FUEL MONITORING ON TANKS FOR LEVEL DETECTION AND PURITY CHECK

Vivek Patil¹, Yash Belgaonkar², Vaibhav Shirwadkar³ and Varun Deshpande⁴

¹Assistant Professor, Dept of Information Technology,
S.I.T.R.C. Sandip Foundation, Nashik.
Email: {vivek.patil@sitrc.org, yashbelg07@gmail.com, vaibhav.s3037@gmail.com, varundeshpande8u@gmail.com}

Abstract
As the number of vehicles are increasing everyday, the demand for fuel is also increasing and this leads to the huge problem of fuel availability and as a result it encourages the petrol pump frauds. Most of the machines at petrol pumps are tampered in such a way that it shows the amount entered but the actual amount of fuel is much lesser than the desired amount. The petrol pump owner witnesses huge amounts of profits by cheating the customers. The vehicles in India consists of analog meters that are incapable of showing the exact amount and therefore it is not feasible for people to verify the amount of petrol that is being added in the petrol tank. In this project we are focused on creating a digital display that is capable enough to show the precise quantity of fuel and helps customers to verify the quantity of fuel they are paying at petrol stations. Adding more to this, the project tends to find the mileage of the bike which is a time engrossing and tiresome job to do manually by recording down the readings all the time.

Key Words : Precise volume detection for fuel; Ultrasonic transducer; Adulteration.

1. Introduction
In the recent time, everybody is talking about the increased fuel prices but the issue of fuel burglary at petrol pumps remain unaddressed which is equally important, according to officials, attendants at petrol pumps alters fuel by 80ml to 100ml per liter and to execute these things they use different techniques such as distraction, deviation, adulteration in petrol and by placing electronic chips in petrol filling machines to eliminate this plunder we must take count of petrol being filled at customer's side and our system focuses on device along with a mobile application which will do this calculations for consumer. There is no such system which can give exact measurements about petrol added in the tank with such precision. Our proposed technology is based on sensors and learning algorithms which will give a precise fuel that's being added vehicle with the existing fuel and that it will monitor at the same time; it will also calculate the distance that the vehicle can cover in the available fuel. The adulteration is checked by the properties of fuel, if its slightly varied then alert is to be passed to the user.

Our system will also monitor the condition of engine oil and it will provide alert to the vehicle user if an engine oil is needed to be changed; in many cases it has been observed that vehicles owned by private firms or government patrolling vehicles issue cash vouchers against hand written bills provided by the driver or the person who filled petrol at petrol pumps in company owned vehicles. They may provide false invoice with increased amount in cahoots with attendant at fuel station.

To avoid this we are maintaining logs and also providing text message to authorized person about exactly how much fuel is dispensed in the tank and location and information of fuel station where the fuel is bought.

2. Related Work
It has been observed that the fuel level in vehicles is not giving accuracy to utilize. The motive of calculating the precise fuel quantity is to display the statistical data on a fuel monitor rather displaying on tank level indicator. The other significant thing is to preserve the authenticity of the information which is going to display vehicle dashboard, the meters are to be trained that they must indicate when the fuel level goes to empty when the fuel level goes lower to a pre-determined level. These apparatus assembly does not guarantee to give an accurate level of fuel available in the petrol tanks. Likewise, such systems can't intimate the customers that they are getting conned at fuel pumps and they don't get the desired amount of petrol. So it winds up important to grow such a framework, that gives a precise estimation of fuel present in the fuel tank, so for this, we must first analyze the work of the existing system.

From the literature-survey the concludes of current technologies were Petr Petlach[1] proposed COTS sensors which were develop for ultrasonic level detection between 100KHz and 300KHz. To gain more precision and accuracy further experiments are carried out on COTS sensors. The propensity of the tank is examined and experiments are being carried out to meet this condition. Then Anwar Sadat [2] describe the
adulteration of petrol with kerosene. This method deals with the light that leads inside on optical fiber, in which the cover of a small length of the cable is removed, thus the fading wave deals with the analyte that states electronic technique to check the adulteration and it is beneficial in deciding the quality of fuel. And J. A. Goundar [3] describe that mechatronics design solutions have been solving practical problems of safety limit of low fuel and leakage of fuel lines in the tank.

3. Proposed System

In the current scenario, fuel gauge are use to detect fuel level and to display on fuel meter. It does not measure accurate amount of availability of fuel. There should be an precise way to display fuel availability. The frauds are become easy to do by using electronic chips in petrol filling machines and thus resulting in serious frauds. To overcome this problem we are going to compare incoming count of petrol to the consumer's vehicle. Also, it has been observed that people often forget to change their engine oil, which results in degradation of engine performance.

In the proposed system (Fig. 1), Printed Circuit Board is used in this system connected microcontroller. PCB is connected with fuel level detection module, adulteration testing module, and oil quality check module, also the GPS and GSM kit installed to PCB. Whereas, PCB connects to Bluetooth to access the network with the Android application. The calculation phase works on android application to display precise information to the user. The device notifies the owner about current status through SMS alerts.

