Water Quality Control by Automatic Dissolved Oxygen Controlling System

Sitthichon Kanitthakun and Komgrit Purisat
Department of Computer Engineering, Engineering Faculty, The Eastern University of Management and Technology
749/1 Chayangkul Rd. Muang Distrct, Ubonratchathani, 34000, Thailand
Tel: 045-283770 Ext. 1600
E-mail: {sitthichon, p.komgrit}@umt.ac.th

Abstract

There are several strategies to improve and controls the quantity of oxygen level dissolved in the water. The simplest strategy is using the oxygen in the air to mix into the water directly. Although these strategies are successive to use, it is achieving by individual or manual machines which often limit to receive fully efficient performances. This paper proposes the automatic system to control the dissolved oxygen for water quality control. The system consists of three main processes including dissolved oxygen sensing, microcontroller, and oxygen quantity controlling process. The experiment shows the consuming time of the proposed system comparing with intentionally adding water pollution.

Keywords: water quality, microcontroller, dissolved oxygen

1. Introduction

There are various factors for receiving high quality of agricultural products. In aquaculture, the most important and significant factor is the quality of the water. Thus, the studies in water quality are rapid developed appealing. The water quality index (WQI) is an indicator value of water quality [1] which consisting of temperature, pH value, CO2, turbidity (transparency and suspended solids), and dissolved oxygen. Although there are several indicators, the one of most interesting is dissolved oxygen.

Dissolved oxygen (DO) index is the quantity of the oxygen [2] dissolved in the water which the oxygen is photosynthesized from the plant and liberating to dissolve in the water. Because the oxygen is the gas which most significant for living thing, finding the quantity of dissolved oxygen is important to consider the water that is suitable to maintain for living thing. It motivates that the oxygen in the water is an important for an aquaculture. There is study such as [3], which is to find the method to improve the quality of the water and to find the quantity of oxygen.

There are several strategies to improve and controls the quantity of dissolved oxygen in the water. The simplest strategy is using the oxygen in the air to mix into the water directly. This strategy is successive by flow up the water into the air individually or electric machines. Another example is using electric pump to add new water which assuming that those water are containing high quantity of quality oxygen.

Although these strategies are successive to use, it is achieving by individual or manual machines which often limit to receive fully efficient performances. For example, in case of human individual, it is tedious task, and thus the facilitated system is needed. In case of manual electric machines, it seems to limit to control the quality. Although it is using the electric machine, it is manual by human to control the machine to work out the task. Thus, the automatic facilitated system for controlling the dissolved oxygen of water quality control becomes necessary.

This paper proposes the automatic system to control the quantity of dissolved oxygen for water quality. Microcontroller is used as control unit to control the quantity of dissolved oxygen for water quality controlling. The oxygen sensor is used to measure oxygen level dissolved in the water, and then converted electric value as input for microcontroller. Microcontroller uses this value to consider oxygen level dissolved in the water and controls water pump to flow the water to mix the oxygen which in the air into the water until the oxygen dissolved in the water is suitable.

The rest of this paper is organized as following; section 2 gives the overview of proposed system; the detail of Automatic Dissolved Oxygen Controlling System (ADOCS) is described in section 3; the experiment of proposed system is shown in section 4; the conclusion is concluded in the final section, section 5.

2. Overview of ADOCS

In this section, the overview of the automatic dissolved oxygen controlling system (ADOCS) is depicted. The system consists of three main processes including dissolved oxygen sensing, microcontroller, and oxygen quantity controlling. In the first process, dissolved oxygen sensing, the dissolved oxygen is measured to find the level of oxygen dissolved in the water. Secondly, after measuring the oxygen level by oxygen sensing, the oxygen level in the term of electric value is used as the input of the microcontroller. In this process, the oxygen level is calculated to find the suitable value of oxygen quantity for the water quality. In the case of the quality of water should be modified, our main task, microcontroller controls the system to add oxygen quantity in the water by driving the pump to flow the water to mix the oxygen in the air into the water. This process is remaining until the oxygen level in the water is suitable which measuring from the sensing process. Figure 1. shows whole proposed Automatic Dissolved Oxygen Controlling System (ADOCS).

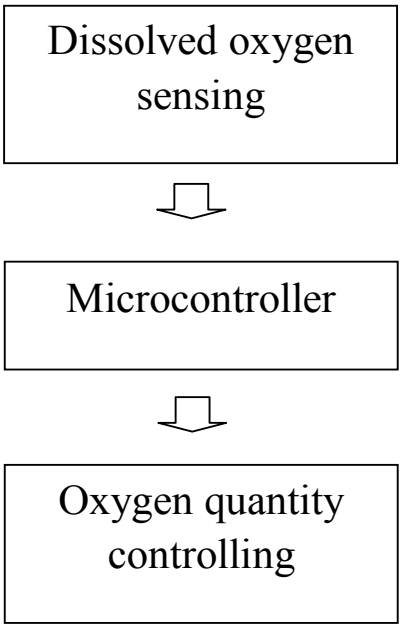

Figure 1. The overview of proposed ADOCS**.**

3. Automatic Dissolved Oxygen Controlling System

In this section, the detail of automatic dissolved oxygen controlling system is given. There are three main processes including dissolved oxygen sensing, microcontroller, and oxygen quantity controlling process. The following subsections are the detail of each process.

3.1 Dissolved Oxygen Sensing

Dissolved oxygen sensor is a rugged reliable water oxygen level measuring device that generates 4-20 mA output. These electric current values divide dissolved oxygen level into 0-18 parts per million (ppm) which often significant use is 5-6 ppm. Each electric current value scale represents each level of oxygen dissolved in the water. The electric current value is used as the input to feed to the control unit, microcontroller.

