CHAPTER – 1

INTRODUCTION

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1.1 Aim and objective

This project aims to accurately indicate in volume, the liquid in the given tank for both vehicular and commercial based tanks. Today in this developing digitalised world it is essential to digitalise this task of checking the liquid level as well which will help to know the exact amount of liquid available in the tank. The above furnished fact is considered in our project and we found out a proper solution for indicating the accurate availability of liquid in the tank in our phone at any given place or time. The technology used is simplistic, easy to understand and easier to operate.

The technology uses simple scientific principles to its advantage in order to put forth the output in the mobile application. The use of simple algorithms has helped comprehend complex data into an application and made readable to the common man. This application in turn helps plan the effective usage of liquids in various platforms (i.e. commercial, industrial, household, vehicular, military and medical usage based). Using simple concepts of IoT and embedded systems this application receives data which is portrayed in a user-friendly interface. The objective of this application is to regulate the usage and reduce the consequent loss of the given liquid.

In terms of statistics, approximately 45 billion litres of water is wasted everyday globally out of which, 78 million litres of water from over-head tanks not stopping the filling process and overflowing in turn. At least 5.6% of occupational deaths in the chemical industry is caused due to the repair of the liquid level indicators on the walls of the container. This problem will be solved in this project.

1.2 About the System

Here we use ultra-sonic sensors to accurately read the liquid level. The reading here, is transmitted to the mobile phone which in-turn reads and interprets the received values and produces the necessary output. To avoid tampering of the connection, we provide authentication to the respective user alone within the application. This in turn makes the data not interpretable by any other device keeping the users data safe. Using the simple concept of Doppler Effect, the ultra-sonic sensors read the level of existing liquid and thereby produce an accurate reading which is turn is the input to the mobile application. Arduino UNO and HC-06 are the main components in terms of data receive and transmission. They play an active role in the continuous and consistent Bluetooth connectivity and the subsequent data transactions that occur. This data must be transmitted on a continuous basis in order to read the changing levels of the liquid in the container which, change due to varying external and internal factors.

1.3 Existing System

The basic and existing system as of now is one of the below:

- Fuel gauge found in bikes, which does not indicate accurately in volume the liquid available which at times may lead to short-comings.
- Manually opening the lid of the given tank and checking the availability of liquid which again, is inaccurate and a crude method of indication of liquid level considering the present technological enhancements.
- Automatic water pumps which indicate one of empty, full or half full which is insufficient for efficient planning. Another problem being the fact that, these automatic systems require power supply which at times may be unavailable.
- Mileage of vehicles is also an estimate based on an approximation of the remaining fuel.

1.4 Problem Statement

- This project acts as an effort to notify the running out of fuel in bikes' fuel tanks beforehand which at times is of utmost importance. In certain conditions, the availability of fuel in the tank, cannot be manually checked and knowing the liquid level is paramount.
- At times we forget to check the fuel level in the tanks and thereby face problems midway a journey as a result. This is troublesome in unfavourable conditions where it is raining or no fuel station is nearby.
- The approximate distance travelable is also unknown which is a problem that this application will solve.
- Overhead tanks with manual pump systems, in cases of power cuts can cause household problems, such as lack of water for daily activities and cooking. If the liquid level is known, plans can be made accordingly aiming for the optimum usage of the remaining water.
- Not knowing the accurate level of liquid in the tank hinders the chances of planning with respect to the liquid resource at hand thereby causing unnecessary wastage and un regulated usage of the resource.

1.5 Proposed System/Solution

- "Digital Liquid Level Indicator" is invented to detect the fuel level in the tank as the input and the percentage of the tank from its full capacity will be displayed on the Mobile app along with other information which turns out to be crucial at times.
- This project in turn aims to keep the owner fully aware of the liquid conditions of his container at any given time or place.
- In cases of power outages where both manual and automatic pumps cannot pump water into storages, and automatic pumps (even with power from UPS's) cannot indicate the volume remaining, this application indicates the liquid level in any condition (with or without power supply in the building).

CHAPTER – 2

LITERATURE SURVEY

CHAPTER – 2

LITERATURE SURVEY

2.1 Smart Digital Fuel Indicator System

The current fuel demonstrating framework in vehicle utilizes simple and computerized visuals for indicating surmised status of fuel level, not displaying the amount in numerical. This framework alluded demonstrates the fuel level in numerical by utilizing LCD. In India, mileage issue has risen to be a major issue prompting clients stalling out in obscure zone since they neglect to check the fuel level. This proposed configuration can give an approach to stop this issue and control the exorbitant utilization of the fuel to the client by demonstrating mileage. This proposed configuration will be useful to control the stream of the fuel in the vehicle, additionally persistently shows the fuel left and the kilometre it can cover. This is finished by controlling the fuel use with the assistance of units put in the fuel tank and when the fuel tank gets unfilled a sign is given for the driver that the fuel is void and the vehicle will kill. On the premise of PIC 16F877A advancement of this plan is done and to demonstrate the fuel that is available in the vehicle LCD show is utilized as yield unit. The Characters got from the controller unit is recently shown and in addition the fuel level and the separation it can travel, so that the client can drive at the existing fuel.

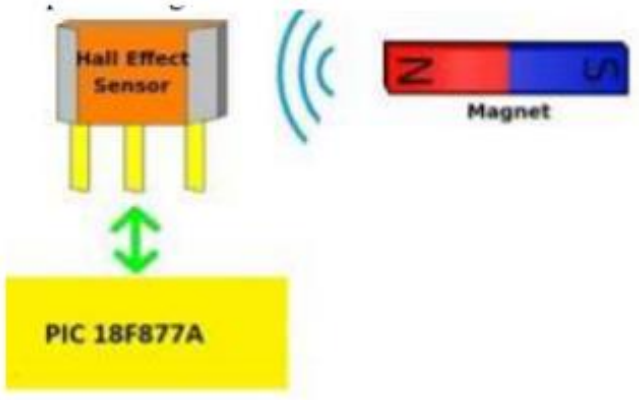


Fig 2.1 Hall effect sensor with PIC18F877A

In the system, the microcontroller PIC18f877A is used. This controller is extremely helpful to utilize, the coding or programming of this controller is additionally simpler. PIC16f877A finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. The sensors that are used is Hall Effect sensor and ultrasonic sensor. The ultrasonic sensor is installed in the tank to sense the level of the petrol. And the Hall Effect sensor is used to count the rotation of the wheel. The GPS is used to get the location of the user. The working of the system is, the ultrasonic sensors which are installed in the tank use to sense the level of petrol and send it to the controller, the controller will show that level in digital (numeric) form like (1.2, 2.2, 5.4etc) on the 20*4 LCD display. Also the rotation of the wheel is counted by the Hall Effect sensor using magnet which is place over it and these pulse are given to the controller. According to that, the LCD which is connected to the controller shows the speed, mileage, fuel level and estimated distance is displayed on the LCD. The additional GPS circuitry is used to provide location of user, by using latitude and longitude of corresponding area of user. GPS fetching the latitude and longitude value of the user location and send it to the system. The Apache Software is used to fetch the latitude and longitude values and MY SQL software is used to store the data of the user location in the web server, and display on the map.

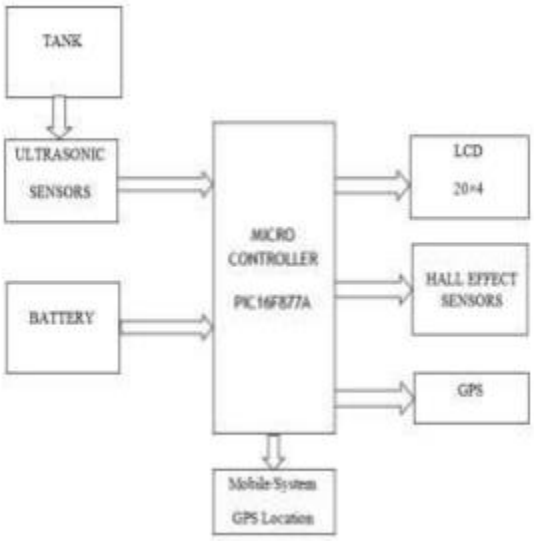


Fig 2.2 Block diagram of digital fuel indicator system

The smart digital fuel indicator[1] is a very advanced type indicating system. The main advantage of this system is that it can gives accurate value of remaining fuel as well as the vehicle running capacity in km. The operation time taken is very less. All the equipment's have long life, durable & quality material. This project is able to show that simple available hardware and technology can be used to construct a robust fuel level monitoring system. It also shows the location of vehicle to the user by using the latitude and longitude value. The system designed and tested in this project presented at the low construction cost of the system. Involving mechatronics in such design applications can eventually solve many practical problems with ease, reliability and at low cost. Even though the quality of material used and components used are of good quality, the cost of the project is not so costly and it can be used and implemented in all vehicles without much increment of cost of the vehicle. This smart fuel indicator[1] is best in its field and will be most widely used and advance system.

2.2 Model Based Design of Digital Fuel Indication System

At present, even after paying a huge amount of money at many of the fuel pumps, we don't get the exact amount of fuel as shown by the filling machine and also there is lots of news regarding the fuel pump frauds which leads to corruption. In many cases it has been observed that there is dissimilarity between the amount of fuel displayed on the fuel filling machine and the fuel filled in the tank. Many of the times the fuel filled are less than the displayed value. This is because of the additional electronic arrangements made in the filling machine which leads to the benefit to fuel pump owner. User having analog systems cannot find out the accurate and exact value of the remaining fuel in tank. Therefore, if the fuel indicator in the automobiles is made digital it will help to know the exact amount of fuel available in the fuel tank. The above mentioned fact is considered in our project and we found out a proper solution for indicating the exact availability of fuel in the tank digitally. Although contactless methods are more complicated than contact methods, there are lots of sensors available for the fuel level measurement. Here, we are indicating the amount of fuel in the tank in millilitres. This project deals with Development of Digital Fuel Meter for Vehicles[2]. Proposed Digital Vehicle Meter is able to give reading in real time units like in Millilitre's. Multiple Ultrasonic Sensors are used to sense depth of fuel in tank. Arduino Controller (ATMEGA328) will be used as the heart of hardware system. Before hardware implementation we will design Simulink Model to simulate and validate output.

