SMART AQUARIUM

MINI PROJECT REPORT

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To

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IN

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Department of Electronics and Communication Engineering

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Department of Electronics and Communication Engineering

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Certificate

This is to certify that the Mini project entitled **SMART AQUARIUM** is a bonafide work carried out by **ANJU MARTIN** (KTE21EC015), **DEEPTHI S PANICKAR** (KTE21EC023), **GIRI SANKAR S (**KTE21EC030), **SREYA KELOTH** (KTE21ECO61) during 2024, in partial fulfilment for the award of the B. Tech degree in Electronics and Communication Engineering of APJ Abdul Kalam Technological University, Rajiv Gandhi Institute of Technology, Kerala.

Guide **Co-ordinators**

Head of the Department

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ABSTRACT

In modern days, many people have fish as their pets at home. The fishes have been fed by the aquarist in the aquarium tanks which demands a proper setup for maintenance. The problems faced are change in water quality, feeding the fish, maintaining the temperature and difficult to check the conditions of an aquarium manually. Therefore, it's necessary to monitor the physical parameters closely and enhance the water condition. So, this project proposes a system which is equipped with sensors to be operated in real time. It performs water pH level detection. An IoT based system is implemented to monitor and deliver the status of the aquarium to user's mobile application along with a feeder system. Thus, an intelligent aquarium management has been implemented so that the fish is neither over nor under fed and thereby reducing the manual effort required in maintenance of aquarium.

CONTENTS

Chapter 1

INTRODUCTION

The project introduces a comprehensive solution poised to transform the landscape of aquarium maintenance amidst the growing trend of home fishkeeping. With a focus on leveraging cutting-edge technology, our system is equipped with real-time sensor to monitor the vital parameter water pH, while also incorporating an intelligent feeding system. This innovative approach, integrated within an Internet of Things (IoT) framework, offers remote monitoring capabilities and delivers instant updates via a dedicated mobile application, aiming to streamline maintenance processes and ensure optimal conditions for pet fish.

At the core of our solution lies a commitment to simplifying aquarium management while empowering users with greater control and insight into their aquatic ecosystems. By harnessing the power of IoT technology, our system not only automates key aspects of maintenance but also enhances the overall experience for aquarium enthusiasts, promising a future where fishkeeping is more accessible, enjoyable, and sustainable.

Chapter 2

SYSTEM DESCRIPTION

A Smart Aquarium integrates technology to automate and enhance the management of an aquarium ecosystem. It typically involves the integration of sensors to monitor water parameters, a microcontroller or IoT device to process data and control equipment. This aims to provide convenience to aquarium enthusiasts by automating tasks such as feeding, maintaining optimal water conditions, and receiving alerts for any anomalies. Additionally, it offers insights into the aquarium's health, promoting better care and enhancing the overall experience for hobbyists.

2.1 BLOCK DIAGRAM

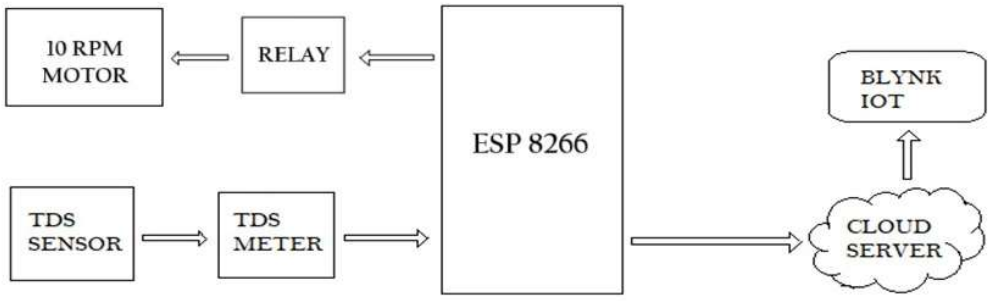

Fig 2.1: Block Diagram

The Block diagram for the Smart Aquarium project has Esp8266 microcontroller as the main unit which is responsible for data acquisition, processing, and communication. The Tds sensor provide real-time data on water quality and environmental conditions. Motor receives commands from the ESP8266 microcontroller through relay circuit to perform specific actions based on predefined schedules or user inputs. Through Blynk app users can monitor real-

time data, set parameters, schedule feeding times, and adjust other settings as needed.

