Auto Aqua-the Smart Aquatic Feeder Revolutionizing Fish Feeding

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Declaration

This to certify that the thesis work entitled "**[Auto Aqua-the Smart Aquatic Feeder Revolutionizing Fish Feeding]**" has been carried out by **[Afia Anjum, Zinia Binte Jamal, Farjana Sultana Rafi]** in the Department of Computer Science and Engineering (CSE), University of Information Technology and Sciences (UITS), Dhaka, Bangladesh. The above thesis work or any part of this work has not been submitted anywhere for the award of any degree or diploma.

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Abstraction

Most fish keepers are preoccupied with the day-to-day duties of feeding their fish and keeping the aquarium's water clean. For the fish tank to have the best possible care, continuous monitoring and upkeep are required. The purpose of the IOT-based Automatic fish feeder prototype that is being presented in this study is to produce an affordable and user-friendly fish-rearing system.

The "Auto Aqua: Smart Aquatic Feeder" project is a suggestion that has been developed to make it simple to operate and include all the characteristics necessary for raising healthy fish. An ESP32 is used to store and transmit sensor data to the Blynk app. The Arduino Uno manages sensors, and Blynk facilitates fish-feeding commands. It is not yet possible to use the Blynk app to change the feeding schedule. This research intends to expand the project in the future, perhaps implementing the system in a fish farm or pond.

[**Keywords**: Preoccupied, Automatic, Esp32, Blynk, implementing]

Preface

This BSc thesis is outlined based on the results obtained from the laboratory experiment. This is carried out in the Department of Computer Science and Engineering (CSE), Faculty of Engineering, at the University of Information Technology and Sciences (UITS), Dhaka, Bangladesh.

This thesis delves into a detailed discussion of the automated fish-feeding system project. It consists of five main chapters that aim to describe and explain the project:

Chapter-1

Chapter 1, the Introduction, provides details about the introduction, motivation, challenges, objectives, contribution, and thesis outline of the automated fish feeding system.

Chapter-2

Chapter 2, the Literature Review, illustrates the progress of related studies, fundamental theories and professional inventions.

Chapter-3

Chapter 3, the Methodology, reveals the project's objective and discusses each criterion of the project. The required materials and components used in this project are also revealed.

Chapter-4

Chapter 4, the Results and Analysis, presents the final performance of the feeding system. The projection problems encountered during this project are also discussed in this thesis.

Chapter-5

Chapter 5, the Conclusion and Future Work, concludes the project and suggests improvements that will be made in the future.

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Abbreviations and Symbols

CSE	Computer Science and Engineering
BSc	Bachelor of Science
IOT	Internet of Things

CHAPTER 1

Introduction

1.1 Introduction

The digital era is constantly evolving, and the Internet of Things (IoT) is one of the trends that's changing the way we interact with our world. IoT is all about connecting physical devices, sensors, and computing systems through the internet to enable efficient data exchange and control. It's a concept that's been applied in many sectors of life, including agriculture and animal care, where it's being used to great effect. The Internet of Things (IoT) technology is widely employed in a variety of applications in almost every aspect of life because it is a detailed model of environmental connection. It is an exciting new development in technology that will change the way we live our lives. With billions of intelligent devices communicating with each other, we can expect to see a world that is more connected and more efficient than ever before. In just a few years, we will have smarter homes, offices, transportation systems, hospitals, enterprises, and factories. The potential of IoT is incredible, and it will undoubtedly improve the quality of our daily lives. Furthermore, these advancements will help to reduce our ecological impact on the planet, which is essential for the future of our world.

IoT in fisheries revolutionizes management by monitoring vessel activity, preventing overfishing, and reducing bycatch. Real-time fish data aids precision fishing, while monitoring water quality ensures marine health. Advanced tech like Autonomous Aquaculture Feeding Systems and computer vision for feed optimization boost efficiency by 10% or more, promising lower costs and higher yields.

Fishkeeping is a hobby that has been enjoyed by many people for a long time. One of the reasons why it is so popular is because it is relatively easy to care for. Many people want to keep fish as pets, and that's why aquariums have become so popular. However, it's important to remember that fish need to be fed regularly if they are going to stay healthy. This can be a challenge for many people who are busy with other activities. To help with this, there are automatic feeding tools that can be used to ensure that fish are getting the nutrients they need. It's also important to monitor the aquarium regularly to ensure that the fish are getting the right amount of food and that the water is properly fertilized. By taking these steps, they can help ensure that their fish are healthy and happy for years to come.

Food is an essential element for the growth and productivity of fish. However, the management of feeding is one of the main challenges that fish owners face. It is an unhealthy practice to leave extra food in the tank before the owner's absence, as it may cause overfeeding of the fish. Overfeeding can ultimately lead to the death of the fish. Additionally, the food decomposes in the water, releasing proteins and nitrites, which reduces the amount of oxygen in the water, thereby posing a potential threat to the life of fish. It is vital to note that fish have a specific feeding schedule of once per day every day, making it difficult for the fish owner to be away from home.

Therefore, there is a need for an automated device that can reliably feed the fish. An automatic fish feeder might be used to provide proper, timely feeding at predetermined intervals while also monitoring and maintaining the environment appropriately. The installation of such an automatic fish feeder not only ensures that the fish are well-fed but also protects the aquatic life from potential harm. Moreover, an alert will be issued whenever the temperature of the water falls below the minimum. This feature will enable fish owners to be notified instantly when any potential danger arises, thus ensuring the safety of the fish. This technology allows fish owners who are away from their aquarium or pond for prolonged periods to stay informed about their aquaculture regularly. In summary, the installation of an automatic fish feeder provides a reliable, safe, and efficient method of ensuring the well-being of fish and promoting successful aquaculture practices.

Here, we designed automatic fish feeding using the NodeMCU ESP32 microcontroller, which has been integrated with an IoT-based Wi-Fi module. In this research, IoT and Blynk app were used because we can make it easier for the aquarium owner to monitor from the Blynk application without having to check the aquarium first. With a system like this, the aquarium owner can monitor the remaining fish feed in the feed container, the water level and temperature if the owner is not at home, the results obtained from this device are that the device works well and helps the aquarium owner to monitor and feed efficiently, despite some challenges such as a delay due to poor internet connection.

1.2 Motivation

Ornamental aquarium fish are kept in aquariums by many individuals in both large and small cities throughout daily life. Since that time, the majority of people are now engaged in raising fish as a pastime. Some individuals want to preserve it because it is easy to maintain. The timing of feeding must be taken into consideration because fish stored in aquariums need to be fed often. However, for many fish owners, it won't be simple to monitor the fish's diet if no one is home. Because this will upset the requirement for fish feed. After considering these issues we determined to make an automated fish feeder system so that people can take care of their fish without being at home.

1.3 Challenges

Automated fish feeding with IoT sensors & Blynk app show promise for aquaculture. Hardware selection is crucial to meet needs & address issues for researchers. Designing a reliable & efficient system should consider power usage, data communication & error handling.

Technical Challenges:

- Enhance calibration, mitigate interference and validate data for accurate fish feeding and health monitoring.
- Sensor data needs advanced processing for timely feeding and fish health interventions.
- The Blynk app monitors and controls automated fish-feeding systems in real-time.

Operational Challenges:

- Automated fish-feeding systems must modify feeding to match diverse fish needs and environments.
- Monitoring fish behavior, water quality, and feeding patterns is vital to detect health issues.
- Make automated fish-feeding systems easy to maintain, troubleshoot, and remotely diagnose for reliability.

Economic Challenges:

- The cost of automated fish-feeding systems components needs optimization for small-scale fish farms.
- Automated fish-feeding systems need clear economic benefits to justify investment.
- Policies, subsidies and training can encourage the adoption of automated fish-feeding systems.

Despite these challenges, research and development for automated fish-feeding systems can transform aquaculture, leading to better fish health, higher productivity, and sustainable seafood.

1.4 Objective

The primary goal of this initiative is to:

- To create and improve structural fish feeders for aquariums, particularly useful when the owners are not at home.

- To keep the user informed while monitoring the aquarium's environment.

- To provide feeding at the right schedule and amount of food.

1.5 Contribution

- Build low-cost System.
- Used waterproof ultrasonic sensor to detect the movement of fish.
- Used turbidity sensor to purify water and cloudiness.

The IoT-based automatic fish feeder helps fish owners feed their fish remotely. It monitors the feed in the container, water level, and temperature, sending alerts when necessary. There's a delay feature to set a time for feeding. It's a reliable way to feed fish, especially when owners are away for long periods. The IoT-based automatic fish feeder helps fish owners feed their fish remotely. It monitors the feed in the container, water level, and temperature, sending alerts when necessary. There's a delay feature to set a time for feeding. It's a reliable way to feed fish, especially when owners are away for long periods.

CHAPTER 2

Literature Review

The concept of smart fish feeders represents a significant advancement in the field of aquaculture and pisciculture, offering innovative solutions to enhance fish farming practices. These automated feeding systems, equipped with various sensors and technologies, aim to optimize the feeding process, improve fish health, and maximize production efficiency Smart fish feeders use automation and sensors to enhance fish feeding, health, and production efficiency, meeting global seafood demand. Feeding methods: manual, semi-auto, auto (electric, hydraulic, pneumatic). Approach: mobile or static.

In 2023, Dewantaraet at. [1] introduced fish feeding through Telegram. Their system supported scheduling and immediate feeding shown in Figure 1. They can't identify the temperature of water which is also very important for fish. Aquarium fish cannot survive in dirty water. They could detect the turbidity of the water through the turbidity sensor.

