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Design and Implementation of System and Monitoring of the variables: Ph, oxygen level and temperature for piscicola cultivation pond in the International Nautical, Fluvial and Port Center

Diseño e implementación del sistema y monitoreo de las variables: Ph, nivel de oxígeno y temperatura para el estanque de cultivo de piscicola en el Centro Internacional Náutico, Fluvial y Portuario

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Abstract

The water wealth in Colombia, the quality of its waters and the climate allow the artificial cultivation of fish or fish farming to be in frank development. This activity, whether handmade or industrial, must fulfill important aspects in relation to techniques and procedures. Water, an essential element for fish farming must be of quality and to achieve such property it is necessary to measure the variables "ph", "dissolved oxygen" and "temperature". The purpose of this work was to study the traditional procedure and then design a measurement monitoring system for these variables with the use of sensors, conditioning circuits, analog-digital conversion, generation of historical records and a user interface. The study was conducted in a pond for fish farming, gathering detailed information and selecting equipment and elements appropriate for the implementation of a new system. The design was done, device tests were performed and a user manual was developed. The result was a system capable of determining, visualizing and storing the results of the determining parameters in water quality. At the conclusion of the study, a pH / OD / temperature meter is obtained, with the ability to determine, visualize and store data. As a recommendation, the design of a meter calibration calendar is suggested.

Keywords: Aquaculture, fish farming, microcontroller, sensor, monitoring, interface.

Resumen

La riqueza hídrica de Colombia, la calidad de sus aguas y el clima permiten que el cultivo artificial de peces o la piscicultura estén en franco desarrollo. Esta actividad, ya sea artesanal o industrial, debe cumplir aspectos importantes en relación con las técnicas y procedimientos. El agua, elemento esencial para la piscicultura, debe ser de calidad y para lograr dicha propiedad es necesario medir las variables "ph", "oxígeno disuelto" y "temperatura". El propósito de este trabajo fue estudiar el procedimiento tradicional y luego diseñar un sistema de vigilancia de las mediciones de estas variables con el uso de sensores, circuitos de acondicionamiento, conversión analógico-digital, generación de registros históricos y una interfaz de usuario. El estudio se llevó a cabo en un estanque para la piscicultura, reuniendo información detallada y seleccionando el equipo y los elementos adecuados para la aplicación de un nuevo sistema. Se hizo el diseño, se realizaron pruebas de los dispositivos y se elaboró un manual de usuario. El resultado fue un sistema capaz de determinar, visualizar y almacenar los resultados de los parámetros determinantes de la calidad del agua. Al final del estudio se obtiene un medidor de pH / OD / temperatura, con capacidad para determinar, visualizar y almacenar los datos. Como recomendación, se sugiere el diseño de un calendario de calibración del medidor.

Palabras clave: Acuicultura, piscicultura, microcontrolador, sensor, monitorización, interfaz

Introduction

Currently, activities that have been carried out in traditional ways for generations, such as fish farming, have been approaching technology in order to improve their procedures and thus guarantee the quality of their crops. As water is the main element in the cultivation of aquatic organisms, it is necessary for the fish farmer to determine the excellence of said water element. Measuring water quality quickly and at affordable costs is essential for the practice of this activity [1].

The purpose of this work is to design a monitoring system for 3 of the variables that have the most effect on water quality and consequently on fish production. The national market offers a wide variety of the basic components to build a monitoring system, which makes its design and implementation feasible.

The Bolivian SENA-regional International Nautical, Fluvial and Port Center is an institution that lacks this kind of equipment due to its high costs in the national market. In addition, its use is not very common for academic purposes and only professional range equipment is marketed for large-scale producers and environmental studies whose prices range between 2 and 3 million pesos, which is why this research will allow said nautical center of the educational access to a monitoring system that meets the basic characteristics of a professional meter to all those people who decide to train to enter the fish farming activity and who in their great majority are not familiar with this type of technology and the advantages that these offer

Theoretical fundament

The theoretical concepts detailed in the research are circumscribed in two aspects: The first is related to the activity that motivated the study, the quality of water in pondsintended for fish farming; and, the second, the one related to the proposed monitoring design of the most important variables that can determine the quality of the water in the ponds.

