FUEL QUANTITY DETECTOR

EMPLOYABILITY SKILLS AND MINI PROJECT REPORT

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CERTIFICATE

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ABSTRACT

In recent years, control systems have created their spot in the developing world and have grown in importance in the field of development and advancement of modern civilization and technology. Practically, every aspect of day-to-day activities is affected by some type of control system. Control systems are found in abundance in all sectors of industry such as quality control of manufactured products, automatic assembly line, machine-tool control, space technology and weapon systems, computer control, transportation systems, power systems, robotics, automobile sector as well.

These kinds of technological developments in the automobile sector are especially on electronic gear, balance, antislip, security systems. The other important application of them is the measurement system which has the same age with automobile history for fuel level of automobile tanks. There is an obligation to use the float systems for automobile companies because of bad operating conditions in the tank such as high temperature and humidity. But, the float system works as if it is a warning lamp more than a measurement component since it has a connection with adjustable resistance which has a nonlinear structure and low solution one. This becomes a drawback to the existing fuel quantity detection system.

Nowadays, at many of the petrol pumps, we don't get the exact amount of petrol as shown by the filling machine. The amount of petrol we get is comparatively less than the amount we should actually get. In today's modern and digital world, if the fuel indicator in the vehicles is made digital, then it will help us to know the exact amount of fuel available/filled in the tank.

The above limitation is challenged in our project. We have opted for a safer way of finding the fuel quantity. The exact amount of fuel available in the tank will be displayed digitally by making the use of an Ultrasonic sensor. The ultrasonic sensor makes a no-contact system, with low power requirement and good accuracy. It over-

comes the problems of contact systems and also fulfils the requirement of fuel quantity detection. To summarise, this project is a contactless fuel level detector .

Keywords : Ultrasonic sound waves, Measurement system for fuel level, Automobile tanks,Microcontroller, Ultrasonic sensor, Lcd, Buzzer.

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LIST OF ABBREVIATIONS

LCD	Liquid Crystal Display
IC	Integrated Circuit
RX	Receive
TX	Transmit
GND	Ground
PCB	Printed Circuit Board

Chapter 1

Introduction

1.1 Background

Technologic developments in automobile sector are especially on electronic gear, balance, anti-slip, security systems. The other important application of them is the measurement system which has the same age with automobile history for fuel level of automobile tanks. There is an obligation in case of automobile drivers to use the float systems for automobile companies because of bad operating conditions in the tank such as high temperature and humidity for long years. This traditional system is depicted in Fig.1.1

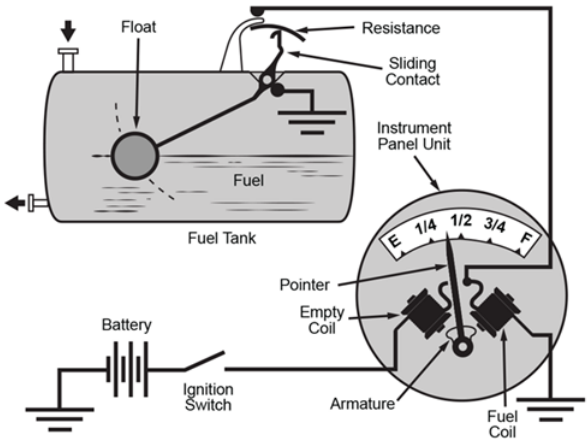

Figure 1.1: Traditional automobile fuel level measurement system

The system consists of a float working with the height of the fuel level, an adjustable

resistance that is mechanically connected to the float and a resistance in series with this adjustable resistance. When the fuel level is decreased, the value of the adjustable resistance that is mechanically connected to the float starts to decrease. As a result of this, the current value coming from the series resistance starts to increase. This change heats bimetal material of the resistance and needle of the related face of the automobile indicates a value. Although this system is simple and low cost, it is just a kind of indicator more than a measurement one showing some disadvantages.

