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Research Article

Real time Cloud based fishes health monitoring using IoT

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A B S T R A C T

This work is based on a prototype model for the Fishery Management System with the help of Internet of Things i.e., IOT.

The proposed system works on IOT & provides real-time monitoring of the fishery system. With the help of various hardware & software devices like Sensors & the Arduino Cloud, data from the fishery system can be collected and analysed using the Cloud which also helps in maintenance of the fishes from time to time. This also helps in creating awareness about the fish whenever necessary.

Along with IOT, Water Level Sensor, Temperature Sensor & pH Sensor is also used to measure the water level, temperature level and get the pH values in the system. The system can be made automatic as well as configured according to the requirement for the survival of the fishes. The Node MCU ESP8266 helps in collecting the information through the sensors & display it in the Cloud which can be accessed from Smartphones, PCs, and Tablets etc.

1. INTRODUCTION

With the rapid development of economy, there are more and more serious environmental problems, including water pollution, which affects thousands of fishes. It is important to collect data on parameters such as temperature and pH as these factors affect and can be affected by pond organisms. Due to the continuous monitoring, problems that may arise in the future are reduced. Research in aquaculture contributes to increasing stabilized production. In the last decade, different scientists have made sustained efforts that have led to the development of modern production technologies that have revolutionized agricultural production.

The main objective of the project is to remotely monitor the fish farming system by using various sensors to mitigate risk. We use sensors such as pH, temperature and water level by which all the work will be automated and it will also be easy to remotely monitor the fish farm from another location. Fish farming refers to the cultivation of a variety of marine species such as freshwater fish, shellfish, wild fish, bait fish, ornamental fish, crustaceans, molluscs, and fish roe for breeding, rearing and harvesting in various aquatic environments such as ponds, rivers, lakes and oceans. Fishes are cold-blooded animals that regulate their body temperature directly through the aquatic environment.

As the water temperature rises, the fish's metabolic rate increases, resulting in less dissolved oxygen in the water. The fish's metabolic rate decreases with less water Temperature and thus the amount of dissolved oxygen in the water increases. If the level of dissolved oxygen in the water falls below a certain limit, the growth of the fish is inhibited. If the amount of dissolved oxygen is below the survival conditions of the fish, they will die. In general, in fish farming, the acidity and alkalinity of water should be kept between 6 and 8.

Too acidic or alkaline solution leads to side effects, acid erosion of gill tissue, coagulation tissue necrosis, increased mucus secretion, abdominal congestion and inflammation. If the pH is below 4.5, the fish will die. Water quality directly affects

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the growth of aquaculture objects, which affects production and economic benefits. Therefore, environmental control is an important part of fish farming management.

The continuous and automatic real-time monitoring of water parameters will not only lead to high-quality aquaculture management, but also provide accurate experimental data that will help optimize the breeding process, reduce culture costs and improve reproductive efficiency.

2. LITERATURE SURVEY

The quality of water available to fish is one of the most important factors in fish production. This becomes more serious for fish kept in ponds or confined water environments, as fish cannot move or move when the water quality becomes too poor. Water quality directly affects feed efficiency, growth rate and general health of fish. The fish pond management system is implemented using a pond controller that includes sensors to monitor water quality, a fish feeding system and a pond water exchange system. A water exchange system includes a system that manages the discharge of water from a pond when a water exchange is required due to the amount of dirt in the pond water or due to high pH values or temperatures [1].

Fish farming is the commercial rearing of fish in tanks, containers or laces. Due to the high demand and widespread human consumption of fish, this business has the potential to be profitable and profitable if proper measures are taken in the development of fish farming [5]. Aspects of modern agriculture require real-time plant growth rate monitoring systems. Plant growth rates depend on many factors, including the plant's genetic makeup and physiological and environmental conditions. Growth rate monitoring is an essential component of horticulture and botanical research for plants growing in natural ecosystems [4].

There are an extraordinary number of applications that can leverage the Internet of Things, from home and office automation to tracking production lines and retail products. The number of applications is endless. A specific IoT service can be applied to each application to streamline application development and speed up application delivery [6].

Fish farming indirectly contributed to the statistically lower prevalence of underweight children in these households through increased purchasing power from the sale of fish, again underscoring the importance of cash income [7].

