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IoT Based Aquaculture Monitoring and Control System

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Abstract— Aquaculture, which has the potential to feed the globe in the upcoming era, needs smart innovative technology for its growth. An aqua farmer's daily routine involves keeping track of the water parameter which affects the growth of fish and shrimps. While some farmers use handheld meters for each parameter, others give their pond water sample to laboratory for testing. Which is time consuming and the results may not be as accurate as real time measurement at the pond site. The system proposed includes of six sensors measuring important water parameters for monitoring the growth of fish, shrimp, and other aquatic organisms. The measured values from the sensors are compared with the established data and an alert message is processed in the form of SMS through web server.

1. INTRODUCTION

Aquaculture is a set of activities, knowledge and techniques for the breeding of aquatic organisms. The aquaculture has a great importance in economic development and food production in our country. By observing the waters parameters physical and chemical variables such as: oxygen, temperature and salinity in water are some of the main conditions to be checked often in the pond. The Internet of Things (IOT) is an upcoming innovation for all the smart gadgets to connect people remotely. In farming system, various sensor nodes are used for checking the water parameter. The wireless sensors networks (WSN) composed of a large number of sensor nodes deployed in a monitoring region to collect, transmit and process information. Currently the aquaculture has become highly challenging due to emerging problems in farming regions. Water preparation before stocking is one part of the areas where the aqua farmers in India totally neglect it, use of good quality prebiotic & probiotics in the pond water helps in establishment of beneficial microbes in the pond ecosystem. Water rich in phytoplankton and zooplankton, which form the natural food for shrimp and also enhances the immunity in shrimp and gives better survival. The main purpose of the project is to observe the farming system remotely by using different Sensor for the water parameter, this will mainly reduce time, labor cost & also the risks.

2. RELATED WORK

The system in [1] .concerns about enhancing development in aquaculture by improved information and communication processes. Need to extend the ability of organizations to meet the needs of its farmers. An IOT based on architecture in [1] is to check SCM of aquaculture product. Uses GSM & GPRS as remote sensor for checking framework, which could be a mandatory piece. The main goal of this research is for the farmers to have an E-Aquaculture.

As the quality of water is a censorious factor for culturing marine & fresh water organisms, It is observed repeatedly for better growth and survival of the . The sensors used are arranged in the water to sense the information which is later transferred. The Raspberry Pi is used in [2] which has inbuilt Wi-Fi module in it.



For calculating a systematized solar harvesting system many factors are required for the potential ease of energy harvesting. The Solar energy transformation and battery energy storage can produce enough electricity for the experimental systems [3] to power sensor nodes by pumping continuously to increase the oxygen of fishponds efficiently.

In [4] the authors have chosen minimum essential product approach to establish the product as quickly as possible. The objective of [4] is to give access at low cost for the measurements of the water quality, to test the prototype with their robustness in African weather conditions, to gather information about the fish pond and with poor internet connection the installment of low-cost gateway to be tested.

The Aquaponics is a combination of Aquaculture and hydroponics. The main aim of [5] is to produce organic food from the waste which is been produced by the aquatic creature. The system embraces continuous tracking of the water quality and the surrounding environment by utilizing different sensors. The data from sensors can be retrieved remotely by using the Iot platform.

The purpose of this work [6] is to give an automatic fish farming monitoring system as its saving time, lowering cost and electricity for the aqua farmer. In the fish farming process, several sensors like pH, temperature and water level sensors are used. By utilizing these sensors, all the work is automated and it will be easy to observe the fish farming remotely from any location.

The WSN plays an important role in system with great potential for improving current applications in intensive aquaculture. In [7], ZigBee is being used due to its low cost and low power consumption property. Based on WSN the system involves the design of monitoring the water quality and a control system. In future, the work would gain remote access by using internet.

This paper [8] presents a prototype and idea of a distributed system with some necessary variables in aquaculture. The proposed system works by observing the quality of the water based on WSN and IOT. The main goal is to design and implement a system for aquaculture to track remotely the values of dissolved oxygen, pH and temperature. This prototype is still under development for future use.

3. PROJECT DESCRIPTION

A. Problem statement

The farmers has to visit many times in a day to monitor the overall activities in the farm. Workers roam around the aqua farm routinely as per their scheduled time to check the water quality of the pond. Some uses handheld meters to manually check water parameters and others test in a laboratory by giving their water sample. Aquaculture is in a lagging scope of technology compared to other areas such as agriculture. So it is supremely important to solve the problems with the support of technology.

