# FUEL THEFT CONTROL SYSTEM USING GSM MODULE


**By**

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# Certificate

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of BS (ETM).

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| Internal Examiner | External Examiner |

# Dedication

Dedicated to our friends and family, who provided their support throughout our life.

# Acknowledgements

We highly acknowledge the expert supervision of our supervisor Associate Professor Imtiaz Ali Khan, without whom this paramount take would have not come into reality.

# Abstract

BTS is an important part of BSS (Base Station Subsystem). It is used for the wireless communication between user and telecommunication network. BTS is part of both GSM and CDMA standards in the field of wireless communication. The project idea is about to design a prototype of an industrial fuel theft control system using GSM. Theme is to control the fuel theft at any outdoor generator mainly BTS towers which is one the biggest problem faced by Telecom Companies now a days. At any time the generator will start, stop or the fuel level changes, the leveling device (potentiometer) will take the reading. The leveling device will send the reading to the GSM module. The GSM module will generate a message containing the time and level of the fuel and send it to the owner's GSM Module or to the knock system in case of Telecom Companies.

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# Chapter # 1

# INTRODUCTION

## 1.1 Overview

The project idea is about to design a prototype of an industrial fuel theft control system using GSM. Theme is to control the fuel theft at any outdoor generator mainly BTS towers which is one the biggest problem faced by Telecom Companies now a days.

### 1.1.1 Introduction

The project idea is about to design an oil (diesel or petrol) Anti-theft system for outdoor generators or anything like that, Using GSM to get an instantaneous message to the owner about the theft and will also notify the owner of "Low Fuel".

### 1.1.2 Beginning

After we got approval for our project, we started our research on the project regarding how to start and proceed to the final ending. For this we consulted some of our seniors our project supervisor and some friends. A lot of brainstorming was involved. We tried to get a hold of to understand the working of a GSM kit, Fuel leveling devices and an outdoor generator (specifically at BTS towers) and how to carry out the reading and analyze them. Result of all this is that we were able to define the steps in which our project will proceed.

### 1.1.3 Data Collection

We are collecting over data that how the system works and what are the components that we need to use in this system and we come to know that the Fuel Theft Control System will work on the following basic principle.

- At any time the generator will start, stop or the fuel level changes, the leveling device (which is yet to be determined) will take the reading.
- The leveling device will send the reading to the GSM module.
- The GSM module will generate a message containing the time and level of the fuel and send it to the owner's GSM Module or to the knock system in case of Telecom Companies.

### 1.1.4 Personal Statement

As above steps been identified our next target will be to implement the data collection, filtering & interfacing with both virtual and hardware simulations. Besides this we will keep working on our research to finalize the best hardware & software for the project & improve our skills on the how to use them perfectly.

## 1.2 Objective and Problem Statement

In every BTS, there are stand-in battery banks and generators for providing uninterrupted power to the BTS. These batteries and generators are very productive, especially in Pakistan, taking into consideration the amount of unpredicted loads shedding and power cuts that we endure daily. At any time, the commercial power supply is disrupted due to any reason the BTS automatically shifts to the backup battery banks and start operating on them before being shifted on the power supply provided by the generators. As a generator takes time to start manufacturing power, therefore, the backup battery banks ensure continuous power supply to the BTS.

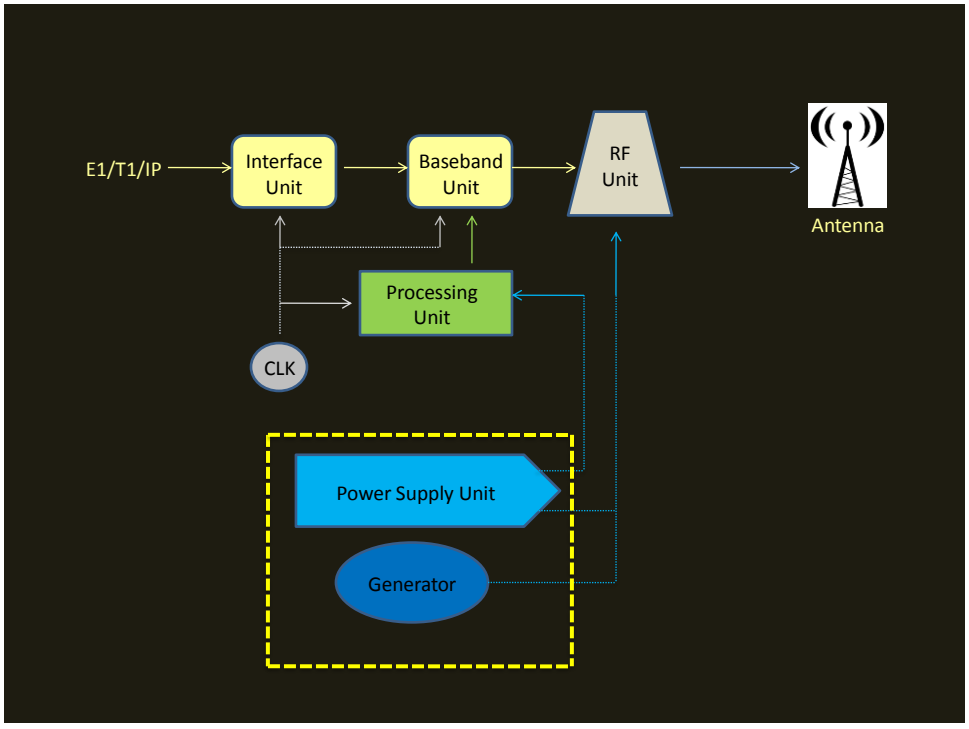



**Fig 1.1 BTS Station**

These generators have finite fuel capacity and regular replenishing of fuel is required in order to keep the BTS running in case the power coming from the commercial lines cuts off due to load shedding or any other reason. Every Telecom Company has a fuel replacement team, which visits all the BTS sites after a fixed amount of time for replenishing the fuel. In many parts of the country, the load shedding is not scheduled and therefore, sometimes it happens too often, and at times it doesn't take place at all. Hence, the process of sending replenishing teams to a BTS location after a precise amount of time is not feasible as we are not sure whether the replenishing is required or not. In case of additional power disruption, which happens at a fair magnitude, the fuel in the standby generator gets finished before the due time, and this leads to site shutdown. This does not only result in interrupted service to the cellular subscribers, but it also results in heavy gross losses to the respective cellular operator. Sending teams for replenishing fuel tanks are not a very feasible solution as well, because it might result in unproductive visits when no fuel is used by the generator. Furthermore, these replenishing teams normally charge the Telecom companies on a per visit basis.

Every BTS has a number of sensors and alarms, which monitor and sense different tools in the BTS. These alarms go off at any time any instrument reacts in an unusual manner. Amongst these alarms, there is one for fuel level as well. This alarm goes off only when the fuel level reaches a critical level. However, these alarms are actually of no practical use because they simply go off in the BTS site, where simply one guard/technician is present.

Taking into consideration the corrupt nature of our community in general, the Telecom companies have practiced instances where the fuel was thieved either by the security guard present at the BTS or by the replenishing teams themselves. This issue is of major interest because there is no appropriate check on it.

## 1.3 Problem Statement

There is no apparatus to monitor fuel level at a incorporated control room location where a constant level of the fuel could be seen by the technical staff, and the replenishing visits could be organized accordingly. The theft of fuel is another issue, which needs to be addressed. A tool needs to be developed that can diminish the theft of fuel from the BTS Generator fuel tank.

## 1.4 Objective

To tender a solution which can help the Telecom companies recorder fuel level wirelessly at a incorporated location. This resolution should also cater for the problem of theft of fuel.

We want to formulate sensors, which can monitor the fuel level of the generator's fuel tank and to transmit it to the control room. The meanest and most commonly used approach is by sending the data with the help of SMS.

So, our intention is to formulate a technique at the lowest expense and that can sense fuel level and also cope with the stealing of fuel.

# Chapter # 2

# LITERATURE REVIEW

## 2.1 What is BTS

BTS is an important part of BSS (Base Station Subsystem). It is used for the wireless communication between user and telecommunication network. BTS is part of both GSM and CDMA standards in the field of wireless communication. BTS itself contains many parts that are used for specific operations. Normally BTS contains equipment that is used for encryption and decryption of the communication data and also spectrum filtering tools like band pass filters.

As mentioned above, BTS is a part of BSS and BSS is an important part of the GSM architecture. We first see briefly the GSM architecture and its important parts so that we can be clear about the role of BSS and more precisely BTS in the wireless communication.

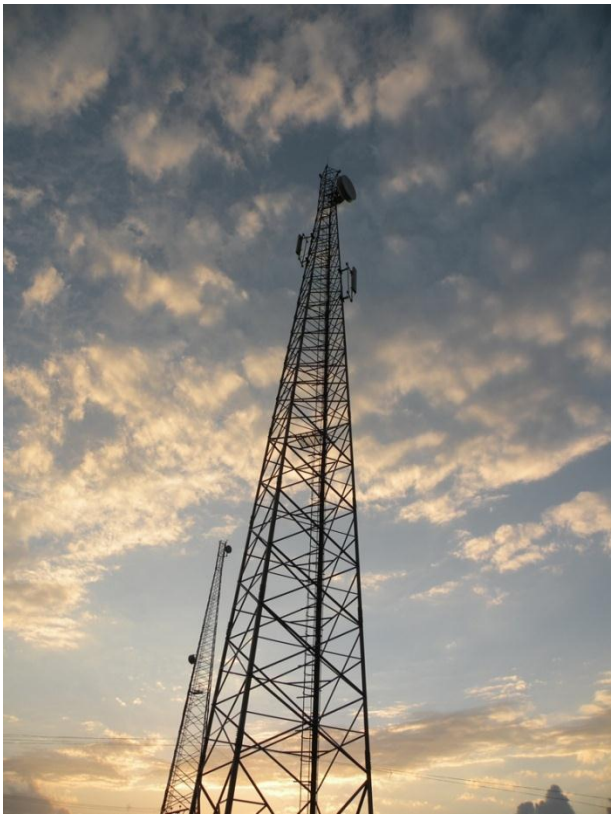


**Fig 2.1 BTS Tower**

## 2.2 GSM Architecture

### 2.2.1 GSM Network Components

The major GSM network components [1] are:

- MS (GSM Module Station) [1]
- BSS (Base Station System) [1]
- NSS (Network Switching System) [1]
- O&MS (Operation & Maintenance System) [1]

These are the principle components of a GSM network. These are further divided into other components; brief details of those are given below.

- MS (GSM Module Station)
    - ME (GSM Module Equipment)
    - SIM (Subscriber Identity Module)

- BSS (Base Station System)
    - XCDR (Transcoder)
    - BSC (Base Station Controller)
    - BTS (Base Transceiver Station)

- NSS (Network Switching System)
    - VLR (Visitor Location Register)
    - HLR (Home Location Register)
    - AUC (Authentication Centre)
    - EIR (Equipment Identity Register)
    - EC (Echo Controller)
    - IWF (Interworking Function)
- O&MS (Operation & Maintenance System)
    - NMC (Network Management Centre)
    - OMC (Operation & Maintenance Centre)

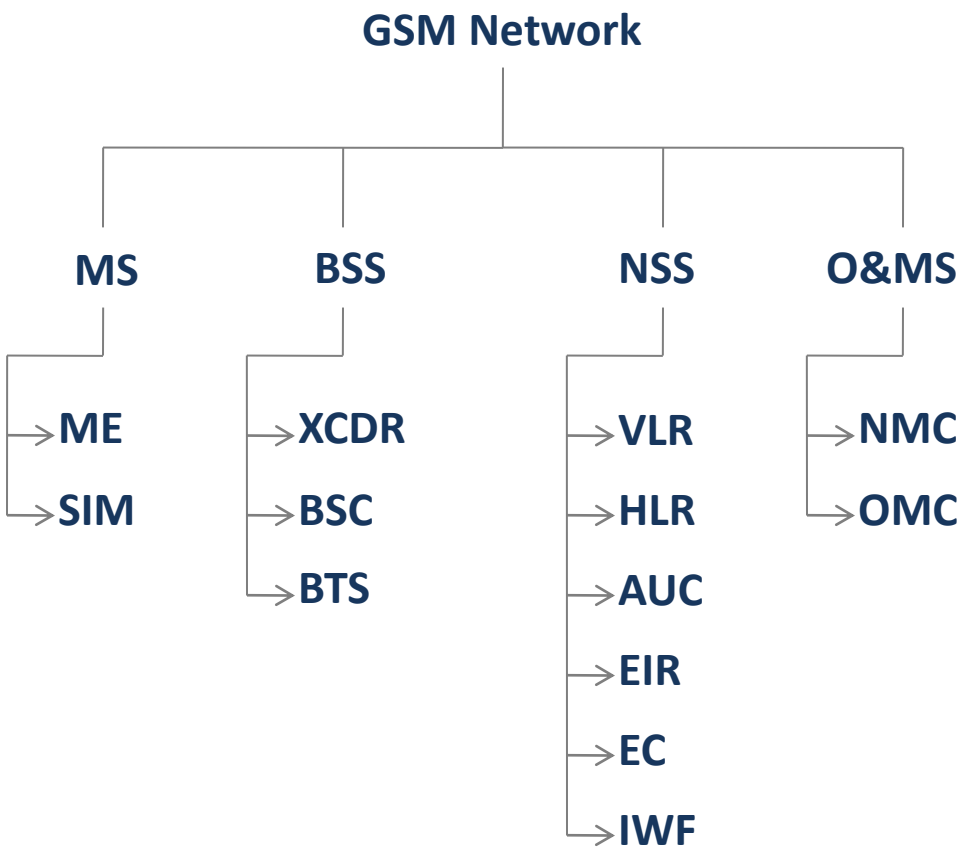



**Fig 2.2 GSM Network**

## 2.2.2 GSM NETWORK DIAGRAM

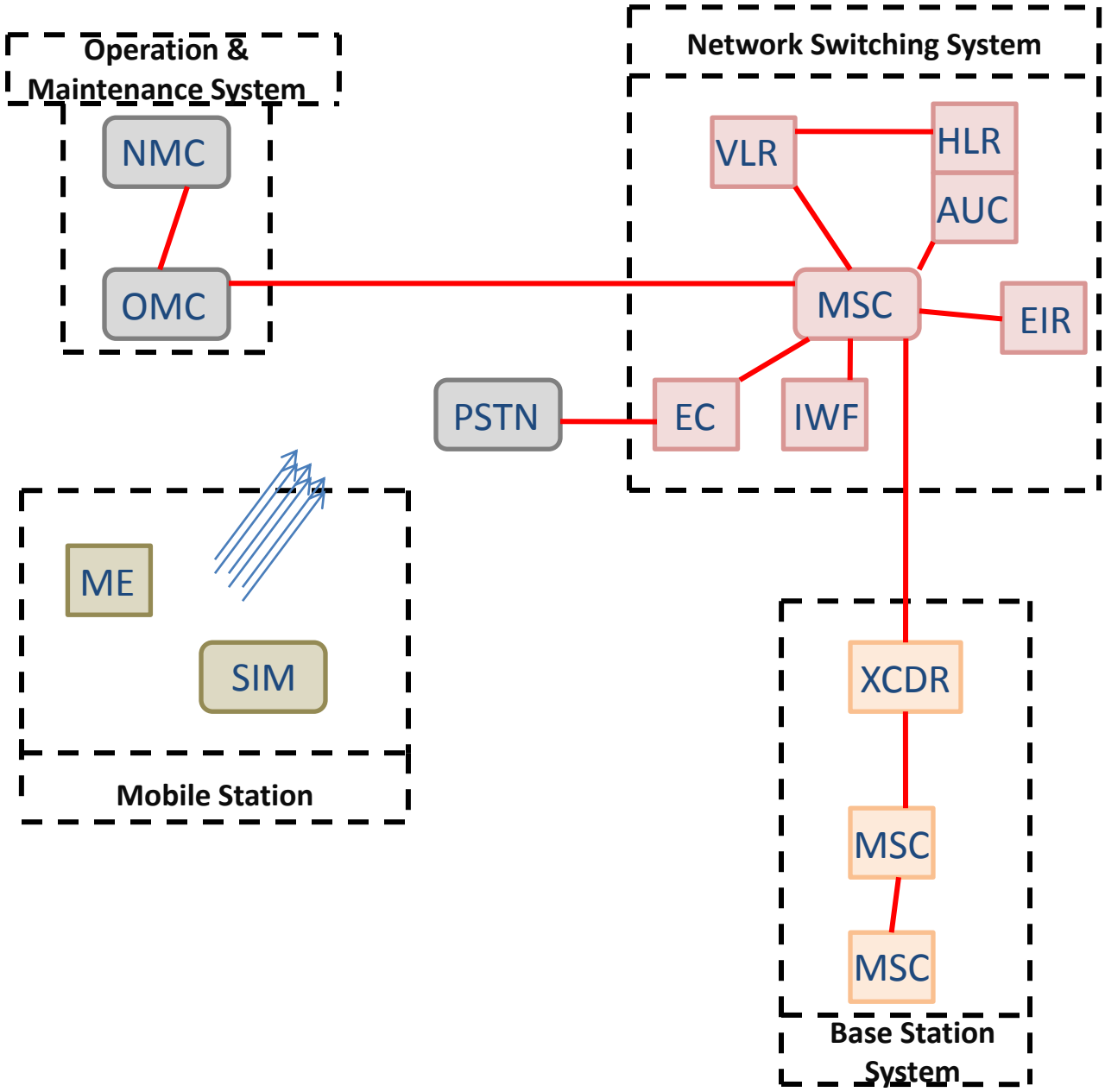



**Fig 2.3 GSM Network Diagram**

## 2.3 BTS

BTS is base transceiver station as we have briefly discussed at start of this chapter. BTS is also known as cell phone tower as its core function is to provide the signals to the user cell phones in order to make the wireless communication possible. BTS is a main part of GSM architecture and has been used these days in all GSM based communication systems.

