Automatic Fuel Checker and Theft Indication for Automobile

Krishna Wattamwar[1], Tushar Belpatre[2], Dasharath Karade[3], Prof. Manish A Dudhedia[4]
[1, 2, 3, 4] Department of Electronics and Telecommunication
[1, 2, 3, 4] MMCOE, Pune

Abstract- *It is a simple device which is used to predict the fuel theft in vehicles. Fuel theft is often occurs in the parked vehicles. Due to this heavy fuel loss occurs to the owners of the vehicles, since it is in great demand and expensive one. Fuel theft is often carried out by the strangers as well as drivers. In earlier days fuel theft device is only capable of sensing the theft. So it can only sense the theft and it cannot be blocked. In order to avoid this drawback we have designed new simple device which can sense as well as detect. In this device we are using GSM modem to send message to particular owner of vehicle. We are using principle of Hall Effect sensor mechanism in the fuel inlet tube. We are using two sensors in fuel inlet as well as to check the filled fuel .We are using control circuit in which we have transmitter and receiver by which we can receive signals in case of fuel theft.*

Keywords- Low cost sensor, Hall Effect sensor, Rotation of rotor, GSM, ARM7 (LPC2138), Theft indication, Keil software.

I. INTRODUCTION

The petroleum products are one of the valuable and rare creations of the nature. The proper use and distribution is important task to survive these products. Our system may be the first approach towards security of petroleum products distribution such as petrol, diesel, and kerosene etc. the project we have developed. This will use to provide security to the fuel distribution and helps the data keeping of the distributed fuel. The advancement of the project to large scale can help financially to the industry indirectly. The main purpose of our project satisfies all the needs related to secure distribution of the industrial products.

In the present days vehicle fuel theft is one of the main concerns of many bike owners and car owners. Many times we have heard or some of us have already faced that petrol from their bike or cars has been stolen. Main intention of this detector is to avoid such situation. It is simple, cost-effective solution is proposed here, by which vehicles fuel security is maintained while the vehicle owner is anywhere across the globe. This model detector has a GSM modem which sends SMS to owner of vehicle when there is fuel theft going on.

These technologies need to be small, economical and consume a minimal amount of power. GSM technology is being used extensively in hand-held devices and wireless computing because of its characteristics. This project aims to use GSM technology to monitor security of fuel. This system is an upgrading and improving vehicle security system by integrating SMS features to alert vehicle owners whenever intrusion occurs. The system is made up of a GSM modem, ARM7 LPC2138 microcontroller, LCD16X2 and a power supply unit. The fuel detector involves hardware and software parts construction and the integration of both parts to create the system.

II. SELECTION OF SENSOR

Flow sensors, the devices that detect and measure water flowing through pipes, are becoming necessary components of efficient irrigation systems and mainly acts as a sensory organ for the brain in the irrigation controller, giving it information to make operating decisions. Flow meter basically works with the output of the flow sensor. In this system in order to calculate the flow the rotor surrounded by a magnet along with the Hall Effect sensor is used. This is known as water flow sensor. As the water flows through the rotor. Magnetic field is produced and accordingly an Ac pulse is generated which is then converted into the digital output with the help of Hall Effect sensor. The number of pulses generated per liter can be counted by the software programming. Thus pulses produce an output frequency which is directly proportional to the volumetric flow rate/total flow rate through the meter. Also measuring flow rate through rotating rotor provides high accuracy, excellent repeatability, simple structure and low pressure loss.

This sensor sits in line with water line and uses a pinwheel sensor to measure how much of liquid has moved through it. The pinwheel has a little magnet attached, and there is a Hall Effect magnetic sensor on the other side of the plastic tube that can measure how many spins the pinwheel has made through the plastic wall.

Water flow sensor consists of a plastic valve body, a water rotor, and a Hall Effect sensor. When water flows

through the rotor, rotor rolls. Its speed changes with different rate of flow. The Hall Effect sensor outputs the corresponding pulse Signal.

The sensor comes with three wires: **red** (5-24VDC power), **black** (ground) and **yellow** (Hall effect pulse output).

