IOT BASED SMART AQUARIUM

A Project Report

Submitted in partial fulfillment of the

requirements for the award of the Degree of

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

By

TANMAY WADKAR

Under the esteemed guidance of

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Assistant Professor, Department of Information Technology

DEPARTMENT OF INFORMATION TECHNOLOGY

VIDYALANKAR SCHOOL OF INFORMATION TECNOLOGY

(Affilliated to University of Mumbai)

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CERTIFICATE

This is to certified that the project entitled **“IOT BASED SMART AQUARIUM”,** is bonafied work of **TANMAY WADKAR** bearing Seat No:________________ submitted in partial fulfillment for the award of degree of BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY from University of Mumbai.

Internal Guide **Coordinator**

Internal Examiner **External Examiner**

Date: **College Seal:** **Principal**

ABSTRACT

Fish keeping is a popular trend nowadays. People from all the age groups like to keep fish at their homes, offices etc. for decoration purpose or as a hobby. Commercial fish farming and ornamental fish farming has become very popular. Therefore, it’s important to automate aquariums/ponds as it is difficult to check the conditions of an aquarium manually. During periodic intervals, water needs to be changed, the fish needs to be fed, the temperature, pH level and water level of the aquarium needs to be maintained.

The project, ‘Smart Aquarium’ is developed using PLC (Programmable Logic Controller) and SCADA (Supervisory Control and Data Acquisition) to automatically control and maintain parameters such as temperature, pH, water level, lighting, feeding, and dissolved oxygen level. ```````

ACKNOWLEDGEMENT

We would like to express our special thanks and gratitude to ur project guide **Mr. LAXMIKANT MANCHEKAR** for guiding us to do the project work on time and giving us all support and guidance, which made complete our project duly. We are extremely thankful to her for providing such nice support and guidance.

We are also thankful for and fortunate enough to get constant encouragement, support and guidance from the teachers of information Technology who helped us in successfully completing our project work.

DECLARATION

I hereby declare that the project entitled, “**IOT BASED SMART AQUARIUM**” done at Vidyalankar School of Information Technology, has not been in any case duplicated to submit to any other universities for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfilment of the requirements for the award of degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as final semester project as part of our curriculum.

Wadkar

(TANMAY WADKAR)

Name and Signature of the Student

Table of Contents

List of Tables

List of Figures

CHAPTER 1 INTRODUCTION

An aquarium is a vivarium of any size having at least one transparent side in which aquatic plants or animals are kept and displayed. Fish keepers use aquaria to keep fish, invertebrates, amphibians, aquatic reptiles, such as turtles, and aquatic plants. The term *aquarium*, coined by English naturalist **Philip Henry Gosse**, combines the Latin root *aqua*, meaning 'water', with the suffix -*arium*, meaning 'a place for relating to'.

An aquarist owns fish or maintains an aquarium, typically constructed of glass or high-strength acrylic. Cuboid aquaria are also known as fish tanks or simply tanks, while bowl-shaped aquaria are also known as fishbowls. Size can range from a small glass bowl, a few litters in volume, to immense public aquaria of thousands of litters. Specialized equipment maintains appropriate water quality and other characteristics suitable for the aquarium's residents.

A freshwater aquarium is a receptacle that holds one or more freshwater aquatic organisms for decorative, pet-keeping, or research purposes. Modern aquariums are most often made from transparent glass or acrylic glass. Typical inhabitants include fish, plants, amphibians, and invertebrates, such as snails and crustaceans.

Freshwater fish may be either Coldwater or tropical species. Although freshwater aquariums can be set up as community tanks, cold-water and tropical fish are generally not mixed due to incompatibilities in temperature requirements. Coldwater aquariums house goldfish and other species that do not require a heating apparatus. Warmer temperatures would actually increase their metabolism and shorten their lifespan. For a tropical fish tank, maintaining a warm environmental temperature ranging between 75 and 80 °F (24 to 27 °C) enables the fish to thrive.

Aquariums may be decorated with sand or gravel, live or plastic plants, driftwood, rocks, and a variety of commercially made plastic sculptures. The smallest aquariums are fishbowls, but these are not recommended for most fish as they are generally too small, tend to stunt fish growth, and may lead to eventual death.

Figure 1: Fish Tank

1.1 Background

- Smart Aquarium is a fish-tank filled with water for keeping underwater lives and it generally used for decoration purpose. Moreover, we can find so many people are interested in petting fish, therefore they collect different types of fishes and provide a proper care for these creatures, but petting fishes is a hard job as it requires full attention time to time to keep the tank adaptable for the fishes by providing a proper environment. Thus, having a smart Aquarium will help people to take care of their fishes without any effort.
- This project designs a system that provide the perfect environment in the aquarium water and control the feeding process for the fishes automatically to help the fish live longer and healthier without any need of a direct observation from the person.
- After the project is completed, the system will be able to generate a perfect environment simulated from the original environment where the fish came from. Moreover, the system controls a few important parameters such as temperature roughly between 20 and 30 degrees Celsius, water level and feeding process which should be maintained for almost all kinds of fishes. The system has many features as follows:
    1. Checks system for a better environment in the aquarium.
    2. Control and maintain the parameters in a proper range automatically such as: temperature, water level.
    3. Providing a food supplier system.
- Temperature sensor is used to check the temperature of the tank this sensor will keep a track of the temperature of the tank and will keep on updating the user about it. To check the water level ultrasonic sensor is used. A fixed level is given to the system whenever the water

level increases or decreases it will pop a message on the application and the user will know when to add or remove the water.

- The final and most important thing in this smart aquarium is its feeder. This feeder feeds the fish just by pressing a button there are few predefined timers set in the system with intervals of 4hours ,6hours and 8hours.The feeder will feed the fish after the interval time selected.

1.2 Objective

1.2.1 Aquarium Maintenance

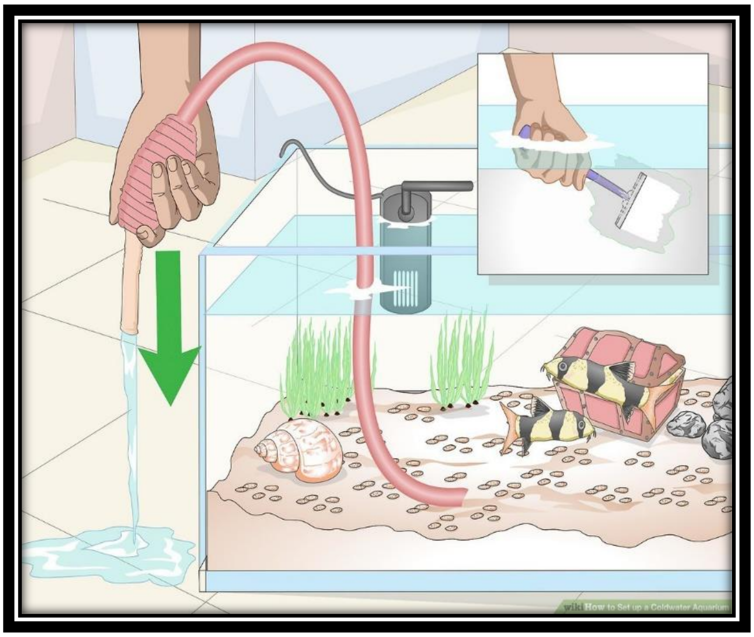


Figure 2: Maintenance of Aquarium

Large volumes of water enable more stability in a tank by diluting effects from death or contamination events that push an aquarium away from equilibrium. The bigger the tank, the easier such a systemic shock is to absorb, because the effects of that event are diluted. For example, the death of the only fish in an 11-litre (3 US gal; 2 imp gal) tank causes dramatic changes in the system, while the death of that same fish in a 400-litre (110 US gal; 88 imp gal) tank with many other fish in it represents only a minor change. For this reason, hobbyists often favour larger tanks, as they require less attention.

Several nutrient cycles are important in the aquarium. Dissolved oxygen enters the system at the surface water-air interface.

Similarly, carbon dioxide escapes the system into the air. The phosphate cycle is an important, although often overlooked, nutrient cycle. Sulphur, iron, and micronutrients also cycle through the system, entering as food and exiting as waste. Appropriate handling of the nitrogen cycle, along with supplying an adequately balanced food supply and considered biological loading, is enough to keep these other nutrient cycles in approximate equilibrium.

An aquarium must be maintained regularly to ensure that the fish are kept healthy. Daily maintenance consists of checking the fish for signs of stress and disease. Also, aquarists must make sure that the water has a good quality, and it is not cloudy or foamy and the temperature of the water is appropriate for the particular species of fish that live in the aquarium.

Typical weekly maintenance includes changing around 10–30% or more of the water while cleaning the gravel, or other substrate if the aquarium has one; however, some manage to avoid this entirely by keeping it somewhat self-sufficient. A good habit is to remove the water being replaced by "vacuuming" the gravel with suitable implements, as this will eliminate uneaten foods and other residues that settle on the substrate. In many areas tap water is not considered to be safe for fish to live in because it contains chemicals that harm the fish. Tap water from those areas must be treated with a suitable water conditioner, such as a product which removes chlorine and chloramine and neutralizes any heavy metals present. The water conditions must be checked both in the tank and in the replacement water, to make sure they are suitable for the species.

1.2.2 Water Conditions

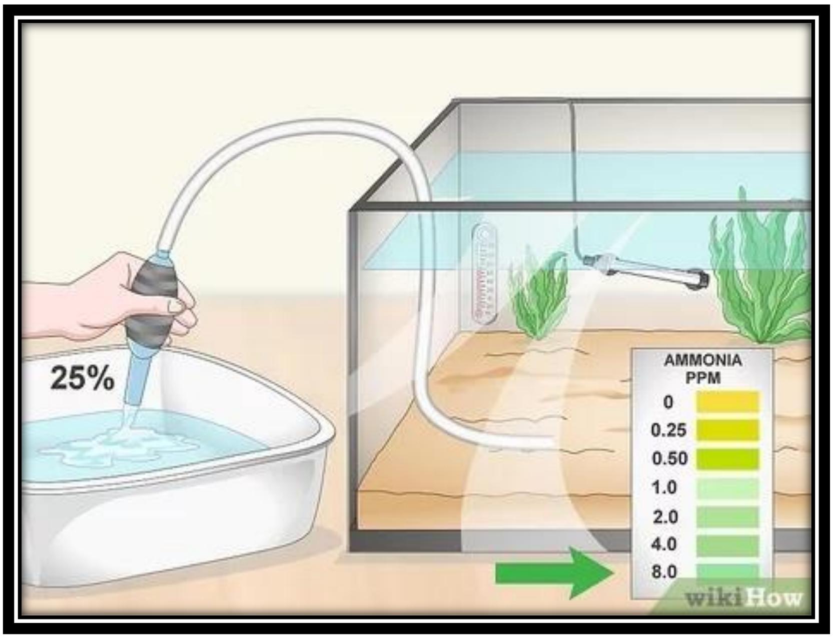


Figure 3: Water Condition of Aquarium

The solute content of water is perhaps the most important aspect of water conditions, as total dissolved solids and other constituents dramatically impact basic water chemistry, and therefore how organisms interact with their environment. Salt content, or salinity, is the most basic measure of water conditions. An aquarium may have freshwater (salinity below 500 parts per million), simulating a lake or river environment; brackish water (a salt level of 500 to 30,000 PPM), simulating environments lying between fresh and salt, such as estuaries; and salt water or seawater (a salt level of 30,000 to 40,000 PPM), simulating an ocean environment. Rarely, higher salt concentrations are maintained in specialized tanks for raising brine organisms.

Saltwater is usually alkaline, while the pH (alkalinity or acidity) of fresh water varies more. Hardness measures overall dissolved mineral content: hard or soft water may be preferred. Hard water is usually alkaline, while soft water is usually neutral to acidic. Dissolved organic content and dissolved gases content are also important factors.

Home aquarists typically use tap water supplied through their local water supply network to fill their tanks. Straight tap water cannot be used in localities that pipe chlorinated water. In the past, it was possible to "condition" the water by simply letting the water stand for a day or two, which allows the chlorine time to dissipate. However, chloramine is now used more often and does not leave the water as readily. Water conditioners formulated to remove chlorine or chloramine are often all that is needed to make the water ready for aquarium use. Brackish or saltwater aquaria require the addition of a commercially available mixture of salts and other minerals.

Some aquarists modify water's alkalinity, hardness, or dissolved content of organics and gases, before adding it to their aquaria. This can be accomplished by additives, such as sodium bicarbonate, to raise ph. Some aquarists filter or purify their water through deionization or reverse osmosis prior to using it. In contrast, public aquaria with large water needs often locate themselves near a natural water source (such as a river, lake, or ocean) to reduce the level of treatment. Some hobbyists use an algae scrubber to filter the water naturally.

Water temperature determines the two most basic aquarium classifications: tropical versus cold water. Most fish and plant species tolerate only a limited temperature range; tropical aquaria, with an average temperature of about 25 °C (77 °F), are much more common. Temperate or cold-water aquaria are for fish that are better suited to a cooler environment. Temperature consistency is more important than range. Most organisms are not accustomed to sudden changes in temperatures, which can cause shock and lead to disease. Water temperature can be regulated with a thermostat and heater (or cooler).

Water movement can also be important in simulating a natural ecosystem. Aquarists may prefer anything from still water up to swift currents, depending on the aquarium's inhabitants. Water movement can be controlled via aeration from air pumps, powerheads, and careful design of water flow (such as location of filtration system points of inflow and outflow).

1.2.3 Nitrogen Cycle

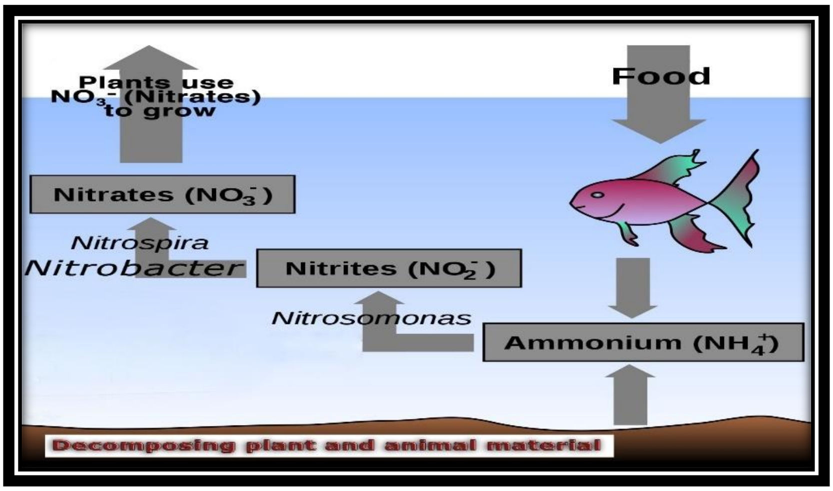


Figure 4: Nitrogen Cycle

Of primary concern to the aquarist is management of the waste produced by an aquarium's inhabitants. Fish, invertebrates, fungi, and some bacteria excrete nitrogen waste in the form of ammonia (which converts to ammonium, in water) and must then either pass through the nitrogen cycle or be removed by passing through zeolite.

Ammonia is also produced through the decomposition of plant and animal matter, including faecal matter and other detritus. Nitrogen waste products become toxic to fish and other aquarium inhabitants at high concentration. In the wild, the vast amount of water surrounding the fish dilutes ammonia and other waste materials. When fish are put into an aquarium, waste can quickly reach toxic concentrations in the enclosed environment unless the tank is cycled to remove waste.

1.3 Purpose, Scope and Applicability

1.3.1 Purpose

- Fish keeping is a popular worldwide. Almost people from all the age groups like to keep aquarium in their home, offices etc for decoration purpose or as a hobby.
- Fish keeping is not an easy job. We always need an aquarium or a pond for that. The hobby of fish keeping is broadly divided into three, freshwater, brackish, marine.
- Among all these three, freshwater is considered to be the most popular hobby of keeping fish because it is easy to handle with freshwater fish and aquariums. It has always been difficult to take care of the fish and aquariums.
- We must feed the fish on time, we must maintain the temperature and also control the light, heater, and filter of the aquarium. All these steps are done manually.
- The project, Smart aquarium has been designed by keeping in mind, the problem of those who cannot take care of their aquarium every day.
- The feeder is powered by servo meter which on trigger of a button feeds the fish, sensor keeps an update of the temperature of the aquarium, and we can know the water level which helps in the growth of fish.

Detailing Of the Problem:

- Pet ownership has been increasing at a steady pace in the last 20 years. After cats and dogs, the most popular pet is now the freshwater fish.

- The maintenance of fish aquariums is a very difficult task itself.
- Whenever you have to clean up your aquarium or you must feed, you have to do a lot of things. You have to turn off your aquarium's power head/air pump and feed manually and turn on the air again after an hour.
- In the Current system all equipment’s such as light, heater, and filter are to be controlled manually using electrical switches for this the person needs to come near the aquarium and manually control the electrical switches to turn on /off the equipment’s.
- The fishes need to be fed twice a day even this requires the owner to walk up to fish tank and feed the fish manually which makes the task of maintaining an aquarium much more difficult.
- At times when the owner is on vacation, he has no control over the aquarium and can’t feed the fish.

1.3.2 Scope

- The current project i.e., Smart Aquarium can easily perform the features like fish feeding using servo motor, water level sensor using ultrasonic sensor and temperature of the aquarium using temperature sensor.
- It can be made a total smart aquarium in future. The smart aquarium has a great future scope as we can implement such a system which not only has the above-mentioned features but also comprises of automatic water changing.
- For making it a total smart aquarium we must design the tank in such a way that it has outlet for water to pass out and to get freshwater in.
- In future we can also add ph. level sensor to it which determines ph. level of the water. Some specific breed of aquatic animals requires a proper ph. level and salinity of the water to be maintained. Mostly for the sea water fishes if kept in aquarium ph. feature can be utilized at its best.
- We can also implement a mechanism which turns on the aquarium heater when temperature of the aquarium water reduces in winter. And, to make future project more eye catching we can add up light and water filter control through android app.
- Also, another servo motor can be used to drop medicines for fishes for white spots, fungus, tail, and fin rot. Thus, our system had great future scope ahead and can include most of the features that make it total smart aquarium.

