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BANGALORE · INDIA

SMART WATER TANK SYSTEM

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A project report submitted in partial fulfillment of the requirements for the award of the degree of Master of Computer Applications of

CHRIST (Deemed to be University)

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CERTIFICATE

This is to certify that the report titled ***SWAT: SMART WATER TANK SYSTEM*** *is a bonafide record of work done by* ***Avatansh Awasthi (1947205), Dharamraj Bhatt (1947216),*** *and* ***Manish Bharti (1947235)*** *of CHRIST (Deemed to be University), Bangalore, in partial fulfillment of the requirements of 4th Semester MCA during the year 2021.*

Head of the Department **Project Guide**

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2. Date of Exam :

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ABSTRACT

In today's busy world, it is very hard to keep up with the number of things one has to keep track of in daily life. Things like paying bills, buying groceries, booking items, and even cleaning houses have all been converted by automation with the help of IoT and connected systems. Since there is a lot of groundwater being wasted by overflow from overhead tanks and tracking and automation is a feasible solution saving water. Hence, there is a need to address this problem and provide a smart solution that is accomplished by IoT devices and sensor integrated systems called Smart Water Tank.

Smart Water Tank helps to monitor the availability of water(the status of water available in the tank or underflow and overflow condition of the tank) and the water consumption in the particular residential society with the help of a smartphone application in real-time. The application will act as a reminder when the water in the tank is near the condition of overflow or underflow. The application will also have the feature of showing the quality and the temperature of the water as well as current water flow which will help the user to make a decision on where and how it can be utilized.

The smart water tank will help the residential society to analyze the water consumption on a daily/weekly/monthly basis, the management will have a basic idea of the amount of water needed on a daily/weekly/monthly basis so that they can be well prepared for a possible water crisis in the area.

The Smart water tank system helps the users to monitor water availability(status) in the tank digitally using a mobile application. Instead of manually turning off the water filling motor/pump and checking the overflow/underflow of water in the tank, it helps do it all digitally through the mobile app. This application can give a quick report on the rate of consumption of water and help to make smart decisions for the future.

LIST OF TABLES

LIST OF ABBREVIATIONS

- IoT – Internet of Things
- WiFi – Wireless Networking Technology
- IDE - Integrated Development Environment

LIST OF FIGURES

Table of Contents

1. INTRODUCTION

Most of the areas in India lack the amount of available usable groundwater. It is also predicted that groundwater availability will decrease the level of scarcity by the end of the year 2050 in most states of India as currently over-exploited by all the sectors. As groundwater is the single largest source for freshwater which is the actual drinking water and usable water, this is a very important resource and hence needs to be saved, preserved, and used sensibly rather than wasting it carelessly or unknowingly.

To overcome this wastage of groundwater done by humans unknowingly and unintentionally, like generally a lot of water gets wasted in a single household if someone forgets to switch off the water pump at the right time, imagine what happens if lots of households fail to do the same. Hence, it is our responsibility to stop this kind of groundwater wastage at any cost. As an aid to water wastage due to pumps in overhead tanks, we can use and apply the available resources of the emerging technologies and save water in a smart and efficient manner. This takes us closer to the solution of saving and using water in a sustainable manner that uses the Internet of things with sensors and an app to control, sense, and manage groundwater in the tank.

1.1 PURPOSE

The purpose of the Smart water tank is to reduce water wastage in day-to-day life. The system will monitor the water level of the tank and automate the water filling process which will, in turn, eliminate the water wastage problem happening while overfilling. Also, since we are using the latest technology sensors and IoT, we can monitor the water and analyze different attributes related to water so that one can track and understand the details about water consumption.

1.2 SCOPE

The project is to be implemented with an android-application that gives a quick real-time report on the water level of the tank that shows the statistics of water. The application will notify users about the underflow and overflow condition of the tank. The app will

have the feature of manually turning off the water-filling motor/pump from the mobile itself. The intended audience/users of this project are general houses and residential societies.

2. APPLICATION ARCHITECTURE

The Smart water tank system helps the users to monitor water availability(status) in the tank digitally using a mobile application. Instead of manually turning off the water filling motor/pump and checking the overflow/underflow of water in the tank, It helps do it all digitally through the mobile app. This application can give a quick report on the rate of consumption of water and help to make smart decisions.

To maintain the same purpose of the Smart Water Tank System, we need to define the architectural document which is necessary to understand the working and usage of the system. Hence following are the description of the architecture document of the Smart Water tank System which explains the usage and working of the system in an easy way.

2.1 COMPOSITION OF THE SMART WATER TANK SYSTEM

The system consists of and interacts with the following hardware components and software. The system is made of the following hardware components and the following software platforms are used to create the project.

2.1.1 HARDWARE COMPONENTS

The project uses the following hardware devices, that includes Arduino UNO which is the most important component of the system, then we have different types of sensors such as the ultrasonic sensor to sense the distance, then we have the Temperature sensor, a water flow sensor to sense the amount of water flowing through the inlet and outlet pipe of the water tank, then we also have the motor to pump the water inside the tank, we then have also used a relay to control the water pump/motor i.e. switch on/off the motor according to the instructions given, then for connectivity we have used Bluetooth and wifi module i.e. for near and long-range distance.

2.1.1.1 ARDUINO UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. 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.

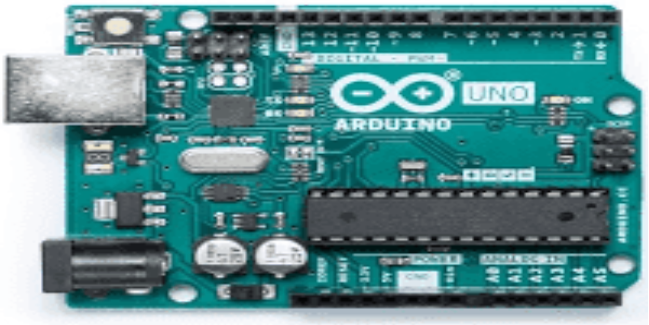

Fig 2.1: Arduino Uno

Board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is 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.

2.1.1.2 WATER LEVEL SENSOR

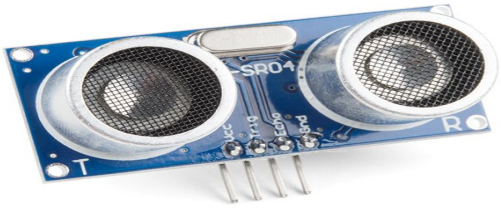

Fig 2.2: Ultrasonic Sensor

The System requires sensors to sense the water level in real-time. Hence, we are planning to use the "Water Level Depth Detection Sensor Module", which will help us to track the amount of water present in the tank to the isolated reservoir at a particular instant in time.

For this, we have used a commonly used ultrasonic sensor called 'HC-SR04'.

This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver, and a control circuit. There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground).

2.1.1.3 TEMPERATURE SENSOR

Fig 2.3: Temperature Sensor

This DS18B20 Waterproof temperature sensor is used to measure the temperature of its surroundings and the output voltage linearly-proportional to Centigrade temperature. The operating voltage is 4 – 30V, and it is an analog sensor, based on an application designed by various transistors.

The DS18B20 temperature sensor is fairly precise and needs no external components to work. It can measure temperatures from -55°C to +125°C with ±0.5°C accuracy.
Temperature Range: -55 to 125°C
Accuracy: ±0.5°C
Resolution: 9 to 12 bit (selectable)

2.1.1.4 WATER MOTOR/ PUMP

The System requires a motor to fill the water in an isolated container, hence we need a water filling motor that will be used to fill the reservoir with water in order to demonstrate the real-time operation of the smart tank system.

Fig 2.4: Water pump

Micro DC 3-6V Micro Submersible Pump Mini water pump For Fountain Garden Mini water circulation System DIY project. This is a low-cost, small-size Submersible Pump Motor that can be operated from a 3 ~ 6V power supply. It can take up to 120 liters per hour with a very low current consumption of 220mA. Just connect a tube pipe to the motor outlet, submerge it in water, and power it. Make sure that the water level is always higher than the motor. A dry run may damage the motor due to heating and it will also produce noise.

2.1.1.5 RELAY

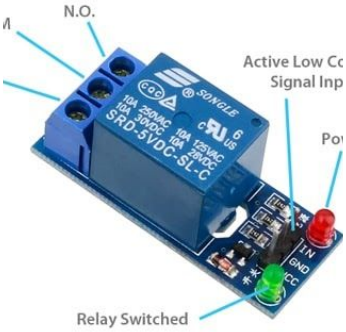

Fig 2.5: 5V Relay

In order to create the simulation of an automatic turn on and off of the water motor, we need a relay to control the power that circulates through the motor on a particular instruction from the code logic through the Arduino UNO.