In GSM architecture we have hexagonal structure to cover an area and successfully perform the communication. BTS position in a cell depends on your way of covering an area. There are more than one ways that BTS can be places in a hexagonal cell.

We now discuss briefly, the parts of a BTS.

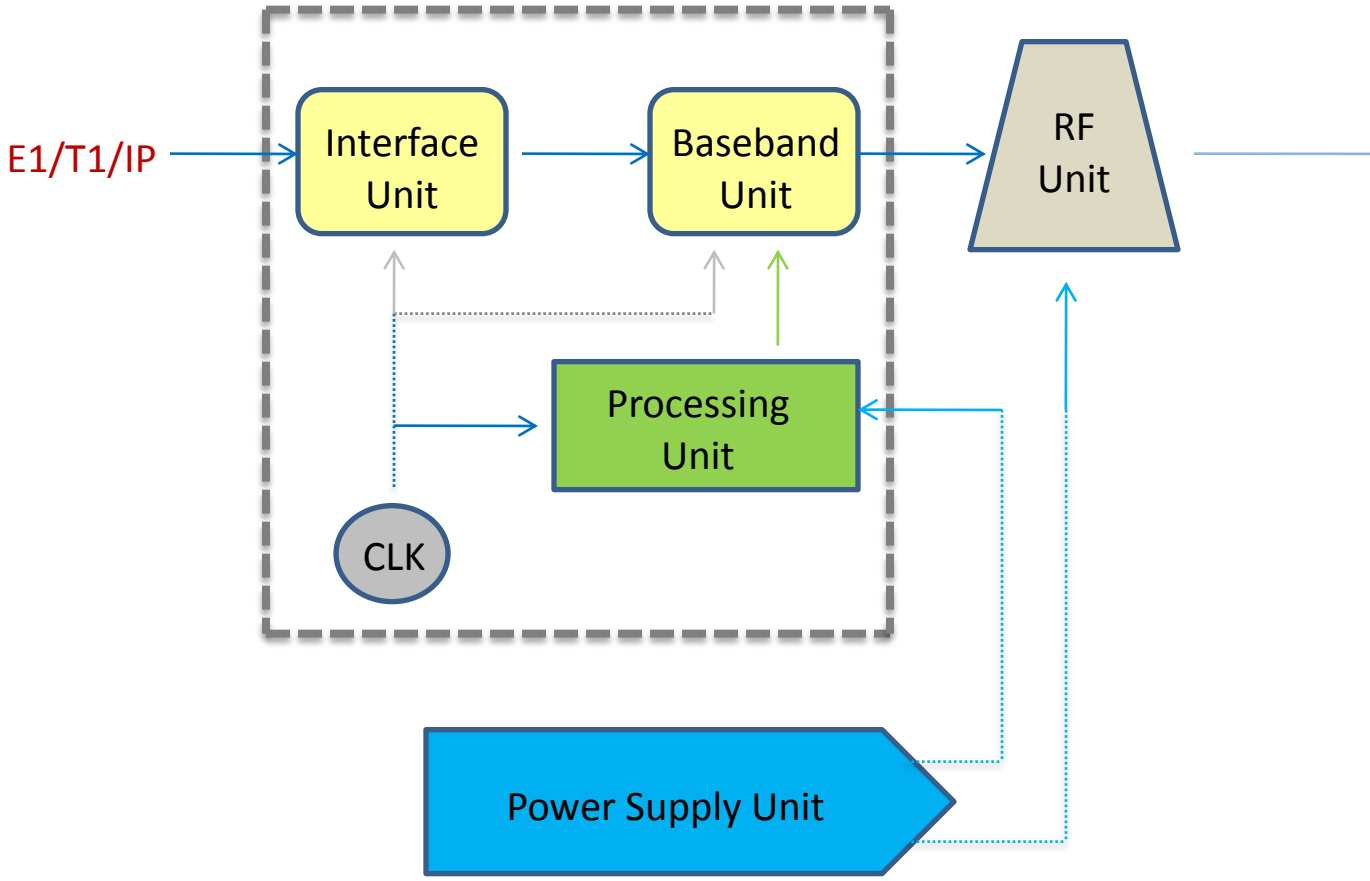



**Fig 2.4 Base Transceiver Station**

The main parts of BTS are

- Interface unit
- Baseband unit
- Clocking source
- Processing unit
- Radio Frequency unit
- Power supply unit
- Antenna part

We briefly see the functions of these parts.

### 2.3.1 Interface Unit

The data that interface unit is receiving is basically in standard formats like it is mentioned in the diagram i.e., E1, T1 etc. So, the purpose of the interface unit to make it in a form that is acceptable for the further units to process it easily. As its name shows that it is interfacing that incoming data to the processing units in BTS.

### 2.3.2 Baseband Units

Baseband units receive the data from the interface unit and process it. The data fed to the base band unit is digital and it performs the signal processing on it. It makes the incoming data in the form acceptable by the RF unit by applying signal processing on it.

### 2.3.3 Clocking Source

Clocking source is providing a clock to all parts of the BTS processing. The purpose is to synchronize all the parts on the same clock so that data flow can be smooth and compatible within different parts of the BTS.

### 2.3.4 Processing Unit

Processing unit is the heart of the BTS. It is the main part doing all the necessary actions and processing in the BTS. All the BTS configurations, testing, initialization and maintenance check is done in this unit.

### 2.3.5 Radio Frequency Unit

The radio frequency unit of the BTS is taking the processed data from the baseband unit and converting it into radio frequency so that it can be transmitted on the wireless medium.

### 2.3.6 Antenna Part

Antenna part is for transmitting the information which it is doing by the converting the electrical signal into electromagnetic signal.

### 2.3.7 Alarming System In BTS

BTS site has got a complete equipment installed in it related to alarming. Different types of alarms are there in order to notify different actions, activities and notifications. There system installed on the BTS site for the alarming purpose is known as ABSAM. We briefly see that details of ABSAM.

### ABSAM

The ABSAM is a complete hardware product that is monitoring different parts of BTS in order to notify the service providers with the current indications and updates of the BTS equipment. The ABSAM is a hardware that is based on efficient and fast microcontroller based technology. The microcontroller is connected to a GSM modem circuit so that different alarm notifications can also be sent wirelessly to the control rooms of the service provider. The ABSAM in general used for following purpose

- Monitoring the temperature
- Monitoring the fuel level of generator
- Monitoring the status of backup batteries
- Monitoring the output load

The ABSAM can monitor around 28 to 30 alarms and can also transmit the information with the help of SMS using the GSM modem circuit integrated with it.

## 2.4 Fuel Monitoring Part

We have seen the ABSAM also monitor the fuel level of the generator. But this equipment is of a very huge cost. Our main purpose is to suggest a way of fuel monitoring of the BTS generator that is efficient and also cost effective. We are designing and fabricating a way that will help to display the fuel level information at the site and also will transmit the information wirelessly with the help of a SMS. Our main concern in doing all this is to make this all an efficient system and also a very cost effective.

# Chapter # 3

# REQUIREMENT SPECIFICATIONS

## 3.1 Proposed Solution

As we have seen in our previous chapter that our main objective is to propose a solution that can be designed & fabricated in a low cost and also it fulfills our requirements. Moving for a definite solution, we first had to move step wise.

Our first step was to plan and make a block diagram to define the parts of our project. We designed a block diagram according to our project. The block diagram we had made is given below.

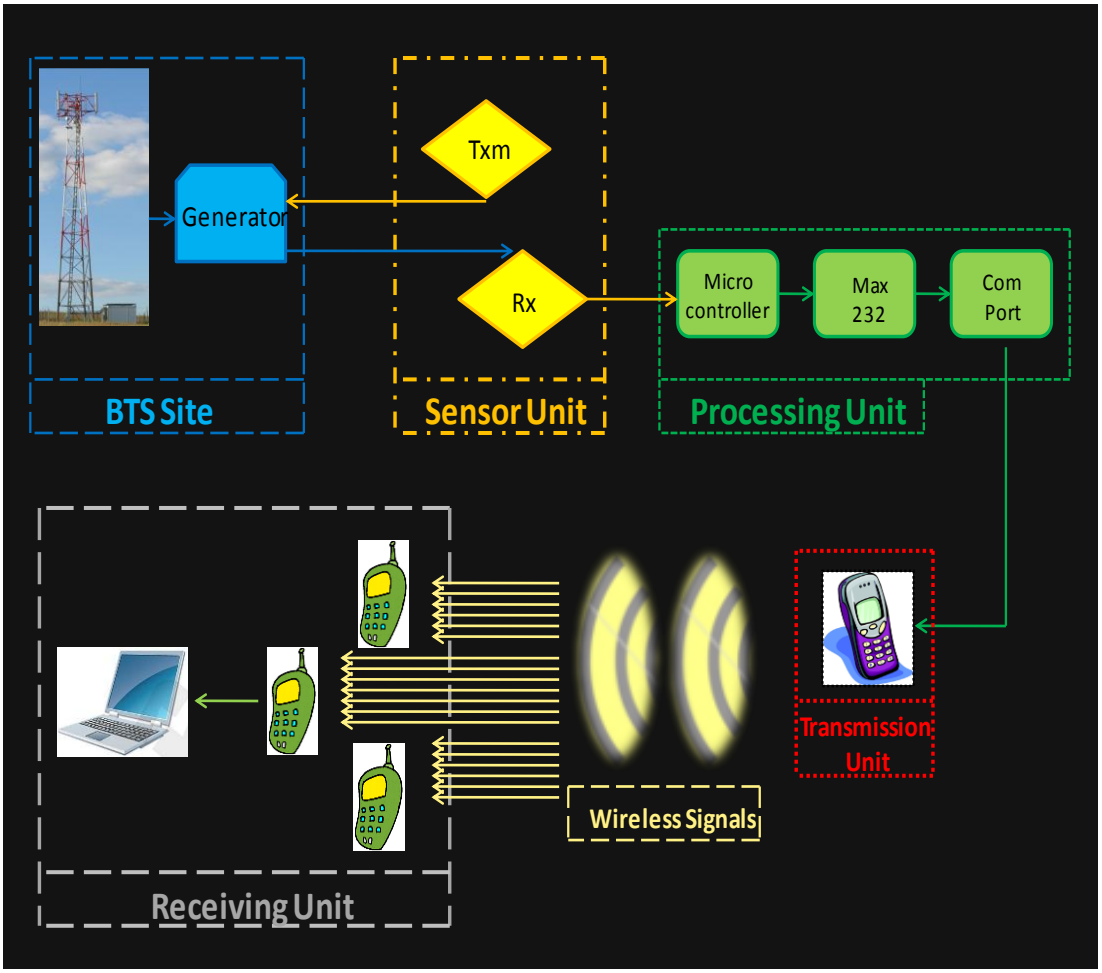



**Fig 3.1 Initial Block Diagram**

Our first task is to select and design the method to measure the depth of the level with help of specific components. On our research we found that we can use different approaches to find level of fuel in the tank.

## 3.2 First Logic

First we have selected the ultrasonic transducer logic [2]. The block diagram of this is given below.

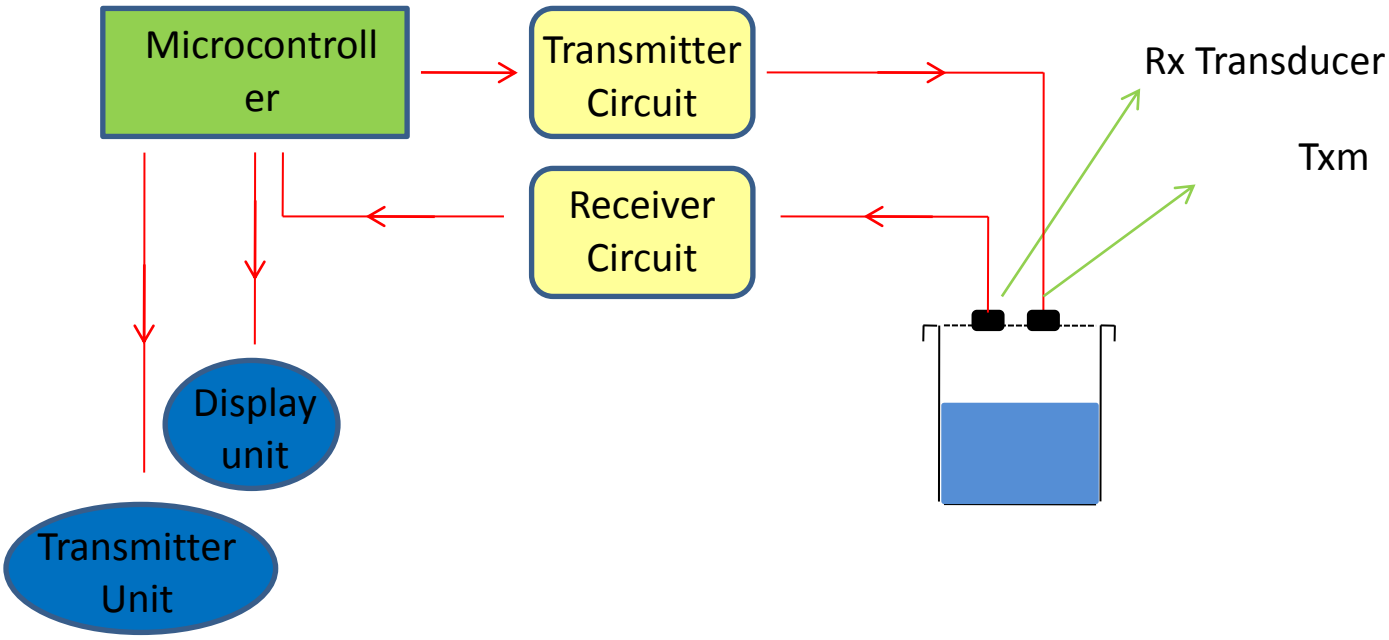



**Fig 3.2 Ultrasonic Transducer Logic**

The parts involved in the circuit are given below

- Microcontroller
- Transmitter circuit (including the transmitting transducer)
- Receiver circuit (including the receiving transducer)
- Display unit
- Transmitter unit

### 3.2.1 Logic

We chose the ultrasonic transducer model OC-40. The ultrasonic transducer needs 40 KHz to operate. More precisely the transducer work between 39 KHz - 41 KHz. So, our first step was to generate a 40 KHz signal in order to make the transmitting transducer work. We designed transmitter in mono-stable state to drive our transmitting transducer. We achieved 40 KHz pulse with the help of 555 timer.

