AquaSense

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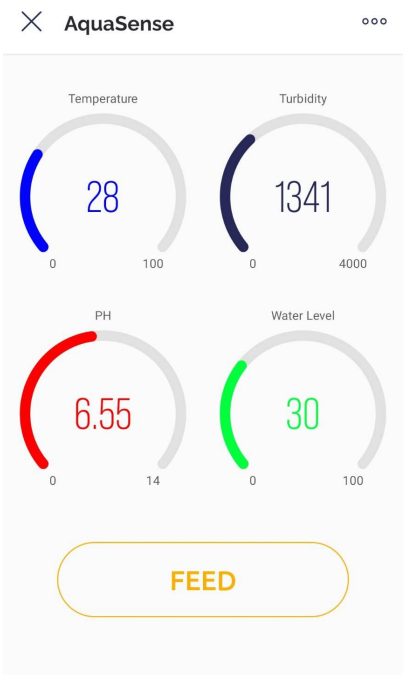
AQUA SENSE HUB



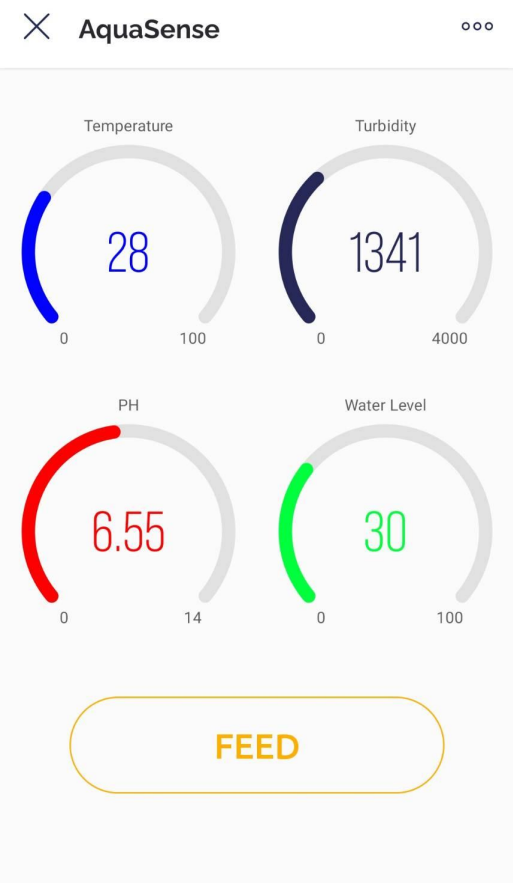
"Empower Your Aquarium Experience with AquaSense Hub: Where Smart Monitoring Meets Intelligent Control!"

Table of Contents

1. INTRODUCTION

1.1 Overview

The AquaSenseHub project presents an advanced aquarium monitoring and control system, utilizing the ESP32 microcontroller and an array of sensors to capture essential data, including temperature, pH, turbidity, and water level. This comprehensive system integrates seamlessly with the Blynk platform, enabling remote access and control through a user-friendly application.



How To Works

The code architecture, organized into FreeRTOS tasks, ensures efficient parallel execution and scalability. Notably, the inclusion of a servo motor facilitates automated fish feeding, sensors to capture essential data, with both scheduled and manual control options available through the Blynk app.

Why Choice AquaSenseHub?

In meeting the defined acceptance criteria, the AquaSenseHub exemplifies a sophisticated and extensible solution, showcasing the harmonious integration of hardware and software components for advanced aquarium monitoring and automation.

1.2 About AquaSenseHub

AquaSenseHub stands as a sophisticated and comprehensive solution that represents the next frontier in aquarium monitoring and control. At its core, AquaSenseHub leverages the advanced capabilities of the ESP32 microcontroller, positioning itself at the forefront of technological innovation in the realm of aquariculture. The system offers a multifaceted approach to aquarium management, providing enthusiasts with real-time insights into key environmental parameters.

