SMART AQUACULTURE SYSTEM FOR WATER QUALITY MANAGEMENT AND CONTROL USING IOT

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ABSTRACT

The system presents the prototype of the concept of distributed monitoring for most important variables in water quality. This is of great importance because aquaculture is lagging area of technology compared to other areas such as agriculture. So it is important to solve the problems that are in this area with the support of technology. Among the problems is the slow response time in the care of water quality, the waste of resources and losses. The system proposed in this work monitors the water quality based on wireless sensor networks and on the internet of things (IoT). This system also performs automatic food feeding for the fishes in the aquaculture, water cleaning process done during the fluctuations in ph of the water and fish dying detection techniques are used to improve the development of this area since it allows sharing of different conditions in the living of aquatic organisms between different organizations. Thus the information is useful to know the conditions in which there is a better development of a product, worse development, what conditions can mean a possible disaster in the environment and how to optimize resources for the care of the aquaculture.

KEYWORD: *sensors, WSN(wireless sensor network, Ph(potential of hydrogen).*

1. INTRODUCTION

Aquaculture consists of the set of activities, knowledge and techniques for the breeding of aquatic plants and some species of animals. This activity has a great importance in economic development and food production. Continuous monitoring of the physical, chemical and biological parameters of pond water helps not only to predict and control the negative conditions of aquaculture, but also to avoid environmental damage and the collapse of the production process.

The monitoring of physical and chemical variables such as: oxygen, temperature and pH in water are vital to maintain adequate conditions and avoid undesirable situations that may lead to the collapse of aquaculture systems. Among the technologies that can support this problem in aquaculture are the wireless sensors networks(WSN) composed of a large number of self-organized sensors deployed in a monitoring region that perceive, collect, transmit and process information from supervised objects from the area covered in a coordinated manner.

2. EXISTING SYSTEM

In existing system, it will control the water level through automatic controller. It will control only the water level in the tank, so this creates our lack of concentration over the overhead tank.it also lead to miss the checking of water quality. This will create hazardous effect on our usage water In this system it has the problem in which the Aquaculture monitoring procedures are currently inefficient, according to the experience of breeders this consumes a lot of time and costs in terms of human resources.

The measurement of conditions is usually only done when the aquaculture has discovered an abnormal condition in the water or there is a drastic change in environmental factors. When the phenomenon occurs, the process to stabilize the system is usually very expensive and very complex. This causes environmental factors to be monitored inefficiently. Among the main problems in aquaculture are the presence of diseases, uncertainty in water quality, high costs of operation and waste.

2.1 System operation

The information flow of the system consists of taking information from the critical variables of the pond from the temperature, oxygen and ph sensors.

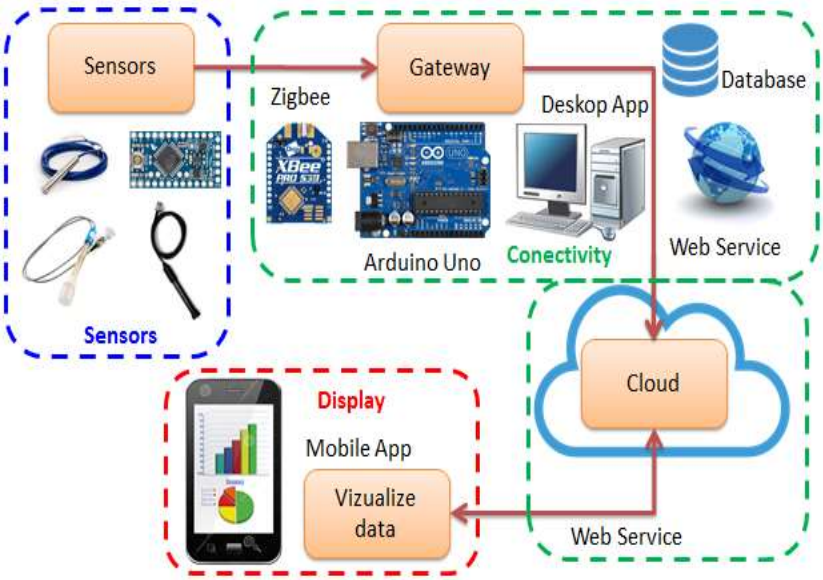

Fig -1 System general blocks and data flow

Previously these sensors were calibrated according to their specifications plus each one has its integrated circuit that provides the characterization of each sensor, in this way it has that the measured data are reliable. The Arduino module coordinates the time in which the information of each sensor is taken and how it is transmitted to the Xbee module. This coordination consists of control signals for a multiplexer.