Due to the increasing demand for accurate, reliable and highly sensitive pH sensors, new materials and methods are being researched to achieve this goal. A promising approach in the field of pH detection is the conductometric pH sensor. It has the advantage of simpler construction over its potentiometric counterpart and can be less expensive to mass produce. The sensors are tested with pH buffers in the pH range from 2 to 11 and any changes in their electrical parameters are recorded [2].

In general fish farming, the acidity and alkalinity of the water should be maintained between 6 and 8. Too acidic or alkaline will have adverse effects, acid erosion of gill tissue, coagulative necrosis of tissue, increased mucus secretion, abdominal congestion and inflammation. If the pH is below 4.5, the fish will die [8].

Ammonia is a dissolved gas that occurs naturally in surface water, sewage and some well water. It is the main nitrogenous waste product of fish and is also formed when organic matter is broken down. It is readily soluble in water, especially at low pH, and is normally removed by plants or bacteria (as a nutrient or source of energy). Ammonia in water exists in two forms: unionized ammonia (NH_3) and ionized form (NH_4^+), with the relative proportion of each type depending on pH and temperature. As the pH increases, the proportion of non-ionized ammonia, which is very toxic to fish, increases. Besides pH, the toxicity of ammonia to fish varies depending on the fish species and whether the fish has time to adapt to elevated levels [11].

The amount of dissolved oxygen in water increases/decreases with the seasons. If the amount of dissolved oxygen in the water falls below a certain limit, the growth of the fish is stunted. If the amount of dissolved oxygen falls below the fish's survival requirements, the fish will die [9].

NodeMCU is used for the purpose of feeding fish, tracking and controlling parameters in the aquarium. It is an open-source firmware and development board that helps create models for IoT-based products. The Espressif Systems ESP8266 Wi-Fi SoC is used to run this firmware in the Lua programming language. The DS18B20 temperature sensor is used to record the water temperature in the aquarium. It has an integrated 12- bit ADC. It is connected to the digital input of the NodeMCU. The single-wire bus is used for communication between sensors and the NodeMCU [10,14,15].

The Internet of Things (IoT) is an integral part of the future Internet, including existing and evolving Internet and network developments, and could be defined conceptually as a dynamic global interoperable

communication protocol, self-configuring network infrastructure in which physical and virtual "things" have identities, physical attributes, and virtual personalities, make use of intelligent interfaces, and are seamlessly integrated into the information network [12,13]. Combining traditional farming methods with IoT has the potential to lead to sustainable agriculture and development of aquaculture [3].

3. TECHNOLOGIES AND METHODOLOGIES USED

In this project we have created a Prototype model using the Aquarium, keeping in mind all the parameters required for the maintenance of the fish. We have used Internet of Things i.e., IOT in our project.

This is the newest technology for transferring data from source to the destination. We use the intra network for the demonstration of our system. It is a network technology based on information detection devices such as Wi-Fi modules, etc. Cloud computing is a large unit of computation that processes at runtime and is also a very inexpensive technology. It is a remote server hosted on the Internet to store, manage and process data instead of a local server or personal computer. The application areas of IoT are home automation, water quality control, and smart garbage also.

A. Hardware

In the hardware requirements we have the NODE-MCU ESP8266 board, water-proof Temperature Sensor- DS18B20, Water level Sensor, pH Sensor, jumper wires & the bread board.

B. Software

In the software requirements we have used arduino.cc as the IOT platform where we can write our code for the measurement of the parameters and then calculate & collect our data. The Arduino cloud shows us the graph of the sensors and by this we're able to monitor our fishery system all throughout the time.

C. BLOCK DIAGRAM

The block diagram shows our plan of work i.e., how we're going to configure our system. Connected to the Node MCU ESP8266 board is the Power supply, the Water level sensor, the Temperature sensor & the pH sensor which are measuring the data & giving it back to the ESP8266 which, then analyses and stores it in the Arduino Cloud. The Cloud then shows the output result in the form of Graph in our smartphone, PC, or Tablets.

