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Article Title: **Water Quality Monitoring and Alert System for Fish Farms using IoT and SMS Integration**

Water Quality Monitoring and Alert System for Fish Farms using IoT and SMS Integration

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ABSTRACT

This project proposes a water quality monitoring and alert system for fish farms using IoT (Internet of Things) and SMS (Short Message Service) integration. The system aims to ensure optimal conditions for fish growth and health by continuously monitoring important water parameters. IoT devices equipped with water quality sensors are deployed throughout the fish farm to collect real-time data on temperature, pH level, humidity and water level. The collected data is transmitted to a cloud-based platform via an IoT network for processing and analysis. If any parameter exceeds the acceptable limits, the system triggers SMS alerts to fish farm operators, providing timely notifications of potential water quality issues.

Keywords: Aquaculture, Wireless Transmission, Life Expectancy, Internet of Things, Robotic Arm

1 Introduction

Aquaculture is prosperous in the southeastern coastal areas of India, and most of its traditional farming methods rely on human expertise. Whether it is the time control of the waterwheel aerator, feeding, or water quality testing, all require human resources and is time-consuming for farmers. Internet of things technology has taken the world by storm. Right from smart cars to smart cities to Smart home, devices are taking full control of sensing the environmental parameters to bring better monitoring and controlling capabilities to ever connected users. With a better control over their day-to-day lives, the connected users can afford a better lifestyle supported with better decision making. Aquaculture industry is one of the top industry which needs technology push because this is projected as one of an alternate source of income to boost employment by various state governments across India.

2 Literature Survey

1. Design and wireless sensor Network Analysis of Water Quality Monitoring System for Aquaculture [Zeenat Shareef (2019)]: Wireless sensor network system consisted of mobile and static zig bee nodes, which are deployed on underground mine galleries for measuring temperature.
Advantages: Efficient, Robust deployment.
Disadvantage: Lesser yield, Complex.

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2. An Integrated Wireless Multi-Sensor System for Monitoring the Water Quality of Aquaculture [Jen-Yung Lin (2021)]: Wireless multi-sensor water quality monitoring system for aquaculture consists of temperature, pH, DO, and EC sensors.
Advantages: Reliability, Easy maintenance.
Disadvantage: Weak market procurement.
3. Automated Monitoring System for the Fish Farm Aquaculture Environment [Jui-Ho Chen (2015)]: ZigBee wireless transmission technology is used for all signals transmitted to the Gateway.
Advantages: Low power.
Disadvantage: Transmission distance is short, susceptible to signal interference.
4. IoT Based Automated Fish Farm Aquaculture Monitoring System [Sajal Saha (2018)]: Internet of Things (IoT) is a very fast growing technology and the field of IoT is extending.
Advantages: Better result, Low cost than other available systems.
Disadvantage: Imbalances of other parameters, Poor resistance.
5. The Real Time Monitoring of Water Quality in IoT Environment [Pradeepkumar M (2016)]: Turbidity sensor can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight.
Advantages: Fast response speed, High sensitivity.
Disadvantage: Long-time analysis.

3 Proposed Methodology

In proposed system, wireless transmission technology with various sensors is designed. It transmits the temperature, pH value and water level sensor in the fish farm to the server. The integrated data are transmitted to mobile devices through the Internet of Things [15]. It enables administrators to monitor the water quality in a fish farm through mobile devices. When the water quality is abnormal, the server sends a message to mobile devices to notify fishers to avoid the loss of fish. By combining IoT and SMS technologies, this system enhances the efficiency and effectiveness of fish farm management [1-4]. Additionally, the system offers SMS-based remote control capabilities to enable immediate corrective actions.

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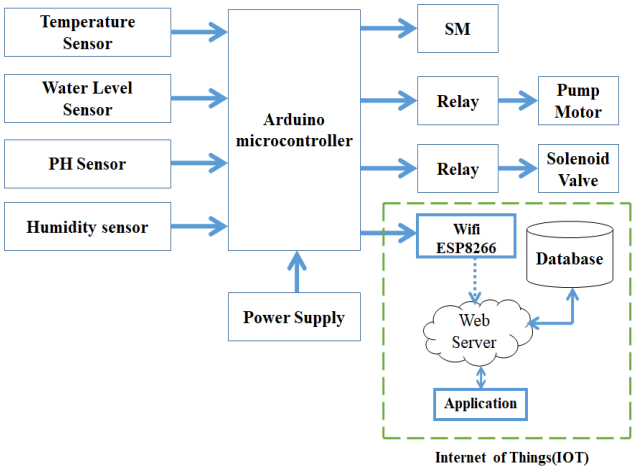