1.- The author [2] defines aquaculture like any activity focused on the breeding and production of aquatic organisms under controlled conditions, this branches according to the organism that is cultivated, being the pisciculture the branch dedicated to fish farming. Within this activity is fish farming, which is the artificial breeding of fish and shellfish in ponds. The SENA virtual community, in the training it offers to Colombians, refers to three aspects of great importance in raising fish in ponds, namely:

Temperature: Temperature: Fish farming can live within certain temperature limits, outside these limits there are problems with growth, breathing, metabolism and reproduction. In the case of fish farming in warm weather, ideal growth occurs in the temperature range between 25 and 32°C, some species such as tilapia according to [3] have an optimal development between 27.24 ± 0.22°C, but can become extinct in temperature ranges between 5-11°C and 38-42°C [4].

PH: The pH values, measure of acidity or alkalinity of the water recommended for fish farming, are all those values close to neutrality (7) within the scale with extreme values of 0 and 14 [4]. All those values far from the point of neutrality produce in the hatchlings irritation in their gills, destruction of their tissues, decrease in growth and deaths. Depending on [3] in tilapia, it can range from 7.56 ± 0.07.

Dissolved oxygen (DO): A shortage of DO causes feeding problems in the offspring, leading to problems in the biomass. Its consumption must be 15 mg for each gram of fish weight, otherwise there can be deaths in the culture [4]. According to the study of [2] in tilapia it can be 7.00 ± 0.76 $O2$ mg/L

2.- To design a monitoring system, it is necessary to know the meaning of the following concepts:

According to [5-6] a signal acquisition and processing system It is a set of elements that, by electronic means, allow transforming physical variables into electrical signals, and then digitize, process, visualize, and in some cases record them.

The author [6] maintains that systems based on microcontrollers and microprocessors are very common, which together with external devices such as RTC's and LCD's are capable of processing, displaying and recording physical study quantities at low cost and high performance.

Regarding temperature [7], points out that temperature sensors are capable of perceiving temperature changes and transforming this energy into electrical signals. The most used are:

- RTD.
- Thermocouple.
- Thermistor.
- IC sensors.

The author [8] explains that pH sensors are called electrochemicals for their ability to perceive chemical parameters, they allow to detect potential changes caused by the difference in acidity of some substances such as water. The most widely used for their accuracy and versatility are those based on glass electrode systems and the ISFET (Ion Sensitive Field Effect Transistor) transistor electrode.

On the other hand, regarding DO Sensors, they report that they allow the amount of dissolved oxygen in the water to be established and that they can be classified depending on the technique on which they are based.

its operating principle, which can be galvanic, polarographic or balance.

Returning to [7], we have to signal conditioners They are circuits that are responsible for amplifying, filtering and adapting the signals coming from sensors, either for their respective A / D conversion or another type of later stage. These circuits, in addition to the basic functions mentioned above, can also fulfill tasks such as linearization of sensors, differentiation and integration, limit comparison, fault detection, among other processing functions.

Objective

Design and implement a monitoring system for the variables: pH, temperature and oxygen level of the water in a pond for fish farming in the SENA NAUTICO- REGIONAL BOLIVAR.

Materials and methods

According to [9], the steps, techniques and procedures used to solve research problems constitute the scientific method. The focus given to the research has been quantitative and descriptive, field and feasibility.

Authors such as [10], rely on the Degree Works Manual of the Universidad Pedagógica Experimental Libertador de Venezuela (UPEL) to point out that feasible research aims to develop a proposal for a viable operating model for problem solving.

The research was carried out in compliance with the specific objectives, which made it possible to achieve the proposed general objective.

To achieve compliance with the proposed strategy, a series of stages were developed, which are described below:

Study of the problem and proposed technology available: Procedures were studied used in fish farming for the measurement of the variables mentioned, the ranges of measurement and the type of technology used for this purpose.

Application technology: With the information acquired in the previous phase, the most appropriate equipment and elements for the implementation of the system were selected, having as a fundamental requirement the availability in the local market and its costs.

Design and calculations: In this phase, the technical specifications of each of the sensors were studied. Based on this information, their respective conditioning circuits were designed. The programming algorithm of the microcontroller was designed to digitize, display and store the data delivered by the sensors.

Device tests: Tests were carried out, faults were identified, corrective measures, adjustments and final asembly of the system were carried out.

User manual: At this stage, a system manual was prepared to guarantee correct use by the user.

The methodological and engineering strategy proposed for the preparation of the work is described below, which is summarized in 6 steps, contained in the following figure 1.

