Sri Lanka Institute of Information Technology

IT1040 - Fundamentals of Computing
Year 1, Semester 1- 2025

Smart Fish Feeder System (Feedify)

“Feedify: Smart Feeding for Aquatic Life”

Progress Report
Y1S1Mtr16

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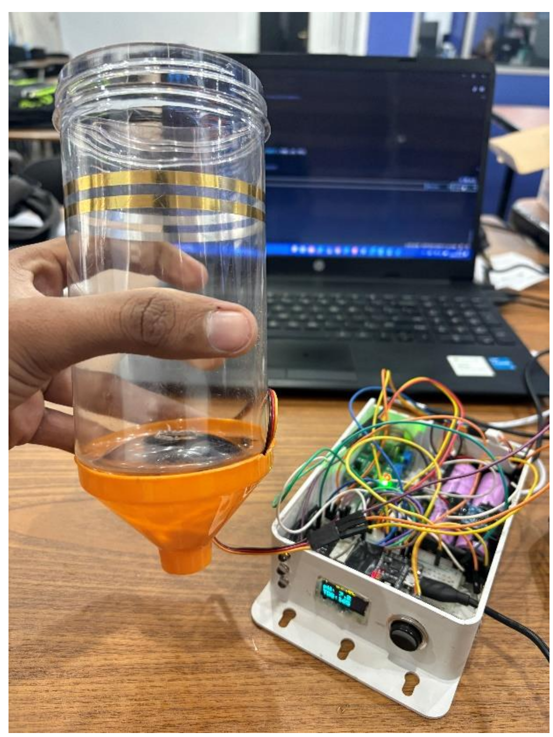
1. Introduction

Aquaculture and home aquarium management are becoming increasingly popular activities worldwide. However, manually feeding fish presents several challenges, as forgetting to feed or overfeeding fish can harm their health and significantly pollute the water environment. Additionally, maintaining optimal water conditions requires constant monitoring, which is difficult to achieve through manual observation alone.

To address these challenges, our project proposes a Smart Fish Feeder System, named "**Feedify**," which uses an ESP32 microcontroller integrated with environmental sensors. The system automates feeding schedules while simultaneously monitoring critical water parameters including pH levels, total dissolved solids (TDS), and temperature. By combining automation with environmental awareness, the system reduces human error, ensures consistent feeding, and promotes a healthier, cleaner, and more sustainable aquatic environment for fish.

The primary objective of this project is to develop a farmer-friendly smart feeding solution accessible through both mobile and web applications. Feedify enables users to monitor water conditions in real-time, manage feeding schedules efficiently, and control the automatic fish feeder remotely. By providing an intuitive yet powerful interface, the system aims to simplify aquaculture management, reduce manual workload, and ensure that aquatic environments remain properly maintained for optimal fish health and productivity.



2. System Architecture

Our Smart Fish Feeder System is designed as an integrated hardware and software solution where multiple components work together seamlessly. The ESP32 microcontroller serves as the central processing unit, continuously reading data from multiple sensors and controlling mechanical and electrical output devices. The architecture supports both automatic scheduling and manual operation through web and mobile platforms.

Key System Components

- **ESP32 Microcontroller**
  The ESP32 acts as the brain of the system, responsible for processing all sensor data and controlling output devices. It reads real-time values from the pH, TDS, and temperature sensors, applies calibration formulas to ensure accuracy, and makes decisions about when to activate the servo motor for feeding. The microcontroller also manages communication with the web and mobile applications through wireless protocols, enabling remote monitoring and control.

- **Servo Motor**
  The servo motor is the primary actuator for food dispensing. It controls the opening and closing of the food feeding mechanism with precise angular movements. When triggered either by the automatic schedule or manual command, the servo motor rotates to dispense the appropriate amount of fish food. The motor is powered by the main power supply and can be controlled programmatically through PWM signals from the ESP32.

- **pH Sensor**
  The pH sensor detects the hydrogen ion concentration in water, which is critical for understanding water acidity or alkalinity. This measurement is essential for maintaining an environment suitable for the specific fish species. The sensor's analog output is converted to digital signals by the ESP32, and calibration equations are applied to ensure accurate readings. The pH readings are displayed on the OLED screen and transmitted to the user applications for monitoring.

- **Temperature Sensor**
  The temperature sensor measures water temperature in real-time. Fish species have specific temperature ranges in which they thrive, making continuous temperature monitoring essential. The sensor output is read by the ESP32 and converted into temperature values in degrees Celsius using a programmed formula. These readings are continuously logged and made available through the system interface.