2.2 CIRCUIT DIAGRAM

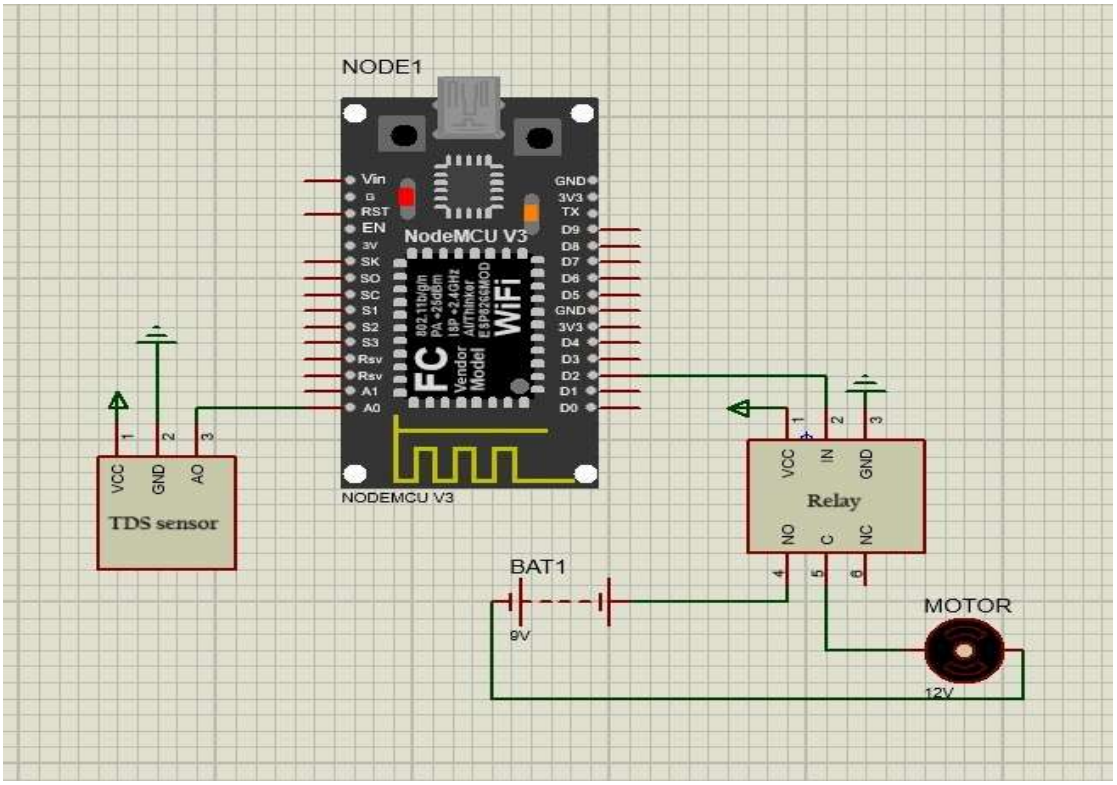

Figure 2.2: Circuit Diagram of Smart Aquarium

The circuit diagram of the smart aquarium is given above. The major components used are Esp8266 microcontroller, 10 rpm motor, Relay circuit, Tds sensor, WIFI-module and blynk app. The ESP8266 microcontroller serves as the central hub, connecting to the sensor and motor. We utilize GPIO pins on the ESP8266 for interfacing with the motor and TDS sensor.

Tds sensor is connected to specific input pins on the ESP8266 to provide real-time data on water quality. Wire the power and ground pins of the TDS sensor to the appropriate terminals on the ESP8266 or external power supply.

Motor responsible for controlling feeding are connected to PWM (pulse width modulation) pins on the ESP8266 for precise

control. The Wi-Fi module interfaces with the ESP8266 for wireless communication, enabling remote monitoring and control.