2-Channel 5V Relay Module is a relay interface board, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM, and so on. It uses a low-level triggered control signal (3.3-5VDC) to control the relay. 5V relay signal input voltage range, 0-5V. VCC power to the system.

2.1.1.6 WI-FI MODULE

To provide global connectivity and control over the full system and to monitor, analyze and display details of the Smart water tank system, we need to provide a way of connectivity of the Arduino UNO and the whole system in order to broadcast sensed data from the sensors in real-time we need a wi-fi connection which is achieved through the wi-fi module.

Since Arduino UNO doesn't come with inbuilt connectivity to the wi-fi hence we needed to integrate and implement the wi-fi module in the Smart water tank system, the wi-fi module that we have used in the system is called ‘ESP-8266’.

Fig 2.6: ESP-8266

The ESP8266 WiFi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield. The ESP8266 module is an extremely cost-effective solution.

2.1.1.7 WATER FLOW SENSOR

Fig 2.7: Water Flow Sensor

To keep a track of how much water is being used daily or how much water is being pumped in the tank there is a need for a water flow sensor, this sensor senses the amount of water flowing through its cross-sectional area at a particular instance.

The YF-S201 water flow sensor consists of a pinwheel sensor that measures the quantity of liquid passing through it. The sensor uses the principles of electromagnetism, such that, when liquids flow through the sensor, the flow action impacts the fins of a turbine in the sensor, causing the wheel to spin. The shaft of the turbine wheel is connected to a hall effect sensor so that with every spin, a pulse is generated, and by monitoring that pulse with a microcontroller, the sensor can be used in determining the volume of fluid passing through it.

2.1.2 SOFTWARE COMPONENTS

The System requires some of the software interfaces and support, this includes the following software services and applications.

2.1.2.1 ARDUINO IDE

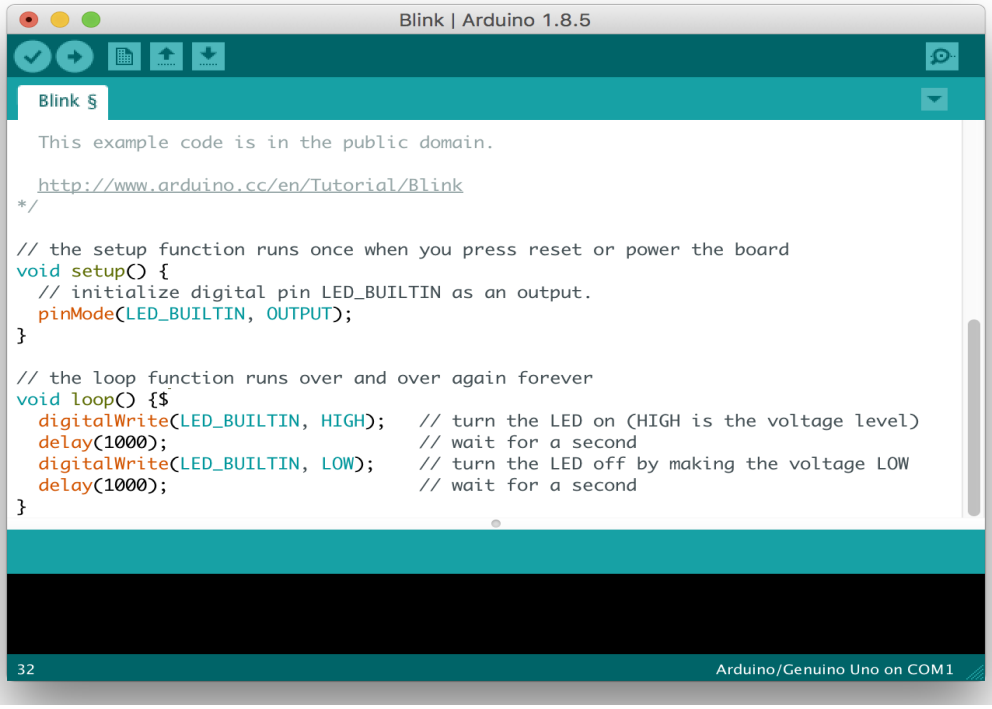

Fig 2.8 : Arduino IDE

The Arduino IDE allows you to write code and upload sketches to any official Arduino board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that is compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs

the program to convert the executable code into a text file in a hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

2.1.2.2 ANDROID STUDIO

Fig 2.9: Android Studio

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux-based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as the primary IDE for native Android application development, the following features are provided in the current stable version: Gradle-based build support, Android-specific refactoring and quick fixes, Lint tools to catch performance, usability, version compatibility, and other problems, ProGuard integration and app-signing capabilities, Template-based wizards to create common Android designs and components, A rich layout editor that allows users to drag-and-drop UI components, option to preview layouts on multiple screen configurations, Support for building Android Wear apps, Built-in support for Google Cloud Platform, enabling integration with Firebase Cloud Messaging (Earlier 'Google Cloud Messaging') and Google App Engine and Android Virtual Device (Emulator) to run and debug apps in the Android studio.

2.1.2.3 GOOGLE FIREBASE

Fig 2.10: Google Firebase

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android, and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiments. Firebase provides a realtime database and backend as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored in Firebase's cloud.

2.2 LAYERED ARCHITECTURE DIAGRAM

Three-tier architecture is a well-established software application architecture that organizes applications into three logical and physical computing tiers: the presentation tier, or user interface; the application tier, where data is processed; and the data tier, where the data associated with the application is stored and managed.

The chief benefit of the three-tier architecture is that because each tier runs on its own infrastructure, each tier can be developed simultaneously by a separate development team, and can be updated or scaled as needed without impacting the other tiers.

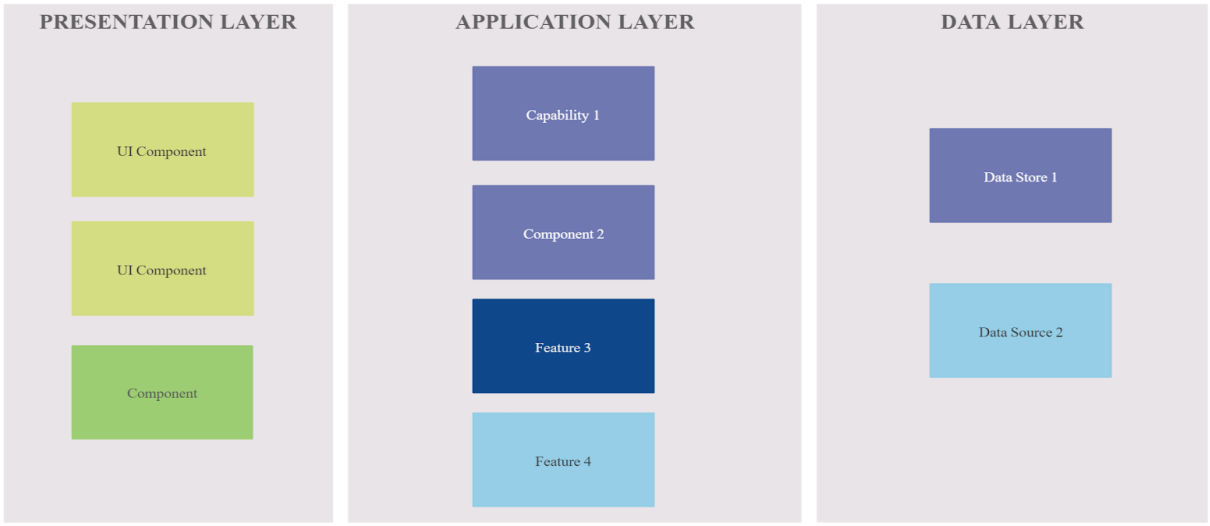

Fig 2.11:Three-tier architecture

In our case, the Presentation Layer consists of the application made in Android Studio (SWAT-Smart Water Tank), with Components like monitoring, visualization, analysis, and control of the motor and the sensors integrated with Arduino UNO in the system.

Whereas the Application Layer consists of the physical system of microcontroller Arduino UNO along with the sensors, motor with relay, and the Wi-Fi module, all the data generation, calculations, and instruction giving is done here. This layer can also be called the Logic Layer.

Lastly, the data layer consists of the data storage and control which is achieved by sending data from the sensors via the wi-fi module to the Google Firebase, where it stores and relays the data to the Android application in real-time.

