the petrol tank measures the petrol level before and after pumping, and the difference in levels is calculated. The data comprising of petrol price, amount to be fueled for is uploaded to the blockchain framework and a unique transaction id is created. Detection of any malpractices reduces the trust factor of the pump leading to blacklisting those petrol pumps. The location of those blacklisted petrol pumps is easily accessible through the Android application. The advantage of using blockchain is that it is a distributed ledger and therefore it cannot be tampered by unauthorized persons, hence being immutable.

***Index Terms*— Blockchain, Internet of Things (IoT), Web scraping, Cloud storage.**

1. Introduction

Petrol pumps play a vital role in today's society as they provide a convenient and essential service of supplying fuel to vehicles. The demand for petrol pumps is driven by the growing number of vehicles on the road, population growth, urbanization, industrial activities, and the overall energy requirements of society. As long as vehicles, industries, and power generation rely on fossil fuels, the demand for fuel and the need for petrol pumps will persist. However, like any industry, petrol pumps are not immune to fraudulent activities. Some common fraudulent practices that can occur at petrol pumps include; Fault adulteration, short measuring, Skimming and overcharging, Tampering with dispensing units etc. To address these fraudulent activities, regulatory bodies and oil companies implement various measures.

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Overall, petrol pumps continue to be important in today's society for fuel supply and transportation infrastructure. However, it is crucial to address and combat fraudulent activities to maintain consumer trust, ensure fair business practices, and protect the interests of both consumers and the fuel industry as a whole. Our aim is to negate this issue by empowering the customers. The idea is to use an app to validate transactions by input from dealer, customer and IoT devices placed in the fuel tank. The data collected is then stored in a blockchain, for purposes of security and immutability, where the data is used to assess the trustworthiness of the petrol pumps. This information is then used to blacklist those petrol pumps which are fraudulent in nature, and made known to the general public, thereby increasing the sales of petrol pumps which do not indulge in
malpractices.

2. Literature Survey

P. Manjunath and P. Gajkumar, "IoT Based Handy Fuel Flow Measurement", proceedings of the third International Conference on I-SMAC,2019 IEEEn Xplore [4], This research paper provides an overview of the IOT based fuel flow digital measurement sensors, by sending the real-time inputs to user mobile, about how much petrol or diesel flow is pumped into vehicle tank. P. Gupta, D.V Singh, J. Chhabra and A. hukla, "IoT based Smart Petrol Pump", (2016 Fourth International Conference on Parallel, Distributed and Grid Computing PDGC) [5]. This paper presents the design and implementation of smart petrol pump in which we are going to measure the level of fuel in the gas station and show it to the central server. Dr. B. Anurudha, B. Priyadharshini, A. Yuvasri and M. Yamuna, "Fuel Level Indication and Mileage Calculator Using IoT" [6], 2019 5th International Conference on Advanced Computing and Communication Systems (ICACCS). Digital technologies shape our everyday lives for calculating everything. This paper is to implement a digital way to view fuel target in a vehicle. The simple aspect of this work is to check whether the fuel filled in the vehicle is appropriate to the given price or not, as for the first two pumps the tank is filled with fuel with air and then for the rest of the pumps, tank is filled with fuel. M.M Gijre, A Mane, R. Gadade and S. Gandhi, "Smart Fuel Level Indication System" [7], 2017, GRD journal for Engineering, 2017.

The proposed system aims in the measurement of the fuel in the vehicle tank using ultrasonic sensor. The ultrasonic sensor has a better accuracy and it is easy to calibrate and interface it with Arduino controller which is used. Z. Zheng, S. Xie, H. Dai and X. Chen, "An Overview of Blockchain Technology; Architecture, Consensus, Future Trends" [1], 2017 IEEE 6th International Congress on Big data. This paper presents a comprehensive overview of blockchain. Blockchain could be regarded as a public ledger and all committed transactions are stored in a list of blocks. This chain grows as new blocks are appended to it continuously. Asymmetric cryptography and distributed consensus algorithms have been implemented for user security and ledger consistency. Y. Ramesh, J. Santhosh, D. Suriya and R.J Poovaraghan," Ultrasonic sensor using Arduino" [8], This paper is an implementation of Internet of Things. It is able to sense and measures the distance remotely. The proposed use of Internet of Things will help to come up with solutions that are inexpensive and more reliable.

