

TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN ĐHQG-HCM

Information Technology Department



Physics for Information Technology

Final Project Proposal

Smart Fish Tank

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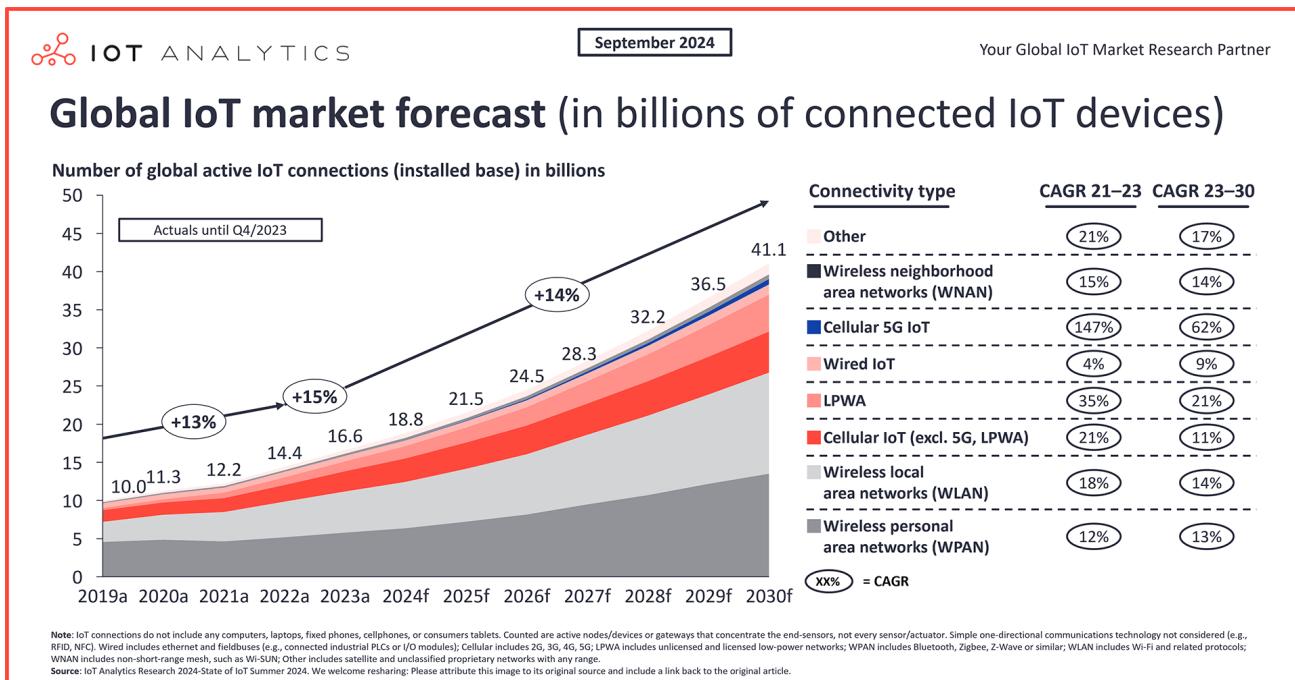
Abstract

The application of modern IoT technology has led to significant advancements in aquaculture management systems. By reimagining traditional fish tanks, this system introduces comprehensive monitoring capabilities through three subsystems: environmental monitoring, fish care, and user-centric features. These functionalities suit real-world contexts such as aquaculture farming and home fish care. Its design is both visually appealing and user-friendly, supported by a website interface packed with smart features and secure cloud data backup. With its cost-efficiency and promising potential, this system is well-positioned to become a competitive market solution.

Introduction

Smart Fish Tank

Since 2019, IoT has grown rapidly, with significant investments aimed at connecting more devices to the internet, leading to new advanced functionalities. [1]



The world wide pandemic has highlighted the limitations of traditional agricultural methods, emphasizing the need for automation due to restrictions on movement and gatherings. In response to these challenges, our team has developed a Smart IoT Fish Tank, designed to address the needs of fish owners and farmers. The system integrates three key subsystems:

- **Environmental Monitoring:** Uses sensors to track water quality metrics such as pH, temperature, and humidity, with real-time and historical data accessible online.
- **Fish Care Automation:** Offers features like scheduled feeding, water filtration, and purity level management.
- **User-friendly Features:** Designed to simplify fish care for home users, with automated lighting and remote control options.

