Experimental Analysis of Boiler Feed Water Level Indication and Pump Monitoring Using IoT

A project & Thesis

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A report submitted to the Department of Mechanical Engineering in partial fulfillment of the requirement for the Award of Degree of Bachelor of Science in Mechanical Engineering.

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ABSTRACT

Modern technology largely depends on automation and control systems. Automation and control system refers to the use of various control systems for operating equipment such as machinery, processes in factories, boilers, heat treating ovens, switching on telephone networks, steering, and stabilization of ships, aircraft, automobiles, and other applications with minimal or reduced human intervention. The greatest advantage of automation and control system is that it saves labor. A water level indicator system is a device that indicates the level of water in a tank or reservoir. It is widely used in industrial applications such as boilers in nuclear power plants and residential applications. The project is to design a water level indicator with an automatic water pump controlling system. The water level sensor has been made to apprehend the water level properly. The microcontroller is responsible for precisely controlling the overall system, which reduces control complexity. It takes input through the sensor unit that senses the water level. After taking input, output intends the pump's action (on/off) with respect to the current water status of the tank. An Android app display unit indicates the pump's status and water level via IoT. Pump control will be possible from remote locations using the internet.

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INTRODUCTION

1.1 INTRODUCTION

In recent years, water has gained incalculable value. The diverse faces are the main reason for this circumstance. Water's various issues have been forerunners of population growth, aging infrastructure, obsolete technology, and groundwater contamination. These difficulties have pushed drinking water to the point where it is now considered a luxury rather than a need. This problem of scarce drinking water necessitates a strategy that is both feasible and effective. The overhead tank and quality monitor system is one such method. The practice of describing or quantifying the amounts of water available for, or consumed by, one or more "consumptive uses" is known as water allocation. This refers to volumes of water utilized in the contributing catchment, used from the lake or reservoir itself, or discharged from the lake or reservoir for downstream use in this lake management context. Irrigation, industrial applications, and home water supply are examples of consumptive uses, which include the removal of water from a river, lake, or reservoir. If a Brief evaluated the absolute or relative volumes of water utilized, or projected to be used, in any of these enterprises, it was seen to be dealing with the matter of water allocation.

During water pumping from the underground storage tank to the feed water tank, there is always water overflow that leads to water wastage. Secondly, as water circulates from the overhead storage tank to indoor utility points, there is a challenge of determining the remaining volume of water in the tank, and this could result in an unscheduled stoppage of economic or domestic activities. Also, ascertaining the water quality to be supplied in the industry or power station for delicate use is of concern, especially when the feed water and demi water tank are not easily accessible. This work seeks to address these specific problems.

Recently, IoT has gained tremendous attention in the industry ranging from simple auto automation-based applications to sophisticated applications. The standard setting of water storage and circulation system in homes and industries consists of overhead storage, pipeline network, and underground storage tanks. In monitoring an overhead tank set-up, remote monitoring and data collection systems are necessary to collect information from the tank based on the pre-set values and communicate processed information to the user when necessary or to make decisions in a dire situation. IoT trend has opened up research areas, including investigating the systematic evaluation of water features by articulating its based sensor networks.

We have designed a real-time wireless monitoring system for tank water levels based on IoT and supported an alarming subsystem. An IoT system for monitoring several waters and pollutant parameters was implemented. We monitored the 5 levels of water. The parametric water and wireless network were configured for accessible signal data collection and assessment. A real-time water level monitoring system was designed and implemented. An ultrasonic sensor was used to detect the desired parameter. If the water level reaches the pre-set parametric value, the signal will be fed in real-time to mobile. A pre-set percentage range of the sensors was used to manipulate the pump's operation through the regulating valves. In this work, a configured monitoring system was discussed based on the ESP-8266 microcontroller to replace the level stick sensor used in beverage industries to monitor the water level in the feed water tank and storage tank. Depending on the sensor reading, the Arduino IDE program sends the data to ESP-8266 and through the nodeMCU board, the pump is switched ON if only the water level in the upper tank is low. Also, the pump is switched OFF if the water level is filled in the upper tank. Depending on the sensor reading, the Arduino IDE program sends the data to ESP-8266 and through the nodeMCU board, the pump is switched ON if only the water level in the feed water tank is low. Also, the pump is switched OFF if the water level is filled in the feed water tank.

1.2 OBJECTIVES OF THE STUDY

- To indicate the water level of the feed water tank and storage tank.
- To measure the water level by using an ultrasonic sensor.
- To develop android apps for monitoring the system.
- To implement the smart pump controller including manual control facility using IoT.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND

Before beginning a new investigation, a literature review builds familiarity with and comprehension of current research on a certain topic. Conducting a literature study should allow us to learn about previous research and determine what is unknown about our topic. In this project, a literature review of Smart Pump Controllers Including Manual Control Facility Using IoT in every industry at the demi water tank and reserve tank for the boiler. Water Level Monitoring can be found in many areas since before. Various types of Water Level Monitoring systems based on the control are:

Individual systems: This is a very popular type of system. Here the whole model is implemented on a targeted single source system. Large control systems: Here the water level is implemented on a very large scale basis and huge amounts of sensors are used.

Central Control systems: Computerized systems programmed to handle all the functions of multiple utilities like air conditioning systems or home entertainment systems, and refrigerators all at the same instant regardless of our presence. Control systems can be accessed through telephone or internet from any corner of the world.

2.2 PREVIOUS STUDIES

Here is some review on Smart Electricity Theft Detection and Power Consumption Monitoring System. Discussion is going to review those papers.

In this paper, Priya J and Sailusha Chekuri proposed that IoT based Water Level Monitoring System is an innovative system that will inform the users about the level of liquid and will prevent it from overflowing [1]. To demonstrate this the system makes use of containers, where the ultrasonic sensors are placed over the containers to detect the liquid level and compare it

with the container’s depth. The system makes use of an AVR family microcontroller, Raspberry Pi, LCD screen, Wi-Fi modem for sending data, and a buzzer.
In this paper, Timothy Malche and Priti Maheshwary develop this project which is based on a water level monitoring system. Water source is necessary and an important factor in agricultural and farm production and is a key to our quality of life as well [3]. The monitoring water level of a water source, such as a water tank or bore well, etc., plays a key role in agriculture. For example, if a water level drops below the threshold level for pumping in a bore well, the pump motor may get damaged due to dry running. This paper proposes a prototype system design, implementation, and description of required tools and technologies to develop an Internet of Things (IoT) based water level monitoring system which can be implemented in future smart villages in India.

This research provides a reliable system for monitoring water levels and quality in overhead tanks in order to reduce current water waste and improve water quality. The project is about an overhead tank monitoring system, in which they monitor the amount of water in the above tank and also determine the type of water. They may choose how much water is required for a certain region based on the water level and provide a suitable amount of water rather than wasting water. Finally, information will be compiled, and it will be viewable on a variety of devices via an Android app via Wi-Fi. Workers will be dispatched to clean the tank based on the information in the app.

In this paper, they discuss the idea of managing and monitoring lake levels as a village water storage source. More specifically, they described how to use a raspberry pi as a controller for wired and wireless water level detection and control. The use of a water level management strategy would aid in minimizing the amount of time needed for water allocation, the need for water during the summer, drought conditions, and water waste. Additionally, it can show how much water is there in the lake to support various Global Water kinds, such as cellular data loggers and GSM through data transmission systems for office water management. Furthermore, recently, cellular phones with comparatively powerful computing capabilities and excellent graphical user interfaces have become available.

In this paper, Mutinda Mutava Gabriel and Kamweru Paul Kuria developed this system. Motion detection has become one of the great areas of research in the world. Many activities are carried out in the presence of motion. One of the research focus has been the use of Arduino Uno microcontroller, Ultrasonic sensor, passive infrared sensor, and many others to sense and measure distances. This study aimed at designing a sensor that can easily measure how far the object is, monitor changes in distances as the object approach, and display the results in the Liquid Crystal Display (LCD), giving a light-coded signal and a sound alarm. The hardware utilized included the Arduino Uno on breadboard interfaced with LCD, LEDs, Buzzer, and Ultrasonic sensor. The study demonstrated that the designed sensor could be used to accurately determine the position of an approaching object and display the distance readings on the LCD.

This paper describes to lay out and build a manually controlled surveillance system. Ultrasonic sensors are first-rate gear to degree distance without real touch and used at several places like water degree measurement, distance dimension, etc. this is an efficient manner to measure small distances exactly. In this assignment, we've got used an Ultrasonic Sensor to determine the space of an obstacle from the sensor. The simple principle of ultrasonic distance measurement is primarily based on ECHO. The module works on the natural phenomenon of the ECHO of sound. A pulse is dispatched for about 10us to cause the module. Ultrasonic sensor HC-SR04 is used right here to measure distance in a variety of 2cm-400cm with an accuracy of 3mm.

2.3 PROBLEM STATEMENT OF THE STUDY

- They did not use any securer’s database system.
- The pump will be turned on depending on the water level in the storage tank, otherwise priming in the pump will be difficult.
- When there is water in the storage tank, the pump will start. That is why we need to develop a sensor-based monitoring system.
- We need a strong data connection for the micro-controller to develop IoT based monitoring system.

CHAPTER 3

DESIGN AND WORKING PRINCIPLE

3.1 DESIGN OF A PUMP MONITORING SYSTEM

Hardware refers to the equipment or modules in the context of technology. A sensor is a device, module, or subsystem that detects events or changes in its surroundings and sends the information to other electronics, usually a computer processor. We have used lots of hardware and software components in our project. Now let's discuss those components below.

- NodeMCU
- Ultrasonic Sensor
- LCD Display
- I2C Module
- Relay Module
- Pump

3.1.1 NodeMCU

NodeMCU is an open-source Lua-based firmware and development board specially targeted for IoT-based Applications. It includes firmware that runs on the ESP-8266 Wi-Fi SoC from Espressif Systems, and hardware that is based on the ESP-12 module.