Hence, we can conclude that the layered Architecture Diagram of the proposed system is as follows:

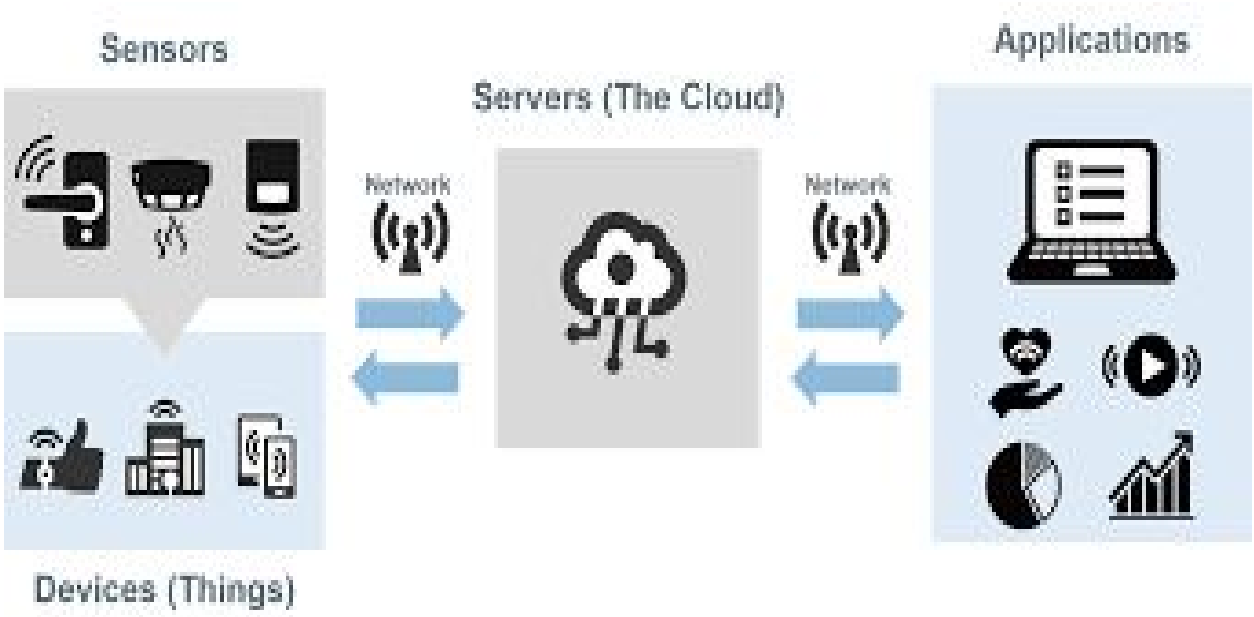

Fig 2.12:.layered Architecture Diagram

2.3 DESCRIPTION OF THE MODULES

There are a number of modules that are integrated in order to achieve the desired functionality in the Smart Water Tank System, the modules that are used in the system are as follows:

2.3.1 WATER LEVEL SENSING MODULE

The System requires sensing the water level in real-time. Hence, we use the "Water Level or Depth Detection Sensing Module", which will help us to track the amount of water present in the tank or the isolated reservoir at a particular instant in time. This is actually done by calculating the distance of the lid or cover of the tank to the current level of the water present in the tank. For this we have used an ultrasonic sensor 'HC-SR04', which helps us to sense the current level of the water present in the tank by calculating/subtracting the distance of the empty tank from the sensed level of the water in real time.

2.3.2 WATER TEMPERATURE SENSING MODULE

There is a need to find the current temperature of the water that is present in the tank in order to save electricity and concerned people with certain kinds of water preference in reference to their health concerns. In these medical conditions the patients are required to use the water in a certain feasible range of temperature as advised by their consulted doctor, this condition is common for old age and newborn babies. So, we are using a waterproof temperature sensor called DS18B20, which is adequate in doing the required task.

2.3.2 WATER FLOW SENSING MODULE

To keep a track of how much water is being used daily or how much water is being pumped in the tank there is a need for a water flow sensor, this sensor senses the amount of water flowing through its cross-sectional area at a particular instance.

The YF-S201 water flow sensor consists of a pinwheel sensor that measures the quantity of liquid passing through it. The sensor uses the principles of electromagnetism, such that, when liquids flow through the sensor, the flow action impacts the fins of a turbine in the sensor, causing the wheel to spin. The shaft of the turbine wheel is connected to a hall effect sensor so that with every spin, a pulse is generated, and by monitoring that pulse with a microcontroller, the sensor can be used in determining the volume of fluid passing through it.

Hence, this module keeps track of the amount of water flowing through the inlet pipe at a particular instant, also we can derive the amount of water that a user consumes at the end of a day, month or year.

2.3.3 WATER MOTOR AUTOMATION AND CONTROL MODULE

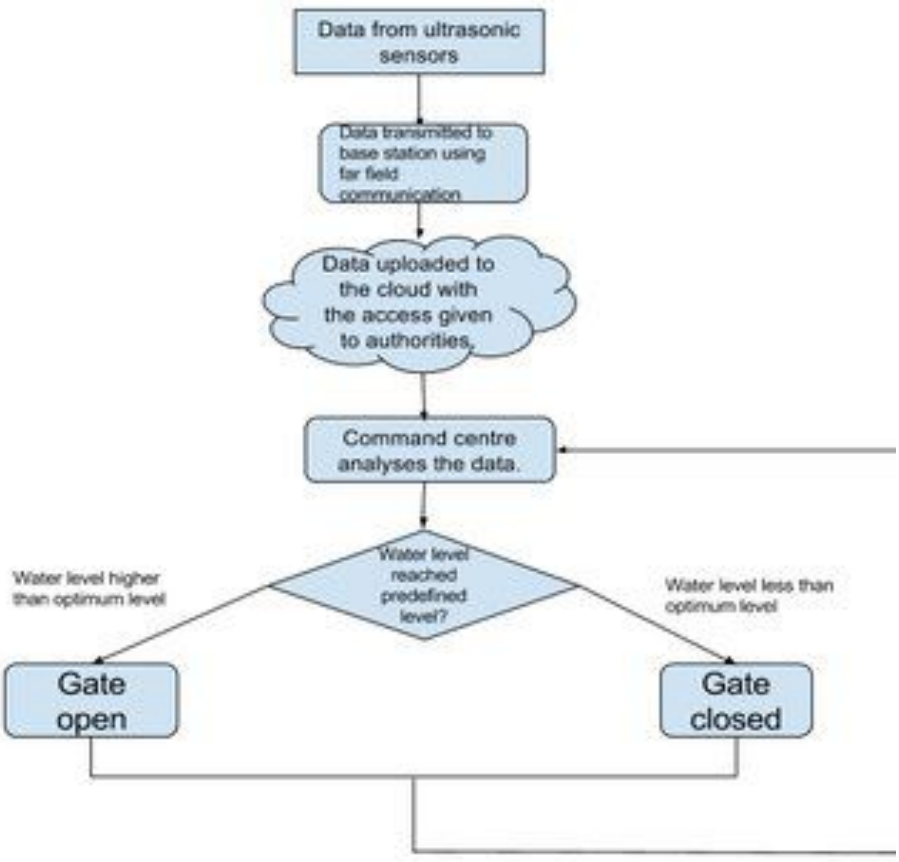

Fig 2.13: Control flow diagram

This module deals with the automation of the motor using a system of water motor/pump and a 5V Relay in order to have control over the turning on and off of the motor as and when needed.

Firstly, we need to understand why is it important to automate the motor, which is because of the fact that there are many instances when the user forgets to turn off the motor in case of filling the tank which leads to the spillage of water from the lank resulting in wastage of water, also the user forgets to turn on the motor in case of less water than required is present in the tank which results in the fact that user may suffer from water scarcity at the time of utmost need.

Hence, the motor needs to be automated to be automatically turned off after a certain amount of water level is filled in the tank, also the motor needs to be automatically turned on after water drops below a certain level in the tank ensuring that the user need not take care of the motor now.

2.3.4 SYSTEM CONNECTIVITY MODULE

This module refers to making and ensuring the connectivity of Arduino UNO to the internet via Wi-Fi connectivity. The need of making the system connected to the internet through wi-fi is to provide real-time connectivity and control of an individual system to the particular user.

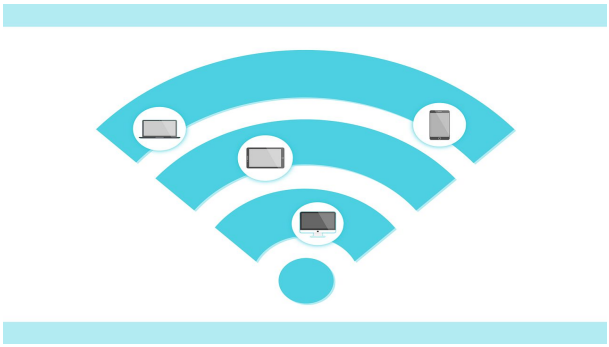

Fig 2.14: Wifi Connectivity

If the user is in proximity of the Smart Water Tank System he/she can use the Bluetooth application to see the details of the system with the help of a sensor module and we can also control the motor using the same application i.e turn on/off of the motor as and when required.