Market

The Smart Fish Tanks Market is characterized by technologically advanced aquarium systems that integrate IoT (Internet of Things) capabilities to monitor and manage aquatic environments. These intelligent fish tanks leverage sensors, connectivity, and automation to create an optimal habitat for aquatic life. The primary objective is to enhance the overall well-being of fish by maintaining water quality, temperature, and other critical parameters. These systems often include features such as remote monitoring, automated feeding, and real-time data analytics, providing users with insights into the aquarium's conditions. The market encompasses a range of offerings, from basic smart aquariums for hobbyists to sophisticated solutions designed for professional aquaculture operations.

Opportunities in the Smart Fish Tanks Market abound as consumers increasingly seek advanced technologies to streamline the maintenance of aquatic ecosystems. The growing popularity of smart homes and the integration of IoT devices further contribute to the market's expansion. Opportunities extend beyond individual consumers to include commercial applications in aquaculture and research institutions that require precise environmental control for breeding and experimentation. Segmentation in this market is driven by various factors, including tank size, application (e.g., home aquariums, commercial aquaculture), and the level of automation and connectivity offered. As technology continues to advance, the Smart Fish Tanks Market is expected to witness increased innovation, with a focus on sustainability, energy efficiency, and the seamless integration of smart features to cater to the evolving demands of both hobbyists and professionals in the aquatic industry.[2]

Features

Key features of the IoT Fish Tank include:

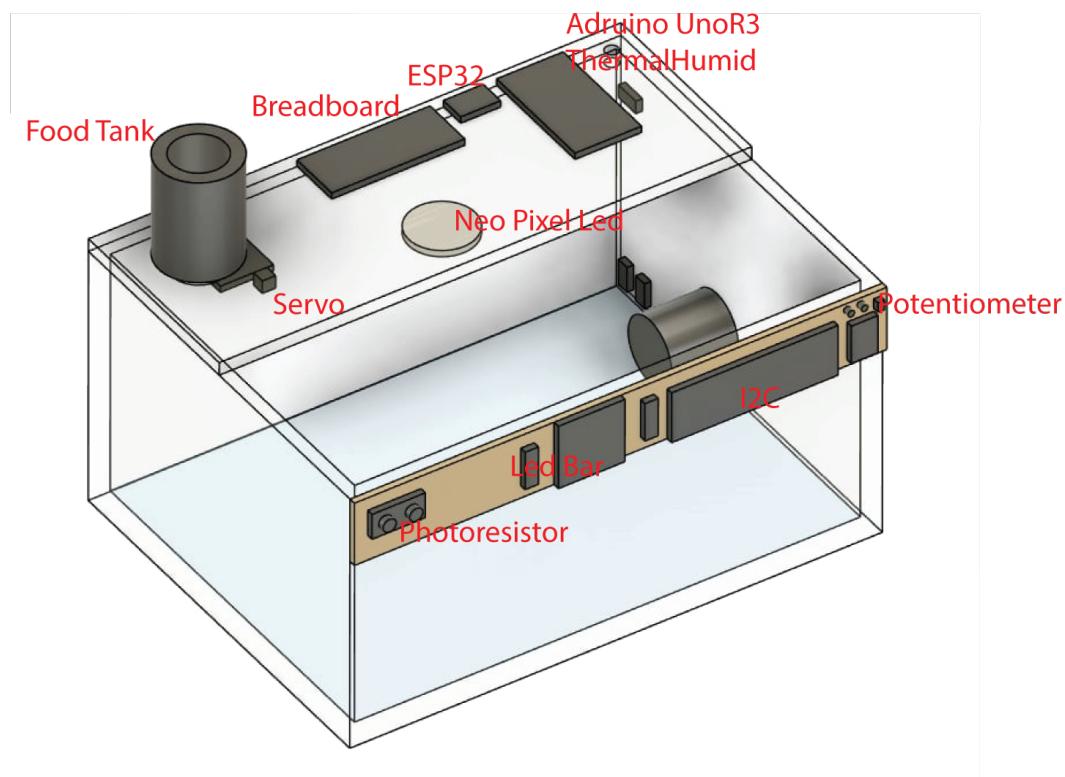
- On-demand and scheduled feeding.
- Temperature and humidity monitoring.
- Water quality tracking.
- Automated and manual LED controls.
- Water pump control for oxygen and filtration.
- An LCD display for essential information.
- Push notifications for critical updates.
- Cloud-based data backup for security and accessibility.
- Water level tracking.