The transmitted pulse in form of sound will strike the bottom and will reflect back as an echo for the receiving circuit. We need to amplify the received echo in order to pass it on to the microcontroller. So, we designed the receiver circuit which amplifies the received echo to a certain level.

When transmitting transducer is triggered by the 555, the timer of the microcontroller starts and when the received echo is amplified and given to microcontroller as an interrupt the timer stops. The round trip time is calculated in this way which can be processed to get the level of the fluid in the tank. The necessary calculations are done in the microcontroller and the results are displayed on the LCD which is on the site.

Once we get the correct level at the site on the LCD we can easily transmit it using the serial communication. The GSM Module phone is connected serially with the microcontroller and the level is transmitted with the help of AT commands through that connected GSM Module.

### 3.2.2 Transmitter Circuit

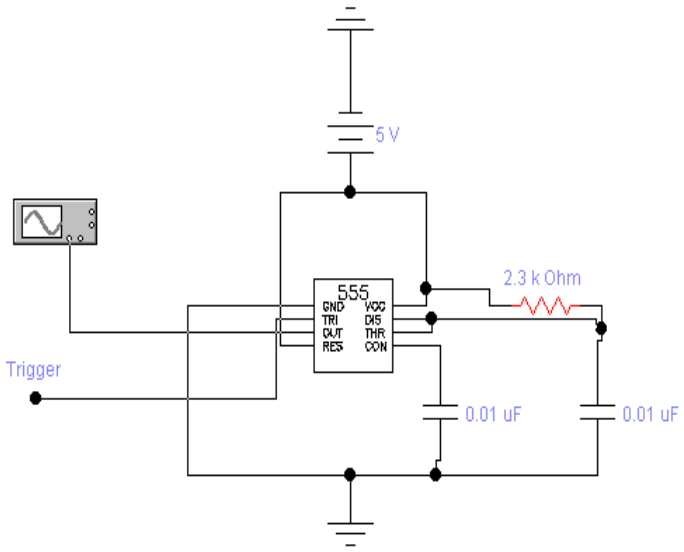



**Fig 3.3 Transmitter Circuit**

### 3.2.3 Formula for 555 Timer

We have calculated the value of R1 resistor and C1 capacitor get a single pulse of 40 KHz. The values were calculated with the help of the formulas for 555 timer mono-stable state.

R1 = 2.3k

C1 = 0.01uF

The frequency calculation is showed below.

f = 1 / T

T = 1.1 x R1 x C1

T= 1.1 x 2.3k x 0.01uF = 0.0000253

f = 1 / T = 1 / 0.0000253 = 40 KHz

### 3.2.4 Receiver Circuit

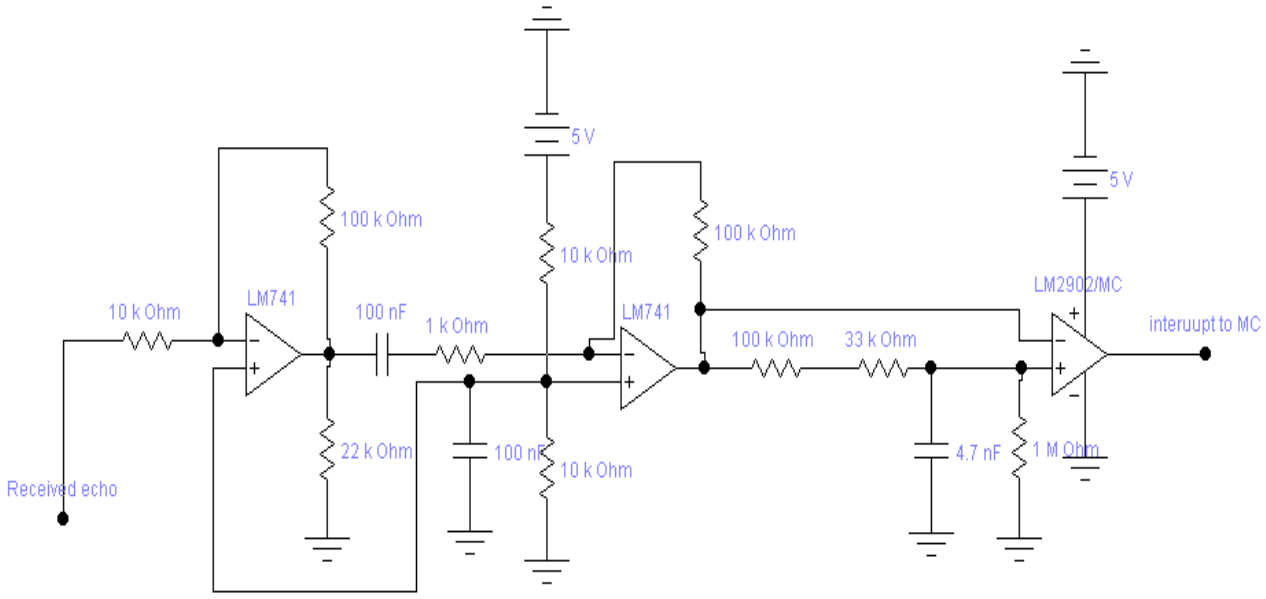



**Fig 3.4 Receiver Circuit**

### 3.2.5 Problem With This Logic

The transmitter and receiver circuit designed above were tested but there was problem with the transducers. On research we found that the model of the transducer we are using is not appropriate for the range finding or we say depth finding. So, we searched the appropriate transducer model and found one.

Another problem was this that we were triggering the transmitting transducer with the help of 555 timer. We studied and found that it is easy to trigger the transducer with the help of microcontroller we were using.

### 3.2.6 Solution Of The Problem

The problem with the OC-40 transducer was solved by selecting the appropriate models to find the range or more precisely depth of the fluid in the tank. We selected the ultrasonic transducer SQ-40 [3] which has the transmitting transducer SQT-40 and receiving transducer SQR-40.

Moreover in the modified logic we are triggering [4] the transmitting transducer with the help of the microcontroller.

## 3.3 Second Logic

The logic is almost same that we used in the previous design. There is only change in the transducer model and also the triggering method of the transmitting transducer. In this logic we are triggering the transmitting transducer with the help of microcontroller. Rest of the process goes the same, the received echo is amplified and given to microcontroller as an interrupt.

### 3.3.1 Complete Circuit Using Sq-40

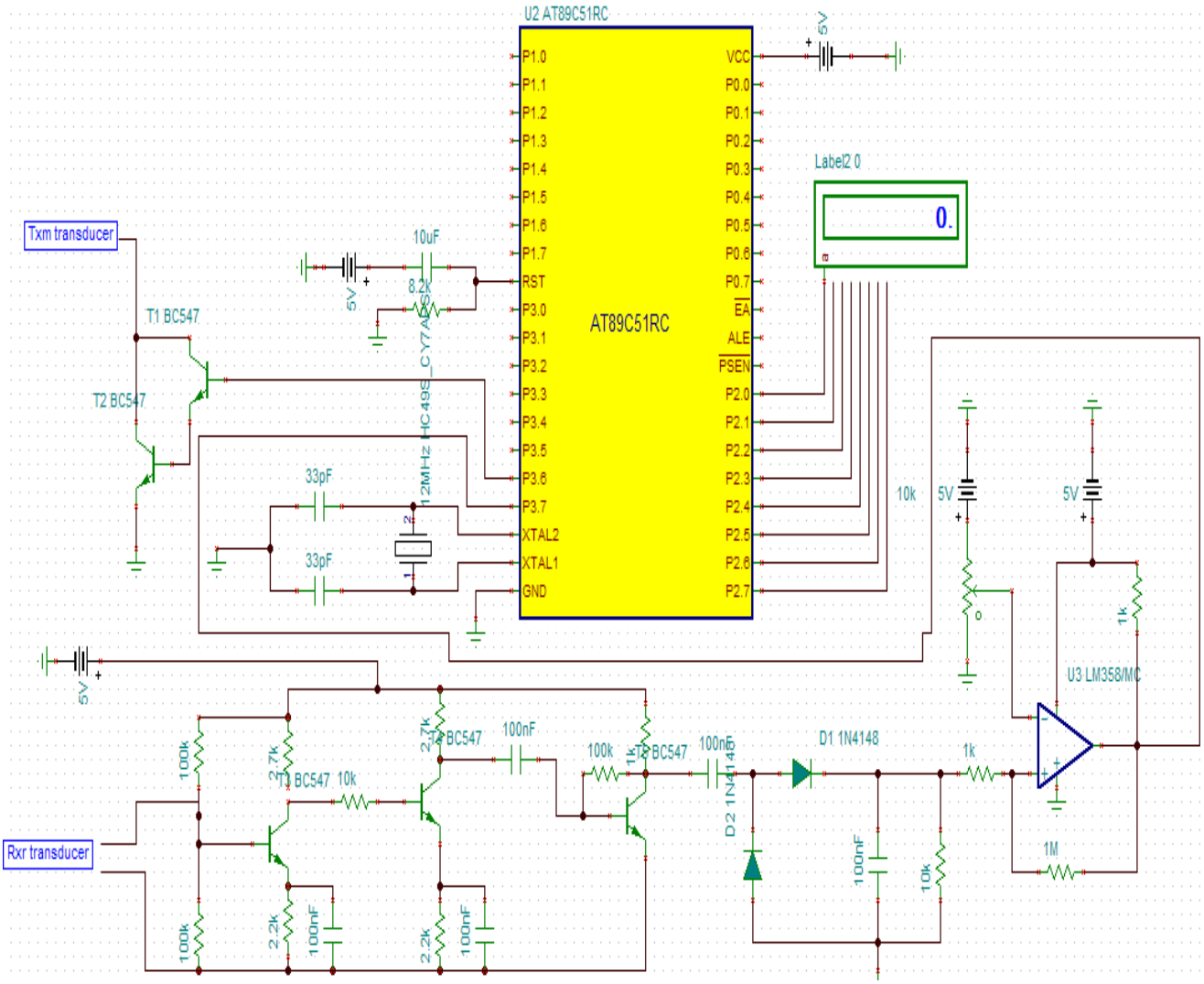



**Fig 3.5 Sq-40 Circuit**

### 3.3.2 Hardware Snapshot

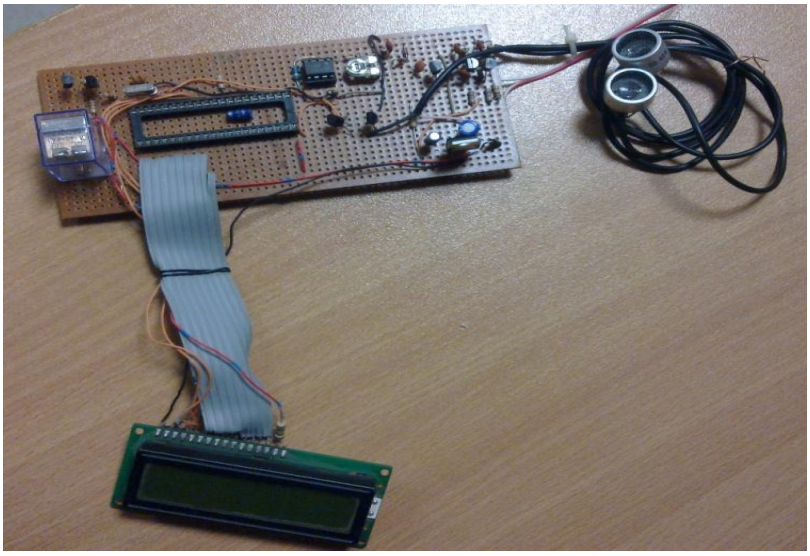


**Fig 3.6 Hardware of Ultrasonic Transducer**

### 3.3.3 Problems With The Ultrasonic Transducer Logic

The problem faced by us here is that ultrasonic transducers are used normally to measure the range of any object from a certain point. They can also be used to find the range in any given medium other than air by simply using the coefficients and velocities of sound in that medium. But in our case to measure level of fuel in the generator tank can have different kind of liquids in it. We cannot just suggest a way to measure the depth of tank when it is containing the water. Because it is very easy to find the speed of sound in water but that method is not accurate to give precise readings of the depth of the tank.

We have designed the transmitter and also the receiver to get the sound transmitted and to receive the echo at the receiver end. We tested our circuit by taking water in a tank. One out of five reading was near to the real value but with amount of error that was not acceptable.

We have concluded that the ultrasonic transducer logic to measure the fuel level of BTS generator is not working accurately. The logic can still be useful and accurate enough to get precise readings if branded modules are used to sense the depth of the level. But the cost of those modules is high and we cannot use them in our project. The purpose of our project was and still is to suggest a method to measure the fuel level of BTS in a low cost. So, we are using another approach now that can be used with any kind of fuel to measure its depth.

The ultrasonic transducer logic is very accurate if you are finding the range of any object from a fixed point. The same logic is used in sonar as well as to find the distance between two vehicles. The ultrasonic logic is successful in air as we know the velocity of the sound in the air medium. The velocity of sound in different mediums is different depending upon viscosity and density of different types of fuel.

### 3.3.4 Solution Of The Problem

We have seen above that the ultrasonic transducer logic is not helping us to find the depth of the tank. The logic itself is not wrong but it is only useful in finding the distance of objects from a fixed one and also in one medium.

The logic we used onward was a complete different one from the previous. We used the float logic to find the depth of the tank. The float logic is very common in measuring the levels of different fluids in our daily routine objects. We worked on the float logic onwards and we find it useful and appropriate in measuring depth of the generator tank. The complete details of the logic are given in rest part of this chapter. The description of the equipment, hardware and software will be coming in the next chapters.

## 3.4 The Float Logic

### 3.4.1 Explanation

The float logic [5] is very simple in understanding. The most common example to understand is the water tank we all have in our homes. There is a pulley type lever in the water tank that is made of plastic material so that it can float on water surface. As soon as water reaches the upper threshold value of the tank, the plastic pulley also comes to almost the straight position which automatically forces the valve in it to close and stop more water coming into the tank. This closing of valve stops the tank to overflow. It can be more cleared from the diagrams given below.

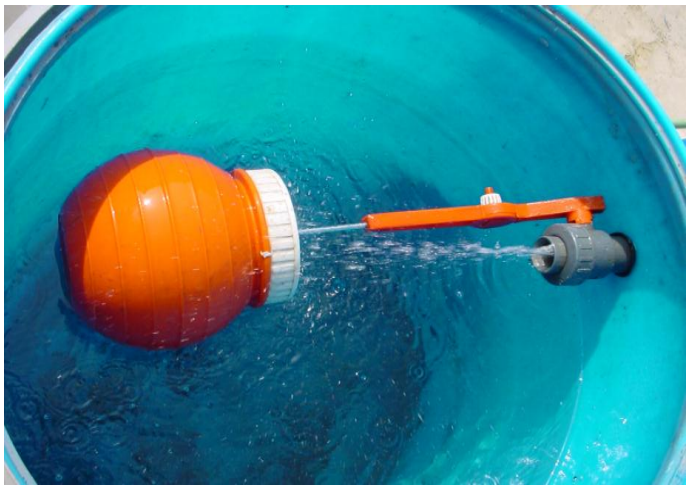


**Fig 3.7 The Float Logic**

The above pictures clearly show that how it works. As water level will be lowered the plastic globe will also go down with the surface of the water. This will open the valve again hence allowing water to fill the tank. This was very common example showing the main logic involved in the float approach.