3.2 Microcontroller

Microcontroller, PIC 16F877, is used as control unit. Figure 2. shows PIC 16F877 microcontroller broad with LCD display. The procedure is starting at the oxygen sensor measuring the level of oxygen dissolved in the water, and then converts the level to the electric current value. This value is used as input to control unit to consider the level of oxygen. If the value more than threshold, the control unit is doing nothing, while if the value is less than threshold, it means that the quantity of oxygen dissolved in the water is low. In this case, the control unit drives the pump to mix the oxygen into the water. The procedure is shown as flow chart in figure 3.

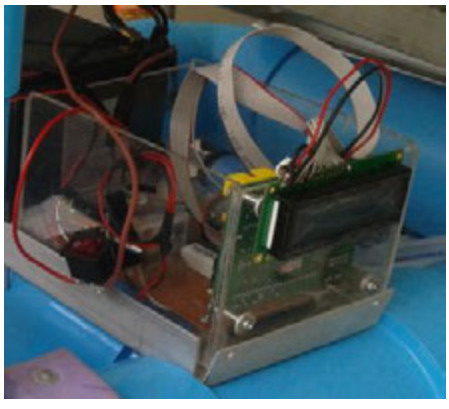

Figure 2. Microcontroller broad.

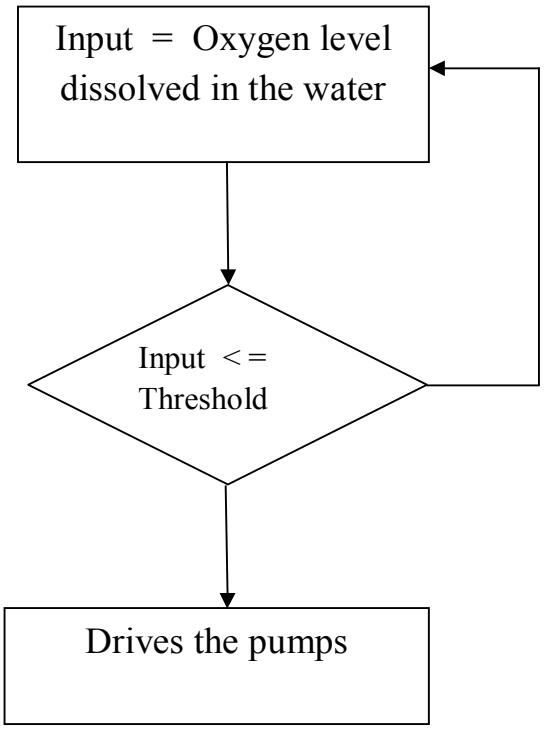

Figure 3. Flow chart of control unit.

3.3 Oxygen quantity controlling

In this procedure, the oxygen quantity is controlled. The technique is flowing up the water and feeding up new water to mix the oxygen to dissolve in the water. Microcontroller considers the input oxygen level through converted electric current value. In case of less value, microcontroller drives the water pumps. Figure 4. shows the water pumps.

Figure 4. The water pump.

3.4 Power supply

In power supply unit, for energy saving, this unit uses the solar cells to serve the electric power to whole system including microcontroller broad with LCD display, oxygen sensor electric driven unit, and the water pumps supply. Figure 5. shows solar cell power supply unit.

Figure 5. The power supply using a solar cell.

4. Experimental result

The system is tested for controlling the water quality by controlling the quantity of oxygen dissolved in the water. To test, the water pollution is intentionally adding into the water increasingly scaling up 10% to 50%, and then the consuming time of proposed system is tested for oxygen quantity improving. In addition, the dissolved oxygen that higher than 5.0 mg/L is assuming to pure water. Figure 6. shows the consuming time curve, which is tending to exponential curve.

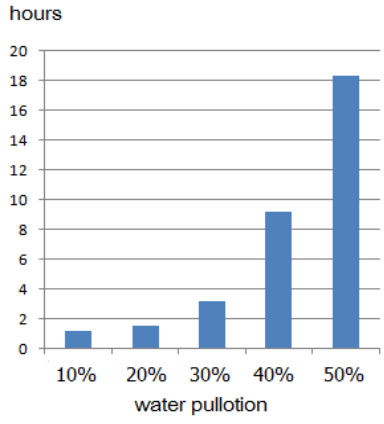

Figure 6. The time consuming curve.

5. Conclusions

This paper proposes the automatic system to control the quality of the water by controlling the oxygen level dissolved in the water. The system consists of three main processes including dissolved oxygen sensing, microcontroller, and oxygen quantity controlling process. In dissolved oxygen sensing process, the dissolved oxygen is measured finding the oxygen. The oxygen level in the term of electric values is used as the input and feed to microcontroller. The oxygen level is calculated to find the suitable value for the water quality. Microcontroller controls the system of oxygen quantity in the water for the case of the quality of water should be modified by driving the pump to flow the water to mix the oxygen in the air into the water and remaining until the oxygen level in the water is suitable. The experiment shows the consuming time of proposed system comparing with intentionally adding water pollution, which it tends to exponential curve.

6. References

[1] Wikipedia, 2013, Water quality, (Online), Available at: http://en.wikipedea.org/wiki/Water quality, Accessed March 1, 2013.

[2] Wikipedia, 2013, Oxygen, (Online), Available at: http://th.wikipedia.org/wiki/Oxygen, Accessed March 1, 2013.

[3] Namtom T. and Suneerat R., "Water Quality in Catfish Ponds under Phytoplankton Bloom Condition", Department of Fisheries Science. Faculty of Agricultural Technology, KMITL.