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Review Paper on Fuel Flow Meter

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Abstract

This paper reviews five types of fuel flow meters based on parameters like efficiency, cost-effectiveness, accuracy and durability. These five fuel gauges are selected as they are currently the best options available. Each fuel gauge is extensively scrutinized with the aim of meeting the current needs of the automotive and aerospace industry.

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1. Introduction

A fuel level detector is a device that measures the amount of fuel present currently in the vehicle. There are many flow meters currently in use, but yet there is not a single meter which has

1. High accuracy (of up to 95%)
2. Low cost
3. Lightweight
4. Simple but robust construction
5. More durability

People are still searching for a meter with all the above characteristics. Such a pump, if and when designed, would revolutionize the automotive and aerospace industry. Currently, there are many different ways to design the fuel level detector, but most of them have several faults that decrease the accuracy of detectors' readings.

Precise readings are necessary as they give the driver the exact amount of fuel left in the storage tank.

Another major concern is regarding the size of these meters. Many of them are huge in sizes and occupy a lot of transient vehicle space.

2. Research

I researched and studied many flow meters and selected these five as they almost satisfy our ideal fuel gauge needs.

2.1 Digital fuel level indicator in two-wheeler along with the distance to zero indicator

In this meter, the analog reading, which is supposed to be directly used in conventional meters, is fed to the A-to-D converter. This helps to overcome the uncertainty of analog data and gives us the result in the exact digital form. Its working consists of input being provided to the microcontroller. This microcontroller processes the data to provide the result in the form of the distance that can be covered by the amount of petrol present in the tank. It considers approximately 49-51 km as its standard mileage for the vehicle. The Analog to digital converter considers unit-litre fuel as its datum. It cannot sense fuel quantity when it is less than a litre. The accuracy level is up to 95 – 98%. The error is around ± 0.2 litres.

Fig1: *Digital flow meter, reference from Google images*

2.2 Flow Meter and Arduino-Based Fuel Gauge

This system digitally displays the level of fuel inside the tank by using a load sensor, flow meter and vibration sensor. These sensors are interfaced with a board Arduino. The meter collects the information from the load sensor, pump, and vibration sensor and sends it to the meter. It then accordingly shows the reading on a 1682 LCD.

Fig2: *Arduino-based flow meter, reference from Google images*

2.3 Modified Type Intelligent Digital Fuel Indicator System

This is an intelligent system which works entirely on sensors. Many sensors are used in this system to measure various parameters like speed, displacement, and acceleration.

Sensors like brake caliper sensors and air conditioning sensors are also used.

The three main components of the system are ECU, CPU and modulator.

The different sensors are situated at different locations in the vehicles.

The sensors sense the data under various conditions.

The data from all the sensors is collected at Electronic Control Unit.

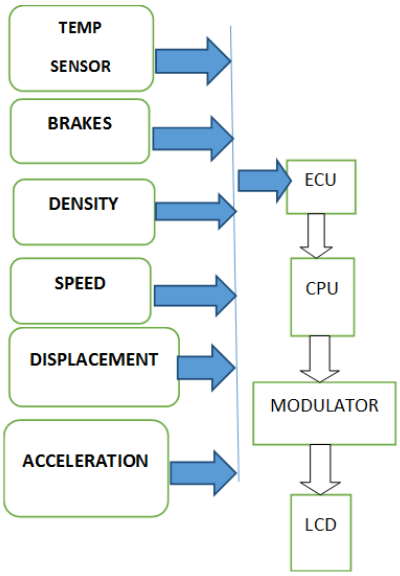

Fig3: *Flow chart of the working of the meter*

This data is then sent to the CPU, where it gets computed and sent to the modulator.

The modulator modulates the data, and finally, it is displayed on the meter screen.it is displayed on the meter screen.

Sensors are also used to calculate the exact losses due to various parameters.

2.4 System and method for measuring a fuel level in a vehicle fuel tank patent/US7865317US

This meter considers dynamic conditions of fuel flow, like splashing and sloshing. It has different working for different road conditions. A conventional sensing system is used when the vehicle runs under normal conditions. During a change in road conditions or change in driving conditions like acceleration, manoeuvring, inclination, system employees more suitable techniques. One such technique is considering the exact combustion of fuel. This is done by installing the sensors on the fuel injectors. This gives the exact reading of the fuel consumed, which is then subtracted from the previous fuel reading. The working of the meter is explained below with the help of a flow chart.