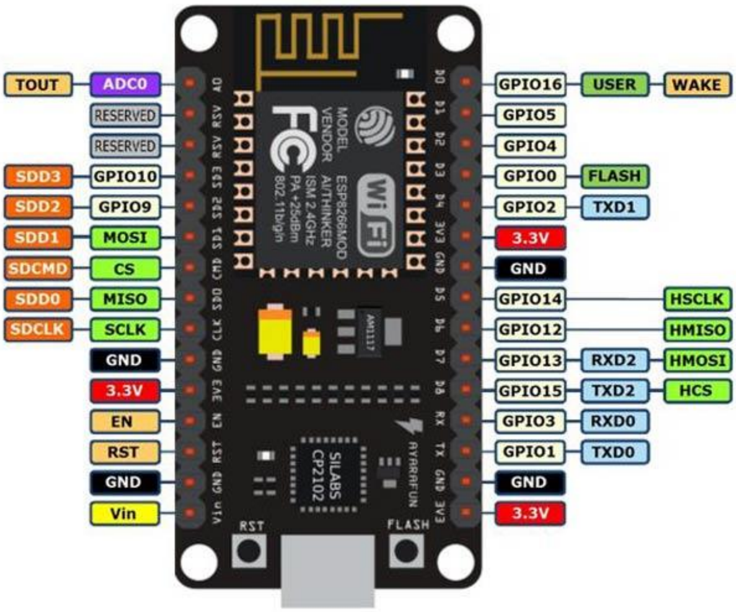


Fig 3.1: NodeMCU Pinout

NodeMCU Specifications:

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- Flash Memory: 4 MB
- Clock Speed: 80 MHz

Working Principle: NodeMCU is the microcontroller of this project. It has some digital pins, one Rx Tx pin, one analog pin, etc. This pin is also used to control input and output devices. For the analog input signal, we have only used the A0 pin. For the digital input signal, we have used D5-D8 pins. These pins are also used as digital input/output. Here, the positive point of the power supply connects with the Vin pin and the negative point connects with the GND pin. All the input and output devices connect between D5 to D8. For the input signal, we have declared this pin as input and for the output signal, we have also declared this as output. We have used three NodeMCU for this project.

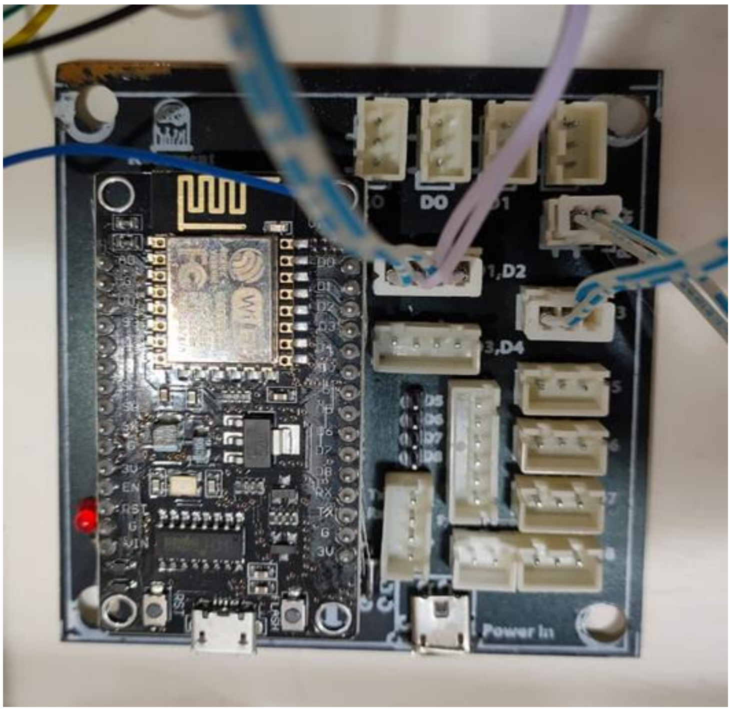


Fig 3.2: NodeMCU placed in the project

3.1.2 Ultrasonic Sensor

The Ultrasonic HC-SR04 Sensor Module is a widely used sensor for measuring distance and detecting objects in a variety of applications. It is shown in figure 5. It works in the same way that a radar system does. Ultrasonic sensors operate by producing high-frequency sound waves those humans can't hear. The transmitter emits a high-frequency sound pulse, which is received by the receiver when it reflects back from any object's surface.

The sensors detect objects in this manner. It can detect objects or measure distances between 2cm and 400cm. The ultrasonic sensor works in the same way that a bat's object detecting system does. We can also claim that it works in the same way that a radar system does. The Transmitter (TX) and Receiver (RX) are the two primary components of the ultrasonic or HC-SR04 module (RX) [17].

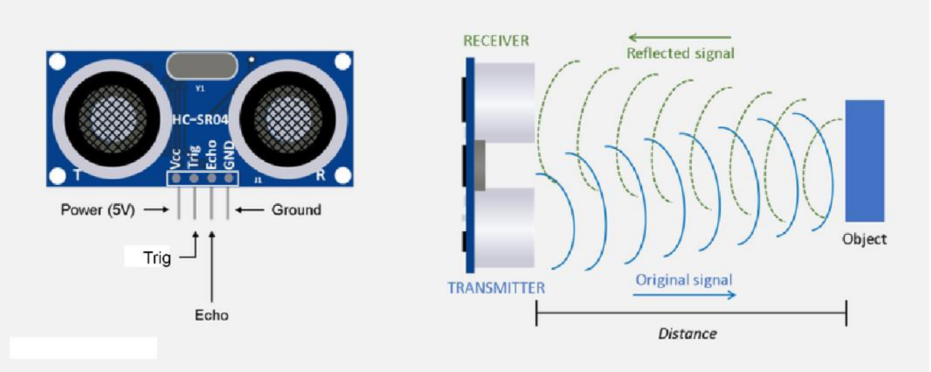


Fig 3.3: Distance measured by using ultrasonic sound

Working Principle:

Echo and Trig pin of the ultrasonic sensor at storage tank connected with D5 and D6 pin of NodeMCU. Again Echo and Trig pin of the ultrasonic sensor at the feed water tank connected with the D7 and D8 pin of NodeMCU. The trig pin emits ultrasonic sound, which is received by the echo pin. To make the ultrasonic sound, we must first set the Trig pin to a High State for 10 seconds (microseconds). Where the distance between the sensor and the object is denoted by s. The sound speed in air is v = 0.034cm/s or 340 m/s. The time it takes for sound waves to bounce back from an object's surface is called t. Because time will be doubled when the waves travel and bounce back from the originating point, we must divide the distance value by two Power Supply − +5V DC.

Operating Condition:

- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance: 2cm – 400 cm/1″ – 13ft
- Resolution: 0.3 cm

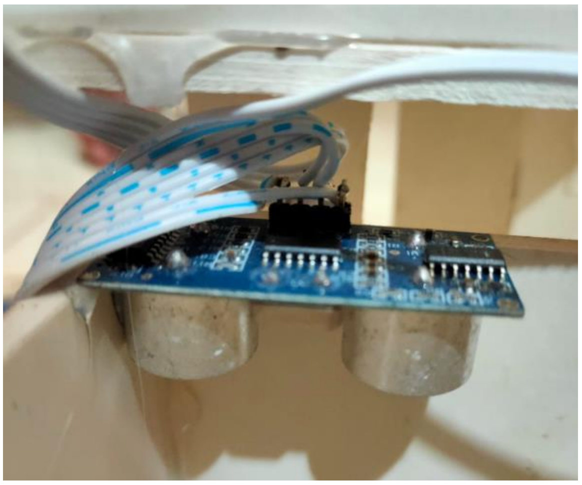


Fig 3.4: Ultrasonic sensor placed in the tank

3.1.3 LCD Display:

With the use of a common overhead projector, the liquid crystal display (LCD) panel is

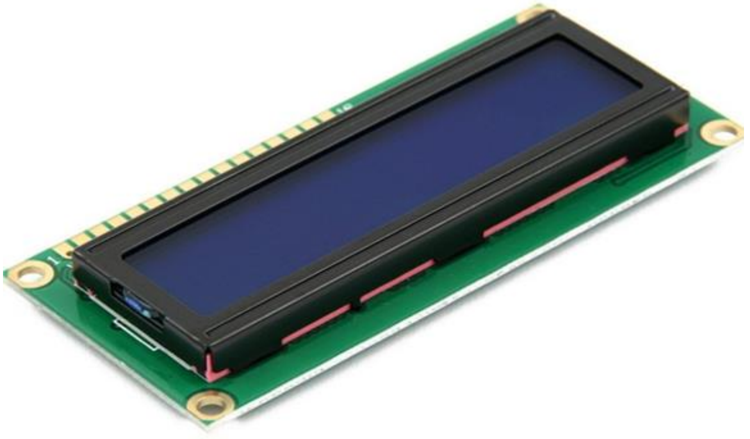


Fig 3.5: LCD Display

designed to project on-screen information from a nodeMCU onto a screen so that condition of the grid could be shown on display. LCD (Liquid Crystal Display) is a type of flat panel display that operates primarily with liquid crystals. LEDs are widely used in cellphones, televisions, computer monitors, and instrument panels, and they have a wide range of applications for consumers and enterprises. Two sizes of LCD display have been used for this
the project which was 16x2 and 20x4.

Working Principle:

The power unit supplies power ultrasonic sensors, I2C module, nodeMCU, and relay module. It activates all the components and other equipment which are used in this water level indicating the project. LCD displays were used to show the output on the display. LCD display connected with I2C module. Before using its needs to initialize the display by coding. In a 16x2 display, we can write 16 characters at a time in one line and only two rows were used. Output result was shown on the LCD display. The level of water and operation of the pump was shown on the LCD display.

3.1.4 I2C Module

I2C is a single-ended, synchronous, multi-slave, multi-master packet switched serial bus. Multiple chips can be connected to the same bus, for example. Serial Data Line (SDA) and Serial Clock Line (SCL), both bidirectional open collector and open drain lines, are pulled up with resistors in I2C. I2C module needed only two pin uses. It is the main benefit of I2C display. Because LCD needed more than 7 or 8 pins of Arduino. It reduced the pin use of Arduino.