We have used the same type of thing with little modification. We will use this logic with the help of our specific chosen components, which will allow us to measure the depth of the fuel in the tank. This logic is simpler than the ultrasonic because in this we are not depending on the type of fluid we are using. This logic will be same for all types of fluids. The ultrasonic logic forces you to depend on the velocity of sound in the medium and also the density of the fluid you are using in the tank.

We selected the float logic and worked on it. The next section contains the information about the equipment selection.

# Chapter # 4

# SYSTEM DESIGN

## 4.1 Equipment Selection

This part of the report covers the equipment we selected to practically implement our logic. Later in this chapter we will see that which equipment we selected and the benefit and reason of selection of the specific models.

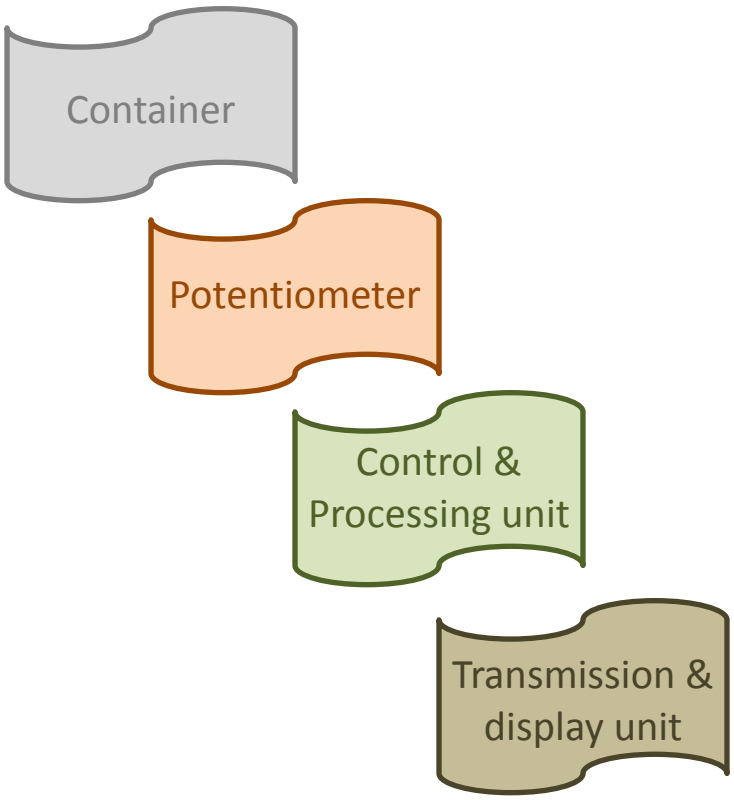



**Fig 4.1 Selected Equipment**

### 4.1.1 Container

We needed a container that can contain some liquid on which we can give our demonstration. The container is basically playing the part of generator's fuel tank. For the purpose of demonstration and implementation of our project on small scale we are using a plastic container that contains the fuel. In our demonstration part, the fuel is shown by water as any liquid can do the job so water is more appropriate for the demo. As our logic is not based on density or viscosity of the fluid we are using so it makes no difference that whatever the liquid we take for demo will do the job.

### 4.1.2 Potentiometer

We are using float logic in order to measure the fuel level so we need a potentiometer. The potentiometer is needed to be fixed on the top of the container so that we can suspend weights on both side of it to float the object on the fluid surface. The potentiometer is controlled by the string that is tied by certain fixed weights on both side of it. The revolving part of the potentiometer is controlled by the thread which moves according to the level of the fluid in the tank.

### 4.1.3 Control & Processing Unit

The control and processing unit contain different things in it namely

- ADC
- Microcontroller

### ADC

The data from the potentiometer is fed in an analog to digital converter (ADC). The ADC converts that data facilitating the microcontroller unit to process the data easily.

### Microcontroller

The microcontroller is the main part that contains the code and the mathematical logic in it. The controller contains the code that is burnt on it to control the processing part. The controller performs all necessary processing on the data and has also got the final result that comes after the whole processing.

### 4.1.4 Transmission & Display Unit

This part of the project displays the results on site as well as transmitting the result through a SMS using a GSM Module phone connected to the serial unit.

### Display Unit

The display unit contains an LCD that is on site which displays the results that is fed to it by the microcontroller.

### Transmission Unit

The transmission unit is the connectivity of a GSM Module to microcontroller. The transmission unit sends the result with the help of a SMS.

## 4.2 Components

The main issue in making any hardware is to select appropriate equipment. After using different components we chose appropriate parts for our hardware, i.e.

- Atmel microcontroller 89c51
- ADC 0804
- LCD 16x2 JRD 162
- GSM Module
- Buzzer (for warning)

## 4.3 Microcontroller 89C51

Atmel microcontroller 8051[6] is a CMOS product which is used for controlling purpose. It is mask programmable device which can be programmed at the time of use and cannot be reprogrammed. So it alternative/derivative is 89c51 because it can be reprogrammed many times.

### 4.3.1 Description

Atmel 89c51 is a low power, high performance CMOS 8 bit microcomputer. It has 4k bytes of flash programmable and erasable read only memory (PEROM). It has 4-ports which are used as input and output. And all ports are bit wise programmed that is each bit can be used as I/P or O/P. it is 8-bit device which means each port have 8-bits for I/O, this makes total of 32-bit controller. The all four ports are not the same. They have different characteristics e.g., port 0 does not have internal pull-ups so we need to connect the external one.

### 4.3.2 Pin Configuration

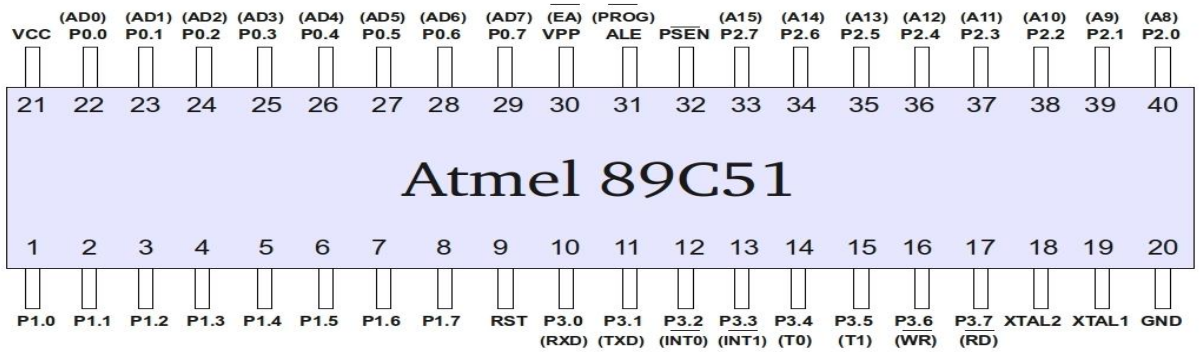



**Fig 4.2 Atmel 89C51 Pin Configuration**

## 4.3.3 Pins Description [7]

### Port 0

Port 0 of the microcontroller 89c51 ranges from pin number 22 to 29. This port is an 8-bit open drain bi-directional input. Port 0 can work in two states. When we are talking about the first state that is when it is being used as multiplexed low order data or address bus. In this state it does not need external pull-ups; it is being served by the internal one. When we are in other state that is when we are using it to give the outputs of the code bytes during program verification. In this state there is no internal pull-ups given to it. So, we need to put external pull-ups that are external pull-ups resistor array to get the output from this port.

### Port 1

Port of 89c51 ranges from pin number 1 to 8. It is also 8-bit bidirectional input output port. This port does not need external pull-ups as it has got internal one. When we write ones on these port internal pull-ups gets high too so we can use it for input purpose.

### Port 2

Port 2 ranges from pin number 33 to 40. Port 2 of the controller is also 8-bit bidirectional with internal pull-ups. Same procedure is followed by this port as we seen it in port 1, if ones are given to this port internal pull-ups also got high hence allowing to use it as inputs.

## Port 3

Port 3 ranges from pin number 10 to 17. Port 3 is also the same as port 2 having internal pull-ups and allowing to be used as inputs. Moreover port 3 has several other functions too which we will see in the coming part.

## Ground

The ground pin of this controller is pin number 20.

## Voltage

The Vcc pin of this controller is pin number 21.

## EA/VPP

This is external access enable pin. If we are fetching the code from external program memory then this pin should be grounded. To use the internal program executions, this pin should be connected to Vcc.

## ALE/PROG

ALE is address latch enable and is used to show the start of any operation.

## PSEN

PSEN stands for program store enable and is used to strobe external program memory. It is activated when we are using external program memory.

## RXD P3.0

The pin number on the controller for this is pin number 10. It is the serial input port.

## TXD P3.1

The pin number for this on the IC is 11 and is used for serial output port.

## INT0 and INT1

INT0 and INT1 are located at pin number 12 and 13 respectively. These are two external interrupts for the controller.

## T0 and T1

T0 and T1 are on pin number 14 and 15 and are serving as timer 0 and 1 for the external input.

## WR

This is pin number 16 of the controller and is used for external data memory write strobe.

## RD

This is pin number 17 and is used for external data memory read strobe.

## XTAL2 and XTAL 1

These are pin number 18 and 19. XTAL1 is the input to inverting oscillator amplifier and also input to internal clock. XTAL2 is the output of the inverting oscillator amplifier.

## 4.4 ADC 0804

Analog to digital converter 0804 is very commonly used ADC. ADC0804 is a successive approximation 8 bit A/D converter. The main feature of this ADC is that it can be sued as a standalone converter. It does not need to depend on some other component with it. This model of ADC is very successful and efficient to be used with microcontrollers. So, the purpose for using this specific model is because it is easy for compatibility with the microcontroller. This ADC can be used simply to give digital data to a microcontroller. There is no need of some programming logic for its interfacing with the microcontroller.

Our purpose was just to convert the incoming data from the potentiometer in digital form and pass it on to the microcontroller. So, this ADC was a very good choice to use with our logic.

### 4.4.1 Pins Configuration [8]

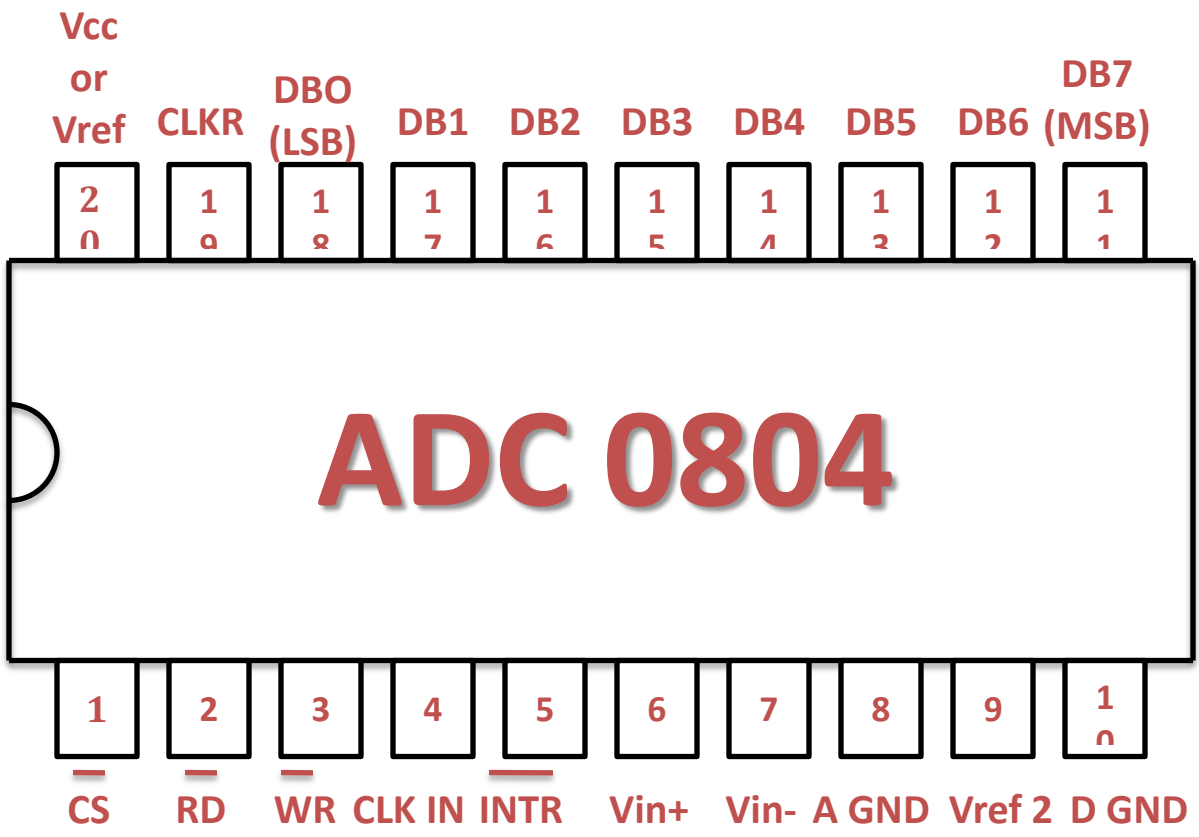



**Fig 4.3 ADC 0804 Pin Configuration**

### 4.4.2 Pins Description

CS → Chip select

RD → Read

WR → Write

CLK IN → Clock in

INTR → Interrupt

Vin+ → Analog voltage input

Vin- →Analog voltage input

AGND → Analog ground

Vref/2 → Voltage reference / 2

DGND → Digital ground

DB 7 to DB 0 → Data bit from MSB to LSB

CLKR → Clock reset

Vcc → Positive supply

## 4.5 Lcd

The LCD is used to display the information of the fuel level at the site of BTS. We have used the LCD model JHD 162A which comes with back light. The LCD is very simple to use. One just has to provide necessary voltage and ground to the LCD pins. The data to be displayed is given to the LCD with the help of data lines simply.

### 4.5.1 Pins Configuration [9]

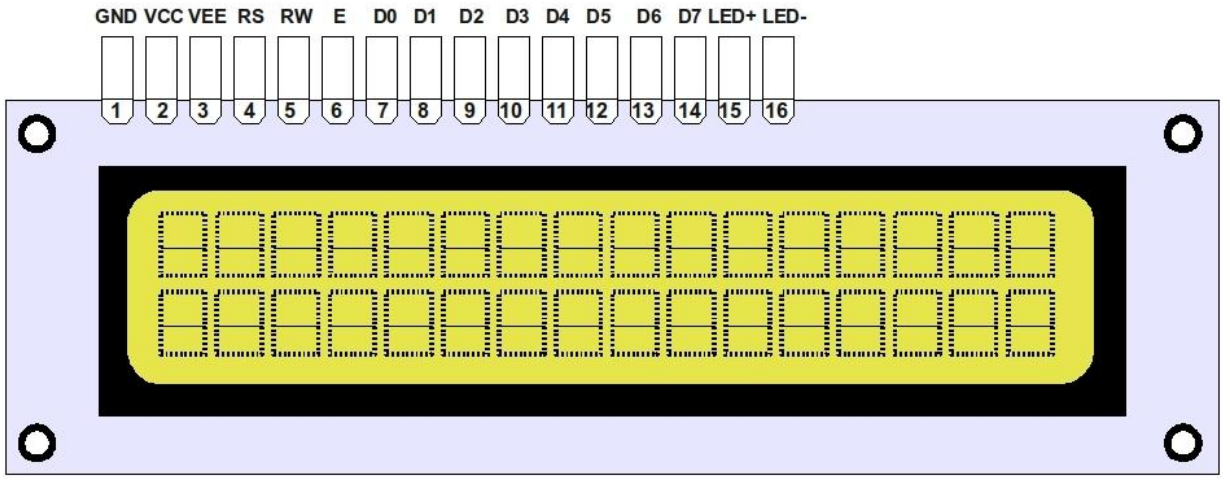



**Fig 4.4 LCD Pin Configuration**

### 4.5.2 Pins Description

Pin 1 → VSS

Pin 2 → Vcc

Pin 3 → Vee

Pin 4 → RS

Pin 5→ R/W

Pin 6 → E

Pin 7 to Pin 14 → DB0 to DB7

Pin 15 → LED+

Pin 16 → LED-

## 4.6 GSM Module


**Fig 4.4 SIM900D GSM Module**

The SIM900D is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications.