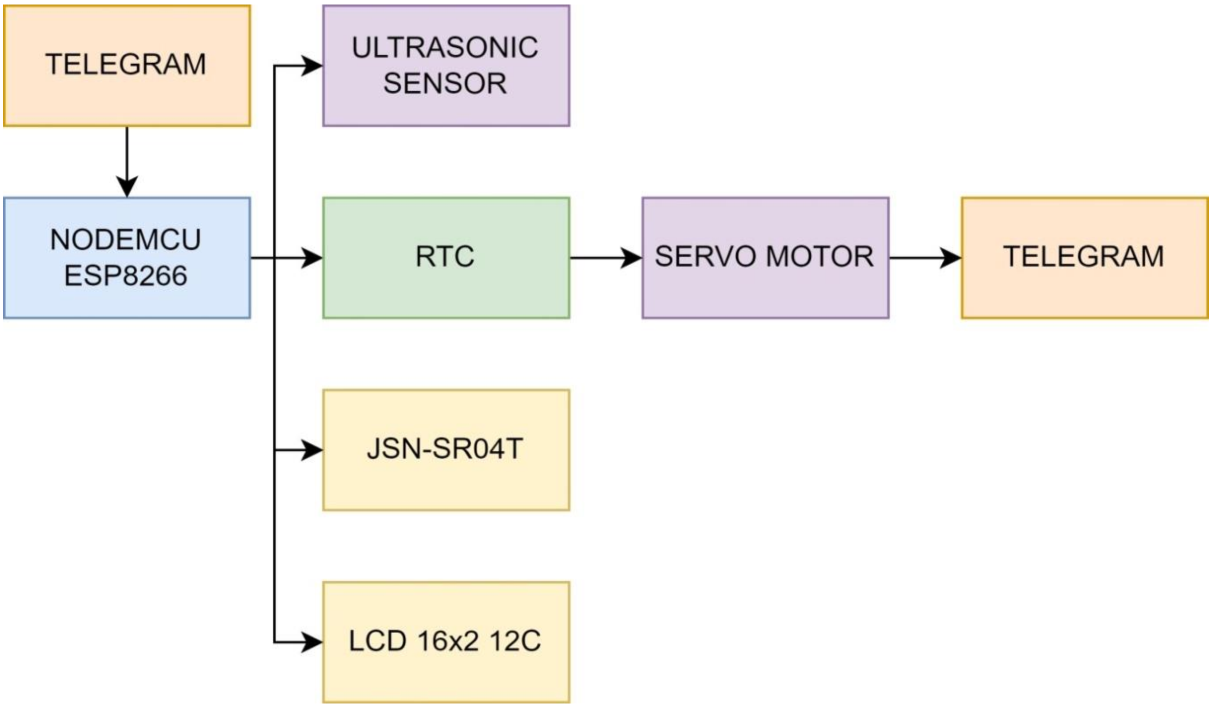


Figure 1: Wiring design of Telegram Based Aquarium Water Level Monitoring

A system for fish feeding was introduced in [2] with focus on energy efficiency and fish welfare. Hey implemented a scheduled feeding system to ensure that the fish received their meals regularly and consistently. One notable limitation was the absence of a wireless connection that would allow remote access and control of the system. Researcher Loo [3] developed an IoT-controlled self-sustaining aquarium system. It managed feeding, monitored water quality, pH, and temperature, with an app . Here they don't use sensors to see fish movement. A model was proposed for supplying food to the fish that was designed in [4]. To enable remote control of the device from anywhere in the world, the researchers created an interface showing in the Figure 2. The research found issues with the transfer mechanism, challenges in quantifying water filtration effectiveness, and a lack of manual control.

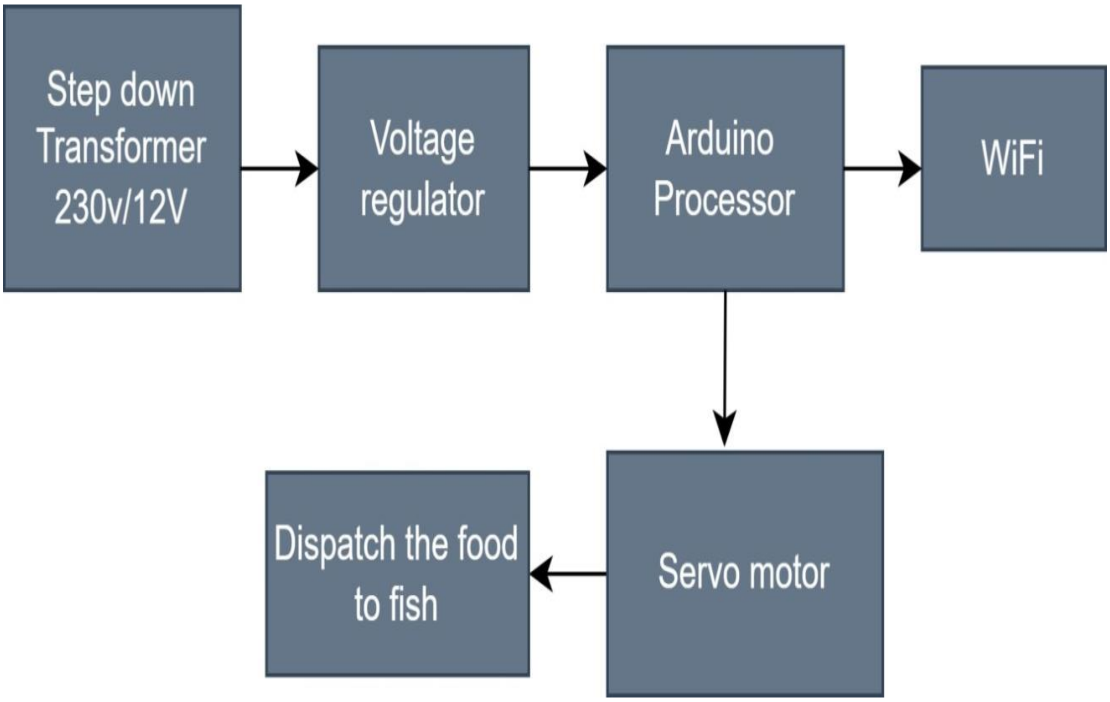


Figure 2: IoT Based Fish Food Dispenser.

Authors [5], presented a system by measuring several variables and utilizing the data to regulate fish growth. In every fish pond had five sensors in each pond and three environmental sensors are used by two fuzzy controllers to regulate the environment and the water quality in the ponds. This paper is in related work because our future work is to work on pond size as well.

A fish feeding methods prototyping techniques and the system development life cycle in the area of software development was proposed by Nelly et al. [6]. Their tool for fish growers was used, and the results showed a 45% increase in production output with an average efficacy in terms of costs and a 25% average improvement in production yields. A special method for fish feeding system was presented by Shaikh et al [7]. It monitored the water's pH level, turbidity, and temperature while also detecting fish eating. An IoT-based system was implemented to keep track of the aquarium's condition and transmit updates to the user's web application.

In 2023, Arvin et al. [8] suggested crustacean cultivation in the Philippines based on water pH and temperature analysis. Combined aquaculture with IoT and a smartphone app for data and recommendations, improving meat production in fishponds. Author et al. [9] implemented mobile App that shows feed and tank levels, temperature, linked to ESP8266 via Firebase. In 2022, an updated fish feeder implemented focuses of this study was the supervision of vital water parameters, such as pH, turbidity, and temperature [10]. These design would have been efficient if they had used an ultra-sonic sensor. Authors of [11], developed a mobile application-based method for autonomously feeding fish. The application provided alerts when the pH level of the water deviated from the desired range. The study found that the system's effectiveness had an average value of 4.16.

In 2019, Cheng et al. [12] utilized Arduino and esp8266-12E for temperature and water quality monitoring. The mobile app-controlled light, water changes, and feeding with cloud settings, while sensors displayed data on an LCD screen. They are not use Ph sensor. This limitation was overcome by the authors et al [13] in 2020.wth ta similar features a system was designed in [14].The test findings show that there is an average discrepancy of 0.66% between the pH sensor and pH metro readings, and an average difference of 2.588% between the TDS sensor and TDS meter readings. With a mere 1% mistake rate, the system has demonstrated its ability to autonomously supply fish feed on a predetermined timetable. In 2020, Bin et al. [15] implemented pH and ultrasonic sensor. Water turbidity and temperature are very important for fish. So here they could bring more improvement if they use their end temperature sensor.

In 2020, an automated aquarium system was developed for marine life in aquariums in [16]. This system can measure the level of water pollution, display the results on a webpage indicating whether the water quality is good or bad, and automatically clean the polluted water by filtering it. Shweta et al. [17] implied the design where user of this system can program the solenoid valve to feed the fish on a timetable, and the relay time to change the water. Additionally, sending an SMS to the feeder system controller makes controlling the feeding mechanism simple. Albert et al. [18],created a system that can intelligently feed the fish, automatically check the quality of the water, and interact with the user via an Android app. The suggested system is neither validated nor given any experimental findings in this research. In 2020 another study suggested an IoT-based smart aquarium prototype with NodeMCU and Arduino MEGA controllers for smartphone-controlled fish feeding and pH monitoring. It aimed to maintain optimal pH levels for specific fish types and the result is shown on a liquid crystal display (LCD) [19].

In 2021, Murizah et al. [20], proposed a prototype with NodeMCU ESP8266 uses sensors for food measurement and quality. Servo motors and sensors detect fish presence, temperature, food quality, and quantity, with data displayed on Thing Speak and collected via Blynk. Another automatic fish feeder was developed using a real-time clock (RTC) by Shafie et al.[21] to install all written programs that provide instructions to run this system automatically. An RTC computer clock uses the current time to set the real-time an LCD to indicate the real-time and when the food should be released, and an LED indicator to show how much food is in the container shown in Figure 3.

Figure 3: Block diagram of an automatic fish feeder using Real Time Clock (RTC).

In 2015, an automated wireless sensor network monitoring system was created which was set up for a fish farm environment simulation. This monitoring system includes modules for measuring temperature, pH, and water level. Capturing the physical sensing signal involves MCU processing. A central processing center receives the data from the ZigBee wireless sensor network. This system was implemented by, Chen et al.[22] In 2019,Abdullah et al.[23] proposed in addition to feeding fish automatically at a time specified by the business owner. Here Agile development style is being adopted, with Firebase serving as the database and Arduino UNO serving as the primary hardware component. Hafid Hardyanto et al. [24], designed an architecture of Smart aquarium which consists of hardware and software. The Smart aquarium architecture includes hardware with sensors providing data to a mega 328 microcontroller. It uses light, humidity, and water level sensors. Also a European research projects established Aquaculture 4.0. They used IoT-based water monitoring with PROTEUS sensors, cost-effective in Ghana's WAZIUP case, and environmentally friendly and intelligent in the IMPAQT project. [25].