Specifications:

- Screen Resolution: 128*64 Pixels
- Screen Active Area: 47.1*26.5mm
- Individual Pixel Size: 0.33*0.33mm
- Communication Mode: I2C(100Kbit/s and 400Kbit/s)
- Operating Frequency 16 MHz

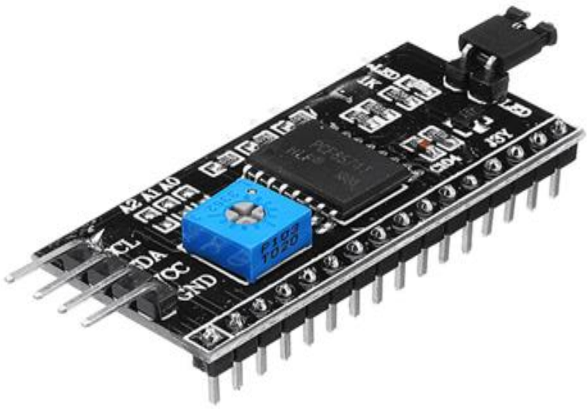


Fig 3.7: I2C Module

Working Principle:

The LCD display used a number of 5 pins of Arduino to control the module. 16x2 LCD display was used for this project. I2C module was attached with an LCD display for control. Controlling LCD was easier after using the I2C module. 5v power was supplied in I2C to activate the module. SDL and SCL pins were connected with nodeMCU D1 and D2 pins. LCD showed monitoring data of this project.

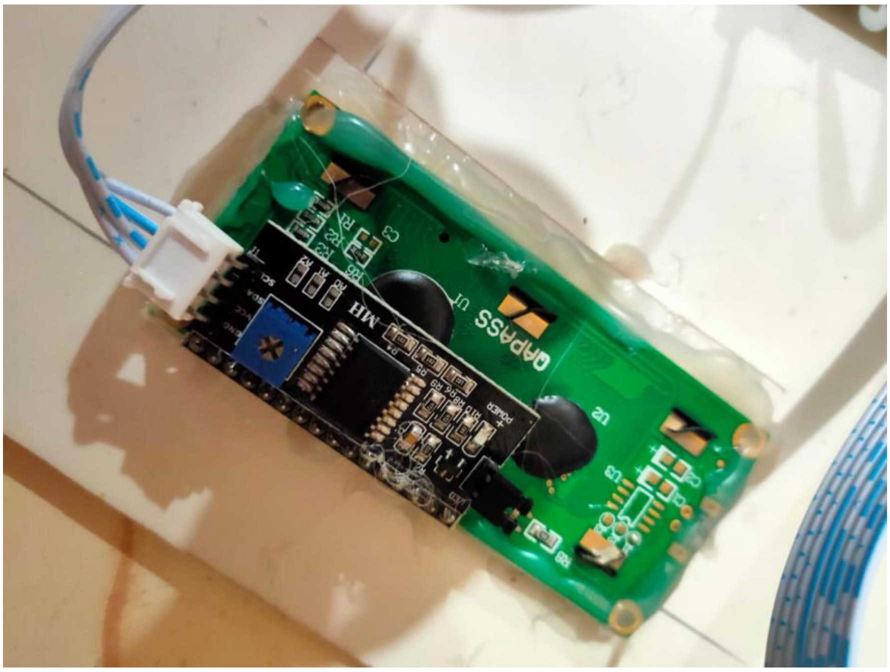


Fig 3.8: LCD and I2C placed in the project

3.1.5 Relay Module

An electromagnet operates a power relay module, which is an electric switching device. The microcontroller sent a low signal in the relay module. The electromagnet pulls to open and close an electrical circuit when energized. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. The relay module had two parts. One part was connected with the controlling part. Another part is connected with the output load. When a relay contact is normally open (NO), there is an open contact when the relay is not activated, as shown in relay schematics.

Specifications:

- Voltage Input: 3.75V – 6V.
- Active current: ~70mA.
- Operative Voltage: 250VAC/30VDC.
- Maximum current: 10Amp.
- Operating time: 10msec
- Release time: 5msec

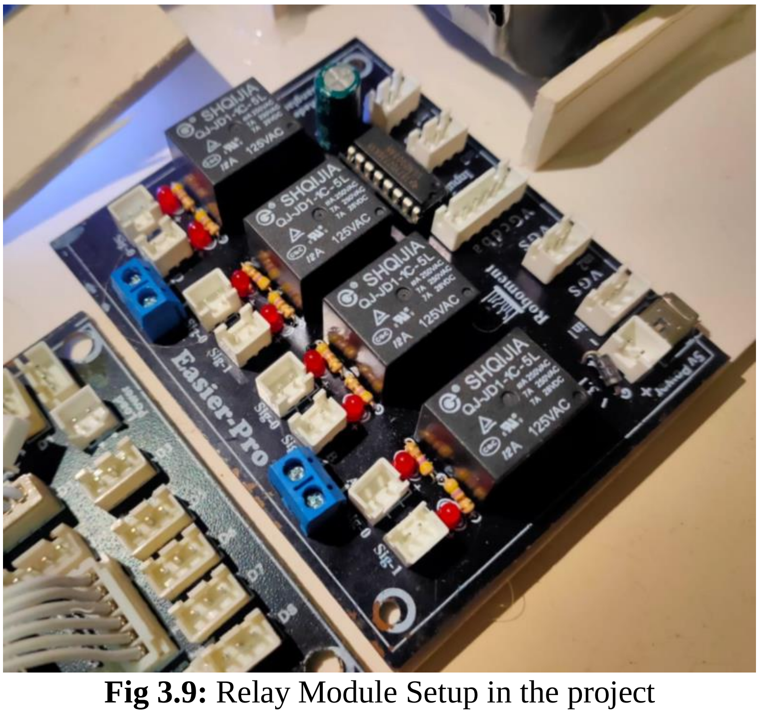


Fig 3.9: Relay Module Setup in the project

3.1.6 Pump

This is a brushless submersible pump that can work at 3.5V to 9V voltage, with low noise, and low power consumption. This is a brushless submersible pump with a USB connector, that can work at 3.5V to 9V voltage, low noise, and low power consumption. It can be easily integrated into our safety security system project. The water pump works using the water suction method which drains the water through its inlet and released it through the outlet.

Fig 3.10: Submersible water pump

Specifications:

- Operating Voltage (VDC): 2.5 to 6
- Operating Current (mA): 130 to 220
- Flow Rate (L/H): 80 to 120
- Material: Plastic
- Inner Diameter (ID): 5 mm
- Outer Diameter (OD): 7.5 mm

Working Principle:

The water level in the tank was bottom in the tank. This pump was placed in the storage tank. At first, this pump connected with a relay module. This module controls the pump by changing the HIGH and LOW signals.

3.2 SOFTWARE DEVELOPMENT

Software development is another important topic for this project. This was a water level indicating process so some programming or coding develop to control the microcontroller. For project purposes, Arduino is used as a microcontroller. Then Arduino IDE was used to control the Arduino controller. By doing this step, electricity theft was detected smartly.

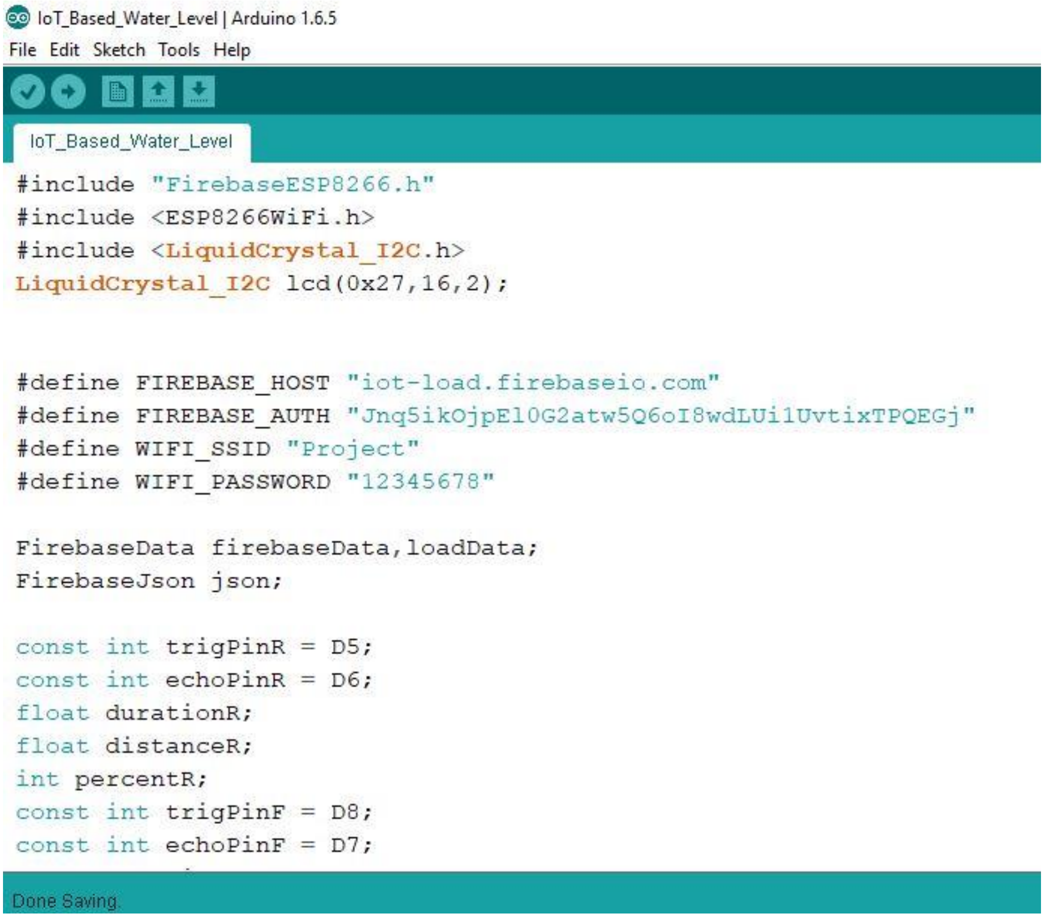
3.2.1 Arduino IDE

Arduino is an open-source electronics platform that uses simple hardware and software to make it easy to use. Arduino boards can take inputs - such as light from a sensor, or a finger on a switch and convert them to outputs - such as turning on an LED, triggering a motor, or publishing anything online.

Fig 3.11: Arduino IDE Software

The Arduino IDE employs C++, however, because the physical environment is constrained, not all C/C++ features are available. The Arduino environment includes auxiliary functions to make using the hardware easier, as well as a serial monitor for input and output. When the board is connected, this will display the serial information of our Arduino. Board and Serial Port tell us what board is being used and what serial port it's connected to.