2.3 WORKING

The smart aquarium project operates based on the following sequence of actions:

1.Water quality Sensing:

· The TDS sensor continuously measures the total dissolved solids (TDS) in the aquarium water.

· The ESP8266 microcontroller collects data from the TDS sensor and converts it into a readable format.

2. Impurity detection and control logic:

· The ESP8266 runs a control algorithm programmed to maintain optimal TDS levels in the aquarium water.

· Based on the TDS readings, the control logic determines if the water needs purification or dilution.

3.Feeding schedule:

· Users set up feeding schedules through the Blynk app or a dedicated interface connected to the ESP8266.

· They specify the frequency and quantity of food to be dispensed at each feeding session.

4.Motor control:

· At the scheduled feeding times, the ESP8266 triggers the relay circuit, thus the motor connected to the feeder mechanism.

· The motor rotates to dispense the predetermined amount of fish food into the aquarium.

5.Feed control and monitoring:

· Users can remotely monitor feeding activity and adjust feeding schedules through the Blynk app or a similar interface.

· This remote accessibility allows users to feed their fish even when they are away from home.

6.Notifications:

· The system is programmed to send notifications to the user's mobile device in case if there is excessively high or low TDS levels.

· This allows users to take immediate action of issues and ensure the well-being of the aquatic environment.

In overall, With the help of these devices, owners can remotely manage and monitor their aquariums, ensuring that the fish are fed and in good health even when they are not there. The systems employ sensors to monitor water quality, and to feed the aquatic organisms at regular interval of time.

Chapter 3
HARDWARE AND SOFTWARE DESCRIPTION

The Smart Aquarium project utilizes a combination of hardware and software components to provide an automated environment for aquatic fishes. The hardware includes an ESP8266 microcontroller as the central control unit, along with a TDS sensor, a motor and relay circuit for the feeder system. The software aspect involves programming the ESP8266 module using the Arduino IDE, allowing for control and monitoring of the system. The Blynk app provides a user-friendly interface to receive notifications and remotely interact with the Smart Aquarium.

3.1 HARDWARE DESCRIPTION

The hardware components include ESP8266 development board, a TDS Sensor for water monitoring process and a 10 rpm Motor along with a Relay circuit for automatic feeding process.

1.ESP8266 BOARD

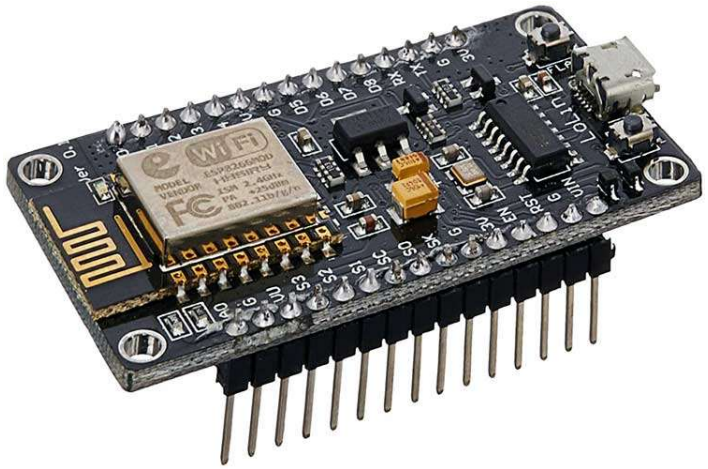

Figure 3.1.1: ESP 8266

The NodeMCU ESP8266 is a popular development board based on the ESP8266 microcontroller. It's widely used for IoT (Internet of Things) projects due to its low cost, built-in Wi-Fi capabilities, and ease of use. The NodeMCU board typically features a USB interface for easy programming and debugging, along with GPIO pins for connecting sensors, actuators, and other components.