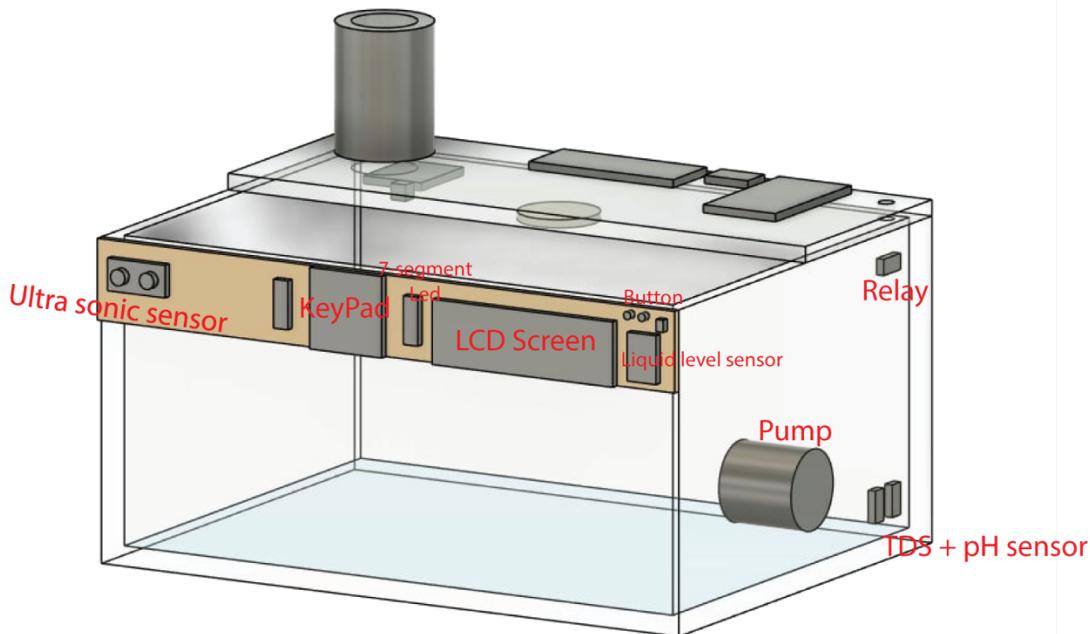
Product Design

Fish Tank Model

Our 3D prototype divides the IoT fish tank design into three main parts: the fish tank itself, the input/output area, and the top section with components.

- Feeding is controlled by a servo that opens the feed container, releasing food into the tank.
- A relay manages the pump's power source.
- Buttons enable users to control the pump, LED lighting, and feeding actions.
- The LCD screen displays critical metrics, while an LED bar indicates real-time water pH levels.
- A schedule feature operates via a keypad, and a potentiometer adjusts light intensity.
- An ultrasonic sensor detects nearby motion, which can trigger pre-set actions such as activating lights or sending alerts.

