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Intelligent Petrol Tank Monitoring

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ABSTRACT. *This article describes a highly intelligent system to measure the flow of petrol into the petrol tank. This approach utilizes ultrasonic flow meter to measure the rate of flow of petrol into petrol tank. The proposed system displays the total volume of petrol that is being inlet into the petrol tank. This also displays the various parameters such as temperature of petrol that is being inlet into the tank. The system also indicates the level of petrol in the petrol tank.*

Keywords: Doppler effect, Floating-point arithmetic, Fluid flow, Fluid flow measurement, Ultrasonic transducers, Volume measurement.

1. **Introduction.** A *Petrol* or *Gasoline* is one of the transparent liquids, which is a petroleum derived product. It is most commonly used a fuel in Internal Combustion Engines which are installed in all most all the vehicles. It is an Organic compound. It is obtained by the fractional distillation of petroleum. Such type of processing is done in Oil Refinery. As said earlier, it is used as a fuel in Internal Combustion Engines. For day-to-day life, petrol is commercially available in petrol bunks. In all the petrol bunk, the amount of petrol entering into the petrol tank is displayed. But it can be controlled by the external factors and adjust the display and customers can be cheated. Thus, there occurs the necessity to propose a system that monitors the volume of petrol entering the tank.

Thus, the proposed system utilizes a ultrasonic flow meter to measure the flow rate of petrol via the tube, so as to measure the volume that is entering the petrol tank. In addition to monitoring the petrol entering the tank, the proposed system also monitors the level of the petrol in the petrol tank and provides an indicator. The whole system is operated with the help of the 8051 microcontrollers.

2. **Literature Survey.** *"Design and calibration of a fuel consumption measurement system for a diesel tractor Maintaining the Integrity of the Specifications"* by H. Fathollahzadeh, H.

Mobli , A. Jafari D. Mahdavinejhad, S.M.H. Tabatabaie. This system utilizes the Flowmeter to measure the rate of consumption of fuel, so as helps to study the running condition of vehicle. The above studied paper monitors only the fuel consumption system. It does not tell us the amount of petrol that is being inlet.

3. **Proposed System.** The proposed system consists of Ultrasonic Flowmeter, which is used to for volumetric measurement of rate of flow of liquid. It is placed at the inlet of the petrol tank. An Ultrasonic Flowmeter is one of the prominent type of a Flowmeter, the helps us to measure the velocity of liquid and also the rate of flow of liquid in volumetric terms. Hence is gives the amount of liquid that is moving per time. It uses the ultrasonic transducers, to measure the velocity of propagating liquid by calculating the differential transit time of pulses that are transmitted into and against the direction of flow of liquid, or by measuring the frequency shift from the Doppler Effect.

Figure 1. Practical Ultrasonic Flowmeter

Here the two basic parameters that can be calculated are,

- Velocity of flow
- Volumetric flow

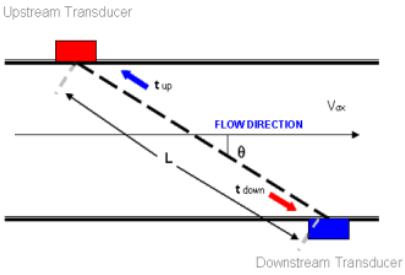


Figure 2. Inner structure of Ultrasonic Flowmeter

The differential transit time of ultrasonic pulses propagating in and against the direction of flow is used to calculate the velocity of the flow, which is shown below:

$$v = \frac{L}{2Sin\alpha}\frac{tup - tdown}{tup.tdown}$$

Where,

v is the average velocity of the fluid along the sound path,

L is the distance between receiving and transmitting transducers,

tup and $tdown$ are two transit times,

α is the inclination angle.

Now the volumetric flow is given by the following equation,

$$Q = v.A$$

Where,

Q is the Volumetric flow,

v is the Velocity of flow, and

A is the cross sectional vector area or surface area.

This above equation is applicable only for flat, plane cross sectional area. In general cases, including the curved surfaces, it becomes the surface integral. Hence the equation becomes,

$$Q = \iint_A v.dA$$

This can be expressed as,

$$Q = v.ACos\theta$$

Where,

θ is the angle between the velocity vector v and unit normal vector n.

Normally, in our case of consideration the angle θ becomes 0^o, and hence the equation becomes,

$$Q = v.A$$

Also, we can relate the volumetric flow with density and hence we can calculate the mass flow of the fluid. Here the fluid taken into consideration is the petrol and hence its density,

ρ = 719.7 kg/m^3 ; 0.026 lb/in^3; 6.073 lb/US gal; 7.29 lb/imp gal.

