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IoT Based SmartAquaPro

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Abstract

This research paper presents development of IoT smart kit designed for improve the management and monitoring of hydroelectric projects and their application. Here, one of its application, home aquarium, is accepted. Nowadays, many people have fish as their pets Home. The fish were fed by an aquarist in aquarium tanks, which requires proper setup maintenance. The problems we face are changes in water quality, fish feeding, maintenance temperature, light control and difficulty manual control of aquarium conditions. That is why it is necessary to monitor the physique parameters closely and increase the water state. So this project proposes a system that is equipped with sensors for real-time operation. The kit integrates the Internet of Things (IoT) technology with a number of sensors, actuators and a user-friendly interface that makes aquarium possible enthusiasts for creating and maintaining a thriving aquatic environment. Key system components include real-time water quality monitoring, an automatic feeding system and fish cleaning water in the tank, automatic environment control and remote access via mobile app. The research outlines design and implementation smart kit, discusses its applications in provisioning the well-being of aquatic life and examines it potential for wider environmental monitoring and conservation efforts. Results of testing and use scenarios demonstrate the effectiveness of and the versatility of the IoT Smart Aquarium Kit it is a valuable tool for hobbyists and researchers alike in the fields of aquaculture and water ecology.

Keywords: Internet of Things (IoT); Smart Aquarium; ESP8266; Mobile App Control; Feeding Automation; Water Quality Monitoring; Temperature Control

Introduction

Aquarium enthusiasts and aquarists alike have long sought to create the ideal habitat for their aquatic companions while minimizing the complexities of maintenance. In this era of technological advancement, the integration of the Internet of Things (IoT) with aquaria management has ushered in a new wave of innovation, giving

rise to the IoT-based Smart Aquarium Kit. An automatic fish feeder is an electronic device that is designed to fish tanks at regular intervals. Aquariums are more than just glass boxes filled with water; they are microcosms of aquatic ecosystems, and maintaining a balanced environment is crucial for the well-being of its inhabitants. This proposed system explores the revolutionary IoT-based Smart Aquarium Kit, which empowers aquarists with a plethora of capabilities for remote monitoring and intelligent control. This kit integrates a suite of sensors, including temperature sensors, water level sensors, turbidity sensors, and dissolved oxygen sensors, to provide real-time data on crucial water parameters. These sensors ensure that the water quality remains within optimal ranges, which is vital for the health and happiness of the aquatic life within the aquarium. Furthermore, the kit incorporates a purification unit, enhancing water quality through filtration and chemical treatment, and a fish feeder for automated feeding schedules, which reduces the reliance on manual interventions. A water pump and cooling fan are included to regulate water circulation and maintain an appropriate temperature, respectively, thus fostering a stable and conducive environment for the aquarium's inhabitants. There are some useful connections for public health; as we know, all people use motors for water purposes. This kit helps not only aquariums but also people's health, like when we use tanks for water storage.

Objective

To develop an automatic home-based fish feeding system using the IOT; to experiment with and implement the automatic home-based fish feeding system using the IOT; to build a smart aquarium kit to provide a user-friendly and automated system for monitoring and controlling various parameters of an aquarium.

Monitor water temperature, manage water levels, assess water quality with turbidity sensors, and monitor dissolved oxygen levels. Implement a Purification Unit, Automate fish feeding, regulate water circulation, and maintain an optimal temperature with a cooling fan—these are various comprehensive solutions for aquatic enthusiasts.

Literature Review

The system proposed by Aman Shakirin Shamshulbahrin[(1)] by implementing the Arduino and mobile app feature, can easily send and receive data from the hardware system to the software system. Usually, fish were abandoned with a lack of care, such as unclean water in the aquarium or fish breeding ponds. An IoT-based smart aquarium monitoring system is one of the solutions to the problems. This research presents a prototype of an IoT-based smart aquarium monitoring system to keep fresh water in the aquarium for fish life habitats.This system operates as a fish feeding system and is controlled by a smartphone in its operation. Arduino Mega and Node MCU controllers are used in the designed system. Wi-Fi communication on the Node MCU is used between the smartphone and the controller to control the operation. The system is designed to monitor the pH value that is suitable for the type of fish life.This research is significant towards IR4.0 system development in supporting fish pets, and a larger project for fish breeding in the pond can be sampled with this project that contributes to economic impacts for the country.