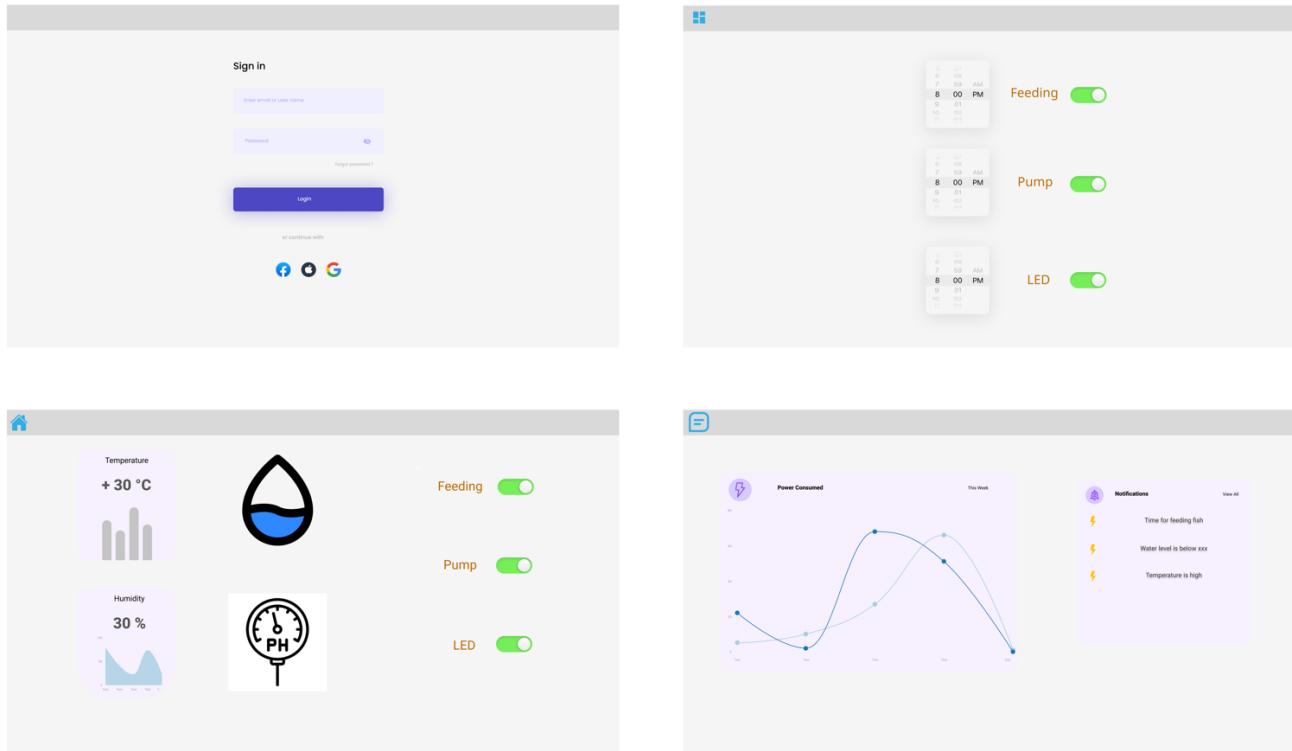




1. **Arduino Uno R3:** Acts as a microcontroller to manage and process input from sensors and control actuators in the fish tank system. It may work in conjunction with the ESP32 to handle specific tasks like interfacing with certain sensors or controlling devices that require more I/O pins.
2. **ESP32:** Serves as the main microcontroller with built-in Wi-Fi and Bluetooth capabilities, enabling the fish tank to connect to the internet for remote monitoring and control. It processes data from sensors and communicates with cloud services or mobile apps.
3. **Humidity and Temperature Sensor:** Measures the ambient humidity and temperature around the fish tank to monitor environmental conditions. This ensures the surrounding environment remains optimal for the fish and alerts the system to any significant changes.
4. **pH Sensor:** Monitors the pH level of the water in the fish tank to maintain a healthy aquatic environment. It alerts the system or automatically adjusts conditions if the pH levels move outside the desired range.
5. **Photoresistor:** Detects ambient light levels to automatically adjust the fish tank's lighting. It helps in simulating natural day/night cycles or maintaining consistent lighting conditions for the fish and plants.
6. **Pump:** Circulates water within the fish tank for aeration and filtration. It can be controlled to regulate water flow or integrated into an automated water-changing system.