- Very low solution and nonlinear measurement result
- Since adjustable resistance is produced manually, it includes machine fault
- In production term of the system, setting time is very long
- The type of components which are working movable and thermal widening increases the possibility of the fault probability
- Movements of automobile and bad operating conditions taking place wrong measurements.

There is a lot of news regarding the petrol pump frauds which leads to corruption. There is difference between the amount of fuel displayed on the meter and the fuel filled in the tank. Most of the times the fuel filled is less than the displayed value. This is because of the arrangements made in the filling machine which leads to the benefit to the owner. In case of analog display user cannot find out the accurate and precise value of the remaining fuel.

By considering this fact, we have designed a digital fuel level indicator which will be of great importance to avoid fuel thefts on the petrol pumps. Although contactless methods are more complicated than contact methods, there are lots of sensors available for the fuel measurement. We have used an Ultrasonic sensor for the calculation of the fuel level.

1.2 Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

Figure 1.2: Ultrasonic Sensor IC

1.3 The Measurement Using Ultrasonic Sensor

Sound waves spread 343.5m/s speed at 20°C. The magnitude of the sound wave striking to any block reflects backward by decreasing from this block. It can easily be

calculated the distance with the following wave theory equation using the signals produced by ultrasonic sound source between going and reflecting time measurement.

$$\mathbf{x = c * t / 2}$$

where c is relative sound speed to environment temperature, t is total time of going and reflecting ones form the source, x is the distance between the source and the block reflecting wave. This is the main principle of how the ultrasonic sensor functions.

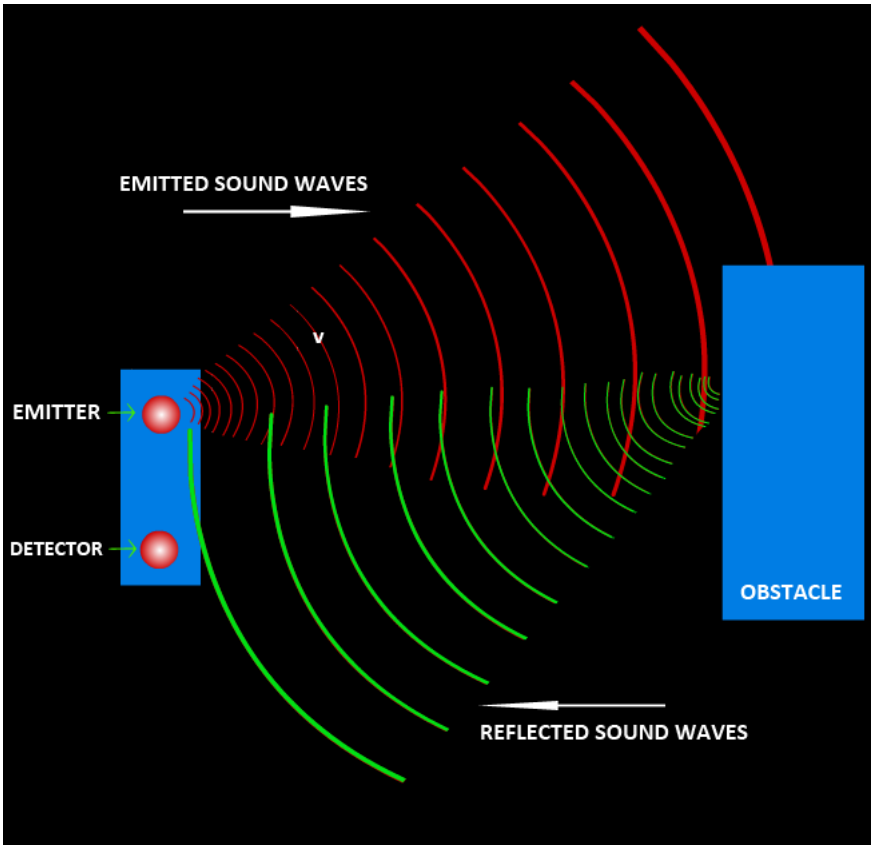

Figure 1.3: Ultrasonic Sensor Working

The effect of the humidity on sound speed is very low and neglected easily. Thus, according to all these conditions, it can easily be seen that ultrasonic sound waves are appropriate to operate in very bad conditions. The temperature effect on sound wave speed is can be given as follows,

$$c = c_0\sqrt{\frac{T^0(K)}{273.15}}$$
$$c = c_0\sqrt{1+\frac{T^0(C)}{273.15}}$$