The ESP8266 microcontroller is a low-cost Wi-Fi chip with full TCP/IP stack and microcontroller capability, manufactured by Espressif Systems. It's capable of connecting to Wi-Fi networks, making it ideal for IoT applications where internet connectivity is required. The NodeMCU board simplifies the development process by providing an easy-to-use platform for programming and prototyping with the ESP8266.

SPECIFICATIONS:

The ESP8266 is a versatile and widely-used microcontroller with built-in Wi-Fi capabilities. General specifications for the ESP8266:

1.**Architecture**: It features a Tensilica L106 32-bit microcontroller core running at 80 MHz (some variants can be clocked higher).

2.**Wi-Fi**: Supports 802.11 b/g/n standards, allowing it to connect to 2.4 GHz Wi-Fi networks. It can function as a station, access point, or both simultaneously.

3.**Memory**:

- **RAM**: Typically, it has around 32 KB to 128 KB of RAM available for user applications.
- **Flash Memory**: Ranges from 512 KB to 4 MB, which is used for storing program code and file system.

4.**GPIO Pins**: Usually equipped with multiple GPIO (General Purpose Input/Output) pins that can be used for digital input/output, PWM (Pulse Width Modulation), SPI (Serial Peripheral Interface), I2C (Inter-Integrated Circuit), etc.

5. **Analog Inputs**: Usually has one or more analog input pins with a resolution of 10 to 12 bits.

6.**Interfaces**: Supports UART (Universal Asynchronous Receiver-Transmitter), SPI, I2C, and other serial communication protocols.

7.**Operating Voltage**: Typically operates at 3.3 volts. It's important to note that the ESP8266 is not 5V tolerant, so level shifting may be required when interfacing with 5V devices.

8.**Power Consumption**: Depending on usage and sleep modes, power consumption can vary. It's known for its relatively low power consumption, especially in sleep modes.

9.**Operating Temperature**: Usually rated for a temperature range of -40°C to 125°C.

10.**Development Environment**: Supports programming through various development environments such as the Arduino IDE, PlatformIO, and others.

2.TDS SENSOR

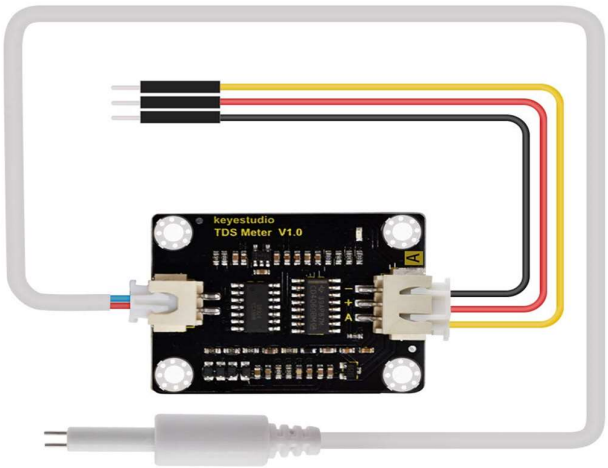

Figure 3.1.2: TDS Sensor

A TDS (Total Dissolved Solids) meter or sensor is a device used to measure the concentration of dissolved solids in a solution. Total dissolved solids refer to any inorganic salts, organic matter, and other substances that are dissolved in water. These can include minerals, metals, salts, ions, and other compounds.

SPECIFICATIONS:

1.**Sensor Components**: TDS sensors usually consist of two electrodes that are placed in the solution being tested. When a voltage is applied across these electrodes, the electrical conductivity of the solution is measured. The level of conductivity is then converted into TDS units, typically displayed in parts per million (ppm) or milligrams per Liter (mg/L).

2.**Voltage required**: TDS sensors are designed to operate within a typical voltage range of 3.3V to 5V DC. This voltage range is commonly compatible with microcontrollers and other electronic devices commonly used in water monitoring systems.

3.**Accurac**y: ±2% of full-scale reading (% FS) is a common accuracy specification for many TDS sensors.

4.**Resolution**:

·Resolution for TDS sensors can vary depending on the intended application and the sensor's design.

·Common resolutions include 1 ppm (parts per million) or 0.1 ppm for higher precision measurements.