But, when the user is not near also he/she can have the connectivity of the system via the application developed which can be accessed through internet connectivity where the real-time data of the system through sensor module and visualize all the attributes related to the water tank.

2.3.5 SYSTEM DATA MODULE

This module is responsible for storing, managing, receiving, transmitting the data from one module to another. Firstly, it fulfills the needs of receiving the system data from the

sensory module, keeping track of the data in real-time, after the same data is transferred to the application module for further processing and visualization. For the same, we have used and found the Google Firebase as the suitable and adequate solution.

2.3.6 VISUALISATION AND CONTROL MODULE1

Fig 2.15 : Data Visualisation

This module corresponds to the Android Application that is being developed for the visualization of all the water tank attributes such as the current level of water, the temperature of water in the tank, and the flow of water if any, these all will be visualized either in the form of a graph, animation of in tabular format, along with this the application provides authority and power to control the motor/pump manually as and when required by the user.

Also, since we have all the data we can derive from the database all kinds of information and have the analysis of all the attributes along with details like the average amount of water used/consumed in a period of time i.e. in a day, month, or year, on basis of such information we can suggest the user about his average consumption of water and similar to improve the decision making of the user in the future.

2.4 APPLICATION DEPENDENCIES

Certain assumptions that are made in the system include that the user is available with an active internet connection, water connection, and availability of electricity at the time of application.

Other dependencies include the availability of fast and stable internet connections, the availability of required sensors to perform the model situation, and a well-controlled and isolated environment to conduct the real-life scenario.

Some of the constraints that the system will face include the number of devices connected. The temperature changes can also affect the sensing mechanism. The application requires an active data connection to track and give notification to the mobile device.

2.5 APPLICATION FLOW AND INTERACTION

The application has 6 modules that interact with each other in order to make the application functioning as required. Hence, we can say that the flow and interaction within the application are explained as follows:

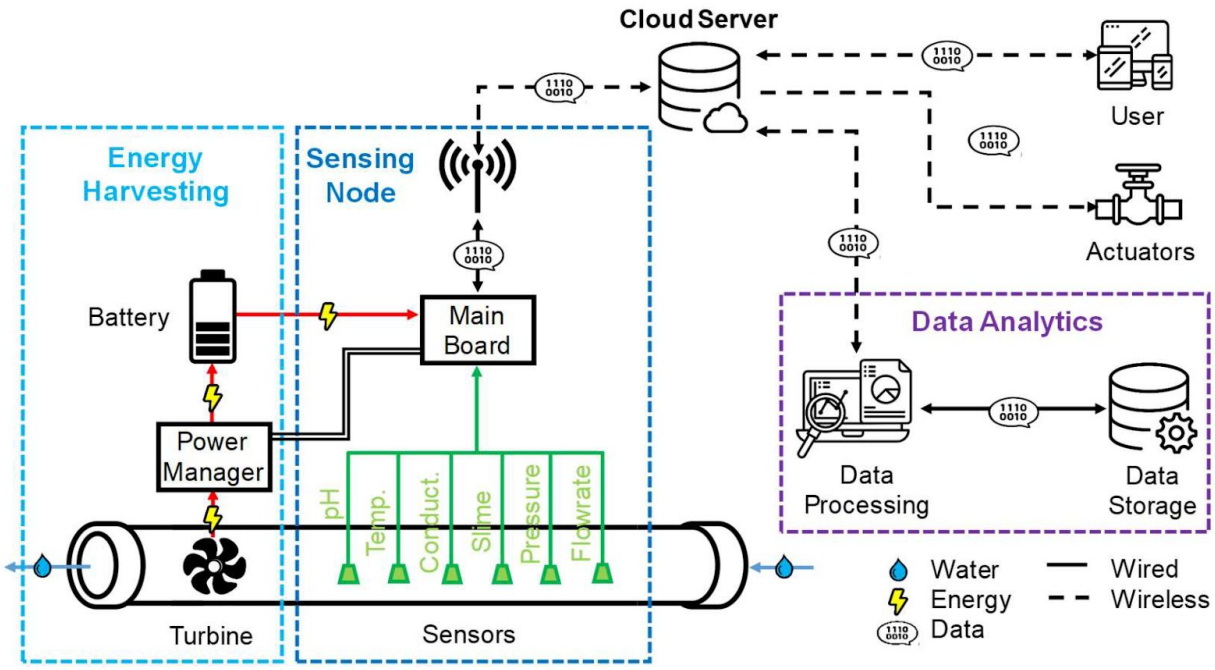

Fig 2.16: Application interaction Diagram

We can see the data flow in the application as follows:

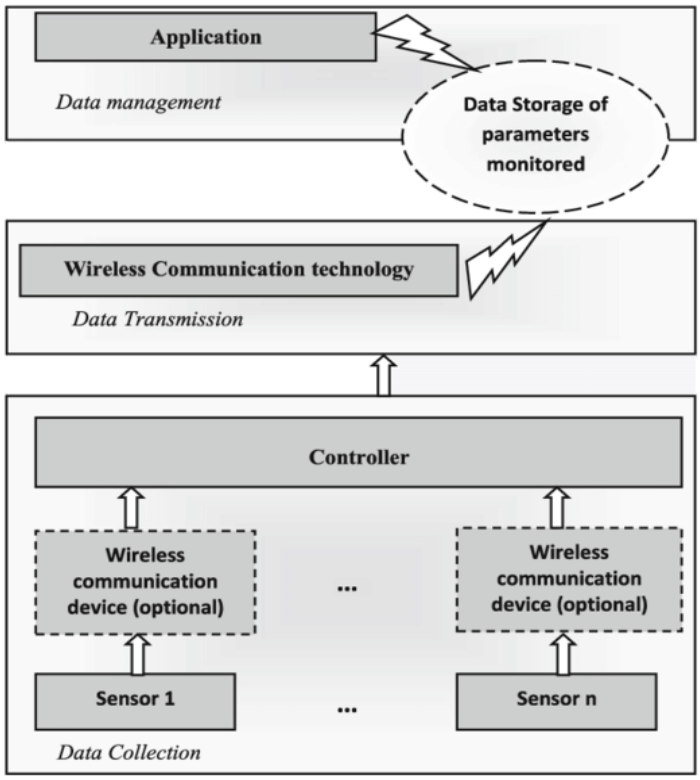

Fig 2.17: Application data flow Diagram

2.6 APPLICATION SERVICES

Since the whole application is designed and developed in order to minimize the wastage of groundwater that is wasted by overfilling and spillage of water from the overhead tanks of general households. So, the most basic service of the Application is to save water. Other than this the Application of Smart water provides the following services:

- Sensing of water attributes like level, temperature, and flow, etc.
- Automation of motor to avoid over spillage of water by human error.
- Manual control of the water pump to fill the tank to the desired level.
- Visualization of attributes in real-time.
- Analysis of water attributes to facilitate decision making.
- Monitoring and controlling power via the Android application over the system globally and in real-time.

2.7 APPLICATION IMPACT

Smart Water Tank helps to monitor the availability of water(the status of water available in the tank or underflow and overflow condition of the tank) and the water consumption in the particular residential society with the help of a smartphone application in real-time. Mobile Application will have the feature of turning off the water filling motor/pump. The application will act as a reminder when the water in the tank is near the condition of overflow or underflow. The application will also have the feature of showing the quality and the temperature of the water which will help the user to make a decision on where and how it can be used.

The smart water tank will help the residential society to analyze the water consumption on a daily/weekly/monthly basis, the management will have a basic idea of the amount of water needed on a daily/weekly/monthly basis so that they can be well prepared for a water crisis.

Hence, we can say that all in all this application can impact the lives of almost all general users with overhead tanks or some kind of water storage reservoir, and minimize the wastage of water, along with smartly suggesting.

3. FUNCTIONAL ARCHITECTURE

3.1 MOST SIGNIFICANT FUNCTIONALITIES AND USE-CASE

The diagram below is a use case diagram that is used to represent how the user will interact with the system. Here the user i.e. homeowner will be able to interact with the smart water tank/ system and perform a variety of tasks.

The system will keep track of the water level of the water tank and alert the user in case there's an overflow or underflow of water. The system will automate the water pump functioning. The system will also show various details of water for say water quantity, water temperature. It will use basic sensors such as temperature sensors, ultrasonic sensors, water flow sensors, and a relay for the motor.

Using a 5V relay, users will have the option of manually controlling the water pump. Using data generated by sensors will be analyzed for future prediction like how much water will be consumed on any certain day. And this prediction will be based on previously generated data.