Figure 1.4: Formula for temperature effect on ultrasonic wave calculation

where Co is sound speed at 0°C. Sound speed for the conditions close to room temperature has a change 0.18 percent per °C. The relationship between temperature and sound speed is given in Figure below:

Temperature (^{0}C)	Sound speed (m/s)
-10	325.5
0	331.5
10	337.5
20	343.5
30	349.5
40	355.5
50	361.5

Figure 1.5: The relationship between Temperature-Sound Speed

Chapter 2

Literature Survey

In an article, “Real Time Generator Fuel level Measurement Meter Embedded with Ultrasound Sensor and Data Acquisition System” [1] by Sadeque Reza Khan and Arifa Ferdousi, mentions Ultrasonic sensors are characterized by a low-cost and by the possibility of being used in environments and situations where it is not possible to use more complex sensors as camera systems and laser devices.

Saikat Patra and Shibendu Mahata [2] “Electronic for you November 2020 edition” HC-SR04 ultrasonic sensor module. The ultrasonic ranging module HC-SR04 provides a 2 cm to 400 cm non contact measurement function.

Deep Gupta, Brajesh Kr. Singh and Kuldeep Panwar[3] presents a study on a Prototyping Model for Fuel Level Detector and Optimizer. In this particular piece written by them we can find the following quoted lines that explain the present scene and the necessity of our project, “Fuel mileage in vehicles refers to the relationship between the distances travelled by an automobile to the amount of fuel consumed. Moreover in today’s world fuel saving is also an important factor. For a developing country, where people are more obsessed with mileage, manual mathematical calculations are carried out to know the mileage of a particular vehicle.”

G. Bucci [4],in his paper "Numerical method for transit time measurement in ultrasonic sensor applications," has explained that with the increase of vehicle usage over the world, fuel necessary has become a tremendous problem. Design and implementation of load cell based fuel measurement measures the accurate level of fuel adding while fuel filling process. There is a large variety of methods for measuring fuel level, ranging from those using mechanical floats and capacitive and optical sensors to ultrasound methods. Nowadays all fuel bunks having types of digital displays unit in order to display the value of fuel adding to the vehicle. But the disadvantage of using load cell is that it can't be used for measurement of highly reactive material such as petrol. So we decided to use ultrasonic technique for petrol level measurement as it is a non –contact type measurement method.

Betta, G., A. Pietrosanto and A. Scaglione[5], in their paper "A digital liquid level transducer based on opticalfiber" have stated that Contactless methods, such as those for optical and ultrasound sensing, measure liquid level without having to contact the liquid. Most of the companies are very interested to manufacture the sensors to indicate fuel from level and save your money. Digital fuel gauge in used to measure the accurate amount of fuel in the fuel tank compared to the previous method .that is previous method consist of dash board in that needles are moved to indicate the amount of fuel but that is not accurate it just show the approximate value.

Chapter 3

Proposed Methodology

3.1 Problem Statement

We as humans are in a continuous state of locomotion most lives. Therefore, in today's world to make it faster we utilize several types of vehicles.

This in return increases our fuel consumption. The conventional fuel quantity measurement system, is contact system which though low in cost and simple is more of an indicator rather than a measurement system.

Therefore, the problem statement we bring forward is of real time monitoring of fuel quantity

Objective:

1. Real time quantity detection of fuel in the tank.
2. To achieve a clarity regarding the amount of fuel one fills in a petrol pump.
3. To avoid fuel theft
4. Monitoring our fuel consumption.