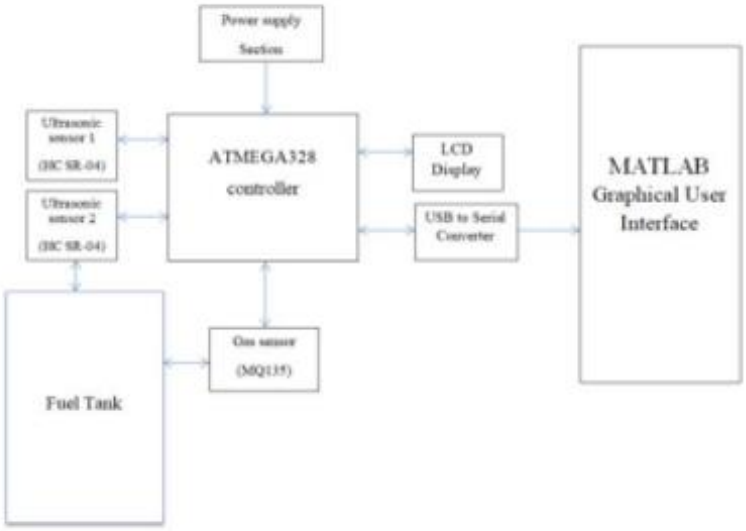


Fig 2.3 Block diagram of proposed system

This system[2] is needed because how much fuel left in the tank, is always a point of tension? So before digital world analog meter were invented to keep a check on the fuel. Those meters gives rough estimate of the fuel left in the tank and sometime this rough idea created trouble for the driver. Today everyone is in a race of making as much profit as possible therefore many petrol pumps does not injects the paid fuel. So this project also keeps a track of this theft. This project tells about parameters that indicate the volume of fuel in the tank available for driving the automobile with more precision compared to the existing system. Calculates and verifies that the paid amount of fuel was delivered to the vehicle or not; indicates, in case of any discrepancy and upgrades its status on the basis of real time.

In this project the main blocks are micro controller unit, ultrasonic sensor, Gas sensor, LCD display, Power supply unit and PC for MATLAB. The power supply section is used for regulated energy distribution to all the components being interfaced. The ultrasonic sensors are mounted on top of fuel tank to measure the level of fuel present in tank and then the measured signal is sent to the microcontroller unit for further operations. While the tank is being filled with fuel (i.e. diesel) the gas sensor detects the quality of fuel flowing through the fuel inlet pipe. The detected quality value is sent to Controller for conversion to digital from analog. All these calculated values are sent to LCD display unit for indication. The serial to USB converter is used to send all this information to PC for simulation of this system.

In this project Two Ultrasonic sensors detects the exact quantity of fuel available in fuel tank along with this the gas sensor will detect the quality of fuel being filled in tank. Thus these two important factors of quality and quantity from customer's point of view are determined.

Hence this project with accurate measurements will help us avoid the major issues of fuel fraud being carried out at fuel stations and it will also help us get the idea about the fuel adulteration.

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
Vh	Heating voltage	5V±0.1	AC OR DC
Rl	Load resistance	can adjust	
Rh	Heater resistance	33Ω±5%	Room Tem
Ph	Heating consumption	less than 800mw	
Tao	Using Tem	-10-45	
Rs	Sensing Resistance	30KΩ-200KΩ (100ppm NH3)	Detecting concentration scope_ 10ppm-300ppm NH3 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
α	Concentration Slope rate	≤0.65	
Detection condition	Temp: 20_±2_ Vc:5V±0.1 Humidity: 65%±5% Vh: 5V±0.1		

Table 2.1 Features of gas sensor

2.3 Advanced Digital Fuel Meter and Electronically Controlled Devices

An advanced digital Fuel meter is the one which shows the level of Fuel in digital format. In this project, we propose a digital measurement system which constantly displays the different parameters like Fuel quantity and battery health. The heart of the project is the microcontroller which takes necessary decision depending on the sensor feeds and displays the results in the digital format. An analogue type Fuel tank level sensor[3] is interfaced to the analogue-to-digital convertor(ADC), which converts analogue voltage output from the sensor to the digital form and feed to microcontroller. Then the microcontroller calculates the level depending on the digital value multiplied with the volume of the tank at that level and displays the digital numeric value on the screen. Our digital indicator will indicate the level of Fuel in millilitres. This type of Fuel indicator has not been implemented in any of the two wheelers till now. In this project, we are using many components.

The important components used in the project are:

[1] Analog to Digital Converter (ADC)

[2] Microcontrollers

[3] Kiel micro vision(software)

[4] Sensors

[5] LCD display with keypad

ADC0804 is one of the most commonly used analogues to digital converter IC. In many applications it is required to convert the output of the sensor, which is analogue in nature to a digital form. The data in digital format can then be utilized for further processing by the digital processors. Typical applications include sound processing, temperature processing etc. This circuit demonstrates the principle and operation of interfacing a simple ADC 0804 using 8051 microcontroller (AT89C51). ADC0804 is connected as shown in the circuit diagram. Here the input is taken from a present, which gives different analogue signals to the ADC. The output pins of the ADC are connected to LEDs. ADC0804 is a single channel analogue to digital convertor i.e., it can take only one analogue signal. An ADC has n bit resolution (binary form) where n can be 8,10,12,16 or even 24 bits. ADC 0804 has 8-bit resolution. The higher resolution ADC gives

smaller step size. Step size is smallest change that can be measured by an ADC. For an ADC with resolution of 8 bits, the step size is 19.53mV (5V/255). The time taken by the ADC to convert analogue data into digital form is dependent on the frequency of clock source. ADC0804 can be given clock from external source. It also has an internal clock. However, the conversion time cannot be more than 110µs.The frequency is given by the relation f= 1/ (1.1*R*C). The circuit uses a resistance of 10Ω and a capacitor of 150pF (Pico farad) to generate clock for ADC0804. Vin, which is the input pin, is connected to a present to provide analogue input.

This idea was actually formed for the good cause of common people. Petrol rates are hiking every day and it's a burning issue. In the present, all bikes which are available in the market are not having a digital Fuel meter in it. With this the person cannot know how much amount of petrol is there. So if the bike consists of a digital Fuel meter in it, the person will be able to know how much petrol is present in millimetres. So, this concept will be very helpful for a common man. Generally, in the winter season the battery gets drained. Because of this, the vehicle will not start soon. So, it's a problem faced by many people. If the vehicle is consisting of a battery indicator, it shows how much amount of charging is present in it. So, if these two concepts are present in the bike or a car it will be very useful to everyone. This is actually an innovative project. This concept is not present in any of the automobile companies like Benz, BMW, Audi and Ferrari. So, this is just an innovative project and we are implementing this on a 2 stroke two wheeler vehicle.

Initializing the LCD: Before you may really use the LCD, you must initialize and configure it. This is accomplished by sending a number of initialization instructions to the LCD. The first instruction we send must tell the LCD whether we'll be communicating with it with an 8-bit or 4-bit data bus. We also select a 5x8 dot character font. These two options are selected by sending the command 38h to the LCD as a command. As you will recall from the last section, we mentioned that the RS line must be low if we are sending a command to the LCD. Fuel gauge: A Fuel level detector (Fuel gauge) is a device inside of a car or other vehicle that measures the amount of Fuel still in the vehicle. This type of system can be used to measure the amount of gasoline or some other type of liquid. It will typically consist of a sensing or sending unit that measures the amount of Fuel actually left and a gauge or indicator that relays this information outside the Fuel container. A Fuel gauge can be designed in a number of different ways and many gauges have several flaws

that can make the readings less than accurate. The two parts of a Fuel gauge are the sensing or sending unit and the indicator or gauge. A sensing unit is the part of a Fuel gauge found within or connected to the actual Fuel storage container on a vehicle. In a car these days, for example, the sensing unit will consist of a float inside the Fuel tank, which is connected to a metal rod that runs to a small electrical circuit. The float raises or lowers depending on the amount of gasoline in the Fuel tank. Relay Driver: Relay is an electro-mechanical switch which can be controlled by an electronic circuit. Relay consists of contact points and electromagnetic coil. In most of the cases there will be a need of a device switches the electrical appliance on or off depending on the logic produced by an electronic circuit board which runs on few volts of DC. In such scenario, relays are used which isolate high voltage AC from DC logic sections. The relay has a high quality contact points which can bare more amps of current. The common relay coil is designed for 5-6V of operation. The output pin of the microcontroller is given to the current amplifier through 1K resister.

Procedure:

i. In sense of the mileage of any vehicle is affected by some factors which we have consider in and also take most economical, useful, intelligent and quick responding sensors to calculate the effect of the all the factors directly as well as indirectly too.

ii. All the sensors are situated on their particular separate place to perform their operation. Sensors are very efficient quick responding units. The sensors collect all the data in running vehicle and then the collected information moves up to the E.C.U. E.C.U. is controlling unit which make command on all the individual sensors give them power to run and forward the collected data to the C.P.U. The E.C.U. is electronic control unit. Then the data moves up to the central processing unit i.e. C.P.U. at this unit the data finally computed into the numeric form by the mean of programming. All the data from the sensors is converted into the one form of mileage means How much the vehicle can run? All the information is in coded form which moves towards the modulator. Modulator is the unit to modulate the information and finally the data in display on the digital Fuel indicator in a numeric form.

iii. To maintain the accuracy level, the C.P.U. has designed. By providing the clearance in data computation there is 3% to 4% of clearance for sensors errors and immeasurable

factors so the information as given by system as near as actual. Thus the modified type intelligent Fuel indicator system operates.