Tds meter

SPECIFICATIONS:

1.**Measurement Range**: Typically, from 0 to 9999 ppm (parts per million) or higher, depending on the model.

2.**Accuracy**: Commonly ±2% of full-scale reading (% FS) or better.

3.**Resolution**: Often 1 ppm or 0.1 ppm, but can vary depending on the model.

4.**Response Time**: Typically, within a few seconds to provide stable readings.

5.**Power Source**: Battery-powered (commonly AA or AAA batteries) or USB-powered.

6.**Operating Temperature**: Usually specified within a certain range (e.g., 0°C to 50°C).

3. 10 RPM Motor

For Feeder System, the hardware required are 10 RPM motor and a Relay circuit.

Figure 3.1.3: 10 rpm Motor

A 10 RPM high-torque motor offers a specialized solution for applications requiring precise, low-speed rotation with substantial torque. Typically, these motors are designed for high-torque applications, capable of delivering significant rotational force at low speeds, making them suitable for tasks like conveyor belt systems, robotics, and slow-turning machinery. With a rotational speed of 10 RPM (Revolutions Per Minute), these motors prioritize torque output over speed, enabling them to handle heavier loads and maintain steady movement without sacrificing power. Such motors often feature robust construction, efficient gearing

mechanisms, and reliable bearings to ensure smooth and consistent performance under demanding conditions.

SPECIFICATIONS:

1.**Speed**: 10 RPM (Revolutions Per Minute), indicating the rotational speed of the motor shaft.

2.**Torque**: High torque output, typically ranging from several kg-cm to tens of kg-cm, allowing the motor to exert significant rotational force even at low speeds.

3.**Voltage**: Operating voltage can vary but commonly falls within the range of 6V to 12V DC, though there are also variations available for higher or lower voltages.

4.**Current**: The current draw depends on the load and the efficiency of the motor, but it's typically in the range of a few hundred milliamps to several amps.

5.**Power**: Power consumption is determined by the voltage and current requirements of the motor. For example, a 12V motor drawing 1 amp would consume approximately 12 watts of power.

6.**Construction**: Constructed with durable materials to withstand the stresses of high-torque operation, including metal gears, sturdy housings, and reliable bearings.

7.**Mounting**: Often designed for easy mounting with standardized mounting holes or brackets, facilitating integration into various mechanical systems.

8.**Size and Weight**: Dimensions and weight vary depending on the specific model and manufacturer, but these motors tend to be compact and relatively heavy due to their high-torque design.

9.**Efficiency**: Generally designed for efficient operation, minimizing energy losses and heat generation during extended use.

10.**Applications**: Suitable for a wide range of applications requiring slow, high-torque rotation, including robotics, conveyor systems, turntables, industrial machinery, and more.

4. Relay Circuit

Figure 3.1.4: Relay

A 5V relay is an electromechanical switch that operates using a 5-volt signal to control the switching of a separate, higher voltage circuit. Here's a description of its main features and functionality:

1.**Operating Voltage**: The relay coil operates on a 5-volt DC power supply. This low voltage makes it compatible with various microcontrollers, Arduino boards, and other digital control systems.

2.**Switching Capability**: The relay is capable of switching higher voltages and currents than what the control signal operates at. For example, it might be rated for switching AC or DC voltages up to 250V or more and currents up to several amperes.

3.**Switching Type**: Relays can be either normally open (NO), normally closed (NC), or have both NO and NC contacts. When the relay coil is energized, it switches

from one state to the other. A 5V relay might have one or more sets of NO and NC contacts, allowing for versatile control of multiple circuits.

4.**Contact Rating**: Specifies the maximum voltage and current the relay contacts can handle safely. This rating ensures that the relay can safely switch loads without damaging the contacts or causing arcing.

5.**Coil Resistance**: The resistance of the relay coil determines the amount of current required to energize the relay. Typically, 5V relays have a coil resistance that allows them to be directly driven by a 5V DC power supply without additional circuitry.