3. Methodology

The method can be divided into three sections; Android applications, IoT Sensors in the tank and Operations at the pump. Both dealer and customer in the petrol pump is provided with separate applications including databases which store information regarding the users of the respective applications. The database is stored online in cloud. The IoT framework consisting of an ultrasonic sensor, Node MCU and LCD display. The changes in the levels are measured by the sensor and send to customer app. The sensor measures the initial depth and the depth after the fuel is filled. The data is then passed on to Node MCU board which is programmed to find the volume change. The dimensions of the fuel tank are initially programmed onto the board and the depth change is used to find the volume change. LCD display is used to display the current level of petrol in the vehicle's tank. Operations at the pump includes:

- The customer requests the dealer to refill his vehicle for a certain amount of fuel.
- The sensor fitted in the vehicle's petrol tank will provide the pumped volume of fuel into the vehicle's tank.
- The dealer enters amount into his app. QR code is generated.
- Customer scans QR code, obtains transaction details and verifies if amount entered is correct.
- The customer pays the bill amount and this marks the end of a transaction.
- If QR code is not generated, the petrol pump is blacklisted.

4. Hardware Requirements

Node MCU - The Node MCU (Node Microcontroller Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. It is a microcontroller development board with Wi-Fi capability. It uses an ESP8266 microcontroller chip.

Ultrasonic Sensor (HC- SR04) - The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters, a receiver, and a control circuit.

LCD Display - LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

5. Software Requirements

Android studio - Android Studio is the official Integrated Development Environment (IDE) for android application development.

Java - Java is a widely-used programming language for coding web applications. It has been a popular choice among developers for over two decades, with millions of Java applications in use today. Java is a multi-platform, object-oriented, and network-centric language that can be used as a platform in itself. It is a fast, secure, reliable programming language.

Arduino IDE - It consists of both a physical programmable circuit board (often referred to as a micro-controller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

6. System Architecture

The petrol pump operator provides a QR code to the customer that contains the details of the current transaction. Each petrol station is provided with a unique id. The operator inputs the requested rupees by the customer into the mobile application and generate the QR code. QR code contains the requested amount, name and location. The customer scans the QR code using the android application and verifies that the requested amount of petrol is been pumped by the dealer. Otherwise QR Code is not generated and that particular petrol pump is blacklisted. The location of the blacklisted petrol pumps is easily accessible through the customer application. The customer app also contains an option to view the daily petrol price so the customer can verify. The data from the sensor is also visible in the customer android app for verification. In cloud, the data is stored using blockchain technology. Each block contains details of a particular transaction and points to another block which contains details of another transaction. The data from the vehicle fuel tank sensor is then multiplied with the fuel price of one litre which is obtained by web scrapping and is cross checked with data from customer's mobile application and the trustworthy of particular pump is evaluated.

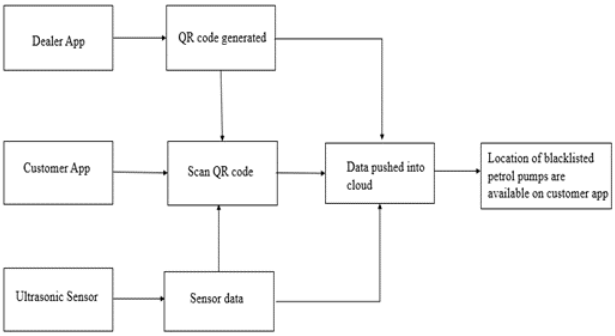

Fig.1. Architecture Diagram

7. System Implementation

A. *Module 1 - IoT system*

This module includes the setting up of the IoT framework and obtaining the readings from the ultrasonic sensor. The IoT framework mainly consists of the ultrasonic sensor (HC-SR04), Node MCU, LCD display, voltage regulator and batteries. The sensor measures the initial depth and the depth after the fuel is filled. The data is then passed on to Node MCU board which is programmed to find the volume change. The dimensions of the fuel tank are initially programmed onto the board and the depth change is used to find the volume change. It is then stored as a table format. That data table values are then passed to cloud and to customer android application. IoT system also consists of an LCD display, the current petrol volume in the tank is displayed in it.