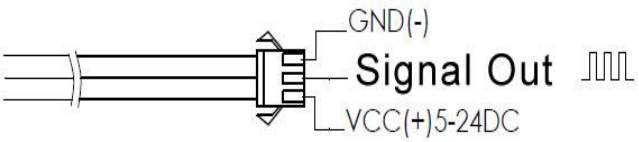

Fig 1: Wiring diagram of Flow sensor

By counting the pulses from the output of the sensor, you can easily track fluid movement each pulse is approximately 2.25 mm. Note this isn't a precision sensor, and the pulse rate does vary a bit depending on the flow rate, fluid pressure and sensor orientation. It will need careful calibration if better than 10% precision is required. However, it's great for basic measurement tasks.

Table 1: Specifications of flow sensor

Parameters of Sensor	Value / Range
Working Voltage	5 to 24VDC
Max current	15mA @ 5V
Working Flow Rate	1 to 30 Liters/Minute
Working Temperature range	-25 to 80°C
Working Humidity Range	35%-80% RH
Maximum water pressure	2.0 MPa
Output duty cycle	50% +-10%
Pulses per Liter	450
Flow rate pulse characteristics	Frequency (Hz) = 7.5 * Flow rate (L/min)
Weight	43g

Working theory of Hall Effect sensor:

Hall Effect sensor attached to water flow sensor is a transducer which examines the rotations of rotor and passes the pulse train which is in the form of electrical signal as a frequency input to the microcontroller that is programmed to convert it to flow rate. They are temperature resistant and stress resistant sensor especially suited for electronic computation.

Fig 2: Principle of Hall Effect senor

The main benefit of using water flow sensor with Hall Effect sensor is that it is highly durable due to non-contact detection, works with high speed operation over 100 kHz, operates with stationary input, no moving parts, highly repeatable operation, highly resistant to contamination such as dust, dirt & oil, small in size and easy subsequent signal processing due to digital output.

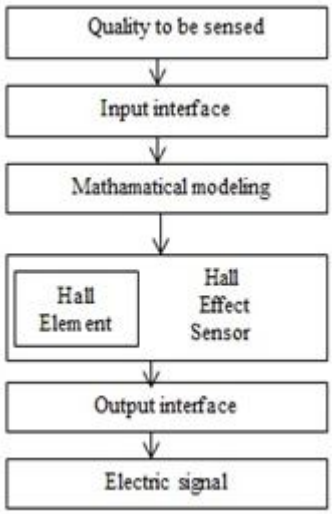

Fig 3: Hall Effect sensor working flow

In order to measure the quantity of water being passed in particular time through the sensor it is first passed through the rotor present inside the sensor with magnet attached to it which is taken as input interface in the flow. Formulas are applied in order to measure the number of rotations in a minute of rotor.

Hall Effect sensor has a hall element which is a magneto-electric transducer and is made of a thin semiconductor layer as shown in figure 4 with two input voltage terminals and two output voltage terminals. The

magnetic flux perpendicular to the semiconductor layer generates a voltage by the Lorentz force.

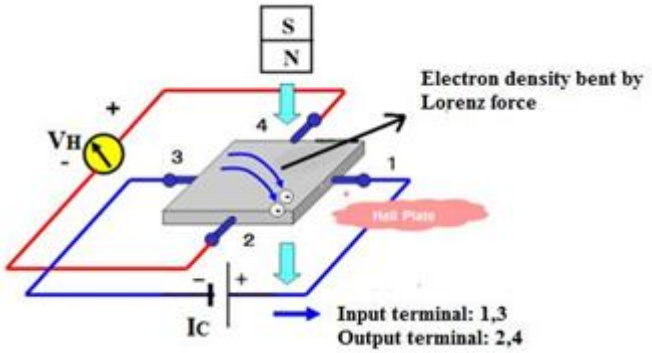

Fig 4: Behavior of hall element in presence of magnetic field

The hall voltage produced in the hall element is directly proportional to the current produced (*I*) and the magnetic flux density (*B*) as shown in equation 1.