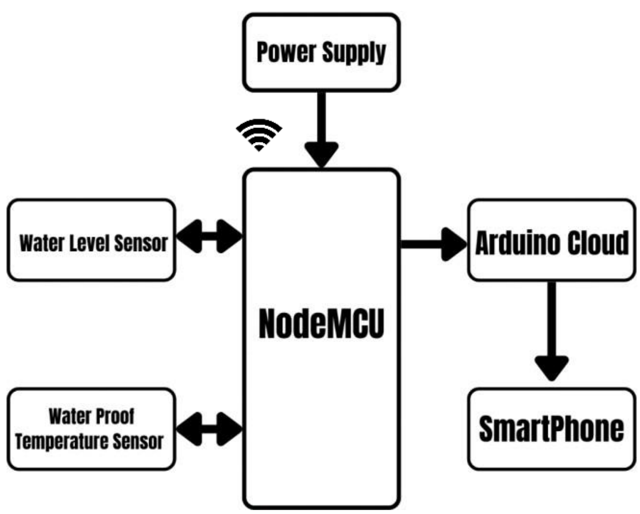
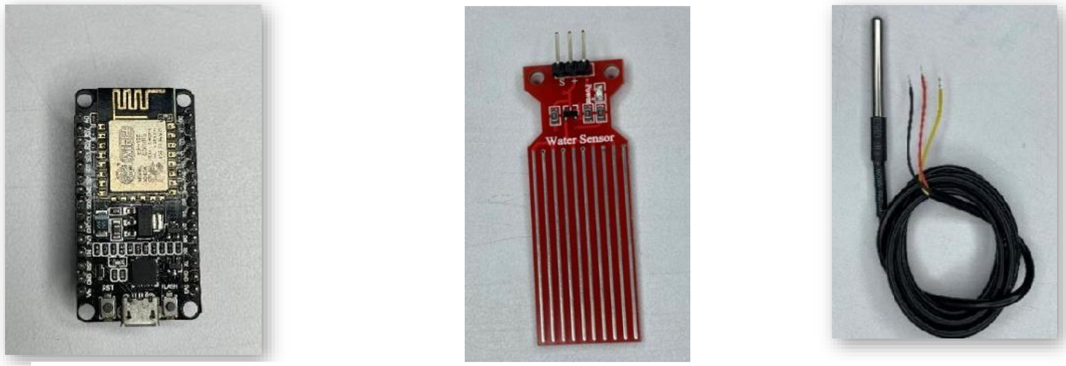


Fig .1. Block diagram of the system

4. TECHNIQUES USED FOR REAL-LIFE IMPLEMENTATION AND WORKING

The project attempts to monitor the physical changes in the water and keep it in ideal conditions. The system performs all operations such as water level, temperature, pH, etc. automatically. The IoT monitoring system constantly transfers the status of the aquarium to the database, and users can monitor it via the Internet. This project has input from IoT platform as control device.

The processing device used in this project is the Arduino/ESP8266 microcontroller. For the output devices used in this project is the sensor database. The below Fig2 describes the hardware devices used in our project.



(A) (B) (C)

Fig .2. Different Hardware devices (A) Arduino/ESP8266 microcontroller, (B) Water level sensor, (C) Temperature sensor are used.

A. NodeMCU ESP8266

Node Micro Controller Unit, a built-in micro-USB, easy to program is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.The ESP8266, designed and manufactured by express if Systems, contains the crucial elements like a computer having CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK, making it an excellent choice for Internet of Things (IoT) projects of all kinds.

B. Temperature Sensor

It is used to detect the temperature of water and manage it according to the requirement of the fishes. The sensor that we've used here is Waterproof Temperature Sensor DS18B20. The DS18B20 temperature sensor, an integrated circuit whose output voltage is proportional to the Celsius temperature. The DS18B20 has an advantage over linear temperature sensors as in that, the user can get a convenient Celsius scale without having to pull a large constant voltage from its output. The ideal temperature range for the survival of the fishes in the fish tank is from 20–30-degree C.