- **TDS Sensor**

  The TDS (Total Dissolved Solids) sensor measures the concentration of dissolved substances in water, expressed in parts per million (ppm). High TDS levels can indicate water quality issues requiring attention. The sensor is calibrated against known standard solutions, and a calibration factor is established to convert raw voltage readings into accurate TDS values. The system uses this data to alert users to potential water quality concerns.

- **OLED Display**

  A 12C OLED display is integrated into the hardware setup to show real-time readings from all sensors. This provides immediate visual feedback for users interacting with the physical device. The display shows pH values, water temperature, TDS measurements, and system status information. This feature is particularly useful for on-site monitoring without requiring a mobile device.

- **Solar Panel and Battery Backup System**

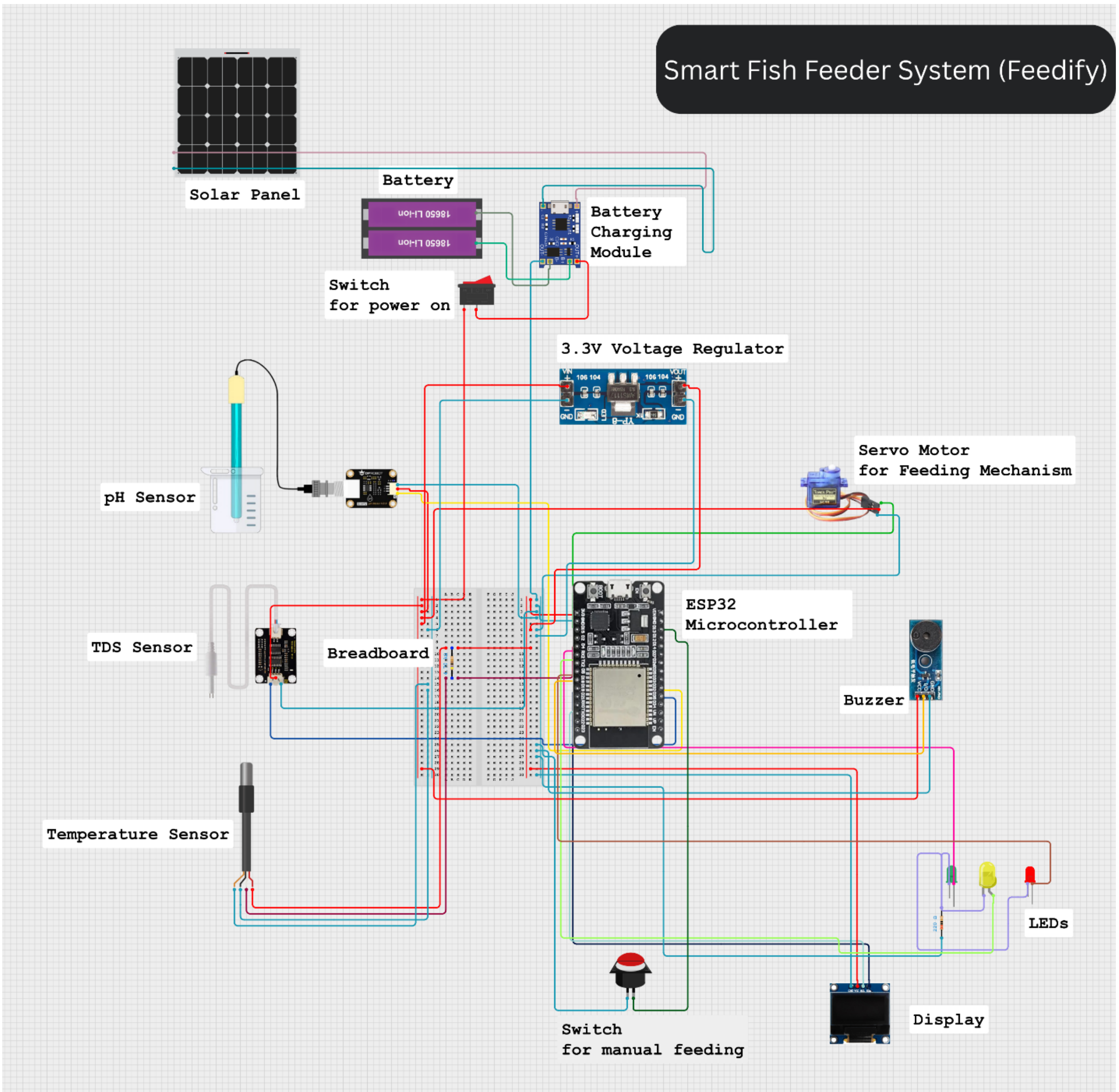
  The system incorporates a solar panel as a renewable energy source, enabling the Smart Fish Feeder to operate independently of traditional power supplies. The solar panel charges a battery that powers the ESP32, sensors, and servo motor, making the system more sustainable and energy-efficient. This feature is particularly advantageous for outdoor aquaculture settings where mains electricity may not be readily available.