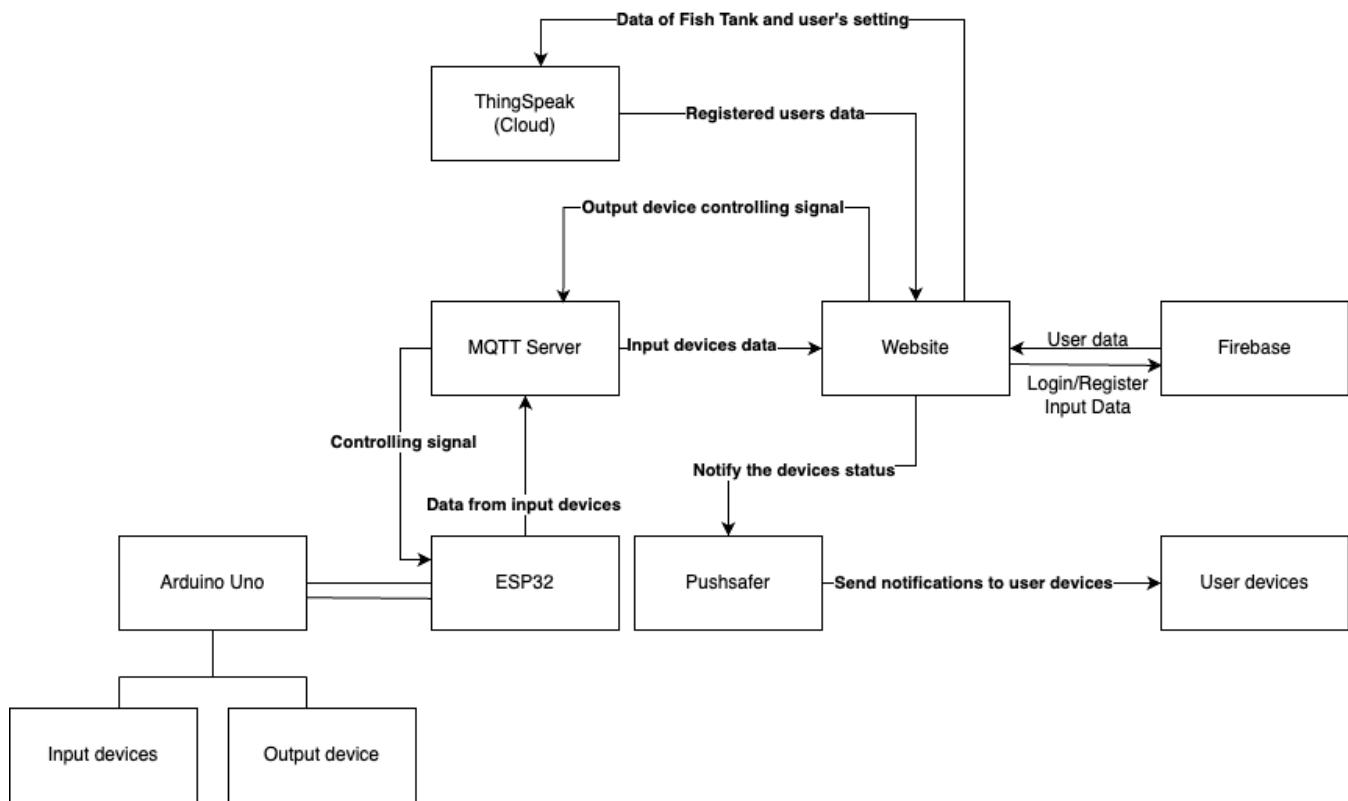
7. **Keypad:** Input specific times and quantities for automated feeding controlled by the servo motor.
8. **Potentiometer:** Provides manual control over variables such as light brightness or pump speed. Users can adjust system settings directly using the potentiometer as an input device.
9. **Relay:** Allows the microcontroller to control high-power devices like the pump or lighting system by acting as an electrically operated switch. It enables automated on/off control of these devices.
10. **Buttons** (2 pieces): Serve as manual input controls for the system. They can be programmed for functions like initiating fish feeding, resetting the system, or toggling between different modes.
11. **LED Bar:** Provides illumination for the fish tank with adjustable brightness or color settings. It enhances the visual appeal and supports the growth of aquatic plants by supplying necessary light.
12. **7-Segment LED Display:** Shows numerical data such as water temperature, pH levels, or the current time. It offers real-time information to users directly on the tank.
13. **NeoPixel Ring:** Features individually addressable RGB LEDs for creating customizable lighting effects. It can simulate natural lighting conditions, display visual alerts, or indicate system statuses through color changes.
14. **Ultrasonic Sensor (Waterproof):** Detect whenever a person goes nearby, the LED will automatically turn on.
15. **TDS Sensor:** Measures the Total Dissolved Solids in the water to assess water quality. Maintaining appropriate TDS levels is crucial for the health of the fish, and the sensor helps in monitoring and managing these levels.
16. **Servo:** Controls mechanical movements, such as operating an automatic fish feeder or adjusting valves. It enables automation of feeding schedules or water flow adjustments within the tank.
17. **Breadboard:** Used for building and testing the electronic circuits of the system without soldering. It facilitates easy prototyping and modification of the circuit designs.
18. **LCD Screen + I2C intergrated:** Display information, real-time data of sensor.
19. **Digital Liquid Level Sensor:** Detects the presence or absence of water at specific points in the tank. It provides accurate water level readings and triggers alerts or automated responses if the water level deviates from desired parameters.

UI website



Data Flow

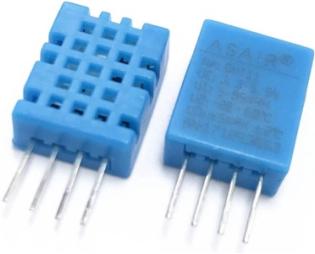
The system links input and output devices to an Arduino Uno R3, which is connected to an ESP32 module for Internet communication. The MQTT protocol acts as a bridge between the ESP32 and the website, enabling data to flow from the Arduino to the web interface and control signals to be sent back. Data is backed up on a cloud service (ThingSpeak or Firebase), with essential alerts sent to users via Pushsafer.