1.3.3 Applicability

- The project with which we came up is a Smart Aquarium. The project will be more efficient than the systems available in market, now days.
- In addition to the efficiency, it will be of lower cost as well. The project's audience is the group of people interested to keep fishes at home or offices but don't have time to take care of, or they are worried to keep asking their neighbours to take care of the fishes in their absence.
- The project is an automated system to take care of fishes. It will replace the manual maintenance of fish aquarium with its automated functions.
- It will monitor the physical changes in the water and will maintain it to the ideal conditions, with required changes.
- It will check the water level using water level sensor, temperature using temperature sensor and will also feed by servo motor.

Chapter 2 Survey of Technologies

What is IOT?

- Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e., objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention.

- Internet of Things can connect devices embedded in various systems to the internet. When devices/objects can represent themselves digitally, they can be controlled from anywhere. The connectivity then helps us capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IoT security.

- IoT is a transformational force that can help companies improve performance through IoT analytics and **IoT Security** to deliver better results.
- Businesses in the utilities, oil & gas, insurance, manufacturing, transportation, infrastructure, and retail sectors can reap the benefits of IoT by making more informed decisions, aided by the torrent of interactional and transactional data at their disposal.

2.1 Hardware

The hardware which we are using for this project is NodeMCU as it is combines the benefits of a microcontroller development board with a WiFi breakout board and provides the entire package as a single development board, officially called the NodeMCU DevKit. It is having an ESP8266 based System on a Chip and is designed for electronics and IoT Projects.

The NodeMCU now has extensive support, a huge community and a plethora of libraries that you can use. The most interesting fact is that it is cheaper than the Arduino Uno development board.

Properties	**NodeMCU**	**Arduino Uno**
RAM	128 KB	2 KB
ROM	4 MB	32 KB
PROCESSOR	32 bit	8 bit
PROCESSOR SPEED	80 MHz	16 MHz
WIRELESS COMMUNICATION	ESP8266 SoC	None
SERIAL COMMUNICATION	UART/I2C/SPI	UART/I2C/SPI
GPIO	9 Digital (3.3 V), T Analog (1.8 V)	10 Digital (5V), 6 Analog (2.5 V)
DIMENSIONS/FORM FACTOR	4.8 x 2.5 Cm	6.8 x 5.3 Cm

Table 1: Difference between NodeMCU and Arduino UNO

2.2 Software Requirements:

Why MIT APP INVENTOR?

MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software(apps) for two operating systems (OS): Android, and iOS, which, as of 8 July 2019, is in final beta testing. It is free and open-source software released under dual licensing: a Creative Commons Attribution ShareAlike 3.0 Unported license, and an Apache License 2.0 for the source code.

It uses a graphical user interface (GUI) very similar to the programming languages Scratch (programming language) and the StarLogo, which allows users to drag and drop visual objects to create an application that can run on Android devices, while a App-Inventor Companion (The program that allows the app to run and debug on) that works on iOS running devices are still under development. In creating App Inventor, Google drew upon significant prior research in educational computing, and work done within Google on online development environments.

App Inventor and the other projects are based on and informed by constructionist learning theories, which emphasize that programming can be a vehicle for engaging powerful ideas through active learning. As such, it is part of an ongoing movement in computers and education that began with the work of Seymour Papert and the MIT Logo Group in the 1960s, and has also manifested itself with Mitchel Resnick's work on Lego Mindstorms and StarLogo.

App Inventor also supports the use of cloud data via an experimental Firebase#Firebase Realtime Database component.

2.3 Arduino IDE Software

For implementing Code, we require Arduino IDE**.** **Arduino** consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or **IDE** (Integrated Development Environment) that runs on your computer, used to write, and upload computer code to the physical board.

An official software introduced by Arduino.cc, that is mainly used for writing, compiling, and uploading the code in the Arduino device. Almost all the Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go. It is easily available foe operation system like MAC, Windows, Linux and runs on the java platform that comes with inbuilt functions and commands that play a vital role for debugging, editing, and compiling the code in the environment.

- ## Why Arduino IDE?

The Arduino IDE supports code highlighting and many other features. Moreover, your Arduino code is in the cloud so you can use and access it everywhere. It supports several boards and if you do not find your board you can upload your board definition. This feature makes this platform very versatile.

Chapter 3 Requirements and Analysis

3.1 Problem Definition

Why did we choose this problem?

- Fish keeping is a popular worldwide. Almost people from all the age groups like to keep aquarium in their home, offices etc for decoration purpose or as a hobby.
- Fish keeping is not an easy job. We always need an aquarium or a pond for that. The hobby of fish keeping is broadly divided into three, freshwater, brackish, marine.
- Among all these three, freshwater is considered to be the most popular hobby of keeping fish because it is easy to handle with freshwater fish and aquariums. It has always been difficult to take care of the fish and aquariums.
- We must feed the fish on time, we must maintain the temperature and control the light, heater and filter of the aquarium. All these steps are done manually.
- The project, Smart aquarium has been designed by keeping in mind, the problem of those who cannot take care of their aquarium every day.
- The feeder is powered by servo meter which on trigger of a button feeds the fish, sensor keeps an update of the temperature of the aquarium, and we can know the water level which helps in the growth of fish.

3.2 Requirement Specification

While looking upon the problems above and feeling to urge to find a permanent and quick solution onto it is necessary. Testing soil nutrients will not work, it also must monitor and analyse the data wisely.

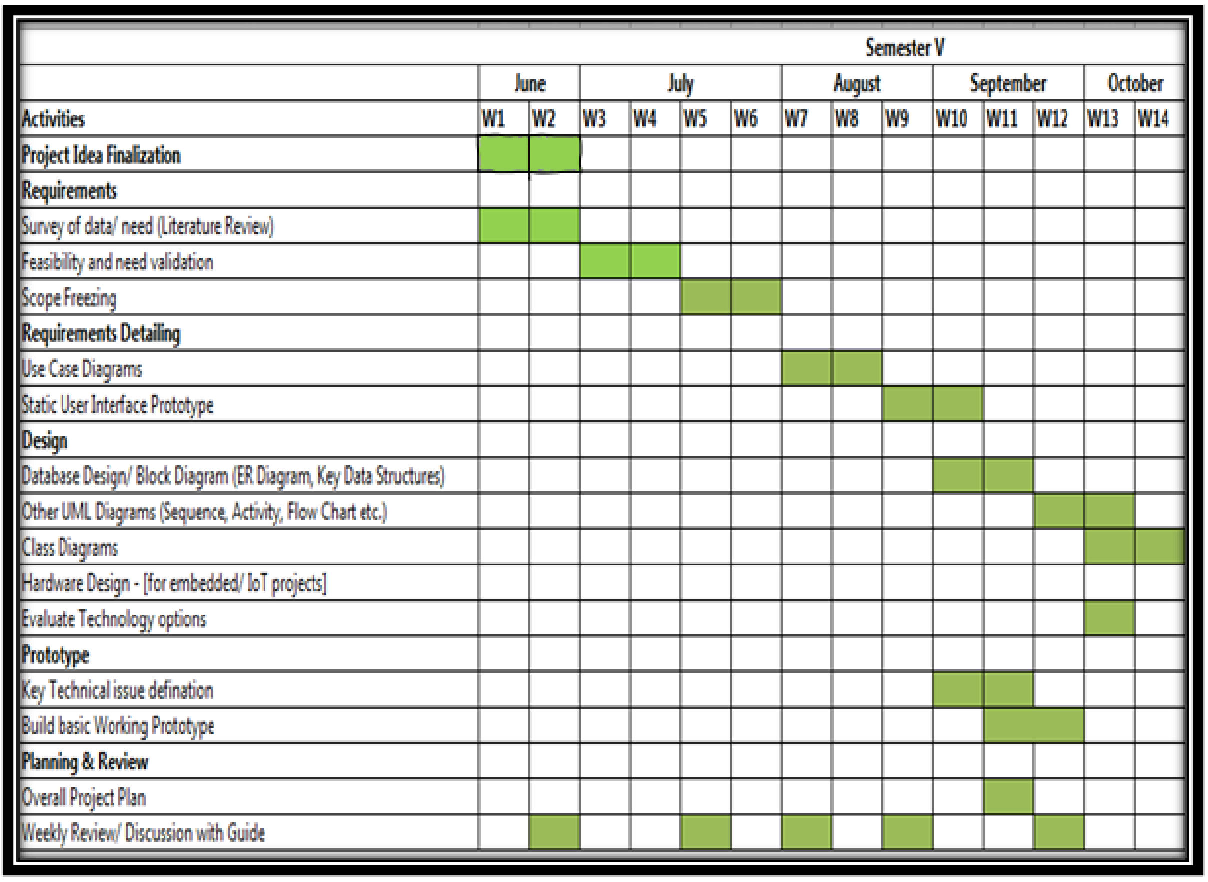
The system will be going to test the soil nutrients and monitor the soil growth and with this farmer will going to make an idea what crops should be grown so that crop productivity will get increase.

3.3 Planning and Scheduling

3.3.1 Gantt Chart

A Gantt chart is a project management tool assisting in the planning and scheduling of projects of all sizes, although they are particularly useful for simplifying complex projects. Project management timelines and tasks are converted into a horizontal bar chart, showing start and end dates, as well as dependencies, scheduling and deadlines, including how much of the task is completed per stage and who is the task owner. This is useful to keep tasks on track when there is a large team and multiple stakeholders when the scope changes. As it's in a bar chart format it is possible to check on progress with a quick glance. You can easily see:

- visual display of the whole project, timelines and deadlines of all tasks, relationships and dependencies between the various activities, project phases.



	Semester V													
	June		July				August			September			October	
Activities	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**	**W11**	**W12**	**W13**	**W14**
Project Idea Finalization	🟩	🟩												
Requirements														
Survey of data/ need (Literature Review)	🟩	🟩												
Feasibility and need validation			🟩	🟩										
Scope Freezing					🟩	🟩								
Requirements Detailing														
Use Case Diagrams							🟩	🟩						
Static User Interface Prototype									🟩	🟩				
Design														
Database Design/ Block Diagram (ER Diagram, Key Data Structures)										🟩	🟩			
Other UML Diagrams (Sequence, Activity, Flow Chart etc.)												🟩	🟩	
Class Diagrams													🟩	🟩
Hardware Design - [for embedded/ IoT projects]														
Evaluate Technology options													🟩	
Prototype														
Key Technical issue defination										🟩	🟩			
Build basic Working Prototype											🟩	🟩		
Planning & Review														
Overall Project Plan											🟩			
Weekly Review/ Discussion with Guide		🟩			🟩		🟩		🟩			🟩		

Figure 5: Gantt Chart

In this project, we are using the Incremental model because it helps to implement each phase of system requirements and each phase of development proceeds in strict order. also, easy to manage the project flow.

3.3.2 Incremental Model

Incremental Model is a process of software development where requirements divided into multiple standalone modules of the software development cycle. In this model, each module goes through the requirements, design, implementation and testing phases. Every subsequent release of the module adds function to the previous release. The process continues until the complete system achieved.

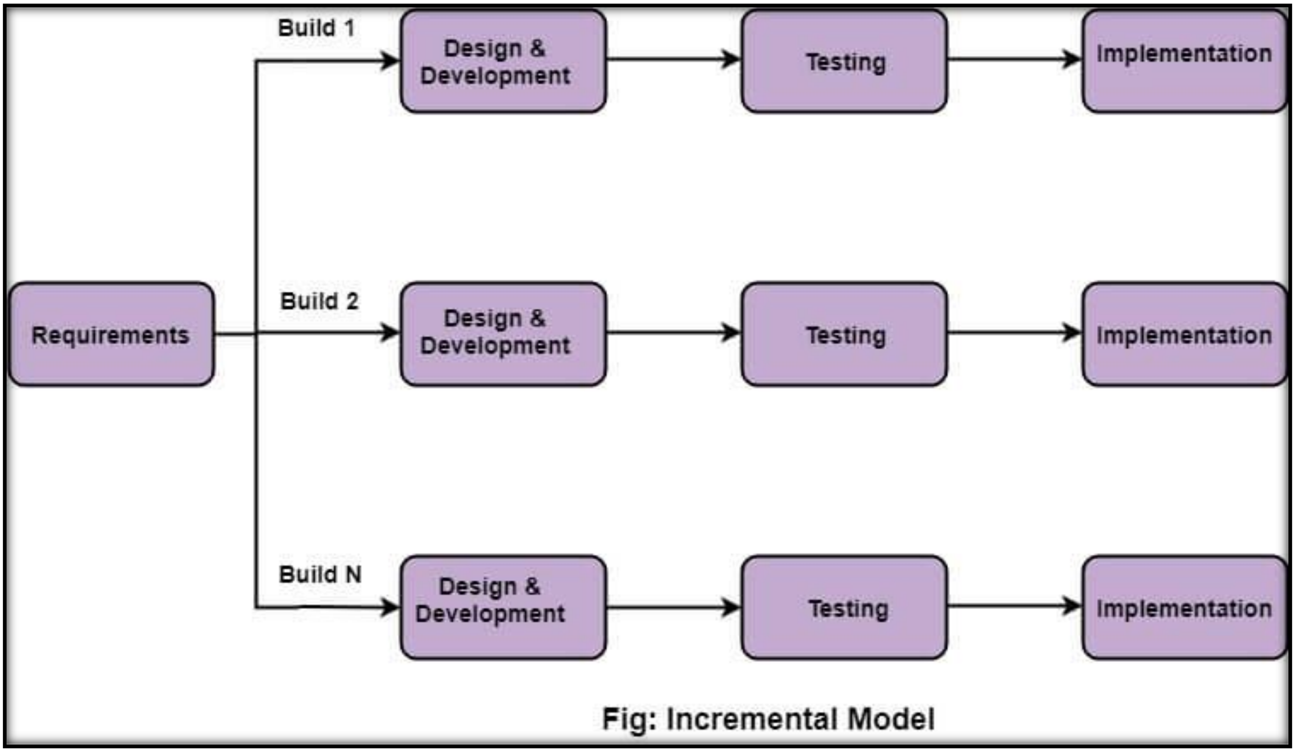


Figure 6: INCREMENTAL MODEL

The various phases of incremental model are as follows:

- **Requirement analysis:**
  In the first phase of the incremental model, the product analysis expertise identifies the requirements. And the system functional requirements are understood by the requirement analysis team. To develop the software under the incremental model, this phase performs a crucial role.

- **Design & Development:**
  In this phase of the Incremental model of SDLC, the design of the system functionality and the development method are finished with success. When software develops new practicality, the incremental model uses style and development phase.

- **Testing:**
  In the incremental model, the testing phase checks the performance of each existing function as well as additional functionality. In the testing phase, the various methods are used to test the behavior of each task.

- **Implementation:**
  Implementation phase enables the coding phase of the development system. It involves the final coding that design in the designing and development phase and tests the functionality in the testing phase.

3.4 Hardware and Software Specifications

3.4.1 Hardware Requirements

3.4.1.1 NodeMCU

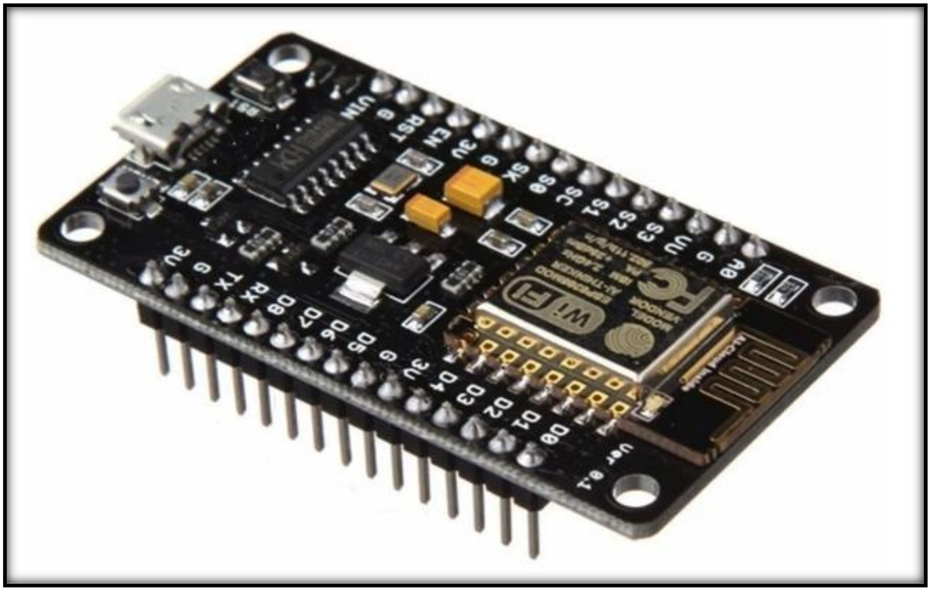


Figure 7: NodeMCU

NodeMCU is an open-source development board and firmware based in the widely used ESP8266 -12E WiFi module. It allows you to program the ESP8266 WiFi module with the simple and powerful LUA programming language or Arduino IDE.

Features

- Finally, programable WiFi module.
- Arduino-like (software defined) hardware IO.
- Can be programmed with the simple and powerful Lua programming language or Arduino IDE.
- USB-TTL included plug & play.

- GPIOs D0-D10, PWM functionality, IIC and SPI communication, 1-Wire and ADC A0 etc. all in one board.
- Wifi networking (can be used as access point and/or station, host a web server), connect to internet to fetch or upload data.
- Event-driven API for network applications.
- PCB antenna.

3.4.1.2 Servo Motor

A servo motor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback. It also requires a servo drive to complete the system. The drive uses the sensor to precisely control the rotary position of the motor.

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use **servo motor**. It is just made up of simple **motor** which run through **servo** mechanism.