6.**Application**: Common applications for 5V relays include home automation, industrial control systems, robotics, IoT devices, and more. They're used whenever there's a need to control high-voltage or high-current devices with low-voltage control signals.

7.**Mounting**: Relays usually come in standard packages such as through-hole or surface mount, making them easy to integrate into electronic circuits.

8.**Protection**: Some relays may include protection features such as diodes or varistors to suppress voltage spikes and protect sensitive electronics from damage.

9.**Durability**: The durability of a relay is often measured in terms of the number of cycles it can withstand before failing. Quality relays are designed to operate reliably for thousands or even millions of cycles.

3.2 SOFTWARE DESCRIPTION

The Smart aquarium system project utilizes the Arduino IDE for programming the ESP8266 microcontroller board and the Blynk app for remote monitoring and control. Here is a description of the software components involved:

1. Arduino IDE:

Figure 3.2.1: Arduino IDE

The Arduino IDE (Integrated Development Environment) stands out as a widely embraced open-source software platform tailored for programming ESP8266 boards. Its intuitive interface streamlines the task of coding, compiling, and transferring code onto the ESP8266 microcontroller, making it accessible even to those with limited programming experience. This IDE not only facilitates the development process but also fosters a community-driven ecosystem where users can share code, troubleshoot issues, and collaborate on projects. Its versatility extends beyond basic functionality, offering an array of libraries and tools that enhance the capabilities of ESP8266 boards, thus catering to a diverse range of applications in the realm of embedded systems and IoT (Internet of Things) development.

2.Blynk App:

Figure 3.2.2: Blynk

The Blynk app revolutionizes the development of IoT (Internet of Things) applications by providing a user-friendly platform that eliminates the need for complex coding. Its intuitive interface empowers users to craft customized user interfaces using a variety of widgets, enabling seamless communication with their

connected hardware devices. Beyond its simplicity, Blynk offers a comprehensive set of features and functionalities, including data logging, push notifications, and real-time monitoring, making it an ideal choice for projects ranging from home automation to industrial IoT solutions. One notable application is in the realm of smart aquarium systems, where Blynk enables users to remotely monitor and control various parameters such as water temperature and level of impurities directly from their smartphones or tablets. This not only enhances convenience but also ensures optimal conditions for aquatic life, ultimately leading to a more enjoyable and sustainable aquarium experience.

3.Proteus Simulation Software:

Figure 3.2.3: Proteus Software

The Proteus Design Suite is a proprietary software suite utilized predominantly in electronic design automation. It's favored by electronic design engineers and technicians for crafting schematics and manufacturing printed circuit boards. This engineering software allows users to create and simulate various electrical circuits on their computers or laptops, including two-dimensional designs. Simulating circuits on Proteus before implementing them practically offers several advantages.

The workflow for the Smart aquarium system's software involves several steps:

1**. Development**: Write code in the Arduino IDE, defining variables, configuring pin modes, and implementing functionalities. Also, integrate libraries for hardware components.

2. **Compilation and Upload**: Compile the code in the Arduino IDE to check for errors, then upload it to the ESP8266 board via USB for execution.

3. **Blynk App Setup**: Configure the Blynk app to connect the ESP8266 with a smartphone/tablet. Design a custom UI using drag-and-drop widgets for control and monitoring, and include an authentication token in the code for secure connection.

4**. Real-Time Monitoring and Control**: The Blynk app connects to the ESP8266, displaying real-time data such as impurity levels and temperature. It communicates with the ESP8266 through Wi-Fi for seamless remote interaction.

This software setup combines the Arduino IDE and the Blynk app, allowing tailored firmware development and providing a user-friendly interface for improved functionality and convenience.

Chapter 4

RESULTS AND DISCUSSION

The Smart Aquarium Management system achieved its objectives by introducing a comprehensive solution tailored to address the challenges of maintaining home aquariums amidst the burgeoning trend of fishkeeping. Through the integration of advanced technology, including real-time sensors and IoT connectivity, the system offers precise monitoring of crucial parameter, Water pH, alongside an automated feeding mechanism. This intelligent approach aims to optimize environmental conditions within the aquarium, reducing manual effort and ensuring the well-being of pet fish.