3.2 Problem Motivation

If we go by the reports of 2016 nearly 785+ people filed cases regarding petrol fraud only in one state. The common/ general public is continuously being cheated upon by the goons behind this scheme. This has suffering of public has become our motivation to come up with this project.

3.3 Process description

The first thing we have to do is understand the structure of the tank and according modify the setup. Therefore, for Test Conditions, here we are considering a Straight Cuboid Tank. Accordingly we have designed the setup. The setup consists of 3 main components: Ultrasonic sensor, LCD and ATMEGA 328P(Microcontroller).
Ultrasonic sensor consists of 2 major components: A transmitter and a receiver. The ultrasonic waves emitted by the transmitter travel at the speed of sound, and hit the top most level of the fuel; i.e the fuel surface and reverts back in path receiving back at the receiver. The time delay between transmission and reception of the ultrasonic waves is what helps us calculate the distance of the fuel. The sensor detects the time in ”ms”, which is converted into ”cm” using functions while coding, this cm or distance betwen sensor and fuel surface is then converted into calculated fuel quantity. This is what will hence forth tell us its quantity which will be displayed on the LCD screen for one to see.

This process makes fuel quantity detection absolutely contactless and more accurate.

3.4 Requirement Analysis

Required Resources are:

1. Atmega328P microcontroller IC
2. HC SR-04 Ultrasonic sensor
3. 16*2 LCD display
4. PCB
5. 5v button cells
6. Mounting base to hold the components
7. Proteus Software for Simulation
8. Arduino Software for Programming

3.5 Impact Analysis

Impact of our project on society and environment:

Usefulness (positive impact):

- LCD helps you see the quantity of fuel present in tank and prevents you from being cheated at fuel pumps.
- This helps you to calculate the mileage of your vehicle also.

Harmfulness (negative impact):

- The major problem with this system is that, if proper connection is not done then due to short circuit there will blast in petrol tank.
- Observation and regular maintenance will be required for this system.

3.6 Professional Ethics Practices to be followed

1. Giving credits.
2. Keeping technical guidelines in mind.
3. Following the norms of engineering Practices.
4. Liabality for outcome caused by one's actions or decisions.

Chapter 4

Project Implementation

4.1 Circuit Designing

The simulation and Designing of the circuit diagram has been done on the **Proteus Software**. Here we have used ATMEGA328P as the microcontroller. We also have used alphanumeric 16 x 2 LCD Display to display the output generated. For the sensor component; we used HC-SR04 which is an ultrasonic sensor.