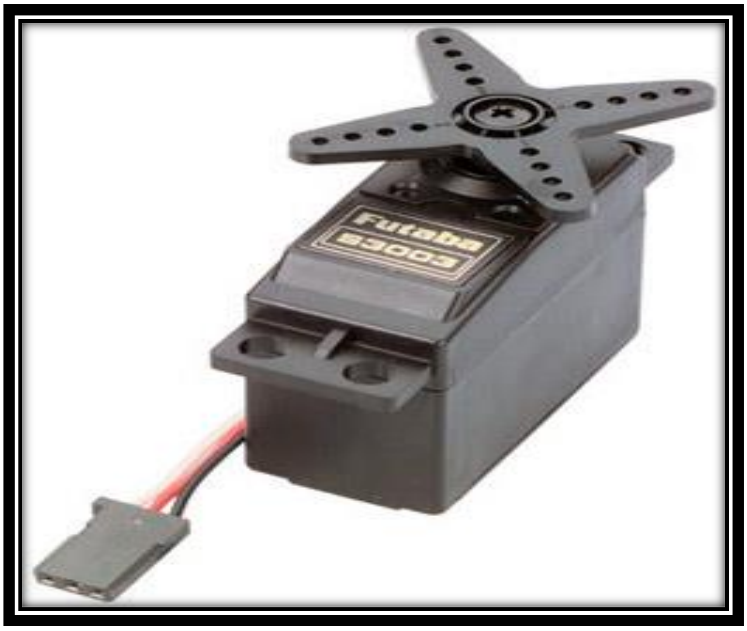


Figure 8: Servo Motor

3.4.1.3 HC-SR04 ULTRASONIC SENSOR

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 were 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

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

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

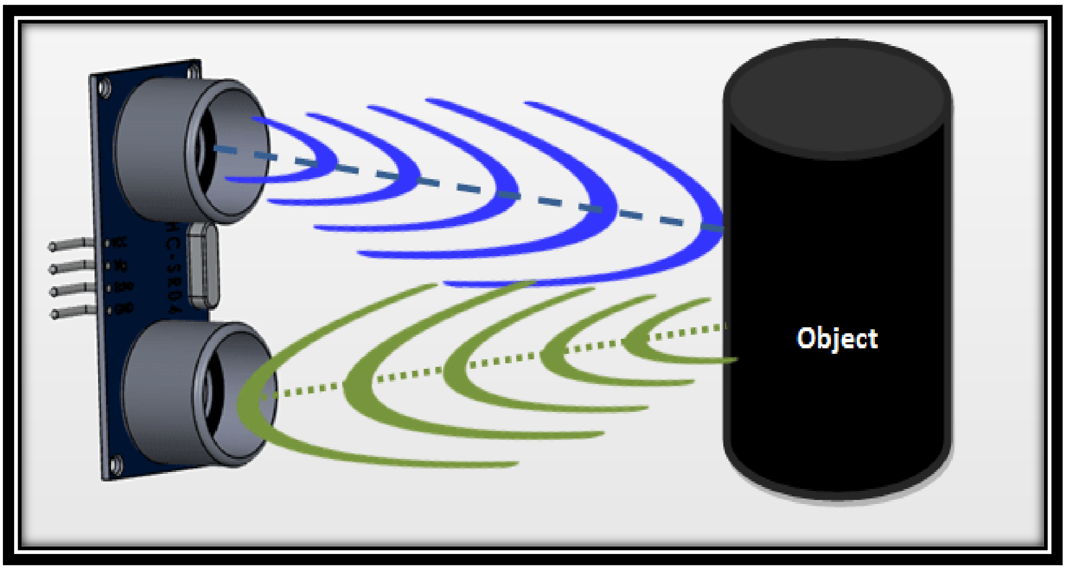


Figure 9: Ultrasonic Sensor.

3.4.1.4 DS18B20Water Proof Temperature Sensor

The resolution of the **temperature sensor** is user-configurable to 9, 10, 11, or 12 bits, corresponding to increments of 0.5°C, 0.25°C, 0.125°C, and 0.0625°C, respectively. The default resolution at power-up is 12-bit.

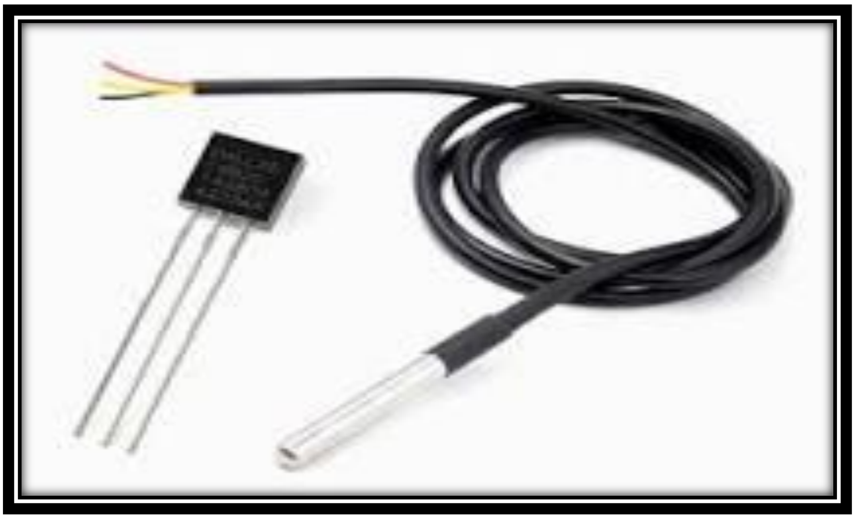


Figure 10: DS18B20Water Proof Temperature Sensor.

3.4.1.5 Jumper Wires

Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. **Male-to-male jumper wires** are the most common and what you likely will use most often. When connecting two ports on a **breadboard**, a **male-to-male wire** is what you'll need.

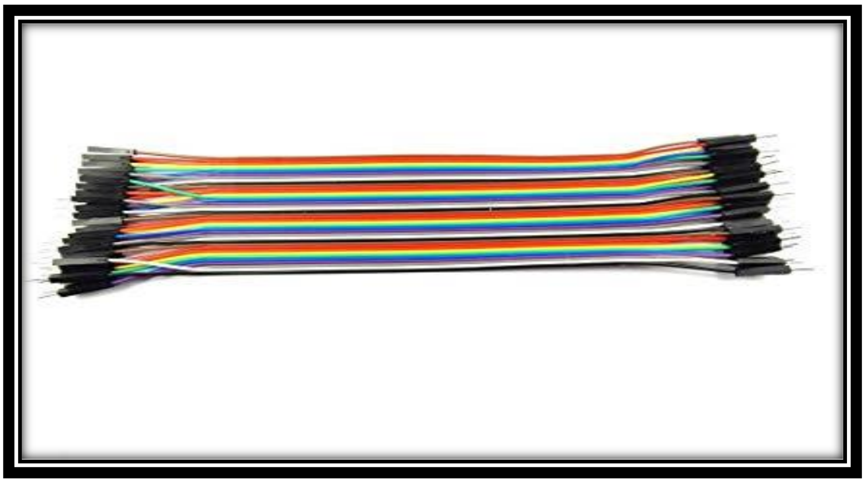


Figure 11: Jumper wires

3.4.1.6 9-12 V Power Supply

This Power Supply is a Regulated Center Positive Power Supply Has a Compact Size & Light Weight. Regulated Stable Voltage. Good Quality SMPS Based Adapter Power LED Monitor (LED Glow When in Use) Stabilized Output, Low Ripple & Low Interference High Efficiency & Low Energy Consumption.

Figure 12: 9-12 V Power Supply

3.4.1.7 Breadboard

A breadboard, or protoboard, is a construction base for prototyping of electronics. Originally the word referred to a literal bread board, a polished piece of wood used when slicing bread.[1] In the 1970s the solderless breadboard (a.k.a. plugboard, a terminal array board) became available and nowadays the term “breadboard” is commonly used to refer to these.

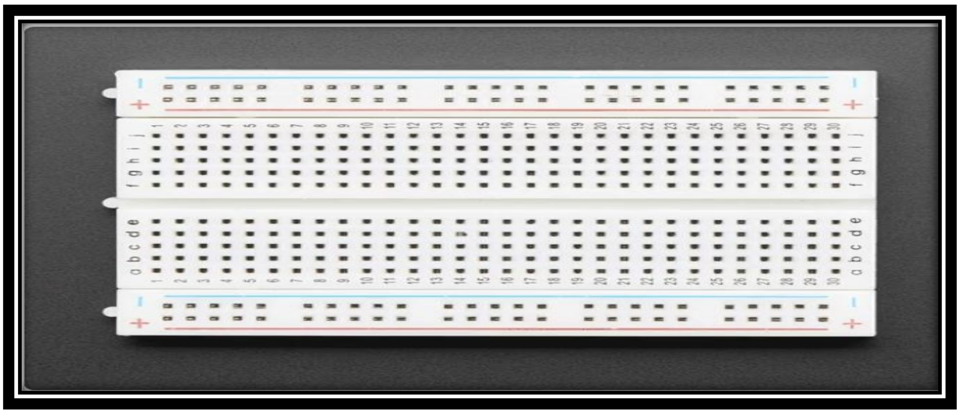


Figure 13: Breadboard

3.5 Preliminary Product Description

Smart Aquarium is a fish-tank filled with water for keeping underwater lives and it generally used for decoration purpose. Moreover, we can find so many people are interested in petting fish, therefore they collect different types of fishes and provide a proper care for these creatures, but petting fishes is a hard job as it requires full attention time to time to keep the tank adaptable for the fishes by providing a proper environment. Thus, having a smart Aquarium will help people to take care of their fishes without any effort. This project designs a system that provide the perfect environment in the aquarium water and control the feeding process for the fishes automatically to help the fish live longer and healthier without any need of a direct observation from the person. After the project is completed, the system will be able to generate a perfect environment simulated from the original environment where the fish came from. Moreover, the system controls a few important parameters such as temperature roughly between 20 and 30 degrees Celsius, water level and feeding process which should be maintained for almost all kinds of fishes. The system has many features as follows:

1. Checks system for a better environment in the aquarium.

2. Control and maintain the parameters in a proper range automatically such as: temperature, water level.

3. Providing a food supplier system.

Temperature sensor is used to check the temperature of the tank this sensor will keep a track of the temperature of the tank and will keep on updating the user about it. To check the water level ultrasonic sensor is used. A fixed level is given to the system whenever the water level increases or decreases it will pop a message on the application and the user will know when to add or remove the water. The final and most important thing in this smart aquarium is its feeder. This feeder feeds the fish just by pressing a button there are few predefined timers set in the system with intervals of 4hours ,6hours and 8hours.The feeder will feed the fish after the interval time selected.

CHAPTER 4. SYSTEM DESIGN

4.1 Basic Modules

- **NodeMCU ESP8266 Module:**

  In this module all sensors will send the data from sensors to nodemcu module as it has an in-built WiFi module the data can be sent wirelessly to mobile phones or laptop.

- **Sensor Module:**

  In this module all the sensors like Temperature, Ultrasonic will sense the data from fish tank and send it to the NodeMCU.

- **Database Module:**

  In this module all the sense data will get stored into MySQL database through php script. ESP8266 will request (HTTP POST request) to hosting server through php script to store the sense data into MySQL database.

- **Data visualization Module:**

  In this module we can see the data in a webpage. This will be achieved by php script, as it will fetch the data from MySQL database and show it to our webpage in the graphical format.

4.2 Diagrams

4.2.1. ACTIVITY DIAGRAM

An activity diagram is a behavioural diagram i.e., it depicts the behaviour of a system. An activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity is being executed.

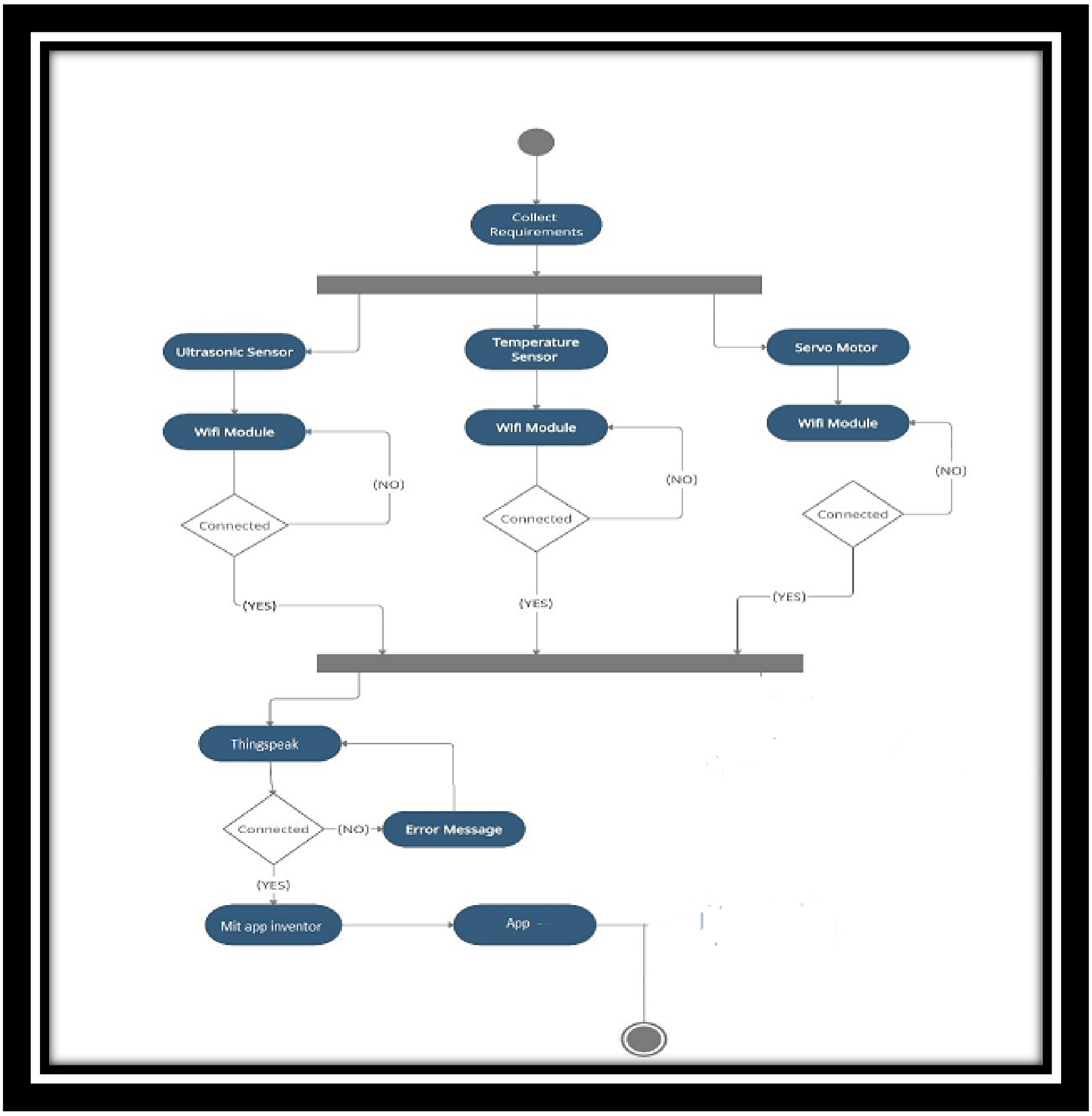


Figure 14: Activity Diagram

4.2.2. BLOCK DIAGRAM

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks. They are heavily used in engineering in hardware design, electronic design, software design, and process flow

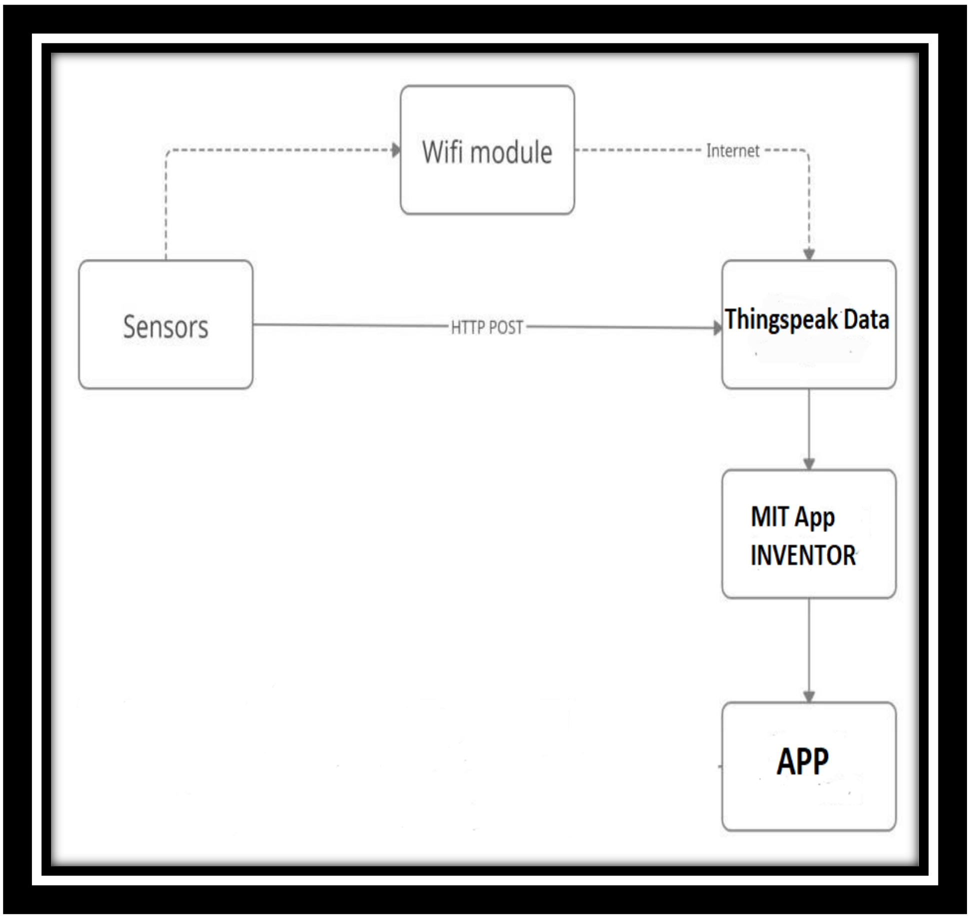


Figure 15: Block Diagram of Components

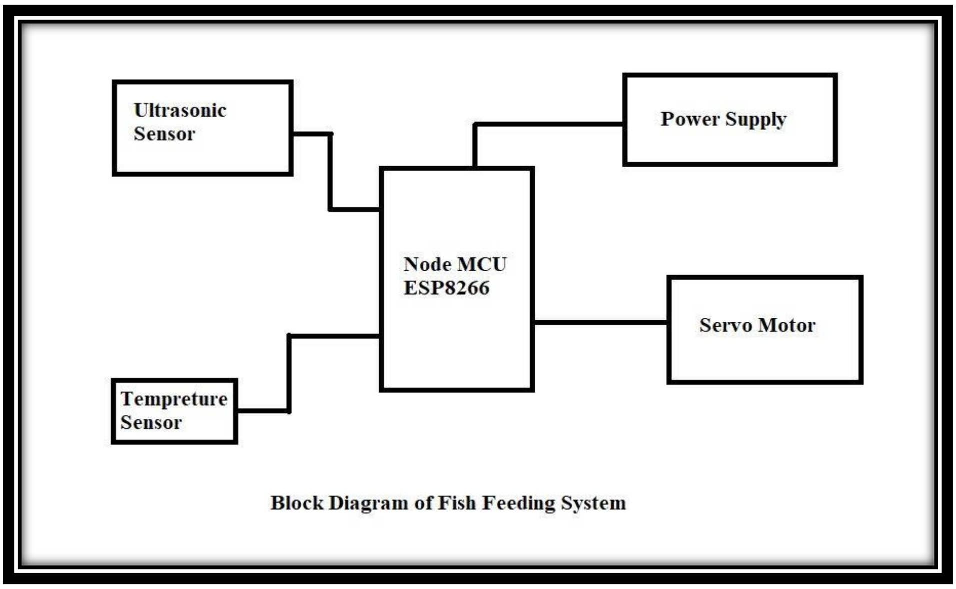


Figure 16: Block Diagram of Fish Feeding System

4.2.3. COMPONENT DIAGRAM

A component diagram, also known as a UML component diagram, describes the organization and wiring of the physical components in a system. Component diagrams are often drawn to help model implementation details and double-check that every aspect of the system's required function is covered by planned development.