$V_H = R_H (I/T*B)$ … [1]

Where, V_H is hall voltage, R_H is Hall Effect coefficient, *I* is current flowing through sensor in amperes, *T* is thickness of sensor in mm and *B* is magnetic flux density in Tesla, Ic is drive current. Hall voltage is of the order of 7 µ V/Vsgauss in silicon and thus requires signal conditioning for practical applications. Signal conditioning circuit consists of a voltage regulator, a signal amplifier that is differential amplifier and a Schmitt trigger in order to convert the analog output to digital output on a single silicon chip as shown in figure 5. A voltage regulator is used to automatically maintain a constant voltage level with the amplifier to amplify the hall voltage according to the application.

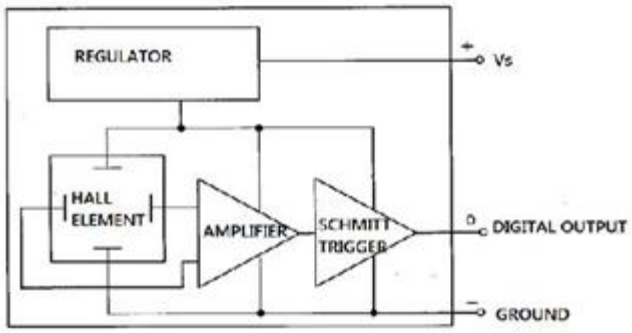

Fig 5: Digital output Hall Effect sensor

The comparison of the output from the differential amplifier is done with the preset reference and if amplifier's output exceeds the reference, the Schmitt trigger turns on and when it falls below the reference point, the Schmitt trigger turns off.

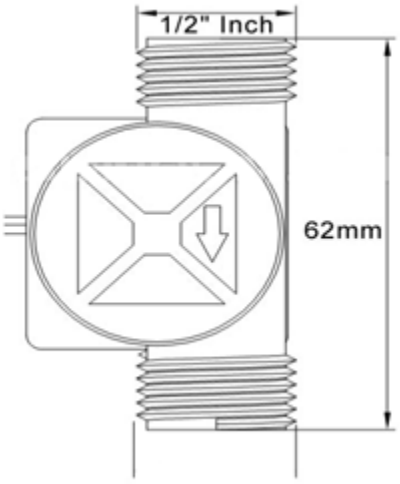

Fig 6: Water Flow sensor internal component

Fuel level sensor:

Fuel level Sensors, by are designed to reduce pilferage / improve fuel efficiency by its level monitoring and measurement. In the world of cut- throat market competition, every day reducing profit margins, fuel level sensors are big boon to industry for the monitoring of fuel consumption, and its pattern.

Our sensors have high end facilities like data logs, DG Alarms, DG RPM, and DG Run Hour etc. GSM / GPRS connectivity make them even more unique and user friendly.

Fig 7: Fuel level sensor

A tank unit (sheet metal / aluminum die cast type) is an instrument to indicate level of fuel in tank. It is used in all kind of vehicles / stationary engines which have tank of any kind.

It normally consists of:

a) Float (NBR type/PU type) with level arm
b) Potentiometer

Working principle:

As the fuel is consumed or emptied in tank the float moves up/down and it increases or decreases the resistance of potentiometer which includes TFR type to indicate the fuel

level on the fuel gauge / dashboard cluster. It can also be of capacitive type and with integrated suction and return tubes among the various options / types, adjustable / universal type tank unit can also be provided for fitment in different fuel tanks, shapes and sizes.

III. SYSTEM DESIGN AND DEVELOPMENT

The selection of a microcontroller plays very important role in any embedded system. According to the need of the system a microcontroller is chosen. Here in this system in order to design a low cost automatic water flow meter ARM 7 LPC2138 microcontroller is used. We have designed and developed a low cost water flow meter mainly for irrigation purposes to deliver only the correct amount of water as per requirement to the irrigation fields. Keeping records of flow meter readings regularly can indicate when the pumping system is deteriorating. LPC2138 microcontroller is used to monitor the sensor with which LCD is interfaced to display the flow rate of water. Flow rate can be determined inferentially by different techniques like change in velocity or kinetic energy. Here we have determined flow rate by change in velocity of water. Velocity depends on the pressure that forces the through pipelines. As the pipe's cross-sectional area is known and remains constant, the average velocity is an indication of the flow rate. The basis relationship for determining the liquid's flow rate in such cases is shown in equation 2.

$$Q = V*A \quad \ldots [2]$$

Where, Q is flow rate/total flow of water through the pipe, V is average velocity of the flow and A is the cross-sectional area of the pipe. Viscosity, density and the friction of the liquid in contact with the pipe also influence the flow rate of water.

