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Monitoring of physicochemical and environmental parameters in fish farming

Summary

Fish farming is a science of great demand for fish production, which historically has been used as a solution to social, economic and nutritional problems. Due to their consumption they provide us with essential nutrients for the development of human activity, which is why the main objective of this article is to monitor water quality and environmental data for the breeding of red tilapia "Oreochromis aureus" in ponds, with the purpose of technifying and improving good production practices in this area, performing real-time monitoring through the ThingSpeak platform, since the aim is to reduce the mortality rate of the species planted.

Motivation

Due to my own experience in which a certain amount of red tilapia fish were planted in a farm belonging to some relatives and after a few months most of the fish died, the question arose as to why this was happening and I set myself the task of investigating what was causing the species to die. In the literature I found that it was due to the physicochemical parameters of the water that were never in the right range that they should be and that is why the fish died, so it occurred to me that if I could design a real-time monitoring system of these parameters, I could make a timely correction to these parameters and prevent the mortality rate of the species from increasing.

Justification

In recent years, there has been a need to implement technologies to optimize the use of natural resources in fish farming in order to reduce the economic impact generated by the death of fish and, in turn, increase the capacity to meet the food needs of the population in the coming years, taking into account the estimated 60% increase in world food demand by 2030 [1].

The production and consumption of fish meat in the country has increased in recent years and is expected to continue to do so, due to the timely implementation of technologies that will positively affect the production and yield of fish crops in the country.

From an academic point of view, this work poses the challenge of developing and integrating an on-line electronic monitoring system.

During the course of the project, the use of some analytical functions will be defined to contribute to the study and management of the water quality of the pond for fattening fish. In order to implement the project, knowledge acquired during the course of study will be applied, such as instrumentation and measurement, programming of embedded devices, database management. The process will be duly recorded and documented, so that more people can have a basis that could be useful in the development of projects similar to this one.

This technological development will provide a record of water quality data of red tilapia fish farming ponds, to which some analytical functions will be applied to provide relevant information according to the needs of the interested party. Finally, a web page will be provided that will allow users to visualize, in real time, the different variables of the water quality of the tilapia farming pond. Different types of data analysis are also performed, allowing users to improve their management and management of the water quality of red tilapia grow-out ponds.

Related work

In today's fish farming processes, water quality measurements are taken in the grow-out and rearing ponds, as well as measurements in different areas of the culture by an operator from time to time. This is why real-time water quality measurement is becoming more and more important to reduce costs and improve the accuracy of water quality analysis in grow-out ponds.

Some researches have set themselves the task of implementing practices that allow the measurement of water quality in a non-conventional way, allowing the measurement in different culture ponds. The following are some researches that fulfill similar objectives to those proposed in this work.

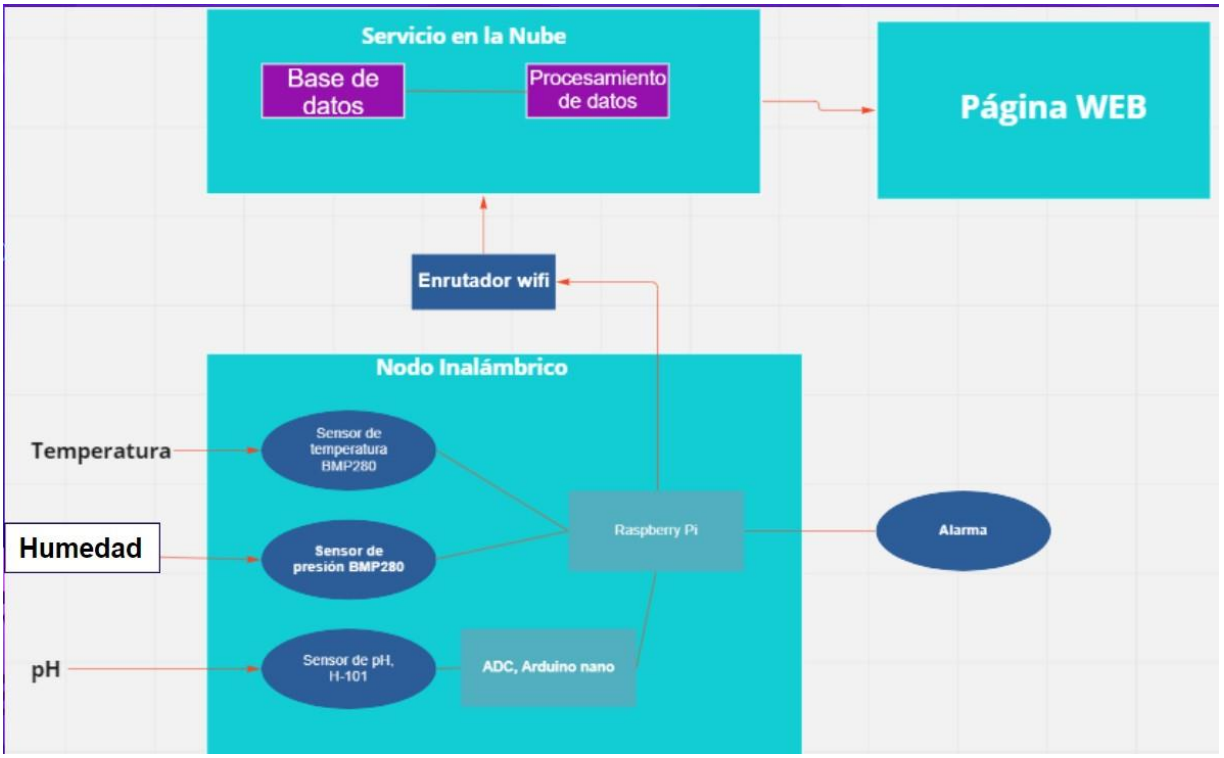
In 2021, Tito Manuel Piamba-Mamian, Leidy Estefanía Zambrano, Luis Alexander Montaño-Ruales, Francisco Arturo Rojas-Gonzáles. They implemented a monitoring system using Internet of Things (IoT) techniques, identified real-time variables such as temperature, dissolved oxygen, pH which allowed them to reduce the mortality of rainbow trout in early stages (eggs, larvae and fry), thus benefiting small producers[12]. In relation to the current project, it is also desired to measure water quality variables in the pond of the red tilapia "Oreochromis aureus" culture using IoT technologies; respective adaptations will be made on the measurement ranges, geographical location, IoT platforms that best suit the solution.