This multiplexer has as input the data as UART for each of the different sensors and as output the Xbee module. This information is transmitted by the Xbee module transmitter of the measurement node to another Xbee module receiver that is connected in a computer, through the serial port Communicates with the data reading application. The application stores the in information in a database and uploads the information to the cloud through a web service. The mobile application asks the web services for the data to be displayed by the sensors as shown in fig-1.

2. PROPOSED SYSTEM

The main aim of this work is to design and implement a distributed system for aquaculture water quality care through remote monitoring of dissolved oxygen, ph and temperature. The system is modular, portable, low cost, versatile and allows sharing information through the cloud that can be used for the development and improvement of aquaculture activities.

The system that is proposed in smart aquaculture system are

- The dead fishes which release some chemicals and contaminate water are detected by the indication of the buzzer sound.
- The automatic water cleaning process is implemented by controlling the motors using the switches.
- The automatic food feeding for fishes by means of corresponding timers given in the arduino board

2.1 Detection of dead fishes

Fishes mostly die in aquarium because it is natural for fishes to produce ammonia and this created when waste is released into the water by the fishes. Excess fish food and debris also rots in the tank and this too can increase ammonia level concentration in water hence increase about 2ppm can cause fishes to die in the aquarium.

2.2 Chemical concentration due to dead fishes

The normal pH level of the fresh water prefers between 5.5 to 7.5.the saltwater prefers pH of 8.0. hence for the normal pH lies between 6.5 to 7.5 in which fishes can live in water without any problem shown in figure. If the pH value exceeds or decreases than the normal level the buzzer sound is created through which the user can replace the contaminated water by the fresh water.

The addition to excess carbon dioxide and tannis in the water, a ph drop may also be caused by the nitrification stage of biological filteration. Nitrification is the process through which beneficial bacteria in the aquarium convert ammonia to nitrate and the into nitrate. Ammonia is highly toxic to fish and other aquatic animals.

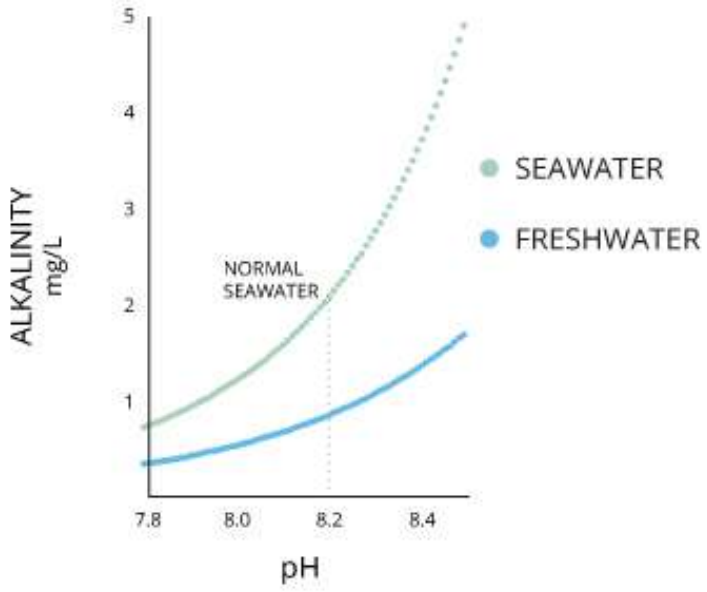

Fig-2 The alkalinity Vs ph of the water

The only safe of ammonia is 0 parts per million(ppm). Even concentrations of just 2ppm can cause fish to die in water as in fig-2

The dead fishes often release some chemicals like ammonia which contaminates the water. This changes the normal ph level in the water. The ph sensor indicates the amount of chemical content in the water. The sensor alerts are made by the buzzer sound through which the intimation is given to the controller. The web page intimates which chemical is present in the water by sensing the water quality. The buzzer sound creates alertness to change the contaminated water automatically by the user through the control switches.