- **Buzzer**

  An audio alert buzzer provides notification signals to the user when specific events occur. The buzzer activates when feeding has been completed, when water quality parameters fall outside acceptable ranges, or when system anomalies are detected. This ensures users remain informed about the system status even without checking the display.

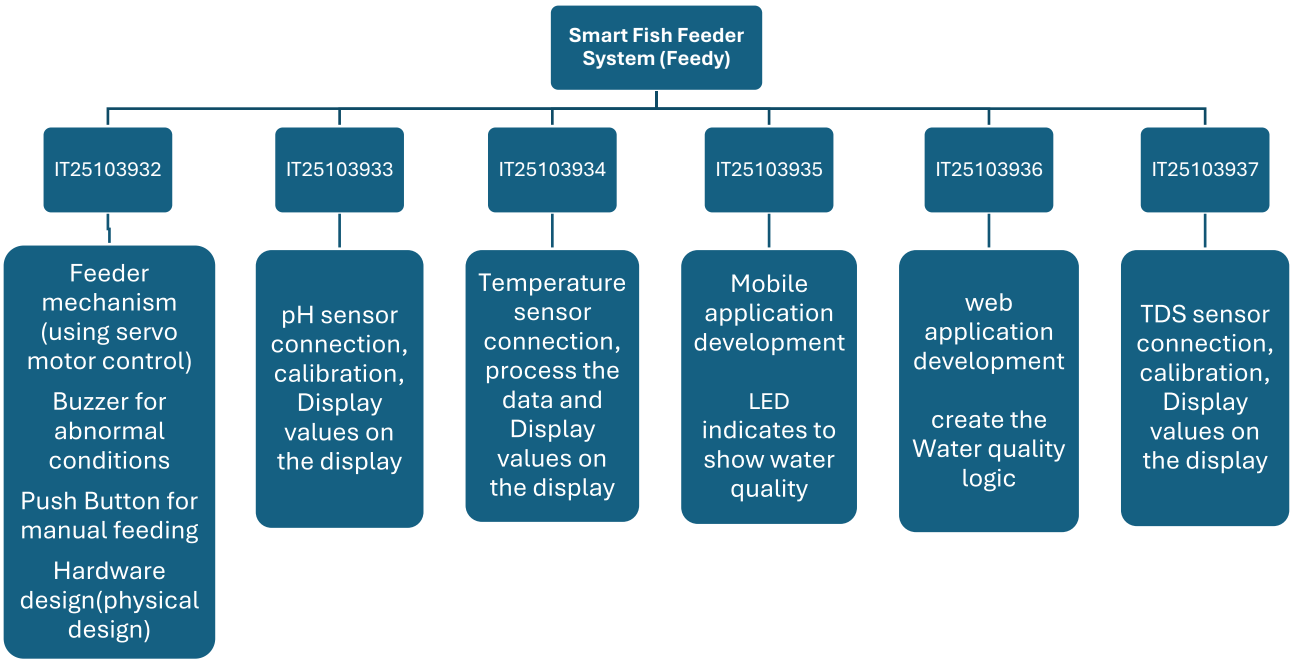
- **Push Button**

  A physical push button provides manual control capabilities, allowing users to trigger feeding immediately or reset the system when necessary. This switch provides an intuitive interface for direct interaction with the device, ensuring functionality even if the wireless connectivity is temporarily unavailable.



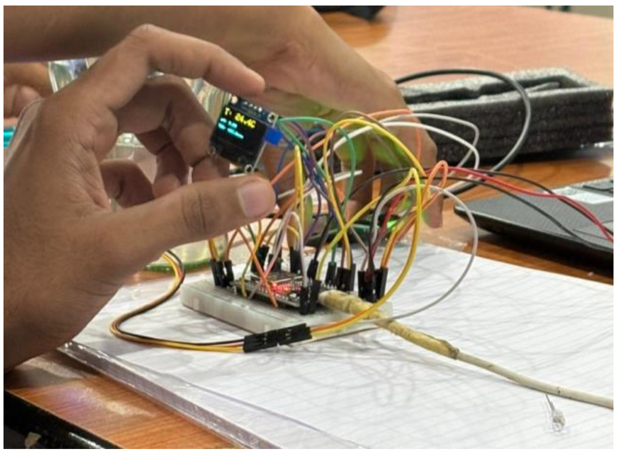
Smart Fish Feeder System (Feedify)
Solar Panel
Battery
Battery Charging Module
Switch for power on
3.3V Voltage Regulator
pH Sensor
Servo Motor for Feeding Mechanism
TDS Sensor
Breadboard
ESP32 Microcontroller
Buzzer
Temperature Sensor
LEDs
Display
Switch for manual feeding