LPC2138 microcontroller based system is shown in figure 8. A tank is used to supply water through the sensor to the required field. Inlet of water to the sensor is through the tank and outlet of water is from another side of sensor which is fed directly to the field. When no water flows through the pipelines as if the supply of water stops at any moment the pump gets automatically off hence saving the electricity too. The system is programmed according to the requirement in the fields. So this reduces the man's effort of keeping eye every time on field when filling water and also helps in conservation of water.

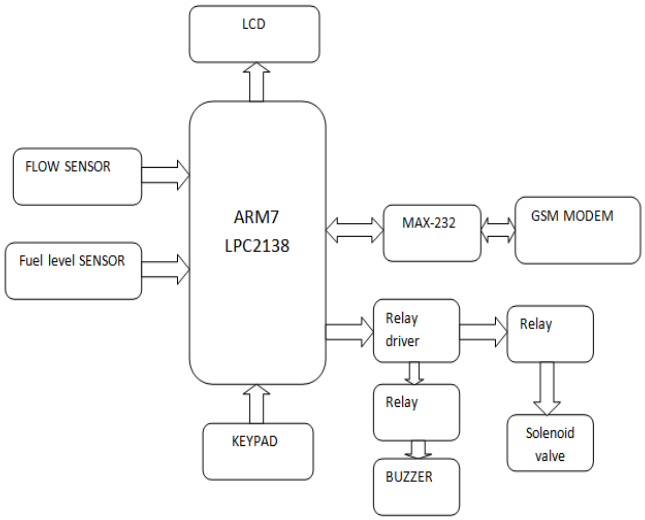

Fig 8: Block diagram of the system

There are two modes in which this systems works effectively:
A) Fuel filling mode
B) Theft detection mode

A) Fuel filling mode:

Fuel is filled by prescribed amount. For that purpose we are using flow sensor. When user enters the quantity of fuel, solenoid valve is open and flow sensor measures the quantity of filled fuel is equal with the entered quantity. If filling is not equal to prescribed amount then buzzer will on.

B) Theft detection mode:

In this mode level sensor checks the level of the fuel. If the level of fuel changes in stable position i.e. when vehicle is parked, then buzzer will get on. At the same time message will be sent to the concerned person, to the owner of the vehicle. So that theft will be detected.

IV. FLOW CHART OF THE SYSTEM

The system working flow is described in figure 9. Water when passes through the rotor cause the rotor to rotate at the speed equivalent to velocity of water. Rotor's speed changes with different rate of flow of water. As each blade passes through the magnet magnetic field is created at the base of the hall sensor and thus pulses are generated. These pulses produce an output frequency proportional to the volumetric flow/ total flow through the sensor. This frequency is converted to the flow rate by using software program for microcontroller LPC2138.