2.3 Automatic water cleaning process

Due to the increased level of the ph level in the water the system automatically controls by releasing the turbid water out by pumping the water using arduino control hence then the pure water is produced into the aquarium by the inlet of the pump these operations are done by arduino timing operation.

The automatic water replacement process is also implemented in this system by means of the controlling switches. Through the outlet the contaminated water is taken out and the fresh water is given in through the water pumping motors. Hence these control are given to the motors by the control switches in the web page provided to the user hence it reduces the severe damage to the fishes.

2.4 Food feeding techinique

The food for the fishes are feeded automatically by means of the coding made in the arduino IDE software. The user sets the time delay and through which the arduino makes the DC motor to rotate and feed the food. The user gives the control through the mobile phone and using IoT the information is transferred to the arduino board which makes to work the DC motor. The food feeding process stops automatically if the motor is made rotated in the anticlockwise direction when the time gets completed in fig-3.

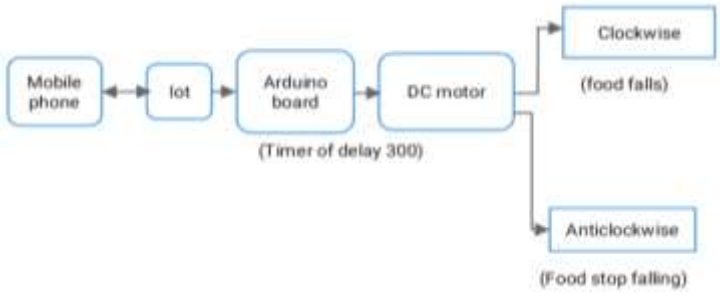

Fig-3 Food feeding process

The timer program is compiled in the arduino board which helps to flow the food corresponding to that timings. This process is made automatically by the control switches in the web page.The application of this technology in aquaculture provides the following benefits

- Production close to market demand.
- Improved environmental control.
- Reduction of damage caused by major disasters.
- Reduction of environmental management costs
- Reduction of production costs.
- Improves the quality of aquatic products.

The system can be implemented in aquaculture farms to monitor in real time the most important physical and chemical variables in water.

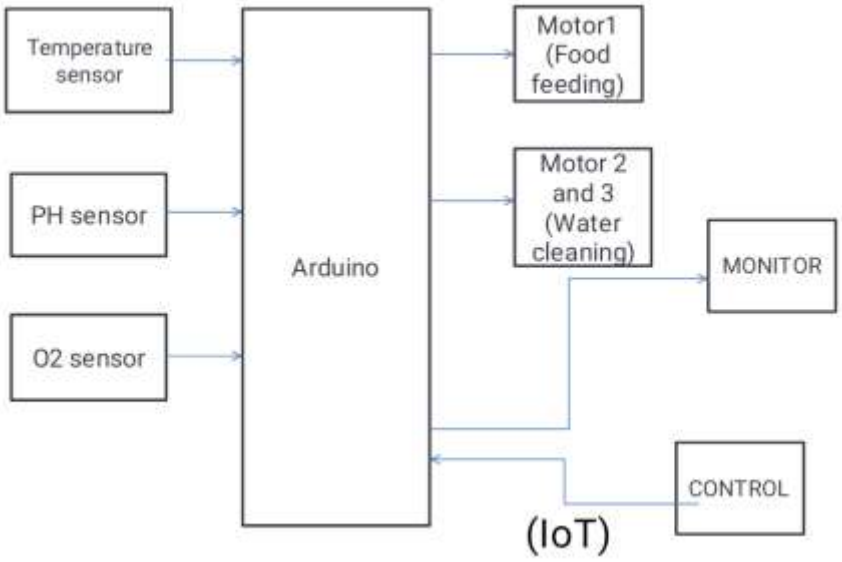

Fig- 4 The block diagram of the system.