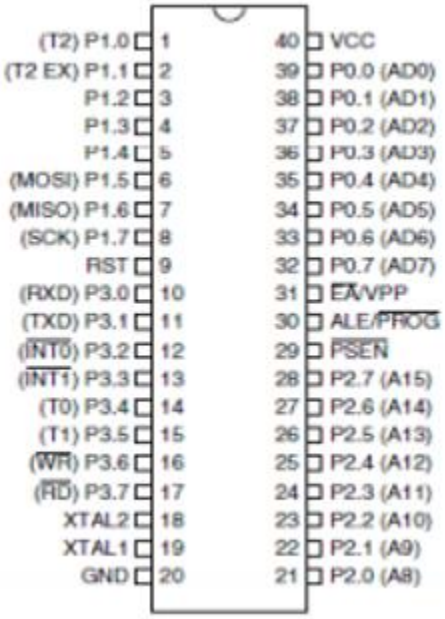


Fig 2.4 40-Lead PDIP

In our present study we have conducted experimental analysis on a two stroke two wheeler vehicle. The project[3] gives us the indication of parameters like Fuel level and battery health.

The result shows us two meters which display

a) Fuel level indicator which shows the amount of Fuel present in the petrol tank.

b) Battery level indicator which shows the percentage of charging left over in the battery.

c) A six digit password substituting the key. The ignition will activate, as soon as we enter the password. From the above results, it is observed that as the digital values of the Fuel are displayed on the LCD, the person can know the accurate level of the Fuel. So that there is no chance of thefts to be done in petrol pumps. The battery indicator helps us to know the amount of charging left over and it helps us mainly in the winter and rainy seasons when the battery generally gets discharged. There is a password which substitutes the key. If the wrong password is entered for

three times, the master code should be entered and it can be changed also. Therefore bike thefts can be overcome up to some extent.

The future scope of this project is to know the amount of impurities present in the total quantity of the fuel. This can be known with the help of sensors which senses the impurity in the fuel. The level of impurity will be shown with the help of digital meter. This idea is taken from the impure milk detector. From that, the amount of water present in the milk can be known. So, using the same principle amount of impurities present in the total fuel can be shown digitally.

2.4 Automatic Water Level Indicator

Water level indicator systems[4] are quite useful to reduce the wastage of water from any reservoir, while filling such reservoir. The wires with colours Blue, Red, Green & Yellow are adjusted to check Level 1, 2, 3, 4 respectively. Each of these four wires are connected to the amplifier. In this project they have designed the sensor to measure water up to four levels.

Four segments of insulated conducting wires are used and the naked ends within water are connected with carbon rods. The length of the wire segments are adjusted according to the water levels within the reservoir.

The circuit consists of 4 sensing probes which are dipped in water to sense the level of water. The probe A is connected as common to other three, which should be at the bottom most part of the water tank, also it act as a reference level. The probes B, C, and D are set as minimum, middle and maximum level respectively. The circuit is assembled on a general PCB and encloses it in a casing and mounts it inside home with the indicator LED's pointing out of the box. A short length three, 18 SWG copper wires can be used as sensing probes and for common sensor Probe A, a bare copper wire can be used.

When water in the tank touches the probe A and B both, a small current flows from A to B through water and to the base of transistor T1 via a 220KΩ resistor. As a result the transistor conducts causing the LED1 to glow and immediately the pump will start functioning and the buzzer starts sounding. Similarly, when water touches sensor C, LED2 glow and indicates that the tank is half-filled and still the pump works and it gives the information about the level of water in the tank. Finally, when the water touches sensor D, LED3 glows and indicates the tank is completely filled and immediately the pump stops functioning and the buzzer connected will stop.

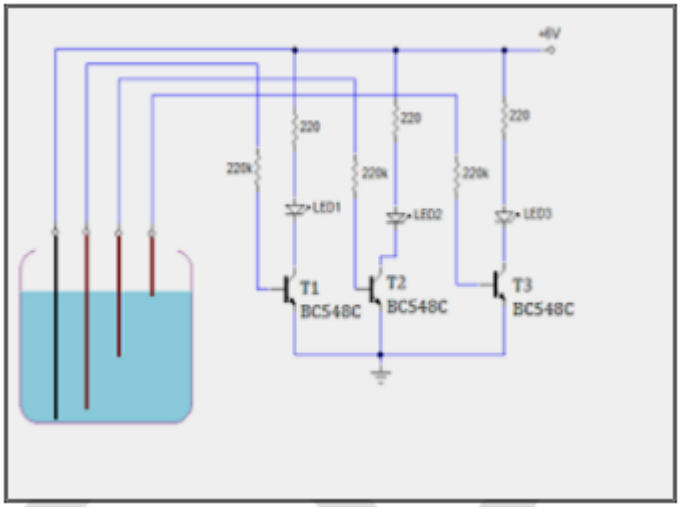


Fig 2.5 Circuit diagram of water level indicator

- Input Voltage: 6-volt power supply is required.

- Transistor: BC548C is general purpose silicon, NPN, bipolar junction transistor. It is used for amplification and switching purposes. The current gain may vary between 110 and 800. The maximum DC current gain is 800.

- Water Sensors: 18 SWG copper wires can be used as sensing probes that can be placed in the water tank. As the current required passing through the wire is in Nano amps. But if needed then carbon rods at the end of wires can be used. These carbon rods should be thoroughly washed.

- LM7805: This is the 5v regulator used to power up the whole circuit.

- Buzzer: Any 6 V buzzer will work here.

Automatic Water level Controller can be used in Hotels, Factories, Homes Apartments, Commercial Complexes, Drainage, etc.

- Automatic water level controller will automatically START the pump set as soon as the water level falls below the predetermined level (usually 1/2 tank) and shall SWITCH OFF the pump set as soon as tank is full.
- It can be used to predict flood
- Liquid level indicator in the huge containers in the companies.
- Low costs.
- Low power consumer.
- Fuel level indicator in vehicles.

The basics need of human being is water and it is one of the most important necessities for all living beings. But unfortunately a huge amount of water is being wasted by uncontrolled use and due to our negligence. Some other automated water level monitoring system is also offered so far but most of the method has some shortness in practice. We tried to overcome these problems and implemented an efficient automated water level monitoring and controlling system. Main intension of this research work is to establish a flexible, economical and easy configurable system which can solve water losing problems. In the near future as home automation web based water level monitoring and control-ling system can be designed, through which the system can be controlled from any place via internet through mobile phone. This could have a substantial benefit from this research work for efficient management of water.

This paper was intended to design a simple and low cost water level indicator[4]. This is not only for water tank but also used for oil level and chemical lab. To design this system, we used transistor as a platform and local materials for low cost. We tried to de-sign a system in such a way that its components will be able to prevent the wastage of water. The whole system operates automatically. So it does not need any expert person to operate it. It is not so expensive. This design has much more scope for future research and development. Though it is a project, we hope some modification in this project will lead to a reasonable diversity of usage.

CHAPTER – 3

SOFTWARE REQUIREMENTS AND SPECIFICATIONS

CHAPTER – 3

SOFTWARE REQUIREMENTS AND SPECIFICATIONS

3.1 hardware Requirements

3.1.1. HC-SR04 Ultrasonic Sensor

Pin No.	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Table 3.1 Ultrasonic sensor pin configuration

HC-SR04 Sensor Features

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 400cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 4mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

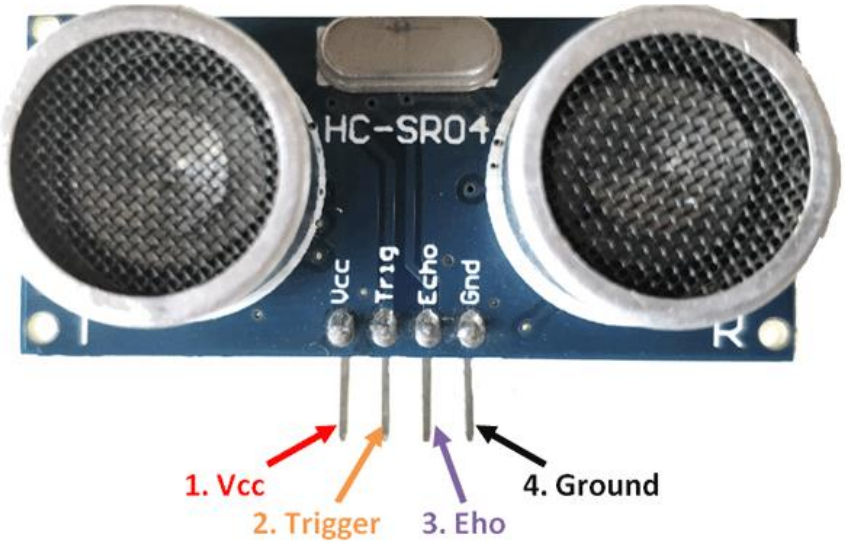


Fig 3.1 HC-SR04 Ultrasonic sensor

HC-SR04 Ultrasonic Sensor - Working

As shown above the HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Usage of the HC-SR04 Ultrasonic Sensor:

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Fig 3.2 Working of Ultrasonic Sensor

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information, the distance is measured as explained in the above heading.

Applications:

- Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2cm to 400cm
- Can be used to map the objects surrounding the sensor by rotating it
- Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water

Working:

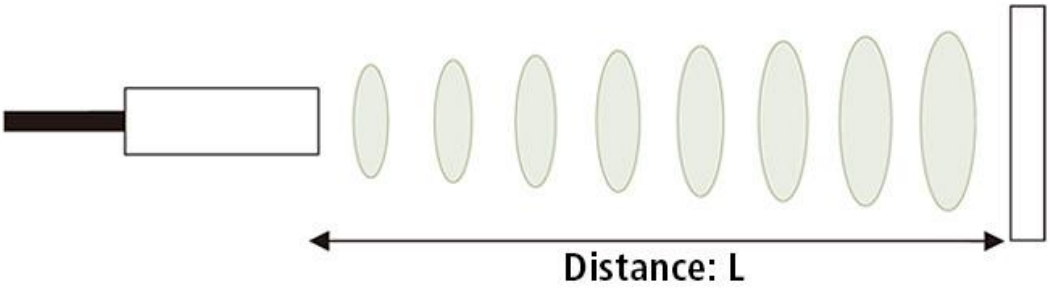


Fig 3.3 Working principle

An optical sensor has a transmitter and receiver, whereas an ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head.