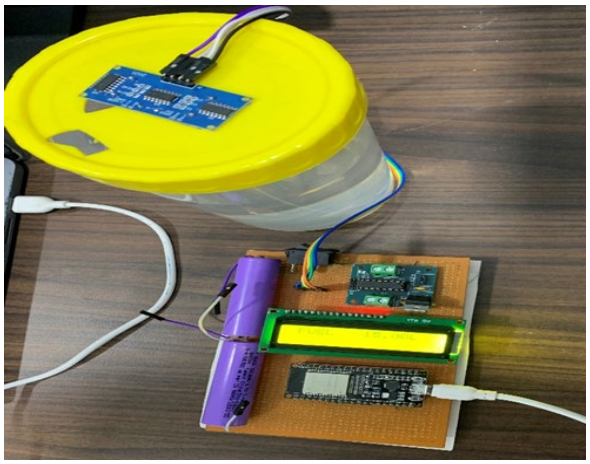

Fig.2. Sensor Implementation

B. *Module 2 - Web Scrapping*

Java program was written to perform web-scraping to obtain the latest required fuel rates. Module 'Json' is used to perform web scraping. Data taken from URL "https://fuelprice-api-india.herokuapp.com/'.

CITY	TODAY PRICE	YESTERDAY PRICE
Alappuzha	₹ 108.49	₹ 108.58
Ernakulam	₹ 107.72	₹ 107.61
Idukki	₹ 109.16	₹ 108.87
Kannur	₹ 107.95	₹ 108
Kasaragod	₹ 108.51	₹ 108.39
Kollam	₹ 109.03	₹ 109.11
Kottayam	₹ 108.36	₹ 108.10
Kozhikode	₹ 107.95	₹ 108.28
Malappuram	₹ 108.04	₹ 108.14
Palakkad	₹ 108.49	₹ 108.79
Pathananthitta	₹ 108.75	₹ 108.68
Thrissur	₹ 108.30	₹ 108.48
Trivandrum	₹ 109.42	₹ 109.42
Wayanad	₹ 109.03	₹ 108.50

Fig.3. Fuel Rates

C. *Module 3 - Android application*

Customer application: If not registered yet, go to Registration Page, enter Name, Password, E-mail id and Phone number. If already registered, go to Login page and enter username/ Email id and password. After Login Customer enters the amount of fuel he requested. He then scans the QR code generated by the dealer app and obtains the transaction details and verifies the amount entered by the dealer.

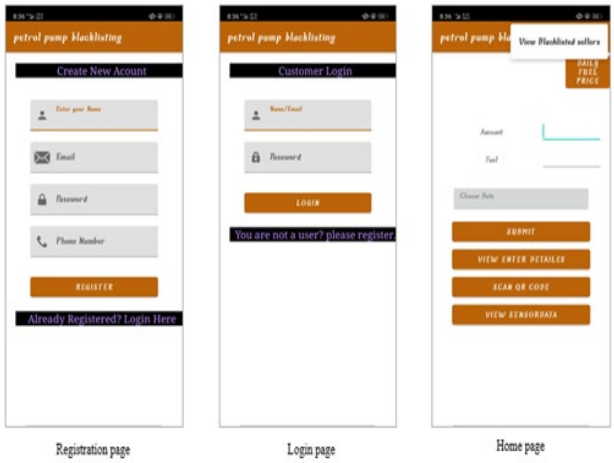

Fig.4. Customer App

Dealer application: If not registered yet, go to Registration Page and enter Petrol pump name, username, Password, E-mail id and District. If already registered, go to login page, enter mail and password. The app obtains real time rates of the petrol based upon the district the pump is located. For this purpose, we make use of web-scraping. QR code is generated with the following Name, transaction id, petrol price and amount to be fueled for. This QR code is then scanned by the customer by means of his app. If QR code is not generated, the petrol pump is blacklisted.