One of the standout features of AquaSenseHub is its ability to monitor critical factors such as temperature, pH levels, turbidity, and water level with unparalleled precision. This real-time monitoring capability is further enriched by the system's seamless integration with the Blynk platform. Users can effortlessly access and manage their aquarium data remotely through the Blynk app, ensuring constant connectivity and control from virtually anywhere on the globe. The user experience is elevated through the inclusion of an OLED display, offering on-site enthusiasts a detailed and visually engaging representation of their aquarium's conditions. AquaSenseHub doesn't stop at monitoring; it introduces a servo motor for automated fish feeding, providing a hands-free and intelligent feeding mechanism. This automation extends to manual control through the Blynk app, granting users the flexibility to tailor their aquarium management based on individual preferences.

In essence, AquaSenseHub transcends traditional aquarium management, ushering in a new era where technology converges with aquariculture. Its comprehensive set of features, ranging from precise monitoring to remote access and intelligent automation, establishes AquaSenseHub as a trailblazer in the dynamic landscape of aquarium technology.

2. PRODUCT DESCRIPTION

2.1 Features and Capabilities

AquaSenseHub distinguishes itself through a rich tapestry of features and capabilities, presenting an all-encompassing solution for aquarium enthusiasts. At its core, the system excels in monitoring key environmental parameters critical to the well-being of aquatic ecosystems. The inclusion of temperature monitoring ensures that users have real-time insights into the thermal conditions of their aquarium, a vital aspect for the health and comfort of aquatic inhabitants. Adding to its repertoire, AquaSenseHub integrates a pH sensor, allowing users to closely track the acidity levels within the aquarium. This feature is pivotal for maintaining an optimal pH balance, crucial for the overall health and vitality of aquatic life. Furthermore, the system incorporates a turbidity sensor, enabling enthusiasts to gauge the clarity of the water. This not only contributes to the aesthetic appeal of the aquarium but also serves as an indicator of water quality.

Water level monitoring is another key facet of AquaSenseHub's capabilities. With a dedicated water level sensor, users can precisely determine and manage the water levels in their aquariums. This feature is instrumental in preventing potential issues such as overflows or insufficient water levels, providing a proactive approach to aquarium maintenance. AquaSenseHub's user interface is enriched by the integration of an OLED display, offering enthusiasts a visually engaging and informative dashboard. This on-site display ensures that users can effortlessly access real-time data without the need for a separate application. The seamless integration with the Blynk platform takes the user experience a step further, allowing for remote monitoring and control via the Blynk app. This cloud-based connectivity ensures that aquarium enthusiasts stay

connected to their aquatic environments regardless of their physical location. The automation capabilities of AquaSenseHub are exemplified by the inclusion of a servo motor. This component introduces an intelligent feeding mechanism, automating the feeding process at scheduled intervals. Users can also exercise manual control over the servo motor through the Blynk app, offering a dynamic and customizable approach to fish feeding.

2.2 Components Included

The AquaSenseHub comes equipped with a meticulously curated selection of components, each contributing to its prowess as a comprehensive aquarium monitoring and control system. At the heart of this innovative setup lies the ESP32 microcontroller, serving as the central processing unit that orchestrates the seamless integration of various functionalities. This powerful microcontroller forms the backbone of AquaSenseHub's ability to collect, process, and disseminate crucial data related to the aquarium environment. To capture the nuances of temperature within the aquarium, AquaSenseHub incorporates the Dallas Temperature sensor, interfaced through the OneWire protocol. This sensor ensures that enthusiasts can monitor the thermal conditions in real-time, enabling them to make informed decisions to safeguard the well-being of aquatic life.