3.2.3 Arduino Variable Declaration and Library Included




```
#include "FirebaseESP8266.h"
#include <ESP8266WiFi.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);


#define FIREBASE_HOST "iot-load.firebaseio.com"
#define FIREBASE_AUTH "Jnq5ikOjpEl0G2atw5Q6oI8wdLUi1UvtixTPQEGj"
#define WIFI_SSID "Project"
#define WIFI_PASSWORD "12345678"

FirebaseData firebaseData,loadData;
FirebaseJson json;

const int trigPinR = D5;
const int echoPinR = D6;
float durationR;
float distanceR;
int percentR;
const int trigPinF = D8;
const int echoPinF = D7;
```

Fig 3.12: Library included and firebase authentication

We will see Arduino IDE screen the header file #include <wire> and #include <Liquidcrystal_I2C.h> are the Ultrasonic sonar sensor and LCD Display library for Arduino IDE. Here we declared distance in float and declared a variable f then trig Pin = 3 and echo Pin = 2 are declared in there. Liquidcrystal_I2C LCD (0*27, 16, and 2) also declared. Sub function is declared. Pin Mode (trig Pin, OUTPUT); pin Mode (echo Pin, INPUT); LCD.

Backlight (); LCD. Into (); are declared here. The Declare and setup function is shown in the figure.

In this, some variables were declared as an integer type and float type variables. Echo and trig pin were declared as integer type variables. So they showed the only number in the serial monitor. trigpinR and echopinR were declared as D5 and D6. Again TrigpinF and echopinF were declared as D8 and D7 pins. The pump was also declared as a D0 pin. percent and percent are set as float-type variables. The Getting sub-function was used to get data in the loop.

3.2.4 Void Setup Function

In this project, a relay module was used to send the on-off signal to the Pump. In the nodeMCU screen, it was seen this project Relay module Pin was declared microcontroller 2&3 pin. The void loop checks the condition when pin1 is high the relay gives a signal to the Pump. When the signal was low the pump is off. Now, the Relay module code is shown in the figure.

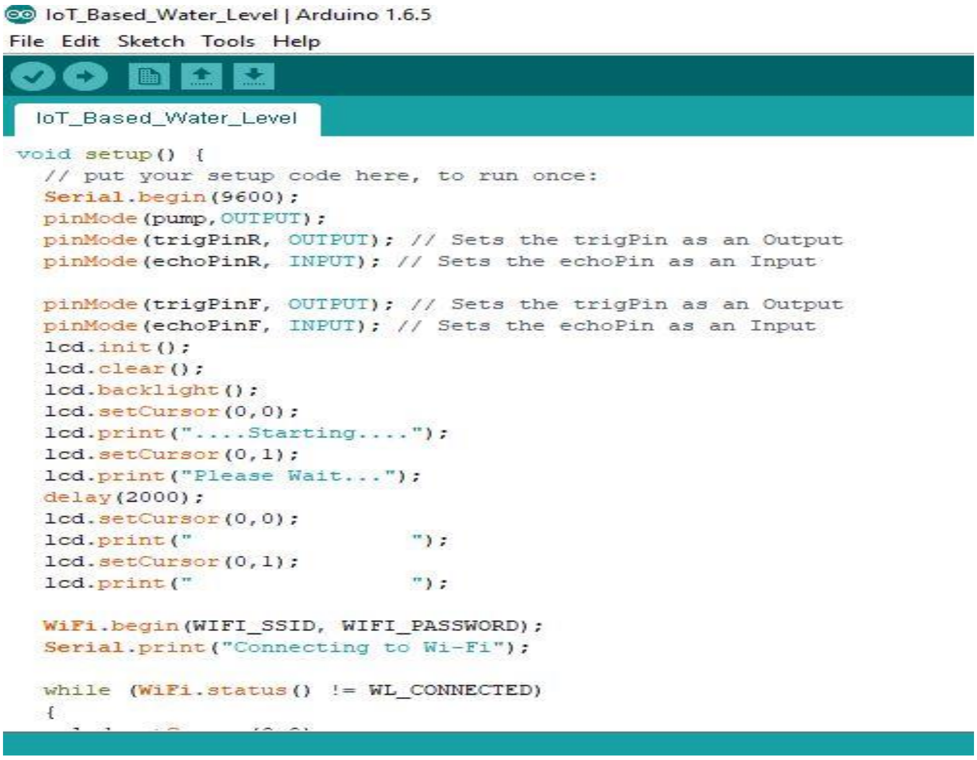


Fig 3.13: Pin mode Setup

In this portion, all the variables are declared globally and pins are also declared which are used. In the setup function, microcontroller pins are to be identified separately. At first serial. begin function was declared. Pump declared as OUTPUT. echopinF and echopinR were declared as INPUT to receive the ultrasonic frequency. trigpinF and trigpinR were declared as OUTPUT to create the ultrasonic frequency. If any pin is called INPUT that means it took data for Arduino IDE. If the pin is declared as an OUTPUT, it will operate a load. For initializing the lcd1. init() sub-function was called. The backlight was turned on using backlight() sub-functions. Serial begin was used to check the serial monitor.

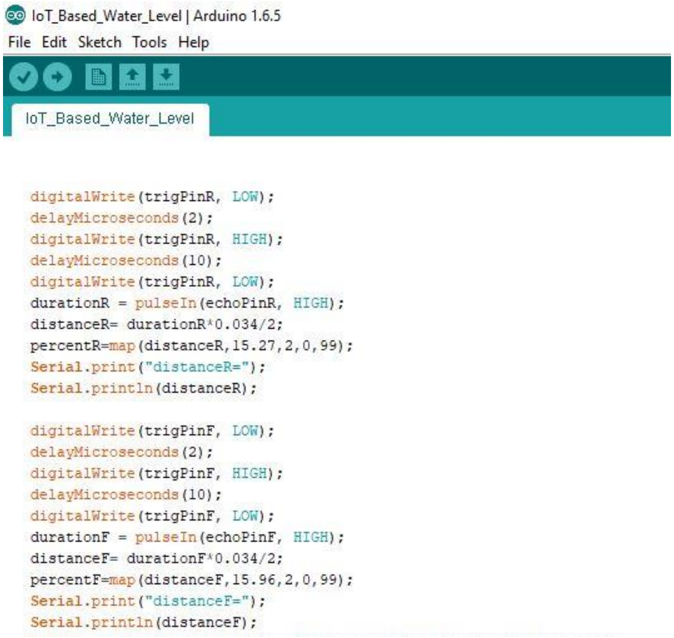
```
lcd.setCursor(0,1);
lcd.print("                ");
Serial.println();
Serial.print("Connected with IP: ");
Serial.println(WiFi.localIP());
Serial.println();
lcd.setCursor(0,0);
  lcd.print("Connected      ");
  lcd.setCursor(0,1);
  lcd.print(WiFi.localIP());
delay(6000);
Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
Firebase.reconnectWiFi(true);

Firebase.setString(firebaseData, "/Project/IoTpump/Mood","0");
Firebase.setString(firebaseData, "/Project/IoTpump/pump","0");
lcd.setCursor(0,0);
lcd.print("                ");
lcd.setCursor(0,1);
lcd.print("                ");
```

Fig 3.14: Program for Firebase setup

Host and author names were set in this code. At a time firebase was added to this setup function. In this portion, firebase is initialized here. FIREBASE_HOST is represented the URL of the firebase and FIREBASE_AUST has represented the password of the database. It gives the security of our database.

3.2.5 Void Loop Function

Loop body initialized loop function. The ultrasonic sensor is very effective to measure distance point by point. We see this picture sensor distance measurement process. In this loop function, trigpin was LOW for 2 microseconds and then it was HIGH for 10 microseconds. The echo pin was HIGH for receiving the signal. This value is calculated and converted as the distance which is put in the distanceR and distanceF variables. Here measurement is measured on the basis of a centimeter scale. Sonar sensor input signal send the microcontroller, microcontroller shows the data the display value by shown LCD display. When the condition is done microcontroller gives the signal to the relay.



3.2.6 Compiling and Uploading System of Arduino

Next, we need to click on the verify button (check mark) that's located in the top left of the IDE box. This will compile the sketch and look for errors. Once it says "Done Compiling" we are ready to upload it. Click the upload button (forward arrow) to send the program to the Arduino board.

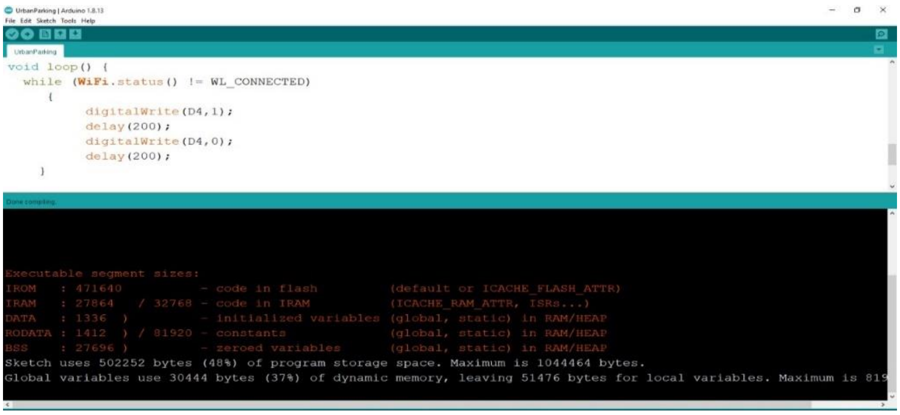


Fig: 3.16: Compile and Uploading Code in Controller

The relevant things must be picked from the Tools > Board and Tools > Port menus before uploading our drawing. The boards are discussed in the following sections. It's most likely COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or above (for a USB board) on Windows; to find out, check for USB serial devices in the Windows Device Manager's ports area. Press the upload button in the toolbar or pick the Upload item from the Sketch menu once we have selected the right serial port and board. As the sketch is uploaded, the RX and TX LEDs on most boards will blink. When the upload is complete, the Arduino Software (IDE) will display a message or an error. When we upload a sketch, we are utilizing the Arduino boot loader, which is a little software put onto our board's microcontroller. It enables us to upload code without the need for any further hardware. When the board resets, the boot loader is active for a few seconds before starting whichever sketch was most recently uploaded to the microcontroller. When the boot loader

3.3 Database Management

A database is an organized collection of structured information, or data, typically stored electronically in a computer system. The database is developed for storing signals from the sensors. Because it stores globally. At this time firebase is used for the database system. Firebase is a platform developed by Google for creating mobile and web applications. This is the flow chart for creating a project in Firebase

3.3.1 Configure Database

After configuring this database. We configured our database as a default account for firebase.