‘

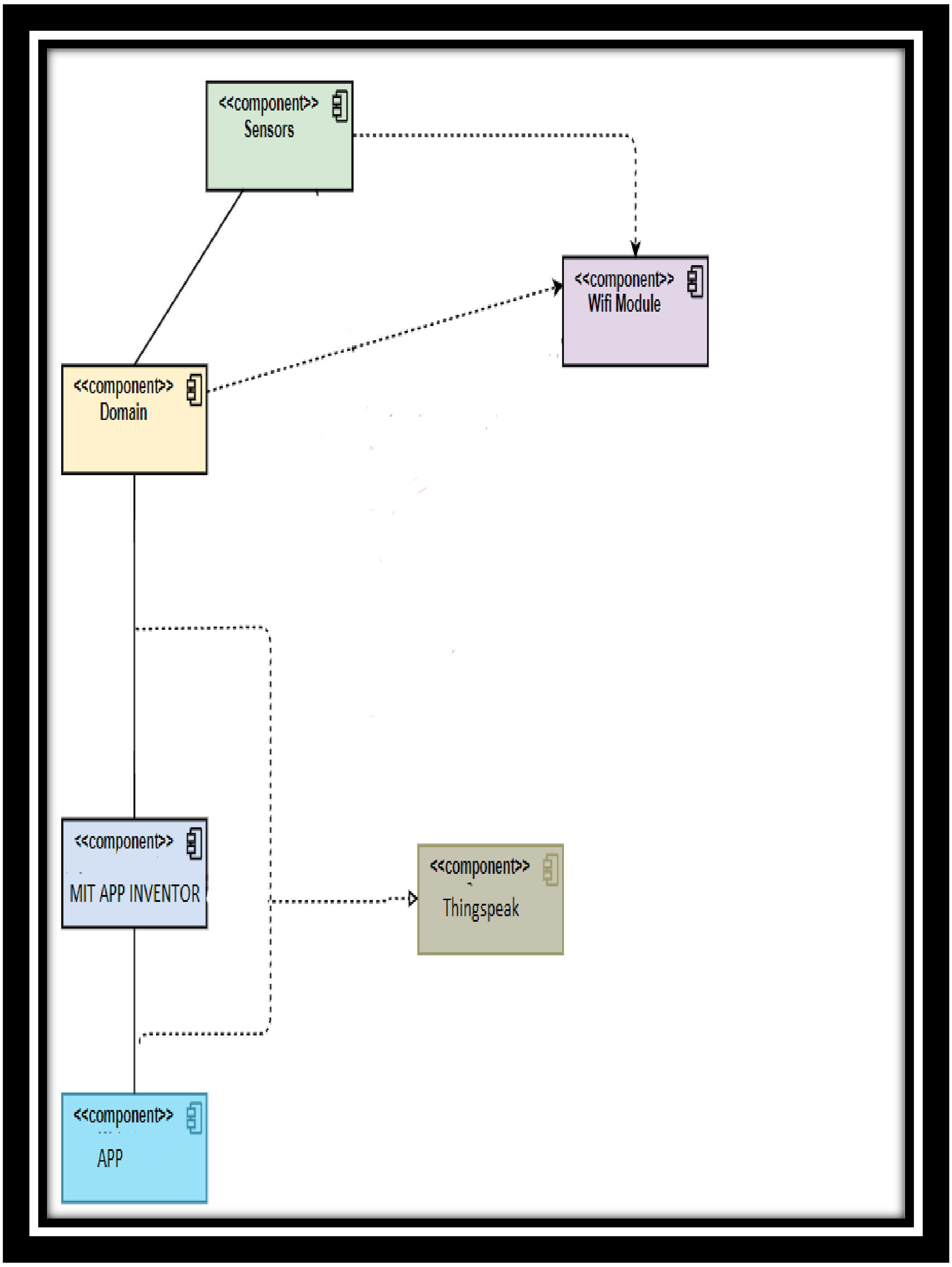


Figure 17: Component Diagram

4.2.4. DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. … It shows how data enters and leaves the system, what changes the information, and where data is stored. The objective of a DFD is to show the scope and boundaries of a system as a whole.

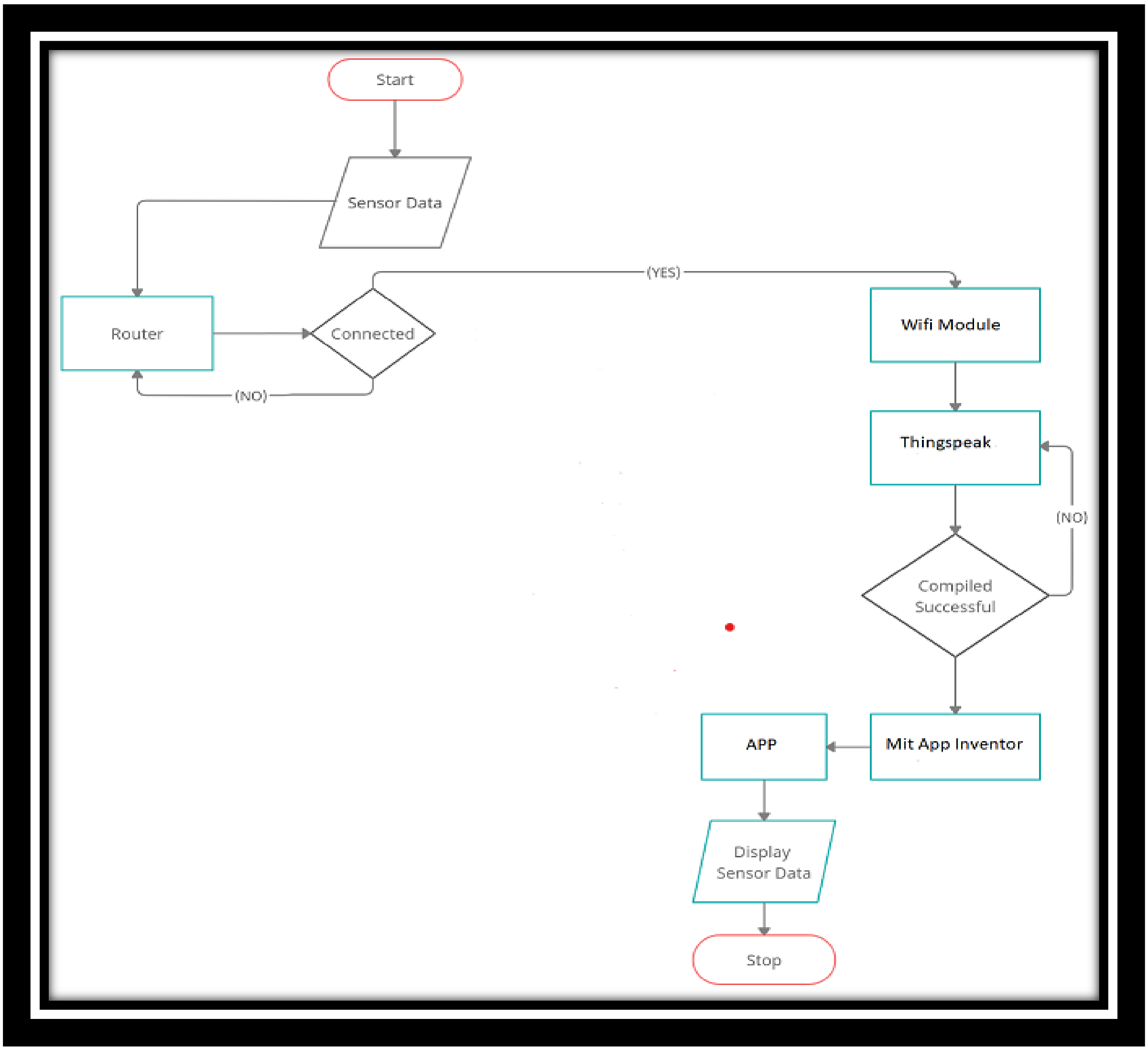


Figure 18: Data Flow Diagram

4.2.5. SEQUENCE DIAGRAM

A sequence diagram or system sequence diagram shows object interactions arranged in time sequence in the field of software engineering. It depicts the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

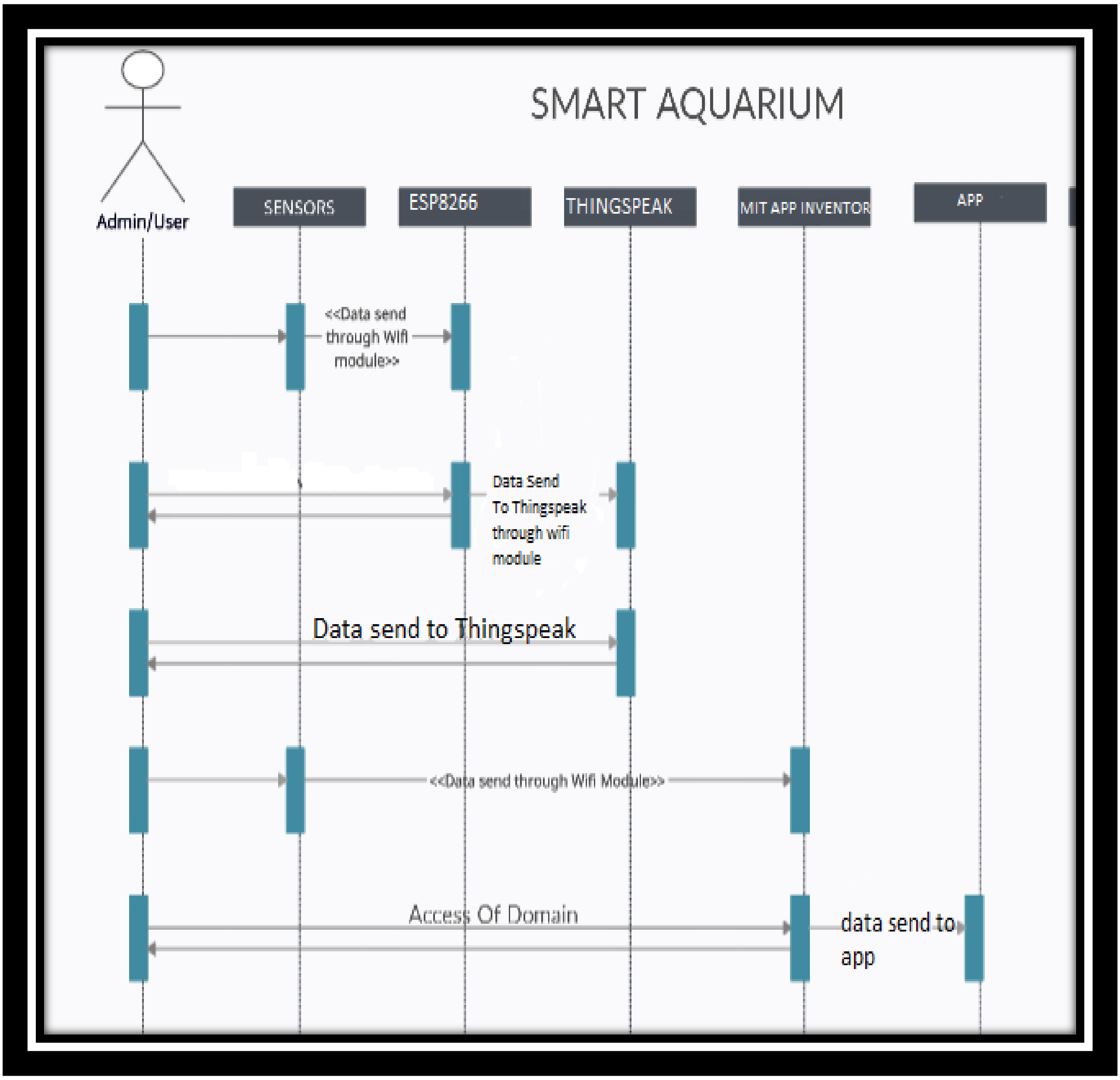


Figure 19: Sequence Diagram

4.2.6 USE CASE DIAGRAM

In UML, use-case diagrams model the behaviour of a system and help to capture the requirements of the system. Use-case diagrams describe the high-level functions and scope of a system. These diagrams also identify the interactions between the system and its actors.

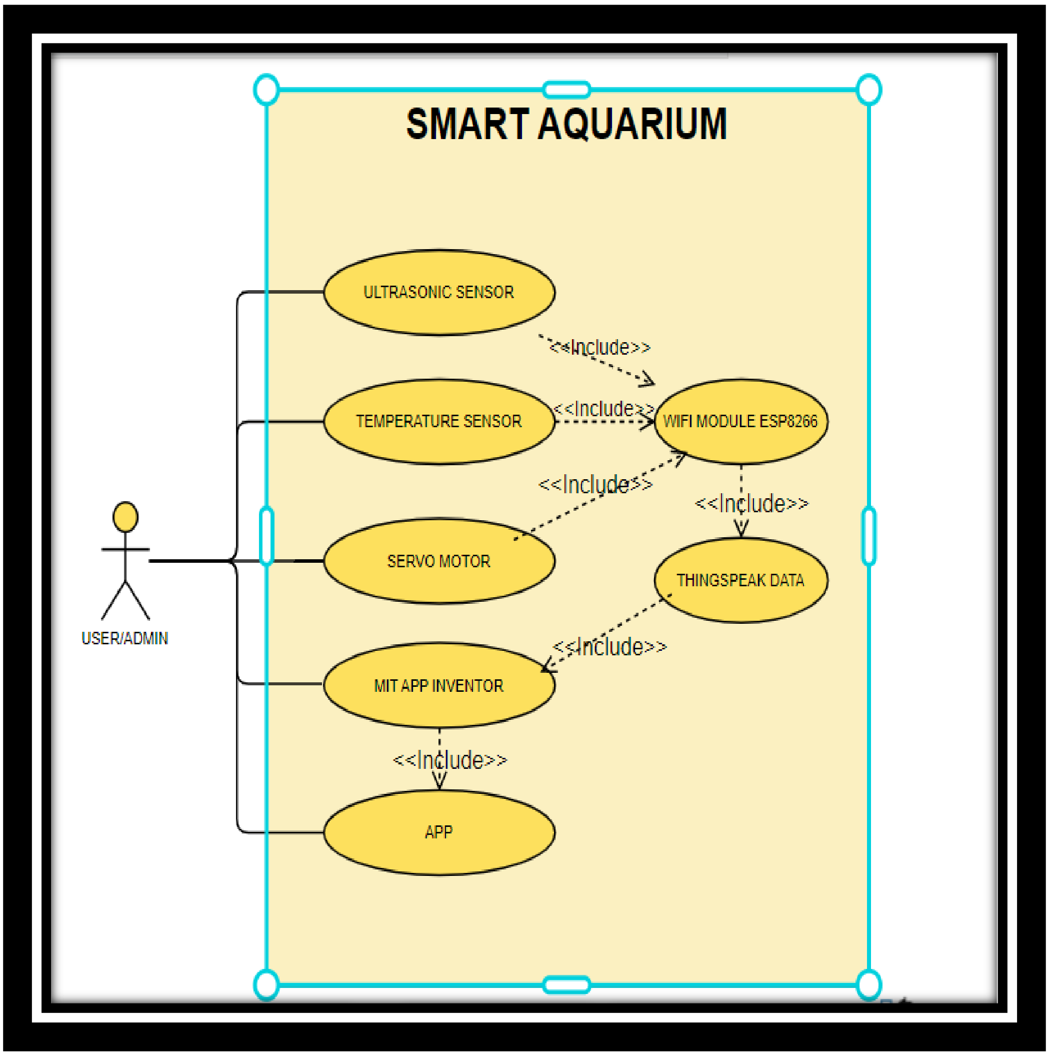


Figure 20: Use Case Diagram

4.2.7 Circuit Design for Smart Aquarium:

A **circuit diagram** is a graphical representation of an electrical circuit. A pictorial circuit diagram uses simple images of components, while a schematic diagram shows the components and interconnections of the circuit using standardized symbolic representations. The presentation of the interconnections between circuit components in the schematic diagram does not necessarily correspond to the physical arrangements in the finished device.