In 2019, Haryanto et al. [26], created a smart aquaponics system with an Ubuntu IoT Cloud server. Water circulation and quality were therefore effectively preserved. The ultrasonic sensor's measurement success rate was 99.94%, the pH sensors at 92.35%, and the temperature sensors at 97.91%. In 2019, another wireless connectivity in the fish feeder for scheduled food was established by Meshram et al. [27] delivery to fish using two containers: one for food storage and the other for dispensing. In 2020, Jadhav et al. [28] implemented a fish feeder where the water's temperature was shown on the Blynk app's virtual LCD panel. It was also employed to show the ultrasonic sensor's distance. The RTC would show the time the motor was moved last on the smartphone. This was achieved by connecting the controller to Wi-Fi.

In 2021, Shahiran et al. [29] specifically focused on the development of a smart fish feeder by using the solar system with charging capability and controlled by the IoT system. One such fish feeder system used a 10W solar panel that was managed by a solar charger controller and a 12V battery. A rechargeable 12 V battery was used to store the solar energy. In order to provide crucial data on temperature and fish feeder timer via the Blynk platform, IoT-controlled sensors were also added to the fish feeder system. The system's performance demonstrated the concept's viability and potential for expansion into a broader sector of the farming business. The system's low cost and energy independence make it a promising addition to smart agricultural technologies.

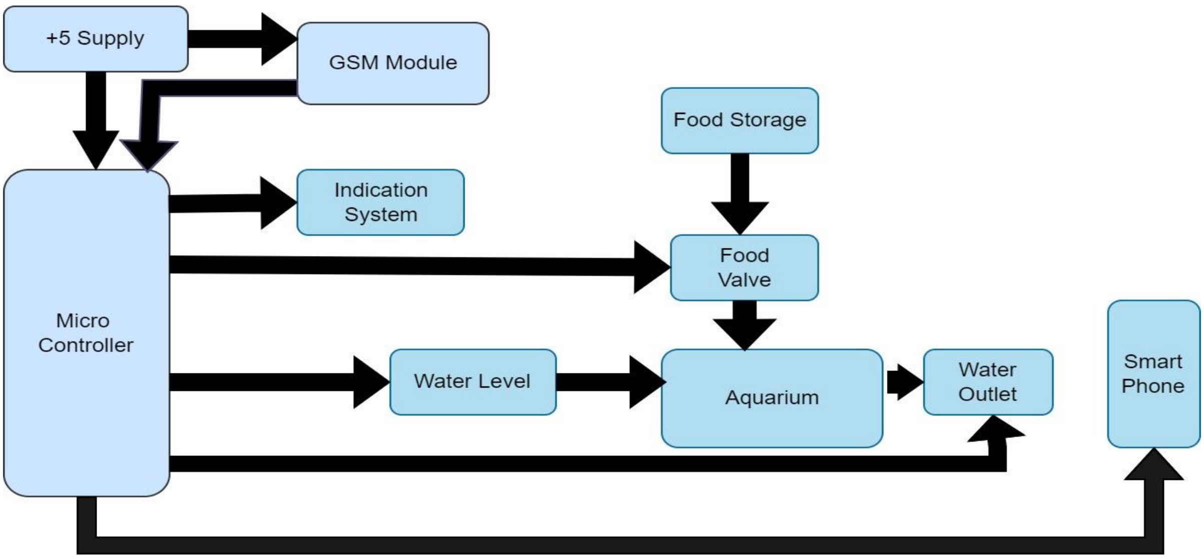


Figure 4: Block diagram of Smart Fish Feeder.

In 2017, Akilesh et al [30] created a straightforward system that responds to the quantity of fish, the number of feeds, and the amount of time needed between each feed. This thesis makes use of a GSM module to alert the user when the water in the tank needs to be cleaned.
The microprocessor will receive the aforementioned information via an LCD and a keyboard that is configured to enter values. The microprocessor retrieves these values, gathers all the necessary information, and opens the solenoid valve (food valve) in the way that they would want it shown in figure 4.

CHAPTER 3

Methodology

3.1 Purpose of this Methodology

The quest for effective and sustainable fish farming methods has led to considerable improvements in the aquaculture industry in recent years. Optimal growth, health, and production of aquatic species are ensured by the precise and computerized feeding of fish, which is a crucial component of contemporary aquaculture. The Automatic Fish Feeder System has developed as a promising option to handle the challenges of operating large-scale fish farms and improve the overall effectiveness of fish feeding.

The goal of this methodology is to provide a thorough grasp of the concepts, layout, and operation of an automatic fish feeder system. To automate the feeding of fish, the system combines a variety of cutting-edge technology, including microcontrollers, sensors, and precise feeding mechanisms. By doing this, it reduces the amount of human intervention while also providing several benefits, such as better feed management, lower labor expenses, and greater fish well-being.

3.2 Planning of the project structure

Planning makes a work perfect. The project Automatic Fish Feeder System seeks to develop an automated fish tank or pond feeding system. Users will be able to program and schedule the dispensing of fish food using this technology, ensuring that their aquatic pets regularly receive the right amount of food. Our project is organized in a way that provides a clear idea of where to begin and how to proceed with it. To make any task much better, it must be conceptually and clearly planned. We created a project strategy, with the primary objective being to remove the barriers associated with an automated fish feeder system. The goal of our project was to create an affordable solution that is simple to use for everyone. The planning is described with a few points:

- Designed a schematic for our project's appearance.
- Choose software and hardware based on the system's requirements.
- Make sure the components you choose don't add to the budget.
- Put the codes and linkages into practice.

Flowchart of the initial work of our project:

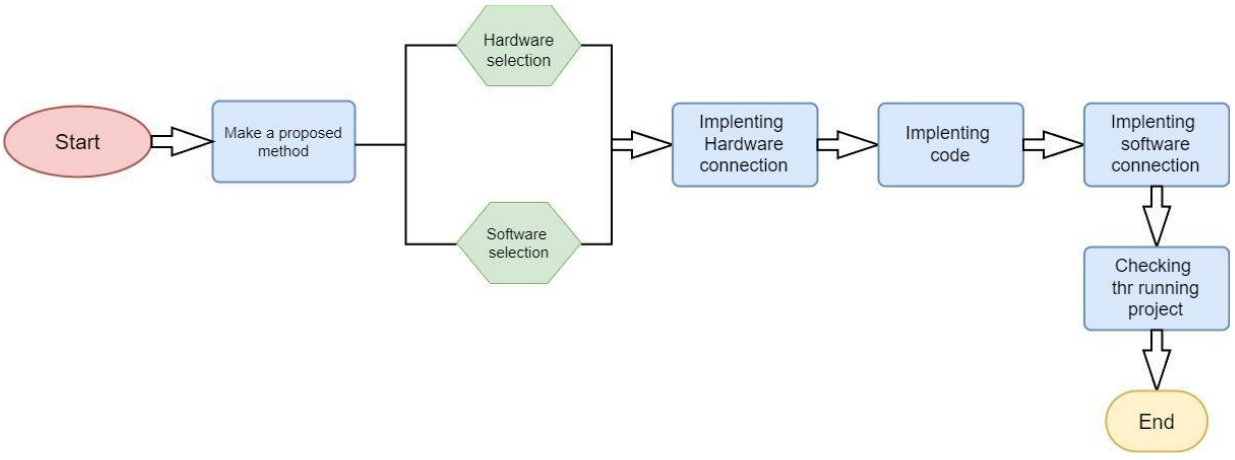


Figure 5: Initial Procedure of the project

3.3 IOT& The Automatic fish feeding system

Devices containing sensors, processing power, software, and other technologies that connect to other devices and systems over the Internet or other communications networks to exchange data are referred to as Internet of things, or IoT devices. Electronics, communication, computer science and engineering are all included in the Internet of things.

IOT was essential to our project since it allowed us to create a system that could be managed remotely via the internet from anywhere. We will go into more detail about the IOT components that we utilized to construct the project.

Software:

Our goal was to make our project accessible to all types of people, therefore we made sure to utilize software that wouldn't add to the cost. For software connection we used Arduino IDE and BLYNK app. Let’s have a discussion on the software components.

<u>Arduino IDE</u>

An editor for writing code, a message area, a text console, a toolbar with buttons for frequently used tasks, and a number of menus are all included in the Arduino Integrated Development Environment, also known as the Arduino Software (IDE). To upload programs and communicate with them, it establishes a connection with the Arduino hardware. We refer to programs written with the Arduino Software (IDE) as sketches. With the.ino file extension, these sketches are written in a text editor and saved. Both text searching and text replacement are possible using the editor's functions. During exporting and saving, the message section shows errors and provides feedback. Complete error messages as well as other information are displayed in text format on the console by the Arduino Software (IDE). Board and serial port configurations are shown in the lower right corner of the window. The buttons on the toolbar let you create, open, save, and verify programs as well as access the serial monitor and make and open sketches. The File, Edit, Sketch, Tools, and Help menus have more commands. Only options that are pertinent to the job being done at the moment are available since the menus are context sensitive.