Figure 1: *Proposed Block Diagram*

3.1 Temperature Sensor Subsystem

The required temperature of the aquaculture environment for the growth of fish is about 25-27 ℃. Sensor PT100 was selected according to the environment and characteristics of the pond [5-7]. PT 100 based on resistance measurement principle. Material is platinum and resistance value is 100 ohm at temperature 0 ℃. Platinum has a positive resistance temperature factor, resistance increases with rising temperature.

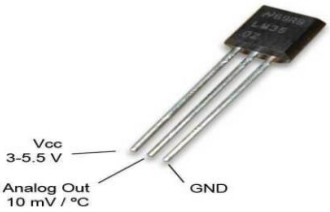


Figure 2: *Temperature Sensor*

3.2 Water Overflow Sensor Subsystem

The water overflow sensor subsystem mainly replaces the traditional floating ball water level switch, as shown in Figure 3. In the traditional floating ball switch, the water level is mainly set at a fixed height, and the water level state cannot be accurately known. When there is a sudden rainstorm or the water quantity needs to be adjusted, it may cause the fish to flow out. Therefore, the main water overflow sensor in this study identifies low, medium, and high water levels, and overflow, which is convenient for aquaculture so the water level can be adjusted according to the needs of farming [8]. The principle of overflow primarily uses the characteristics of water conduction to judge water level. The advantage is that compared with the traditional float switch or the water overflow sensor in the industry, the system is more convenient and less expensive.

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Figure 3: *The traditional floating ball water level switch.*

The purpose of this subsystem circuit, is to adjust the water level within the safe height range. When the water level is higher than the high-water level during monsoon season, the subsystem notifies the manager about condition of the fish farms and reminds them to avoid loss of fish. When there is no rain for a long period of time, water level decreases due to evaporation. To avoid this automatic pump motor is introduced to pump the underground reserve tank to replenish the water level to normal.

3.3 Humidity sensor

A humidity sensor is a device that measures the amount of water vapour in the air. DHT22 capacitive humidity sensor was selected according to the environment. The working principle of a humidity sensor is based on the fact that the electrical properties of certain materials change when they come into contact with water vapour. For example, the capacitance of a capacitor changes when it absorbs water, and the resistance of a resistor changes when it absorbs water.

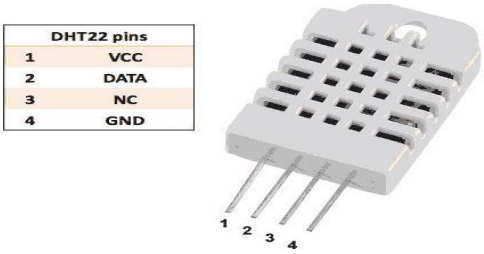


Figure 4: *Humidity sensor*

In a capacitive humidity sensor, a thin film of metal oxide or polymer is sandwiched between two electrodes. As the humidity level changes, the capacitance of the film changes. This change in capacitance can be measured and used to determine the humidity level.

3.4 pH Sensor Subsystem

The pH value, also known as the hydrogen ion concentration index, is a measure of the concentration of hydrogen ions in a solution. The large amount of excrement in fish farms produces amino acids, which increase the acidity of the water and cause the fish to become sick. The required pH of the aquaculture environment for the growth of fish about 6.5~8.5.

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The survival rate of fish in an acidic environment is higher than in an alkaline environment. Long-term water pH that is too high or too low makes the fish sick, poisons them, stagnates their growth, and increases their mortality rates. Furthermore, the excessive accumulation of fish excrement or excessive feeding results in the excessive accumulation of waste at the bottom of the pool, which cannot be effectively decomposed, and the oxidation state efficiency significantly reduces. Continuous anaerobic fermentation produces a large number of anaerobic bacteria and toxic substances such as methane, hydrogen sulfide, ammonia nitrogen, nitrite, etc. In this study, to detect the life of the pH sensor and record the change in pH value, the detected data were compared with those obtained by the sensor.