The main aim of this project is to develop an aquarium that can be monitored through the Internet. It is not only used for aquariums; it is also useful for daily life, for example, in a water tank in a house and in agriculture. Fish can be fed using the servo motor when it can be monitored, as can the water temperature.

Arduino and ESP8266 are versatile and cost effective platforms that have been widely used in IoT applications, including aquaculture. Researchers and aquaculture enthusiasts have increasingly adopted these platforms to create smart aquarium kits that can be effectively monitored and control various parameters in the aquarium. These platforms have become essential in designing IoT-based solutions for aquarists.

While intelligent aquarium kits based on the Internet of Things have produced significant progress, challenges such as power consumption, sensor accuracy and safety concerns remain. Future research should focus on improving these aspects. In addition, improving connectivity and interoperability these systems along with the introduction machine learning algorithms for prediction maintenance and anomaly detection is promising way for development.

System designed by Yi-Bing Lin (liny@csie.nctu.edu.tw) and Hung-Chun-Tseng. The project is designed to build an IOT based automatic aquarium set. The aquarium set consists of electronic components that control the fish Tank environment by maintenance and control parameters such as temperature, PH, dissolved in water gases such as carbon dioxide, oxygen and many more and feeding fish.

The project is very useful for people who like decorating their houses with an aquarium. Therefore, here the project presents how smart it is the system works. To develop this project, NCTU developed an IOT solution called IOT talk. Based on IOT talk, this paper proposes Fish Talk a system that allows you to control aquarium sensors actuators in real time. Intelligent system has three main functions; supply of food, water filtration and system maintenance.

The food supplier system provides food for fish in the aquarium set automatically correctly proportions, so there is no danger of overshooting or less feeding. So no effort is needed for the user to feed the fish. Also this system has a video equipment. Fish Talk provides video monitoring not found in any other smart aquarium solution. Various gas sensors are supported by FISH talk. This system has dissolved

carbon oxide sensor. Dissolved carbon dioxide causes stewing and lowers the pH of the water which leads to stress states of hypercapnia for fish. Then there is the DO sensor. The aquarium needs it oxygen to support livestock. Reduced oxygen concentration combined with elevated carbon the concentration of oxide in water leads to suffocation. Oxygen requirements vary depending on the type and weight of the fish. This the system also has a temperature sensor. Study show that higher temperatures within the optimum the temperature range of the species usually leads to healthier fish with stronger immune functions. For most fish the optimum temperature ranges from 25◦ to 27◦C. Extreme temperature changes are more harmful to fish than constant high or low temperature. There is also heating fan in mini aquarium for heating and cooling water tank. There is a system in the aquarium kit project maintain pH level, moisture level and temperature. It has a water pump and lights when the water level is low and the water is pumped in.

The article includes much information about the water pump, sensors and actuators including that it can be used in aquariums or is usually used in aquariums. Development of IoT-based Fish Tank Monitoring System proposed by Ronnie Concepcion II De La Salle University 238 Rogelio Ruzcko Tobias De La Salle University 30 PUBLICATIONS 419 Jonnel AlejandrinoDe La Salle University 59 [(2)].

The aquaculture management system will has been greatly improved by the adoption of the recent technological progress. This study presents development of an aquarium monitoring system using Internet of Things (IoT) modules. four subsystems – water quality monitoring, video aquarium supervision, feeding on request machine and cloud data storage. During evaluation, calibrated sensors for water quality monitoring was accurate for monitoring purpose. In contrast, simultaneous transmission data collected by sensors from IoT modules to cloud storage has been 100% successful since Send speed 0.25 Mbps to 10 Mbps. The automated video surveillance was able to record 98.45% of scheduled time. Modern aquaculture fish farming has advanced in intensive production to meet human demand consumption.