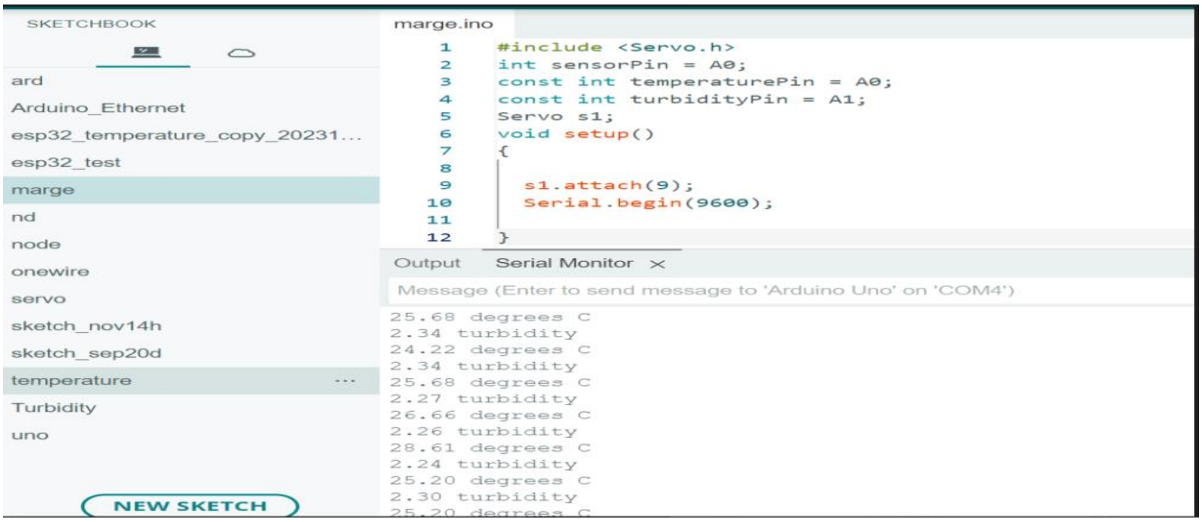


Figure 6: Arduino IDE interface

Blynk App

Blynk is an IoT platform for iOS and Android smartphones that allows Internet-based control of Arduino, Raspberry Pi, and NodeMCU. By gathering and supplying the necessary address on the available widgets, this application is used to create a graphical user interface, or human machine interface, or HMI.

Blynk was created with the Internet of Things in mind. In addition to many other awesome things, it can store, visualize, and remotely operate hardware. It can also show sensor data. The Blynk app lets you use a variety of offered widgets to create stunning interfaces for your projects. All of the communications between the smartphone and hardware are handled by the Blynk Server. You can host your personal Blynk server locally or utilize the Blynk Cloud. It can run on a Raspberry Pi, is open-source, and can easily handle thousands of devices. Libraries in Blynk provides communication with the server for all widely used hardware platforms and handles all incoming and outgoing commands. When a user hits the button in the Blynk application, data is transferred to the Blynk Cloud and then somehow makes its way to the installed hardware.

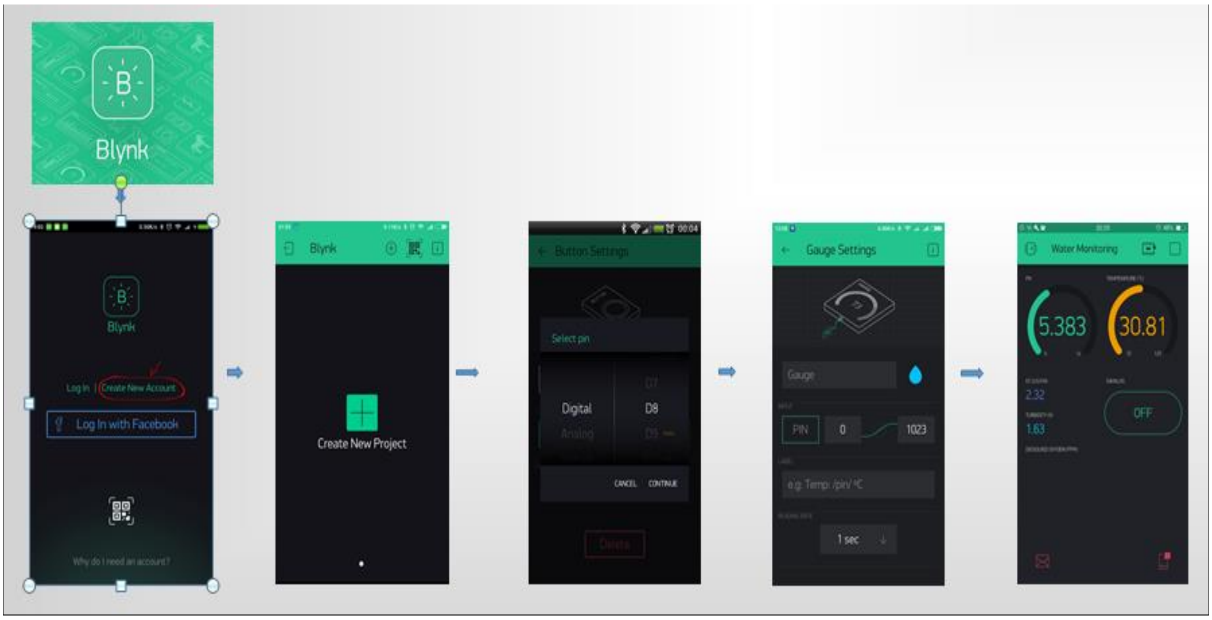


Figure 7: Blynk App setting and interface

Hardware components:

1. <u>Canister for food: To</u> feed the fish, a food container is fastened to the apparatus.
2. <u>Servo motor:</u> We employed a servo motor, which may be manually operated or rotated according to a predetermined time, to spin the container.
3. <u>Arduino Uno: The</u> Arduino Uno was essential in connecting the sensors.
4. <u>Node MCU:</u> We used Node MCU microcontroller ESP 32 for Wifi connection in the system.
5. <u>Temperature sensor:</u> Temperature sensor played a role to check the temperature of the water.
6. <u>Turbidity sensor:</u> Turbidity sensor measured the cleanliness of the water.

7. Waterproof Ultrasonic sensor: Waterproof ultrasonic sensor measured the distance of objects under water.

The devices are briefly described here.

Arduino Uno Rev3 SMD

A microcontroller board based on the ATmega328 is the Arduino Uno Rev3 SMD. It has a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 6 analog inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to get started, just plug in a USB cable FTDI USB-to-serial driver chip is not used by the Uno, which is how it differentiates from all earlier boards.

The following extra features are included with the R3 version:

- As a USB-to-Serial converter, ATmega16U2 is used instead of 8U2.
- SDA and SCL pins for TWI communication have been added, and they are located next to the AREF pin. Additionally, two new pins have been added, and they are located close to the RESET pin: one is an IOREF that enables the shields to adapt to the voltage supplied by the board, and the other is a pin that is not connected but is reserved for future use.
- More powerful RESET circuit i.e., an AC-to-DC adapter or a battery.

Figure 8: Arduino Uno R3 SMD

Node MCU microcontroller ESP 32

A popular microcontroller for IoT and embedded systems projects, the ESP32 Dev Board CH340 - USB-C is a type of development board made for use with the ESP32. The CH340 is the name of the board's USB to serial converter chip, which enables USB communication with the ESP32. Features of esp 32:

1. USB Type-C port: The board features a USB Type-C port for easy connectivity and data transfer.

2. Built-in Wi-Fi and Bluetooth: The board has a built-in Wi-Fi and Bluetooth module for wireless connectivity.
3. Low power consumption: The ESP32 chip on the board is designed for low power operation, making it a good choice for battery-powered projects.
4. Arduino-compatible: The board can be programmed using the Arduino IDE, which is a popular platform for building embedded systems.
5. Extensive I/O: The board has a wide range of I/O pins and headers for connecting sensors, motors, and other components.

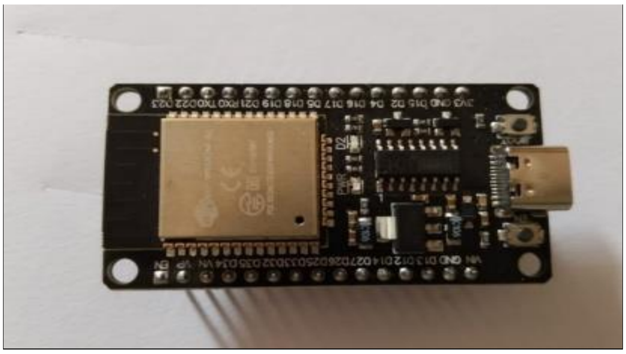


Figure 9: Node MCU Microcontroller ESP 32

Mini servo SG90:

A small, light-weight server motor with high output power is called a micro servo motor, or SG90. Servo rotates around 180 degrees (90 in each direction) and functions similarly to larger types of servo. These servos can be controlled by any servo code, hardware, or library. The servo motor is used to rotate the container of food so that the fish get food. The servo is managed by a code and it is connected with the Arduino uno which will rotate the motor in certain angle to drop a measured amount of food to the fish.

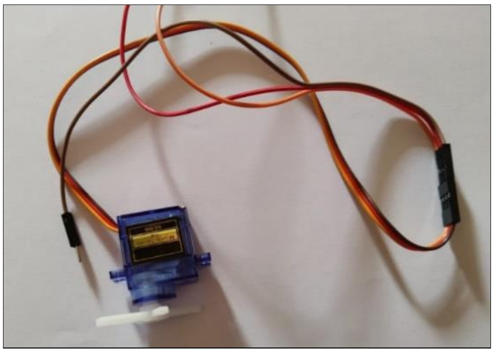


Figure 10: Servo motor SG 90

TMP 36 temperature sensor:

The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn't require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°Cover the −40°C to +125°C temperature range. We like it because it's so easy to use: Just give the device a ground and 2.7 to 5.5 VDC and read the voltage on the Vout pin. The output voltage can be converted to temperature easily using the scale factor of 10 mV/°C. This tmp 36 sensor will measure the temperature of water where the fish are kept. The perfect water temperature for fish is around 25^{o} Celsius to 27^{o} Celsius.

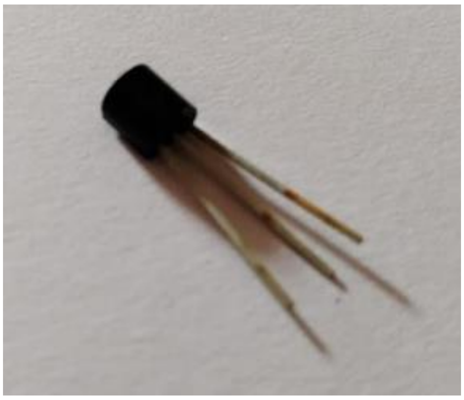


Figure 11: Temperature sensor TMP 36

Turbidity Sensor DC5V:

To determine the turbidity of a liquid solution, this turbidity sensor uses an optical approach. The current signal from the sensor is converted to module output voltage by this module. The turbidity value increases with decreasing output voltage. Turbidity sensor is used to detect the clearness of water. As healthy fish need a healthy environment, for rearing fish the turbidity level of water should be around 10V.