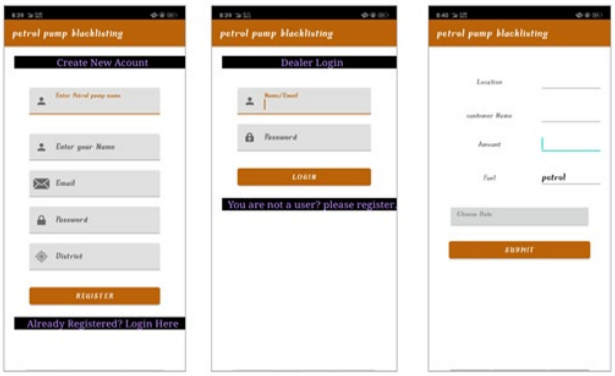

Fig.5. Dealer App

D. Module 4 – Blockchain

It consists of decentralized network of nodes where the data is stored. The reason for using blockchain is for the security and confidentiality it provides. We have tried to implement blockchain to store the data pushed from the dealer app into tamper proof blocks. Each transaction will be recorded as a block. Transaction Id along with the price entered by dealer along with the amount calculated by the sensor will be pushed into a blockchain. Each block will contain the SHA-256 hash value of its previous block. The 4 values are again hashed and stored in the block. If somebody tries to change the value of any one data, a Stored Procedure will be triggered which will recalculate the hash value. But since this hash value doesn't equate with the previous block's hash value stored in the next block the chain would be broken and the try would be failed.

8. Results

The outcome of the implementation of this project will be the blacklisting of the petrol pumps that using fraudulent methods. Furthermore, customers are empowered with the tools, helping them identify whether they are being cheated or not. If the dealer entered amount is as per the customer requirements, QR code is generated with transaction id, customer name, amount and date.

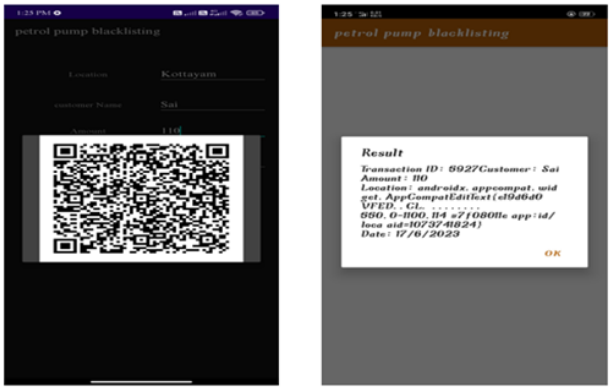

Fig.6. QR Code details

After fueling, If the petrol is not in the tank as per the amount suggested by the customer, then the QR code will not be generated and that petrol pump will be blacklisted which can be viewed by the customer through the customer app and it will mark on the google map. Therefore, the dealer doesn't able to make any fraudulent methods in the petrol pump.

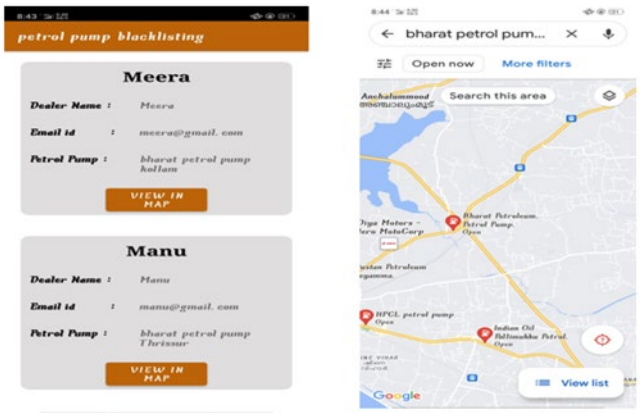

Fig.7. Blacklisted petrol pumps details and location

9. Conclusion

Petrol pump fraudulent methods pose significant risks to consumers, the fuel retail industry, and overall public safety. These deceptive practices, such as adulteration of fuel, short-measurement, calibration manipulation, false readings, unauthorized surcharges, and skimming, can result in financial losses, damage to vehicles, and a loss of trust in the industry. This paper proposes a method to blacklisting those petrol pumps make use of any tricks to reduce the amount of fuel pumped into the vehicle's petrol tank by means of IoT sensors and cloud storage. Blockchain ensures that the data cannot be tampered or manipulated and thus enhancing the safety and reliability of the process. Android application is used as the front end.

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