ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 5, Issue 8, August 2016

Embedded System Based Environmental Condition Monitoring for Fish Farming

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***Abstract*-This paper presents a flexible solution for improving the accuracy in monitoring the environmental conditions and reducing man power for fish farming. A RF module Wireless Sensor Network was used to monitor the critical conditions of a pond with the help of low power embedded PIC16F88 microcontroller. This system is capable of collecting and analyzing data on a GUI programmed with data acquisition systems. It also allows the user to get the updated sensor information online based on Google spread sheet application through internet connection. There by system reduces the effects of environmental fluctuations caused by sudden changes in a pond. The proposed system saves the cost of hiring labour as well as electricity usage and the design promotes a flexible, low cost for small and medium sized fish farming operations**

***Index terms*—PIC16F88, Wireless Sensor Network (WSN), RF Module, Aquaculture**

I.INTRODUCTION

In present days, the development of fish farming has been rapidly improving in our society. Successful fish farming is reliant on management of environmental conditions. Usually, farmers monitor the environmental conditions in the pond manually and irregularly. Mostly according to the famers experience it is time consuming and costly in terms of man power. To overcome these effects, Soonhee Han has decided that the monitoring of the environment on a regular basis [1] and automated control mechanism is essential.

Shrimp farmers are mainly uses the mechanical paddle-wheels to slap, beat and churn oxygen into the surface of the water. It is high cost and is not suitable for small and medium shrimp farming business [2]. By examining the actual needs of fish farming with low cost, reduced human power and factors like water temperature, ph value, and oxygen levels we propose a system, which is highly interactive and easy to use for monitoring the environmental condition of a pond.

The system provides two important features as follows:

- Regular monitoring: The proposed system monitors and records the water quality around the clock based on a wireless sensor network. And the system monitors two critical parameters such as pH value and temperature of the pond with the help of respective sensors
- Automated control mechanism: In this system, whenever values of sensor nodes reaches the respective preset values it automatically informs to the user system Google spread sheet via, internet connectivity with different indications

II.SYSTEM REQUIREMENTS

For effective management of fish ponds, we need early detection of disease problems and the capacity to implement appropriate methods before condition becomes uncontrollable [3]. More importantly any changes of the environmental factors in the pond will contribute significantly to the health of the overall fishes in a pond. So a wireless sensor network is an advanced solution compared to traditional monitoring. Sensor nodes can be deployed inside the pond which is also an economical savings, and at the same time a way to implement monitoring and control mechanism.

The proposed monitoring and control system meet the following requirements:

1) *Systematic*:
   - Work to be done at the same place and time to time.
   - Work to be performed and repeated at regular intervals.

2) *Responsive:*
   - The information must be available when required.
   - Information must be presented in user friendly way.

3) *Predictive:*
   - Allows user response based on the data collected to analyze prospective problems.
   - Provides the ability to react promptly to the problems encountered.

To overcome all these requirements, a system is proposed that can monitor the conditions of fish pond with appropriate methods.