Hence the Mass flow rate is given by,

$$m = v.\rho \text{ Kg/s}$$

Thus, the volumetric flow of the fluid (i.e) petrol is calculate using the Ultrasonic Flowmeter.

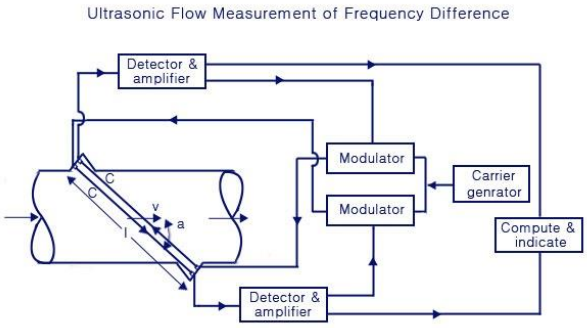


Figure 3. Frequency difference measurement

The system consists of a 8051 microcontroller to control the operations of the proposed system. Considering this volumetric flow as a Floating point value, it is stored in the General Purpose Registers (GPR) of the 8051, say R1.

IN P0

MOV R1,P0

Also in this proposed model, it needs a digital stop clock to calculate the time of flow of the fluid, so as to calculate the total volume of petrol that is entering into the tank. This stop clock can be constructed using the counters of 8051 microcontroller. The system consists of motion sensor inside the tube which is connected to the Port 1 (P1.0). Thus this pin acts as a reset pin for the stop clock and hence the value of the stop clock is converted into second format and it is stored in the temporary registers, called General Purpose Registers of 8051, say R2. Also the above value of stop clock is considered as floating point number.

Hence the total volume of the petrol that entered into the petrol tank is calculated using the following c code, from which Hex file can be created and loaded into the microcontroller.

```
Void floatmul()
{
    float R1,R2, R3;
    R3=R1*R2;
}
```

This multiplied value gives the total volume of the petrol that entered into the petrol tank. Now the LCD display is interfaced with the 8051, so as to display the volume of inlet petrol to the consumer.

Also this system consists of sensors on the inner surface both at top and bottom of the petrol tank, so as to indicate the level of the petrol in the tank. The sensor at the top is

connected to P2.0 and the sensor at the bottom is connected to P2.1. So this is further connected to LED with buzzer indicator to intimate the consumer.

When P2.0 is set, the Red LED with Buzzer which is connected to P2.2 is Set.

```
LOOP1:  JNB  P2.0,LOOP1
        SETB P2.2
```

Also, when P2.1 is set, the Yellow LED with buzzer is connected with P1.3 is Set.

```
LOOP2:  JNB  P2.1,LOOP2
        SETB P2.3
```

Hence, the system indicates the consumer when the level of petrol in the tank is in the exhausting level and it indicates when the tank is to be filled with the petrol.

The system also has a temperature sensor, which is place in the inner surface of the tank. This value is sent to the microprocessor via the input port, and it is displayed in the separate LCD Display.

```
IN P2.4
MOV R4,P2.4
```

Here the value in R4 is sent to the LCD Display.

4. **Flow Diagram.**

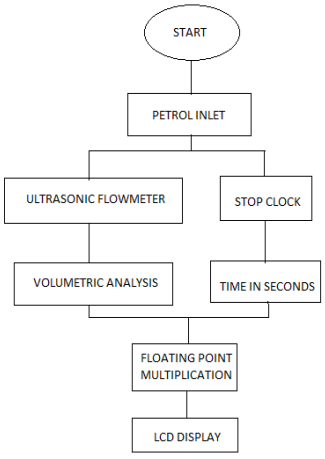


Figure 4. Flow Diagram of the Proposed system

5. **Prototype Model.** The proposed model which is discussed above is placed at the entry point of petrol into the petrol tank. Here the microcontroller is operated from the supply that is available from the battery of the vehicle which is inbuilt in the vehicle.

Here the proposed model is connected to the sensors which are also discussed above. Thus the following diagram shows the complete prototype of the proposed system.

