MONITORING AND AUTOMATIC CONTROLLING OF PHYSICAL PARAMETERS IN AQUACULTURE USING IOT

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Abstract:

In Aquaculture, the yield depends on the water characteristics of the Aquaculture pond. In this paper, we are monitoring the parameters such as pH value of water, dissolved oxygen, temperature, automatic controlling of aerators, water level and providing luminescence. pH value can be monitored by using pH sensor and the data will be send to the Arduino board similarly it will be displayed on the LCD display. The temperature levels of the aqua pond can be monitored using DS18B20 and similarly automates the aerators. Water level sensor is used to get the status of water level in the pond and controlling automatically by using motor to maintain sufficient water level. Real time clock (RTC Module) and a bulb is provided for continuous illumination for period of time in a pond. All these sensors are connected to Arduino board and based on the output the aerators, motor and bulb starts working. For user interface a webpage is created using python program and in the case of absence of internet (Wi-Fi module ESP8266) and smart phone we get the message to normal phones by using GSM module- SIM900.

Keywords: DS18B20, RTC Module, Arduino, Water Level Sensor, Wi-Fi Module-ESP8266, Aerators, GSM module- SIM900.

I. Introduction:

Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The things in IoT built with sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. The embedded technology in the objects helps them to interact with internal or the external environment, which in turn affects the decisions to be taken. IoT platforms can help organizations to reduce the cost through improved process efficiency, asset utilization and productivity. With improved tracking of devices/objects using sensors and connectivity, they can benefit from real-time insights and analytics, which would help them, make smarter decisions. The growth and convergence of data, processes and things on the internet would make such connections more relevant and important, creating more opportunities for people, businesses and industries.

Aquaculture is one of the flourishing sectors in India as it contributes nearly 1.07% of the GDP and it also provides nutritional security to the food basket of India. For maximizing fish or prawn yields, the parameters which are to be kept at certain optimum levels in water are dissolved oxygen, temperature, salinity, pH level, alkalinity and hardness, ammonia, plankton, blue-green algae and macrophytes and nutrient levels. These parameters can vary a lot during a period of a day and can be rapidly change depending on the external environmental conditions. Hence it is necessary to monitor continuously these parameters to avoid the losses in aquaculture.

In recent years, due to the increasing density of the aquaculture, along with the feed increasing, microbial breeding, and the water limitation, the DO problem of the aquaculture water is more and more serious, which has affected the healthy growth, survival and reproduction of the aquaculture animal seriously. In practice, water quality parameters in aquaculture are monitored by manual testing and continuously monitored by a person throughout the period of time. Due to manual monitoring it consumes more time to respond if there is a drastic and sudden change in the environment, which results in losses for aquaculture producers. In order to overcome these losses, technology has to be brought in manual monitoring system in aquaculture.

II. Literature Review

With the development of technology, science is being infiltrated into various fields, and traditional breeding is also developing to the factory-farm, making the intelligent supervising and control system about multi-factors receiving more and more attention in the application of aquaculture [1].In EARC (Eco Aqua farm Research Center), various research projects based on advanced IT technologies are progressed to provide better tools for aquaculture industries [2].

The optimal water quality for aquaculture determines by DO more than 4 ppm, acidity 7-8 pH, and the temperature is 20- 29°C[3]. The monitoring of dissolved oxygen (DO) of the aquaculture water is very important for safety of the aquaculture production [4].The volume of oxygen contained in water, is often the most critical parameter in the health and well-being of yield. In general, most fish species will grow and thrive within a DO range of 5–12 mg/L (ppm). However, if levels drop below 4 mg/L they may stop feeding, become stressed and begin to die. This series of events can start a chain reaction in a pond aquaculture system that could prove detrimental [5].

A continuous, stable power supply is very important for the aquaculture industry. The scholar designed a system will use municipal electricity coupled with a battery power source to provide power with battery intervention if municipal power is interrupted. The battery system is

designed to avoid the self-discharge phenomenon which reduces the battery lifetime. Solar power is used to provide charging at any time [6].

An intelligent supervising and control system about multi-factors are researched and applied in aquiculture. Expert system and image processing are introduced to automatically diagnose and predict the illness of fish. Remote sampling and control of data are realized by mobile GPRS telecommunication technology and Internet technology and made in a timely manner to various emergency situations reflected to avoid or reduce losses, greatly increased efficiency and cost-effectiveness, and to promote the gradual automation of farming industry[7]. Still some other scholars have done the research on monitoring different parameters using different techniques and technologies in aquaculture.

III. Aquaculture monitoring based on IoT:

In this paper, aquaculture is monitored as per the design flow as shown in the figure 1. In the previous models the alert message is provided through GSM, this helps in taking the effective action for the improvement at present and it is not useful in future for any kind of predictions based on the previous data. The communications over internet have more advantages then in cellular communication. So this paper added this scenario by using advanced technology such as IOT along with GSM module.