3. RESULT AND DISCUSSIONS

3.1 The monitoring system of aquaculture

The proposed system was successfully developed using the proposed hardware, software and architecture. The data is transmitted regularly, without errors and with a very small latency. The system was tested using the system in a local network A in which the computer is connected and is the place where the cabinet with the sensors is located and the information was requested from an external network B as shown in figure-5.The remote monitoring of the aquaculture is followed by measuring the different variables like temperature, ph and oxygen. This contribution provides the aquaculture system to improve in its production and development by analyzing the water quality in the tank. The figure-6 shows the sensor connection using arduino board.

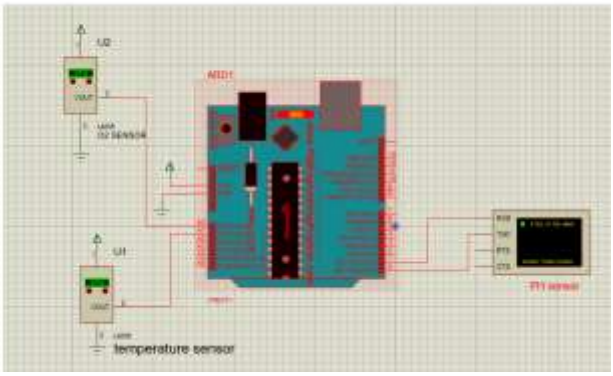

Fig-5 The pin diagram of the sensors in arduino

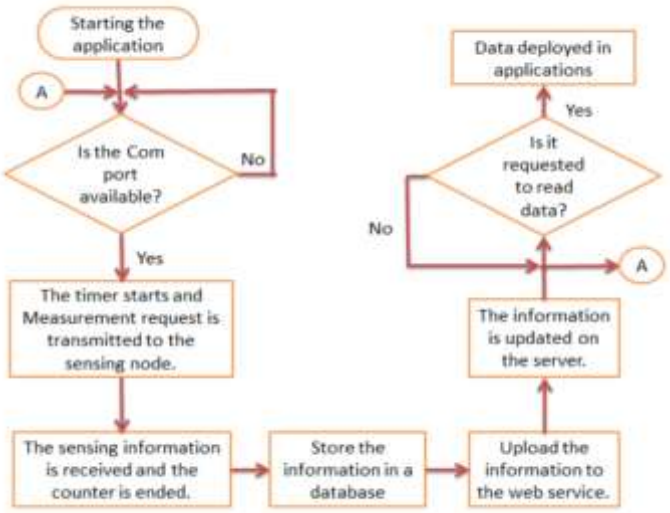

Fig-6 The data read and store of the arduino and sensors.

3.2 The output of the monitoring aquaculture

The sensor senses information and provides to the arduino board for giving better knowledge of the water quality in the aquaculture which is updated to the web page of the user who is carrying the user id and password the fig-7 shows the updated values of the sensors.

Hence This system lasts approximately 8 hours using rechargeable batteries of 200mA / h. This is sufficient for proof of concept of this prototype. The 15 seconds counter is used to take the measurements every 5 seconds. A request is sent to a sensor to take the measurement and when the request of each sensor is sent, the sensed information is sent to the application.