Use Case Diagram for Smart Water Tank System:

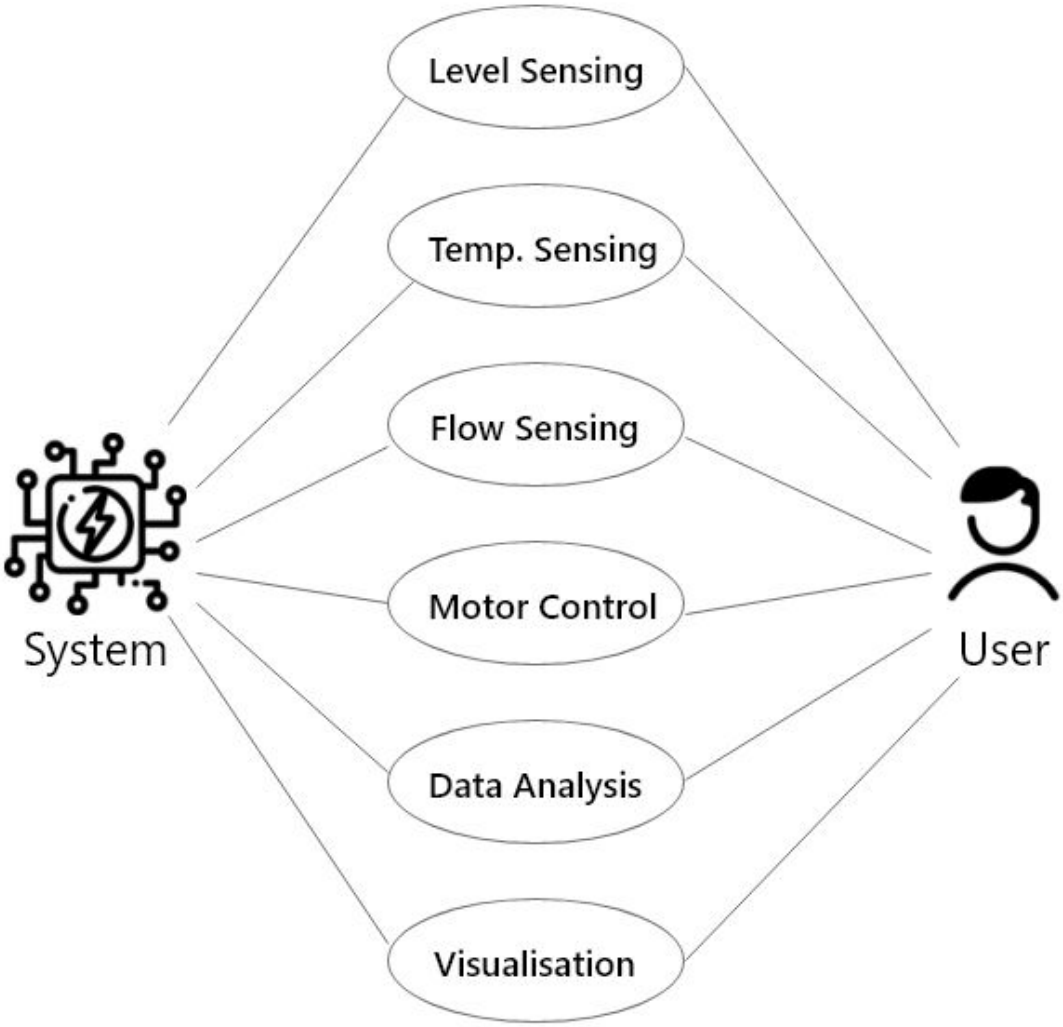

Fig 3.1: Use Case Diagram

The flow of the System step by step will be as follows:-

- The user will turn on the power supply to the system. Then the smart water tank's microcontroller will work with various sensors and start processing the data generated by sensors.
- The ultrasonic sensor will start detecting the water level of the water tank, the temperature sensor will sense the temperature of the water and other sensors will do their respective tasks.

- The pump will start filling the water in the tank if the water level is less than the specified level and it will continue filling the tank until the water level reaches a certain upper limit. And after reaching that level, it will automatically turn off.

- The wifi module will keep syncing all data to the cloud database. And keep all the data handy accessible anywhere and anytime.
- All these tasks will continue until the power supply is turned off.

3.2 FUNCTIONAL COMMUNICATION AND INTERACTION

The system needs to check that the information from the various sensors is valid. This can include tasks like identifying that water level is correctly sensed. If the water level hits the upper limit, the microcontroller must alert the system by using the buzzer and send the notification to the user's phone. and the system will automatically turn off the water pump. Also, the buzzer should make sound before the water is too close to the upper limit. Otherwise, it will result in overflow of water.

Similarly the system should calculate the water quantity flowing to the water tank. Which happens through the water flow sensor. Similarly the micro controller should keep interacting with the ultrasonic sensor, temperature sensor, and it should be able to sense the water temperature. The system should make sure that the integration and inter-communication of all the sensors is well maintained so that it provides highly accurate output.

3.3 FUNCTIONAL IMPACT

The IOT device consists of various sensors. The ultrasonic sensor periodically measures the distance and transmits this data to the microcontroller, which is connected to Arduino Uno. Then depending on the distance between the water and sensor, the system analyses the situation and alerts the user. The intensity by which the user is alerted is different

depending on how far the water level is. Similarly, the water temperature sensor acts according to the temperature change in the surrounding which may be water or air too. Then the water flow sensor functions in order to sense the amount of water flowing through it at that particular time/instance.

3.4 DATA MODEL

Once the system is started, all the sensors come online. Each sensor starts performing their respective task. Ultrasonic sensors start working on water level, Water flow sensors on water quantity measurement and similarly all other sensors attached to the water tank start doing their specific tasks.

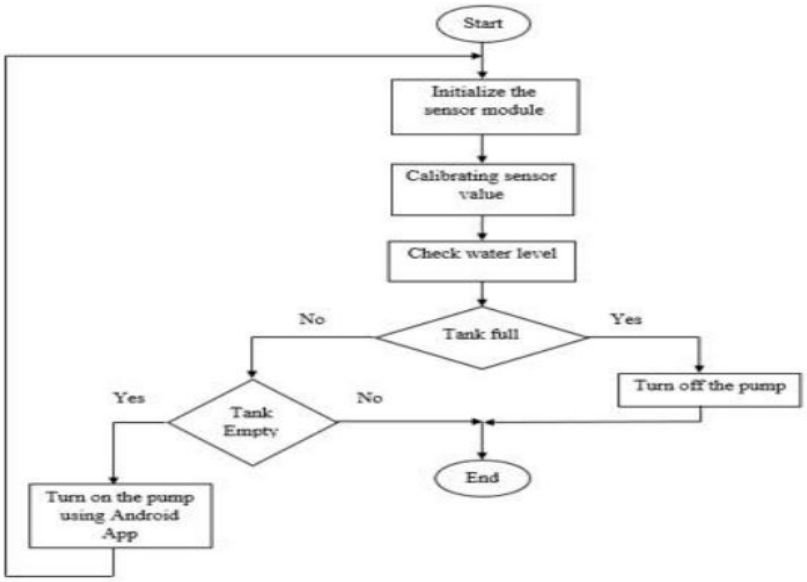

Fig 3.2 : Water pump control diagram

4. TECHNICAL ARCHITECTURE

4.1 TECHNICAL COMPOSITION

S.No	Technology	Architecture Layer	Features Identified
1	HTTP	Application	● Metadata
2	Direct Connection	Application	● Scalability ● Multiple connections
3	WiFi (WLAN)	Network Infrastructure	● Short Range ● Low power consumption
4	Arduino Uno	Network infrastructure	● Fetch information as input and Share information
5	wifi module (ESP8266)	Network infrastructure	● Low power consumed ● Required for Wifi
6	Water Flow sensor	Sensing	● To sense the flow of the water
7	UltraSonic Sensor	Sensing	● Input the information ● sensing the level(distance)
8	Temperature Sensor	Sensing	● sensing the temperature
9	5v relay	switch	● used to automate motor
10	Submersible motor	water pump	● used to to pump the water

4.2 LIBRARIES AND FUNCTIONS

1. **OneWire:** OneWire lets you access 1-wire devices made by Maxim/Dallas, such as temperature sensors and ibutton secure memory. For temperature sensors, the DallasTemperature library can be used with this library. OneWire communicates with 1-wire devices.

OneWire requires a single 4.7K pullup resistor, connected between the pin and your power supply. When using very long wires, or with counterfeit DS18B20 chips and 3.3V power, a resistor in the 1K to 2.7K range may be required.Then just connect each 1-wire device to the pin and ground. Some 1-wire devices can also connect to power, or get their power from the signal wire. Please refer to the specifications for the 1-wire devices you are using.