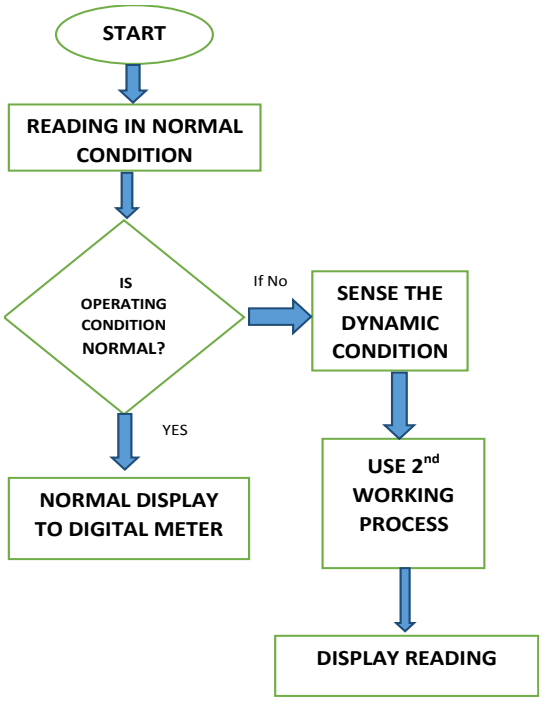

Fig4: *Flow chart of the working of the meter*

2.5 Prototype Model for Liquid Detector Optimizer

This fuel meter compares the fuel readings shown on the petrol pump and the amount which actually enters the vehicle. Initially, it weighs the fuel tank with the amount of petrol already in it. Then the user has to give input about the fuel density and the amount of fuel to be inserted into the vehicle fuel tank from the pump.

As the fuel is being filled into the fuel tank, the microcontroller compares the volume at every instant. When the desired reading is finally obtained, the buzzer rings and the drivers know the exact amount of fuel filled in the vehicle.

If the buzzer does not ring, it indicates that there is some difference in the amount of fuel that is supposed to be filled and the amount that is actually put into the vehicle tank.

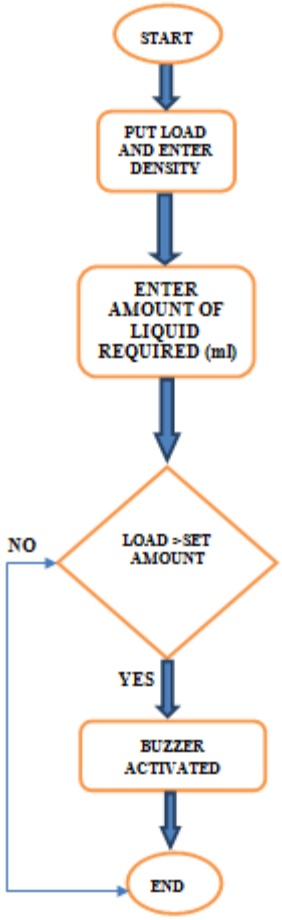

Fig5: Flow Chart of the working of meter

3. Review

After studying all the different meters, the main problem I identified is that the fuel that leaves the petrol pump is measured only by the digital meter on the petrol pump and the fuel meter on the vehicles. Thus, there may be some losses between the pump line and the vehicle pump. These losses may be due to some inherent faults in the line or due to purposely made arrangements to supply less fuel to the customer. The fuel after reaching the vehicle pump is not measured; hence, no direct comparison is made between the two readings since the vehicle meter is mostly analog.

As a solution to this problem, many intellectuals designed different pumps, but none could implement those and apply them to vehicles.

The first meter gives the readings of the distance that could be covered with the available petrol, but this does not solve our issue. The analog to digital converter considers unit litre fuel as its datum. It cannot sense fuel quantity when it is less than a litre.

The second Arduino-based fuel meter is large in size and could not easily accommodate the vehicle. It also requires many sensors making the construction bit confusing. Nevertheless, other than these two factors, the meter is almost perfect.

Thus, these two meters are more reliable to use than conventional systems.

The third intelligent fuel digital system has advantages similar to the second one. As it has many sensors situated at different locations, we get precise readings on display. However, using many expensive sensors adds to the manufacturing cost making this system practically unaffordable. These sensors also make the construction delicate and confusing and increase the risk of sparking inside the vehicle. So this sensor is risky to use.

The fourth system is a patent by a major US company. Its primary advantage is that it considers all the vehicle's dynamic conditions. It changes its working according to the road conditions. It could not be implemented in the vehicle because the system needs constant inputs of the fuel density. It also needs other inputs at its various stages of working. So it is not yet implemented in the vehicle.

The fifth prototype meter is the most accurate of all the above. The buzzer helps the layman to know quickly about the fuel input in the vehicle. However, the meter requires inputs like density value at various stages, disturbing the driver. After some modifications, this can be a 'fit to use' meter.

This shows that though some of the meters are good to use, the ideal one is yet to be designed to satisfy all the aforementioned needs. The accuracy of all the above-stated meters is almost 90% which could still be increased. Installing a meter with less accuracy in the automobile is of lesser use. Less accurate meters lead to errors in readings and ultimately loss of petrol and money to the customer. The meter should also be readable to the non-technical person and user-friendly.

There are many fuel measurement systems available depending on various phenomena. We can make a suitable meter based on any phenomenon that would work better than others. This project is essential as we can directly save fuel, help our economy to grow and serve our people better.

4. Conclusion

The fuel flow meters reviewed in this paper are the best available currently, but still, they have many issues regarding their accuracy, size, cost and durability.

Thus, there is an urgent need to design a cost-efficient fuel flow meter with better overall characteristics.

Thus, extensive research in this field is the need of the hour.

Future Endeavors

Advance developments may also include systems which would indicate the exact distance that could be covered by the fuel available in the tank. This will help to calculate and compare the average that vehicles give.

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