C. Water-Level Sensor

We've used it to detect & maintain the water level of the system and set it according to the number of fishes & size of the fish tank. The sensor has ten exposed copper traces, five of which are current traces and the remaining five are sensor traces. These tracks are intertwined so that between every two energy tracks there is a sensory track. Normally, the energy and sensory tracks are not connected, but when immersed in water, they connect. There is a power LED on the board that lights up when the board is powered on. The power and sensor traces form a variable resistor (similar to a potentiometer) whose resistance value varies around depending on contact with water.
This resistance changes inversely with the depth of immersion of the sensor in water:
The more the sensor is immersed in water, better conductivity and less resistance. The less the sensor is immersed in water, the poorer the conductivity and the higher the resistance. The sensor generates an output voltage proportional to the resistance; by measuring which, the water level can be determined.

5. VISUAL REPRESENTATION OF THE OUTCOMES / OUTPUT

The whole circuit is set up and is shown in Fig3 & Fig4. Fig 3 shows the design circuitry of the system i.e., how we have connected the ESP8266 and the sensors & put it inside our Aquarium. Fig 4 shows the overall setup of working model of our Project i.e., the data collection in the Arduino Cloud & displaying it Live. The result was collected from arduino.cc platform.

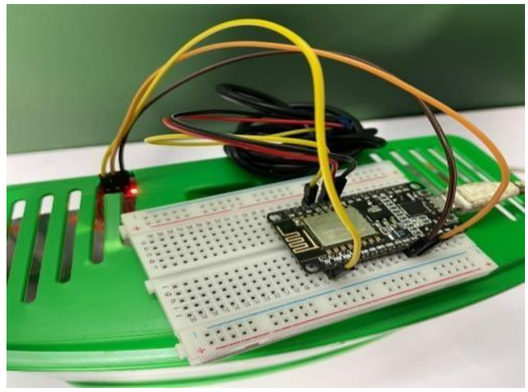


Fig .3. Design Circuitry

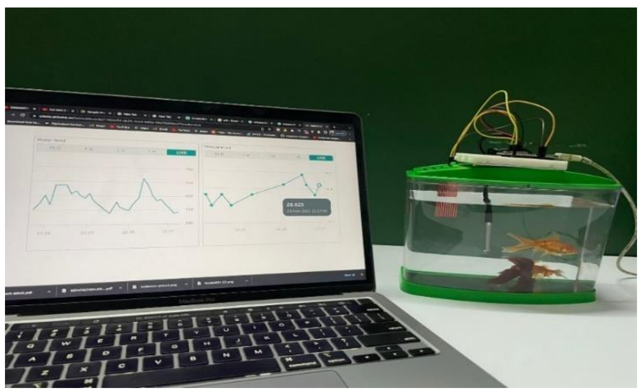


Fig .4. Overall Setup of the working model

The graphs obtained as result are also shown in Figure 5 & 6. Fig 5 Shows the Live data collection of the water level & the Temperature sensor. The resultant graph is being displayed in the Arduino Cloud which is accessible from anywhere through Smartphones. Fig 6 shows the data already being collected for a period of 1 hour. This clarifies that our System works totally fine & is able to give us accurate data.