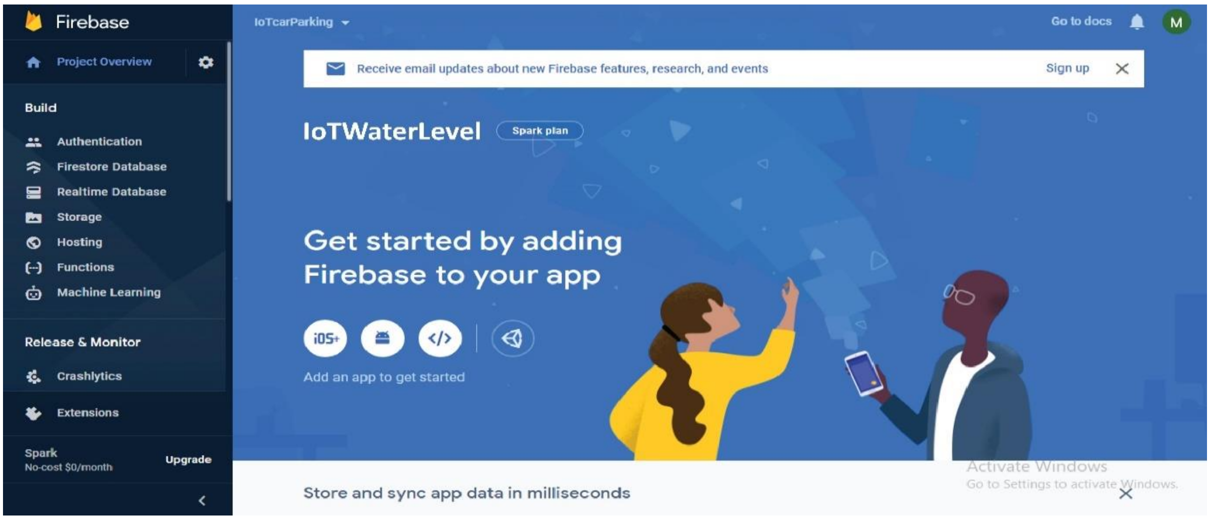


Fig 3.17: Dashboard of Database

Then this dashboard was opened. Different types of database options are shown on this board.

3.3.2 Realtime Database

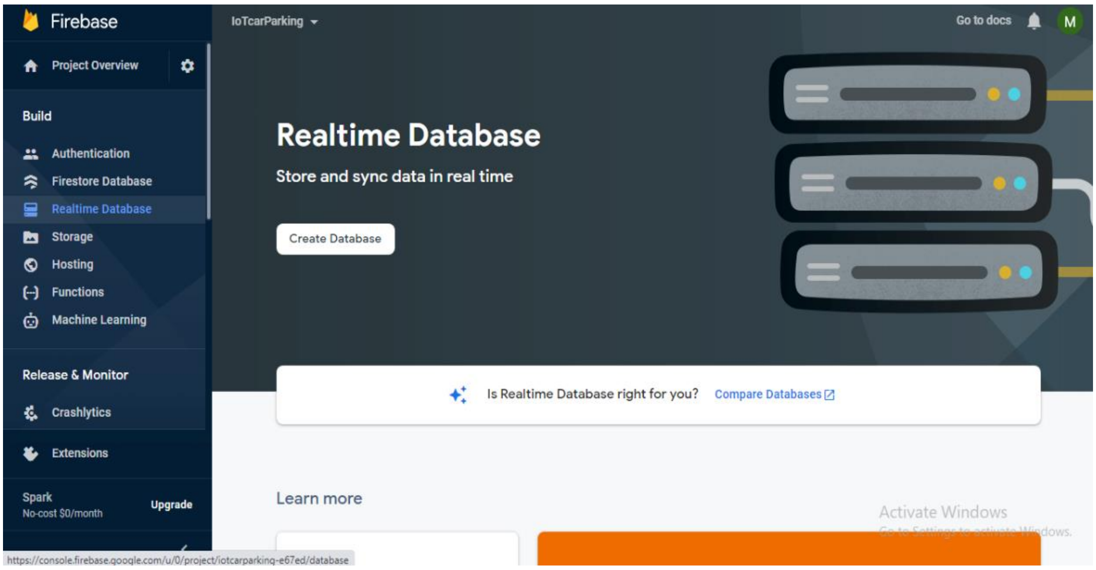


Fig 3.18: Realtime Database Selection

A real-time database is selected for monitoring real-time data. It is selected from the left side dashboard.

3.3.3 Database URL and Authentication Code

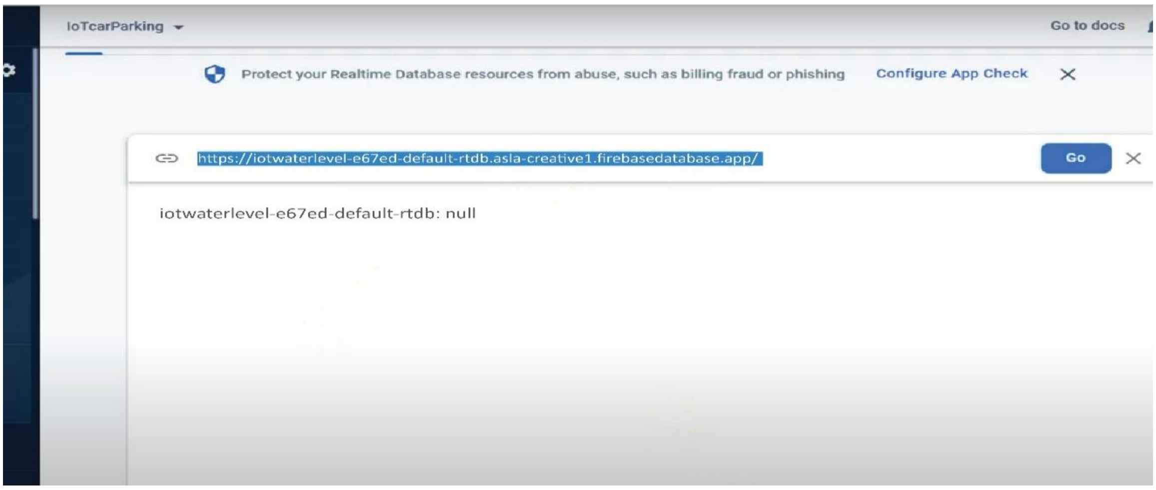


Fig 3.19: Database URL

Database URL and database authentication code were shown here. Firebase initialized in Arduino with help of this URL and code. Through this URL microcontroller connected with a particular database and transferred data to the firebase.