In essence, it is intensive aquaculture the production system needs to expand operations management to manage the intensification properly inputs and waste water. The good living conditions of the fish are above all else affected by water quality, where it is not ideal water quality status, eg dissolution oxygen (DO), pH, temperature, ammonia, nitrites, and nitrates, will cause stress, health problems and fish kill. Primary are uneaten feed and feces solid wastes that can cause acceleration deterioration of water quality. A system designed by Amel Yousif Ali Mohameda, Vrajesh Dinesh Mahetaa [(3)] The project is intended to build an automatic aquarium set. The aquarium set consists of electronics components that control the aquarium environment by maintaining parameters such as temperature and PH. The project is very useful for people who like to decorate their homes with an aquarium. Therefore, here the project presents how smart it is the system works.

The smart system has three main functions; Food supply, water filtration and maintenance System. The food supply system provides the food for fish in the aquarium set automatically. Therefore, no effort is required from the user when feeding fish. The filtration system ensures cleanliness water in the aquarium set. In case water gets in dirty in the aquarium, then the user will be allowed to enter the system to activate the water pump using a manual switch. There is a system in Aquarium kit project for pH maintenance level, humidity level and temperature. The temperature is kept between 20 and 35 degrees Celsius by water pump. Water the pump recycles water for cooling temperature in the system. However, if moisture exceeds 20%, then the system starts the fan blow air in the aquarium to reduce humidity below 20%. In case the PH level drops above 7, an alarm will be activated to notify the user read the PH level. The most suitable is the V shape use in this project because it works according to be tested at each stage. Article contains a lot of information about the water pump, including that it can be used in aquariums or is usually used in aquariums.

Proposed System

Methodology

The proposed system operates as an automated system to control the water quality of the aquarium, the temperature of the water, and the turbidity sensor used for the purity of the water. The project is an automated system to take care of fish. The software design and hardware of the system is discussed below.

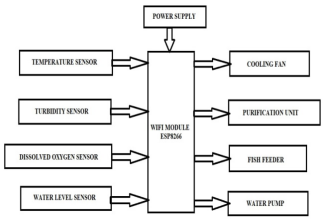

Fig 1. Block Diagram

Sensors for monitoring aquarium parameters

- **Turbidity Sensors:** Turbidity sensors play a crucial role in monitoring water clarity and the presence of particulate matter. These sensors use light scattering to assess water quality. Various studies have examined the integration of turbidity sensors in smart aquarium kits for real-time monitoring and their importance in

Table 1. Literature Survey

Sr. No.	Year of Publication	Title and Name of Authors'	Main Findings	Methodology	Limitations/ Gap
1.	Between 2015, and 2017	Title: Aquarium Monitoring System via IOT Authors': AmanShakirin Shamshulbahrin, Dr. Izanoordina Ahmad	The project clearly demonstrates how end-users know the appropriate pH, temperature, and water level. The dosing system developed in this system is ideal for use in any aquatic life, such as aquaculture for breeding or a home aquarium. It will encourage users to prepare for aquarium maintenance, such as water changes and filtering devices	This project uses the Arduino IDE as the software component to write the code, which will burn into the ESP8266 Node MCU. In this case, the C++ language was used to write the code. For the mobile phone, Blynk apps have been used as they come with multifunctional apps for the user.	Internet connectivity, cost, and water utilization
2.	2019	The title of the document is "FishTalk: IoT-Based Mini Aquarium System," and the author is Y.-B. Lin and H.-C. Tseng.	developed an analytic model, simulation, and measurement experiments to investigate the effects of IoT message delays and losses on water condition control. Such a study has not been conducted by existing smart aquarium solutions.	To control the dissolved gases and other factors that affect the health of fish, Several sensors have been deployed, e.g., the dissolved oxygen (DO), the temperature, the pH, the electrical conductivity, the water level, and the total dissolved solids (TDS) sensors. The sensors send the measured data either periodically or when some events occur.	In an IoT system, the delays of messages delivered from the sensors to the actuators significantly impact the execution of the IoT applications. If the delays are too long, the system may fail to carry out the desired tasks.
3.	FEB 2023	Title: An IoT-Based "Smart Aqua: Remote Monitoring And Controlling Of Aquarium Using Iot And Telegram Authors': Mrs. Leena Shruthi, Gautami Gurav, Kritika Desai, Keerthana P., and Dyuthi R.	The findings indicate that the sensors and actuator components of the system underwent functional testing and calibration.	This project used a Node MCU as a microcontroller and an Arduino Mega as the hardware implementation. Feeding system (SG90) is utilized as a fish feeder mechanism for the actuator. The pH sensor (SKU: SEN0161) is the only sensor used in this project to calculate the water's pH level.	There were limitations in terms of internet connectivity, which were addressed in phase 3 with the inclusion of the WiFi module.
4.	Nov 2023	Title: Development of an IoT-based Fish Tank Monitoring System. Authors': Maria Gemel B. Palconit, Ronnie S. Concepcion, Rogelio Ruzcko Tobias, Jonnel Alejandrino, and Vincent Jan D. Almero, Argel A. Bandala, Ryan Rhay P. Vicerra, Edwin Sybingco, and Elmer P. Dadios	This includes the hardware assembly, coding, calibration, and evaluation of the connectivity of the IoT modules with sensors. Results have shown that the calibrated sensors are accurate.	The development of the fish tank monitoring system is divided into three main subsystems: water quality monitoring, on-demand feeding, and video surveillance of the fish tank.	There are some limitations, like connectivity issues, cost, power supply, scalability, and data security.
5.	Nov 2021	Title : Smart Aquarium kit Authors' : Amel Yousif Ali Mohammed , Vrajesh Dinesh Maheta	The article includes much information about the water pump, including that it can be used in aquariums or is usually used in aquariums	The V-shaped-shaped is the most suitable one to be used in this project because it works according to testing at each and every stage.	Limitations for oxygen levels, water levels, and network connectivity