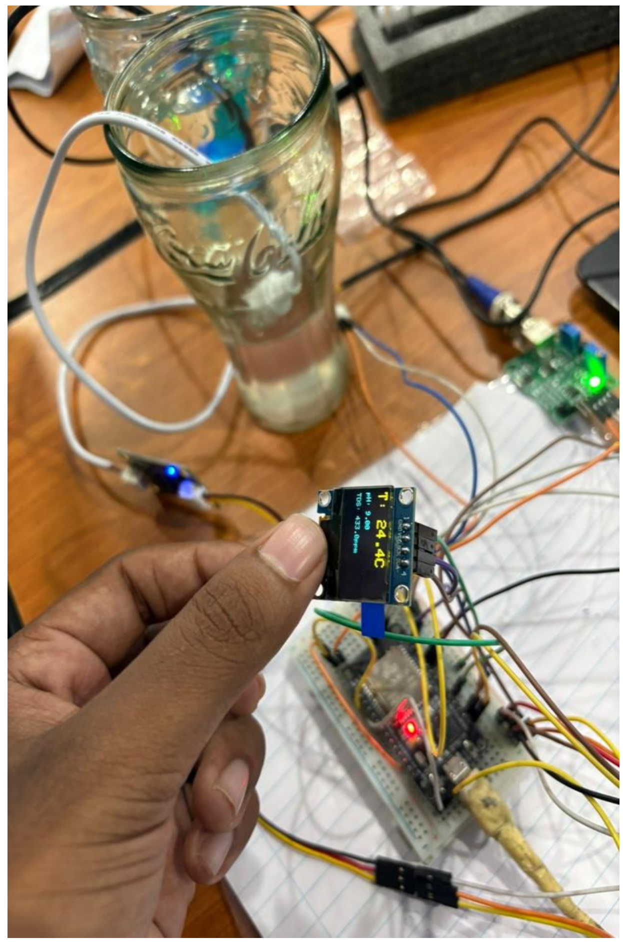
3. Work Breakdown Structure

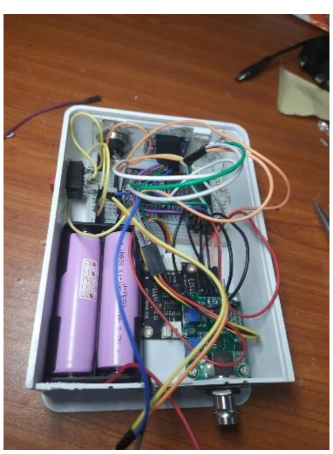


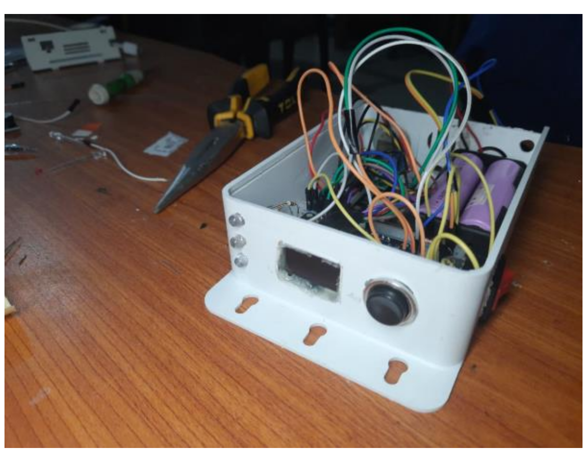
4. Proof of Work

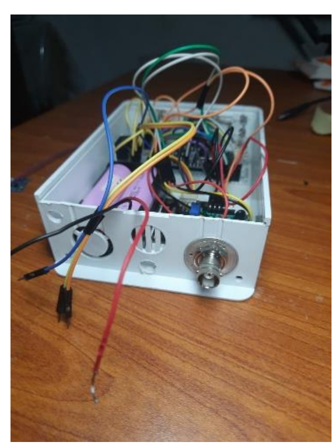
The team has assembled a fully functional hardware prototype demonstrating all major components working together. Photographs of the assembled system show the ESP32 microcontroller board with connected sensors, the servo motor mechanism, OLED display showing real-time readings, and the battery backup power system. The circuit assembly is clean and properly documented with components.