2. **DallasTemperature:** This library supports the following devices :DS18B20, DS18S20 (note: there appears to be an issue with this series.), DS1822, DS1820, MAX31820. You will need a pull-up resistor of about 5 KOhm between the 1-Wire data line and your 5V power. If you are using the DS18B20, ground pins 1 and 3. The centre pin is the data line '1-wire'.

3. **HC-SR04:** Library for HC-SR04 ultrasonic distance sensor.
   You can measure distance in microseconds, millimeters, centimeters and inches. It's possible to utilize one trigger with multiple echoes simultaneously. This library is compatible with all architectures so you should be able to use it on all the Arduino boards.

4. **attachInterrupt():** The first parameter to attachInterrupt() is an interrupt number.Normally you should use digitalPinToInterrupt(pin) to translate the actual digital pin to the specific interrupt number. For example, if you connect to pin 3, use digitalPinToInterrupt(3) as the first parameter to attachInterrupt().

5. **ESP8266WiFi library:** ESP8266 is all about Wi-Fi. If you are eager to connect your new ESP8266 module to a Wi-Fi network to start sending and receiving data, this is a

good place to start. If you are looking for more in depth details of how to program specific Wi-Fi networking functionality, you are also in the right place.

6. DetachInterrupt(): It is used to turn off the given interrupt.

7.Delay(): Pauses the program for the amount of time (in milliseconds) specified as parameter. (There are 1000 milliseconds in a second.)

5. DEPLOYMENT ARCHITECTURE

5.1 GEOGRAPHICAL DEPLOYMENT

Fig 5.1 : Smart Water system

The device will send the real time data or value detected by the sensors to the cloud where they will be stored in their respective table. A sensor detects the water level by assuring the distance to the nearest obstacle. In our case if the water level is above 80% of the tank we say that the tank is full and the motor should automatically turn off. if the water level is below 10% the motor should get automatically turned on. The temperature sensor will sense the temperature of the water and it will send it to the cloud. The water flow sensor will calculate the flow rate and it will find out how much litre water is flown in the tank in a particular time.

When a user accesses the system via mobile application, a signal is sent to the Lambda function. It reads the values from the firebase and displays the water level of the tank, temperature of the water and the water quantity in a litre.

5.2 OPERATIONAL CONSTRAINTS

Reliability: System must be very reliable as the person is able to see. The system must calculate the water level accurately as everything depends on the water level data only.

Though it can be expected that malfunctions may occur, the error rate of the system should be kept below 2%.

Availability: The system must be available for use regardless of weather conditions.

The sensor has the warning sound or the buzzer along with a distance sensor, which will indicate the obstacle appropriately. Buzzer will be activated when the sensor will sense obstacles and water ahead.

Security : The system will help homeowners and they have to make sure that their username and id should not leak.

Maintainability : The system must be able to handle updates in the electronic control units that it interfaces with, as well as the network that it operates within. The system must also be able to be updated accordingly should an enhancement be made.

6. APPLICATION OVERVIEW

Following are the sketch of the UI/UX of the planned Android application :

1) Loading Screen : As soon as the user launches the SWAT application on his/her phone, this screen comes up and shows that the system is being configured and connection is being established in the background.

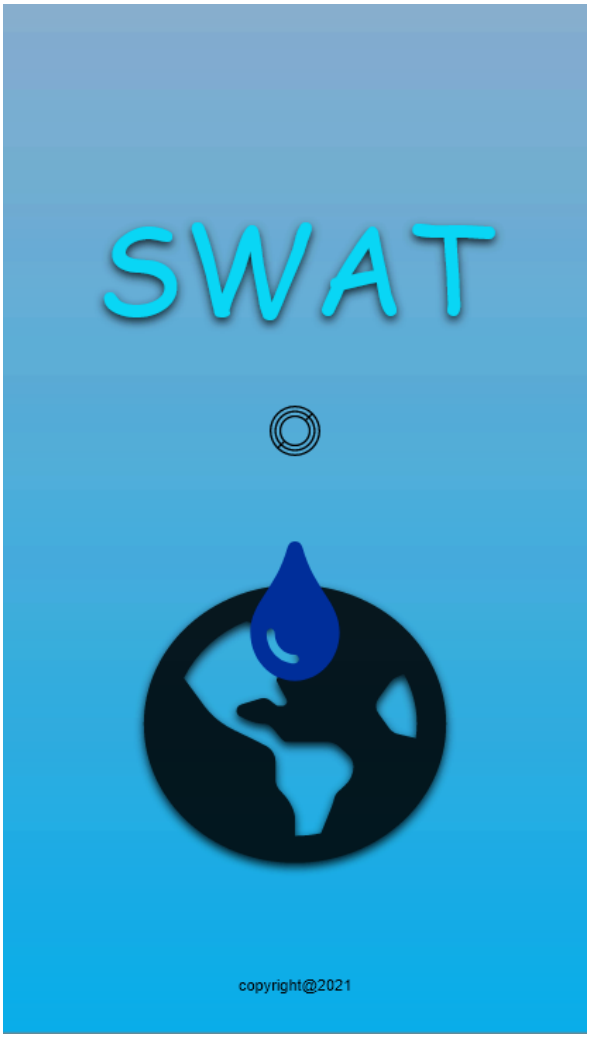

Fig 6.1 : Application Splash Screen

Hence, this screen prompts the user to be patient till the next screen is being loaded on the SWAT application.

2) Login Screen: This screen is for the user to login into the system.

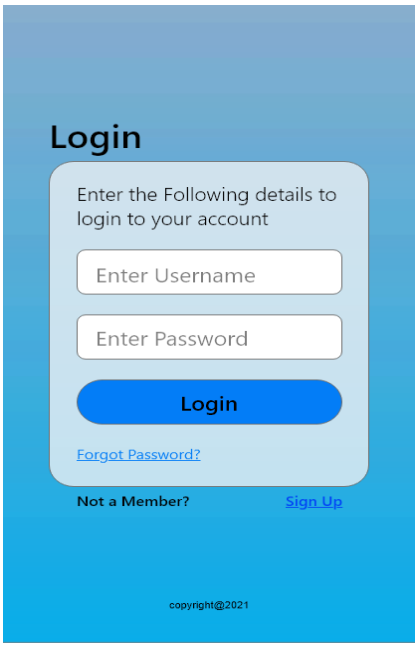

Fig 6.2 : App Login Screen

3) Dashboard : After login the user lands on the home or the dashboard where there are various details and options for the user to select.

Fig 6.3: App Dashboard

4) Sensor Tabs : Tabs with vital information of the system through sensors.

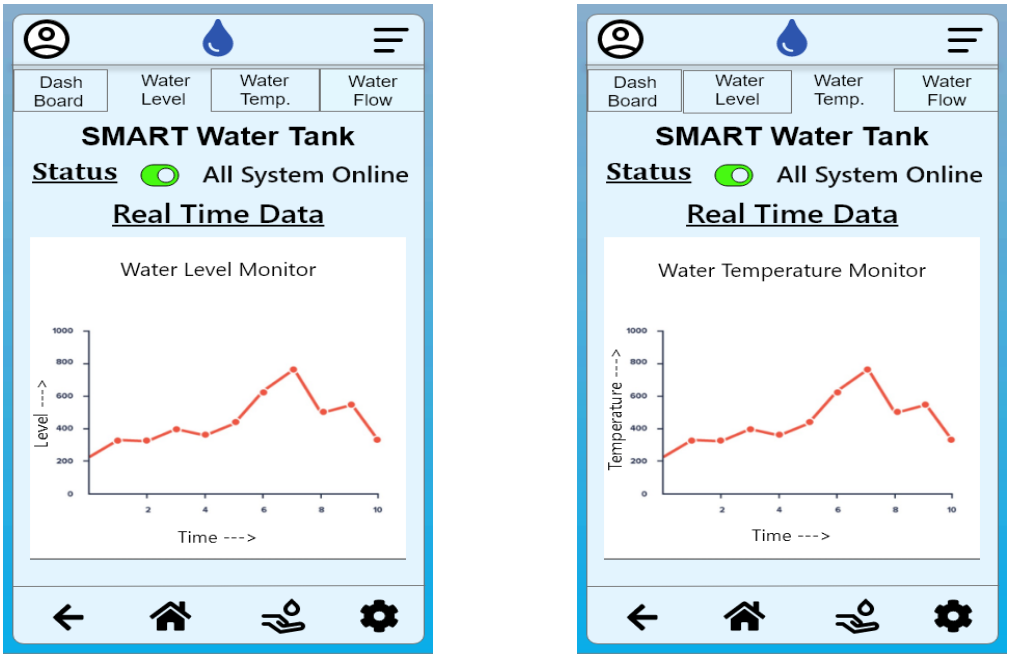

Fig 6.4 : App Sensor Tabs

5) Analysis Page : This page shows the analysis of different attributes of water.