Project Management

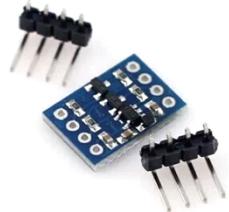
Quotation

Our components list:

No.	Name	Price (VND)	Amount	Source
1	Arduino Uno R3 	125.000	1	https://hshop.vn/arduino-uno-r3
2	ESP32 	190.000	1	https://hshop.vn/kit-rf-thu-phat-wifi-ble-esp32-nodemcu-32s-ch340-ai-thinker
3	Humidity and Temperature sensor 	35.000	1	https://hshop.vn/cam-bien-do-am-nhiet-do-dht11
4	pH sensor 	750.000	1	https://hshop.vn/cam-bien-do-do-ph-giao-tiep-uart
5	Photoresistor 	10.000	1	https://hshop.vn/cam-bien-anh-sang-photodiode

				
6	Pump	12.000	1	https://hshop.vn/dong-co-bom-chim-mini-5vdc
7	Potentiometer	26.000	1	https://hshop.vn/mach-bien-tro-mkl-m04-potentiometer-module
8	Relay	19.000	1	https://hshop.vn/mach-relay-tre-ic555
9	Button	40.000	2	https://hshop.vn/mach-nut-nhan-mkl-m02-push-button-tact-switch-module
10	LED bar	118.000	1	https://hshop.vn/grove-led-bar-v2-0-led-hien-thi-muc

				
11	7-segment LED  	20.000	1	https://hshop.vn/mach-hien-thi-4-led-7-doan
12	NeoPixel Ring 	18.000	1	https://hshop.vn/mach-hien-thi-neopixel-ring-12-rgb-led-ws2812
13	Ultrasonic sensor (water proof) 	195.000	1	https://hshop.vn/cam-bien-sieu-am-chong-nuoc-jsn-sr04t-v3-0-waterproof-ultrasonic-sensor
14	TDS sensor 	365.000	1	https://hshop.vn/cam-bien-tong-chat-ran-hoa-tan-dfrobot-gravity-analog-tds-sensor-meter-for-arduino

15	Servo		210.000	1	https://hshop.vn/dong-co-digital-rc-servo-towerpro-mg92b-chinh-hang-genuine
16	Breadboard		135.000	1	https://hshop.vn/breadboard-zy-204-1660-lo-165x110x10mm
17	I2C circuit		10.000	1	https://hshop.vn/mach-chuyen-muc-ton-hieu-i2c
18	Digital Liquid Level Sensor		310.000	1	https://hshop.vn/cam-bien-muc-chat-long-dfrobot-gravity-non-contact-digital-liquid-level-sensor-for-arduino
19	Keypad		12.000	1	https://hshop.vn/ban-phim-ma-tran-mem-4x4
20	LCD + I2C		95.000	1	https://hshop.vn/lcd-text-lcd2004-xanh-duong
	Total		2.695.000	21	

Project plan

No.	Task	Responsible	Deadline
1	3D design model – proposal	Vo Hoang Anh Nguyen Le Hung	2024/11/06
2	Data flow design - proposal	Hoang Le Minh Dang	2024/11/07
3	UI design - proposal	Nguyen Le Hung	2024/11/07
4	Quotation - proposal	Vo Hoang Anh	2024/11/07
5	Writing proposal	Nguyen Le Hung	2024/11/08
6	UI implementation - production	Hoang Le Minh Dang	2024/11/15
7	device-website implementation-production	Nguyen Le Hung	2024/11/15
8	website-device implementation-production	Hoang Le Minh Dang	2024/11/18
9	Design wokwi model - production	Vo Hoang Anh	2024/11/15
10	Telegram AI chat - production	Vo Hoang Anh	2024/11/22

Reference

- [1] State of IoT 2024: Number of connected IoT devices growing 13% to 18.8 billion globally <https://iot-analytics.com/number-connected-iot-devices/>
- [2] Smart Fish Tanks Market Size, Projections: Share, Trends, and Projected Growth from 2024-2031 <https://www.linkedin.com/pulse/smart-fish-tanks-market-size-projections-yfl2c/>
- [3] Development of IoT-based Fish Tank Monitoring System.
Palconit, Maria Gemel & Concepcion II, Ronnie & Tobias, Rogelio Ruzcko & Alejandrino, Jon-nel & Almero, Vincent Jan & Bandala, Argel & Vicerra, Ryan & Sybingco, Edwin & Da-dios, Elmer. DOI:[10.1109/HNICEM54116.2021.9731950](https://doi.org/10.1109/HNICEM54116.2021.9731950)

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