4. System Modules

The proposed system were separated in modules for controlling task were bifurcate as follows,

- Fuel level Detection.
- Flow Module.
- Oil quality checking.
- Notification.
- Logs storage.

Fuel level Detection: In this module, Ultrasonic transducers are used which has sending and receiving nodes is transmit ultrasonic waves in specific time interval then receive those ultrasonic waves which are reflected from an object (refer fig. 3). The computing pulse in between receiving and transmitting are count in the form of delay is used to identify the accurate mapping of the object. This concept is used to measure the exact location of the object by the ultrasonic sensor.

The same technic can be used to determine the depth or level of filled petroleum in a tank. Thus level detection module transmits an acoustic wave towards the surface of the fuel in the tank (refer Fig. 2). Then by receivers node, the ultrasonic echo pulses which are reflected from the fuel surface is then converted from acoustic pulses to an electrical pulse.

The PCMS process the electrical pulses from the ultrasonic transducer and performs fuel quantity measurements and then this data will be display on LED mounted at the speedometer and in the application.

Flow Module: The liquid flow sensor is used and its made of a plastic body, contains input and output valve, liquid turbine, and hall-effect electrical conductor.
when the fluid flow by flow module, it gives outputs in corresponding pulse Signal. This module is fixed at the fuel tank cap so that the flow rate sensor will provide an accurate amount of fuel being added in the tank when fuel passes and give motion to the rotor.

3) Oil quality checking: The oil quality module is concerned with the checking of oil quality in case it needs to be changed. This feature will notify the user when its time to change the engine oil. The module works with the IR rays which examine the density of oil and accordingly decides

4) Notification: If notification module deals with notifying the user and giving updates about the fuel entry. Whenever there is an update over old entry the user will get notified about the new entry. Sending notifications to the user is the easiest way to stay connected with the user. Notifications will be sent using an android application that will be installed in the user's phone.

5) Logs storage: All the logs will be stored using cloud and accessible whenever the user demands for it. Logs can be useful to the user because as we know there is travelling allowance provided by the companies, thus it can be useful to the users as well as companies.

5. Mathematical Model

The operations of pcms depend on various constants. The set theory contains mathematical phrasing used in the proposed system are as follows:

PCMs = {Q,Σ,δ,q0,qF}
Q = {q0, q1, q2, q3, q4, q5, q6, q7, qF}
Σ= {yes, no}
q0 = {Start Operations}
qF = {Stop Operations}

are as follows, Start state(q0),Current fuel level(q1), Alert if low(q2), Measure dispensed/Incoming amount of fuel in tank(q3), newly added fuel(q4), Oil Quality check(q5), Alert if low(q6), Maintain logs of fuel transaction(q7) and Final state/stop(qf).

Fig. 5 : Flow Rate Sensor

Its movement in proportional to the fluid flowing rate. And it will provide data in the form of pulses using circuit we can convert those pulse signal into digital form. And this output will be sent to LED display and application.

Fig. 6 : Mathematical Model

| States | Inputs |
|--------|--------|
| q0     | {q1,q3,q5} | {qF*} |
| q1     | {q2} | - |
| q2     | {q3,q7} | {q1} |
| q3     | {q4} | - |
| q4     | {q7} | {q3} |
| q5     | {q6} | - |
| q6     | {q7} | {q5} |
| q7     | {q3,qF*} | {q1,q5} |
5. Results

We have implemented our system using ultrasonic sensors and arduino for accurate level detection of fuel in fuel tanks of vehicles. An ultrasonic sensor is capable of emitting as well as receiving ultrasonic waves at both the ends which is done using speaker and microphone. It measures the level by measuring the clock cycles of sound to return back from the fuel.

![Fig. 7: Implemented Model - 0.1](image)

By using the API level 21 i.e. Android 5.0 (LOLLIPOP) we are combining the results obtained from the output of ultra-sonic sensor and we displayed it using an android application.

![Fig. 8: Output](image)

**Table Results**

| Desired Output | Actual Output |
|----------------|---------------|
| Flow Module    | Level Module  |
| 0.100 L        | 0.100 L       |
| 0.250 L        | 0.250 L       |
| 0.500 L        | 0.500 L       |
| 1.000 L        | 1.000 L       |
| Flow Module    | Level Module  |
| 0.102 L        | 0.102 L       |
| 0.249 L        | 0.148 L       |
| 0.500 L        | 0.500 L       |
| 0.999 L        | 1.001 L       |

As a result, the level module has achieved the accuracy of +- 2ml per liter i.e. 0.002L. We get precise value when the pressure of petrol through the flow sensor is constant.

6. Conclusion

We conclude that there can be different technologies that are used to improve the accuracy of obtaining the exact level but they tend to be self-serving and do not interact much with each other. In our project, scenario is different as we combine different technologies to get the best results. This helped us to procure the precision that we thought of.

Additionally, a combination of all these advancements is not an overwhelming task and can be effectively completed. Looking towards further changes and modifications in case of more enhancements, the data stored can be used as a platform for future plans and new strategies at any instance of time. Further changes will be made to make this system less costly and more firm for deploying in different types of vehicles.

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