Fuel Theft Alarming System

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Abstract: In this modern era, automobile vehicles have become a necessity. With the increasing demand of automobiles, there have been a drastic increase in cases where fuel stations cheat the customers by not filling the correct amount of fuel in the vehicle. They adopt various techniques to fool the customer by not filling the specified amount. In this project we aim at eradicating fuel theft by making the indicators digital so that it can help us know the exact quantity of fuel available before refuelling and after the refuelling is done. The quantity of the fuel available and the quantity filled in the tank can be displayed digitally with the help of sensors.

Index Terms: Arduino Uno, Fuel Theft, Digital Fuel Meter, Ultrasonic sensor, Flow sensor, Load cell.

I. INTRODUCTION

In recent days everything is digital. In some of the vehicles, digital fuel meters have been implemented, but they do not show the quantity of fuel which is present or which is filled in the tank. In recent times we are hearing about the theft in fuel a lot. There are a lot of news regarding the petrol pump frauds as there is a small difference between the amount of fuel that has been displayed on the meter and the fuel that has been actually filled in the tank. Most of the times the displayed value is greater than the actual filled value. All this happens because of the cheating arrangements done in the machine for the benefit of the owner. In analog meter display, people are not able to find the accurate value of the remaining fuel. So we propose this project to avert the fuel theft by using various sensors like flow sensor, ultrasonic sensor and load cell. By using ultrasonic sensor and load cell, we can get the measured value of fuel filled when the engine is in rest condition. We can make a digital fuel meter which is used to display the level of fuel available/filled digitally with accuracy. By using these sensors, we can measure the amount of fuel in the tank after refuelling which can be displayed in the LCD for demonstration purposes. (Liquid Crystal Display).

II. METHODOLOGY

The system is designed using ultrasonic sensors which is fixed on the top of the fuel tank at multiple points for monitoring the amount of fuel level at various instances from various points. This has been done because the fuel is not stable inside the fuel tank and in order to receive accurate results as far as possible. The specifications of the fuel tank has been pre-loaded in the system. The change in distance through the ultrasonic sensor will give the amount of fuel filled in the car based on the standard defined and the change in the weight of fuel tank will give the amount of fuel added considering the fact the fuel density is constant. The system of ultrasonic sensor and load cell works in synchronisation with the flow sensor which is used for detection of fuel flow into the tank.

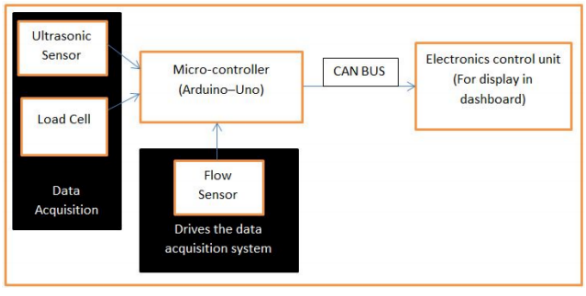


Figure1: System Representation

III. WORKING

The Digital fuel metering device works on 12 volts supply from the vehicles battery. It only starts working once the petrol lid is open otherwise the device is in off state. One must make sure that battery isn't turned off while refuelling for usage of the device.

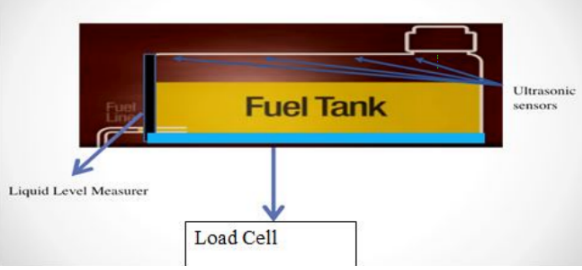


Figure 2: Fuel Tank Block Representation

The step by step working of system is as follows:

•The device starts its operation when the car opens its petrol lids.
•Once the petrol lid is open various sensors attached start collecting the data for initial level of petrol which is before refuelling.
• Data collection process continues till the time flow sensor does not indicate any flow of fuel or if it exceeds a time span of 2 minutes.
•As soon as flow of fuel starts the sensors stop collecting data and process the recorded data according to statistical algorithms applied on the data and take out the closest possible value to initial level of fuel with an deviation possibility.
•As soon as flow sensor indicates no flow of fuel for a time span of more than 5 seconds then again the data from various sensors is started collecting till the time petrol lid is closed and up to 3 seconds after that the data is collected.
•We calculate the final fuel level using our statistical algorithms and calculate the difference between initial and final levels with an error percent and pass on the volume to user for further verification.

IV. SENSORS

1)Flow Sensor: A Flow sensor is used to measure the flow rate of the fluid. The flow sensor used here is YF-S201.The sensor contains a pinwheel sensor which is used to measure how much liquid has moved through it. The sensor uses electromagnetic fields and acoustic waves to measure the flow of the fluid. We have used this sensor here to detect the flow of liquid if it exists or not. We initiate and stop the data acquisition system on the basis of flow sensor.

2) Ultrasonic sensors: Ultrasonic sensors measure the distance by using ultrasonic waves. The ultrasonic sensor used here is JSN-SR04T.It is placed at the top of the fuel tank. The head of the sensor emits an ultrasonic wave and receives the wave reflected by the target.

The sensor measures the time between the emission and reception and hence the distance to the target is measured by the equation D = (T ∗ C)1/2 where D is the distance, T is the time between emission and reception and C is the speed of ultrasonic wave. Ultrasonic sensors are used here because of its high accuracy with the measurement resolution of 0.2mm, high stability, easy installation, strong reliability and resistant to dust and mist.

3) Load Cells: This sensor is a transducer that generates an electrical signal whose magnitude is directly proportional to the measured force. The load cell can be used because of its easy availability, better accuracy which is less than 0.1(percent) of the full scale and resistant to chemical reactions with petrol and diesel. The load cell is placed at the bottom of the fuel tank and as the fluid level increases in the vessel, the weight on the load cell increases. The amount of the fuel added can be measured by calculating the difference between the initial reading i.e. weight of the fuel before adding the fuel, and the final reading i.e. weight of the fuel after adding the fuel. The density is usually expressed in kilograms per cubic meter. Hence, greater the density, greater the mass of the fuel. Fuel density is used to calculate fuel volume ratio which is then used to calculate the tank mass.

V. STATISTICAL ANALYSIS

For estimating the data, we are going to use two methods, first 'mean' or 'average', which has been given by

observation	value(litre)
1.	L1
2.	L2
3.	L3
4.	L4
.	.
.	.
N	LN

Mean= (value of observation / total number of observation)

$$\text{Mean} = \frac{(L1+L2+L3+\ldots Ln)}{N} \quad (1)$$

Second Method that we are going to use is the Standard deviation about the mean.

Firstly, we are going to calculate the mean of the data. Then we going to find the deviation along the mean which is calculated by

d1=|x-x1|
d2=|x-x2|
d3=|x-x3|
.
.
.
dn=|x-xn|

For calculating the Standard deviation we will use

$$SD = \frac{\sqrt{d1\text{^}2 + d2\text{^}2 + d3\text{^}2 .... dn\text{^}2}}{\sqrt{N-1}} \quad (2)$$

The uncertainty of the average value is the standard deviation of the mean, which Is always less than the standard deviation.
Applying this method to our proposed model. We are measuring the value of the fuel and sending to the Arduino to for further processing.
Firstly, we are taking the initial reading of the tank with the some initial fuel present in the tank.