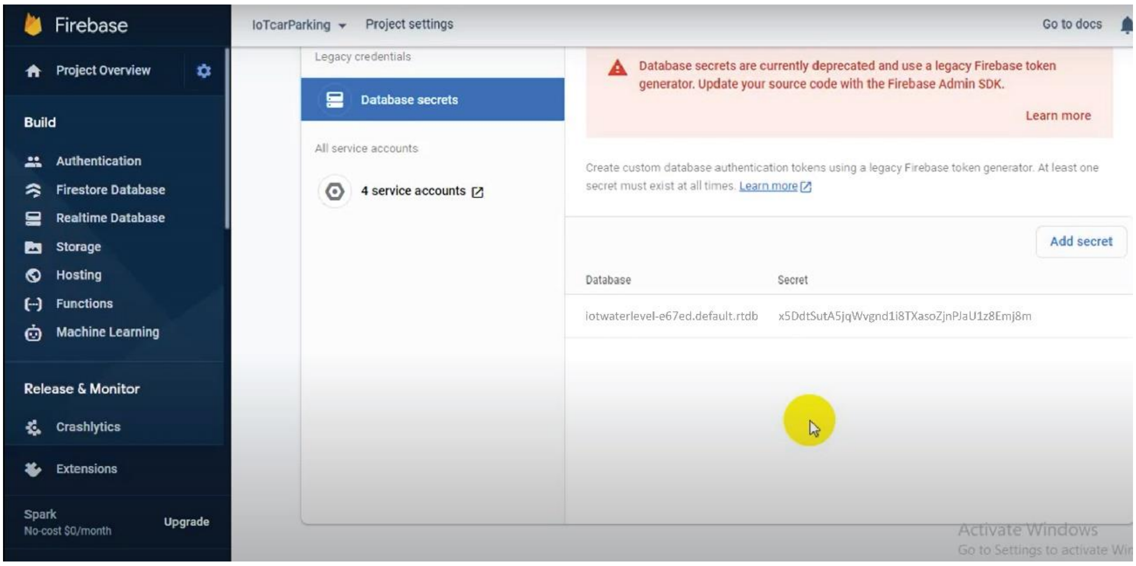


Fig 3.20: Database Authentication Code

3.3.4 Data Communication

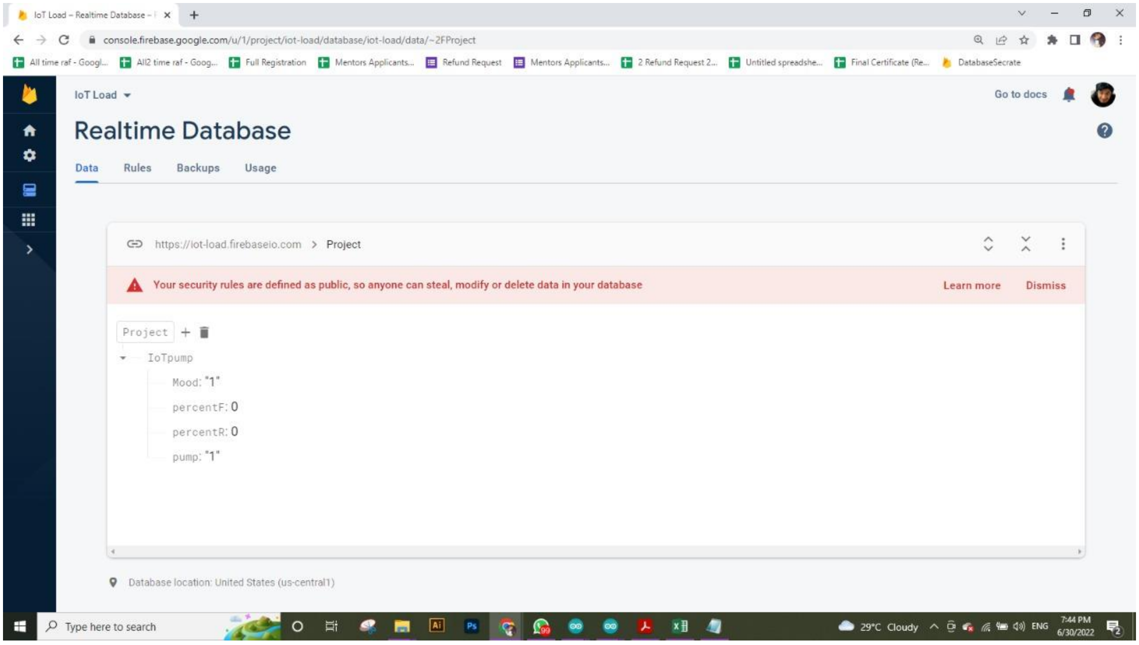


Fig 3.21: Data Communication System

Real-time data communication system was developed here. This data comes into the firebase as an integer. But it also comes as a string and character. This system was built with tag, sub-tag, and value. Mood, percent, and pump were represented as tags, and slots were represented as sub-tag. These are found as a string. But the value was one kind of signal which came from the sensor via a controller. When the demi water tank was filled up with water, the water level changed. This percentage was sent to the database via nodeMCU. Initially, this percentage was zero. It was changed with a respective input value of the sensor. At a time, the pump and other conditions sent a signal to monitor the data. This database was connected with android apps.

3.4 APP DEVELOPMENT

We develop an app for monitoring this project. It is an android app. It is a user-friendly app. This app is built with help of the MIT app inventor platform. It is an intuitive, visual programming environment that allows everyone to build fully functional apps for Android phones, iPhones, and Android/iOS tablets. Blocks-based coding programs inspire intellectual and creative empowerment. In this app, the percentage of water for both tanks were shown here.

This is the mobile view of the front page. The developer and team members were included there. Also, attached is our supervisor's name and her image. Go to Dashboard indicates to go to the next page of this app. If we pressed this dashboard, then we would shift to the monitoring page. This app has been connected to a database This was blocking the programming of monitoring. Get Value was used to get data from the database. The tag was used to mention the percentage of water level in a storage tank and a demi water tank.

At first, data was collected from the feed water tank, and the percentage of water was shown on the display. Then collected data from the reservoir tank. This percentage is also shown in apps. At a time, pump status also showed in the app. The method of the monitoring system was changed by pressing automatic and manual modes.

CHAPTER 4

Methodology

4.1 INTRODUCTION

The methodology is a broad research approach that describes how the research will be carried out and, among other things, the methodologies that will be used. These techniques are detailed in the methodology.

Even while great emphasis is paid to the nature and types of processes to be followed in a particular operation or to achieve a target, the methodology does not define specific procedures. Such processes, when appropriate to a methodology study, form a constructive generic framework that can be broken down into sub-processes, amalgamated, or their sequence adjusted. We develop our smart theft detection project following this methodology step by step.

4.2 FLOW DIAGRAM OF WATER LEVEL INDICATOR

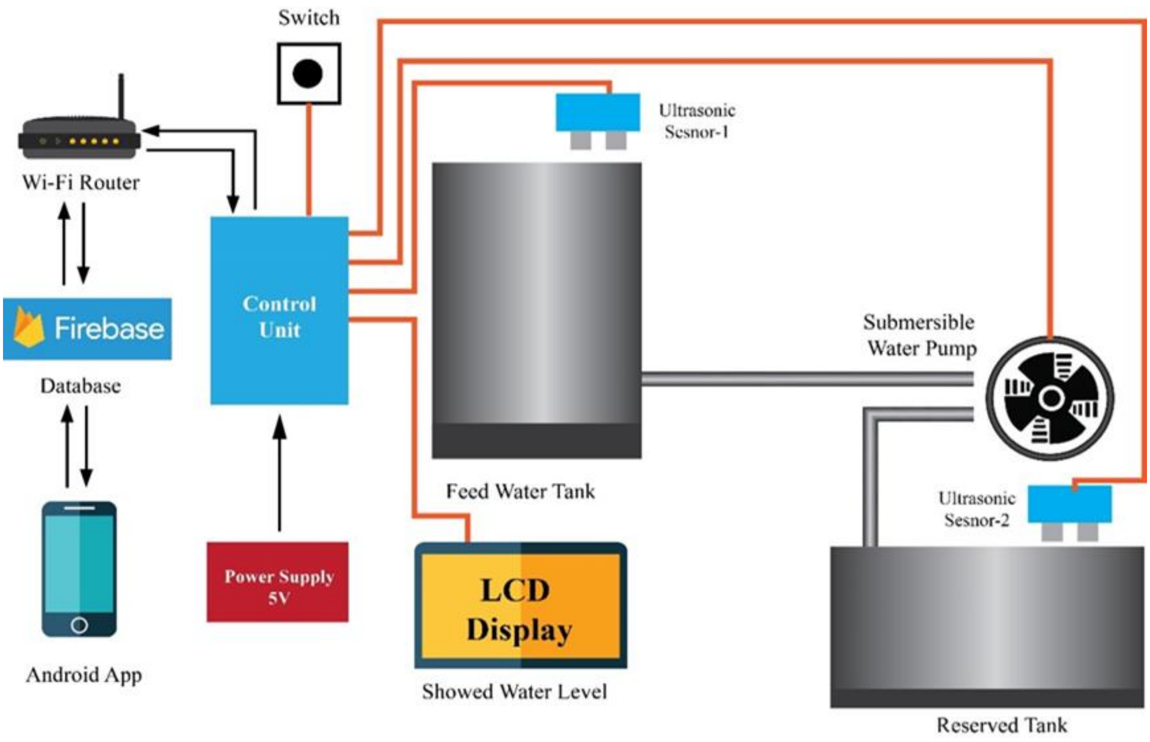


Fig 4.1: Flow Diagram of Project

System design is the process of defining the components, modules, interfaces, and data for a system to satisfy specified requirements. System development is the process of creating or altering systems, along with the processes, practices, models, and methodologies used to develop them. We have designed a system using NodeMCU, Ultrasonic sensors, a Submersible pump, switch, relay module, I2C module, and power supply. The hardware connection was built by wire. Ultrasonic sensors were placed on the reserved feed tank for measuring the water level. Output results and operation

The system was shown on the LCD Display. All the modules and sensors were connected with a power unit to activate. The controller was connected with a Wi-Fi router or mobile data for transferring data into a database. This database was connected with mobile apps. These apps read all data and signals from the database. Finally, results showed in mobile apps and LCD displays.

4.3 CONTRUCTED MODEL

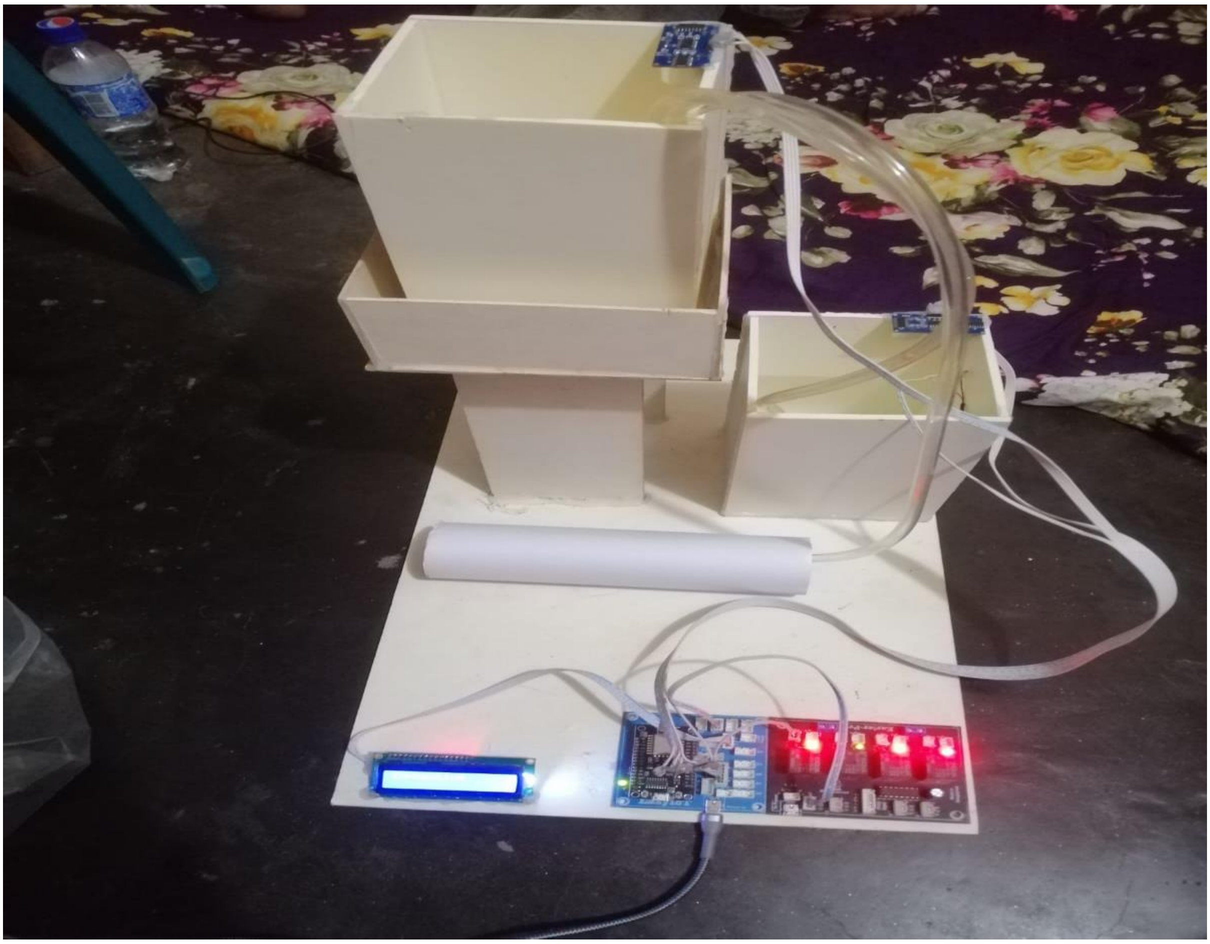


Fig 4.2: Design Model

To fix those issues patches are released. A resistor was implemented to fix this bug. We check any bugs in the code and fixed this issue immediately. First, the sensor measured the water level of the reserve tank using ultrasonic sound. Similarly, it was checked the water level in the feed water tank. If the feed water level was not correct, it would send a signal to the controller to start the pump. Before turning on the pump, the level of the reserve tank was also checked. If there were water in the tank then the pump would start and the feed water tank would fill up at the same time.