Featuring an industry-standard interface, the SIM900D delivers GSM/GPRS 850/900/1800/1900 MHz performance for voice, SMS, Data and Fax in a small form factor and with low power consumption. With a tiny configuration of 33mm x33mm x 3mm, SIM900D can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

- SIM900D is designed with a very powerful single-chip processor integrating AMR926EJ-S core.
- Quad-band GSM/GPRS module with a size of 33mm x 33mm x 3mm.
- SMT type suit for customer application.
- An embedded powerful TCP/IP protocol stack.

# Chapter # 5

# SYSTEM IMPLEMENTATION

## 5.1 Hardware

The hardware part of the project is usually the most important one. The reason of its importance is because all the work done up till this stage is planned and designed to implement it on hardware. So, this part is basically the practical implementation of all the approaches and ideas thought and considered till now in order to get the required results.

The hardware part of our project contains the fabrication of circuits of different parts and then interfacing them to get the required product. We decided to go on with the fabrication process in steps.

The first step was to make the circuits on bread board in order to check them and make necessary changes if needed in the initial design and parts selection. So, all the circuits were first made on bread board to check their working and finalizing their components so that they can be fabricated for permanent use.

Now, we see that which circuits we had to make for the desired outcome. The hardware part contained the following things

- Potentiometer fitting on a container
- Complete control & processing unit circuit
- Transmission & display unit circuit
- Interfacing of potentiometer unit with control & processing unit
- Interfacing of the control & processing unit with the transmission & display unit.

## 5.2 ADC

The model we used for analog to digital converter is ADC 0804. The pin configuration of the ADC 0804 is given below.

### 5.2.1 Pins Configuration

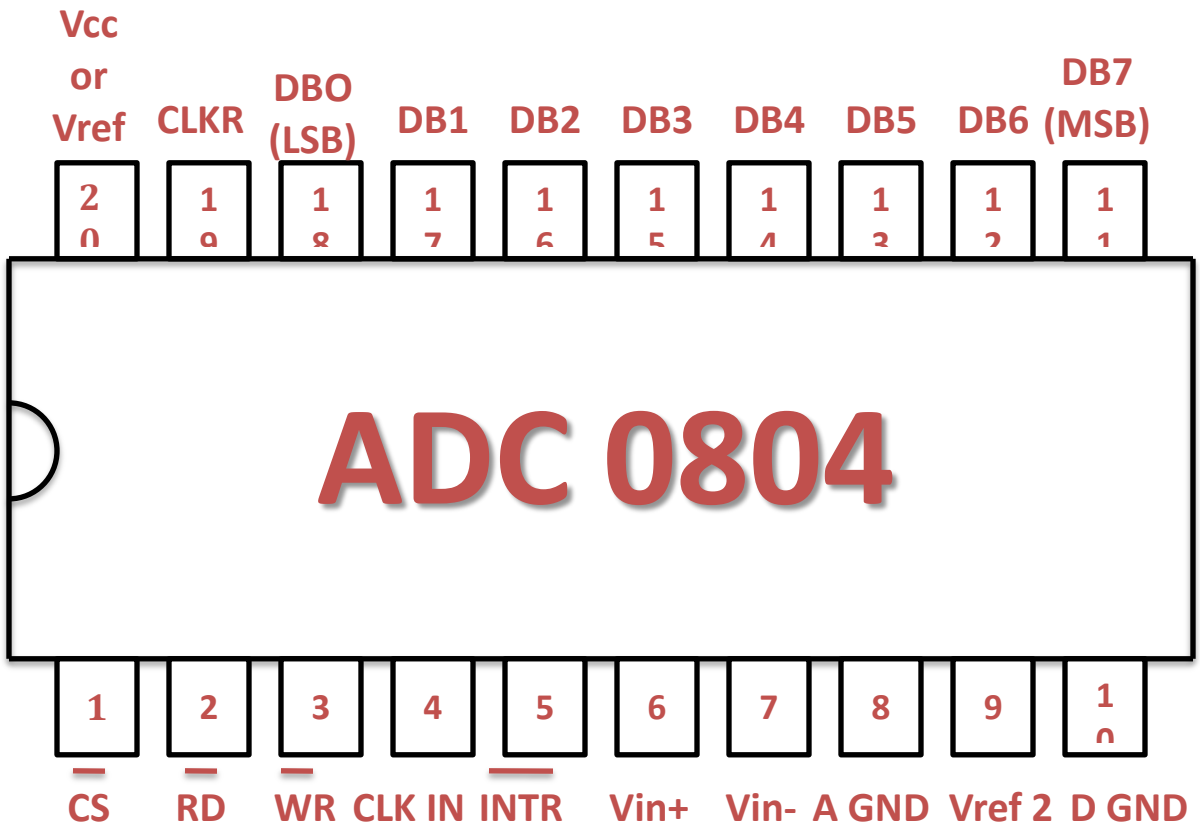



**Fig 5.1 ADC 0804 Pin Configuration**

### 5.2.2 Working

The ADC 0804 is integrated in the circuit to convert the analog data coming from the potentiometer. The potentiometer is sending the analog data to the ADC so that it can be converted to digital form. The data is needed in digital form so that it can be processed in the microcontroller. The data pins of the ADC 0804 are from pin no 18 to pin no 11. Pin 18 is the least significant bit and the pin 11 is most significant bit. The digital data converted by the ADC is fed to microcontroller with the help of data pins of the ADC. The data is directly fed to one of the ports of the microcontroller. The hardware snapshot of the ADC fabricated in the hardware circuit is given below.

### 5.2.3 Components Used

- ADC 0804 IC with jacket
- Capacitor
- Resistors

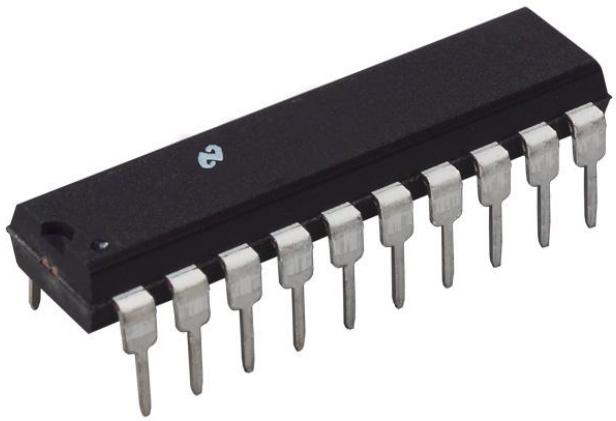
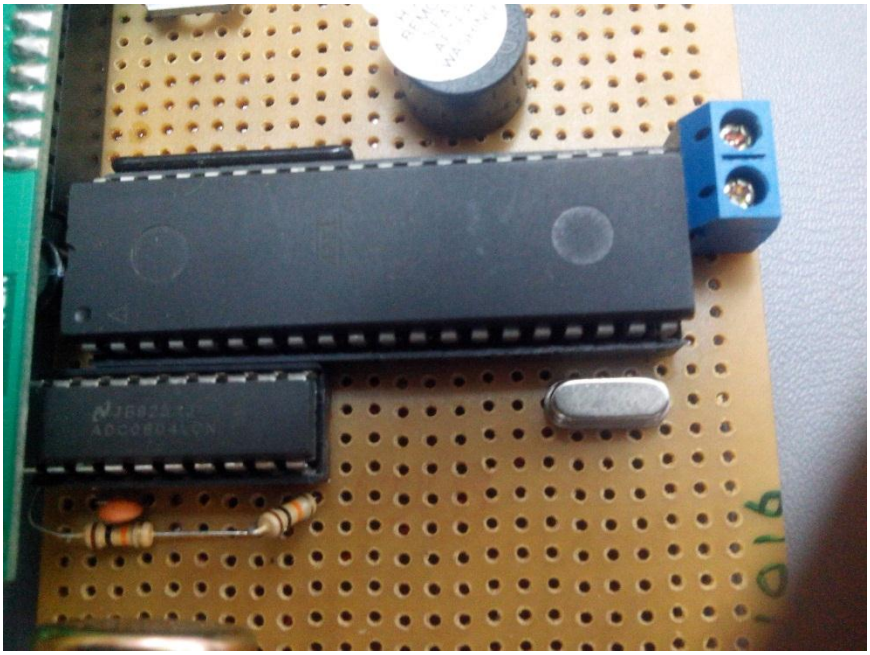
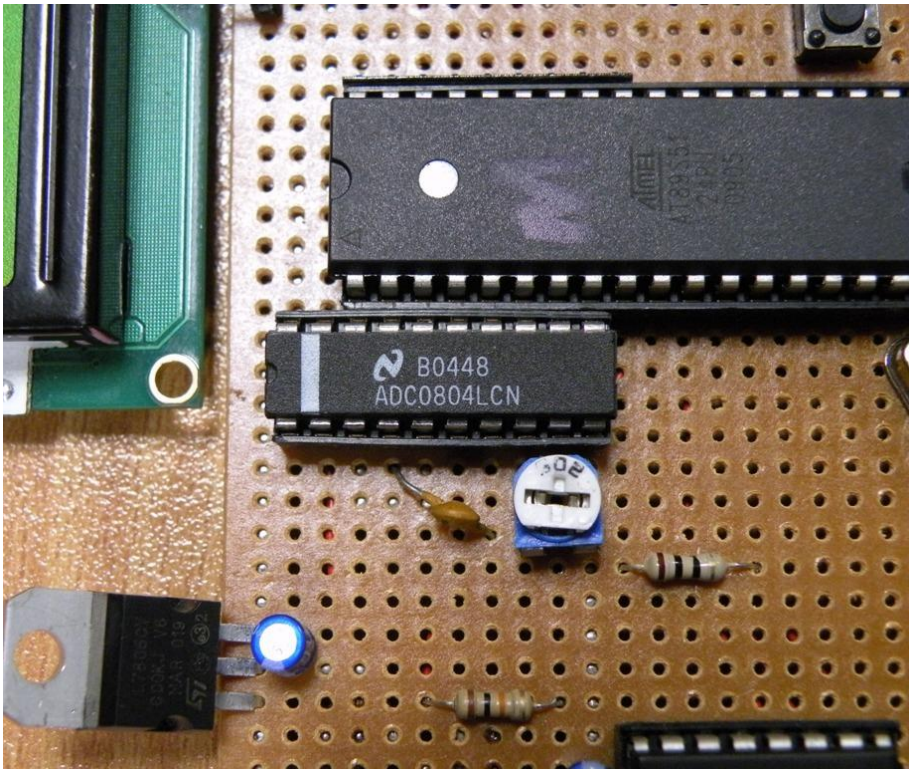


**Fig 5.2 ADC 0804**

### 5.2.4 Hardware Snapshot





## 5.3 Microcontroller

The microcontroller we used is 89C51. The reason for selecting this microcontroller and also the specification of this model is already been discussed in the equipment selection chapter.

Microcontroller pin configuration is given below.

### 5.3.1 Pin Configuration

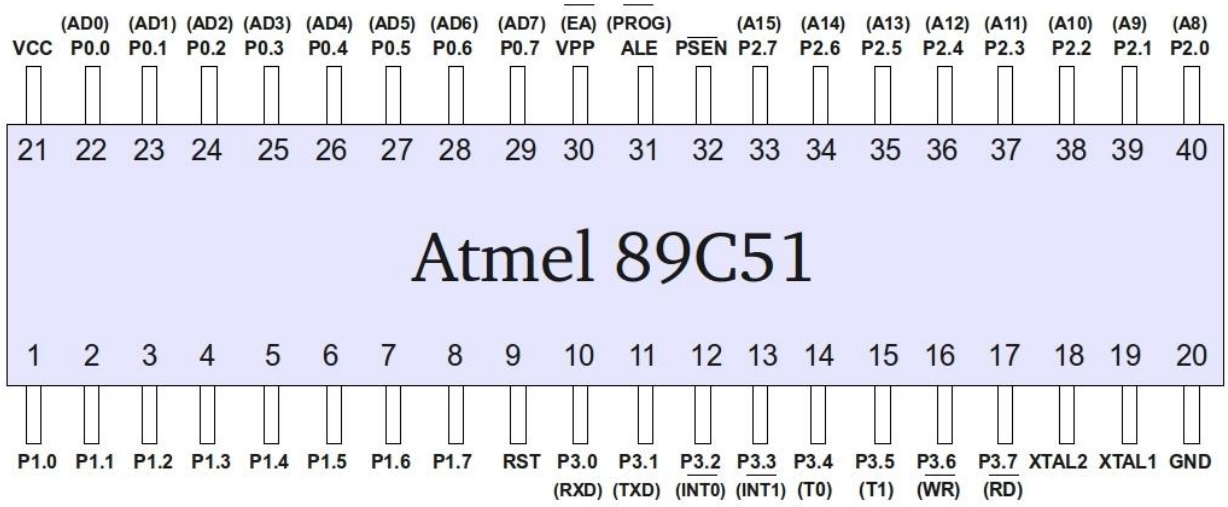



**Fig 5.3 Atmel 89C51 Pin Configuration**

### 5.3.2 Working

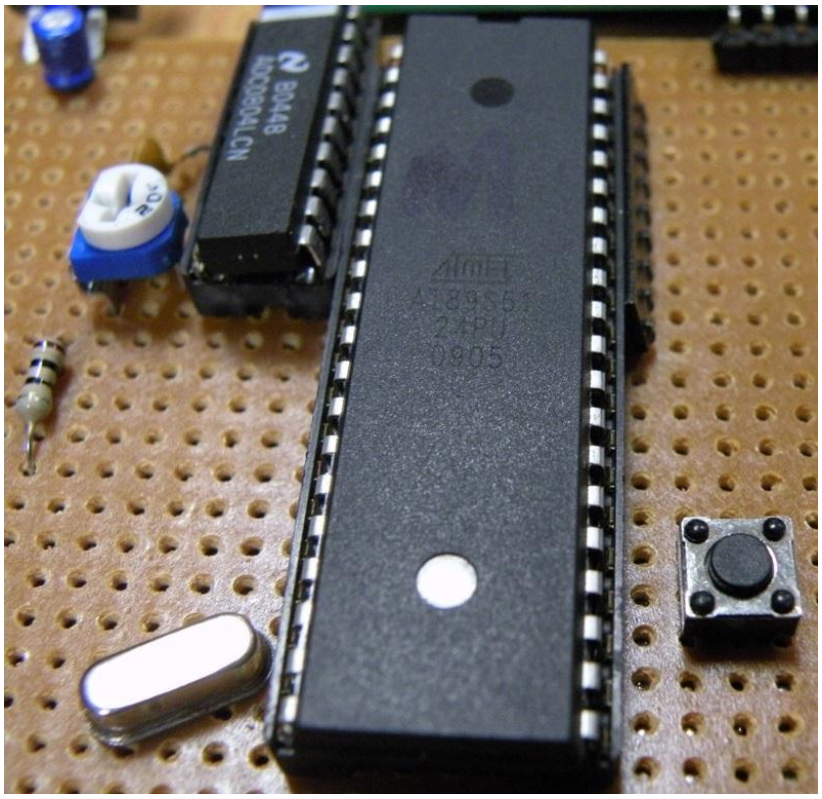
The microcontroller is the main part of the hardware. It is controlling all the processing of the logic. The data is fed to its one of the ports by the ADC. The data fed is digital and is easy to process it.

The microcontroller coding is done by us in C language. The reason for using the C language for coding is this that we are familiar with the C language coding and is also easy than the assembly language coding. The code is burnt in the microcontroller which was made on the software first.