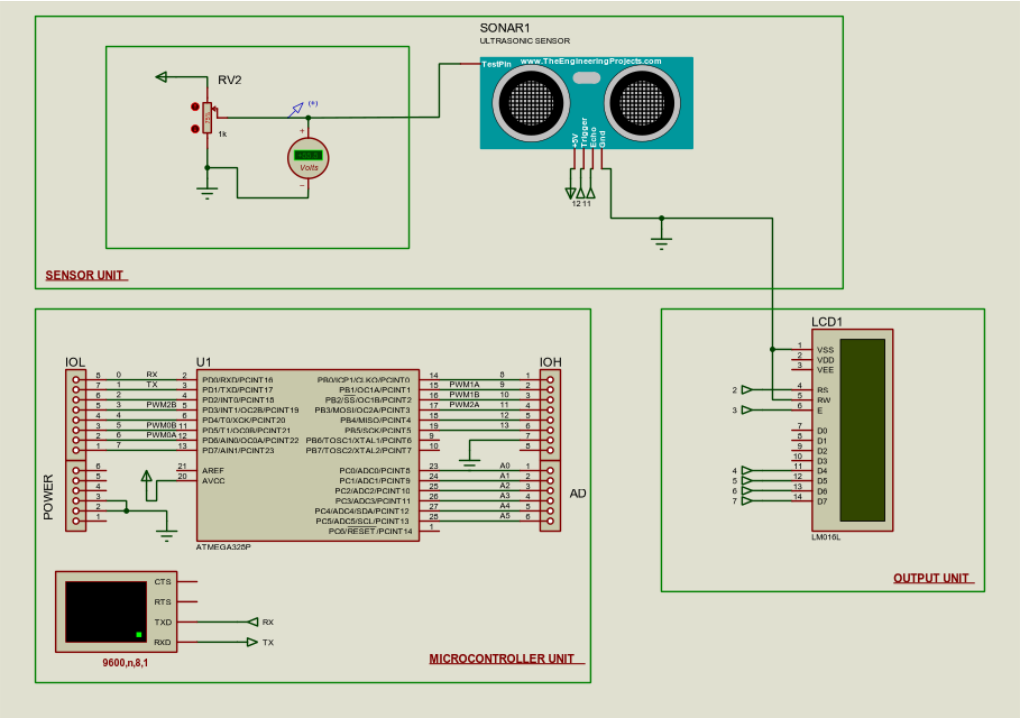

Figure 4.1: Circuit Designing

4.2 Simulation

On simulating the given circuit, the sensor measures some inputs(distance) and then passes it to the microcontroller which then processes the given inputs i.e distance measured into estimated fuel quantity based on formula and then calculates the estimated distance which the car can travel, based on the quantity measured.

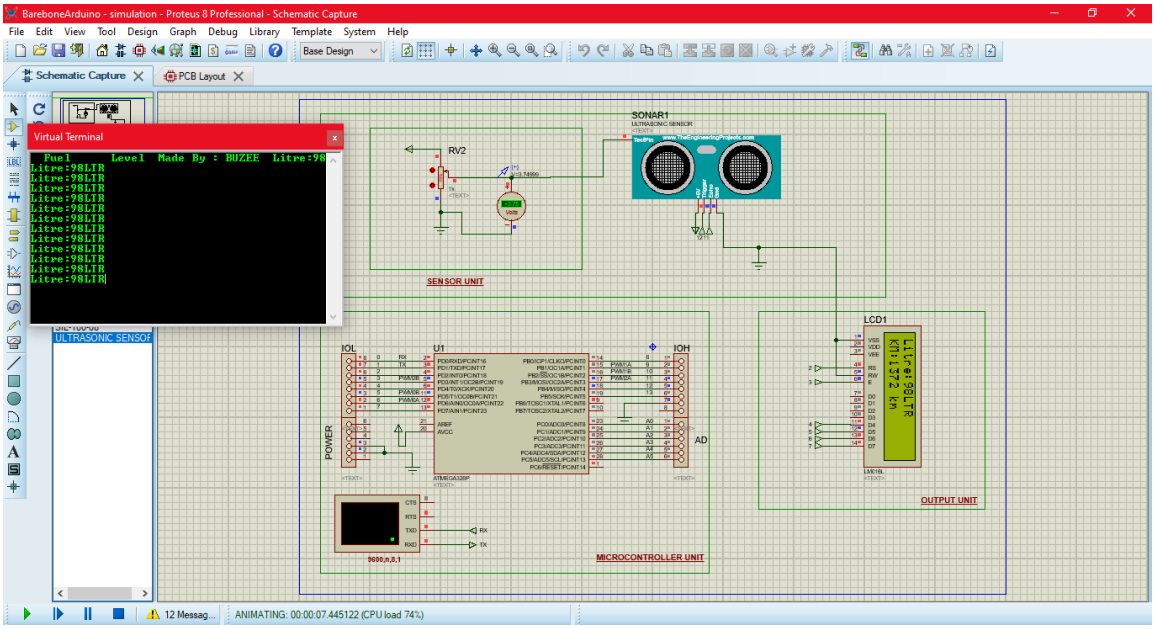

Figure 4.2: Simulated Output

4.3 PCB designing

In the PCB designing process, the layout has been made such that the microcontroller is positioned on one half of board while the LCD and sensor are placed on the other half of the board. Such a layout has been made so that there is no interruption in transmission and reception of generated ultrasonic waves.