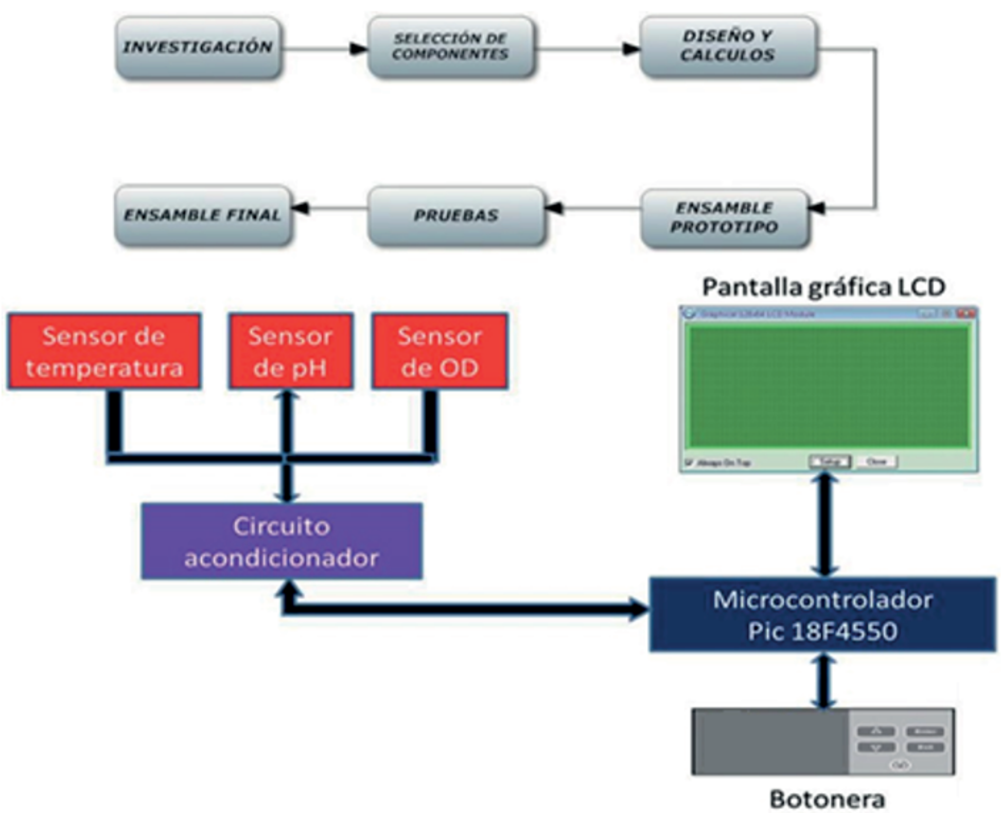

Figure 1. Device block diagram

Results and Discussion

The information required on site, makes it easier for you to interpret the variables obtained through an easy-to-operate menu, as well as providing the possibility of evaluating the results, taking preventive and corrective actions to improve your crops, and most importantly a low cost compared to existing meters on the market.

The implementation of this device resulted in a system capable of determining, displaying and storing the variables pH, dissolved oxygen and temperature in fish ponds, allowing efficient management of the water quality of fish cultures. The work developed allows the user to obtain

The monitoring system is made up of 5 modules: sensor module, data acquisition module, signal conditioner module, display module and power module. In the following graph it is possible to visualize in general form how each one of the components that make up the operating modules of the measurement system, interconnect with each other.

Conclusions

With the compilation and analysis of the information, it was possible to obtain a sufficient theoretical basis for the design and subsequent implementation of a monitoring system for the variables pH, oxygen level and temperature in the fish ponds of the International Nautical, River and Port Center - Sena Bolívar Regional

With this research, a pH / OD / temperature meter was obtained, capable of displaying the required parameter through a graphic interface, either for its measurement, storage or sensor calibration.

The Bolívar Nautical-Regional Sena was provided with an important tool for the improvement and better use of its fish farming.

The complexity of the dissolved oxygen sensor hindered the development of the investigation since aspects such as its calibration and measurement require the measurement of other variables and parameters such as barometric pressure, salinity, altitude and depth of water, these variables and parameters at not being considered in the work affected aspects such as the accuracy and precision of this measurement.

The symmetrical power requirement of some components compromised the portability of the equipment.

Recommendations

It is suggested to design a meter calibration calendar for each of its variables,

Initially, it is advisable to perform it every 4 days in the first 2 weeks of use, in case of not showing measurement errors, increase it every time. 8 days and gradually increase until determining the time in which the equipment requires calibration.

In case of future improvements in the equipment, the inclusion of all those parameters that influence the measurement of dissolved oxygen is suggested, likewise expanding the scope of the equipment with the incorporation of new variables that influence the estimation of water quality, all with the aim of making this project a much more complete fish farming tool.

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