Distance Calculations:

The distance can be calculated with the following formula:

$$\text{Distance } L = 1/2 \times T \times C$$

where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.)

Doppler Effect:

Ultrasonic sensors use the principle of Doppler effect. The Doppler effect is the change in frequency or wavelength of a wave in relation to an observer who is moving relative to the wave source. It is named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842.

A common example of Doppler shift is the change of pitch heard when a vehicle sounding a horn approaches and recedes from an observer. Compared to the emitted frequency, the received frequency is higher during the approach, identical at the instant of passing by, and lower during the recession.

The reason for the Doppler effect is that when the source of the waves is moving towards the observer, each successive wave crest is emitted from a position closer to the observer than the crest of the previous wave. Therefore, each wave takes slightly less time to reach the observer than the previous wave. Hence, the time between the arrival of successive wave crests at the observer is reduced, causing an increase in the frequency. While they are traveling, the distance between successive wave fronts is reduced, so the waves "bunch together". Conversely, if the source of waves is moving away from the observer, each wave is emitted from a position farther from the observer than the previous wave, so the arrival time between successive waves is increased, reducing the frequency. The distance between successive wave fronts is then increased, so the waves "spread out" for waves that propagate in a medium, such as sound waves, the velocity of the observer and of the source are relative to the medium in which the waves are transmitted.[1] The total Doppler effect may therefore result from motion of the source, motion of the observer, or motion of the medium. Each of these effects is analysed separately. For waves which do not require a medium, such as light or gravity in general relativity, only the relative difference in velocity between the observer and the source needs to be considered.

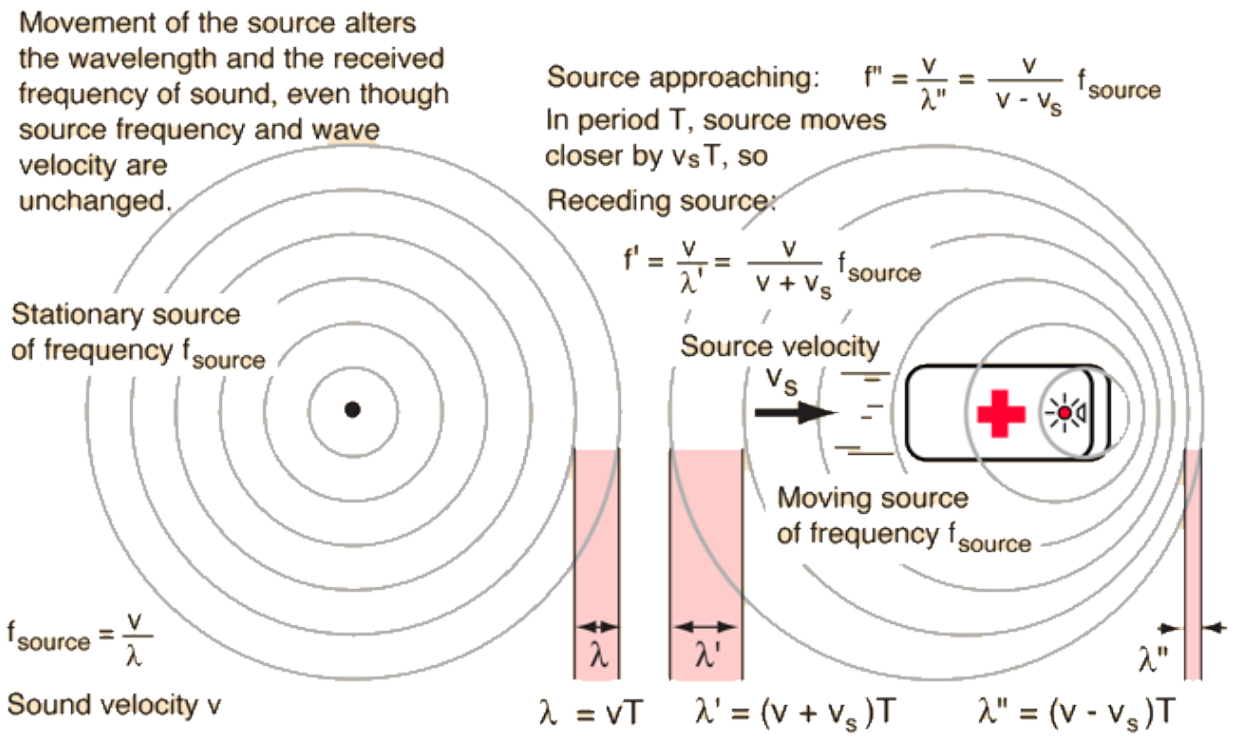


Fig 3.4 Working of Doppler's Effect

3.1.2. Arduino UNO R3 Compatible with DIP Atmega 328

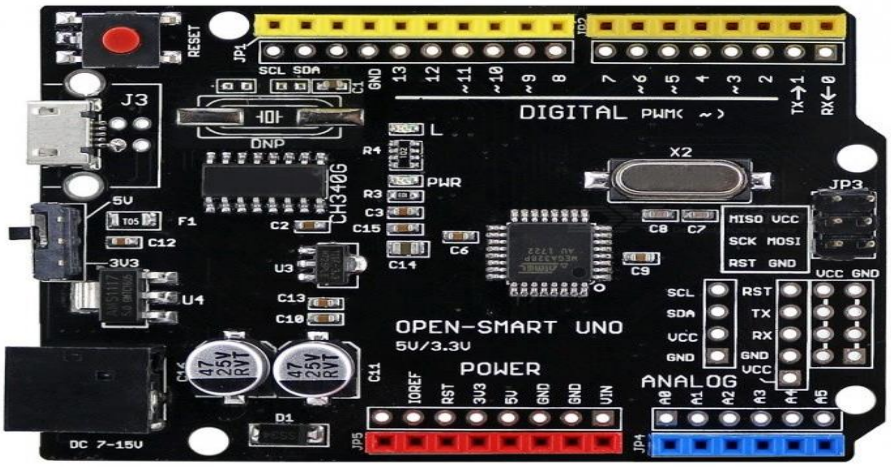


Fig 3.5 Arduino UNO R3 Compatible with DIP Atmega 328

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal needed to support the microcontroller; simply connect it to a computer with a

USB cable or power it with a AC-to-DC adapter or battery to get started. We can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was a USB connection, a power jack, an ICSP header and a reset button. It contains everything chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or out dated boards see the Arduino index of boards. The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes preprogramed with a bootloader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Technical Specifications:

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts

- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

Communication:

The Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows serial communication on any of the Uno's digital pins.

Pins:

General Pin functions

- **LED**: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

- **VIN**: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- **3V3**: A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.
- **IOREF**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
- **Reset**: Typically used to add a reset button to shields which block the one on the board.

Special Pin Functions

Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.[7]

In addition, some pins have specialized functions:

- **Serial** / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- **External Interrupts**: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM** (**P**ulse **W**idth **M**odulation): 3, 5, 6, 9, 10, and 11 Can provide 8-bit PWM output with the analogWrite() function.
- **SPI** (**S**erial **P**eripheral **I**nterface): 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI** (**T**wo **W**ire **I**nterface) / I²C: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- **AREF** (**A**nalog **REF**erence): Reference voltage for the analog inputs.