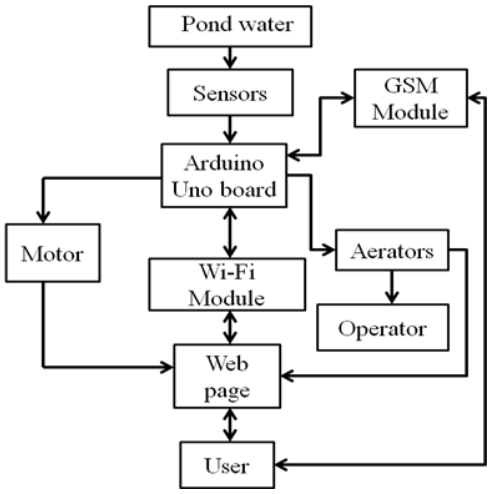


Figure1. Design flow of system

The sensors in the system are connected with the pond water and after sensing the physical parameters such as pH value, temperature value and water level, the information is send to the

Arduino Uno board with the help of sensors i.e pH sensor, temperature sensor(DS18B20) and water level sensor. This Arduino Uno board is connected with the motor and aerators, automatically automates the motor if water level in the pond is insufficient and aerators will also starts working automatically if the temperature value is more than 29°C.

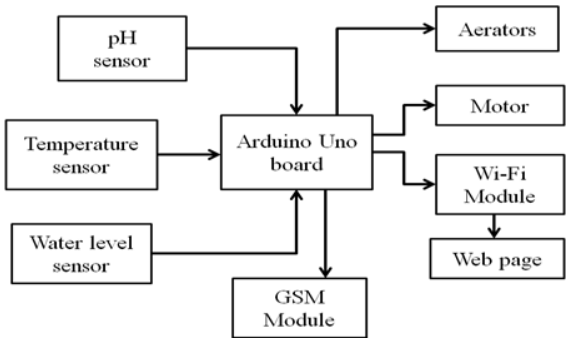
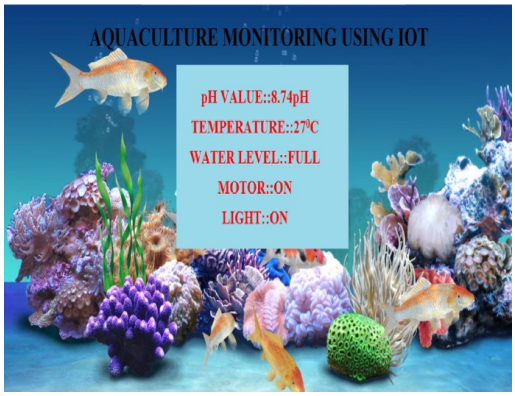


Figure2. Arduino Uno board connected with peripherals

Similarly, Wi-Fi (ESP8266) and GSM (SIM900) Modules are connected to the Arduino Uno board for the user interface. To communicate the user with internet, a webpage is created using python with Flask as its frame work. Python program can easily get the data from the Arduino Uno board which will be displayed on the webpage. Program will be running continuously to get the data from sensors for user communication.

IV. Results and Discussions:

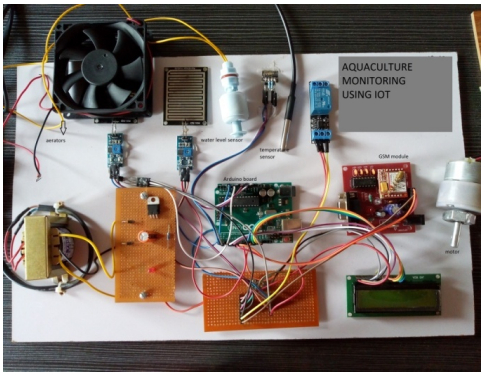
The values of the temperature, water level status will be displayed in the web page as shown in below figure.



The other output includes also in the database table which holds the value of parameters. The data can be used in future to get some useful predictions on the data using data analytics.

ESP8266(Wi-Fi module) is used to upload the values from the Arduino to the python file so we can access Arduino through internet webpage created by using HTML,CSS for front end, Python as back end and Py-mysql is used as data base for storing the data for future use.

Above figure shows the pH value on the LCD display and the total idea of monitoring is represented in the demonstration board as shown below.



V. CONCLUSION AND FUTURE SCOPE:

In this paper we have monitored the parameters which are useful in the aquaculture to reduce the losses due to weak monitoring practices and also reduce the man power. The purpose of this paper is to monitor the physical parameters of pond water such as pH value, dissolved oxygen,

temperature and water level. It also automates the aerators in order to increase the oxygen holding capacity of the water thus providing better living conditions for aqua. Similarly, it automates motor if water level in the pond is less than the required level.

In future, it can include additional sensors such as DO sensor, salinity sensors to obtain the information about DO and salinity of water in the pond water. Also, in future we can make this assembling unit of sensors as a dynamic one using the advancements in the robotics. We can create it as a robot in a shape of fish which will move under water as per our requirements to get the information of the pond.

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