III.SYSTEM ARCHITECTURE

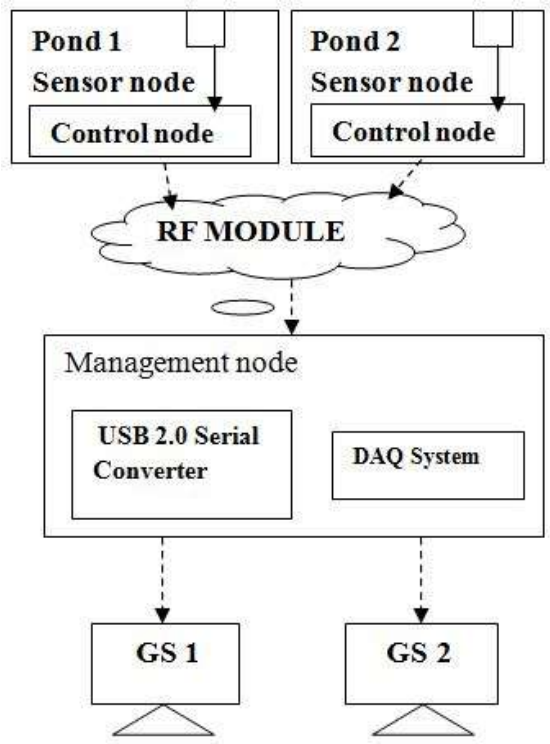

Figure.1. System architecture of the proposed system

Figure 1 shows the schematic diagram of our proposed system with important modules. To support the scalability of the system, first a wireless sensor network is built to collect information in each separate pond [4]. The network consists of different sensors to collect the critical sensor information. Second one is management station that is base station, which is heart of the proposed system is built and is responsible for many tasks including gathering sensor information.

Principle of operation: The information gathered from the sensor node is sent to the management section with the help of Radio Frequency Transmitter through RF module. The data is analyzed and presented on a graphical user interface, programmed by DAQ system using Lab VIEW. It allows user to update information about the environmental factors in the pond and control equipment easily through the webpage gateway. It provides great utility for the user as they can access the information or receive warnings (when the environmental factors change in the pond) at any location where GPRS services exist.

IV.SYSTEM DEVOLOPMENTS

In accordance with the overall system architecture analysis, the implementation of system consists of hardware and software development.

A) Hardware Design:

The hardware implemented in this project includes three parts: (1) sensor end node platform (2) control and transmission node platform (3) receive and management end node platform

1) The Sensor end node platform

Our sensor node platform was developed and implemented with consideration to low power consumption requirements. Figure 2 shows the block diagram of sensor node platform. It consists of two temperature sensors for inside and outside of the pond and pH sensor. All these sensors are communicated with the microcontroller named as programmable interface controller of type 16F88 [5].

For temperature measurement, 1-wire digital temperature sensor is selected which measures the temperature range from -50ºC to +120ºC with accuracy ±0.5ºC. It is able to connect to any GPIO port due to its digital output capabilities.

For pH level measurement, it is found that "Three way pH meter kit" [6] can provide us a good solution. This kit consists of a pH sensor circuit board and two electrodes. It provides a full range of pH measurement from 0 to 14. It works under a temperature range from 0 to 60ºc with a high accuracy of ±0.1pH. Simply connect the

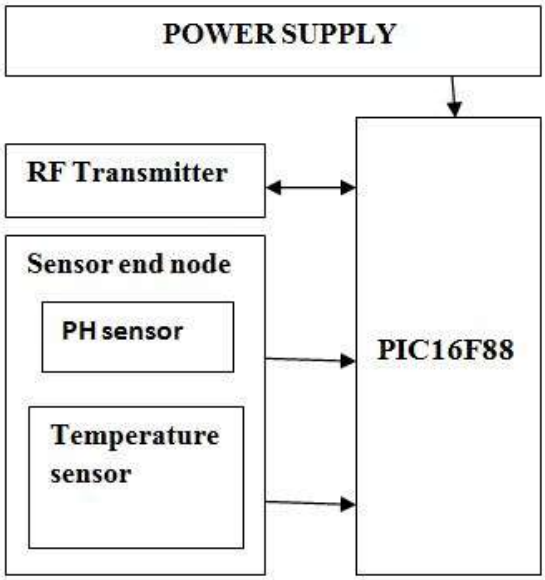

Fig2. Sensor node platform block diagram

2*) Control and transmission node platform*

The microcontroller receives the data from the various sensors used in the system. RF Transmitter is used for sending data to the management node platform through the RF module. In this, micro controller plays a key role in monitoring the sensor information to the data acquisition system and updating information on web pages.