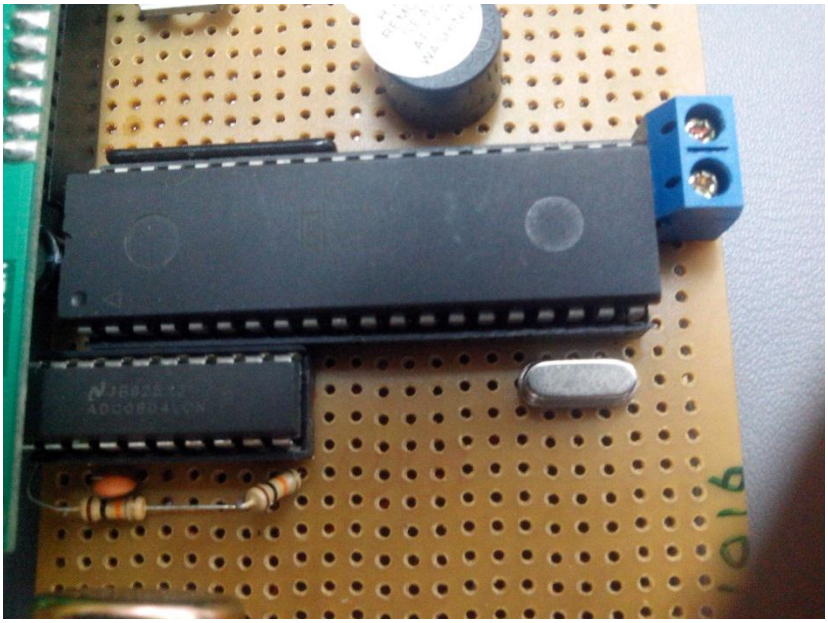
The coding part of the project will be explained in one of the next chapters that will be the software part. The main logic used is very simple. The data which is coming from potentiometer is giving variable values. The analog data is fed into the ADC to get the digital form of the data so that it can be easily processed by the microcontroller.

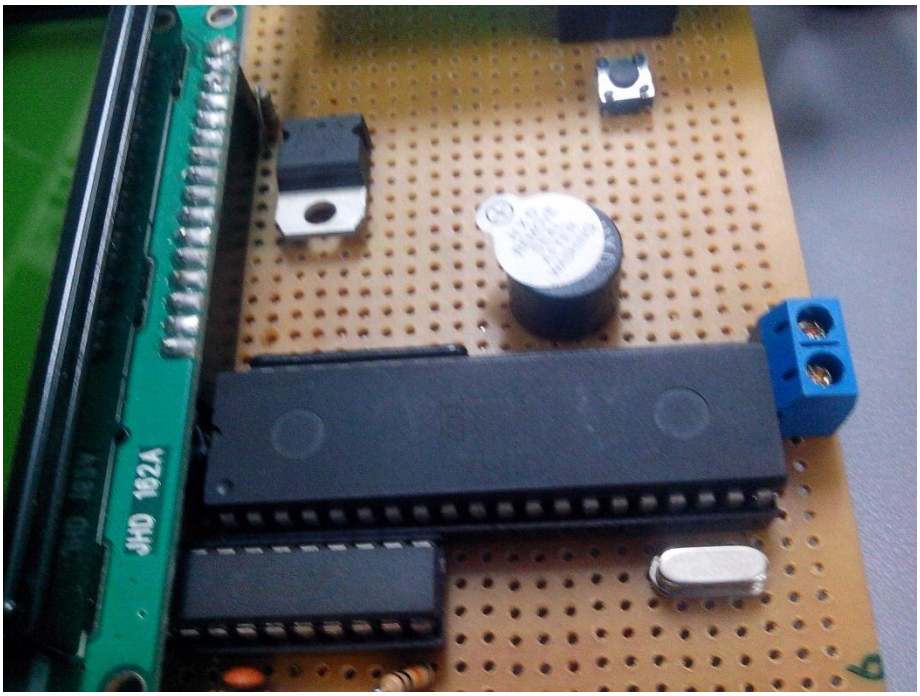
### 5.3.3 Components

- 89C51 microcontroller IC with jacket
- Crystal oscillator
- Capacitors
- Resistors
- Push button



### 5.3.4 Hardware Snapshot





## 5.4 LCD

LCD is used to display the results at the site of BTS. We are transmitting the information via SMS but we are also displaying information on LCD at site. The LCD is connected to port 0 of the microcontroller. It has been discussed earlier also that there is no internal pull-ups resistor in the port 0 of the microcontroller so we used external resistors in order to get the outputs from the port 0 of the microcontroller.

### 5.4.1 Pins Configuration

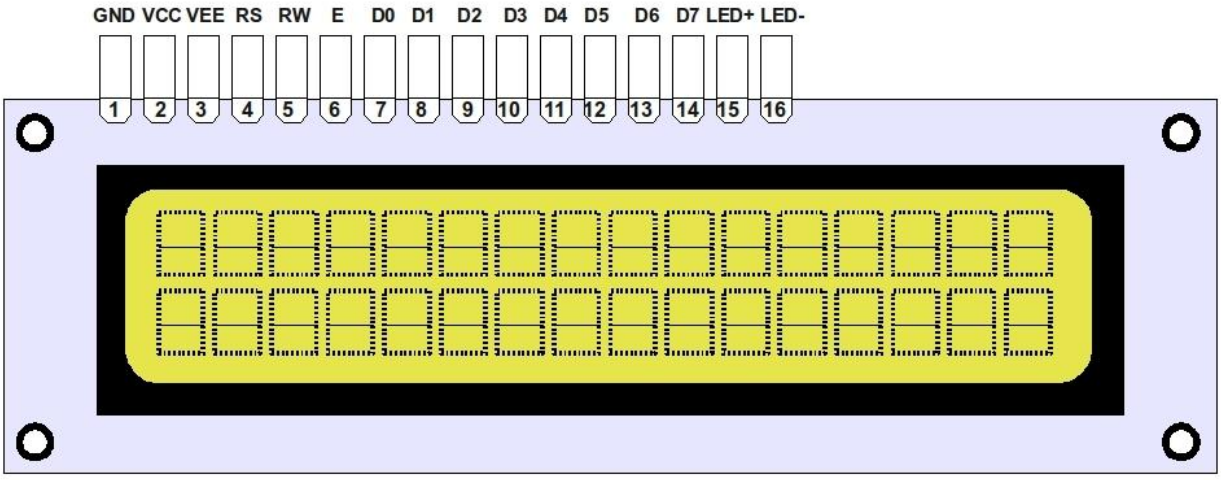
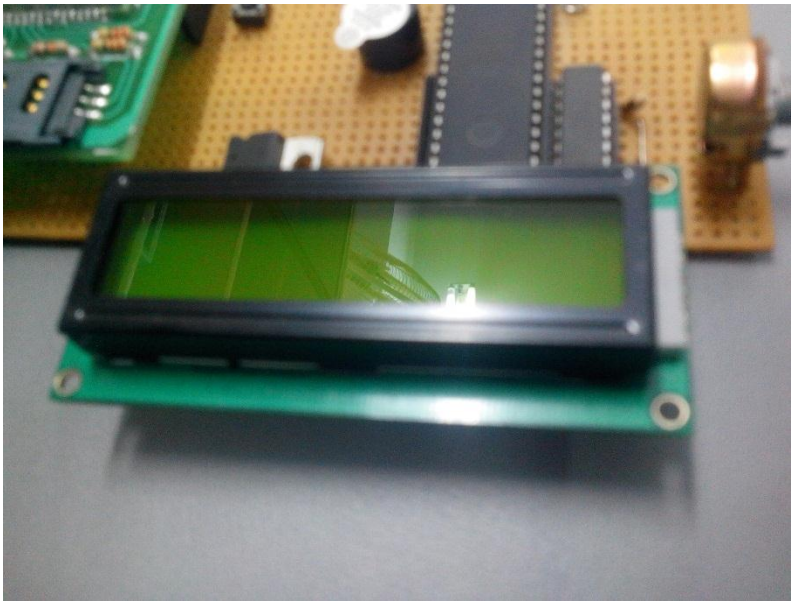


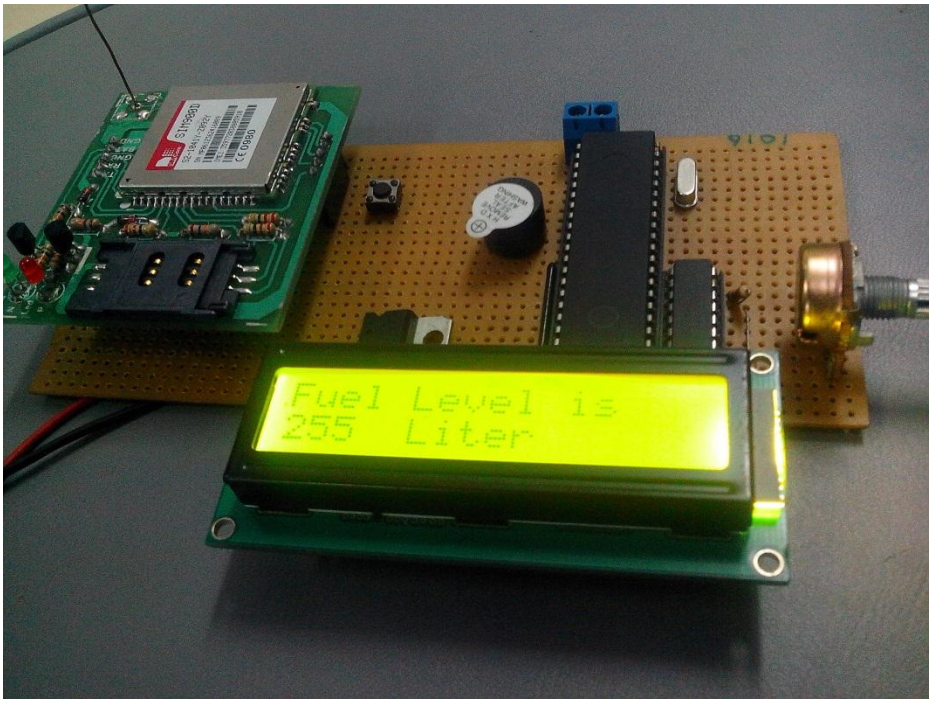

**Fig 5.4 LCD Pin Configuration**

### 5.4.2 Working

The LCD working is simple. We are giving proper voltage and ground at the specific pins of the LCD. Moreover the data from port 0 is being sent directly to all data pins of the LCD. The LCD is simply displaying all the information that is being sent by the controller at the port 0. We have used a resistor array at the port 0 that is acting as external pull-ups. A variable resistor is also used with pin number 1 and 2 and output is given to pin number 3 of the LCD. The purpose of this variable resistor is to control the brightness of the LCD.

### 5.4.3 Hardware Snapshot





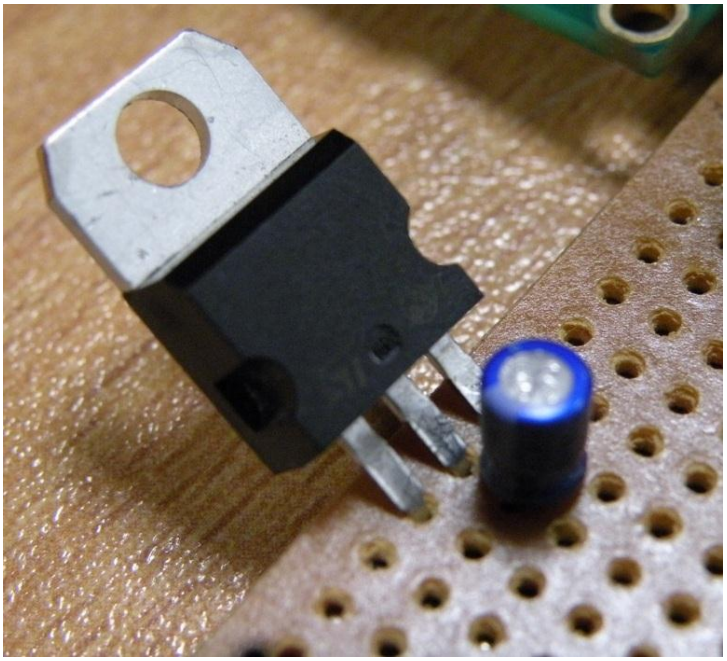
## 5.5 Voltage Regulator

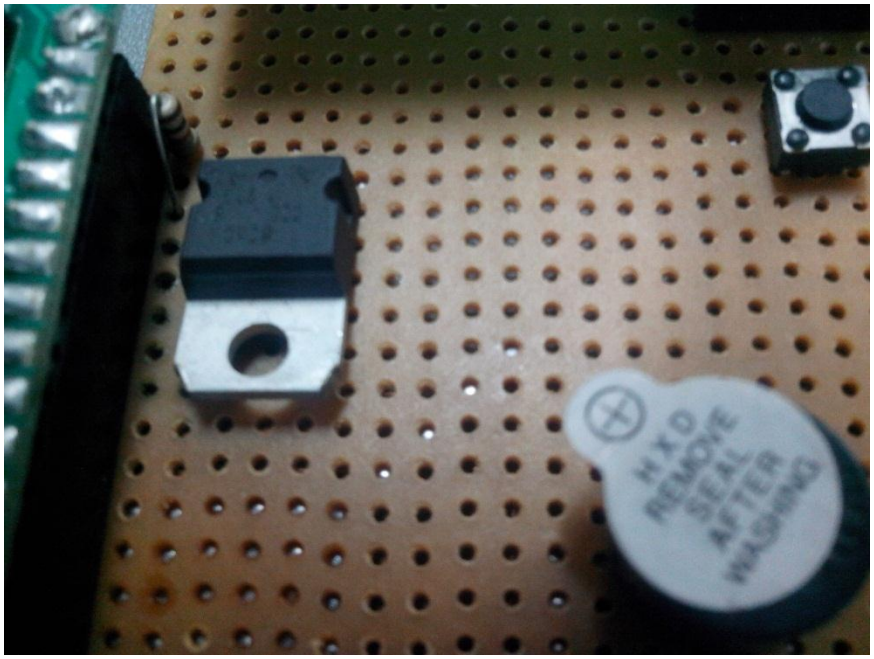
The voltage regulator is made in the circuit to maintain the voltage for all ICs and LCD to be 5V. The output of the power supply is 9V DC. So we are using a voltage regulator that will convert that 9V DC to 5V DC.

### 5.5.1 Components Used

- Voltage regulator 7805
- Capacitor

### 5.5.2 Hardware Snapshot




H.K.D
REMOVE
SEAL
AFTER
WASHING

# 5.6 GSM module

GSM Module we are using is SIM900D. It is interfaced with the micro controller. The snapshot of that is given below.