Sensor Calibration Testing

pH Sensor Calibration Results

The pH sensor was systematically calibrated using standard buffer solutions:

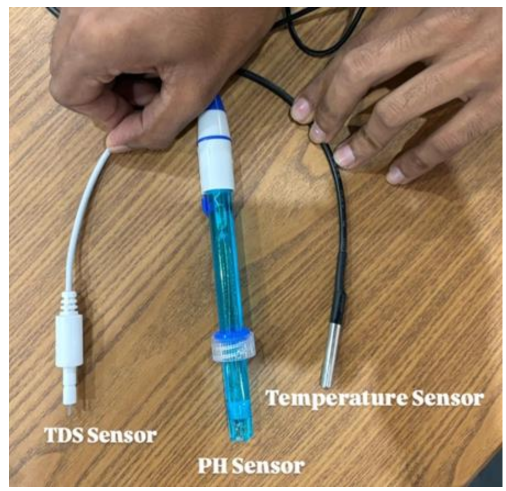
- At pH 4 buffer: Voltage recorded = 2.260 V
- At pH 7 buffer: Voltage recorded = 1.864 V

Derived calibration equation:
Slope = (7 – 4) / (1.864 – 2.260) = 3 / (−0.396) = −7.57

Final formula: pH = −7.57 × (Voltage – 2.260) + 4

Testing with multiple water samples confirmed accuracy within ±0.2 pH units.

Temperature Sensor Testing



The temperature sensor was immersed in water samples at known temperatures. The ESP32 converted the sensor output to temperature values using the programmed formula. Serial monitor verification confirmed readings accurate to within ±1°C across the tested range (15°C to 60°C).

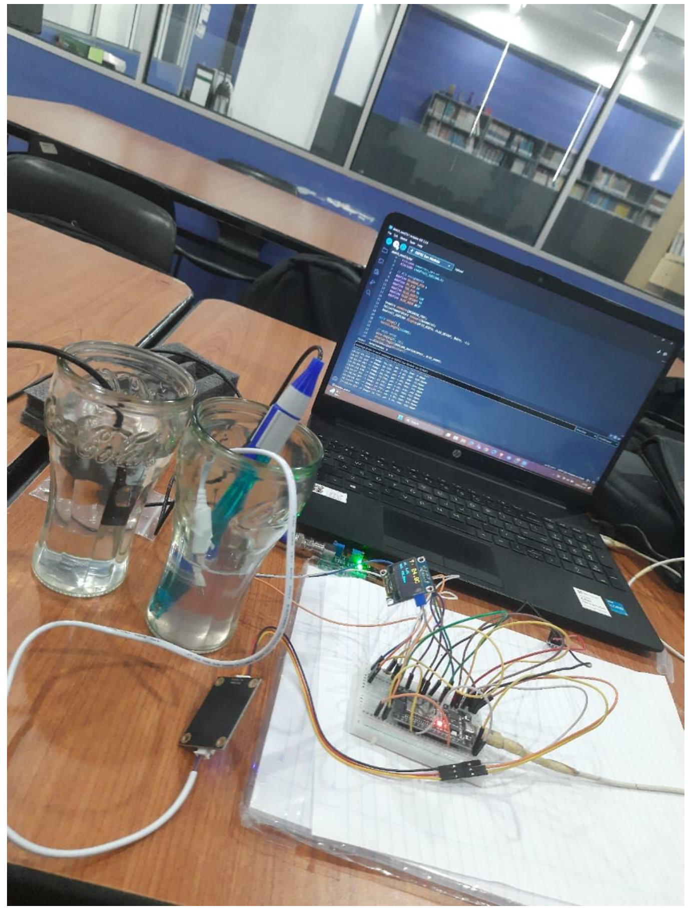
TDS Sensor Calibration

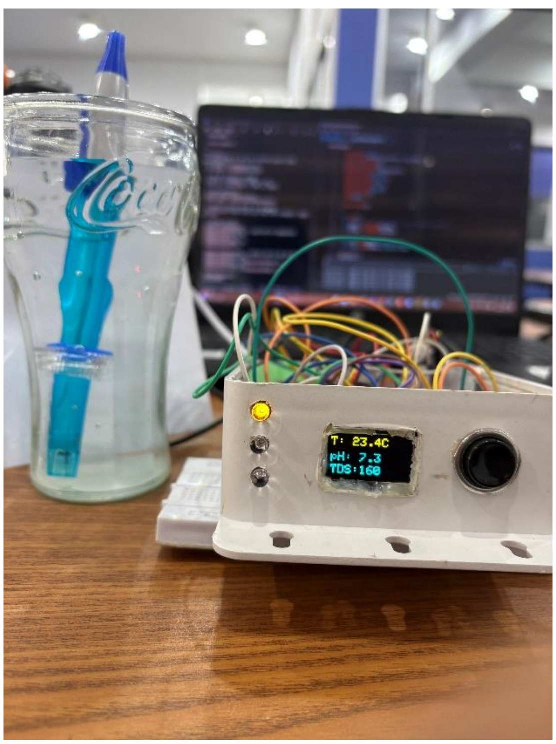
The TDS sensor was calibrated using standard drinking water solutions with known TDS values (50-150 ppm). Voltage readings were recorded and a calibration factor was established:

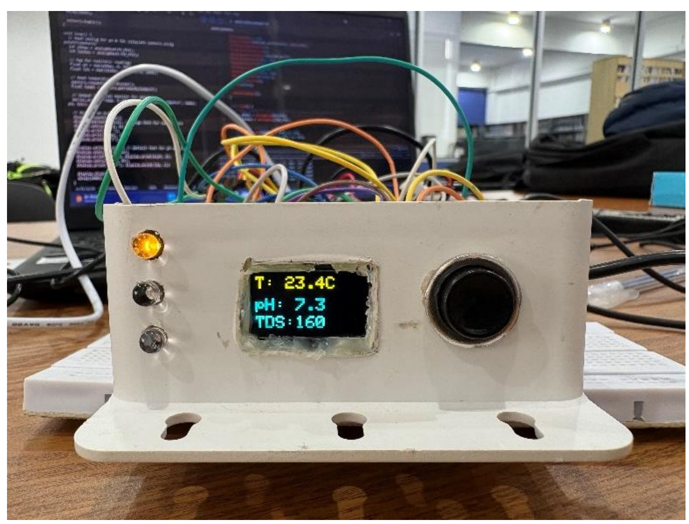
TDS (ppm) = Voltage × Calibration Factor

Testing with water samples of varying salinity confirmed calibration accuracy, with results within ±5 ppm of expected values.