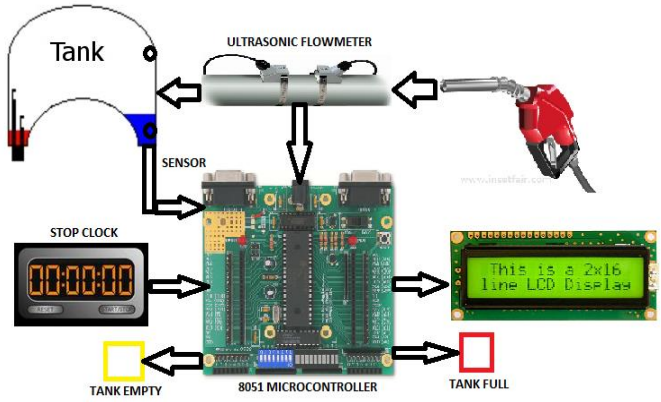


Figure 5. Prototype model for proposed system

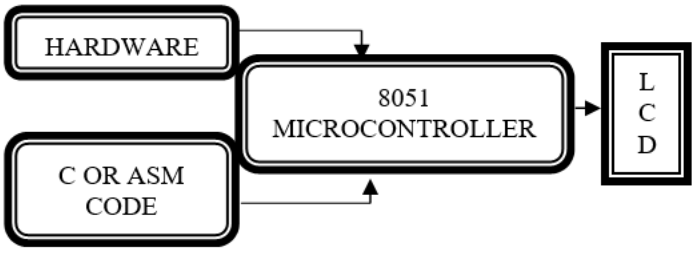
6. **Experimental Setup.** The components used to design the proposed system are as follows:

- Ultrasonic Flowmeter
- 8051 Microcontroller
- Level monitoring sensor
- Temperature sensor
- 16 X 2 LCD Display
- LED's
- Buzzer

Here the microcontroller is needed to be loaded with the operating logic, so as to obtain the optimum operation of the proposed system.

Here the required operating logic can be either written as 'C' Coding or as ASM Coding. These coding are written in Keil C. Then these codes are converted into the HEX file (i.e) hex file is created from the C Code or ASM Code. Then this file is loaded into the 8051 microcontroller using the Flash Magic Software.

Here for simulation purpose, we use NI Multisim so as to simulate and verify the optimal operation of the proposed system.



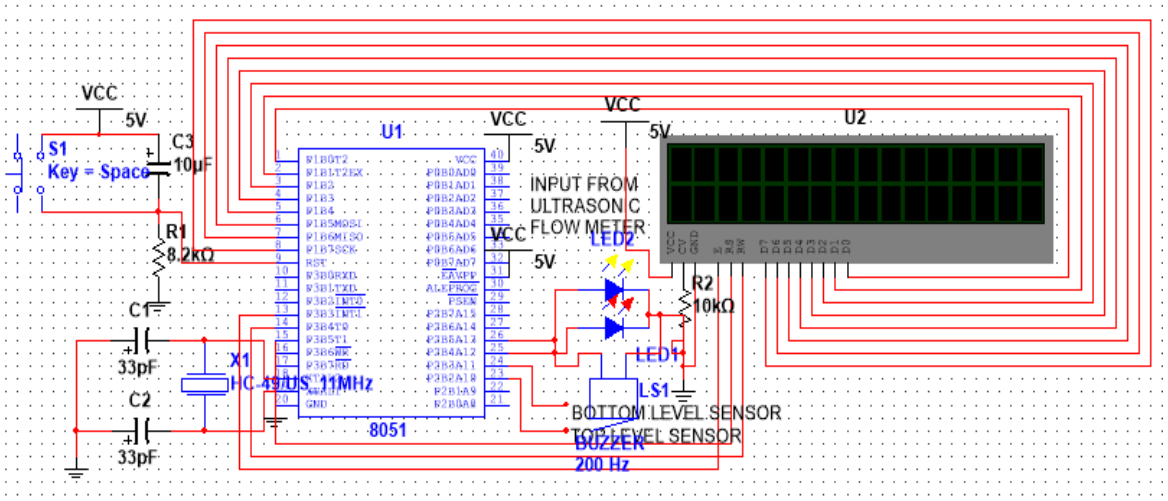


Figure 6. Capture scress of simulated proposed system

7. Conclusion. Thus, the proposed system intelligently monitors the flow of petrol into the petrol tank. Today no such system hardly measures the volume of petrol that is entering the petrol tank. This system safeguards the consumers from being cheated. Moreover, this system also indicates the Temperature inside the petrol tank, so as to indicate in case of any fire. Also, the proposed system monitors the level of petrol in the petrol tank. Thus, it indicates the consumer either when the volume of petrol in the tank is decreasing of when the tank is full. Also, the cost of the proposed system is reasonable and hence the proposed system is much efficient to monitor the petrol flow into the tank.

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