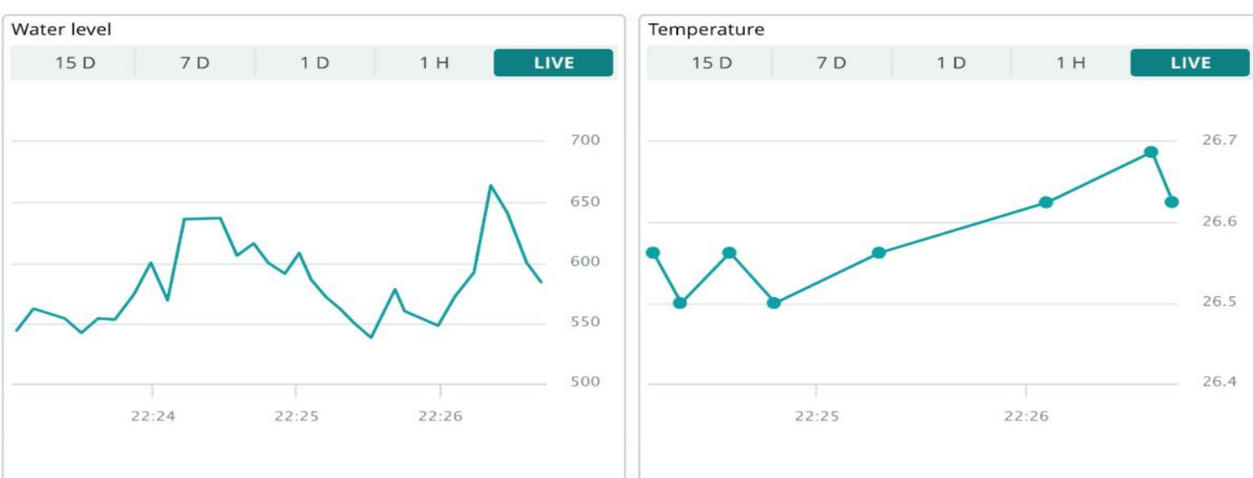


Fig .5. Live data of Water-Level Sensor & Temperature Sensor

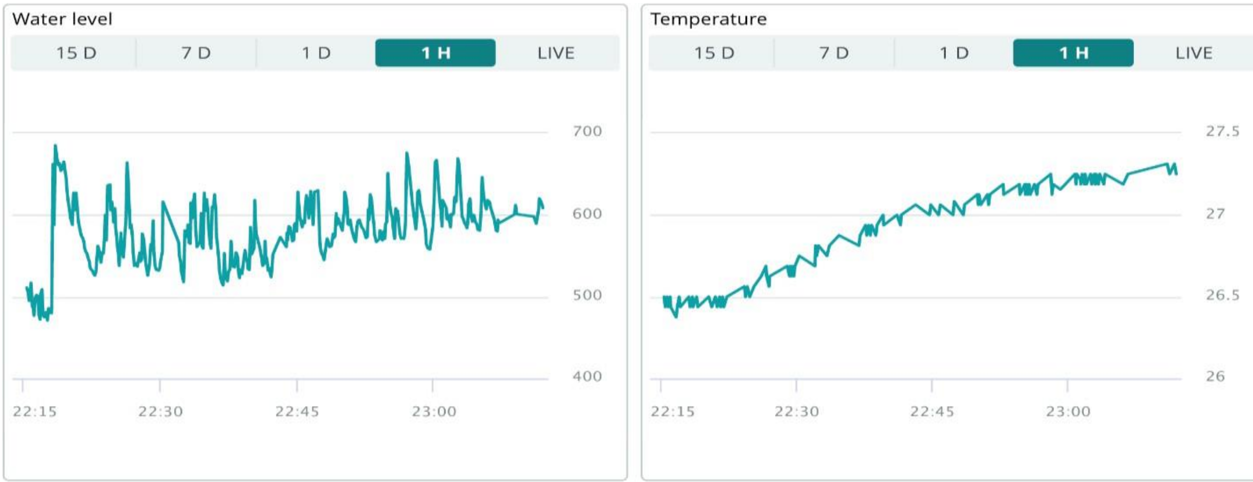


Fig .6. Data collected by both the sensors for a duration of 1 hour

6. FUTURE WORK

In this project, we have just made a prototype where we have worked upon Aquarium fishes like Gold fish, Fighter fish etc. In the coming future, we'll be working on more various kinds of sensors like pH sensor, Ultrasonic sensor, etc to collect the data and show it in the Arduino Cloud so that more parameters are measurable. We'll use the pH sensor to detect the acidity or alkalinity of the water ranging between 0-14. We'll be implementing our system for big ponds where there will be Fresh-water fishes which will give us a bigger picture & more solutions to provide to the real fishery management people. The requirements & parameters will change for the pond system.

7. CONCLUSION

Our Cloud-Based Prototype Model has been successfully proposed & can be implemented to ease the management of the fishery. The system is user-friendly & can be accessed remotely through the Cloud via mobiles, PCs, Tablets etc. The system makes its own decision-making based on pre-programmed instructions without user intervention. Different parameters such as water temperature, water level, pH level etc. can be controlled & managed easily. The water quality is kept at the right level based on the temperature sensor and pH sensor to help freshwater fish breeding. With the use of IOT, we are able to lower the cost as well as make the fishery management easier.

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Conflicts Of Interest

The author declares no conflicts of interest with regard to the subject matter or findings of the research.

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