## 5.6.1 Snapshot

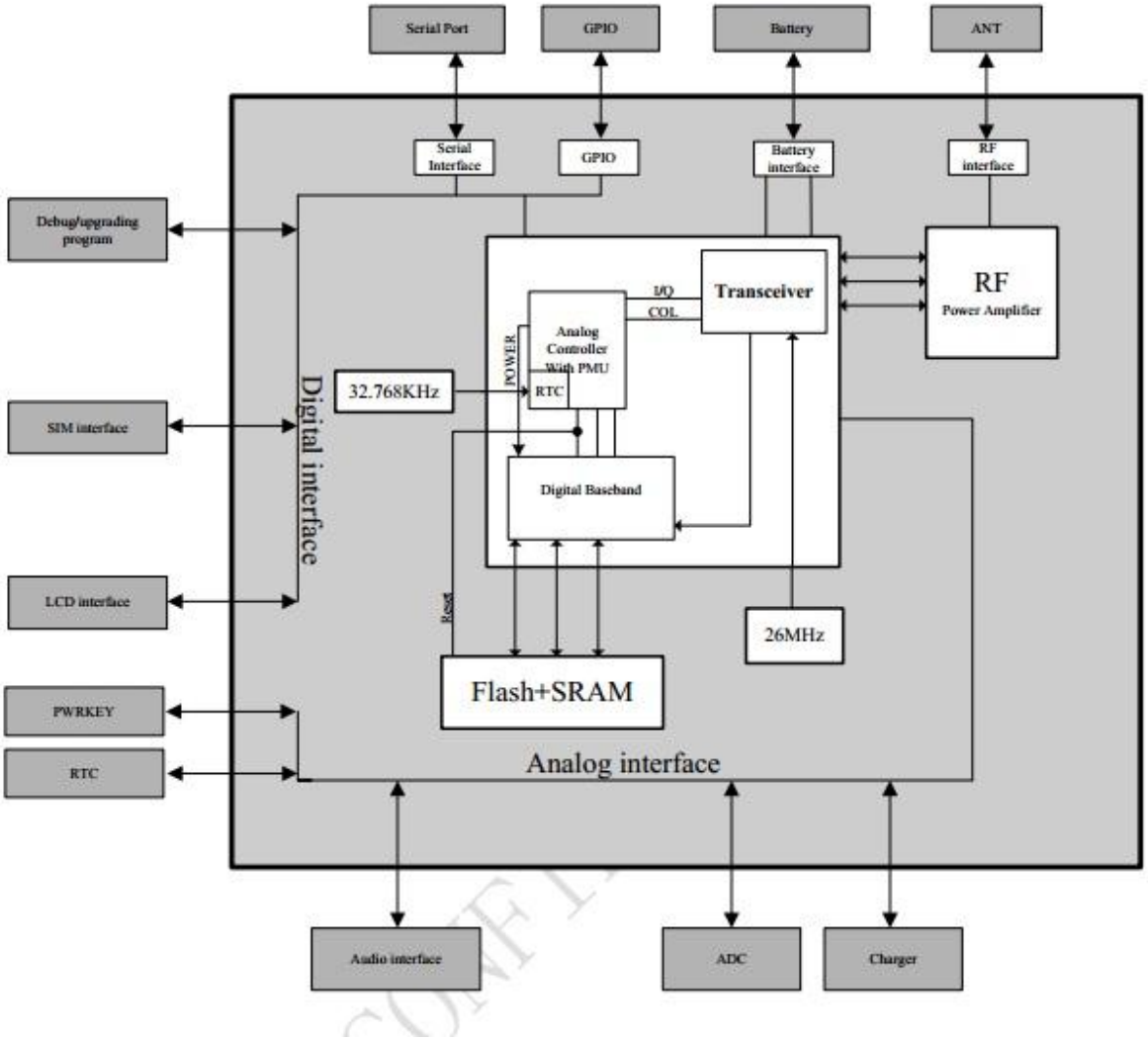
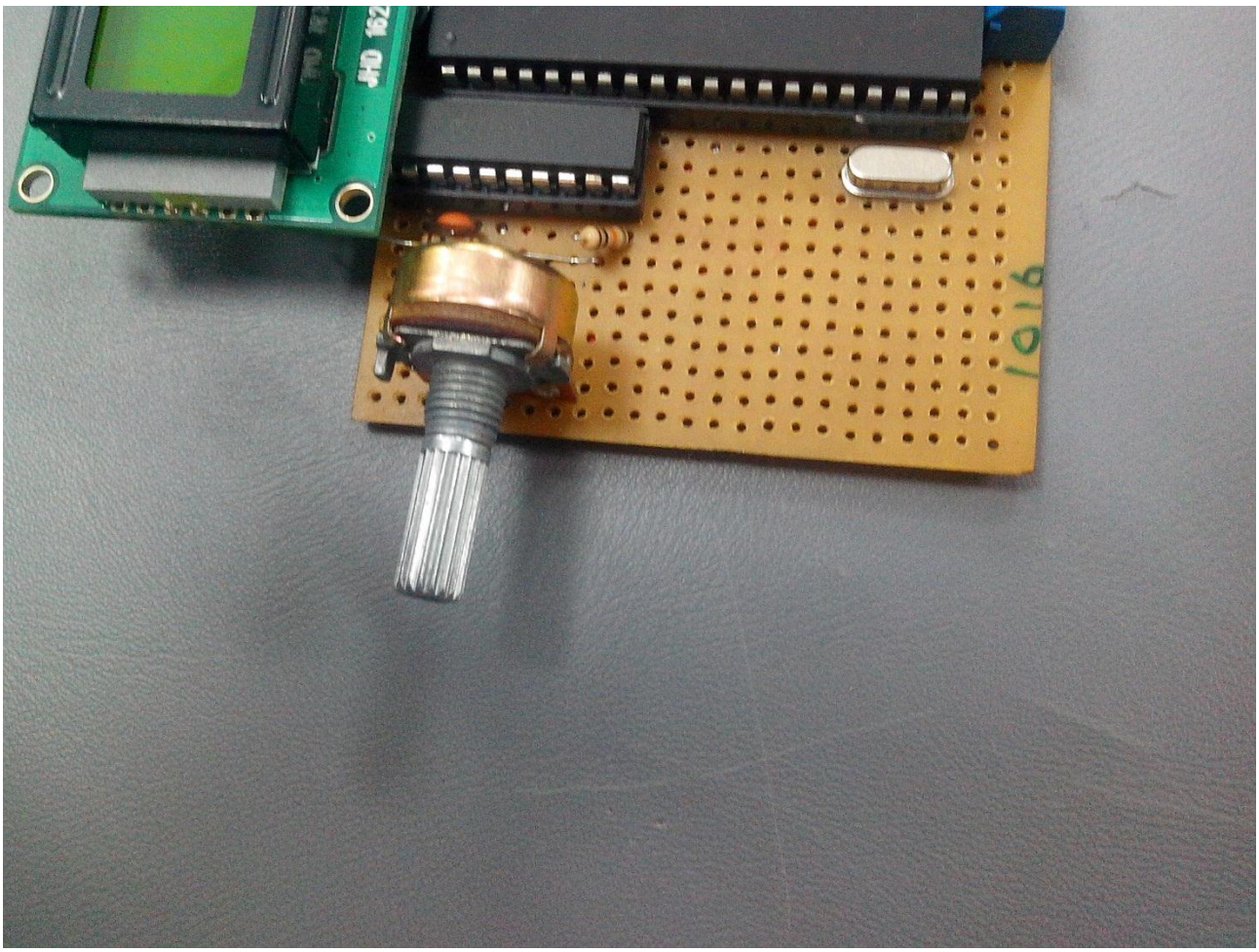



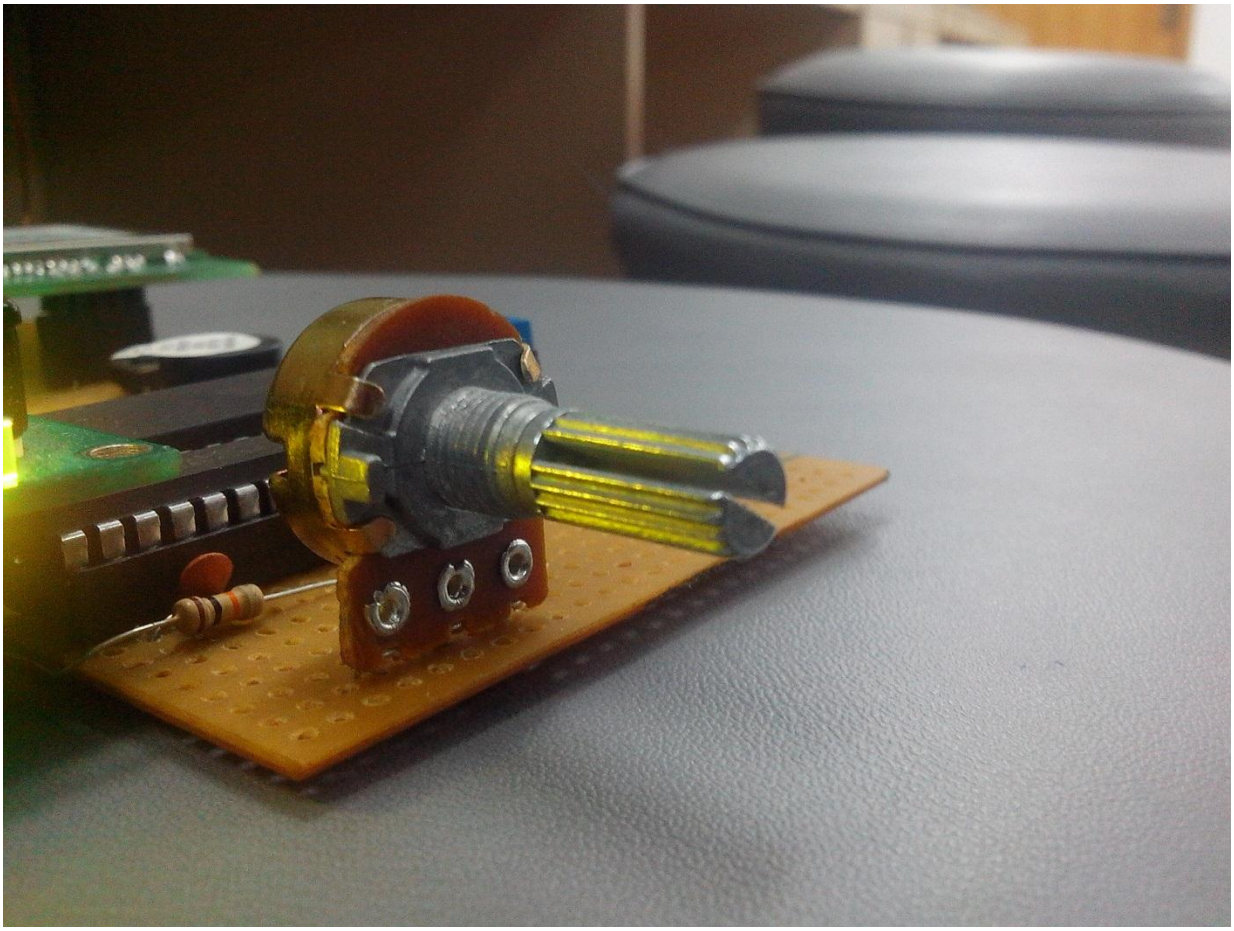

**FIG 5.5 SIM900D Functional Diagram**

## 5.7 Potentiometer

The potentiometer fixed at top of the tank to suspend wait in the water is the model that give 0 to 5 V in 255 steps. The steps are from 0 to 255 that make it 256 steps in total. The total number of steps explains the logic that it is 8 bit data that is send to the ADC to get its digital form. The 8 bit digital form of the data is send directly on data line to microcontroller for processing.

### 5.7.1 Hardware Snapshot





## 5.8 Complete Hardware Fabrication

The hardware was fabricated and different parts were interfaced with each other in order to complete the hardware. All the parts of the hardware were fabricated on Vero board and all the fixation of the components and the soldering was done by us. The circuit diagram and snapshots of the hardware are given below.