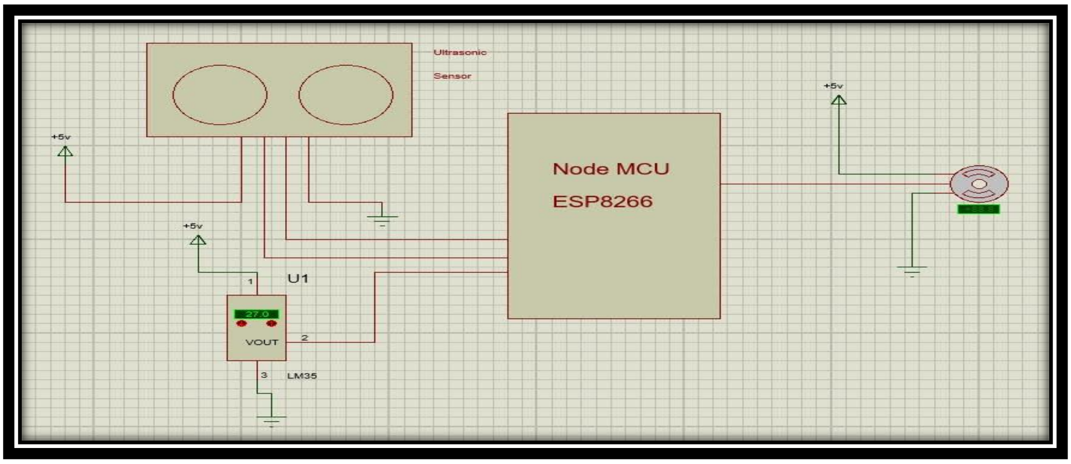


Figure 21: Circuit Diagram

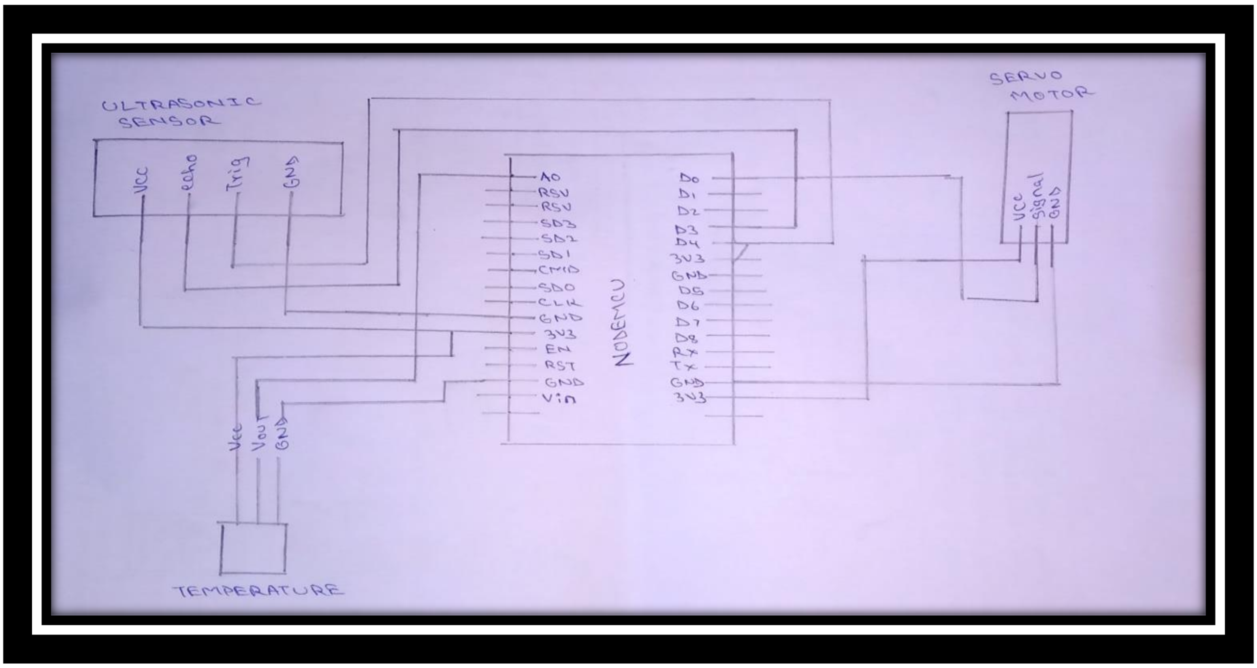


Fig 22 Circuit Pinout Diagram

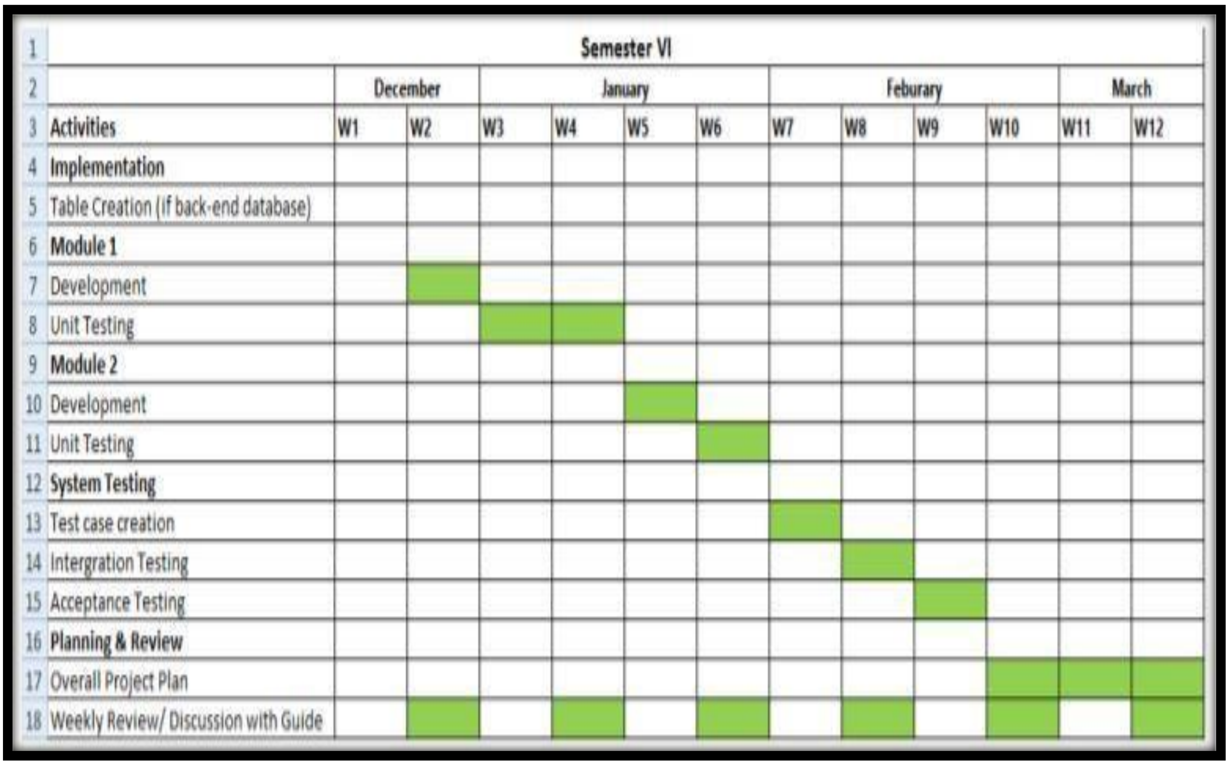
4.3 Event Table

Sr No.	Events	Trigger	Source	Action	Response
1	User	Get information	NodeMCU ESP8266	View sensor information	View
2	NodeMCU ESP8266	Sensors connect and setup internet connection		Data transmission	Data transfer
3	Ultrasonic sensor	Sense distance	Data server	Read water level	Information captured
4	Temperature sensor	Sense temperature	Data server	Read temperature value	Information captured
5	Servo motor	Rotate the object	Data server	Read food feeding	Information captured
6	Data server collect information	Proceed	NodeMCU ESP8266	Storing data from sensors	Data stored
7	Collect	Data from database	MySQL database	Sensors stored values	Data collected
8	Collect	Data from database	SMTP Protocol	Sensors stored values	Data collected
9	User received information		Website	Viewing values	Sensor values displayed
10	User received information		Email	Viewing values	Sensor values displayed

Table 4: Event Table

Chapter 5 Implementation and Testing

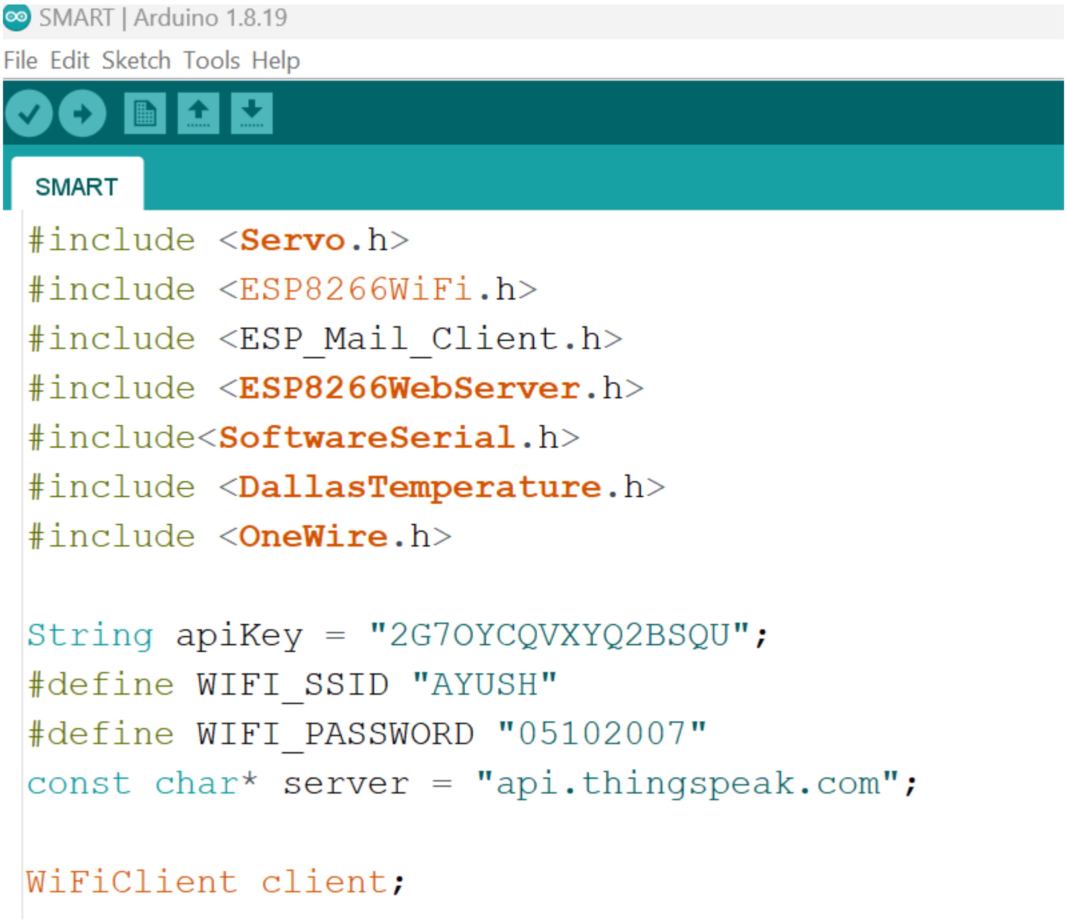
5.1 Implementation Approach



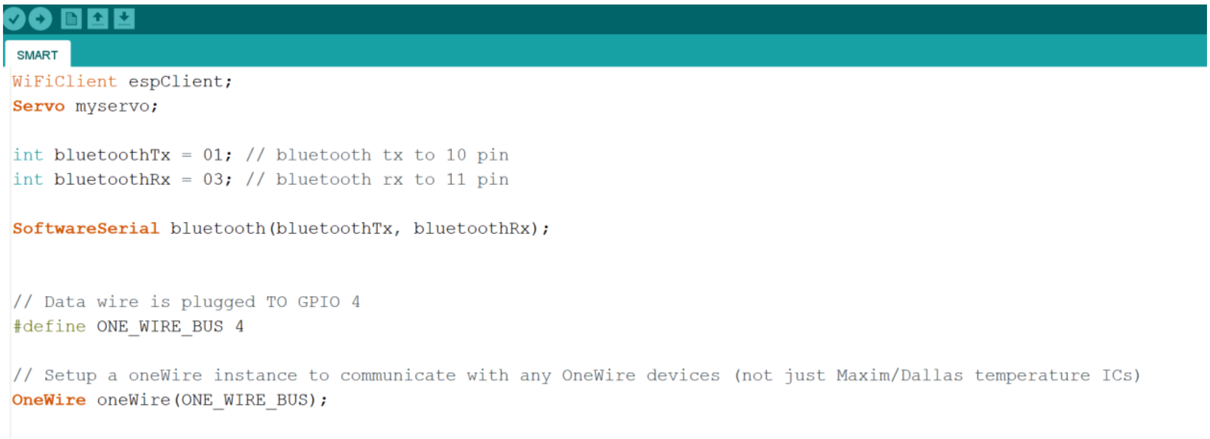
1		Semester VI											
2		December		January				Feburary				March	
3	**Activities**	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
4	**Implementation**												
5	Table Creation (if back-end database)												
6	**Module 1**												
7	Development		🟩										
8	Unit Testing			🟩	🟩								
9	**Module 2**												
10	Development					🟩							
11	Unit Testing						🟩						
12	**System Testing**												
13	Test case creation							🟩					
14	Intergration Testing								🟩				
15	Acceptance Testing									🟩			
16	**Planning & Review**												
17	Overall Project Plan										🟩	🟩	🟩
18	Weekly Review/ Discussion with Guide		🟩		🟩		🟩		🟩		🟩		🟩

5.2 Coding Details and Code Efficiency

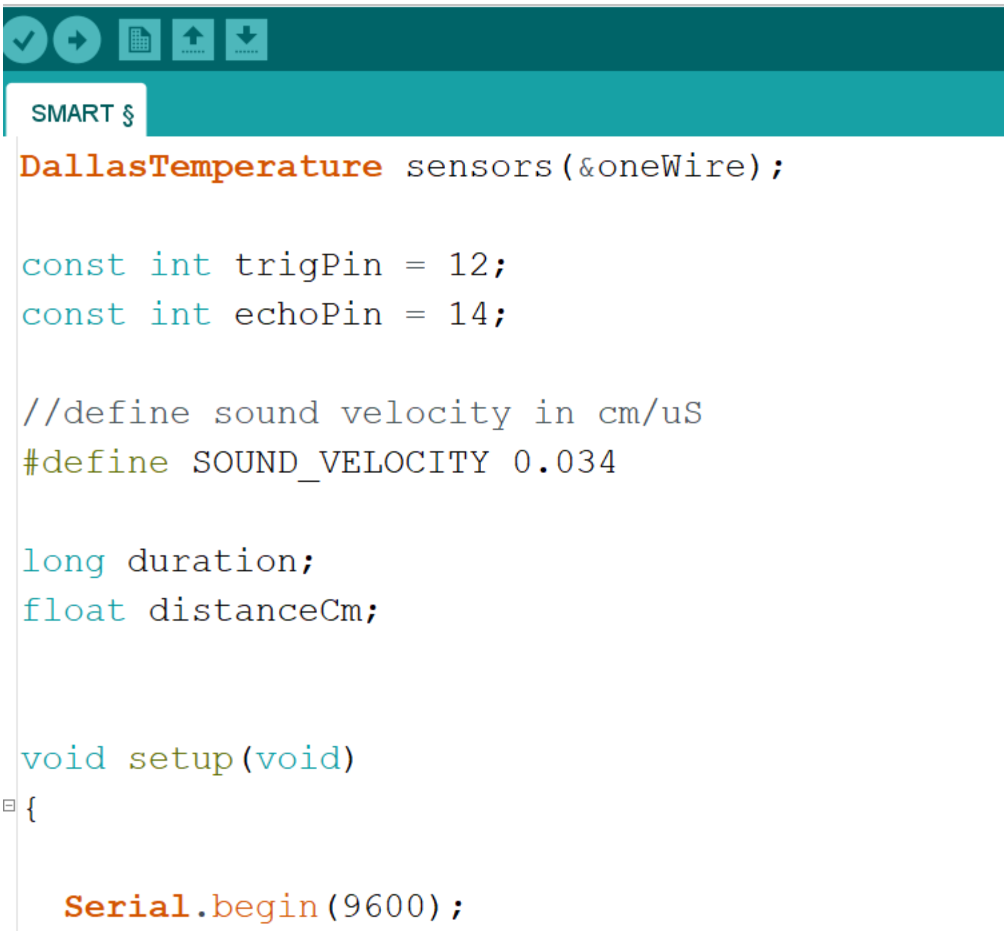
Code efficiency is a broad term used to depict the reliability, speed and programming methodology used in developing codes for an application. Code efficiency is directly linked with algorithmic efficiency and the speed of runtime execution for software. It is the key element in ensuring high performance.