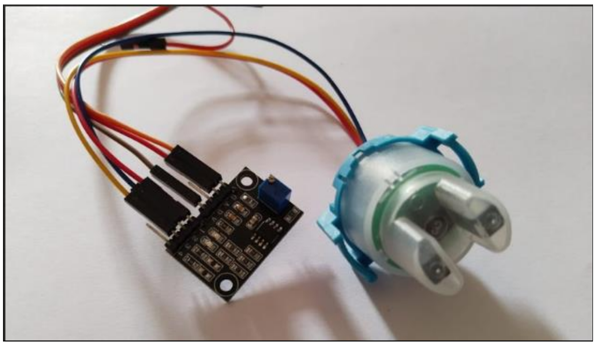


Figure 12:Turbidity Sensor DC5V

Waterproof Ultrasonic Distance Sensor MOD-00231:

A versatile sensor that can measure distances precisely in a variety of settings, including wet or submerged ones, is the Waterproof Ultrasonic Distance Sensor MOD-00231. It is appropriate for applications such as robotics, object detection in difficult environments, and water level monitoring due to its waterproof design, which enables it to produce accurate distance measurements utilizing ultrasonic technology. Its robust and sealed design guarantees steady operation even in wet or submerged conditions, making it an excellent option for a variety of applications needing accurate distance detection in locations where water is a concern.

Figure 13: Waterproof Ultrasonic Distance Sensor MOD-00231

Except these sensors and devices, we used male-to-male and female-to-male jumper wires and medium size Breadboard while building the project.

Figure 14: Jumper Wire

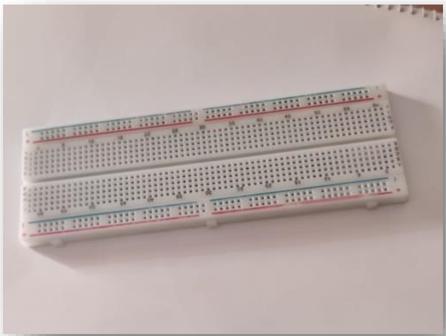


Figure 15: Breadboard

3.4 Proposed method

The automated fish feeder machine method that is being suggested aims to offer an economical, effective, and user-friendly way to feed fish in aquaculture settings. In order to automate the feeding of fish, this system combines hardware and software components, resulting in precise feeding schedules and decreased labor needs. Since aquaculture and fish farming are now major sources of seafood production, efficiency and cost-effectiveness depend heavily on the automation of routine processes like feeding. This suggested technique describes the creation of an automated fish feeding device that can be used in various aquaculture environments.

Since aquaculture and fish farming are now major sources of seafood production, efficiency and cost-effectiveness depend heavily on the automation of routine processes like feeding. This suggested technique describes the creation of an automated fish feeding device that can be used in various aquaculture environments.

Study and Layout:

We had to study and evaluate a number of relevant papers in order to begin work and obtain an overview of our task. These publications provided us with a concept to launch our endeavor. A flowchart explaining our project methodology is created here:

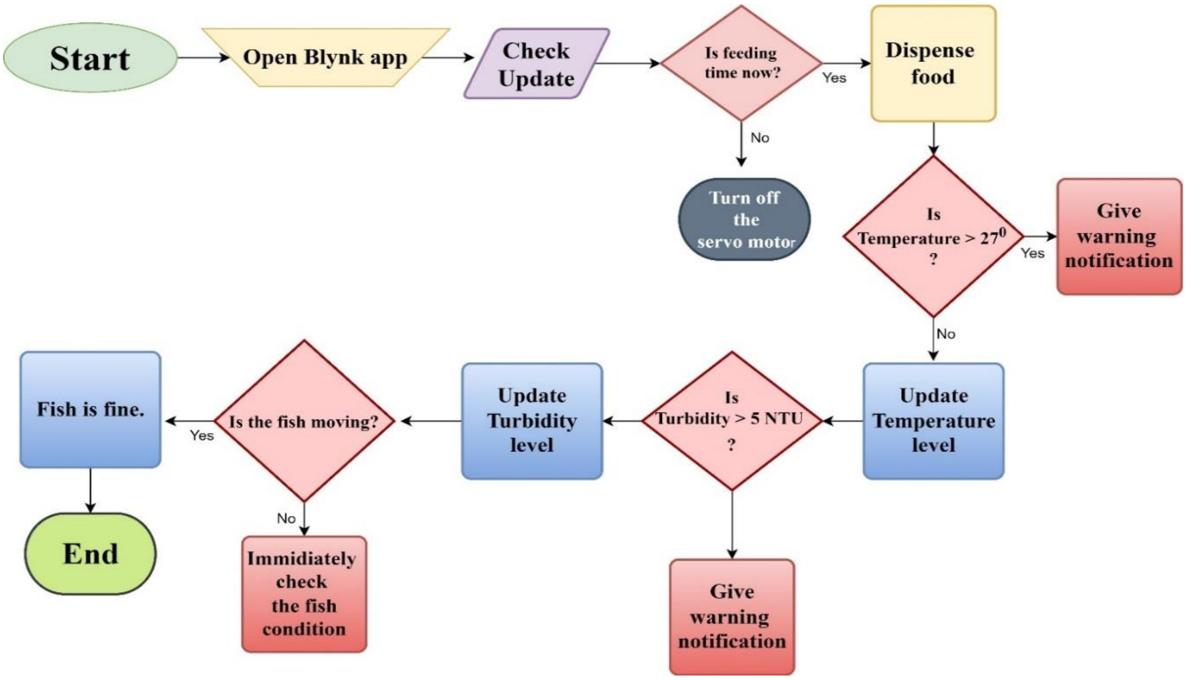


Figure 16: Flowchart showing the methodology of the proposed project

The flow chart shows the working procedure of the automatic fish feeding system. The system starts by opening the Blynk app where we can start the servo motor by pressing the on button and this will rotate the motor and dispense the food. For now the temperature, turbidity and ultrasonic sensor reading is shown in the Arduino uno serial monitor. After seeing all the results, the water condition can be determined.

Circuit Design:

Our project's workflow is clearly depicted in the flowchart. In order to make the hardware connection correct and error-free, we created a circuit design while keeping that process in mind. Due to TinkerCad's ability to design every connection beforehand, the circuit schematic also improved our productivity and ease of work. The circuit schematic for our project is displayed in the accompanying figure.

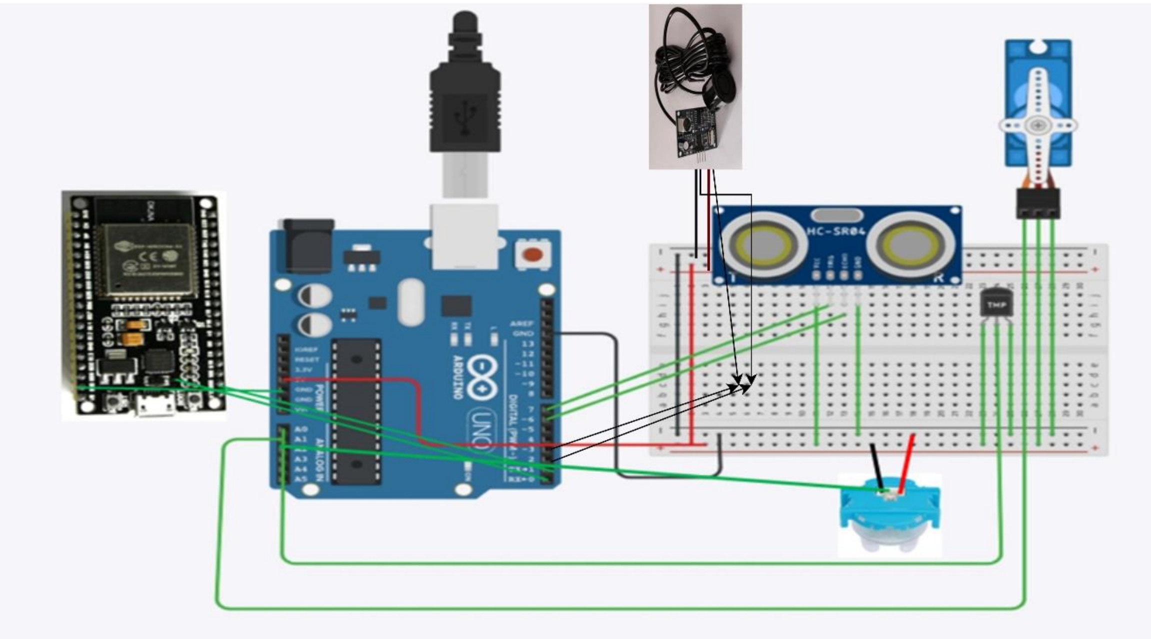


Figure 17: Circuit Diagram of proposed system.

Conceptual Framework:

Our project eventually started working on the practical side after all the preparations. First, we construct every piece of hardware in accordance with the circuit schematic. The temperature sensor and turbidity sensor were subsequently linked to the Arduino Uno via cables from the servo motor. In order to use both rows of the breadboard as the power source and the ground, we built a short circuit of power and ground point.

In order for the hardware to function, the second step was to upload the code into the Arduino IDE. We created the programs for every part, combined them, and uploaded the result to the Arduino Uno. The hardware started operating as soon as the code was uploaded. The temperature and turbidity sensor readings were shown on the Arduino ide's serial monitor while the servo motor rotated continuously.

Next, we developed the BLYNK app interface so that we could use a smartphone to operate our automated system. BLYNK app required setting up a login. We created the button and gauge to display the most recent reading of the day and to transmit commands to the servo motor after logging in. We had to establish a link between the ESP 32 and the BLYNK app after the designing phase. Sensor data will be stored by the ESP 32 and sent to the BLYNK app. Additionally, data will pass via the ESP 32 when the user sends a command to rotate the motor to feed the fish.