TDS:160

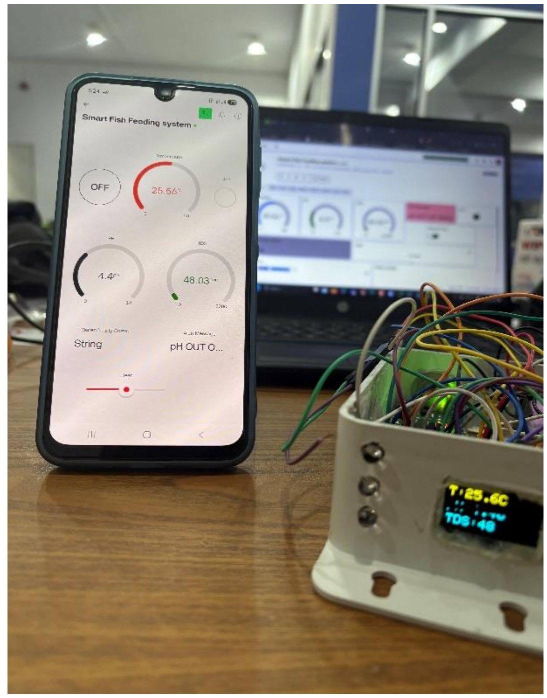


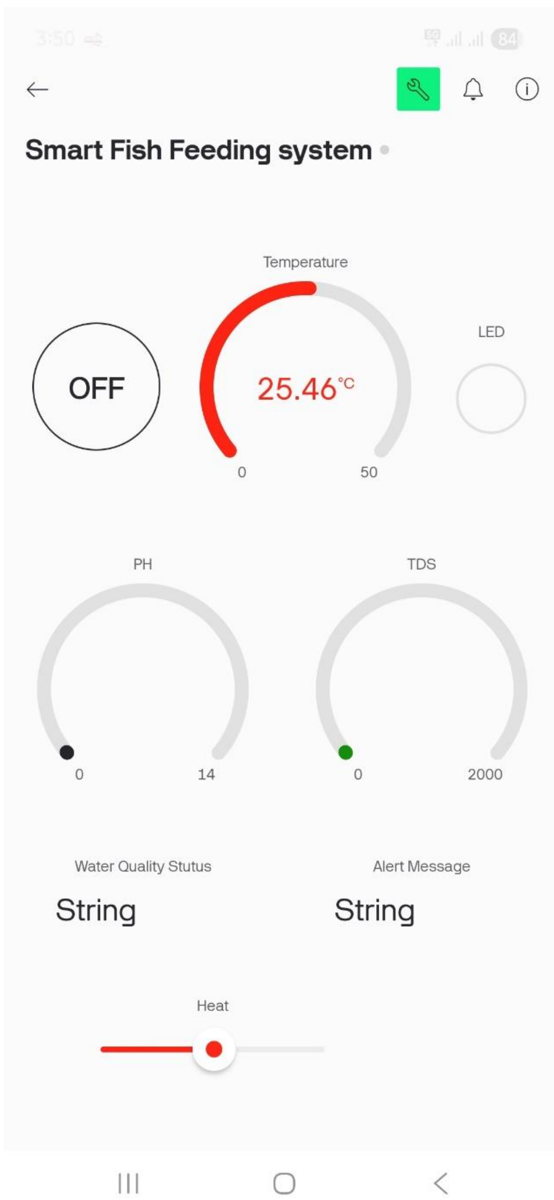

T: 23.4C
pH: 7.3
TDS:160

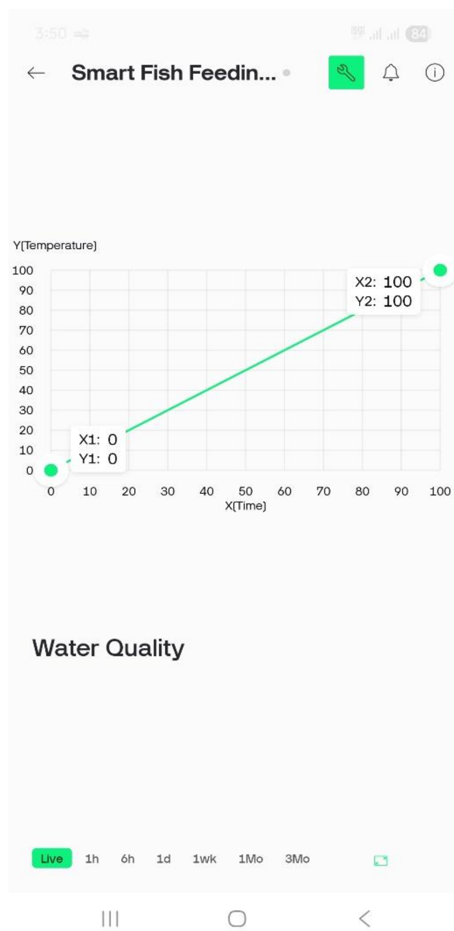

T: 23.4C
pH: 7.3
TDS:160

Mobile Application Interface

The mobile application interface displays a dashboard with real-time sensor readings, a feeding schedule management screen, manual feeding control buttons, and system status indicators. Screenshots demonstrate clear, intuitive design with large, readable fonts suitable for various user ages and technical backgrounds. The app successfully communicates with the hardware and updates data in real-time.