Algorithm of Water:

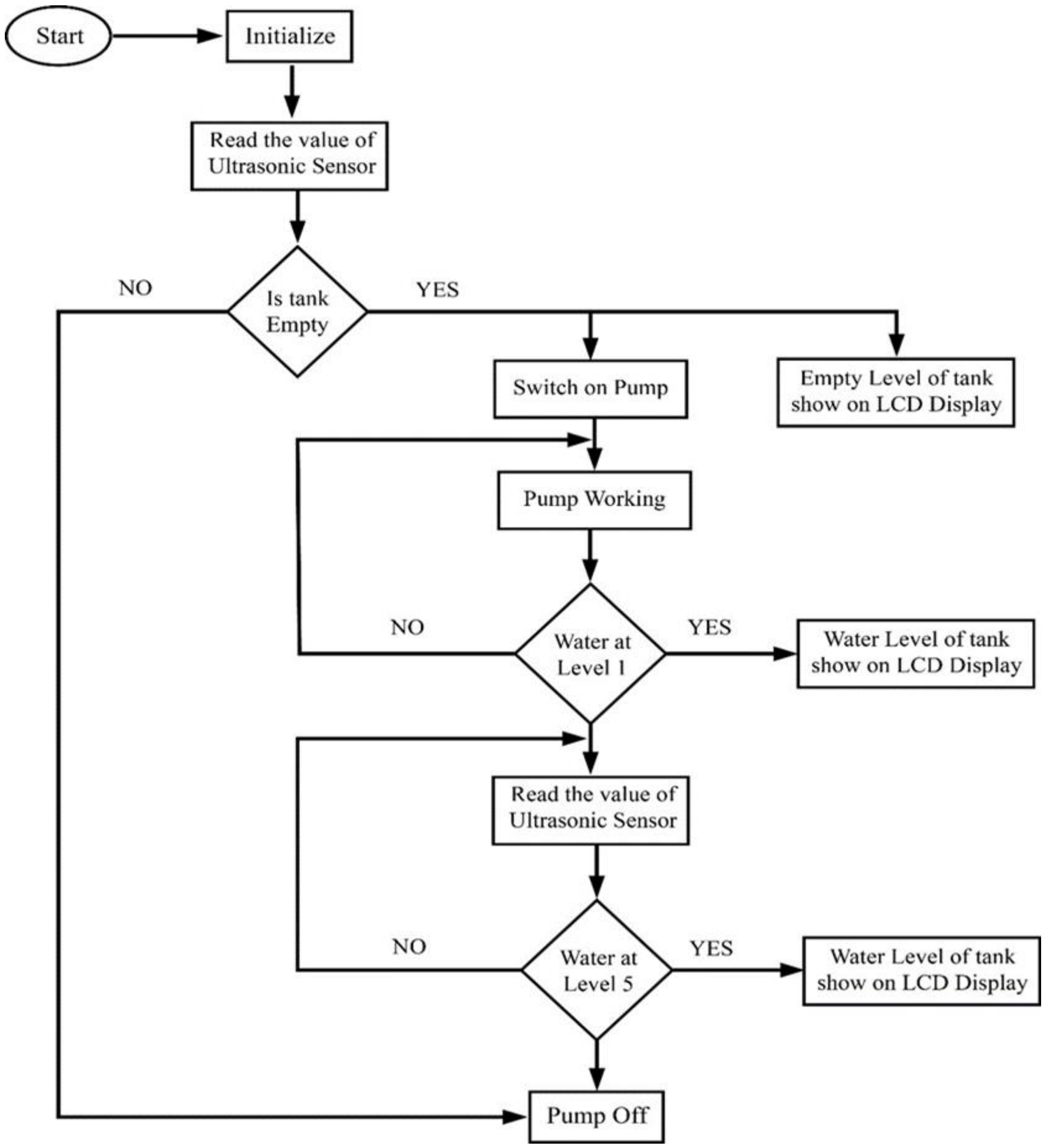


Fig 4.3: Flow Chart of this Project There are some issues that come up in the Algorithm of Water

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INDEX

The signal processing by the microcontroller required some time. All of this information is accessed via the internet. As a result, processing time was determined by the speed of the Internet. The value of the ultrasonic sensor was the main factor for this project. This value collect via controller and calculated this value automatically by using Arduino IDE software. This system took 3 to 5 seconds for the Wi-Fi module to cross the high-speed internet zone or connect with high bandwidth. Otherwise, it took between 5 and 12 seconds. Due to a weak connection, the controller will occasionally disconnect from our database

5.2 RESULT

At first, the system was connected with Wi-Fi or mobile data. Then it was automatically connected with firebase. If it was connected successfully, then the IP address was also shown on the LCD. Otherwise, nodeMCU was searching this IP address for connecting.

Fig 5.1: Manual operating system

In this figure, the percentage of the feed water tank was 38% and the percentage of the reservoir was 84%. Pump status was stand by. 1 represented the manual mood of this system. A condition was developed for this system. If the percentage of the feed water tank was

higher than 20%, then the condition of the pump would be ready to stand by. Again the percentage of the feed water tank was less than 20%, then the condition of the pump would run. If the percentage was above 80%, the pump was automatically off.