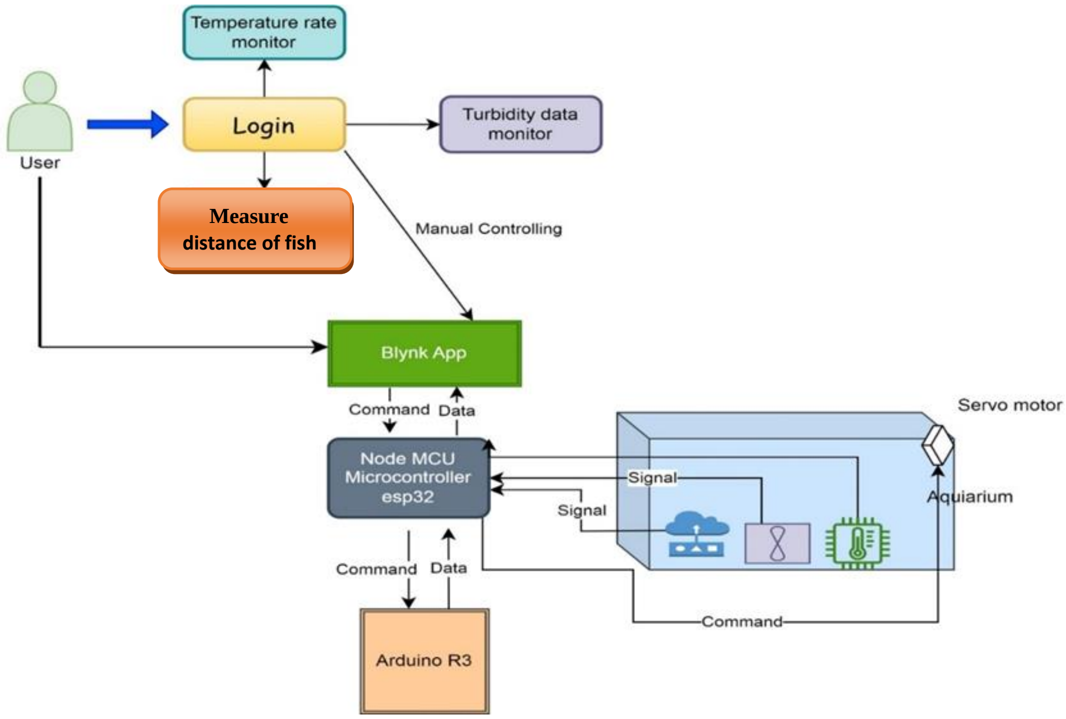


Figure 18: Use case diagram of automated fish feeding system

The synchronization between the hardware and software is depicted in the above diagram. The user can quickly check the water quality by logging into his mobile device. Additionally, a notice system will be in place for when the quality of the water deteriorates. With the aid of all these characteristics, a user can raise healthy fish without worrying about how he will care for them when he is away from home.

CHAPTER 4

Result Analysis & Comparison

System implementation and testing:

This section presents the results of the experiments carried out to evaluate the performance of the proposed system. The fish feed control system with automatic servo activation is functioning effectively, according to the findings. Our servo motor can feed successfully at 90°- 0° angle shown in Table 1. The pivotal component of our system, the servo motor, has proven to be highly effective in facilitating successful feeding at a versatile range of angles, specifically within the 90°- 0° spectrum, as detailed in Table 1. This adaptability ensures optimal nourishment for the aquatic inhabitants, contributing to their overall well-being and growth.

Testing servo motor:

Testing	Condition	Waiting time(s)	Servo motor angle
Day 1	**Successful feeding**	**4**	**90º – 0º**
Day 2	**Successful feeding**	**5**	**90º – 0º**
Day 3	**Successful feeding**	**4**	**90º – 0º**
Day 4	**Successful feeding**	**3**	**90º – 0º**
Day 5	**Successful feeding**	**2**	**90º – 0º**
Day 6	**Successful feeding**	**2**	**90º – 0º**
Day 7	**Successful feeding**	**2**	**90º – 0º**
Day 8	**Successful feeding**	**3**	**90º – 0º**

Table 1: Testing Servo motor

With the variety of fish species that are commonly kept in aquariums at homes or businesses, it is essential to keep the conditions in which they thrive. Based on our research, we have found that most of these species do best in aquarium water that is between 24 and 26.5°C (75 and 80°F).

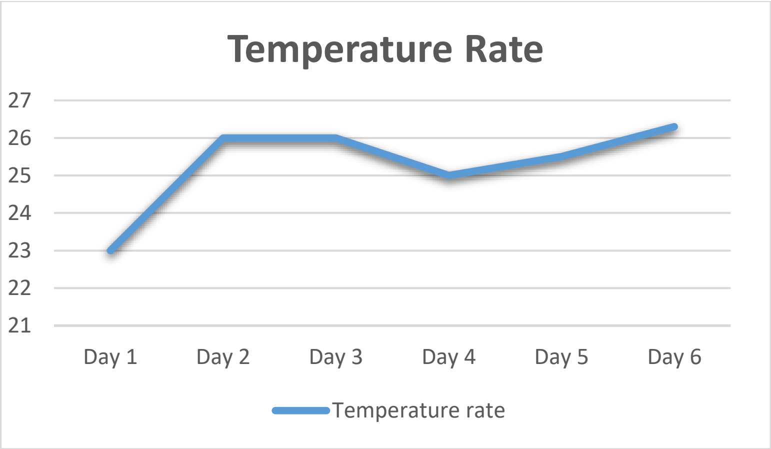


Figure 19: Temperature rate chart

Our water aquarium’s daily temperature reading is displayed in the above chart, daily temperature rate that is suitable for fish rearing. We took temperature readings to ensure that our project is producing results with an accuracy rating of between 90% and 98%. Our temperature sensor's data, which has been painstakingly documented and organized in Table 2, offers important insights into the ideal temperature maintenance that our system achieves, guaranteeing the aquatic ecosystem's health and vitality.

Temperature Sensor		
Testing	Water level	Accuracy(%)
Day1	23°	94%
Day2	24°	96%
Day3	24°	96%
Day4	23°	94%
Day5	25°	98%
Day6	29°	93%

Table 2 : Testing result Temperature Sensor

Maintaining a healthy aquatic habitat depends on a number of factors, including temperature regulation and water purity. The water clarity has been measured thanks in large part to our integrated turbidity sensor. The following chart shows the turbidity rate of each day:

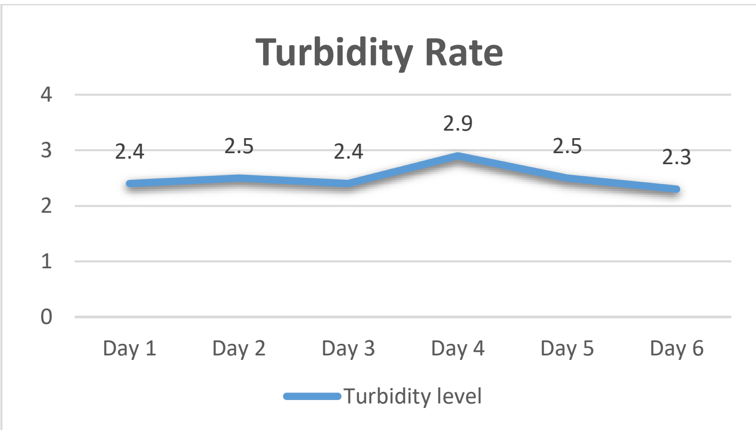


Figure 20: Turbidity rate chart

Table 3 provides a thorough breakdown of the findings. This data is a useful indicator for assessing the general environmental conditions of the fish aquarium.

Turbidity Sensor		
Testing	Water level	Accuracy(%)
Day1	2.4 - 2.5	96%
Day2	2.4 - 2.7	98%
Day3	2.3 - 2.4	95%
Day4	2.7 - 3	98%
Day5	2.4 - 2.5	96%
Day6	2.2 - 2.5	94%

Table 3: Testing result of Turbidity sensor.

In addition to maintaining fish health and water quality, it is also important to observe the movement of our fish. The following chart shows the distance of each day fish movement that has been monitored:

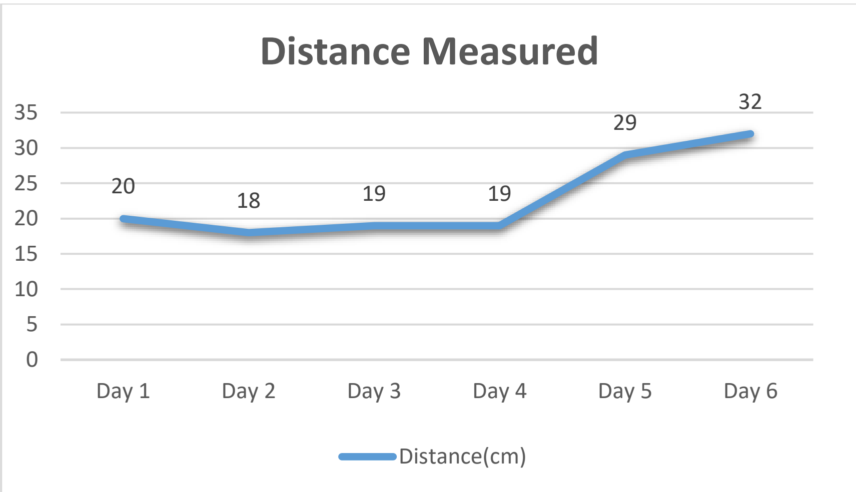


Figure 21: Distance measured of fish movement chart

We can understand whether the fish is alive or not through the movement of the fish. We can see the movement of the fish through our waterproof ultrasonic sensor showing in table 4.

Ultrasonic Sensor		
Testing	Distance	Accuracy(%)
Day1	20 cm	94%
Day2	18 cm	96%
Day3	19 cm	96%
Day4	19 cm	94%
Day5	29 cm	98%
Day6	32 cm	95%

Table 4: Testing result of Waterproof Ultrasonic sensor.

The following screenshot is taken from the serial monitor of Arduino IDE. The screenshot shows temperature and turbidity level.