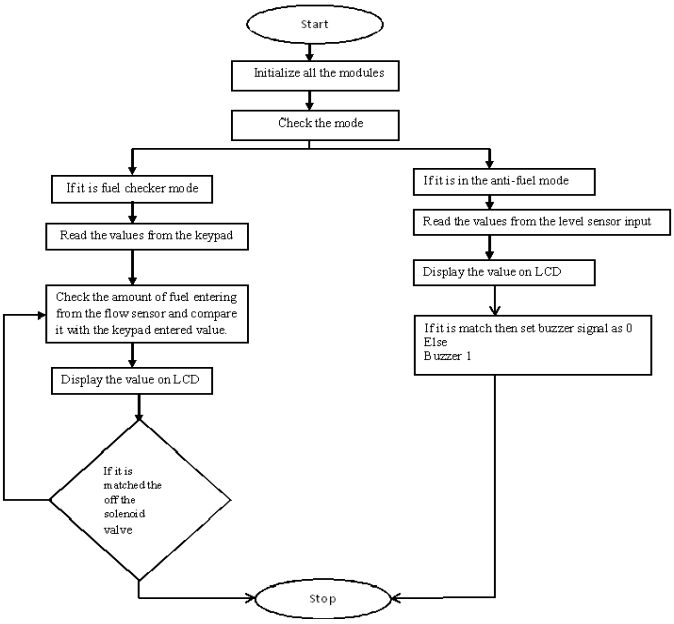

Fig 9: Flow chart of the system

V. RESULTS AND PERFORMANCE ANALYSIS

As in table 2 with the increase in multiplication factor the readings shown by the sensor degrade as compared to actual readings and a point comes where it becomes close to the actual value that is the rate at which the water actually flows as measured without the sensor.

Table 2: Calibration of sensor and observed readings

Multiplication Factor	Observe reading with sensor (Liter per minute)	Actual reading (Liter per minute)
1.5	18	20
1.6	19	20
1.7	21	20
1.8	24	20
1.9	25	20
2.0	26	20

The table 2 lists reading of water flow rate with different multiplication factors with and without sensor.

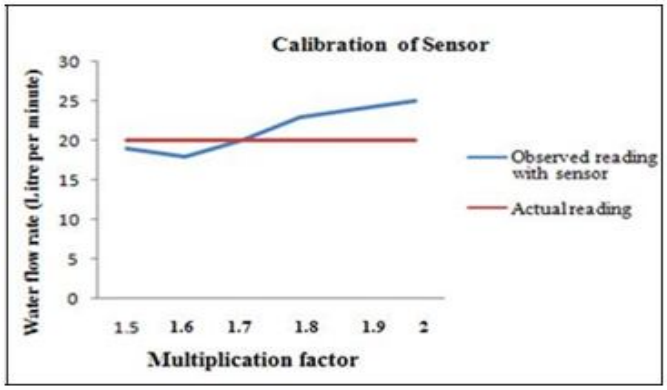

Fig 10: Calibration of water flow rate with sensor

Figure 10 shows the graph of calibration of sensor which indicates that the actual reading we have observed with our sensor is a little bit deviates from original due to air present.

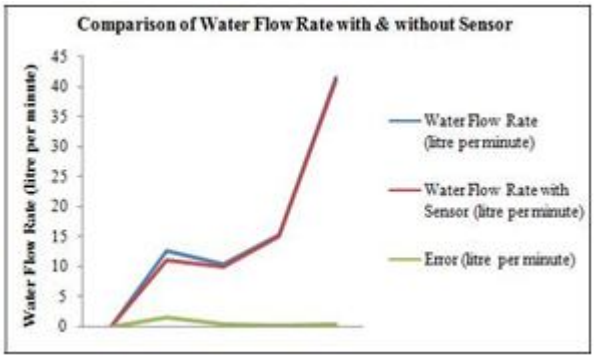

Fig 11: Comparison of water flow rate with and without sensor

VI. CONCLUSION

This technique has benefit of using Hall Effect sensor in measuring the flow rate of water within the tank. Application of hall sensor in this field proves to be a good system that can detect the leakage in the pipelines if we observe the flow rate of water regularly, saves water as excess water would not be delivered to the crops which may also damage it and at last but most important that is in the terms of cost the system proves to be a low cost with many of the benefits as compared to the other products available in the market. So development of low cost water flow meter can replace the other high cost water flow measuring meters available in the market. This system eliminates the manual mistakes in flow rate measurement. Also it is more accurate in comparison to other types of meters. This system is more attractive, as it provides automatic operation with great accuracy and the most too cheap method to measure flow rate of water in some application.

It is a small kit that consists of a GSM module and several other components. The system makes use of an embedded system based on the GSM technology. An interfacing mobile is connected to the microcontroller. When a person attempts fuel theft then the microcontroller commands the GSM modem to send a text message as an alert to the vehicle owner and further an alarm is raised by the buzzer installed within the system.

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