Observation	Value(cm)	Observation	Value(cm)	Observation	Value(cm)
1	6	11	5	21	8
2	7	12	7	22	6
3	8	13	8	23	7
4	7	14	8	24	8
5	6	15	6	25	7
6	8	16	8	26	7
7	9	17	9	27	7
8	7	18	6	28	7
9	6	19	6	29	7
10	9	20	6	30	7

Final reading of the tank after the fuel is filled in the tank

Observation	Value(cm)	Observation	Value(cm)	Observation	Value(cm)
1	12	11	14	21	14
2	13	12	15	22	12
3	13	13	16	23	14
4	13	14	14	24	13
5	14	15	15	25	14
6	12	16	14	26	14
7	11	17	15	27	15
8	13	18	13	28	14
9	14	19	14	29	14
10	15	20	11	30	14

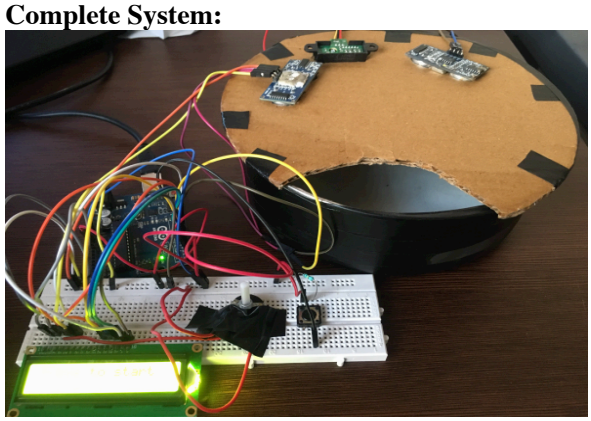
Mean of the initial reading is =7.1 cm
Mean of the final reading is =13.6
Now applying the Standard deviation to this:
SD for the initial value=0.18784929151274
SD for final value=0.22658551623

Now we will feed the arduino with the values of the standard deviation of the initial value and final value, and mean of the initial value and final value.

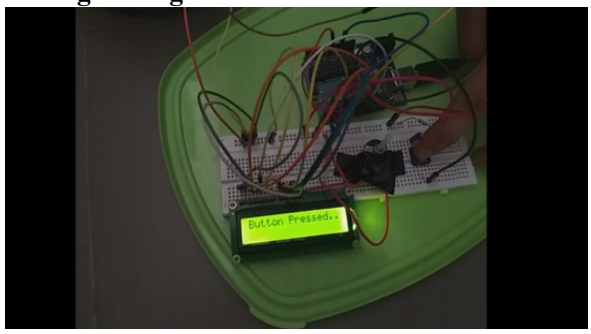
According to the algorithm present in device and the given (length, breadth and height) of the tank, in the device it will calculate the amount of the fuel which is been filled and with the percentage error in while calculation of the fuel.

VI. RESULT ANALYSIS

Complete System:



During Testing :



CONCLUSION:

In this paper, we have identified the problem of fuel theft and have proposed a solution for it. Our proposed solution aims at calculating the difference between the initial reading and the final reading, where the former stands for the reading before the petrol is filled in the tank and the latter stands for the reading after the fuel is filled in the tank. A system will be initiated as soon as the lid of the tank opens and will take initial readings, after filling of the fuel, the system will again take readings for the next three seconds giving it time to become stable. The difference in the amount will be displayed on the screen helping us identify if there was any fraud. For this we have installed sensors such as ultrasonic sensors and infrared sensors in our devices. The accuracy of the device fluctuates depending upon the stability of the petrol at that point of time varying from 20ml to 50ml. This way we detect the amount of fuel that was filled in the tank, and are able to identify any frauds attempted by the fuel station. Seeing the rising prices in the fuel, we feel that problem of fuel theft needs to be

addressed and a viable solution for it needs to be found. We aim at installing this device in each and every vehicle and eradicating fuel theft in India. For future, we plan on installing sensors in our device which could provide us with more accurate and precise results, which will result in a more efficient and error free device . Our prime concern is to wipe out petrol theft completely with the use of our device.

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