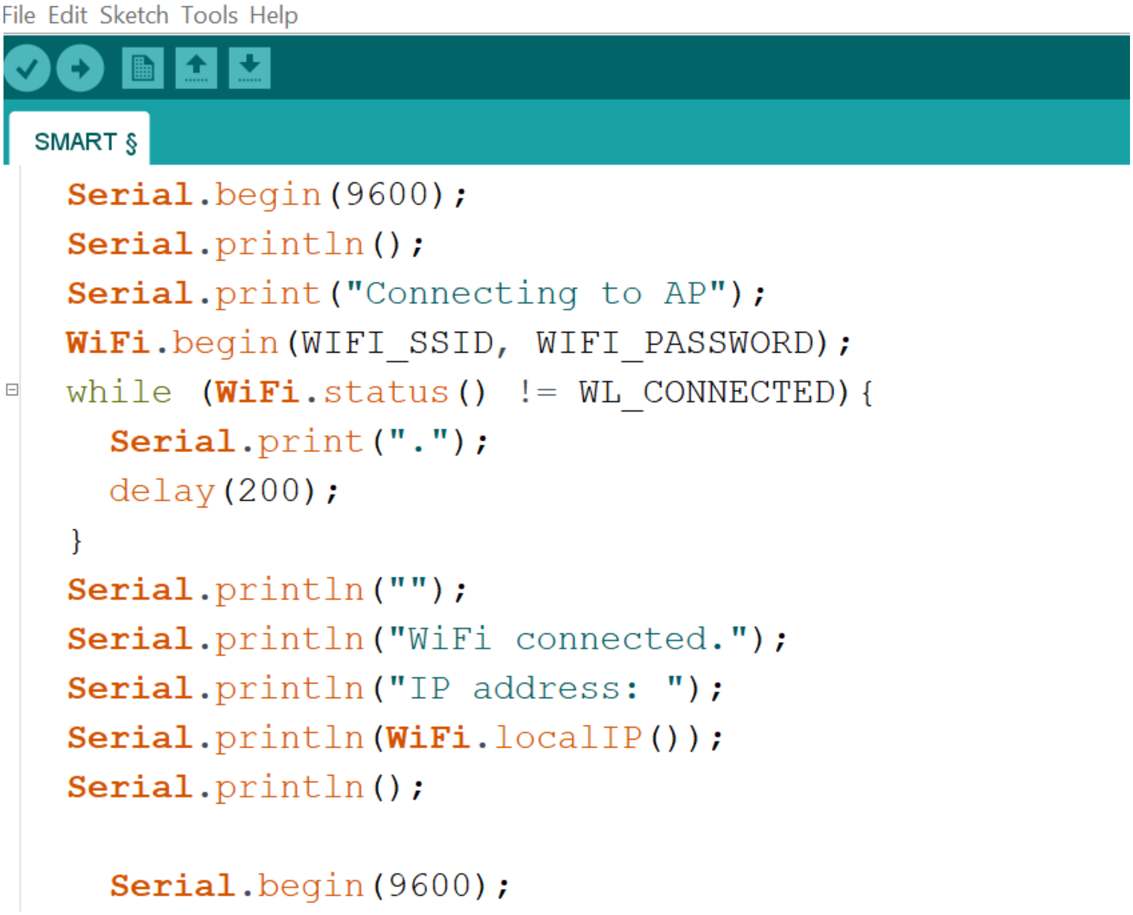
```
#include <Servo.h>
#include <ESP8266WiFi.h>
#include <ESP_Mail_Client.h>
#include <ESP8266WebServer.h>
#include<SoftwareSerial.h>
#include <DallasTemperature.h>
#include <OneWire.h>

String apiKey = "2G7OYCQVXYQ2BSQU";
#define WIFI_SSID "AYUSH"
#define WIFI_PASSWORD "05102007"
const char* server = "api.thingspeak.com";

WiFiClient client;
```



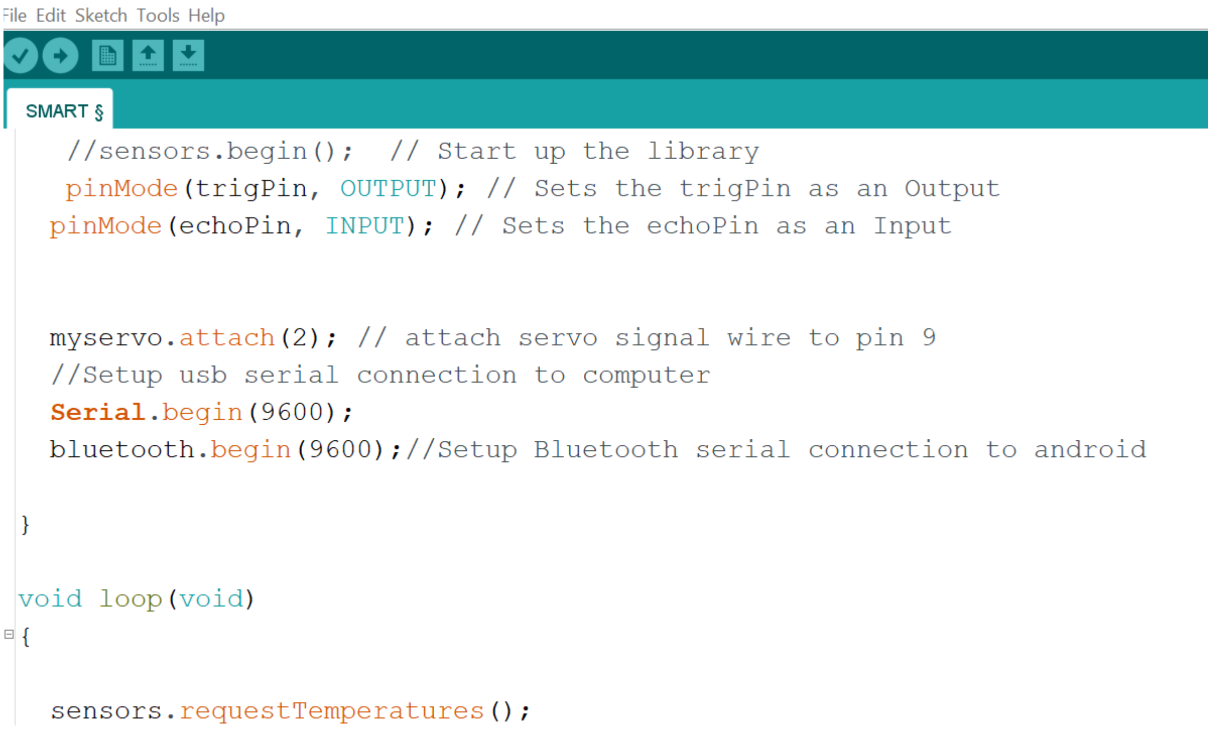
```
WiFiClient espClient;
Servo myservo;

int bluetoothTx = 01; // bluetooth tx to 10 pin
int bluetoothRx = 03; // bluetooth rx to 11 pin

SoftwareSerial bluetooth(bluetoothTx, bluetoothRx);


// Data wire is plugged TO GPIO 4
#define ONE_WIRE_BUS 4

// Setup a oneWire instance to communicate with any OneWire devices (not just Maxim/Dallas temperature ICs)
OneWire oneWire(ONE_WIRE_BUS);
```



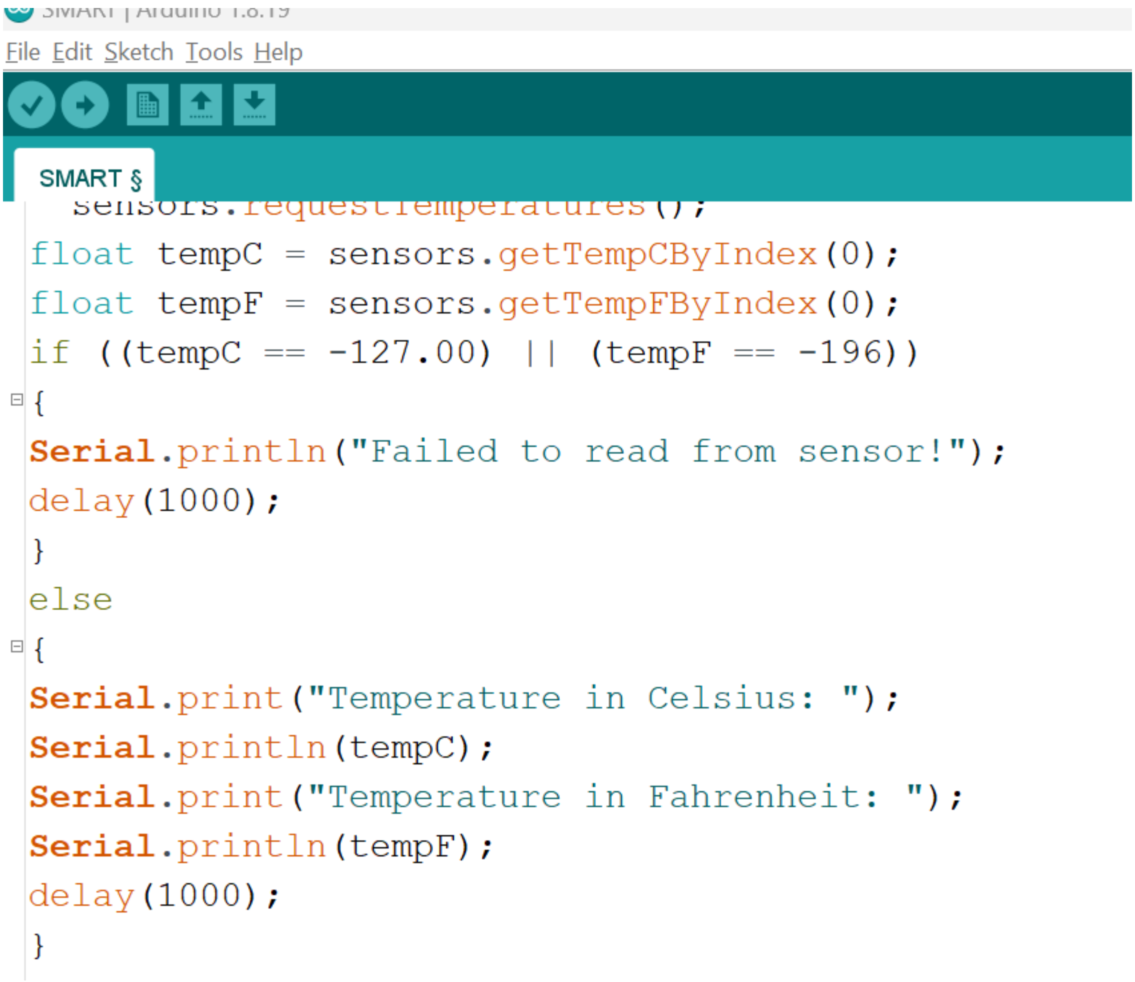
```
DallasTemperature sensors(&oneWire);

const int trigPin = 12;
const int echoPin = 14;

//define sound velocity in cm/uS
#define SOUND_VELOCITY 0.034

long duration;
float distanceCm;


void setup(void)
{

  Serial.begin(9600);
```



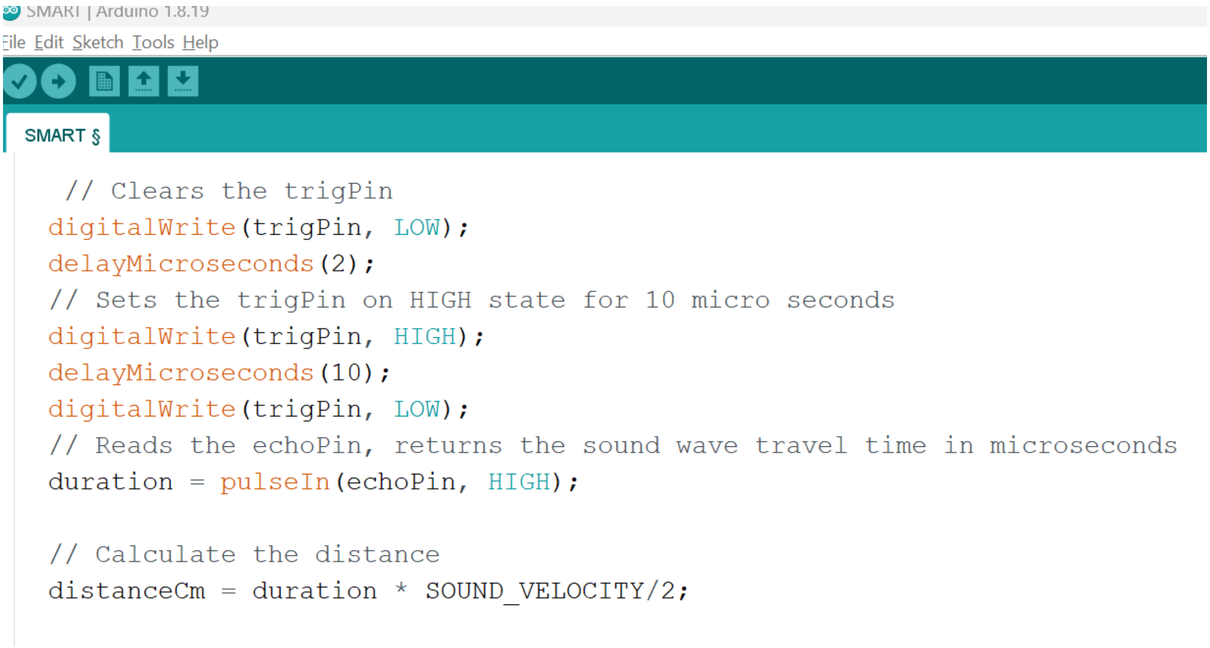
```
  Serial.begin(9600);
  Serial.println();
  Serial.print("Connecting to AP");
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED){
    Serial.print(".");
    delay(200);
  }
  Serial.println("");
  Serial.println("WiFi connected.");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.println();

    Serial.begin(9600);
```



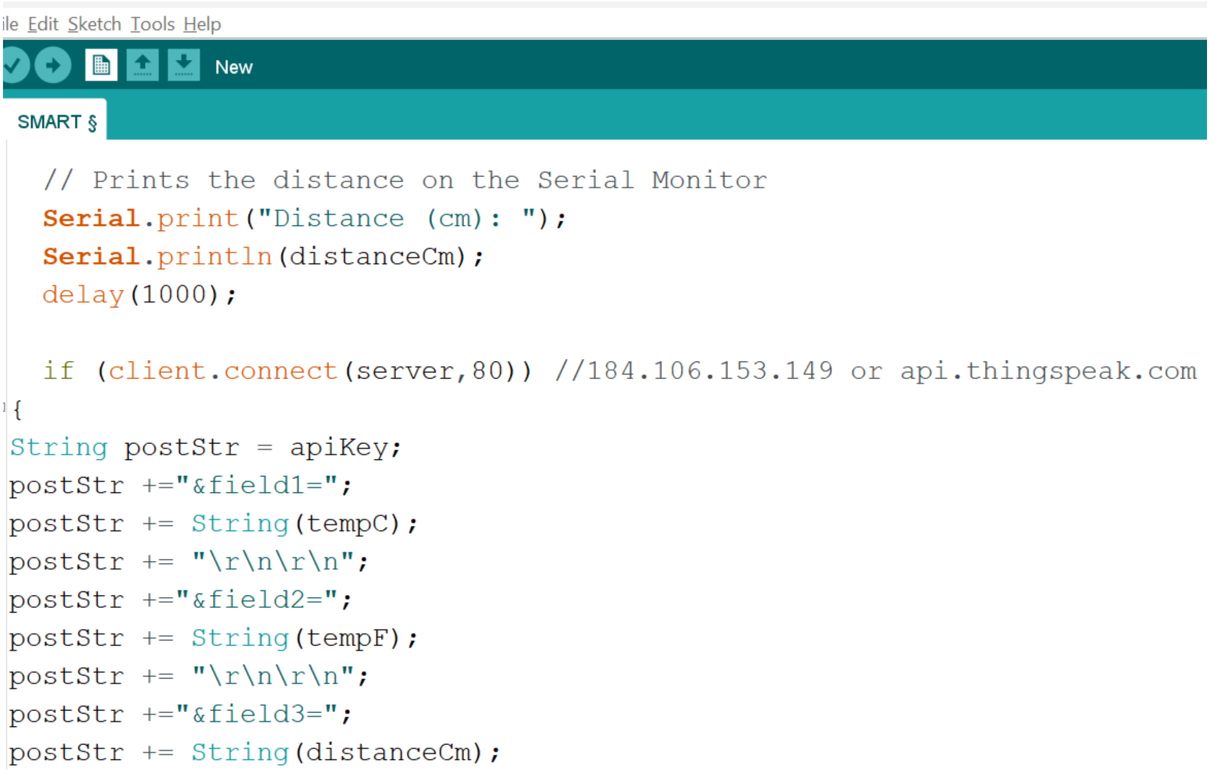
```
    //sensors.begin();  // Start up the library
    pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input


  myservo.attach(2); // attach servo signal wire to pin 9
  //Setup usb serial connection to computer
  Serial.begin(9600);
  bluetooth.begin(9600);//Setup Bluetooth serial connection to android

}

void loop(void)
{

  sensors.requestTemperatures();
```



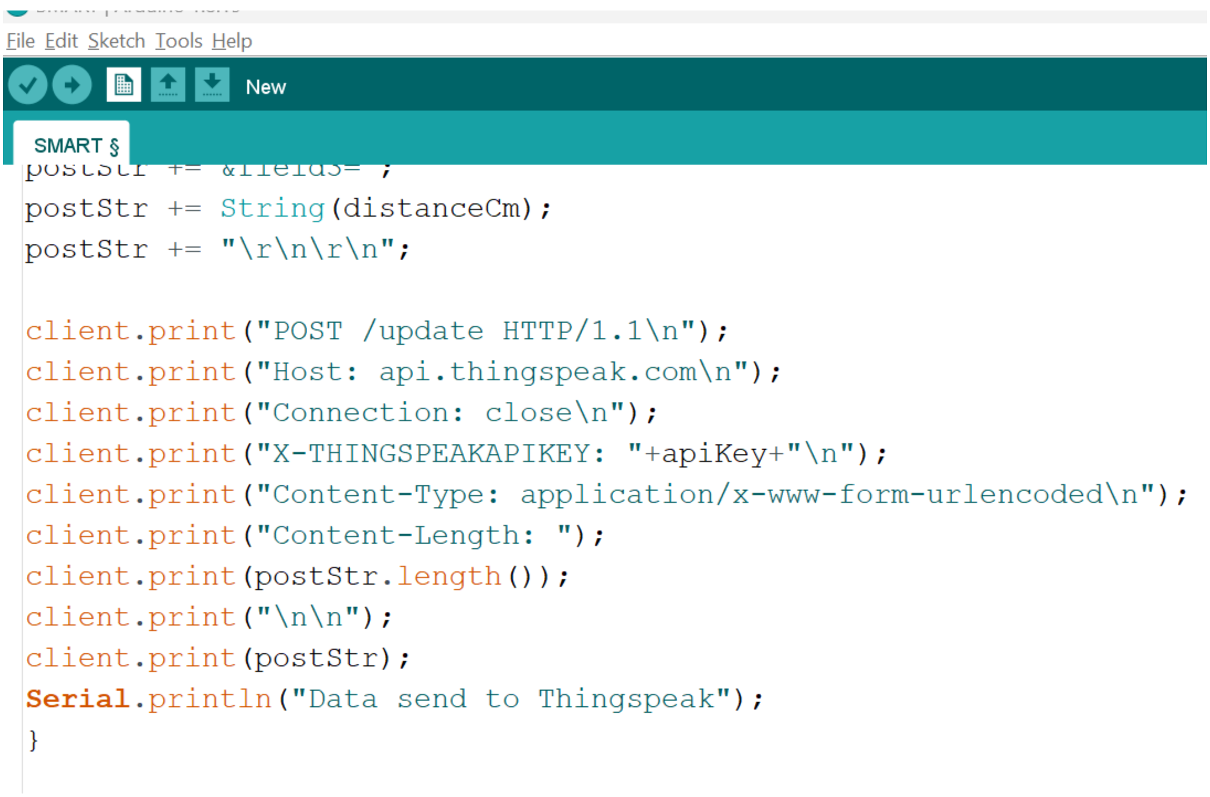
```
  sensors.requestTemperatures();
float tempC = sensors.getTempCByIndex(0);
float tempF = sensors.getTempFByIndex(0);
if ((tempC == -127.00) || (tempF == -196))
{
Serial.println("Failed to read from sensor!");
delay(1000);
}
else
{
Serial.print("Temperature in Celsius: ");
Serial.println(tempC);
Serial.print("Temperature in Fahrenheit: ");
Serial.println(tempF);
delay(1000);
}
```