Figure 5: *pH sensor*

3.5 Integrated Design of IoT Gateway

The design of IoT gateway is based on the purpose of solving the need for data transmission using two different protocols, namely, WiFi and GPRS. The gateway nodes transmit the data to the remote server in the packet format of Wi-Fi. Wi-Fi provide the underlying communication of the IoT architecture to enable the integration and interconnection of physical and virtual things. Every gateway is given a unique user ID, which is randomly generated after sign up in the designed Website portal. The IoT Gateway serves as the bridge between the IoT devices and the SMS gateway. It collects data from the IoT devices and communicates with the SMS gateway to send and receive SMS messages. The gateway may also perform data processing, filtering, or aggregation tasks before forwarding the information to the SMS gateway. The SMS gateway is responsible for sending and receiving SMS messages. It interfaces with a mobile network provider or SMS service provider to establish the communication channel. The gateway typically provides an API (Application Programming Interface) that allows integration with other systems, such as the IoT gateway [9]. This API enables programmatically sending SMS messages from the IoT gateway to designated recipients. The IoT gateway processes the collected data to extract relevant information or detect anomalies. This processing may involve applying algorithms, performing calculations, or comparing the data against predefined thresholds. For example, if the water temperature exceeds a certain threshold, it may trigger an alert for the fish farm manager.

3.6 NODE MCU (ESP8266)

General-purpose input/output (GPIO) is a pin on an IC (Integrated Circuit). It can be either input pin or output pin, whose behavior can be controlled at the run time. NodeMCU

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Development kit provides access to these GPIOs of ESP8266. The only thing to take care is that NodeMCU Dev kit pins are numbered differently than internal GPIO notations of ESP8266 as shown in below figure and table. For example, the D0 pin on the Node MCU Dev kit is mapped to the internal GPIO pin 16 of ESP8266.ESP8266 is a system on a chip (SoC) design with components like the processor chip. The processor has around 16 GPIO lines, some of which are used internally to interface with other components of the SoC, like flash memory. The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly [10]. However this version of the module has only 2 GPIO pins (you can hack it to use up to 4) so you have to use it along with another microcontroller like Arduino, else you can look onto the more standalone ESP-12 or ESP-32 versions. So if you are looking for a module to get started with IOT or to provide internet connectivity to your project then this module is the right choice for you.

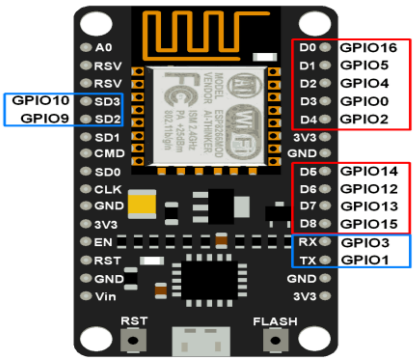


Figure 6: *Node MCU DevKit GPIOs*

4 Results

This system takes Arduino as the core, which collects various water quality data. Using sensors to analyze water quality replaces the previous method of judging the water quality through aquaculture expertise, which can improve water quality control and be used to detect early signs by observing changes in data, identifying problems and improving them. The sensed data are graphed, and the remote monitoring of the breeding environment can reduce labor costs. IoT is highly promising: the existing the network does not need to be rebuilt, and the industry chain is also consistent with the existing telecommunication network industry. Using an web app through Wi-Fi within Wi-Fi range and through Internet from anywhere in the world. Some analysis is performed with the three parameters value to determine the

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overall approximate condition of the water and required action. Every feature in this checking gadget can work legitimately and easily.The use of IoT, SMS integration in water quality monitoring and alert systems for fish farms is a promising technology with the potential to improve the efficiency, profitability, and sustainability of fish farming operations. The system can provide real-time monitoring, remote monitoring, and early warning of water quality problems. This would help the farmers to ensure the health of their fish.

5 Conclusion and future Scope

Overall, the use of IoT and SMS integration in water quality monitoring and alert systems for fish farms has the potential to revolutionize the fish farming industry. By providing farmers with real-time information about the water quality in their farms, the system can help them to make better decisions about how to manage their farms and ensure the health of their fish. As a result, IoT and SMS integration will become a more widespread technology in the fish farming industry.

In the future, artificial intelligence analysis and deep learning feedback control technology will be combined to build a complete intelligent breeding system including production technology, facilities, equipment, information, communication, Internet of Things, artificial intelligence, or related front-end technologies connected in series. We must continue to accumulate expert experience from water testing institutes and import the basic aquaculture environment parameters into database systems. To improve breeding, breeding experience can be accumulated, inherited, and adapted to form best practices.

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