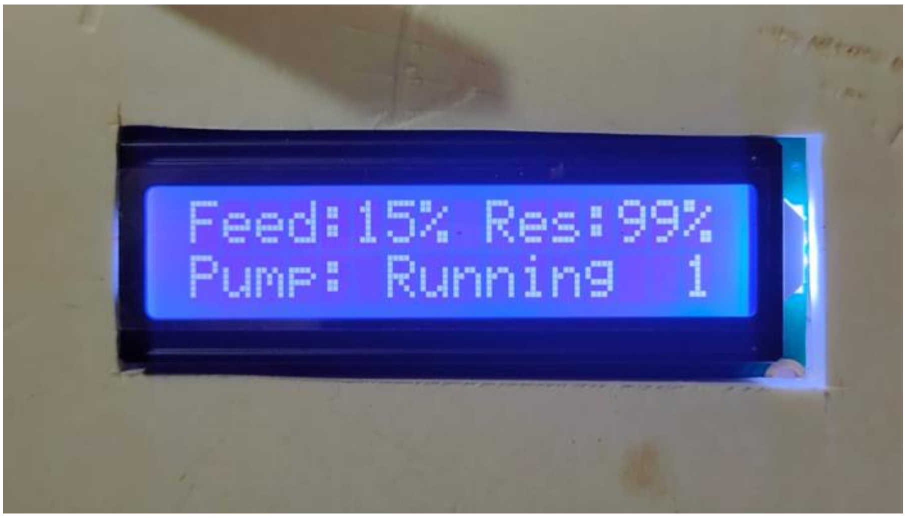


Fig 5.2: Pump running status is shown on the display

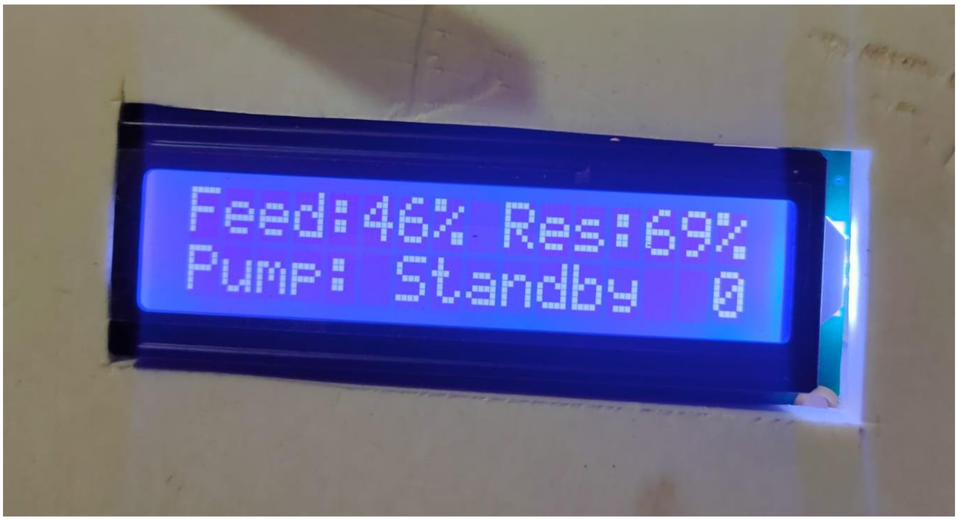


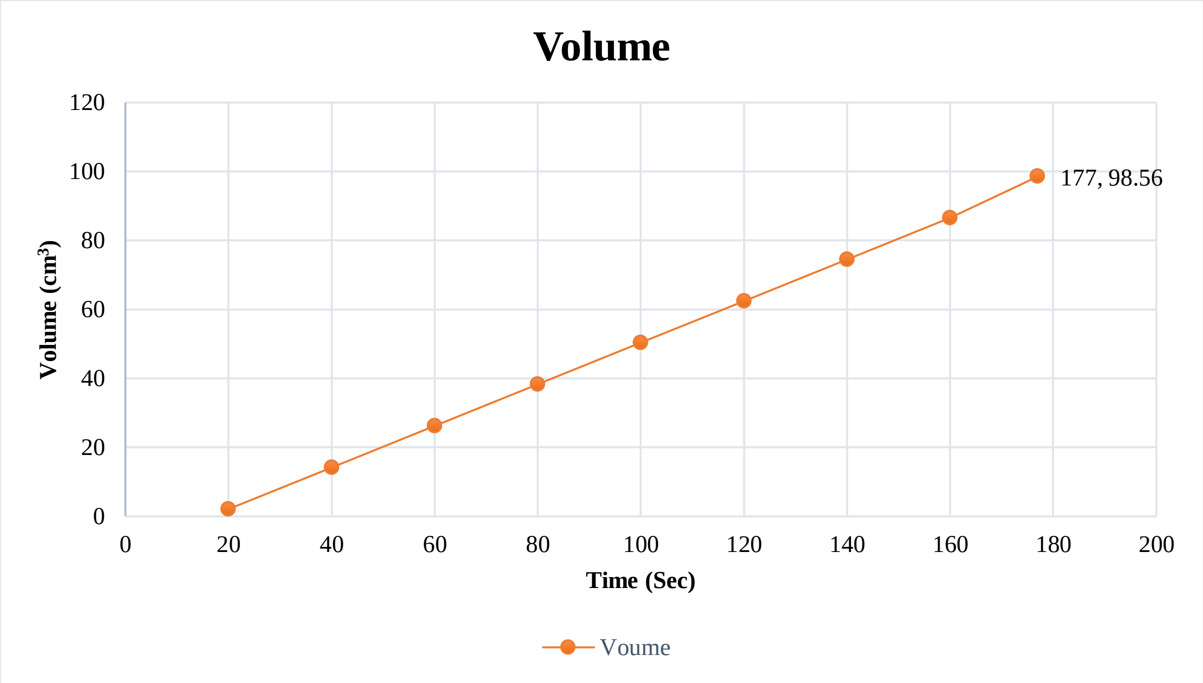
Fig 5.3: System running automatically

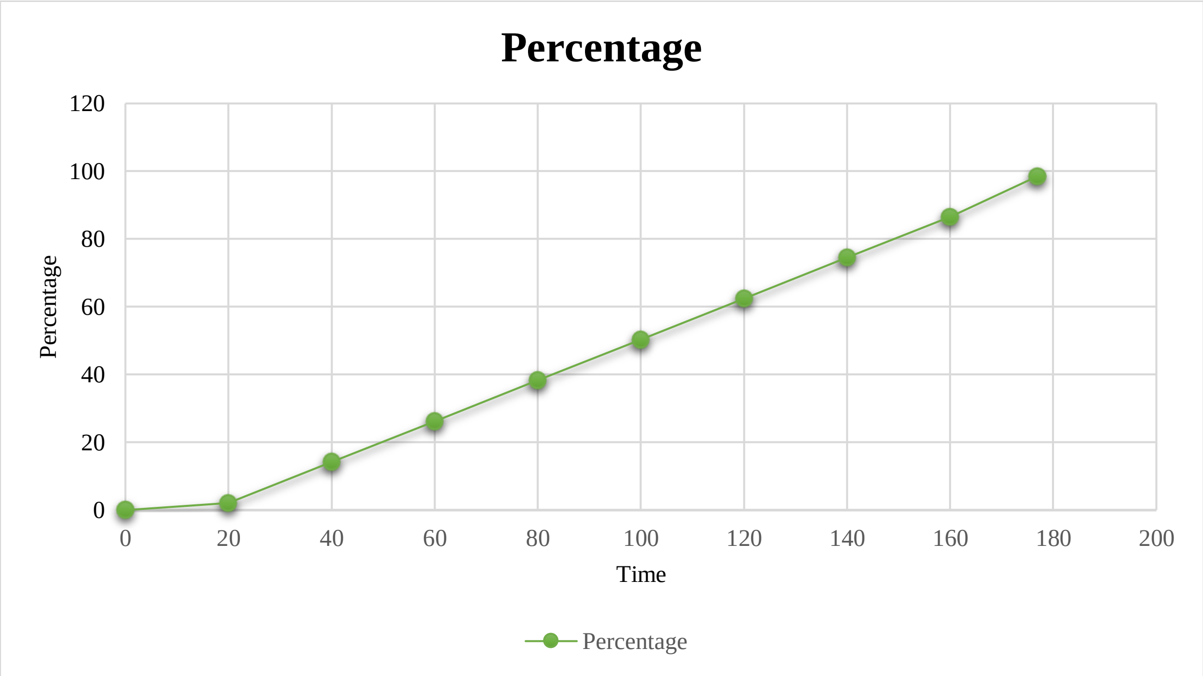
Zero (0) represented that this system was running automatically. The pump was turned on or off automatically concerning the condition. This mood was changed from the mobile apps.

Mood changing feature was included in the mobile apps.

5.3 Data Analysis

The water tank was filled with time. The time required for filling the tank is around 3 minutes. The average time was calculated for this data table. Water filled up 188 cm^3 for each 20 sec. The total volume of the water was 1675.3 cm^3. It took time 0 to 177 sec. This time was changed with respect to the mass flow rate of the pump.





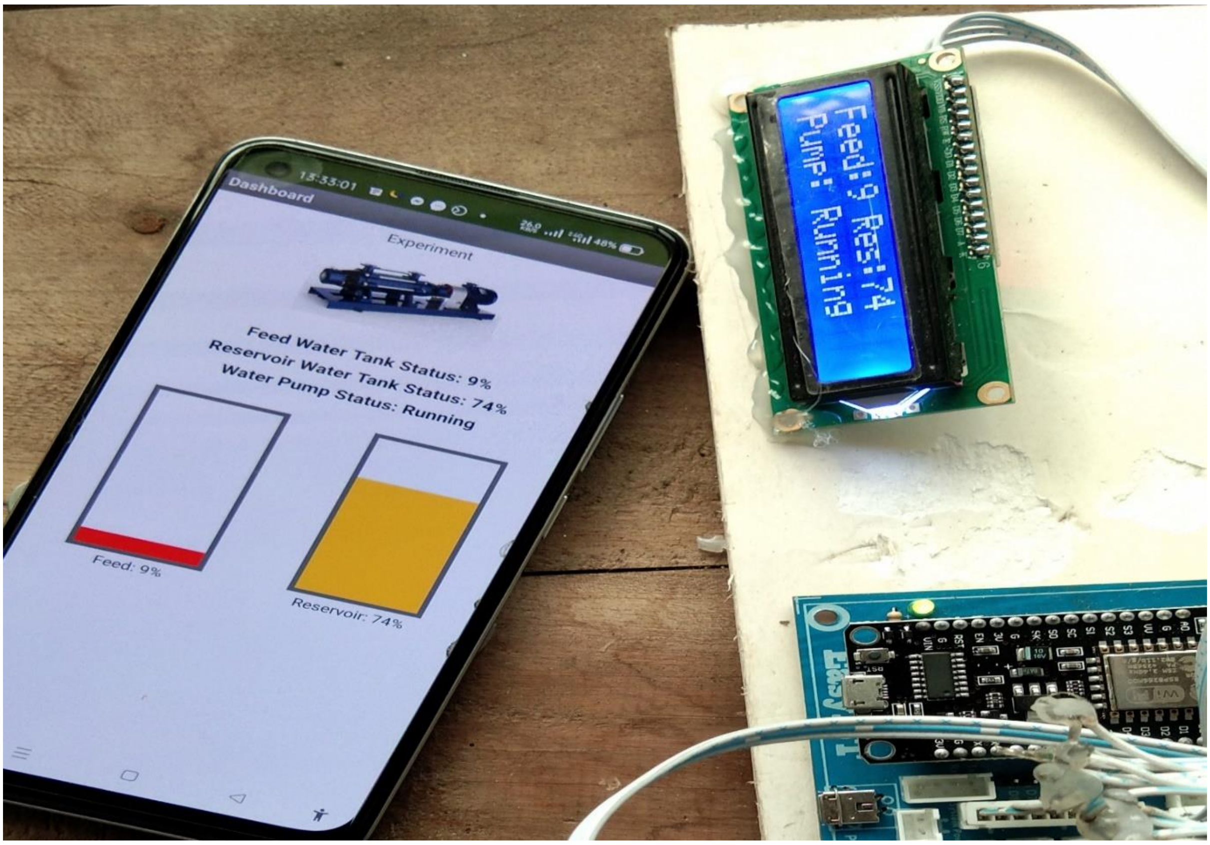


Fig 5.4: System running with android apps

5.4 DISCUSSIONS

This IoT-based proposed system is used to acquire water level details of a water source in real-time from any location, any device connected to the Internet. This water level data can be used for various purposes for better management of water sources. The ultrasonic sensor detects the surface of the water. Data from the ultrasonic sensor send to nodeMCU. The process of this system shows on the LCD. The way this monitoring work is by using an ultrasonic sensor to detect the surface. The data from the ultrasonic sensor will be processed by a microcontroller in the form of an Arduino. Processed by Arduino and transferred data in relay module. IoT-based smart pump control and water level monitoring system will be helpful to collect, analyze, and predict the water level detail, water usage, and other information of a particular water source at a particular location in real-time remotely. It also signifies when the water level is below and above then the requirement. System design and architecture are discussed, thus being a cost-effective and simple strategy to monitor the water level system.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

- The smart water level indicator is a cutting-edge sort of display. The key benefit of this technology is that it can accurately calculate the percentage of water in the feed water tank and reservoir tank.
- The adoption of a smart water level indicator system helps to develop the fourth industrial revolution. Compared to the manual system, this system offers the advantage to monitor via a mobile app.
- The authority of the industry is always alert for supplying water in the boiler. Now, this data will be saved on the mobile via IoT by using the nodeMCU, ultrasonic sensor, database, and mobile app.
- The percentage of water was shown in a display so that operator can determine the condition of the water level in the tank.
- Finally, the **Experiment Analysis of Boiler Feed Water Level Indication and Pump Monitoring Using IoT (Internet of Things)** has implemented of water level indication and monitoring system. This project can develop with the help of our supervisor.

6.2 RECOMMENDATIONS

- We will implement a float sensor in the tank. The accuracy of this sensor is more than ultrasonic sensor.
- PH sensor will also attach in the future. So that properties of water will also know.
- Program logical control (PLC) will implement here to operate the high-pressure pump or high amp pump.

6.3 SUGGESTION FOR FURTHER STUDY

Future Work can involve the analysis of water level in a particular area so that the wastage of water is prevented. We can also include the GSM-based system where the message will be sent to the particular authorized person when the water level is below the required level. Arduino GPS shield can be integrated into the system to obtain location data of the water source dynamically.

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