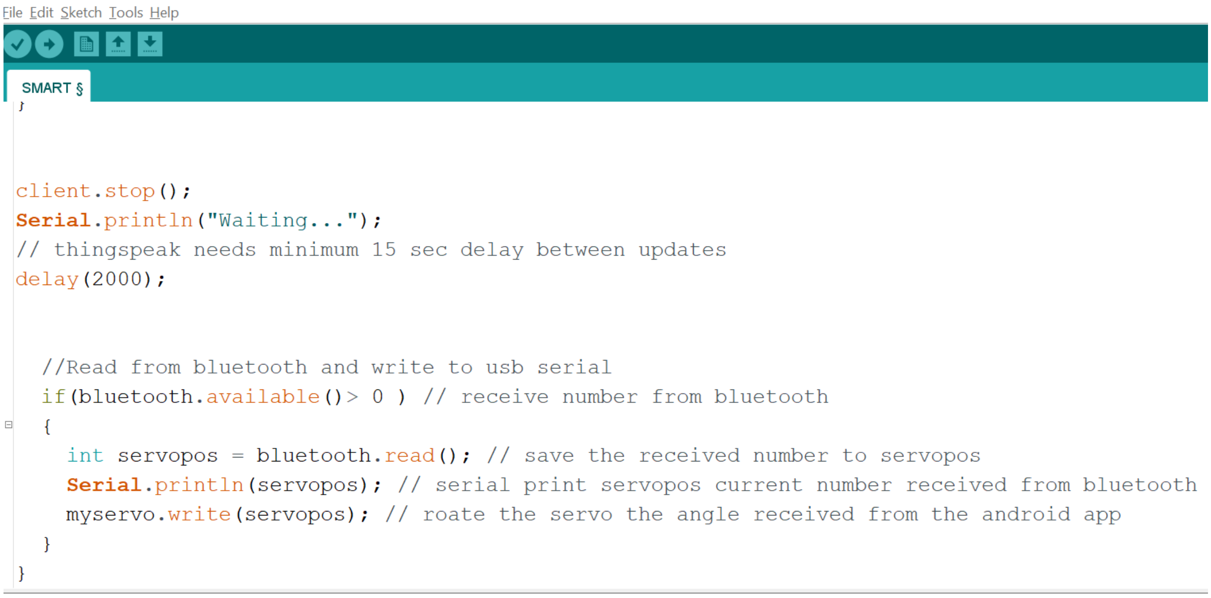
```
  // Clears the trigPin
 digitalWrite(trigPin, LOW);
 delayMicroseconds(2);
 // Sets the trigPin on HIGH state for 10 micro seconds
 digitalWrite(trigPin, HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin, LOW);
 // Reads the echoPin, returns the sound wave travel time in microseconds
 duration = pulseIn(echoPin, HIGH);

 // Calculate the distance
 distanceCm = duration * SOUND_VELOCITY/2;
```



```
  // Prints the distance on the Serial Monitor
  Serial.print("Distance (cm): ");
  Serial.println(distanceCm);
  delay(1000);

  if (client.connect(server,80)) //184.106.153.149 or api.thingspeak.com
{
String postStr = apiKey;
postStr +="&field1=";
postStr += String(tempC);
postStr += "\r\n\r\n";
postStr +="&field2=";
postStr += String(tempF);
postStr += "\r\n\r\n";
postStr +="&field3=";
postStr += String(distanceCm);
```



```
postStr += "&field3=";
postStr += String(distanceCm);
postStr += "\r\n\r\n";

client.print("POST /update HTTP/1.1\n");
client.print("Host: api.thingspeak.com\n");
client.print("Connection: close\n");
client.print("X-THINGSPEAKAPIKEY: "+apiKey+"\n");
client.print("Content-Type: application/x-www-form-urlencoded\n");
client.print("Content-Length: ");
client.print(postStr.length());
client.print("\n\n");
client.print(postStr);
Serial.println("Data send to Thingspeak");
}
```



```
}


client.stop();
Serial.println("Waiting...");
// thingspeak needs minimum 15 sec delay between updates
delay(2000);


  //Read from bluetooth and write to usb serial
  if(bluetooth.available()> 0 ) // receive number from bluetooth
  {
    int servopos = bluetooth.read(); // save the received number to servopos
    Serial.println(servopos); // serial print servopos current number received from bluetooth
    myservo.write(servopos); // roate the servo the angle received from the android app
  }
}
```

Code:

```
#include <Servo.h>

#include <ESP8266WiFi.h>

#include <ESP_Mail_Client.h>

#include <ESP8266WebServer.h>

#include<SoftwareSerial.h>

#include <DallasTemperature.h>

#include <OneWire.h>

String apiKey = "2G7OYCQVXYQ2BSQU";

#define WIFI_SSID "AYUSH"

#define WIFI_PASSWORD "05102007"

const char* server = "api.thingspeak.com";

WiFiClient client;

//#include <Servo.h>

WiFiClient espClient;

Servo myservo;

int bluetoothTx = 01; // bluetooth tx to 10 pin

int bluetoothRx = 03; // bluetooth rx to 11 pin

SoftwareSerial bluetooth(bluetoothTx, bluetoothRx);

// Data wire is plugged TO GPIO 4

#define ONE_WIRE_BUS 4
```

```
// Setup a oneWire instance to communicate with any OneWire devices (not just Maxim/Dallas temperature ICs)
OneWire oneWire(ONE_WIRE_BUS);
// Pass our oneWire reference to Dallas Temperature.
DallasTemperature sensors(&oneWire);
const int trigPin = 12;
const int echoPin = 14;
//define sound velocity in cm/uS
#define SOUND_VELOCITY 0.034
long duration;
float distanceCm;
void setup(void)
{
  Serial.begin(9600);
  Serial.println();
  Serial.print("Connecting to AP");
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED){
    Serial.print(".");
    delay(200);
  }
  Serial.println("");
  Serial.println("WiFi connected.");

  Serial.println("IP address: ");

  Serial.println(WiFi.localIP());

  Serial.println();

    Serial.begin(9600);

   //sensors.begin();  // Start up the library

   pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output

  pinMode(echoPin, INPUT); // Sets the echoPin as an Input

  myservo.attach(2); // attach servo signal wire to pin 9

  //Setup usb serial connection to computer

  Serial.begin(9600);

  bluetooth.begin(9600);//Setup Bluetooth serial connection to android

}

void loop(void)

{

  sensors.requestTemperatures();

float tempC = sensors.getTempCByIndex(0);

float tempF = sensors.getTempFByIndex(0);

if ((tempC == -127.00) || (tempF == -196))

{

Serial.println("Failed to read from sensor!");

delay(1000);
}
else
{
Serial.print("Temperature in Celsius: ");
Serial.println(tempC);
Serial.print("Temperature in Fahrenheit: ");
Serial.println(tempF);
delay(1000);
}
   // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculate the distance
  distanceCm = duration * SOUND_VELOCITY/2;
  // Prints the distance on the Serial Monitor
  Serial.print("Distance (cm): ");
  Serial.println(distanceCm);
  delay(1000);
  if (client.connect(server,80)) //184.106.153.149 or api.thingspeak.com
{
String postStr = apiKey;
postStr +="&field1=";
postStr += String(tempC);
postStr += "\r\n\r\n";
postStr +="&field2=";
postStr += String(tempF);
postStr += "\r\n\r\n";
postStr +="&field3=";
postStr += String(distanceCm);
postStr += "\r\n\r\n";
client.print("POST /update HTTP/1.1\n");
client.print("Host: api.thingspeak.com\n");
client.print("Connection: close\n");
client.print("X-THINGSPEAKAPIKEY: "+apiKey+"\n");
client.print("Content-Type: application/x-www-form-urlencoded\n");
client.print("Content-Length: ");
client.print(postStr.length());
client.print("\n\n");
client.print(postStr);
Serial.println("Data send to Thingspeak");
}
client.stop();
Serial.println("Waiting...");
// thingspeak needs minimum 15 sec delay between updates
delay(2000);
  //Read from bluetooth and write to usb serial
  if(bluetooth.available()> 0 ) // receive number from bluetooth
  {
    int servopos = bluetooth.read(); // save the received number to servopos
    Serial.println(servopos); // serial print servopos current number received from bluetooth
    myservo.write(servopos); // roate the servo the angle received from the android app
  }
}
```

5.3 Test Approaches

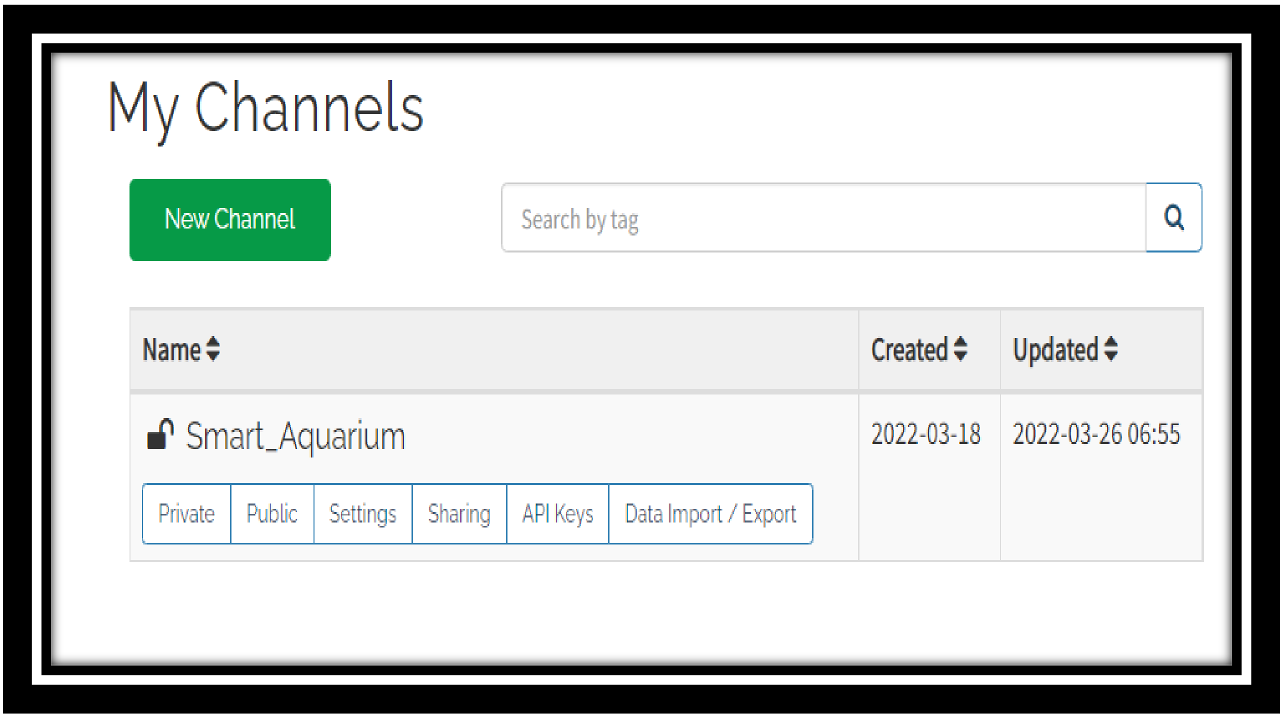
A test approach is the test methodology execution of a task, characterizes how testing would be completed. Test approach has two methods:

- Proactive - A methodology wherein the test configuration measure is started as right on time as conceivable to discover and fix the imperfections before the final product is made.

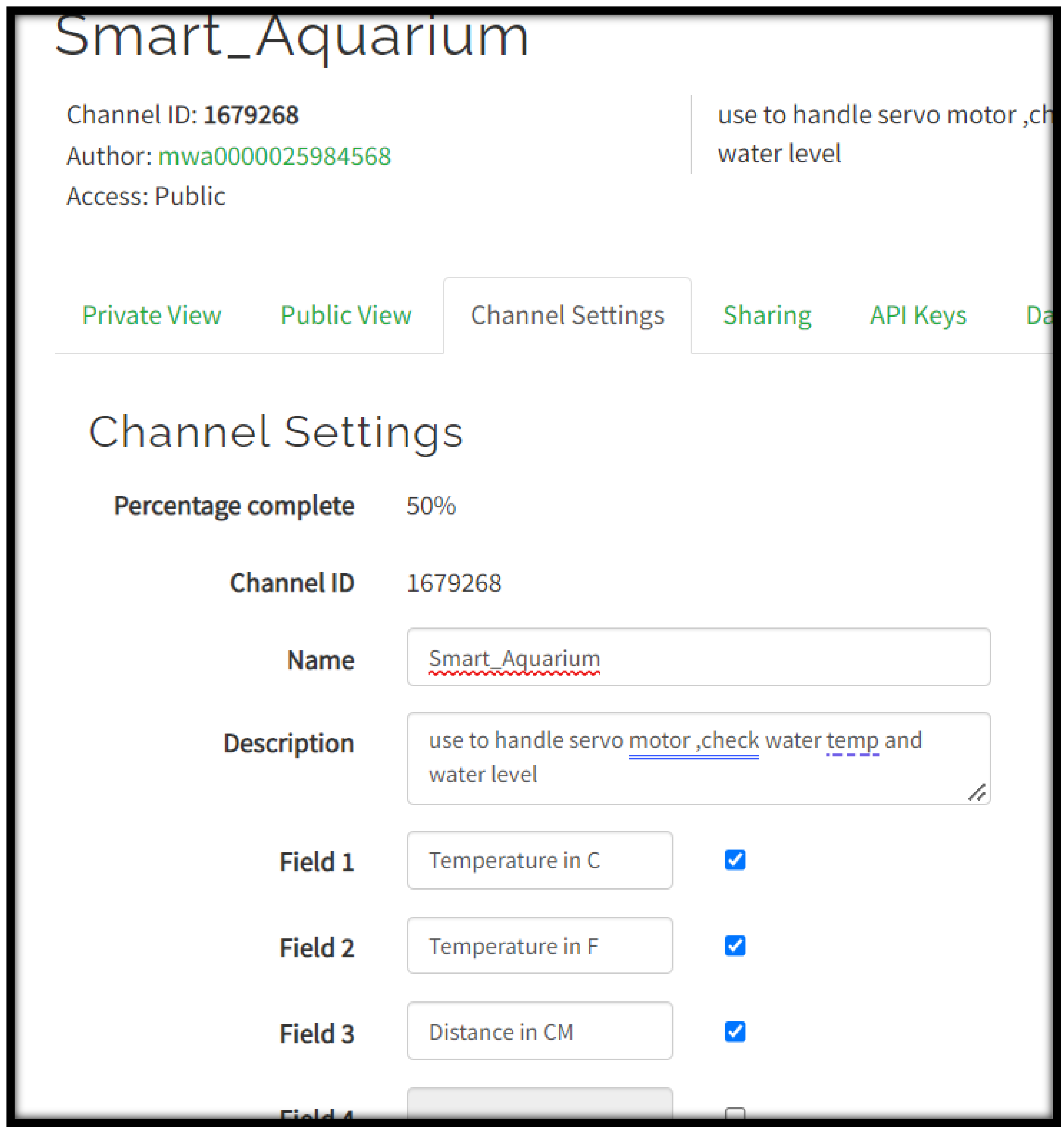
Reactive - A methodology where the testing isn't begun until plan and coding are finished