Proposed solution

The proposed solution consists of a web page where the fish farmer user can enter and verify in real time the data of the physicochemical variables of the water by simply entering a username and password to the platform to view the data.

These results also include a small analytic in which the averages of the input values are taken, a historical record of how the measured variables behave over time and an alert system which tells you when a variable is not in the right range via email.

Proposed architecture



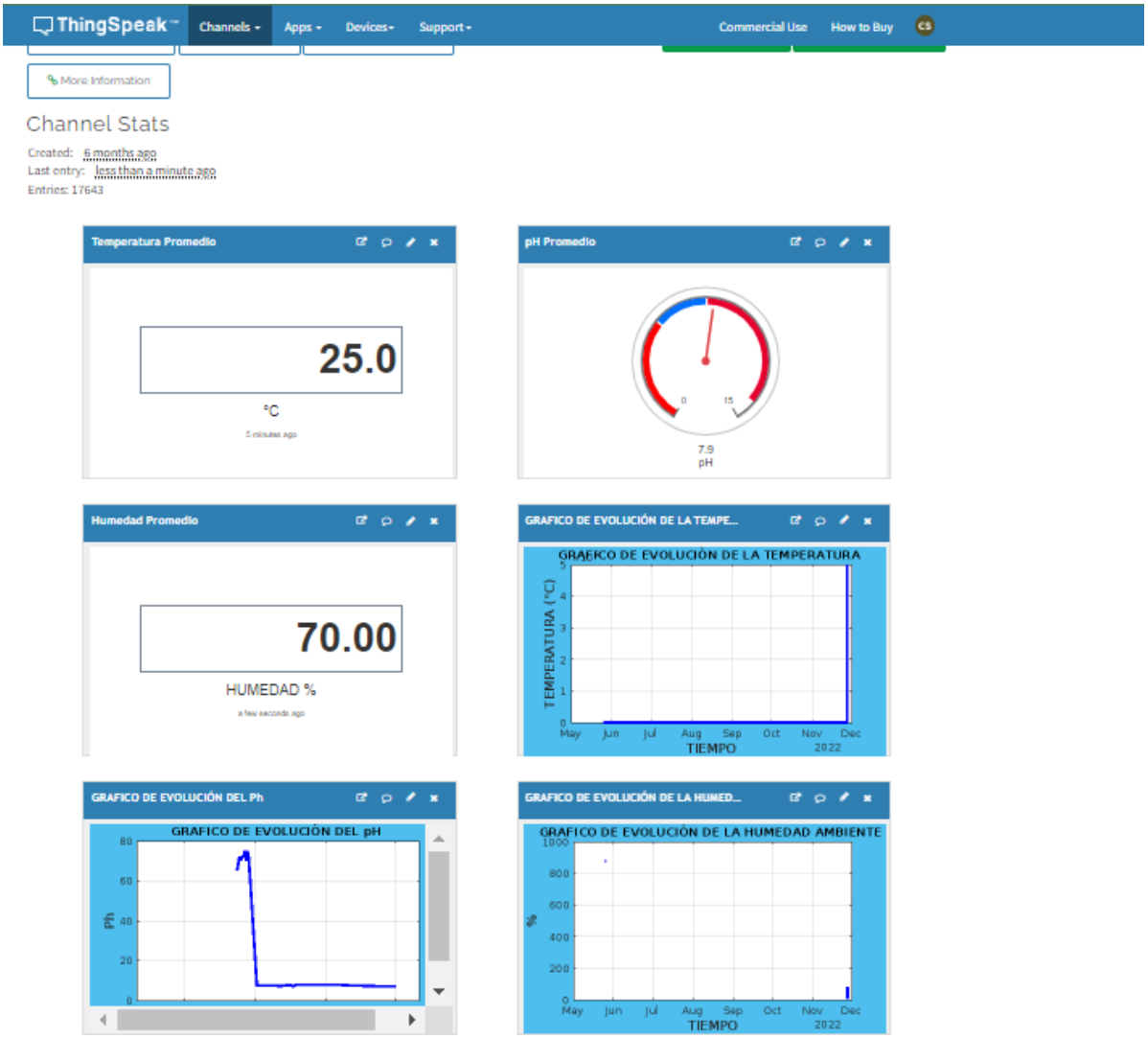
Modular theoretical development

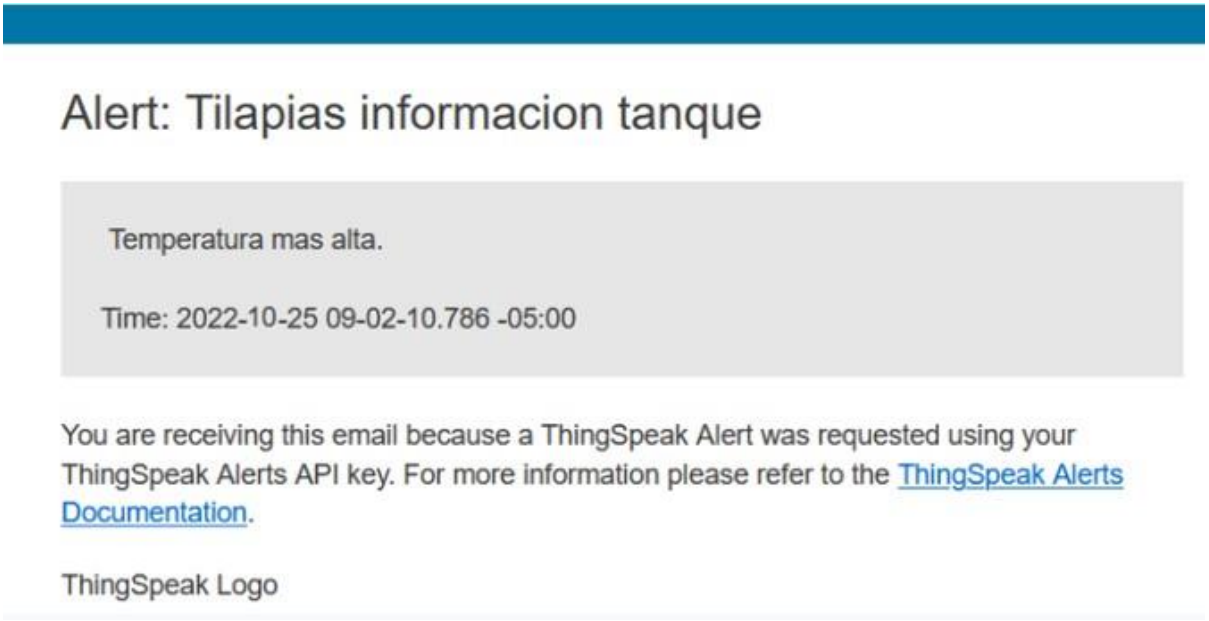
For the development of the proposed architecture what was used was a temperature sensor of dth11 temperature and humidity and a pH probe of df robot h101 the dth11 sensor as it is a digital output is connected directly to the raspberry and for the ph probe an ADS115 was obtained, which is a 16 bit analog to digital converter with i2c communication and the analog signal was converted from analog to digital and connected to the raspberry later the signals from the sensors are directed to a wi-fi router, to have a connection with the thingspeak database and a small analysis of the data was performed and finally published on a web page. In addition, the system has an alarm system that transmits alerts via email when one of the variables is outside the range that should be.

Results and analysis

Using the ThingsPeak platform for iot solutions is a very good alternative when talking about a level of testing or experimentation but not for an implementation in the work field due to the little limitation you have with the power to do analytics with the data, as a positive part can also have many options that connect us with the environment of evil allows us to generate analytics from bad and visualization.

Below are images of the results obtained in the thingspeak channel where the data is received, the graphs are shown and the alert system notifies by e-mail.





Conclusions

With the completion of this project it has been possible to consolidate much of the theoretical knowledge taught in the classroom, as well as to develop skills in the field of embedded systems programming.

It is of great importance to have used the use of services that allow us to run scripts in whatever language we are working and that when the internet connection is lost or the power goes out, the operating system is able to upload the service again without the need for a person to reload the program, thus being able to automate processes in this case of fish farming.

Future work

As a future work, it is proposed to use the data of the physicochemical variables of the water to be able to apply artificial intelligence analysis to be able to predict with much more time in the state in which the physicochemical variables of the pond will be in contrast and, despite this, to be able to further reduce the mortality rate of the species to be cultivated.

In the same way, the use of classical or modern control techniques that allow real-time control of the variables and physicochemical parameters of the water in the fish pond.

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