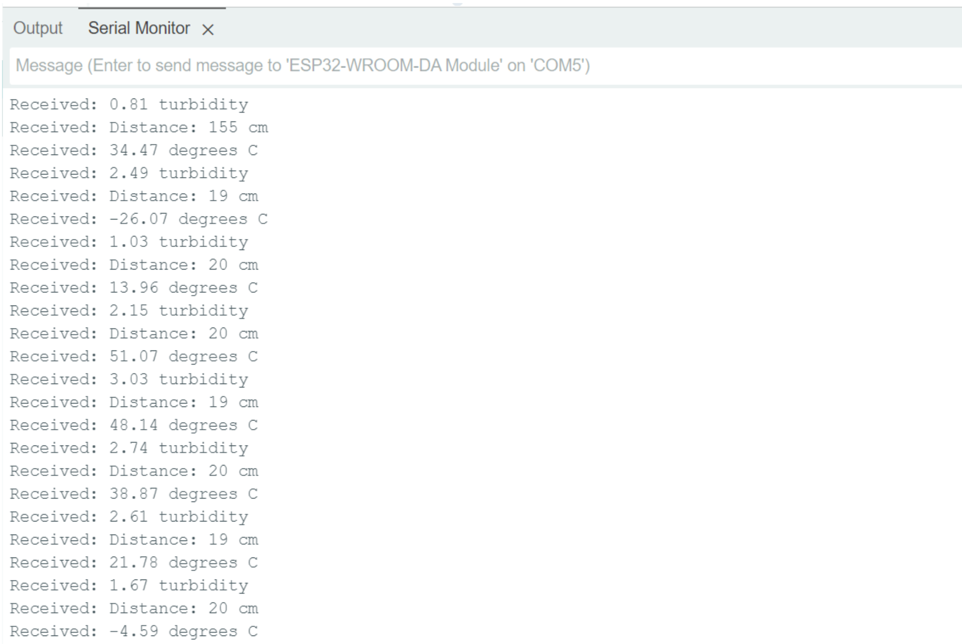


Figure 22 : Showing turbidity level, temperature level and distance of fish in the serial monitor of esp32.

After all these setups our project looked like the following.

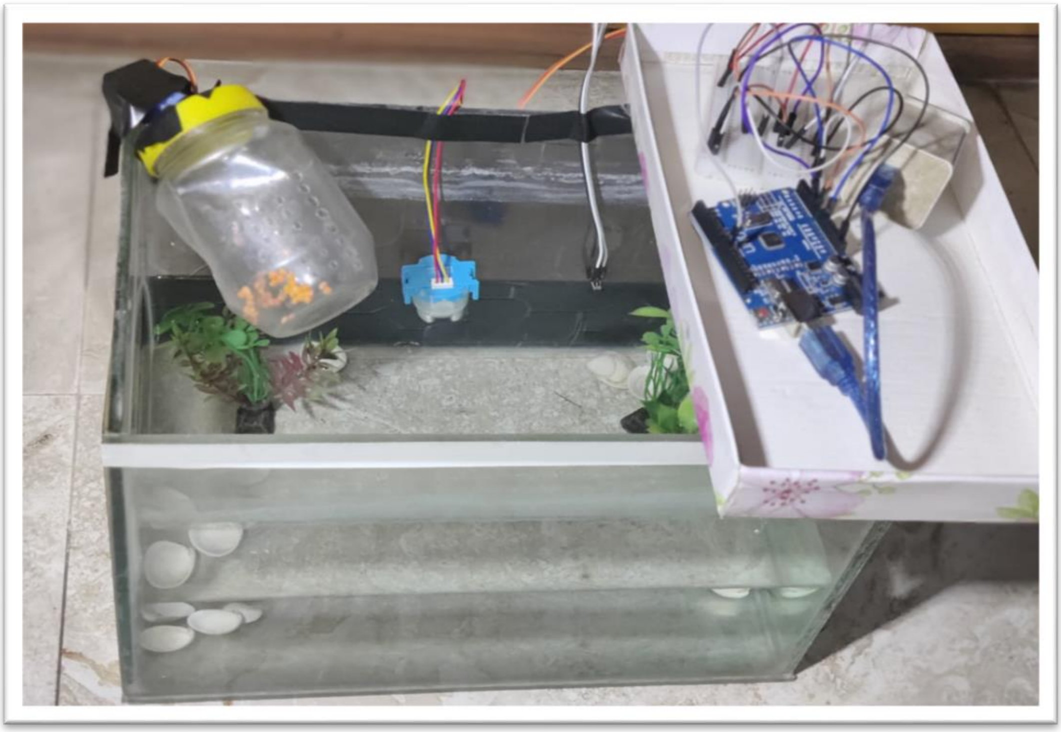


Figure 23: System Prototype

Figure 24 illustrates how the output produced by our Arduino, which is a key element of our experimental setup, is carefully shown and tracked via the Serial Monitor interface. This interface is an essential tool for monitoring and analyzing the system's performance in real time, and it offers insightful information about the nuances of the data produced by the Arduino.

CHAPTER 5

Conclusion & Future Work

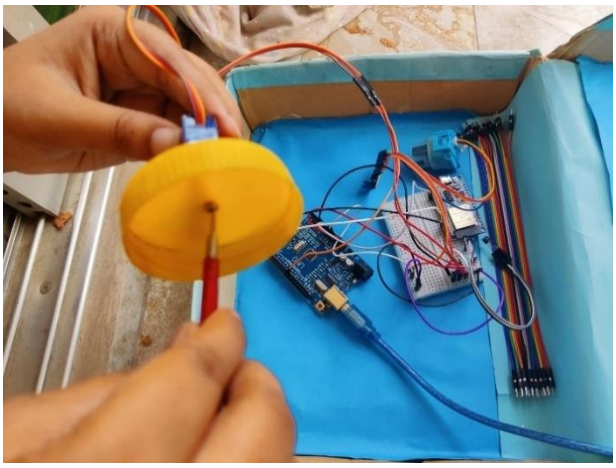
5.1 Conclusion

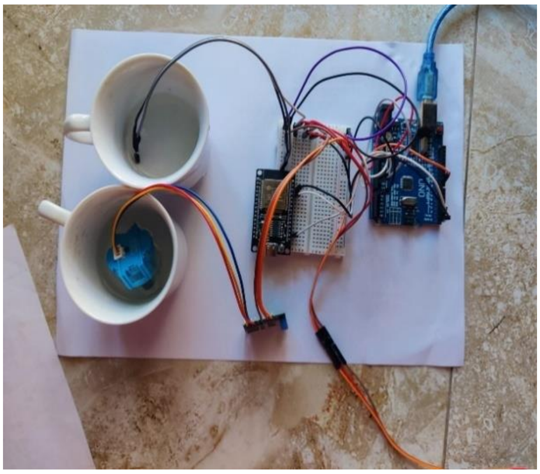
The study combined the development of aquaculture species for human consumption with an IoT platform. This system improves the water quality and detects the movement of fish for the fishing industry, aquaculture and aquariums. The suggested system increases the profitability, productivity, and sustainability of the aquatic environment. In this system, there are three sensors implemented, which are turbidity, temperature and waterproof ultrasonic sensor. According to the outcome, these sensors are operating flawlessly to assist users in preserving the water temperature value, turbidity level and movement of fish in aquariums. Through an additional mobile application on the Blynk platform, the user can view the retrieved data in real-time. Through this initiative, we will be able to put our management expertise to use in a real-world setting, helping to create the perfect habitat for fish in an aquarium.

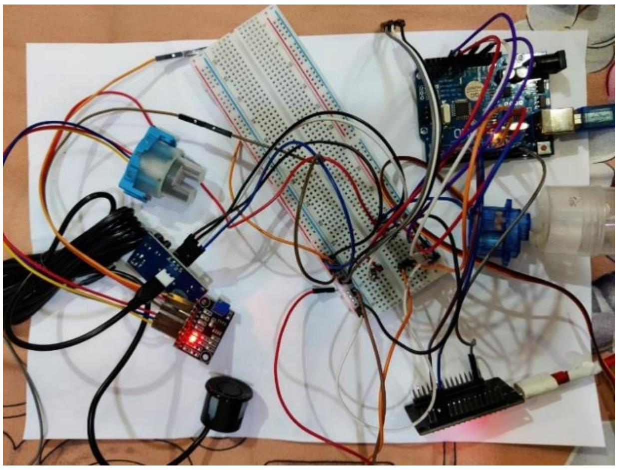
5.2 Future Work

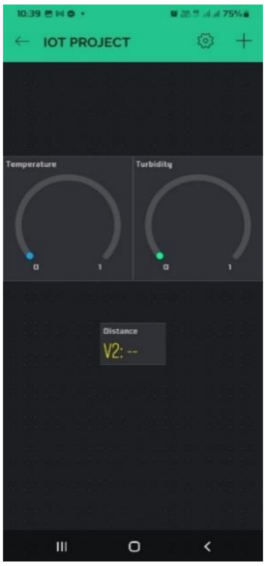
The livelihood of the maximum people of Bangladesh depends on the river. Bangladesh's economy largely depends on fish farming. We are now working on a small-scale fish aquarium project. In the future, we hope to expand our project by adding more sensors to make it appropriate for fish farming. We will advance our project to cover pond size as well. We will work on how to measure ammonia in water.