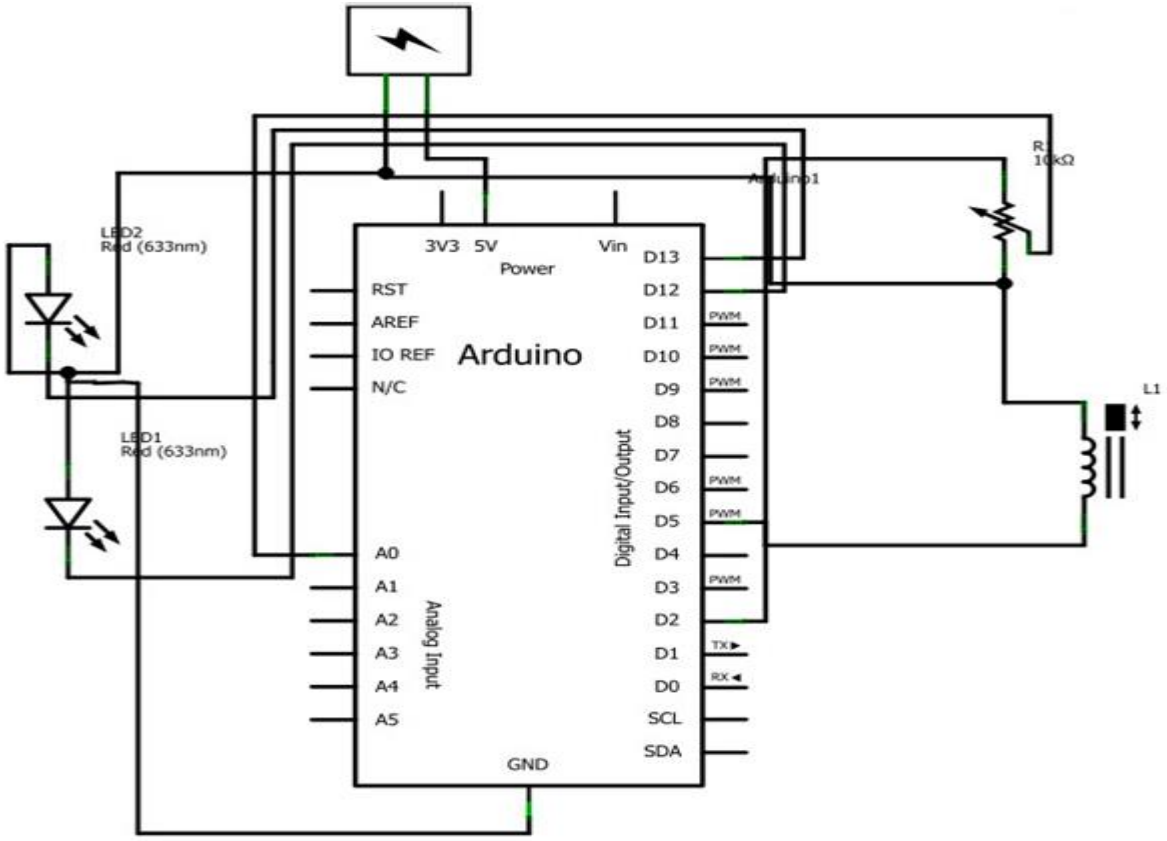


Fig 3.6 Pin Diagram of Arduino UNO

3.1.3. HC-06

This Bluetooth module can easily achieve serial wireless data transmission. Its operating frequency is among the most popular 2.4GHz ISM frequency band (i.e. Industrial, scientific and medical). It adopts Bluetooth 2.0+EDR standard. In Bluetooth 2.0, signal transmit time of

different devices stands at a 0.5 seconds interval so that the workload of Bluetooth chip can be reduced substantially and more sleeping time can be saved for Bluetooth. This module is set with serial interface, which is easy to use and simplifies the overall design/development cycle.

Fig 3.7 Front view of HC-06

Fig 3.8 Back view of HC-06

HC-06 is a Bluetooth module designed for establishing short range wireless data communication between two microcontrollers or systems. The module works on Bluetooth 2.0 communication protocol and it can only act as a slave device. This is cheapest method for wireless data transmission and more flexible compared to other methods and it even can transmit files at speed up to 2.1Mb/s.

HC-06 uses frequency hopping spread spectrum technique (FHSS) to avoid interference with other devices and to have full duplex transmission. The device works on the frequency range from 2.402 GHz to 2.480GHz.

HC-06 Features and Electrical characteristics

- Bluetooth protocol: Bluetooth V2.0 protocol standard
- Power Level: Class2(+6dBm)
- Band: 2.40GHz—2.48GHz, ISM Band
- Receiver sensitivity: -85dBm

- USB protocol: USB v1.1/2.0
- Modulation mode: Gauss frequency Shift Keying
- Safety feature: Authentication and encryption
- Operating voltage range: +3.3V to +6V
- Operating temperature range: -20ºC to +55ºC
- Operating Current: 40mA

Pin configuration

HC-06 module has six pins as shown in the pinout. In them we only need to use four for successfully interfacing the module. Some breakout boards will only leave four output pins only because of this reason.

Pin	Name	Function
1	Key	The pin state determines whether the module works in AT command mode or normal mode [High=AT commands receiving mode(Commands response mode), Low or NC= Bluetooth module normally working]
2	Vcc	+5V Positive supply needs to be given to this pin for powering the module
3	Gnd	Connect to ground
4	TXD	Serial data is transmitted by module through this pin (at 9600bps by default), 3.3V logic
5	RXD	Serial data is received by module through this pin (at 9600bps by default),3.3V logic

6	State	The pin is connected to the LED on the board to represent the state of the module

Table 3.2 Pin configuration

HC-06 Bluetooth Module Advantages:

HC-06 is best option when short distance wireless communication is needed. The module is used for wireless communications of less than 100 meters.

- The module is very easy to interface and to communicate.
- The module is one of the cheapest solutions for wireless communication of all types present in the market.
- The module consumes very less power to function and can be used on battery operated mobile systems.
- The module can be interfaced with almost all controllers or processors as it uses UART interface.

Usage of HC-06 Bluetooth Module:

The communication with this HC-06 module is done through UART interface. The data is sent to the module or received from the module though this interface. So we can connect the module to any microcontroller or directly to PC which has RS232 port (UART interface). A typical interface circuit of the module to an Arduino is shown below.

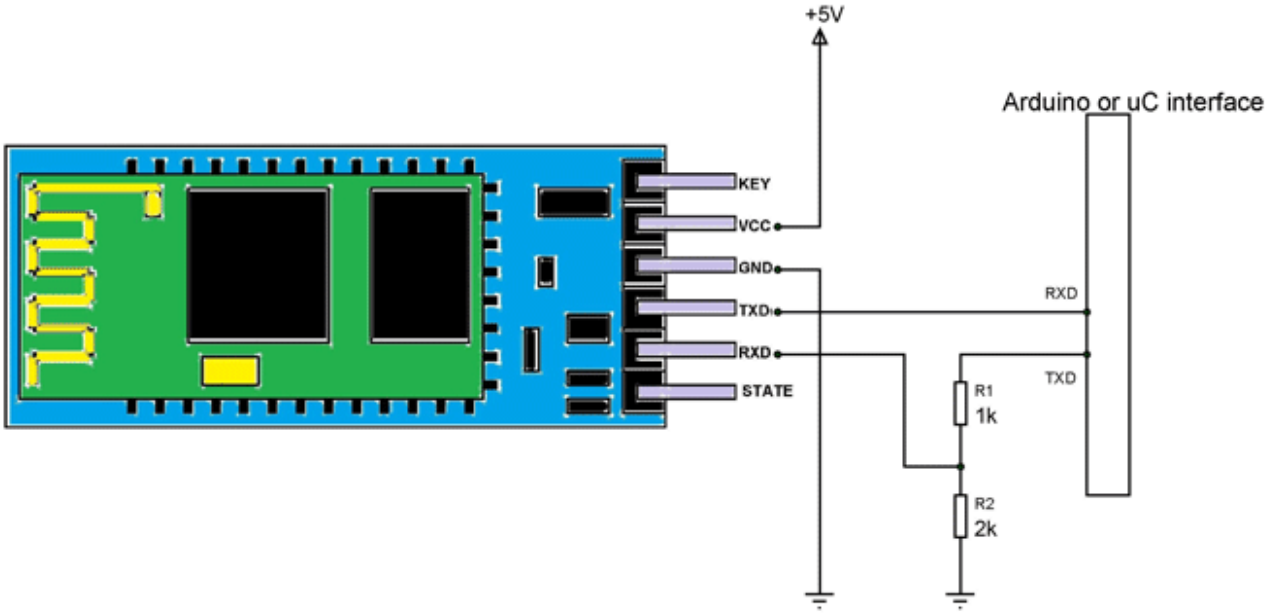


Fig 3.9 HC-06 and Arduino Connection Interface

Here the module is connected to +5V standard regulated power supply and UART interface is established as shown in figure. All you need to do is connect RXD of Arduino to TXD of module and TXD of Arduino is connected to RXD of module through a resistor voltage divider. This voltage divider is provided for converting 5V logic signal sent by Arduino to +3.3V logic signals which are suitable for the module. The ground of Arduino and module must be connected for voltage reference in case separate power sources are used.

After connecting the module, you have to write the program in Arduino IDE to receive and send data to the module. For successful wireless communication you need to remember a few things:

- In programming you need to set default baud rate of UART serial communication to 9600. The value is default setting of module and can be change in program.
- The module is a slave and so you need a master to establish a successful wireless interface. For that you need another [Arduino + module (with master feature)] setup or you can use a smart phone as a master and search for HC-06 slave.
- The master searches for slave and connects to it after authenticated with password. The HC-06 module has default password '1234' which can be changed.

- In program you can receive data master sends (After authentication) and perform tasks based on it.
- Also one can download libraries for module through the websites and use them to make communication easy. All you need to do is download these libraries and call them in programs. Once the header file is included, you can use simple commands in the program to tell the Arduino to send or receive data. The module sends this data to master through wireless Bluetooth. If the module receives any data from master, it will transmit it to Arduino through UART serial communication.
- You can also interface HC-06 to PC using RS232 cable. Once you interface is done you can use serial terminal on PC or any similar software to send or receive data to module. You need to type in AT command in serial terminal to communicate with the module.

Applications:

- Engineering applications
- Robotics
- Servers
- Computer Peripherals
- Sports and Leisure Equipment
- USB Dongles

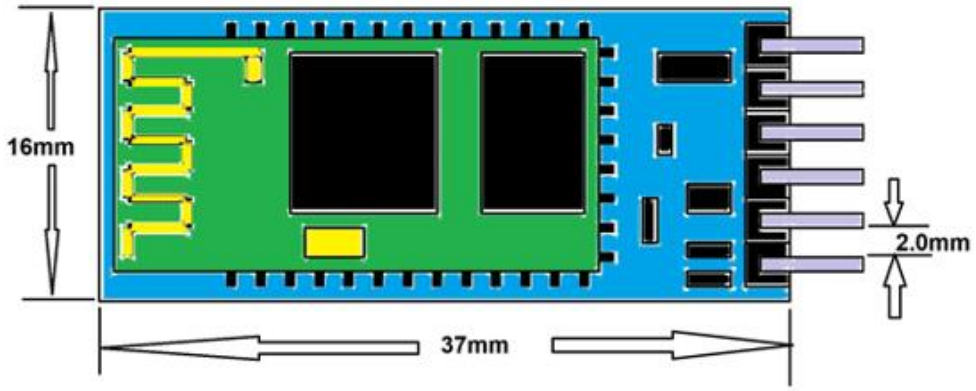


Fig 3.10 2-D Model

3.1.4. Smart Phone

Fig 3.11 Smart Phone

Android Platform	: v4.4(Kitkat) or Higher
RAM	: 512MB
Processor	: DualCore 1.2-1.4GHz
Memory	: 8GB

Smartphones are a class of mobile phones and of multi-purpose mobile computing devices. They are distinguished from feature phones by their stronger hardware capabilities and extensive mobile operating systems, which facilitate wider software, internet (including web browsing over mobile broadband), and multimedia functionality (including music, video, cameras, and gaming), alongside core phone functions such as voice calls and text messaging. Smartphones typically include various sensors that can be leveraged by their software, such as a magnetometer, proximity sensors, barometer, gyroscope and accelerometer, and support wireless communications protocols such as Bluetooth, Wi-Fi, and satellite navigation.