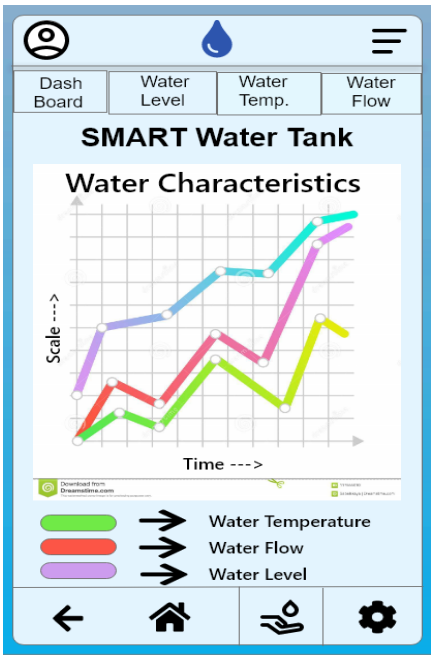

Fig 6.5 : App analysis screen

6) Logout : This is to demonstrate how a user can log out of the system.

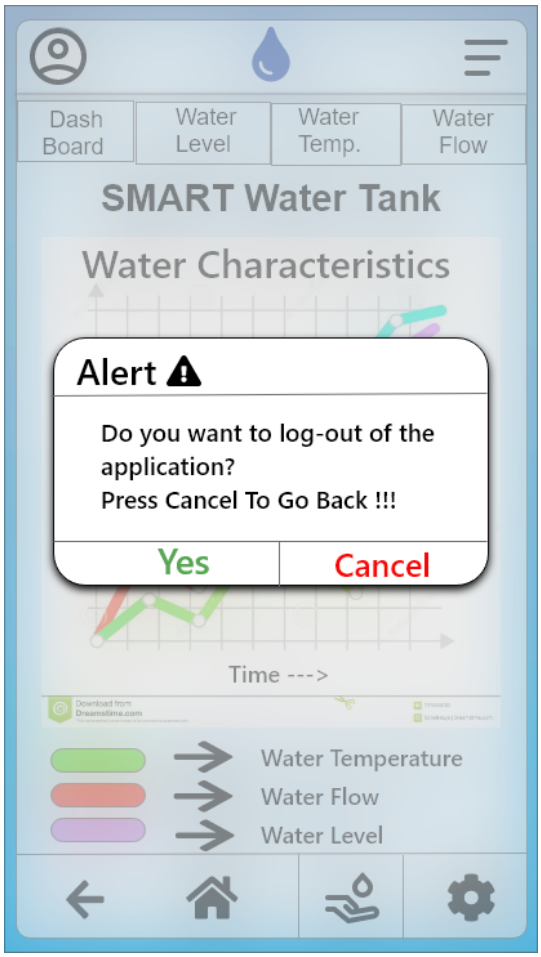

Fig 6.6 :App logout screen

7. IMPLEMENTATION AND RESULTS

7.1 PSEUDO CODE

```
include libraries
define pins

define global variables

void setup()
{
  // put your setup code here, to run once:
  Serial.begin(9600);
  sensors.begin();

set initial pins value
set initial delay
}
void funWaterFlow(){
            get water quantity from sensor
            print quantity in liter
  }
void funTemperature(){
  get temperature from sensor
  print temperature
}
void funWaterLevel(){
    define local variable like distance height and level
    //please change container height as required
   //height in cm
    print data like level and distance and water level percentage

    if(levelPercent >= 80.0  )
    {
      turn off the motor
    }
```

```
    else
    if( levelPercent < 10.0 )
    {
      turn on the motor
    }
}

void bluetooth(){
 if(Serial.available()>0)
   {
     reading the data received from the bluetooth module
     switch(data)
     {
       case 'A':  when a is pressed on the app on your smart phone turn on motor
       case 'B':  when b is pressed on the app on your smart phone  turn off motor
       default : break;
     }
     Serial.println(data);
   }
}



void loop(){
          Clears the trigPin and add delay

          Sets the trigPin on HIGH state for 10 micro seconds

          Reads the echoPin, returns the sound wave travel time in microseconds

          call all three functions

          setup delay in loop

}
```

7.2 OUTPUT

The smart water tank system which is simple, economic, easy and provides an effective solution to maintain water usage and to monitor the real time data such as water level, temperature, water quantity etc through the mobile application. . Thus it helps to prevent water wastage and maintenance related issues. So it reduces time, man-power and it is cost effective.