B. Proposed mode

The system proposed is being implemented with sensors for temperature, water level, salinity, dissolved oxygen, and ammonia. These sensors are kept in the pond for observing the farming system. Each and every sensor gets detected instantly, stores the information in cloud and checks for upper and lower limit range, if any deviation is found at once an alert message is sent. The system designed runs in of arduino connected with sensors to it. The farming system can be monitored remotely with internet. The hurdle towards the establishing the aqua farm is based upon IOT for monitoring the real environment, the sensors will be accordingly interfaced and works automatically by giving the values in

- Distance
- NH₃ (ppm)
- Temperature
- Salinity

- Oxygen

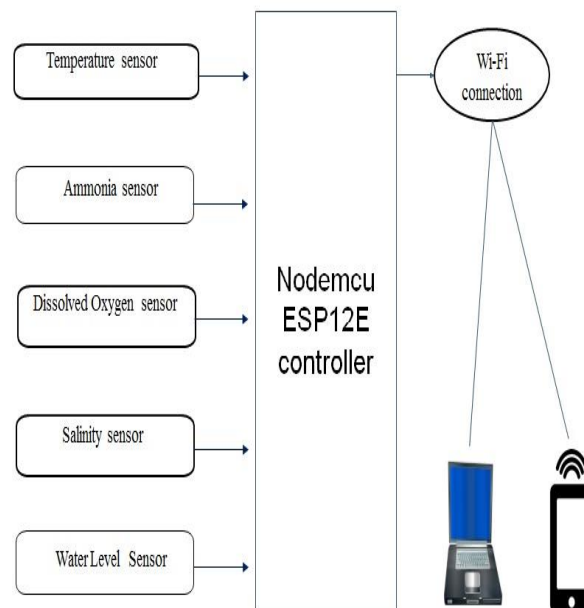


Fig. 1:Nodemcu ESP12E Controller

Every 5 seconds the measurement is taken, as the request of each sensor is sent, the information is redirected to the application connected to the computer it means that, a request is given to take the measurement and when the request of each sensor is sent, the sensed information is sent to the application.

The application of this technology in aquaculture will provide the following benefits:

1. Improved environmental control.
2. Lowering of damage caused by major disasters.
3. Reduction of environmental management costs.
4. Improves the growth of aquatic products.

4. REQUIRMENTS

- Temperature Sensor



Fig. 2: Temperature Sensor

Water temperature sensor measures the temperature of the water, by dipping the metal chase in the water the readings will be displayed. The Thermistor is a variable resistance element; whose resistance varies with change in temperature. The change in resistance value is a measure of the temperature. Thermistors are classified as PTC (Positive Temperature Coefficient) or NTC (Negative Temperature Coefficient). The NTC type is the most common. In both types the thermistor is protected behind the sensor's metal chasing, it should not have a direct contact with the coolant.

- Ammonia sensor



Fig.3: Ammonia sensor

Ammonia (NH_3) in general is a colourless gas but in aqua farm it is formed by the remaining feed when gets settled in the bottom of the pond and forms a sludgy black soil. As it reacts violently with water and can seriously damages the respiratory system of the shrimp. This gas sensor is installed to warn the amount of an Ammonia being released in the water.

- Water Level Sensor

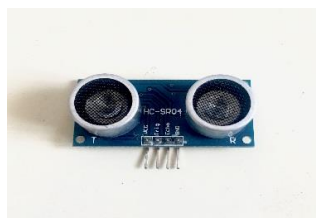


Fig.4: Water Level Sensor

This sensor's mechanism is to detect and indicate the level of water in the overhead tank and also in the other small containers. Once the water level dips down an alert message is sent.

- Nodemcu controller



Fig.5: Nodemcu controller

The [8] NodeMCU is an open source IOT platform which has inbuilt Wi-Fi platform in it. It mainly refers to the firmware which uses scripting language. The main features are the Wi-Fi access point & microcontroller. In Arduino IDE, the code will be written & dumped into the node MCU.

- Dissolved Oxygen Sensor



Fig.6: Dissolved Oxygen Sensor

The probe measures the production of the oxygen in the water, the main use of this sensor is to monitor the respiration of the shrimp in the water. This probe can be fully immersed in marine or salt water as it consists of a polyethylene membrane, in which the oxygen molecules diffuse inside it. Once the oxygen molecules cross the membrane the values are noted. If no oxygen molecules are present, then the probe will give an output-0.

- Salinity Sensor



Fig.7: Salinity Sensor

The term salinity is defined as a mass of dissolved salts in water. The level of salt in the water affects the growth & survival of the shrimp. In the pond the salinity should be maintained between 25-30 if not water exchange should be given.

5. MODULES

- SYSTEM ARCHITECTURE
- A. *Sensors* :

In this section six different sensors are used for checking the temperature, ammonia, salt, oxygen and water level. The sensors transmit their information to the Arduino connected via UART (Universal

Asynchronous Transmitter- Receiver). Each of these sensors is submerged in the pond where the measurement can be taken.

B. *Connectivity*:

The Nodemcu is used as the communication coordinator to the five analog sensor and hence for communication of sensors with nodemcu requires an external ADC channel multiplexer for processing data, since we have only one analog pin in Nodemcu. The 16 channel analog multiplexer is named as 74HC4067. The 74HC4067 can operate on voltages between 2 and 6V DC, which allows use with 3.3V and 5V microcontrollers and boards such as Arduino, Nodemcu and Raspberry Pi. The sensors connected to the boards, once the WIFI gets connected to the nodemcu the values are shown in an IOT platform "Ubidots". The sensors data gets displayed in the dashboard & also gets stored. In the ubidots events are created for higher & lower values to be emailed or a text message and even a voice call regarding the sensor's values, the timestamp & the solution.

6. CONCLUSION

This research presents a remote monitoring system using the concept of IOT for aquaculture water quality. In future the sensors will be submersed in water for the entire farming system as the data would be helpful before harvesting and some other important sensors can also be added if required according to the environment.

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