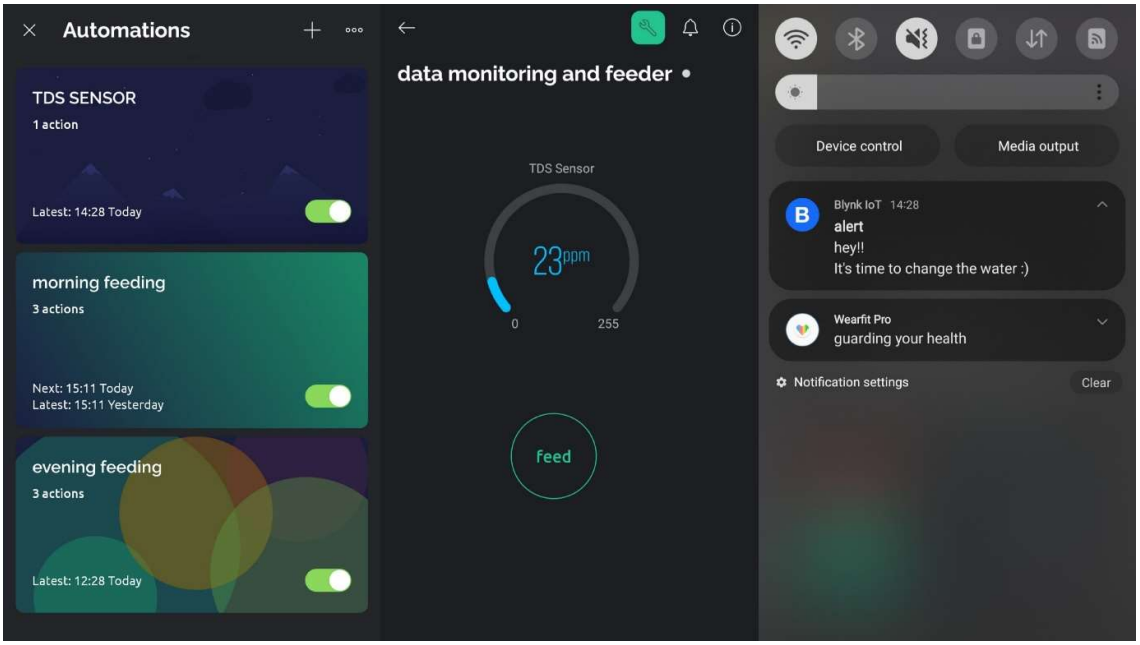

Figure 4.1: Blynk Platform

Key results include:

1**. Real-time Monitoring and Control**: The system effectively monitors water pH, and feeding schedules, providing users with instant updates and alerts via a dedicated mobile application. This real-time access empowers aquarium

enthusiasts to make informed decisions and intervene promptly to maintain optimal conditions for their fish.

2. **Automation of Maintenance Tasks**: By automating essential maintenance tasks such as feeding and environmental parameter monitoring, the system streamlines the upkeep of aquariums, minimizing manual effort and promoting consistency in care routines.

3**. Enhanced User Experience**: Through seamless integration with IoT technology, the system enhances the overall user experience by offering remote monitoring capabilities and intuitive control interfaces. This ensures that aquarium enthusiasts can enjoy their hobby with greater convenience and peace of mind.

In discussions, it's evident that the Smart Aquarium Management system represents a significant advancement in the realm of fishkeeping, aligning with the growing demand for innovative solutions to simplify maintenance processes. The integration of IoT technology not only addresses common challenges but also opens up possibilities for further customization and enhancement. Future developments may include features such as automatic water quality adjustments, intelligent lighting control, and integration with aquarium ecosystems for comprehensive monitoring and management.