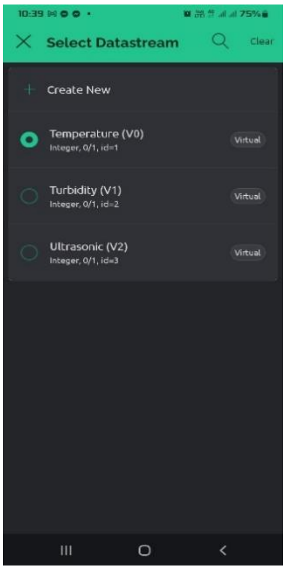
Appendix A



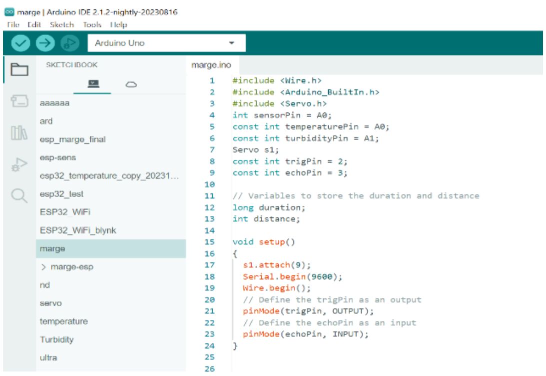








Codes in Arduino uno:



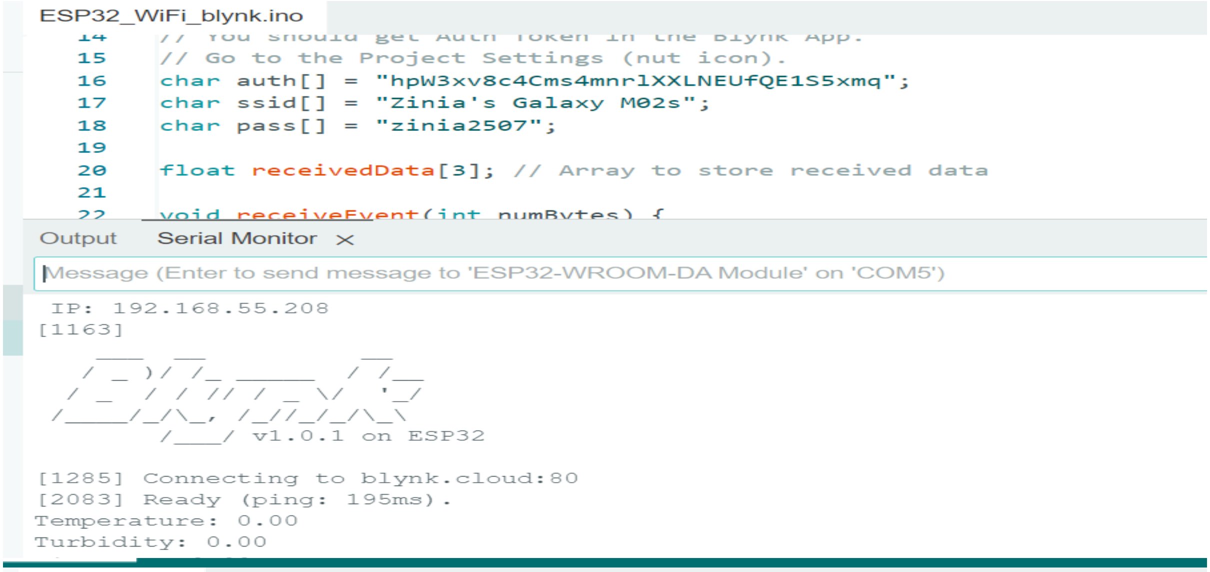
marge | Arduino IDE 2.1.2-nightly-20230816

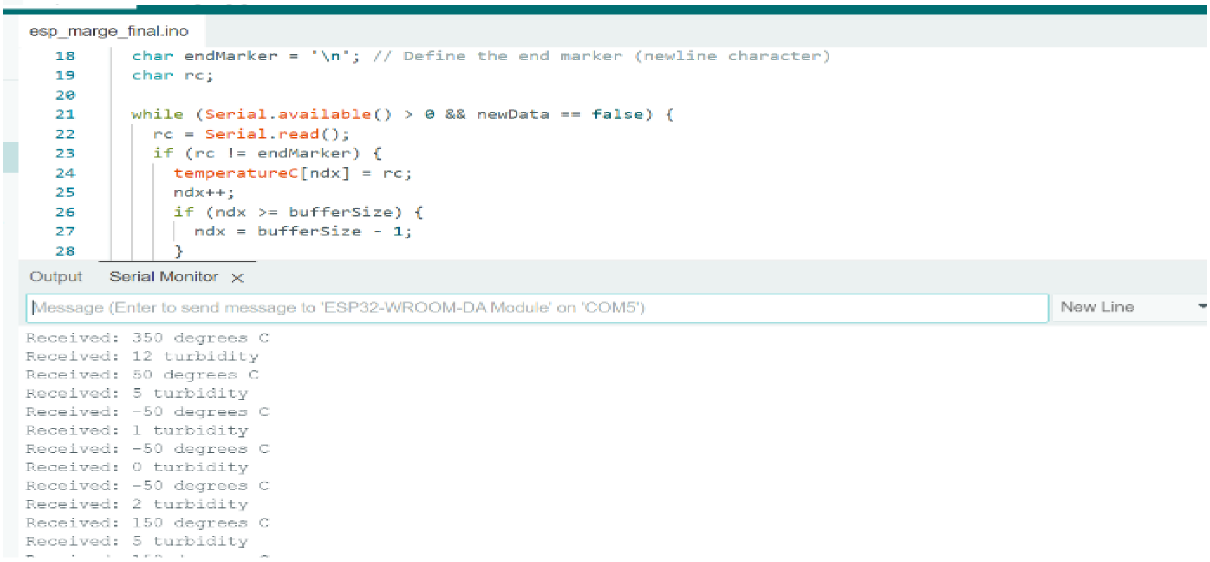
marge.ino

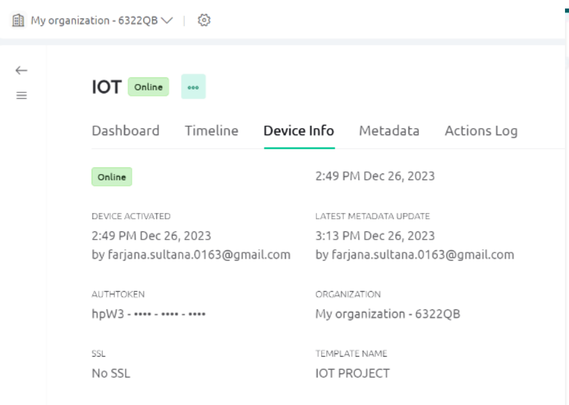
```
#include <Wire.h>
#include <Arduino_BuiltIn.h>
#include <Servo.h>
int sensorPin = A0;
const int temperaturePin = A0;
const int turbidityPin = A1;
Servo s1;
const int trigPin = 2;
const int echoPin = 3;

// Variables to store the duration and distance
long duration;
int distance;

void setup()
{
  s1.attach(9);
  Serial.begin(9600);
  Wire.begin();
  // Define the trigPin as an output
  pinMode(trigPin, OUTPUT);
  // Define the echoPin as an input
  pinMode(echoPin, INPUT);
}
```

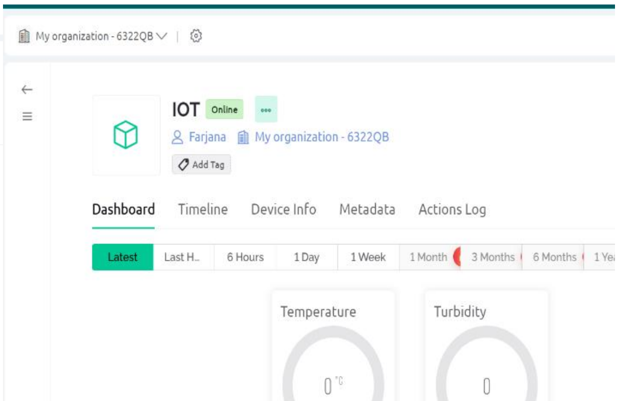
ESP32_WiFi.ino

```
/* Comment this out to disable prints and save space */
#include <Wire.h>
#define BLYNK_PRINT Serial
#define BLYNK_TEMPLATE_ID "TMPL6E9CSzrzN"
#define BLYNK_TEMPLATE_NAME "IOT PROJECT"
#define BLYNK_AUTH_TOKEN "hpW3xv8c4Cms4mnrlXXLNEUfQE1S5xmq"
/* Fill-in your Template ID (only if using Blynk.Cloud) */
//#define BLYNK_TEMPLATE_ID   "YourTemplateID"
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "hpW3xv8c4Cms4mnrlXXLNEUfQE1S5xmq";
char ssid[] = "Zinia's Galaxy M02s";
char pass[] = "zinia2507";

#define BLYNK_VIRTUAL_PIN_TEMPERATURE V0
#define BLYNK_VIRTUAL_PIN_TURBIDITY V1
#define BLYNK_VIRTUAL_PIN_DISTANCE V2

int temperatureC;
int volt;
int distance;
```


ESP32_WiFi_blynk.ino
// Go to the Project Settings (nut icon).
char auth[] = "hpW3xv8c4Cms4mnr1XXLNEUfQE1S5xmq";
char ssid[] = "Zinia's Galaxy M02s";
char pass[] = "zinia2507";
float receivedData[3]; // Array to store received data
Output
Serial Monitor
Message (Enter to send message to 'ESP32-WROOM-DA Module' on 'COM5')
IP: 192.168.55.208
[1163]
/___/ v1.0.1 on ESP32
[1285] Connecting to blynk.cloud:80
[2083] Ready (ping: 195ms).
Temperature: 0.00
Turbidity: 0.00


esp_marge_final.ino
char endMarker = '\n'; // Define the end marker (newline character)
char rc;
while (Serial.available() > 0 && newData == false) {
rc = Serial.read();
if (rc != endMarker) {
temperatureC[ndx] = rc;
ndx++;
if (ndx >= bufferSize) {
ndx = bufferSize - 1;
}
Output
Serial Monitor
Message (Enter to send message to 'ESP32-WROOM-DA Module' on 'COM5')
New Line
Received: 350 degrees C
Received: 12 turbidity
Received: 50 degrees C
Received: 5 turbidity
Received: -50 degrees C
Received: 1 turbidity
Received: -50 degrees C
Received: 0 turbidity
Received: -50 degrees C
Received: 2 turbidity
Received: 150 degrees C
Received: 5 turbidity


My organization - 6322QB
IOT
Online
Dashboard
Timeline
Device Info
Metadata
Actions Log
Online
2:49 PM Dec 26, 2023
DEVICE ACTIVATED
2:49 PM Dec 26, 2023
by farjana.sultana.0163@gmail.com
LATEST METADATA UPDATE
3:13 PM Dec 26, 2023
by farjana.sultana.0163@gmail.com
AUTHTOKEN
hpW3 - •••• - •••• - ••••
ORGANIZATION
My organization - 6322QB
SSL
No SSL
TEMPLATE NAME
IOT PROJECT


My organization - 6322QB
IOT
Online
Farjana
My organization - 6322QB
Add Tag
Dashboard
Timeline
Device Info
Metadata
Actions Log
Latest
6 Hours
1 Day
1 Week
1 Month
3 Months
6 Months
Temperature
Turbidity
0

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