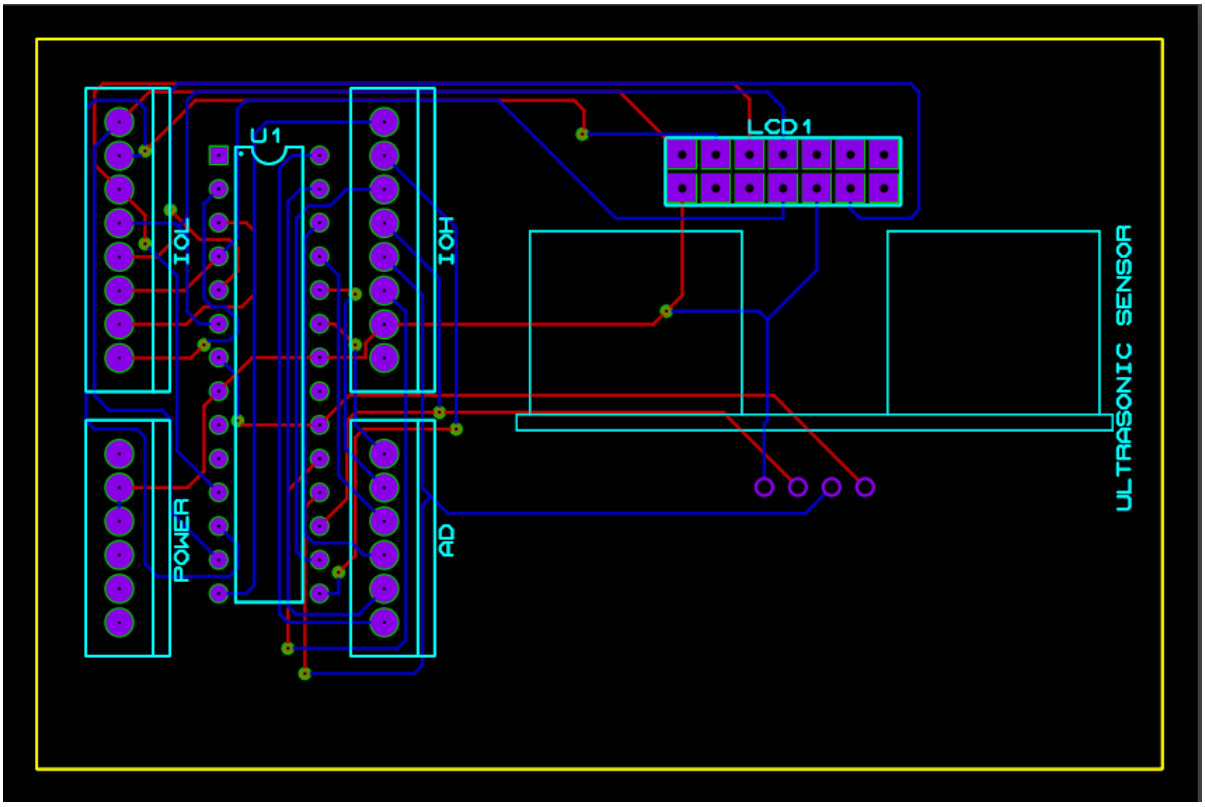

Figure 4.3: PCB Layout

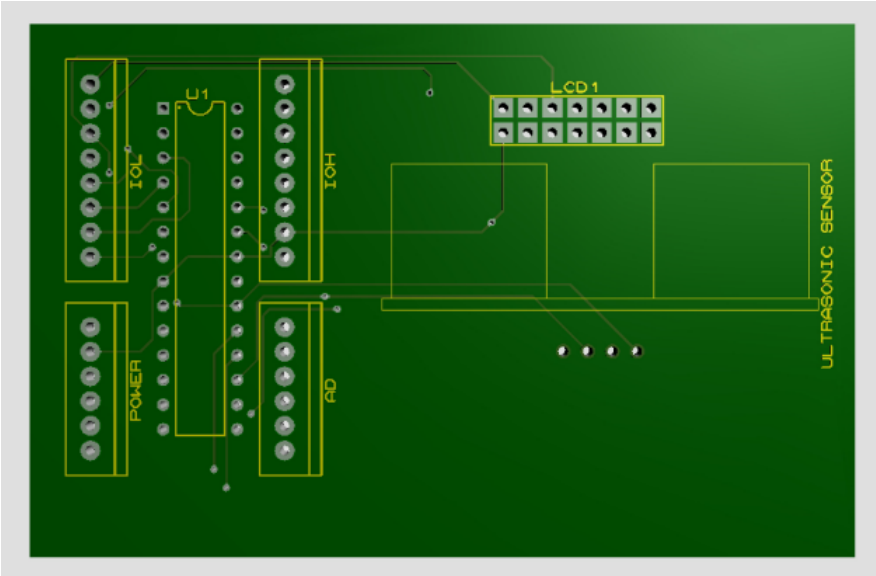

Figure 4.4: Simulated 3D view of PCB without the components

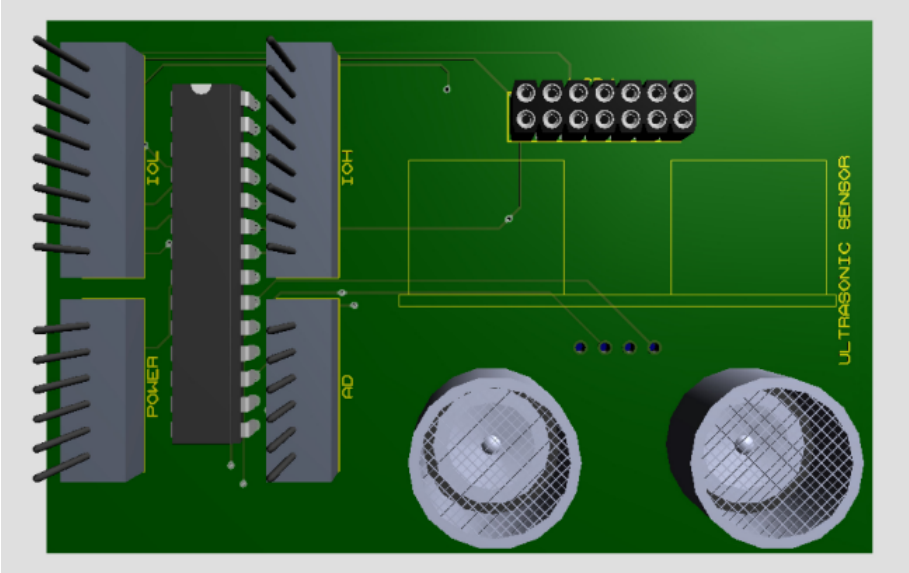

Figure 4.5: Simulated 3D view of PCB with the components

4.4 Programming

In this simulation the main parameter which is varied during the simulation is the distance i. e distance between the sensor and the fuel level inside the tank. On basis of this change in distance the output gets varied.

Algorithm :

Step 1 : Ultrasonic Sensor Measures the distance between itself and fuel.

Step 2 : The readings are passed to microcontroller.

Step 3 : The distance is converted to Fuel in Litres using formula.

Step 4 : The estimated km is calculated based on the fuel quantity obtained.

Step 5 : The calculated Outputs are displayed on the LCD Display.

Step 6 : Step 1 - Step 5 repeat in a loop.