3.2 Software Requirements

1. Arduino

   Coding Software : Arduino IDE

   Coding Language : C/C++

2. Android Application

   Coding Software : MIT App Inventor 2

CHAPTER – 4

SYSTEM DESIGN AND ARCHITECTURE

CHAPTER – 4

SYSTEM DESIGN AND ARCHITECTURE

4.1 Design

4.1.1 Architecture Design/System Architecture

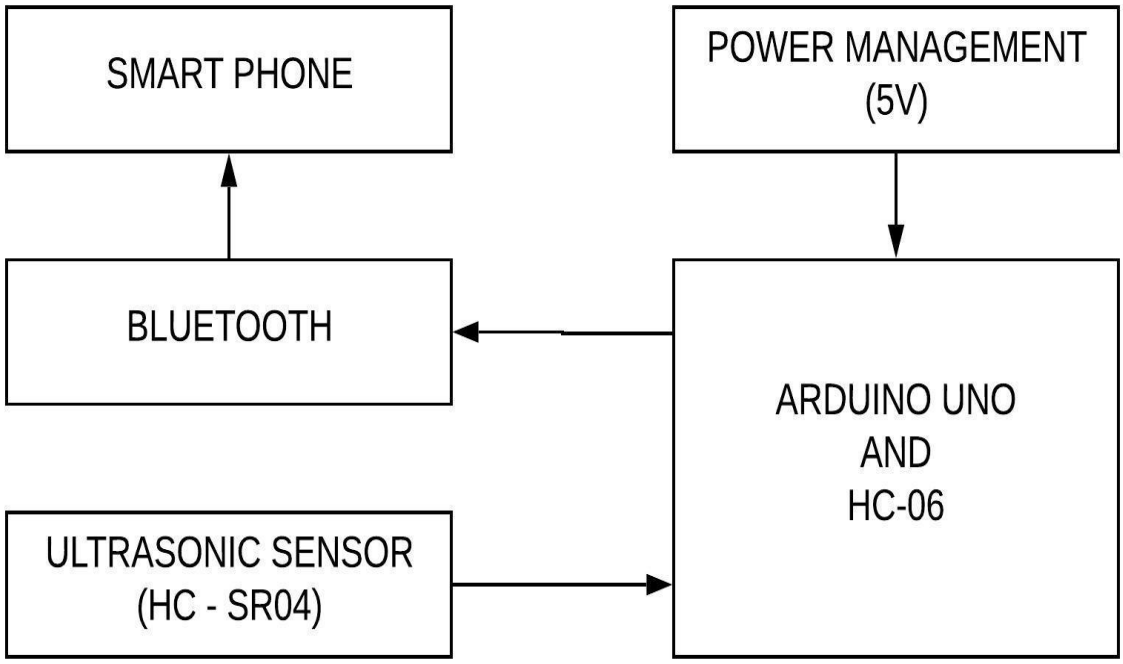


Fig 4.1 System Architecture

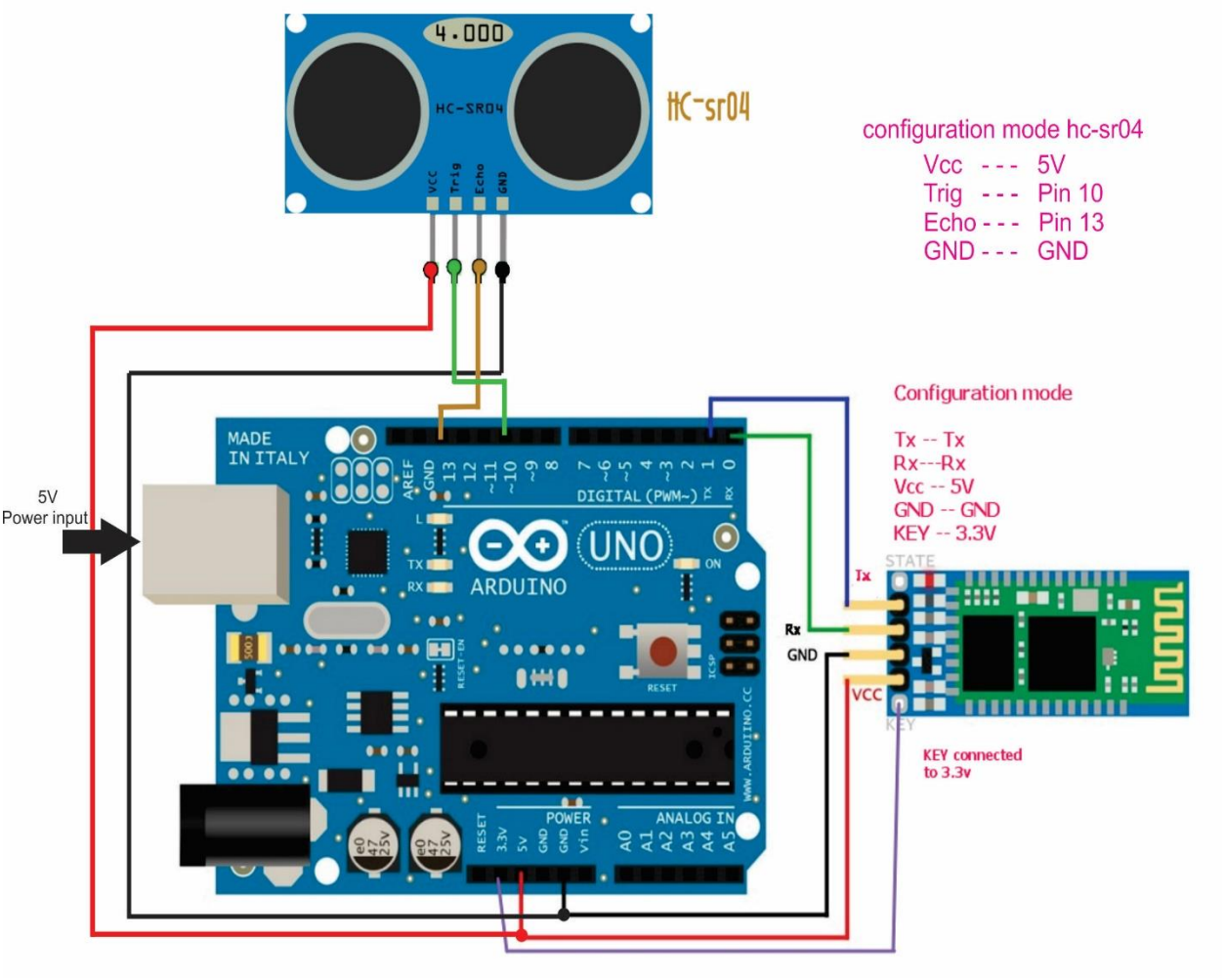


Fig 4.2 Arduino, HC-06 and HC-SR04 connection

4.1.2 Data Flow Diagram

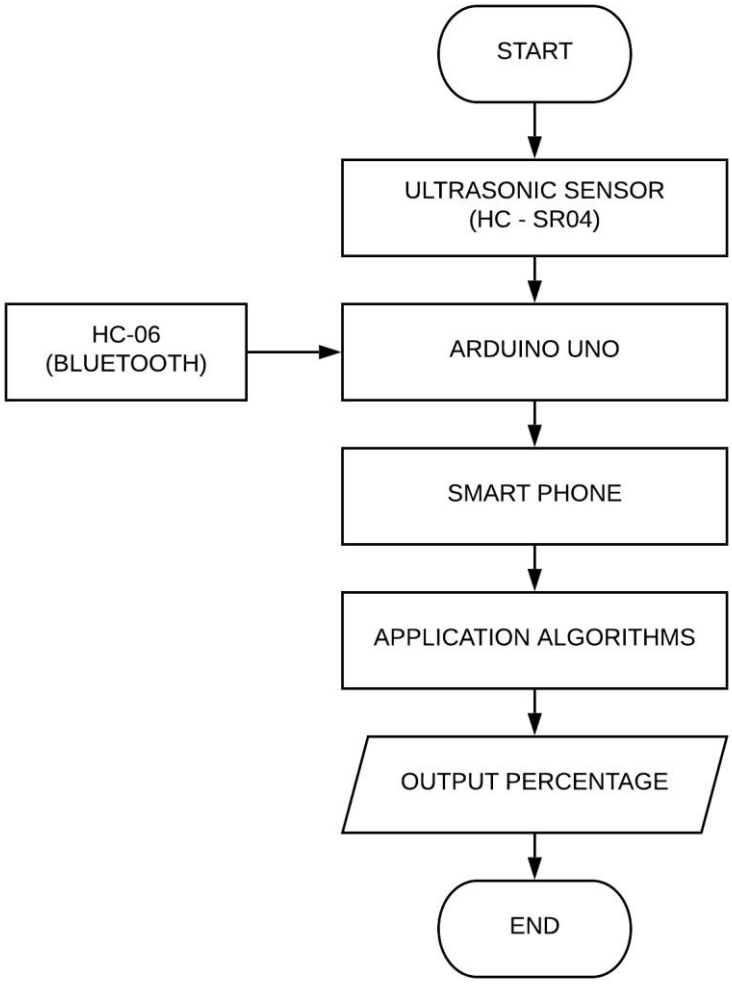


Fig 4.3 Data flow Diagram

4.2 Modules

4.2.1 Development Method/Algorithm

- At initial state, the volume of the container should be calculated.
- Liquid level in that container will be detected by floating sensor.
- The data from the floating sensor will be sent to Arduino.
- The mobile application will fetch the data from Arduino via Bluetooth.
- Liquid level will be displayed in mobile application.