Chapter 6 : Results and Discussions

6.1 Outputs



Name	Created	Updated
Smart_Aquarium	2022-03-18	2022-03-26 06:55



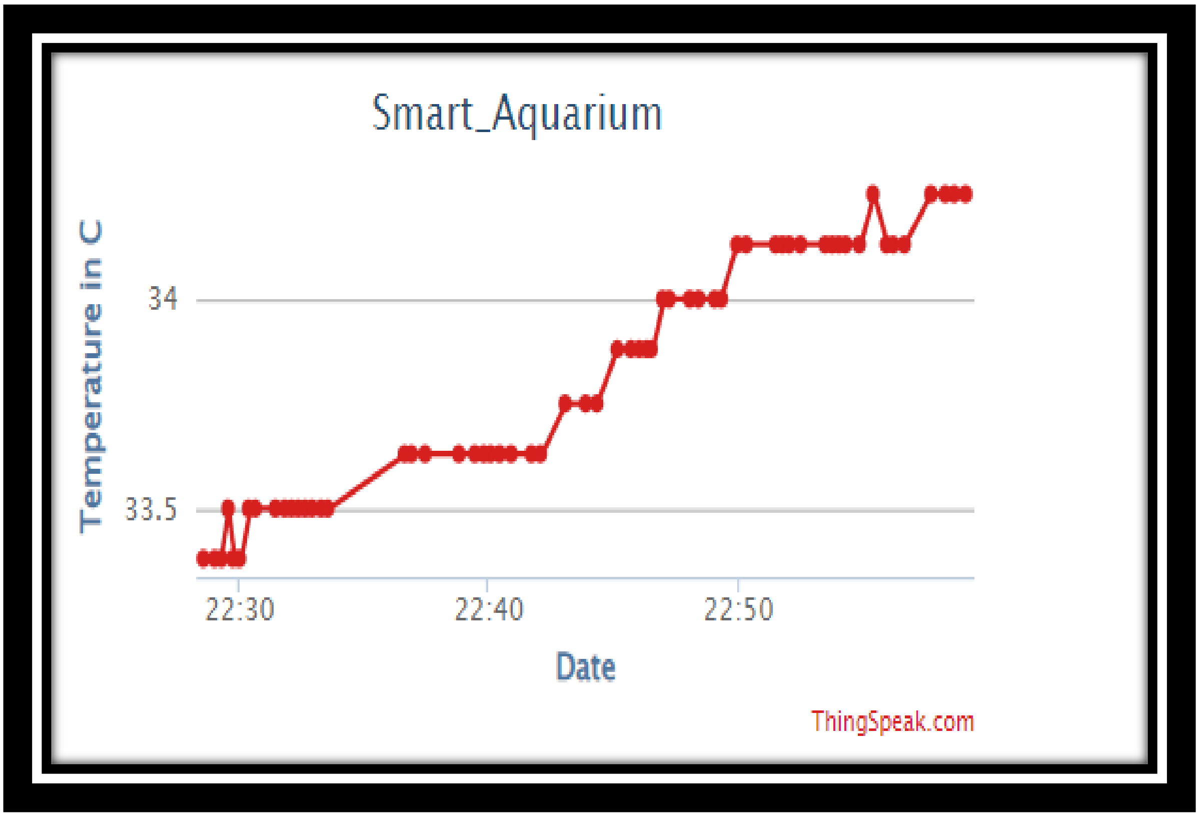
Smart_Aquarium

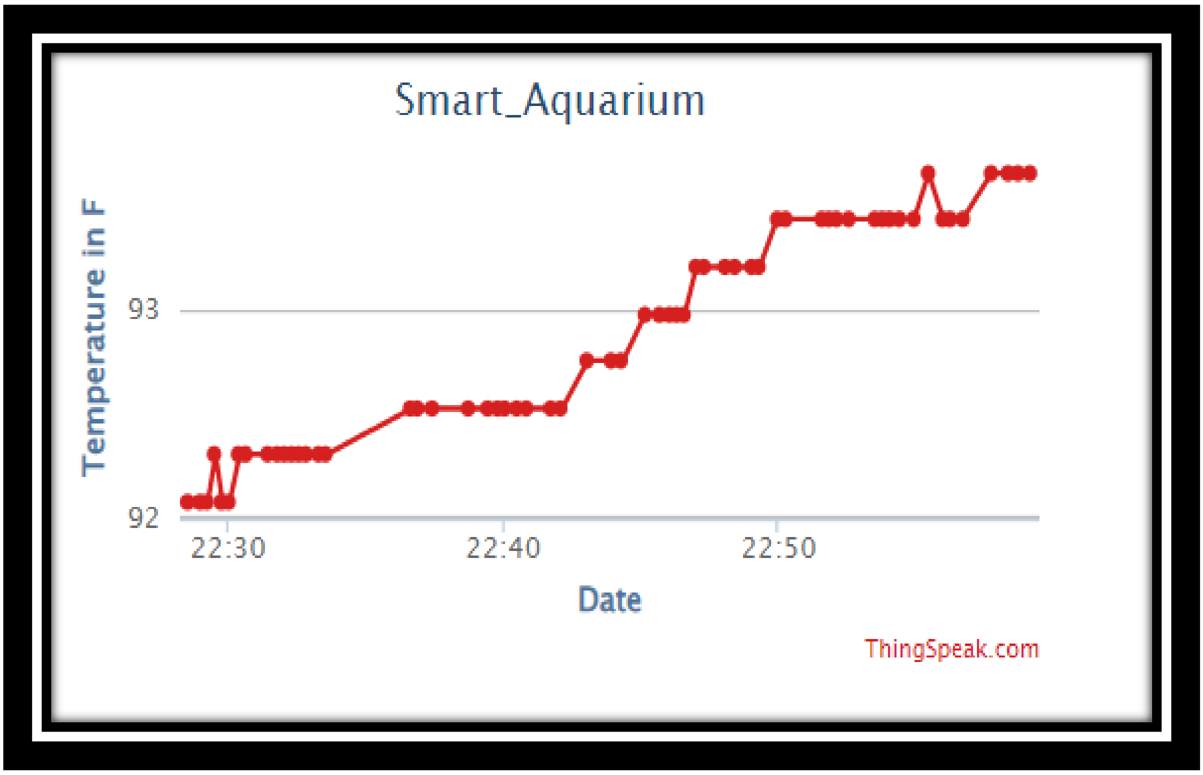
Channel ID: **1679268**
Author: mwa0000025984568
Access: Public

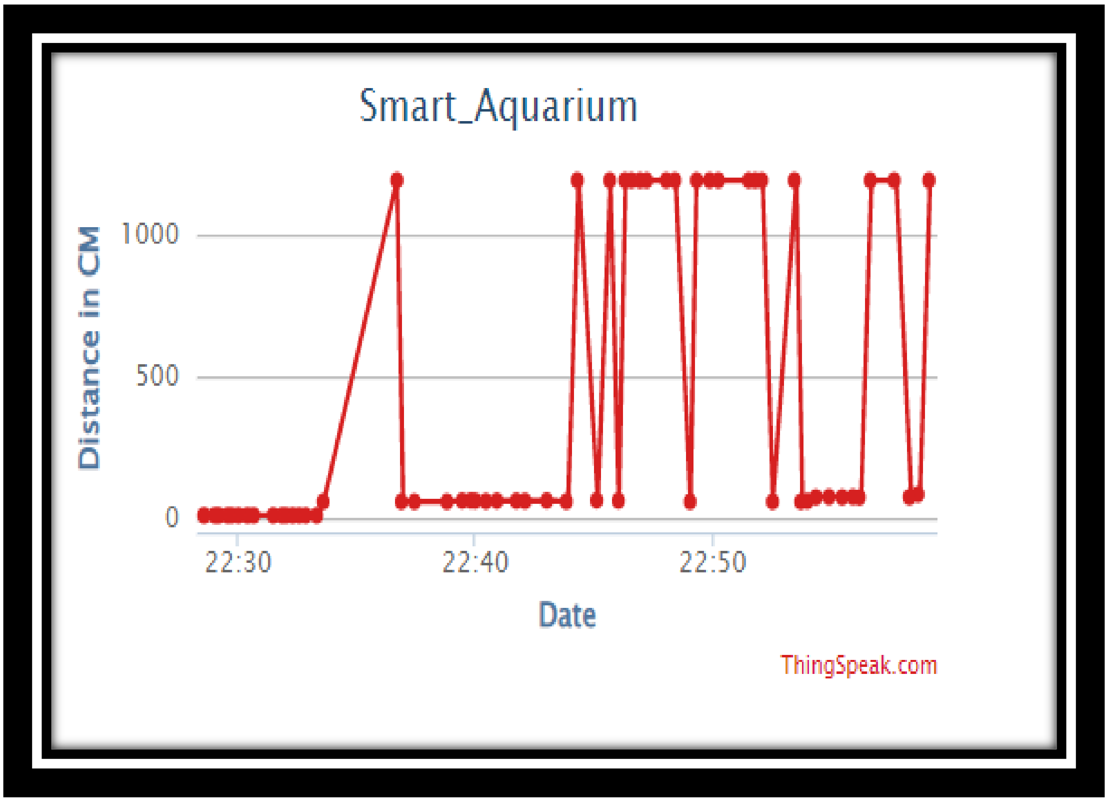
use to handle servo motor ,ch
water level

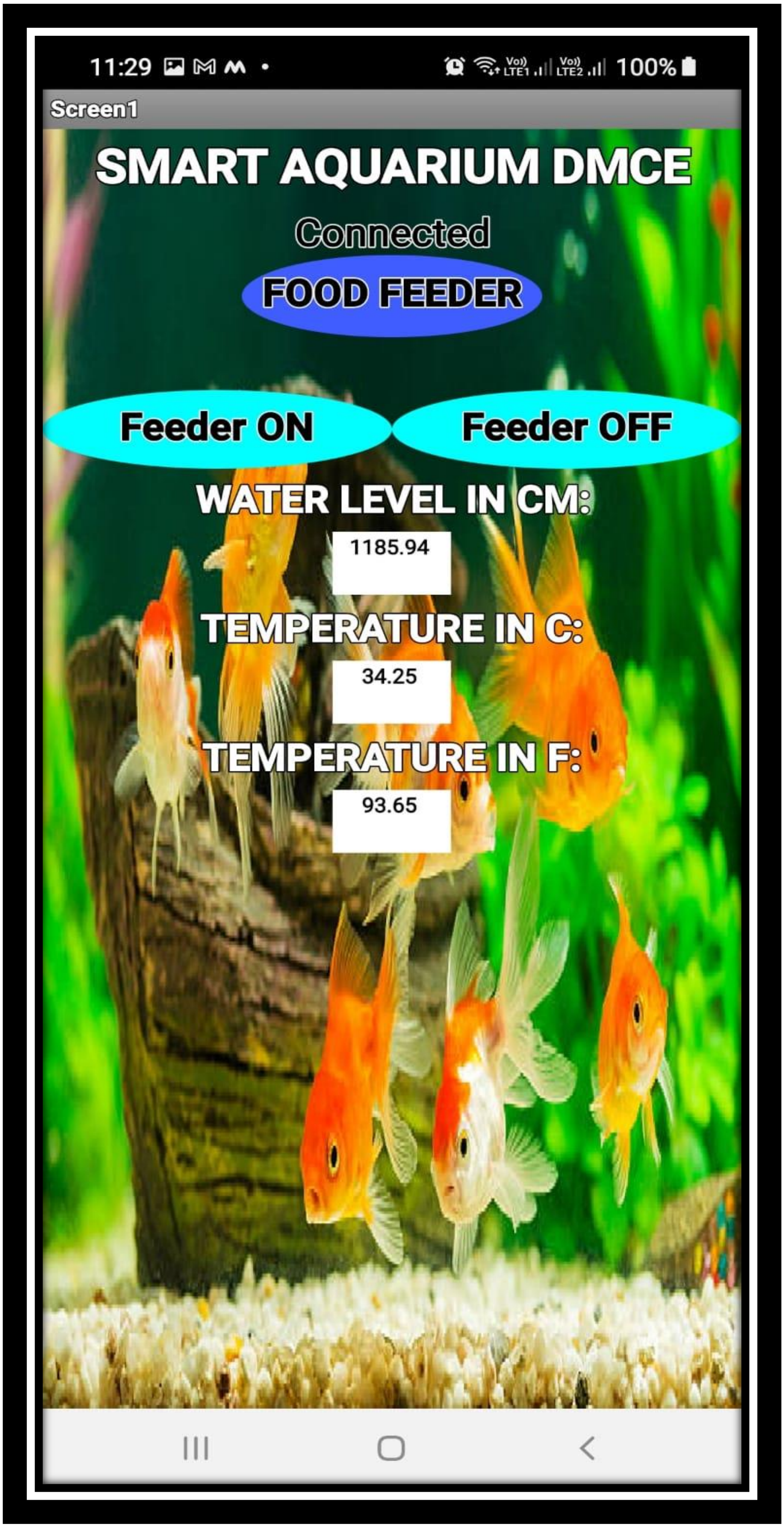
Channel Settings

Percentage complete	50%	
Channel ID	1679268	
Name	Smart_Aquarium	
Description	use to handle servo motor ,check water temp and water level	
Field 1	Temperature in C	☑
Field 2	Temperature in F	☑
Field 3	Distance in CM	☑
Field 4		□


Smart_Aquarium
Temperature in C
34
33.5
22:30
22:40
22:50
Date
ThingSpeak.com


Smart_Aquarium
Temperature in F
93
92
22:30
22:40
22:50
Date
ThingSpeak.com


Smart_Aquarium
Distance in CM
1000
500
0
22:30
22:40
22:50
Date
ThingSpeak.com



SMART AQUARIUM DMCE

Connected

WATER LEVEL IN CM:

1185.94

TEMPERATURE IN C:

34.25

TEMPERATURE IN F:

93.65

Chapter 7 : CONCLUSIONS

7.1 Conclusions

As we study and learn in future most used technology is Internet of things and smart aquarium is solves many issues caused by owners negligence. This project aims to reduce overfeeding problem and starvation problem, thus reduces chances of fish dying. Smart Aquarium being user friendly and also covering important features which are required for maintaining a aquarium reduces work of the user at a great extent. Many peoples who keep aquarium forget to do essential things that are must for fishes to survive like feeding, water changing. Thus our system does all of this work itself. Many fishes die due to low temperature thus use of temperature can notify the user about the current temperature and then in turn user can add up a heater to the aquarium.

7.2 Future Scope of the Project

The current project i.e Smart Aquarium can easily perform the features like fish feeding using servo motor, water level sensor using ultrasonic sensor and temperature of the aquarium using temperature sensor. It can be made a total smart aquarium in future. The smart aquarium has a great future scope as we can implement such a system which not only has the above mentioned features but also comprises of automatic water changing. For making it a total smart aquarium we have to design the tank in such a way that it has outlet for water to pass out and also to get fresh water in.

In future we can also add ph level sensor to it which determines ph level of the water. Some specific breed of aquatic animals require a proper ph level and salinity of the water to be maintained. Mostly for the sea water fishes if kept in aquarium ph feature can be utilized at its best. We can also implement a mechanism which turns on the aquarium heater when temperature of the aquarium water reduces in winter. And also to make future project more eye catching we can add up light and water filter control through android app. Also another servo motor can be used to drop medicines for fishes for white spots, fungus,tail and finrot. Thus our system had great future scope ahead and can include most of the features that make it total smart aquarium.

Chapter 8 : References

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- SakshiNirwan, RaginiSwarnakar, ArunaJayarajan and Prakruti Shah.” The Developement of Automatic Fish Feeder System using Arduino UNO”. International Journal of Modern Trends in Engineering and Research (IJMTER)Volume 04, Issue 7, July– 2017.
- W Fang and C.M Chang. “Development of an automatic feeder with the capability of knowing when to stop feeding”. Proceedings of the Annual International Conference and Exposition of the World Aquaculture society, Australia, 26 April–2 May, 251, 1991.

Chapter 9 :WEBSITE USED

https://thingspeak.com/channels/1679268/charts/3?bgcolor=%23ffffff&color=%23d62020&dynamic=true&results=60&type=line&update=15

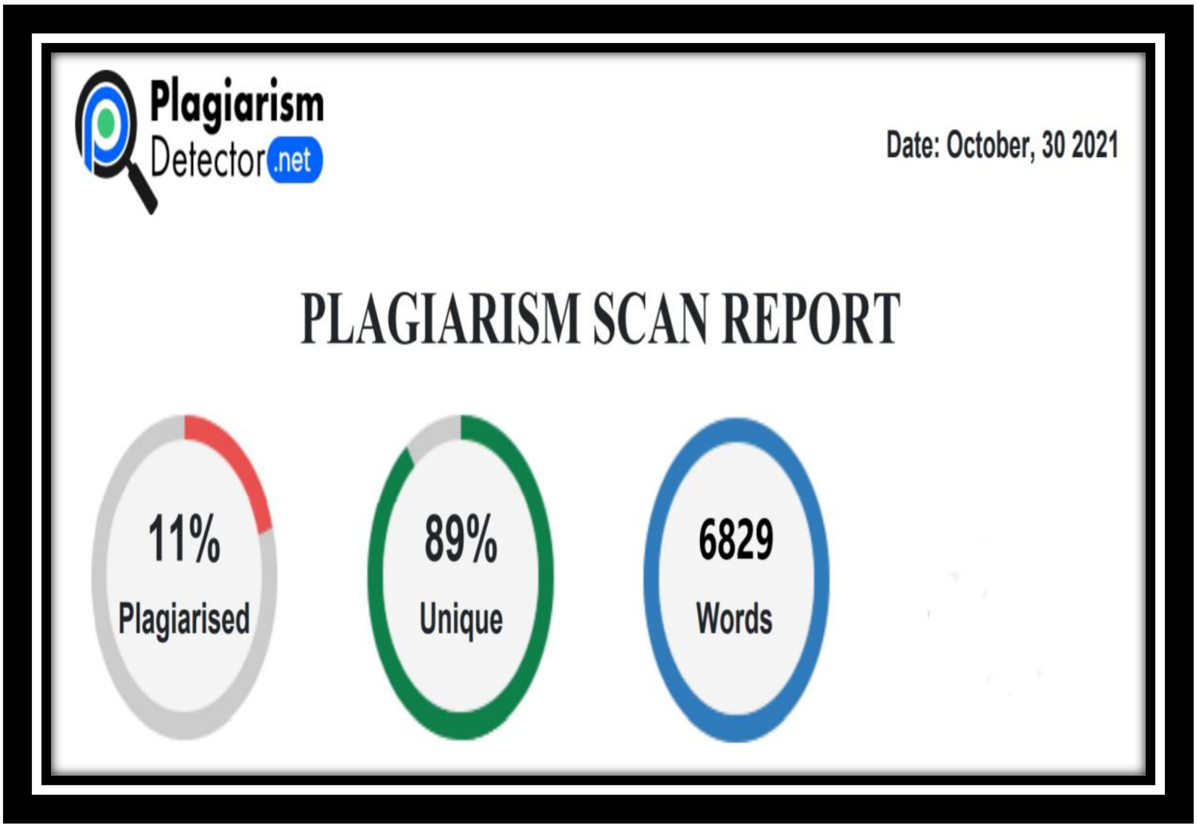
https://www.google.com/search?q=mit+app+inventor&rlz=1C1CHBD_enIN938IN938&oq=&aqs=chrome.0.35i39i362l8.146627j0j7&sourceid=chrome&ie=UTF-8

https://roboindia.com/tutorials/ds18b20-temp-sensor-nodemcu/

Chapter 10 :Summary

As we study and learn in future most used technology is Internet of things and smart aquarium is solving many issues caused by owners’ negligence. This project aims to reduce overfeeding problem and starvation problem, thus reduces chances of fish dying. Smart Aquarium being user friendly and covering important features which are required for maintaining an aquarium reduces work of the user at a great extent. Many peoples who keep aquarium forget to do essential things that are must for fishes to survive like feeding, water changing. Thus, our system does all this work itself. Many fishes die due to low temperature thus use of temperature can notify the user about the current temperature and then in turn user can add up a heater to the aquarium.

Chapter 11 : Plagiarism



Date: October, 30 2021

PLAGIARISM SCAN REPORT

Figure 23: PLAGIARISM Diagram