The inclusion of a water level sensor is instrumental in maintaining optimal water levels within the aquarium. By leveraging analog readings from the water level sensor, AquaSenseHub empowers users to prevent potential issues such as overflows or inadequate water levels, fostering a stable and secure aquatic habitat. For monitoring pH levels, AquaSenseHub integrates a dedicated pH sensor. This component plays a pivotal role in tracking the acidity levels of the aquarium water, providing a critical parameter for ensuring the health and vitality of aquatic organisms. The real-time data

from the pH sensor enhances the user's ability to enact precise adjustments to maintain an optimal pH balance. AquaSenseHub further enhances its monitoring capabilities with a turbidity sensor. This sensor allows users to gauge the clarity of the water, providing insights into water quality and aiding in the prompt identification of any issues that may affect the overall well-being of the aquatic environment.

The servo motor stands out as a dynamic component, adding an element of automation to AquaSenseHub. Primarily employed for the automated feeding of fish, the servo motor introduces an intelligent and scheduled feeding mechanism. This not only caters to the nutritional needs of aquatic life but also offers users the flexibility to manually control the feeding process through the Blynk application. The user interface is enriched by the inclusion of an Adafruit SSD1306 OLED display, providing enthusiasts with an on-site dashboard for real-time data visualization. This visual feedback ensures that users can stay informed about the aquarium conditions without the need for a separate application. AquaSenseHub's seamless connectivity is facilitated by its integration with the Blynk platform. The ESP32 establishes a connection to the Blynk server using the provided authentication token and Wi-Fi credentials. This cloud-based integration empowers users to remotely monitor and control their aquariums through the intuitive Blynk application, transcending geographical constraints.

3. GETTING STARTED

3.1 Assembling The AquaSenseHub

Assembling the AquaSenseHub is a meticulous process that involves the careful integration of various components to create a cohesive and functional aquarium monitoring and control system. The process begins with the central component, the ESP32 microcontroller, which serves as the brain of the system. The ESP32 is responsible for orchestrating the communication between different sensors, the OLED display, the servo motor, and the Blynk platform. Its versatile capabilities make it the ideal choice for managing the complexity of the AquaSenseHub.

The next step in the assembly process involves connecting the Dallas Temperature sensor through the OneWire protocol. This sensor is strategically positioned within the aquarium to capture accurate temperature readings, ensuring that users have real-time insights into the thermal conditions of the aquatic environment. Precise temperature monitoring is crucial for maintaining an optimal habitat for aquatic life, and the OneWire protocol facilitates efficient communication with the ESP32.

The water level sensor is carefully integrated to enable precise monitoring of the aquarium's water levels. By providing analog readings, this sensor contributes to preventing potential issues such as overflows or insufficient water levels. Its strategic placement within the aquarium ensures that it accurately captures the water level variations, enhancing the overall stability and safety of the aquatic habitat.

A dedicated pH sensor is seamlessly integrated into the AquaSenseHub to monitor the acidity levels of the aquarium water. The accurate measurement of pH is vital for maintaining a healthy and balanced aquatic environment. The pH sensor communicates with the ESP32, providing real-time data that empowers users to make

informed decisions about adjustments required to preserve the well-being of aquatic organisms.

To gauge the clarity of the water, AquaSenseHub incorporates a turbidity sensor into its assembly. This sensor plays a pivotal role in assessing water quality by measuring the suspended particles in the water. The data collected by the turbidity sensor adds another layer of information for enthusiasts, enabling them to identify and address potential issues that may impact the overall health of the aquarium.

The inclusion of the servo motor introduces an element of automation into the assembly process. This dynamic component is responsible for the automated feeding of fish within the aquarium. Its integration involves attaching the servo motor to a designated location within the aquarium and linking it to the ESP32. The servo motor's intelligent feeding mechanism ensures that aquatic life receives timely and scheduled nourishment, contributing to their overall well-being.

The assembly process is completed with the integration of an Adafruit SSD1306 OLED display. This display serves as the user interface, providing a real-time dashboard for on-site data visualization. The OLED display is connected to the ESP32, allowing enthusiasts to monitor key parameters directly without the need for a separate application. Its clear and concise presentation enhances the user experience, making it easy for users to stay informed about the aquarium conditions.