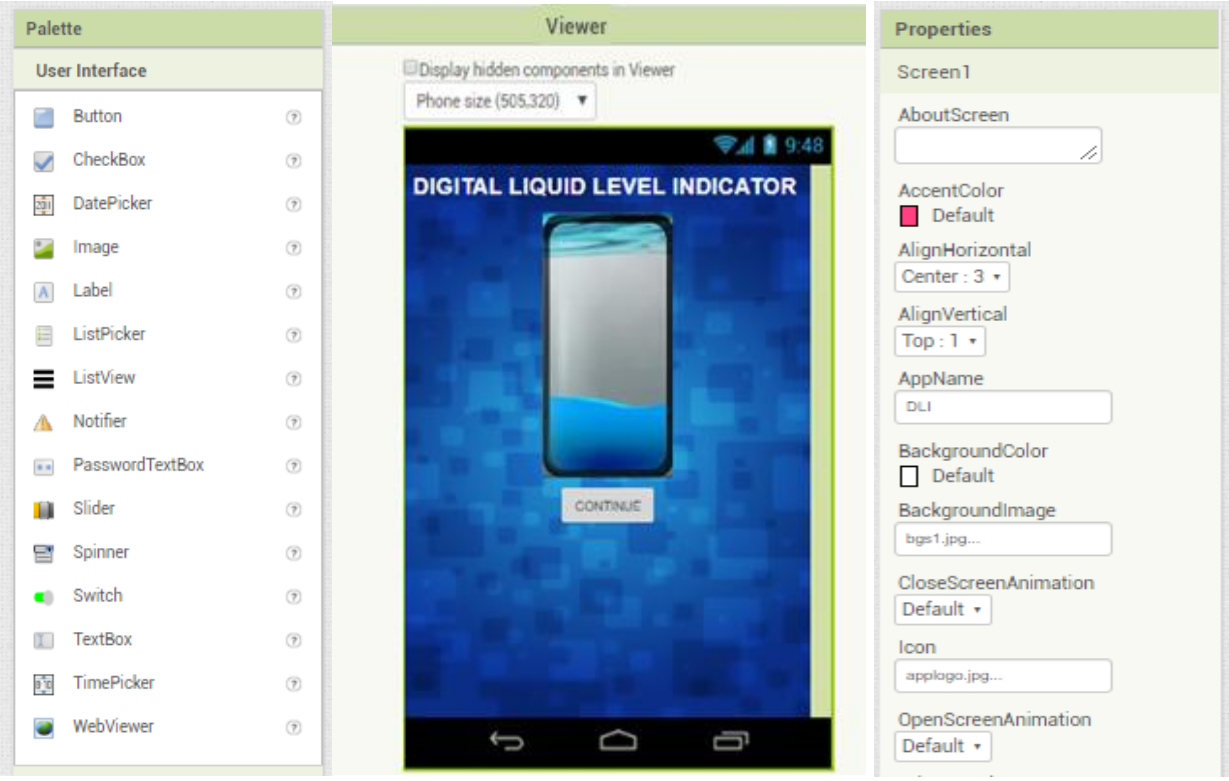
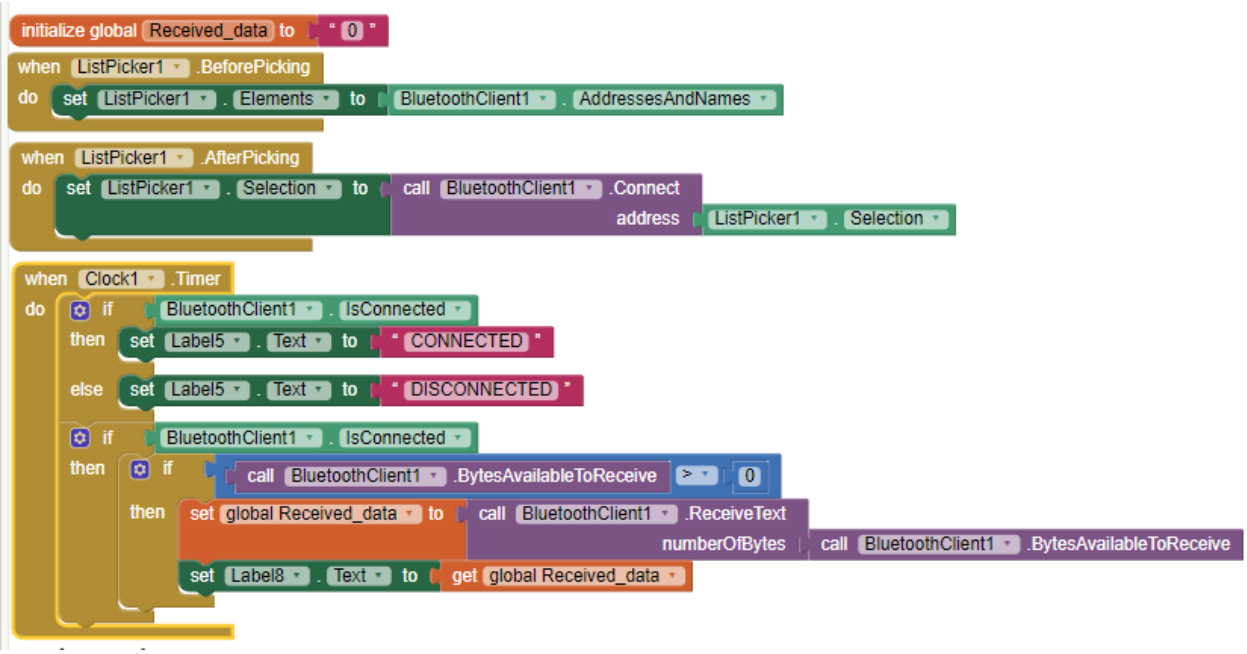


Fig 4.4 Application Interface

CODE DESIGN :



The following elements are present:

- Project name: The name of the project is visible here.
- Designer/Blocks: Here, the information on which view is active is shown. The button that is shown as pressed is actually the active view. In this case, the view is in designer mode (more about the same in the next section).
- User Interface: In the palette, all GUI visible components, i.e., those that are made visible on a screen in your app and are associated with some functionality, are present under User Interface.
- Screen name: Your app can have multiple screens. The default screen, which is named screen1, is visible here. You can also see the same under the Components tab (more on this later).
- App name: By default, the App name is the same as the project name that you have given. You can change the app name by changing this attribute under Properties
- Media: Any Android app should have diverse and rich media capabilities. You will find widgets or components related to Media under this section (more on this later).

Arduino programming code

```
#define trigPin 10
#define echoPin 13
void setup() {
  Serial.begin (9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
}
void loop() {
   float duration, distance, v, per;
  float speed;
   digitalWrite(trigPin, LOW);
  delayMicroseconds(1000);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(1000);
  digitalWrite(trigPin, LOW);
   duration = pulseIn(echoPin, HIGH);
  speed = 331.4 + (0.606 * 25) + (0.0124 * 65);
  distance = (duration / 2) * (speed / 10000);
  v = (3.142 * 30.25 * distance) * 0.09564796;
  per = 100 - v;
  if (distance > 11.5  || distance < 0){
       Serial.println("Out of range");
  }
  else {
       Serial.print(per);
    Serial.println(" % ");
```

```
    delay(1000);
  }
  delay(1000);
}
```

CHAPTER – 5

CONCLUSION AND FUTURE ENHANCEMENT

CHAPTER – 5

CONCLUSION AND FUTURE ENHANCEMENT

5.1 Conclusion

This project has given knowledge and experience in coding, designing, testing and implementation. This project has also helped in putting into practice of various software engineering principles, algorithms, data structures and file structure principles like integrity and consistency of data.

Furthermore, this has helped to learn more about the concepts of embedded systems.

We'd like to thank our guide for her un-parallel support and invaluable contribution in guiding us throughout the whole project process.

We also would like to thank our friends and family for their continuous and unwavering support.

5.2 Future Enhancement

There is always room for improvement in any software package, and we aim to improve it as well.

As of now, the data from the Arduino to mobile via Bluetooth is not at its highest speed. In the coming times we will find higher speed technology for faster transmission of data.

The volume of tanks right now must be input by the user. In the near future we will have datasets for all vehicles and tanks, thereby reducing the effort by the user.

Considering the fact that we have provided for future enhancements, the system is designed in such a way that provisions can be given for the same without affecting the system presently developed.