3) *Receive &Management node platform*

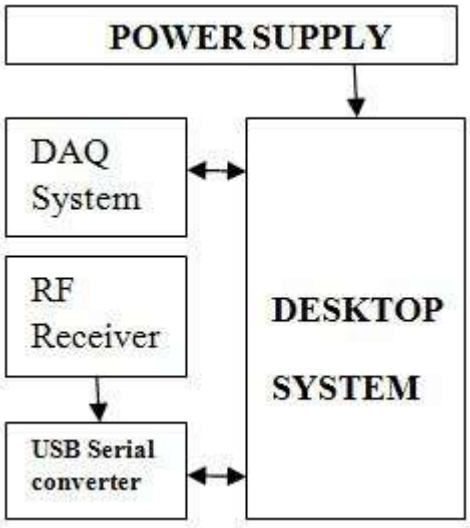

Figure.3. Management node hardware block diagram

Figure 3 shows the block diagram of management node. RF receiver receives the information from radio frequency transmitter through RF module

By using Universal Serial Bus (USB) 2.0 serial converter we get the data on to the user system with the help of Lab VIEW software having DAQ (Data Acquisition System). This updated information can be uploaded onto html web pages through the Google spread sheet application

B) Software Design

DAQ System is used to develop the monitoring software in the proposed system. The gathered sensor data will be displayed on table form and waveform chart at the Graphical User Interface (GUI). The data received will be compared with predetermined threshold values. By using embedded C program a code is developed for the operation of proposed system.

V.RESULTS & DISCUSSIONS

The transmitter and receiver modules of the proposed system is shown in figure 4 and figure 5 respectively.

Figure.4.Transmitter module of the proposed system.

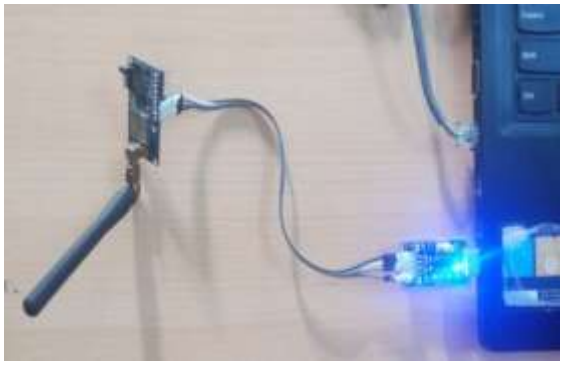

Figure.5. Receiver module of the proposed system

Finally developed kit is placed on a pond surface. DAQ system is to be installed on the user system to monitor the environmental conditions of the pond. In order to test the system performance experiments are done with different conditions of the water. Figures 6 to 10 gives the information about the test results.

Figure.6. Port setting of the DAQ system page

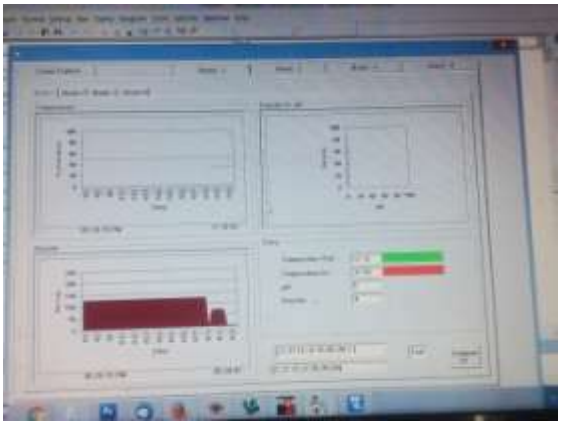

Figure.7. Detecting water condition as less than neutral

Figure.8.Updated sensor node information on Google spread sheets

Different colours glow on Google spreadsheets indicate that the proposed kit is tested for different environmental conditions of the pond.

Figure.9. Detecting water condition as greater than neutral

Figure.10. Updated sensor information on Google spread sheets

V. CONCLUSIONS

Finally it is conclude that the proposed system will report the environmental changes in the pond immediately. This is a low cost, easy-to-use and low power system that can be used for small and medium size fish farming operations. In this project it is used for fish farming purpose, but it is also used in various domains, where water quality is to be measured.

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