In conclusion, assembling the AquaSenseHub involves a systematic integration of components, each serving a specific purpose in creating a sophisticated and comprehensive aquarium monitoring and control system. From precise environmental sensors to intelligent automation and user-friendly displays, the assembly process ensures that AquaSenseHub stands at the forefront of advanced aquarium management technology.

3.2 Powering On and Operation

1. Powering On the AquaSenseHub:
    - Ensure a stable power supply for the AquaSenseHub components, including the ESP32 microcontroller, sensors, display, and servo motor.
    - Connect the AquaSenseHub to a power source that meets the specific power requirements of each component.
2. Initializing Wi-Fi Connectivity:
    - The ESP32 microcontroller initializes and establishes a connection to the configured Wi-Fi network upon powering on.
    - Wi-Fi connectivity is essential for remote access and monitoring, allowing users to control the AquaSenseHub and receive real-time data.
3. Temperature Monitoring:
    - The Dallas Temperature sensor captures real-time temperature readings within the aquarium.
    - The Adafruit SSD1306 OLED display visually presents temperature fluctuations, offering users an immediate overview.
4. Water Level Monitoring:
    - The water level sensor actively monitors and provides analog readings of water levels within the aquarium.
    - Analog readings are translated into a percentage, visually representing the current water level on the OLED display.
5. pH Level Monitoring:
    - The pH sensor assesses the acidity levels of the aquarium water.
    - Real-time pH data is communicated to the microcontroller, allowing users to gauge and regulate pH balance as needed.
6. Turbidity Measurement:

- The turbidity sensor evaluates water quality by measuring suspended particles within the aquarium.
- Turbidity readings are displayed on the OLED screen, enabling users to address potential water quality issues.

7. Automated Feeding with Servo Motor:
    - The AquaSenseHub incorporates a servo motor for automated feeding within the aquarium.
    - Users can schedule feeding times or manually trigger the servo motor via the Blynk app, ensuring timely nourishment for aquatic life.

The AquaSenseHub's user-centric design provides comprehensive monitoring and control capabilities. From temperature and water levels to pH balance and turbidity, each aspect is meticulously addressed, fostering a thriving aquatic environment. The AquaSenseHub seamlessly integrates technology to empower users with real-time insights and convenient control. The user-friendly design ensures that aquarium enthusiasts can manage their aquatic environment with confidence and ease.

3.3 Power Off Device

Ensuring a proper shutdown process is crucial for maintaining the integrity of the AquaSenseHub and its components. Follow these steps to power off the device safely:

1. Access the Blynk App:
    - Open the Blynk application on your mobile device or tablet.
2. Navigate to Servo Control (V4):
    - Locate the Servo Control widget on the Blynk app interface, typically assigned to Virtual Pin 4 (V4).
    - Ensure that the Servo Control widget is in the default or neutral position (usually denoted by 0 degrees).
3. Initiate Manual Servo Reset:

- If the servo motor is currently in operation or has been manually adjusted, initiate a reset to the default position.
- Use the Blynk app to set the Servo Control widget to 0 degrees, ensuring that the servo motor is not in a feeding or extended position.

4. Stop Scheduled Feeding (if applicable):
    - If you have scheduled automated feeding times, ensure that these schedules are paused or disabled.
    - This step prevents any unintended feeding actions during the power-off process.
5. Exit Blynk App:
    - Close the Blynk app on your mobile device to disconnect from the AquaSenseHub remotely.
6. Turn Off External Power Source:
    - If the AquaSenseHub is connected to an external power source, such as a power strip or dedicated power outlet, turn off the power source.
    - This action cuts off the electrical supply to the AquaSenseHub and its components.
7. Wait for Components to Power Down:
    - Allow a brief moment for all components, including the ESP32 microcontroller, sensors, display, and servo motor, to power down completely.
    - This ensures that all processes are halted before physically disconnecting any power supply.
8. Disconnect Power Supply (if applicable):
    - If the AquaSenseHub is connected to a dedicated power supply, unplug the power cable from the device.
    - Ensure that the power cable is safely disconnected from both the AquaSenseHub and the power source.
9. Optional: Power Off Display and Sensors (if applicable):
    - If the AquaSenseHub includes additional components like external displays or sensors with their power sources, follow the respective power-off procedures for these elements.
10. Store or Cover the Device (if applicable):