Fig 2. DS1820 Temperature $_{Sensor}$ TurbidityWater level Sensor Dissolved oxygen

Fig 3. Servo Motor $_{sensor}$ Relay water pump

maintaining optimal conditions for aquatic life.

- **Temperature Sensors:** Temperature control is vital for aquarium health. Temperature sensors integrated with Arduino and ESP8266-based systems allow aquarists to monitor and regulate water temperature. Numerous research projects and practical implementations have demonstrated the use of these sensors in smart aquariums.
- **Purification Units:** Water quality is of paramount importance in aquariums. IoT-based smart aquarium kits often incorporate purification units such as UV sterilizers, protein skimmers, and mechanical filters. The integration of these units, alongside sensors and controllers, ensures that water quality remains at desirable levels, mitigating the risk of disease and algae blooms.
- **Cooling Fans:** Maintaining the right water temperature can be a challenge, especially in warmer climates. Cooling fans controlled by IoT systems help with temperature regulation. Research has explored the use of cooling fans in conjunction with temperature sensors for efficient cooling solutions.

Actuators for Control and Automation

- **Servo Motors:** Servo motors are commonly used to control aquarium equipment like feeding systems, lighting, and adjustable water flow. Researchers have designed Arduino and ESP8266-based smart aquarium kits that integrate servo motors for automated feeding schedules and adjustable water flow rates.
- **Water Pumps:** Water circulation is essential for the overall health of an aquarium. IoT-based systems using water pumps provide the necessary water movement required for oxygenation, filtration, and preventing dead spots within the aquarium.
- **Two-Level Sensors:** Two-level sensors are employed to monitor water levels and prevent overflows or low water levels in aquariums. Integrating these sensors with the Arduino and ESP8266 platforms ensures that water levels are always maintained within safe parameters.

Software design

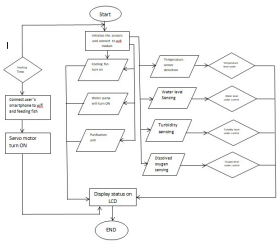

Fig 4. Flowchart

Conclusion

The incorporation of Arduino and ESP8266 platforms, along with a range of sensors and actuators, has brought about a revolution in smart aquarium management. These systems provide real-time monitoring, remote control, and automated responses to maintain a stable aquatic environment. The existing literature underscores the significance of these technologies in smart aquariums and suggests a wide array of opportunities for further research and development in this field. As IoT technology continues to evolve, we can anticipate even more advanced and sophisticated solutions for both casual aquarists and aquaculture professionals.

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