### 5.8.1 Circuit Diagram

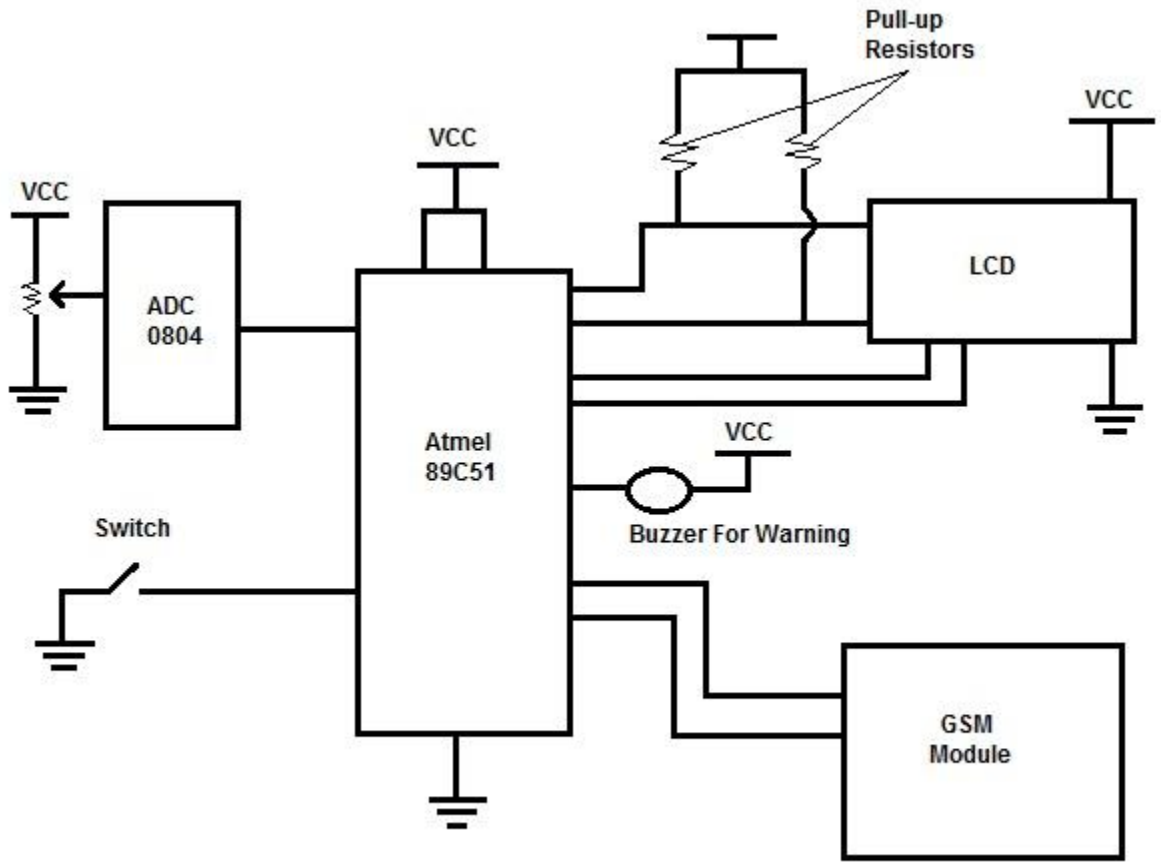
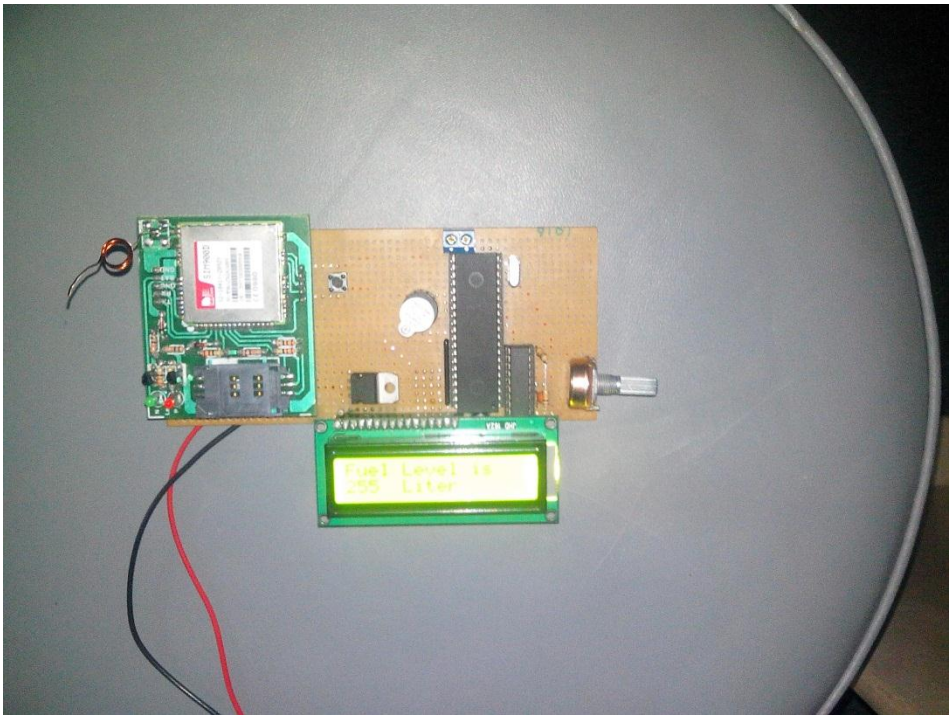
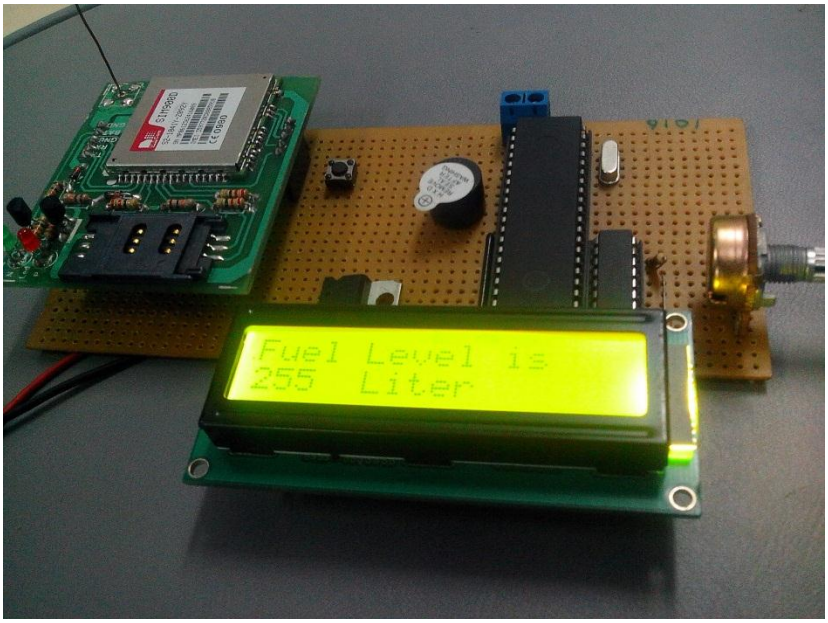
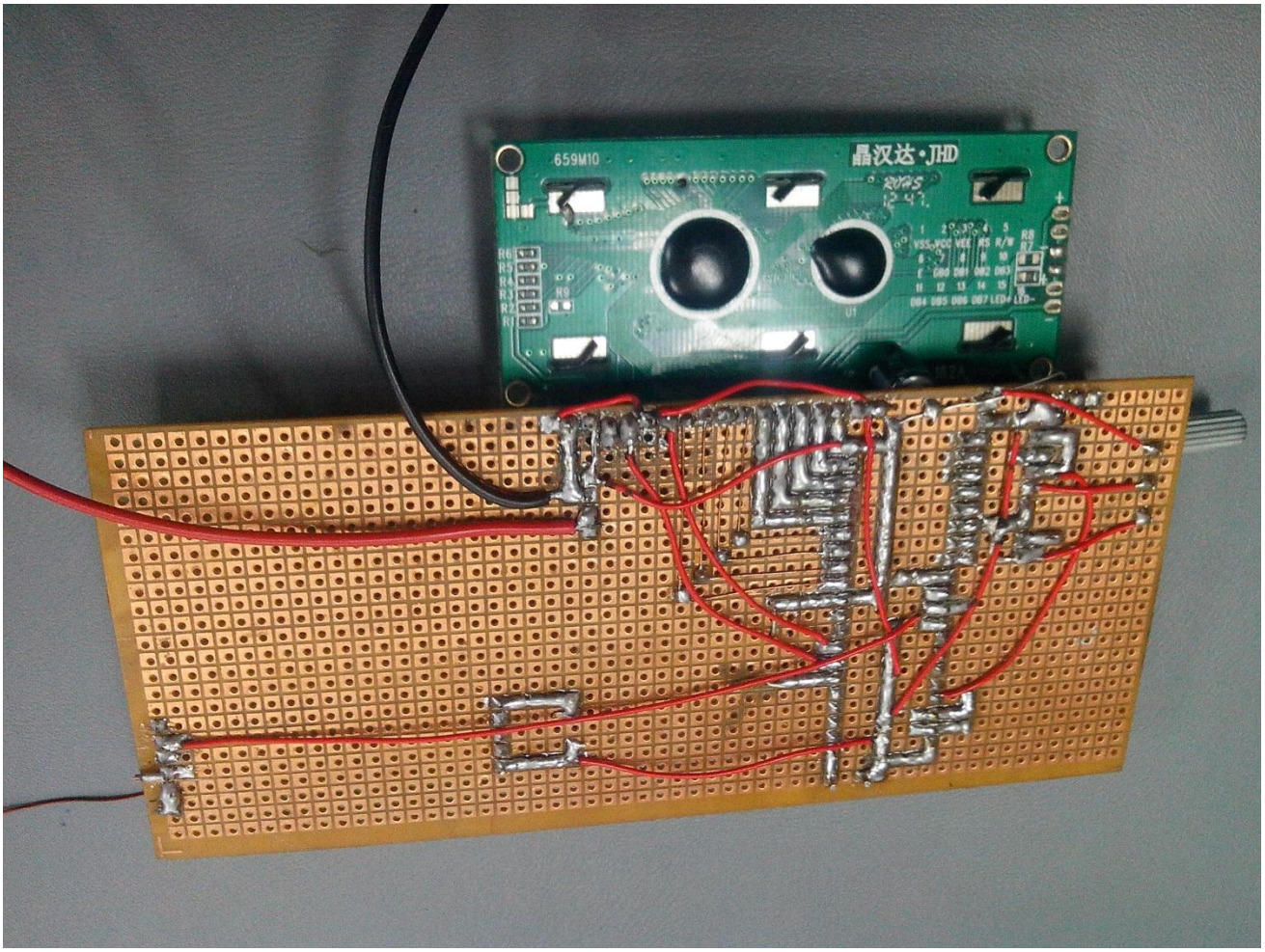


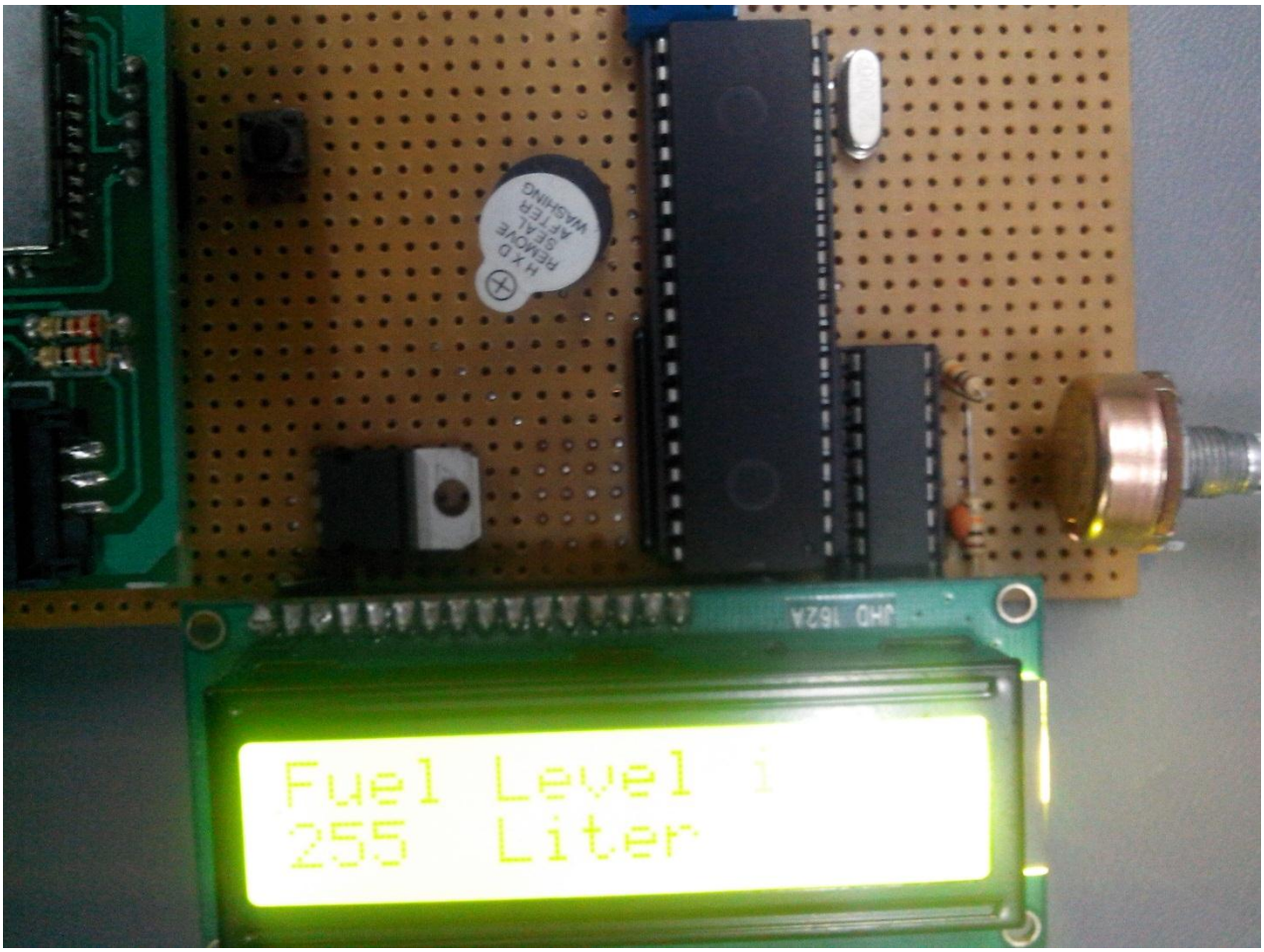

**Fig 5.6 Circuit Diagram**

## 5.8.2 Complete Fabricated Circuit Snapshots




659M10
晶汉达·JHD


REMOVE SEAL AFTER WASHING
Fuel Level
255 Liter

# Chapter # 6

# SYSTEM TESTING AND EVALUATION

## 6.1 Software

The software part of the project contains interfacing of the GSM Module with circuit and programming of the microcontroller and the ways of retrieval of the sent SMS on the receiver's side.

The purpose of our project is to measure the fuel level of the generator tank. We have seen the hardware part of the project that how we fabricated different parts and how we interface them with each other. The processing of the data that was coming in the microcontroller is done in the coding part of the project. The coding is done using Micro Vision software.

## 6.2 Coding

```
#include <AT89X51.H>
#include <string.h>

char unit = 0;
char tens = 0;
char hundred = 0;

int fuel = 0;
int fuel_temp = 0;

void decode(int i)
{
unit = i % 10;
tens = (i % 100) / 10;
hundred = (i % 1000) / 100;
}


void display(void)
{
print_lcd("Fuel Level is");
decode(fuel);
send_char(hundred);
send_char(tens);
send_char(unit);

send_char('L');
send_char('i');
send_char('t');
send_char('e');
```

```
send_char('r');
}


void send_SMS(void)
{
comm_talk("AT+CMGF=2");
comm_talk("AT+CMGS=00923027055155");
comm_talk("Fuel is being stolen. Previous reading was ");
decode(fuel_temp);
SBUF = hundred;
SBUF = tens;
SBUF = unit;

comm_talk(" liter. And current reading is  ");
decode(fuel);
SBUF = hundred;
SBUF = tens;
SBUF = unit;
comm_talk(" liter. While generator is off");

}

void main (void)
{
SCON = 0x50;
TMOD = 0x22;
ES = 1;
EA = 1;
TH1  = -13;
TR1  = 1;

print_lcd("Anti Fuel Theft ");
print_lcd("and Fuel Meter  ");


while(1)
{
fuel = P1;

display();
if(P2_0 == 0)
{
fuel_temp = fuel;
}

else
```

```
{
if(fuel < (fuel_temp - 10))
{
print_lcd("Fuel is being   ");
print_lcd("stolen          ");
P2_5 = 0;
send_SMS();
fuel_temp = fuel;
P2_5 = 1;
}
}
}



}
```

## 6.3 Receiver Side

There are so many ways to retrieve the SMS at receiver side. It totally depend on Telecom companies and their control room system that how they maintain the log of the received messages.

One simple way to connect the receiver GSM Module using the USB cable and connecting the GSM Module to computer in pc suite mode. So, you can maintain a log of the incoming messages and also you can back up the messages in the computer.

The other method is to connect the receiver GSM Module to com port of the computer. Then by using the MATLAB, Visual basic or any other software you can read the GSM Module data by reading the com port and the maintaining a log of the fuel levels or making a graph showing the fuel level of previous hours or days.

## 6.4 Testing and Troubleshooting

The hardware components we fabricated are interfaced to check the working of the circuits. All the components were interfaced and connected using appropriate cables and connectors.

All the fabricated circuits were working fine and there were giving the desired results. The level of the fluid in the tank is displayed on the LCD. Moreover the level is also transmitted automatically via SMS through the connected GSM Module. The necessary AT commands to send the SMS through the GSM Module is being given by the microcontroller. The microcontroller code also contain the AT commands that have been used to transmit the information via SMS.

## 6.5 Power Rating of the Hardware Parts

The power rating of different components in the circuit is given below.

| Component | Voltage (V) | Current (mA) | Power (W) |
|---|---|---|---|
| **Microcontroller circuit board** | 9 | 600 | 5.40 |
| **GSM Module** | 4 | 450 | 2.21 |
| **Potentiometer** | 3.3 | 50 | 0.165 |
| **Total** | | | 7.78 |

**Table 1.1 Power Rating of the Hardware Parts**

# Chapter # 7

# Conclusion

## 7.1 Cost Analysis

We tested different logics by using different components. Finally we succeeded in selecting the approach and logic to get the fuel level of the generator tank. The cost of design and circuits of the final logic that is tested successfully are given below.

| Component Name | Cost in PKR Rupees |
|---|---|
| **Potentiometer** | 300 |
| **ADC** | 50 |
| **Microcontroller** | 220 |
| **LCD with backlight** | 450 |
| **Other components** | 450 |
| **Vero board** | 130 |
| **GSM Module** | 5000 |
| **Total Cost** | **6600** |

**Table 1.2 Cost Analysis**

## 7.2 Future Work

The float logic is used to measure the level of the fuel in the tank. This logic is very useful in measuring any liquid level in any tank or on larger basis. The same logic can be used to measure the water level in home tanks and getting the information about the level on your GSM Modules. This can be very useful as you need not to check the level by physically monitoring the water tank.

The logic and programming used to transmit the information wirelessly via SMS can be used in so many applications. Car security systems are very important application for this. At any time you leave the car and it is away from you, you can have a check on your car via SMS. The circuit can be designed that can operate on your car battery. At any time someone will start your car or try to steal it, you can get a SMS giving information regarding the theft or starting of the car by unauthorized person.

These days home automated systems are very popular around the world. There are different functions in it like controlling different operations of your home via SMS. You can control you home central air conditioning system with just one SMS. There are so many other applications of this in home automated system.

The work we did on the project can be further taken forward to make the system more efficient and different other features can be added. On the receiving side of the messages you can have complete software that is controlling the fuel level. There can be fixed threshold levels of the fuel that At any time that level is reached an automatic SMS is generated to the replenishing team notifying that replenishing is needed at the BTS site of some city or some mentioned place. Moreover, same circuit and design can be made as a product so that it can operate efficiently.

# REFERENCES


[1]http://downloads.ziddu.com/downloadfiles/7773232/GSM%20MATERIAL%20CP02.pdf

[2]http://www.electronicsinfoline.com/Projects/Electronics/Infrared_and_Ultrasonic/Distance_Measurement/ultrasonic_range_finder_uses_few_components.shtml

[3] http://uk.farnell.com/multicomp/sq-40-t-10b/transmitter-ultrasonic/dp/213214

[4] http://www.best-microcontroller-projects.com/pic-sonar.html

[5] http://www.answers.com/topic/float-switch

[6] 8051 Microcontroller 3rd Edition Scott MacKenzie and 8051 microcontroller and Embedded System By Mazidi

[7] http://www.atmel.com/dyn/resources/prod_documents/doc0265.pdf

[8]http://www.datasheetcatalog.org/datasheet/nationalsemiconductor/DS005671.PDF

[9]http://www.alldatasheet.com/datasheetpdf/pdf/127934/ETC/JHD162A.html