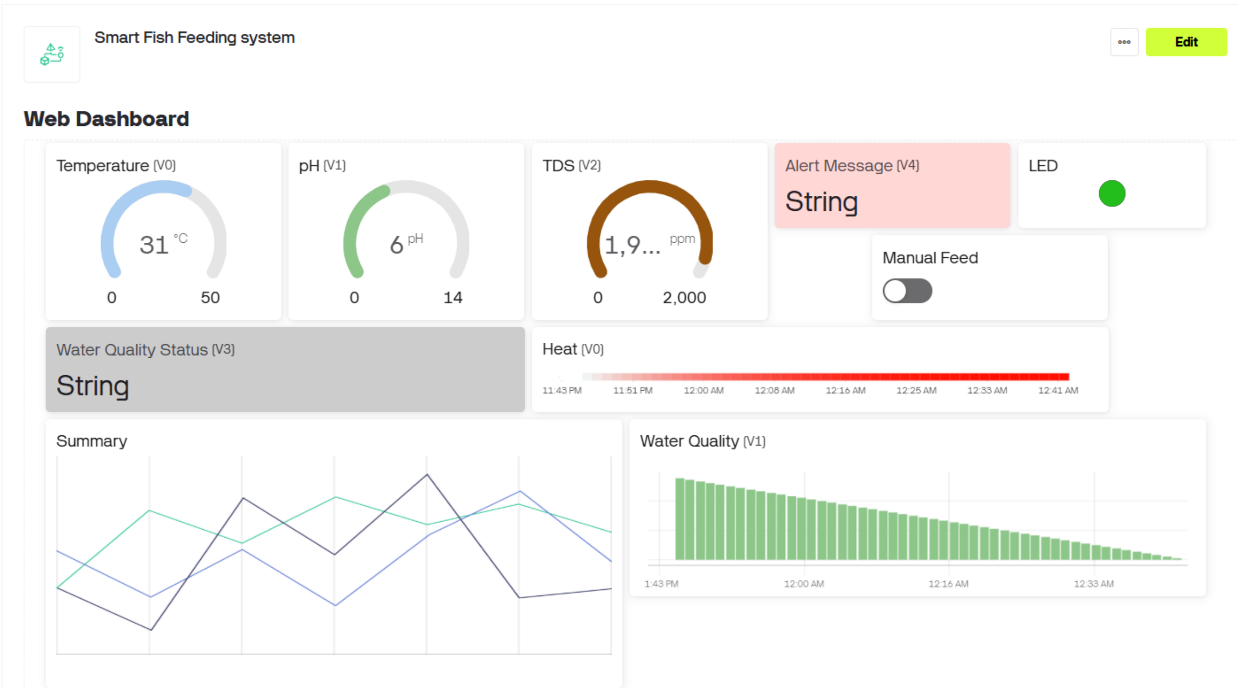


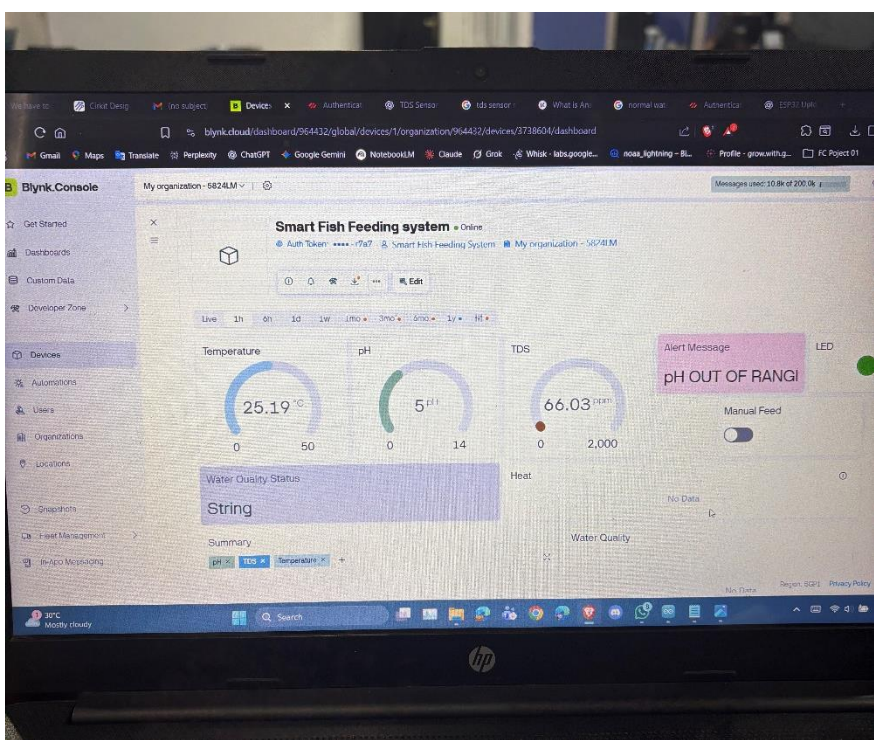




Web Application Dashboard

The web platform provides a desktop-friendly interface for monitoring and controlling the system. Real-time graphs display sensor trends over time. The feeding history log shows all feeding events with timestamps. Users can manage multiple devices if they have multiple aquaculture installations. The responsive design works on tablets and laptops.





Feeder Mechanism

The automatic fish feeder mechanism is designed to dispense precise quantities of fish food based on water quality parameters and user input via a mobile/web application. The system uses a servo motor to control a gate that regulates food release.

Feed Calculation Algorithm

The feeding decision is made based on:

1. **User Input:** Fish count, fish type, fish size (via mobile app).
2. **Biomass Calculation:** Total biomass = Fish count × Average weight per fish.
3. **Feeding Rate:** Determined from a temperature-dependent lookup table:
    - < 18°C: 1% of body weight daily (cold water, slow metabolism)
    - 18–28°C: 3% of body weight daily (optimal range)
    - *28°C: 2% of body weight daily (warm water, reduced feeding)*
4. **Health Factor: If water quality is outside safe ranges (ex:- pH 7.5–8.5, TDS > 400 ppm, Temp 28–35°C), feeding is reduced or stopped.**

Formula:

$$\text{Daily Feed (grams)} = (\text{Fish Count} \times \text{Avg Weight}) \times \text{Feed Rate \%} \times \text{Health Factor}$$

Servo Timing: Calculate open time:

$$\text{Open Time (seconds)} = \frac{\text{Feed Weight (grams)}}{\text{Flow Rate (g/s)}}$$