- If the AquaSenseHub is part of a larger aquarium setup, consider covering or storing the device in a secure location to protect it from environmental factors or accidental damage.

4. How To Using AquaSenseHub

4.1 Interface Description

The provided code defines the interface for the AquaSenseHub project, which is based on the ESP32 microcontroller and incorporates various sensors for monitoring an aquarium environment. Let's break down the key elements of the interface description:

1. Blynk Configuration:
    - The code begins by configuring Blynk with a template ID, template name, and authentication token. This establishes a connection between the AquaSenseHub and the Blynk application, enabling remote monitoring and control.
2. Task and Timer Initialization:
    - The code initializes different tasks for monitoring water temperature, water level, turbidity, pH, OLED display, and servo control. Each task runs independently, ensuring efficient parallel execution through the FreeRTOS multitasking library.
    - A timer (servoTimer) is created to trigger the servoTimerCallback function at regular intervals, facilitating automated fish feeding.
3. Sensor Configuration:
    - The code sets up configurations for various sensors, including the Dallas Temperature sensor for water temperature, a water level sensor, a turbidity sensor, and a pH sensor.
4. WiFi Connection:

- The AquaSenseHub connects to a WiFi network using the provided SSID and password. This enables communication with the Blynk server for remote access.

5. Blynk App Interaction:
    - Blynk_WRITE(V4) is a Blynk callback that listens for input on Virtual Pin 4. When activated, it triggers the activateServo() function, allowing users to manually control the servo through the Blynk app.
    - The Blynk.virtualWrite statements update the Blynk app with real-time sensor data (temperature, water level, turbidity, pH) for user visualization.
6. Task Functions:
    - Each task function (e.g., taskWaterTemp, taskWaterLevel, taskTurbidity, taskPhSensor, taskOled, taskServo) is responsible for collecting and processing specific sensor data or controlling components.
7. Semaphore and Queue Management:
    - Semaphores (e.g., temperatureSemaphore, waterLevelSemaphore) are used to manage access to shared resources, ensuring synchronized data access among tasks.
    - Queues (e.g., temperatureQueue, waterLevelQueue) facilitate communication between tasks, allowing seamless data transfer.
8. OLED Display:
    - The taskOled function manages the OLED display, presenting real-time information about aquarium conditions, including temperature, water level, turbidity, and pH.
9. Servo Control:

- The activateServo() function controls the servo motor, simulating automated fish feeding. The taskServo function manages the servoTimer, ensuring periodic activation for scheduled feeding.

10. Setup and Loop:
    - The setup function initializes necessary components, tasks, semaphores, and queues.
    - The loop function is dedicated to running the Blynk application.

4.2 Step To Operation

To effectively operate the AquaSenseHub aquarium monitoring and control system, follow these comprehensive steps:

1. Power On the Device:
    - Connect the AquaSenseHub to a stable power source using the provided power adapter.
    - Ensure proper power input to the device and wait for the initialization process to complete.
2. Initialization and Boot-up:
    - Upon powering on, the AquaSenseHub undergoes an initialization sequence, initializing all essential components, sensors, and establishing connections.
    - Monitor the status messages on the serial monitor to confirm successful initialization.
3. Connect to WiFi:
    - The AquaSenseHub is designed to connect to a WiFi network for remote access and control.
    - During the initialization process, the device will automatically attempt to connect to the WiFi network specified in the code (SSID and password).