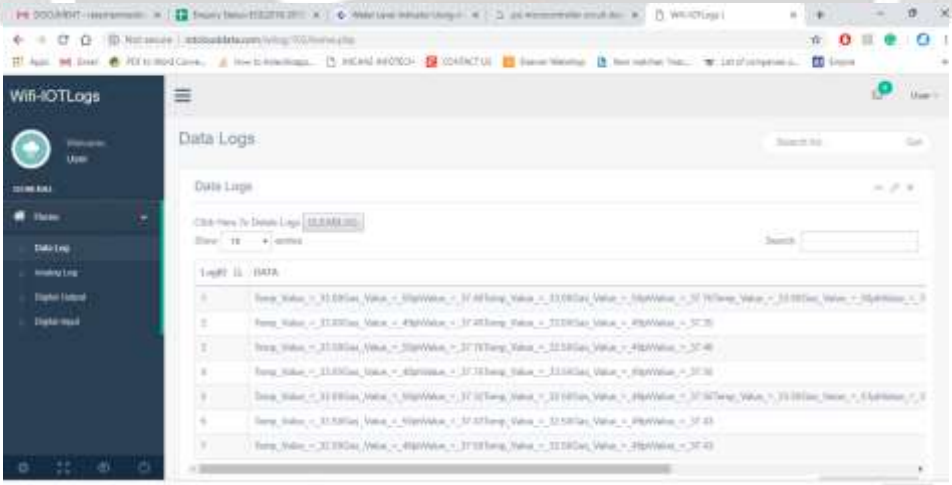

Fig-7 The output of the sensor interfacing

The sensor interfaced and accessed with the iot in the personal computer and the output of the sensors are updated for every 2 seconds are shown in the Fig-8 these data are updated with repect to the sensors in the water system the condition of the water is detected easily using arduino UNO.

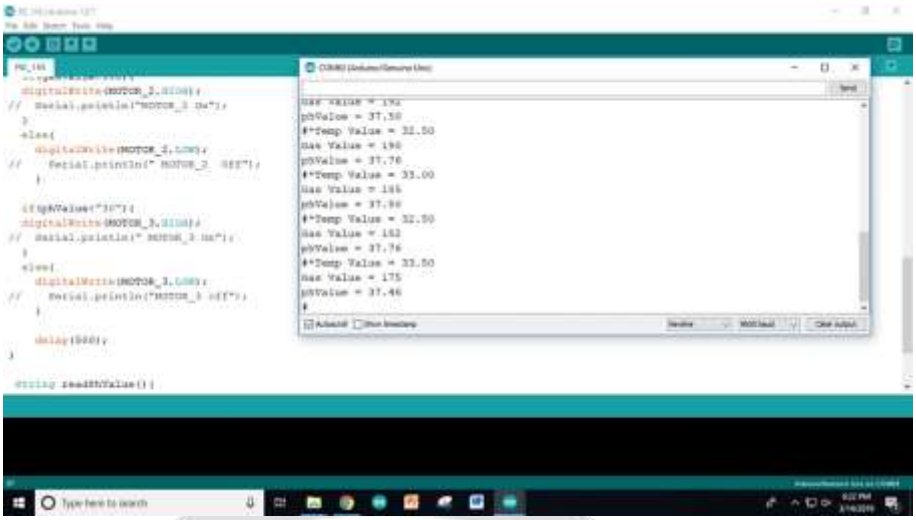

Fig-8 The output displayed in personal computer.

3.3 The controlling process of aquaculture

The water quality measurement when results to the critical situation then the water in the tank is cleaned by pumping the turbid water using the motor with respect to the control switches provided in the control panel as shown in figure 9.

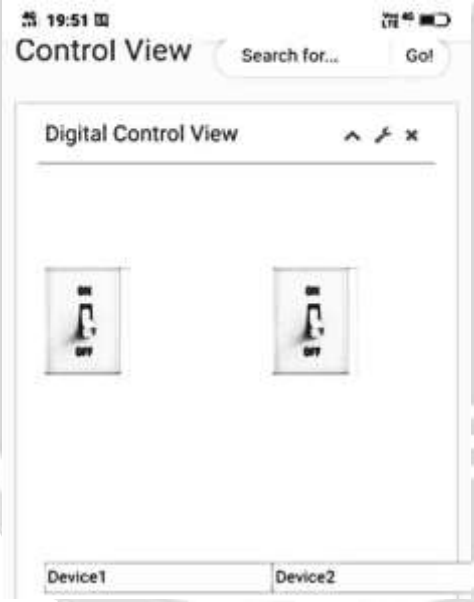

Fig-9 The control switches for cleaning water

4. CONCLUSION

The system of water quality monitering through the remote controller using the concept IoT among other technologies addressed to aquaculture water quality. In the existing system only the water quality is checked as well the proposed system contributes the automatic food feeding and the chemicals released by the dead fish is detected and the controlling the critical situation of fishes by cleaning the water automatically by the control from the user.This system is of low cost, less power consumption, versatile and accurate. The automatic implementation of these parameters reduces the manpower in the aquaculture development activities. The improved process in the aquaculture reduces the manpower by advanced application of technology in the aim of development of environment and resources.

5. REFERENCES

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