Flow Chart :

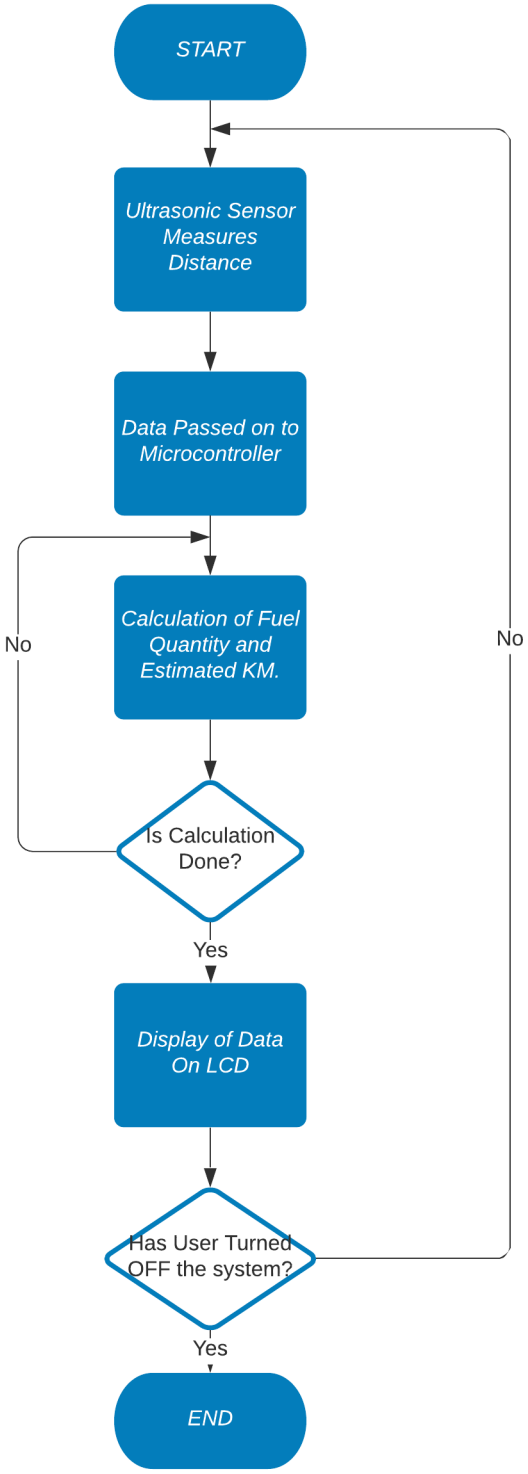

Figure 4.6: Flowchart of the system

Chapter 5

Result and Discussion

Fuel tank have bad operating conditions such as high temperature, pressure and humidity. But, ultrasonic sensors are not affected with the most of these ones except for high heat. The effect of the heat is very low fault as it has been observed by the temperature-sound speed relationship table

The proposed idea consists of ultrasonic technique for fuel measurement that acquires the measured fuel level and sends the information to the display unit which is present on the dash board. The data acquired from the sensor is given to the microcontroller. The processor processes the data by calculating the liter value that send to the display unit.

It is seen that the system displays accurate value indicating the fuel quantity present in the vehicle's tank.

Chapter 6

Conclusion and Future Scope

As mentioned above, fuel tank has bad operating conditions such as high temperature, pressure and humidity. But, ultrasonic sensors are not affected with the most of these ones except for high heat. The proposed idea consists of ultrasonic technique for fuel measurement that acquires the measured fuel level and sends to the display unit which is present on the dash board. The data acquired from the sensor is given to the microcontroller . The processor processes the data by calculating the liter value that send to the display unit. Through this data we can determine the fuel levels, which in turn will help in reducing fuel theft.

Future Scope:

1. In future alarm system can be added to alert the user of any fuel theft that might happen.

2. The system can be made more accurate to compute the estimated fuel in ml also.

3. We can add module to determine fuel quality as well based on density of the fuel.

4. A sensor mounting movable board could be added for better calibration of the sensor.

5. The future version of the system could be adapted to using a better quality sensor to ensure more System-life

References

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