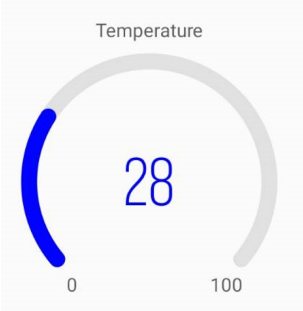
4. Blynk Application Setup:
    - Download and install the Blynk application on your mobile device from the respective app store.
    - Create a new project in the Blynk app and configure it with the provided Blynk template ID, template name, and authentication token.
5. Monitor Sensor Data:
    - Open the Blynk app and access the AquaSenseHub project.
    - The app displays real-time data from various sensors, including water temperature, water level, turbidity, and pH.
    - Ensure that the displayed values are within the desired ranges for optimal aquarium conditions.
6. Remote Control via Blynk:
    - Leverage the Blynk app interface to remotely control the AquaSenseHub.
    - Use the provided Blynk widgets to trigger manual actions, such as activating the servo motor for fish feeding.
    - Monitor the response of the system to ensure seamless remote control.
7. Automated Fish Feeding:
    - The AquaSenseHub integrates a servo motor for automated fish feeding.
    - The servo is programmed to activate periodically, simulating the feeding process.
    - Verify that the servo motor operates as expected during the automated feeding cycles.
8. On-site Monitoring with OLED Display:
    - The AquaSenseHub features an OLED display that provides on-site insights into aquarium conditions.
    - The display shows real-time data, including temperature, water level, turbidity, and pH.
    - Check the OLED display for accurate and up-to-date information.

9. Scheduled Tasks with Timer Mechanism:
    - The AquaSenseHub employs a timer mechanism for scheduling tasks.
    - The timer activates the servo motor at regular intervals, ensuring consistent and timely automated fish feeding.
    - Confirm that the timer mechanism is functioning correctly and that scheduled tasks are executed as planned.
10. Shutdown and Power Off:
    - When done, safely power off the AquaSenseHub to conserve energy.
    - Disconnect the power supply, ensuring a graceful shutdown of all components.

5. AquaSenseHub Features

5.1 Sensor Temperature

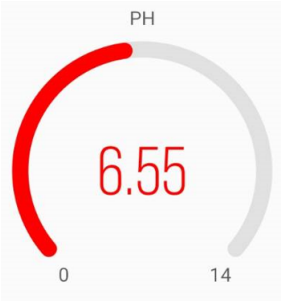
The temperature sensor in the AquaSenseHub plays a vital role in monitoring the aquarium's thermal conditions. Managed by the 'taskWaterTemp' function within a dedicated FreeRTOS task, this sensor, utilizing the Dallas Temperature sensor and OneWire library, delivers precise temperature readings in degrees Celsius. The AquaSenseHub employs dynamic LED indicators controlled by pins 5, 19, and 23 to visually convey temperature information. The LEDs signal optimal, moderately warm, or potentially elevated temperatures based on predefined thresholds.



Integration with the Blynk platform enhances the sensor's functionality, allowing users to remotely monitor temperature (V0) through the Blynk application. The 'Blynk.virtualWrite'

function facilitates seamless data transmission. To ensure efficient data management, the 'temperatureQueue' queue is implemented, enabling inter-task communication. The OLED display task, 'taskOled,' further enriches the user experience by presenting real-time temperature data on-site. This integration ensures that users have immediate and accessible insights into the aquarium's temperature status.