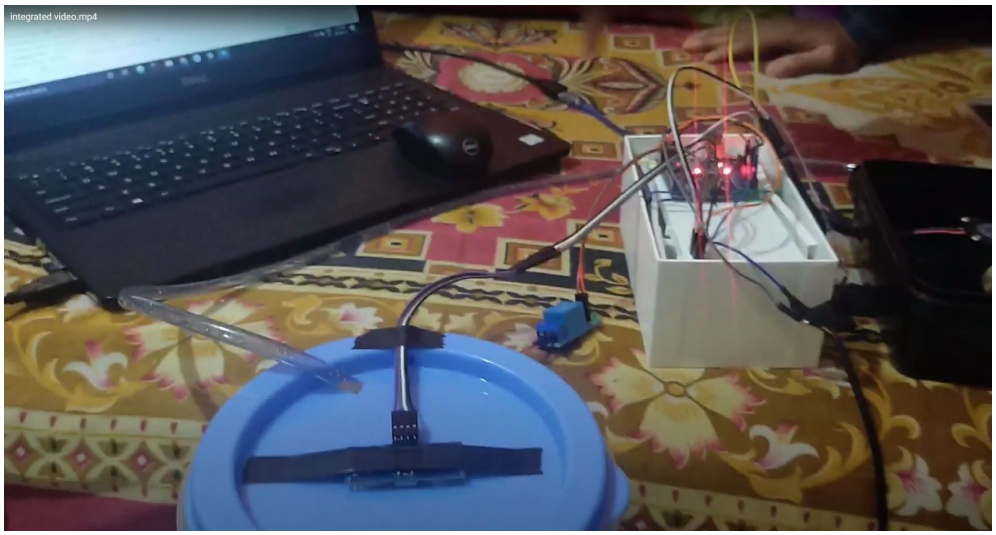

Fig 7.1 : System Setup

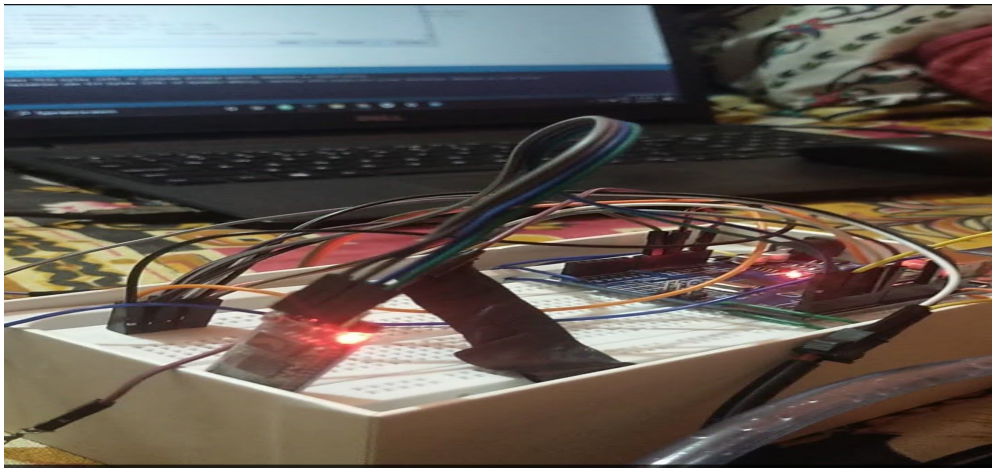

Fig 7.2 : Arduino setup

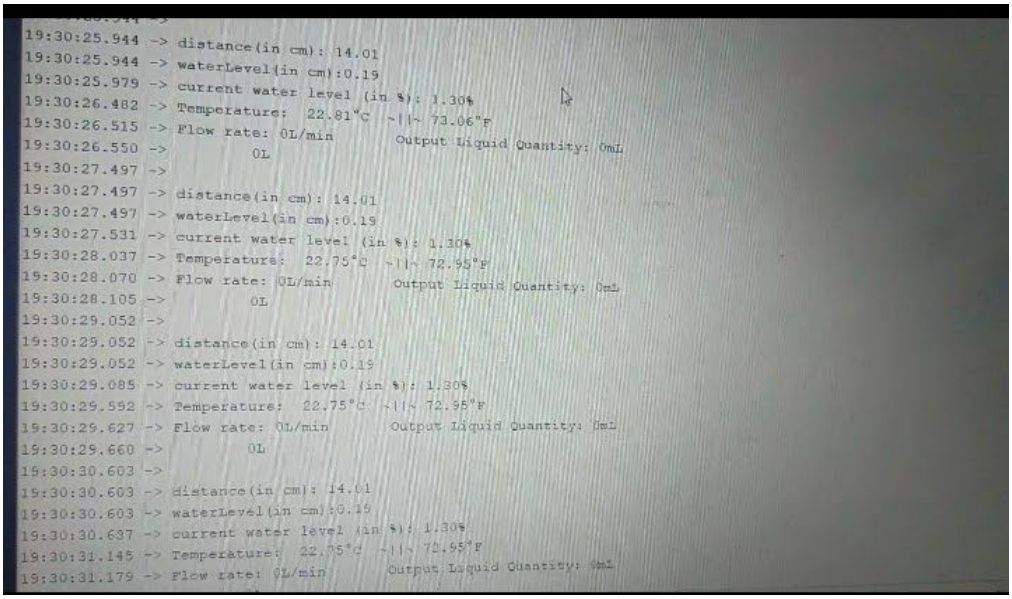

Fig 7.3 : Initial output

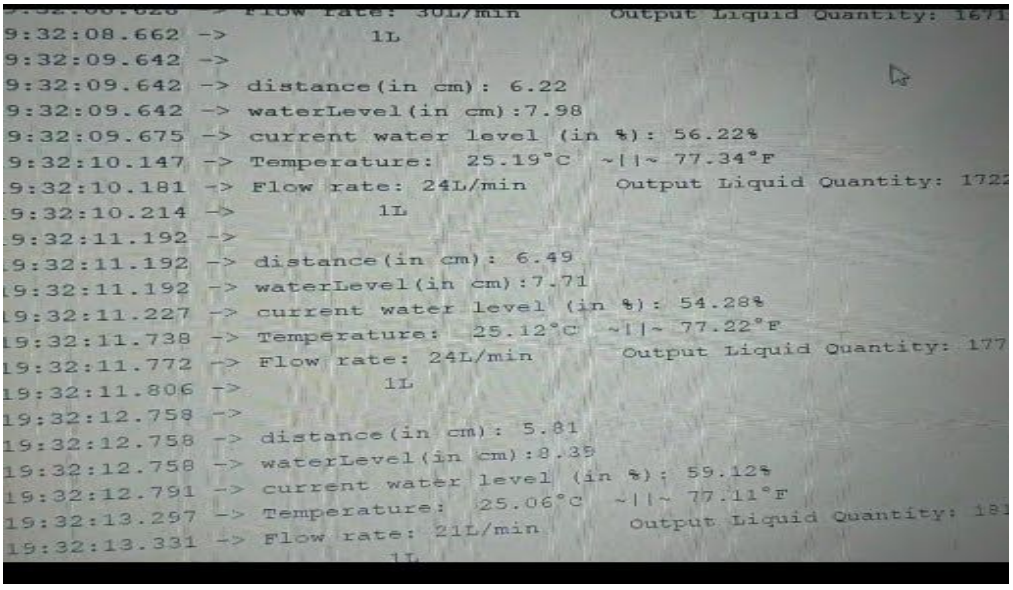

Fig 7.4 : Final output

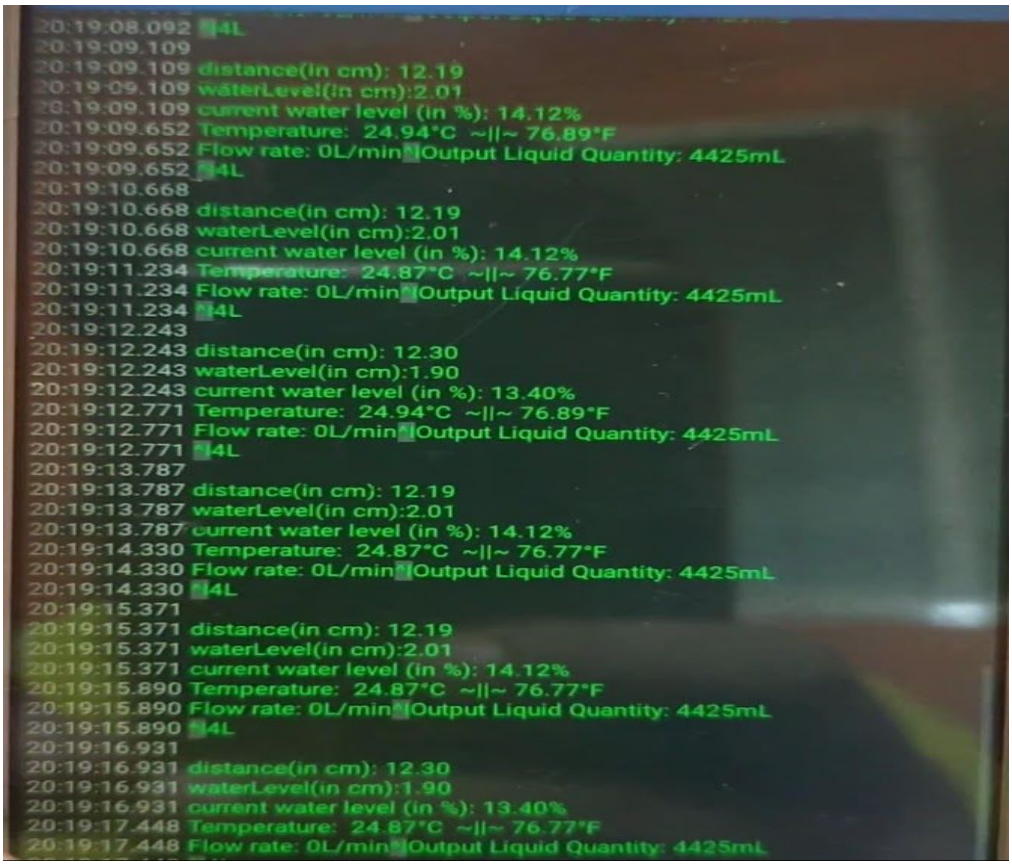

Fig 7.5 : Final Output In Mobile

8. CONCLUSION

Humans have been quite casual in using water whether it is for domestic or industrial purposes. And due to the improper and unmonitored usage of water, we have reached a situation where if we don't take immediate measures to conserve water, very soon half of the world's population will suffer from water scarcity. Moreover, it is also necessary for industries globally to save water as a part of their corporate social responsibility towards the community and the environment in which it operates.

Our smart water tank solution is built using an arduino and various iot sensors. It helps individuals to use water efficiently and monitor all its aspects with ease through mobile applications. As discussed above, it helps at different levels and solves various problems effortlessly. It also allows you to set the upper and lower limit of water level in the tank as per your requirements. The system will help conserving water at home level.

8.1 ADVANTAGES OF PROPOSED SYSTEM

Following are the advantages of the proposed system:

- The proposed system is developed on such an architecture that it is highly scalable.
- The system has the ability to be easily synchronized with the application as well as in any geographical position on Earth.
- Monitoring and Controlling of the proposed system can be done from anywhere in the world.
- The system is highly customizable and modifiable as per the requirements of the user or usage conditions.
- The model is automated hence the user need not keep track of the system at any point time.
- Minimal or nearly none manpower is needed to maintain and manage the system.
- Essential resources like water, electricity, time and energy are saved by this system.

8.2 DISADVANTAGES OF PROPOSED SYSTEM

Following are the advantages of the proposed system:

- Operator should be a little careful while handling the system.
- The system is network dependent, the system needs constant and reliable internet connection inorder to properly function.
- In case of network failure, the system has a backup offline mode to keep the system up and running accordingly till the network connection is restored.
- The system is highly power dependent hence constant need of electricity is needed for the desired functioning of the system.
- The proposed system may not function as desired in extreme weather conditions like extensive heat or cold as the system components come with a limited serviceable temperature range after manufacturing.

8.3 FUTURE ENHANCEMENT

This application is an initial step in reaching the effective solution for the daily water wastage at household level. Hence there is a lot of scope for improvement and enhancement in this early stage model.

This project can be enhanced in multiple ways as listed follows:

- To provide a central management system that makes sure that only authenticated information is sent to the homeowner, i.e. dealing with the security issues.
- More analysis can be done using the water tank data data by which users can get recommendations or suggestions on how they should plan for water usage.
- This project is only a prototype and to implement this in a real world scenario, there are many things that require modification to support real world different use cases.
- Proposed project can be modified for industrial use.

9. REFERENCES

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