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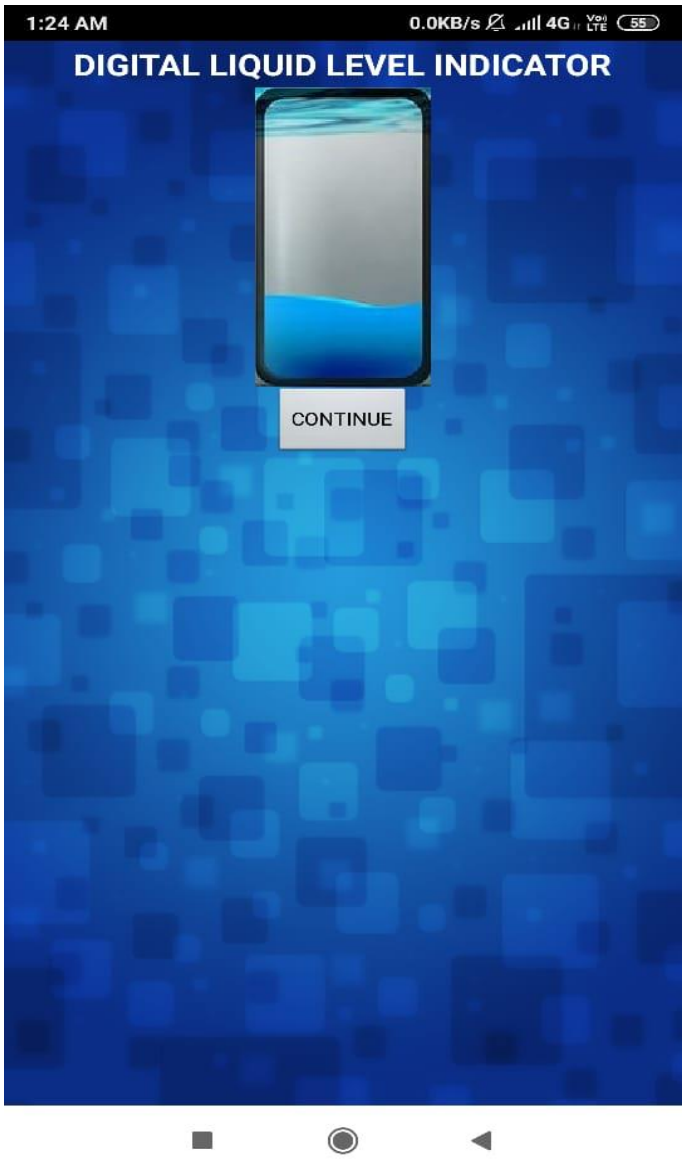
APPENDIX – A

SNAPSHOTS

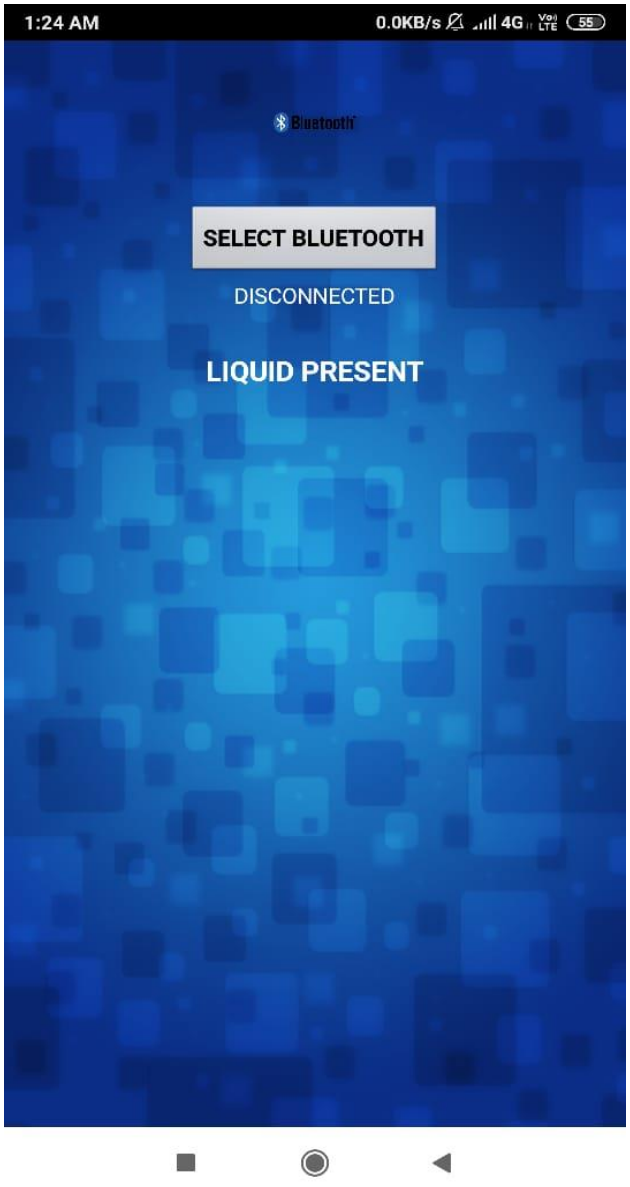
HOME PAGE:

- This is the landing page once you land in the application



BLUETOOTH CONNECTION PAGE:

- This is the page wherein the connection is established to HC-06 device via Bluetooth.

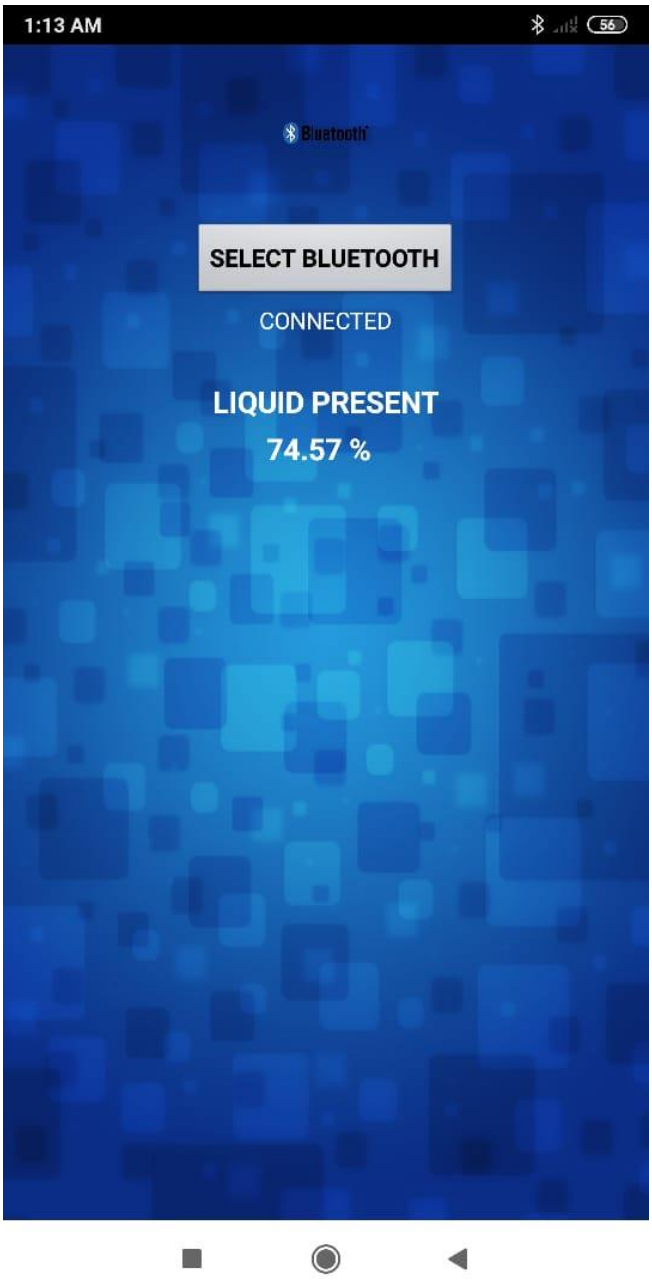


BLUETOOTH SELECTION PAGE:

- This page is to establish connection with the HC - 06

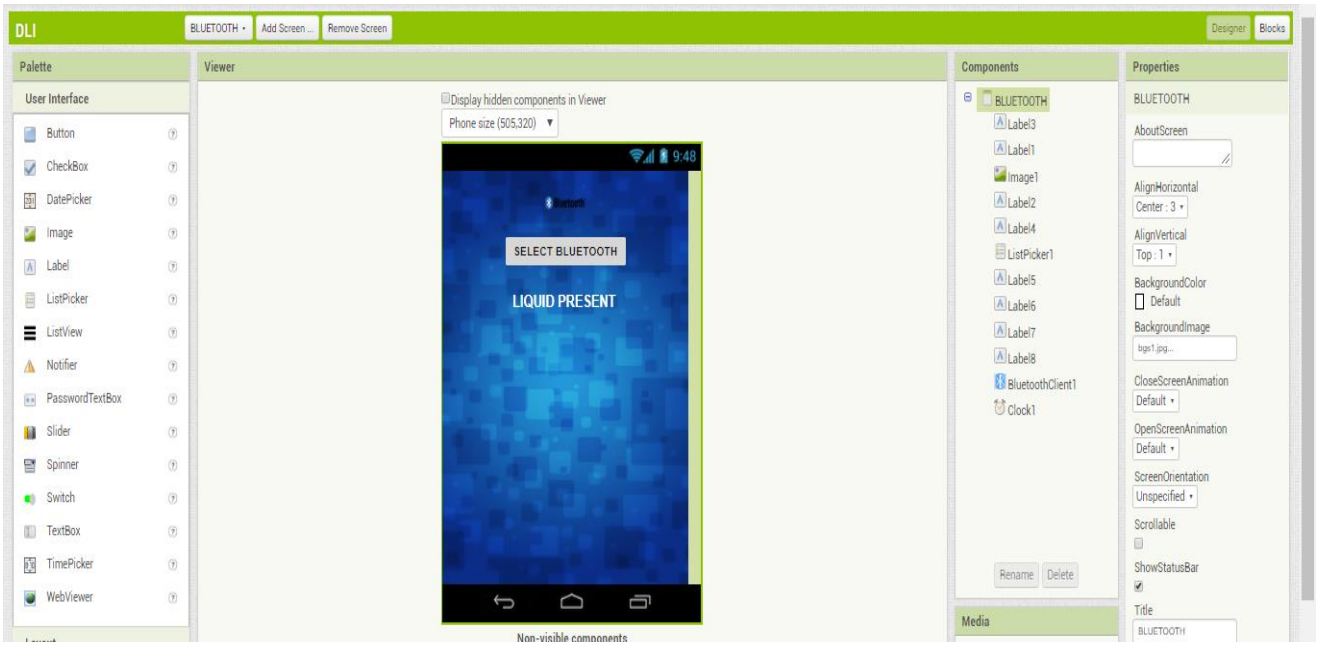
OUTCOME PAGE

- This is the page where the result is displayed



MIT APPLICATION DEVELOPER

- MIT is the interface which was used to develop our app.



APPENDIX B

PAPER PUBLICATION

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