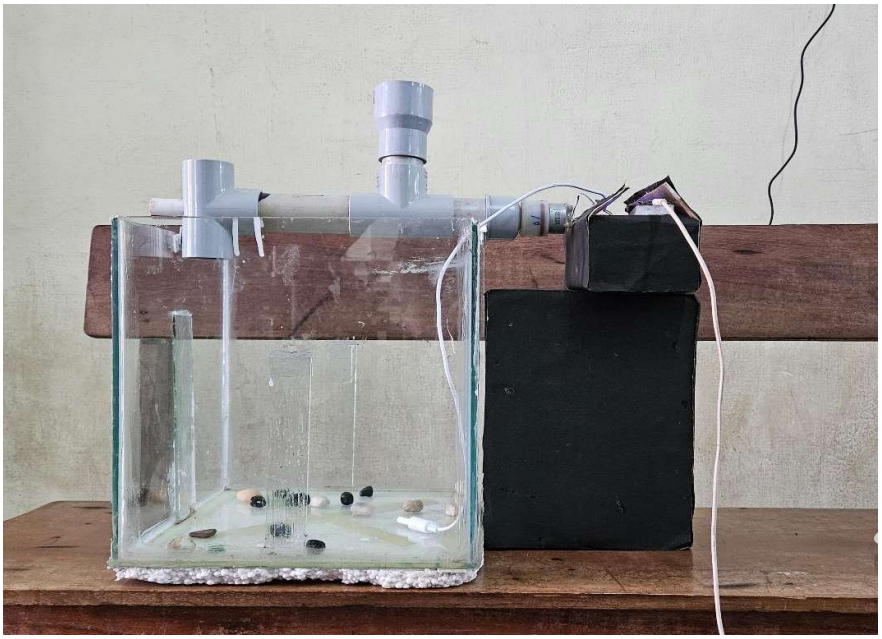

Figure 4.2: Final Model

Chapter 5
CONCLUSION

The Smart Aquarium Management System offers practical benefits for everyday fishkeeping. With the mobile app, users can conveniently check in on their aquarium's status from anywhere, giving peace of mind during busy days or while away from home. The system's ability to regulate feeding amounts helps prevent overfeeding, a common issue that can harm fish health. Plus, its automated water quality monitoring means fewer worries about sudden changes that could endanger aquatic life. Beyond convenience, it's a learning tool, providing insights into fish behavior and ecosystem dynamics. And by optimizing energy use, it's not just good for fish—it's eco-friendly too. With features like community sharing, it fosters connections among fishkeeping enthusiasts. Ultimately, it's about making the hobby more enjoyable and sustainable for everyone involved.

While acknowledging potential limitations such as sensor sensitivity fine-tuning and reliance on stable Wi-Fi connectivity, the Smart Aquarium Management system showcases its capacity to revolutionize fishkeeping practices, offering enhanced convenience, safety, and peace of mind for users.

Chapter 6

REFERENCES

- Balasubramani Sa, Aakash Ram Sb, Akshay Bharadwaj S c, and Bennet Niffin N d, "Smart Aquarium Management System," R.M.D. Engineering College, Chennai, Tamilnadu.
- P. Vijay Kumar, K. P. Siddhardha Varma M., Sathish Kumar, Ravikumar C. V., and Ashish P., "Aquaculture Monitoring System Using Machine Learning," School of Electronics Engineering, Vellore Institute of Technology, Vellore-632014, India.
- Nikitha Rosaline, and Dr.S. Sathyalakshimi, "IoT Based Aquaculture Monitoring and Control System," Hindustan Institute of Technology and Science, Chennai, India.
- A. K. Pasha Mohd Daud, N. A. Sulaiman, Y. W. Mohamad Yusof, and M. Kassim, "An IoT-Based Smart Aquarium Monitoring System," in 2020 IEEE 10th Symposium on Computer Applications & Industrial Electronics (ISCAIE), Malaysia, 2020, pp. 277-282
- Dr. B. S. Tarle, Gauri Joshi, Divyata Borse, Samiksha Mahadik, and Kadambari Pawar, "IoT Based Smart Fish Aquarium," Maratha Vidya Prasarak Samaj's Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik, Maharashtra, India.