5.2 Sensor PH



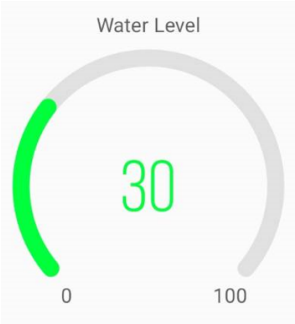
The pH sensor in the AquaSenseHub is integral for assessing the acidity or alkalinity of aquarium water, a key factor in maintaining a healthy aquatic environment. Managed by the 'taskPhSensor' in a dedicated FreeRTOS task, this sensor, connected to PhSensorPin, continuously provides real-time pH readings. Utilizing an analog pH sensor, the AquaSenseHub employs the 'convertToPhLevel' function to transform voltage readings into precise pH values. This data is then integrated into the monitoring system, contributing to a holistic understanding of the aquarium's conditions. For Blynk platform integration, pH sensor data is transmitted to the Blynk application via 'Blynk.virtualWrite' on virtual pin V2. This enables users to remotely monitor pH levels, enhancing convenience and enabling prompt responses to any fluctuations.

5.4 Sensor Turbidity

A turbidity sensor measures the cloudiness or haziness of a fluid caused by large particles or suspended solids present in the water. In the context of aquariums or water monitoring systems, the turbidity sensor provides information about the clarity or opaqueness of the water. High turbidity levels may indicate the

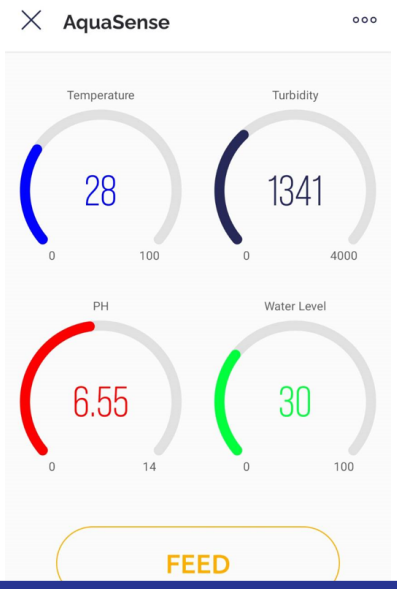
presence of particles or impurities, affecting water quality. Monitoring turbidity is crucial in maintaining a healthy aquatic environment, as excessive particles in the water can impact the well-being of aquatic organisms and hinder the effectiveness of filtration systems.

5.5 Sensor Water Level



The Water Level sensor plays a pivotal role in the AquaSenseHub, contributing to its comprehensive monitoring capabilities. This sensor is designed to accurately gauge the water level within the aquarium, providing real-time data on the depth of water. By employing technologies such as ultrasonic or capacitive sensing, the Water Level sensor ensures precise measurements, allowing users to monitor fluctuations and maintain optimal water levels for the well-being of aquatic life. The AquaSenseHub leverages this sensor to enhance the user's understanding of the aquarium environment, providing valuable insights for effective and proactive aquarium management. The Water Level sensor is an integral component of the AquaSenseHub's commitment to creating an intelligent and user-friendly system for aquarium enthusiasts.

5.6 Display and Blynk



The AquaSenseHub is equipped with a display module, which is an OLED screen. This module serves as a local display, presenting real-time sensor readings and system status directly on the device. Users can conveniently check critical parameters such as water level, pH, temperature, and turbidity at a glance, enhancing the device's usability

and accessibility. In addition to the local display, the AquaSenseHub integrates seamlessly with the Blynk platform. Through the Blynk mobile application, users gain remote access to their aquarium's data. The Blynk app provides an intuitive and user-friendly interface, allowing users to monitor sensor readings, receive notifications, and even control certain aspects of the aquarium remotely. This integration extends the AquaSenseHub's functionality beyond the physical device, empowering users to manage their aquariums from anywhere.

6. Call Center and Contact Information

For inquiries, assistance, or collaboration opportunities, you can reach out to Team AquaSense through the following channels:

Email:

- General Inquiries: aquasense.team@gmail.com
- Technical Support: support.aquasense@gmail.com
- Collaboration Opportunities: partnership.aquasense@gmail.com

Phone:

- Call Center: +62 123 456 7890

Social Media:

- Facebook: facebook.com/AquaSenseTeam
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- Instagram: instagram.com/AquaSenseTeam

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