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Monitoring and Maintenance of Aquaculture Water Quality

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Abstract: *Technological significance has been a great support for settling on choice in various fields especially in aquaculture. The advancement of aquaculture has been under development for past many years because of the absence of knowledge in aquaculture learning and natural changes by the fish farmers. Here, it generally concentrates on the upgrading of rural aquaculture development through advanced information and communication processes. It extends the aquaculture organization's ability to meet the needs of fish farmers. This study gives the preferred data at any moment of time from any part of the world and screening their concern instantly at any part of the location. In existing system, the monitoring process of the water level and temperature is done. This will just monitoring the level than controlling it. So, it will miss the checking of water quality. This will create hazardous effect on our usage of water. In the technique we can measure the quality of water using hardware and software. In hardware part it consists of Raspberry Pi version 3, Water Level Sensor, Temperature Sensor, pH Sensor, Pump Motor for controlling water level and pH level and in software in consist of python and HTML. Using both of these operations we can find the quality of water and can improve the aquaculture maintenance process.*

Keywords used: *aquaculture^{[1][2][3][4]}, raspberry pi^[1], water level sensor^{[1][2][3][4]}, threshold value 600mV, temperature sensor^{[2][3][7]}, pH sensor threshold value 12mV, python, HTML.*

I. INTRODUCTION

Aquaculture consists of the set of activities, ideas and techniques for the breeding of aquatic plants and some species of animals. This activity plays an important role 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 water level, 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 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. These networks have a very important commercial value, with the continuous development of wireless sensors networks, more and more countries and companies of software showed great interest. In this era of mobile technology and The interconnectivity of devices, the concept of the Internet of Things (IoT) is born, which consists of having interconnectivity and communication with objects. This provides a smart service, this by the combination of Internet and a network of sensors. In simple terms, it is an interdisciplinary piece of research that gets not only people but also connected object. Aquaculture pond 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. .

Online continuous monitoring of these physical quantities from remote control stations to co-ordinate the uninterrupted operation in the process plants and industries. Keeping this situation in view, an attempt has been made in this work to monitoring data online through wireless sensor network for measurement of temperature, pH and water level. All the measured data are transmitted from site to the control station. The aim of this work is to design and implement a distributed system for aquaculture water quality care through remote monitoring of water level, pH and temperature. This work will contribute remote monitoring distributed system through what is known as the Internet of Things to monitoring water quality in ponds. 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.

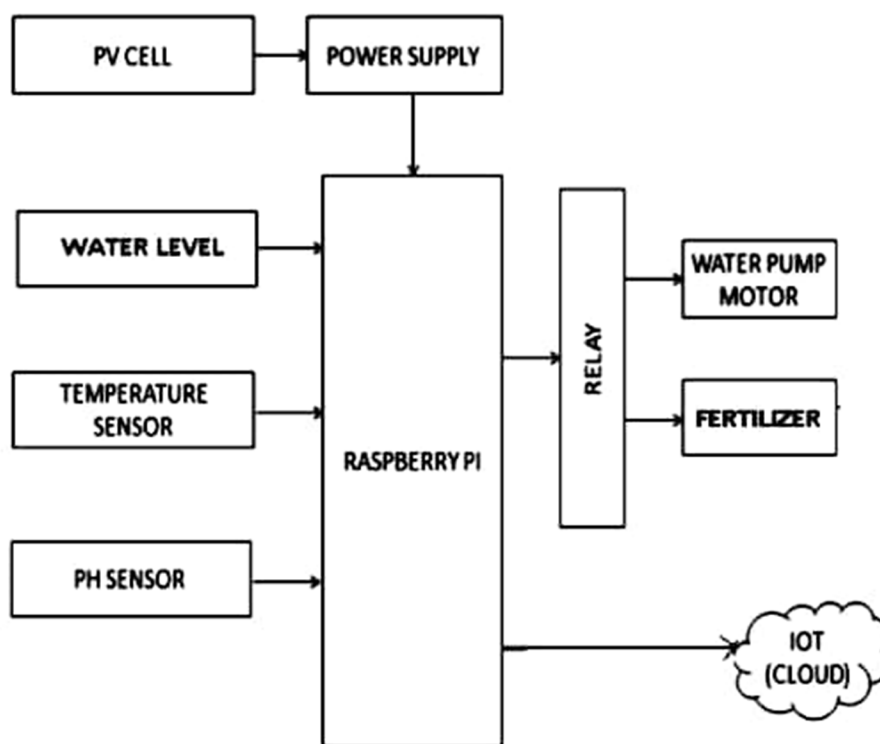
A. Existing System

The system monitors pH value, water level repeatedly as these are important for aquaculture. The system has different sensors for monitoring these parameters. The values are measured from a pond or lake and sent to a server over a wireless communication. This information transmission need not be at very fast speed as the parameters do not change fast in the lake. The system is designed with MSP430 platform and it has in built Analog to Digital Converter (ADC)^{[2][4][5][6]} and very good power down modes. The system will be in low power mode normally and wakes up after every 60 minutes, reads the parameters, sends them to server and again goes into low power mode. The HC -12 Transceiver is used for the transmission of the data and to create the wireless network, water level sensor and PH probe are used to measure water level and pH in lake, pond or artificial tank.

B. Proposed System

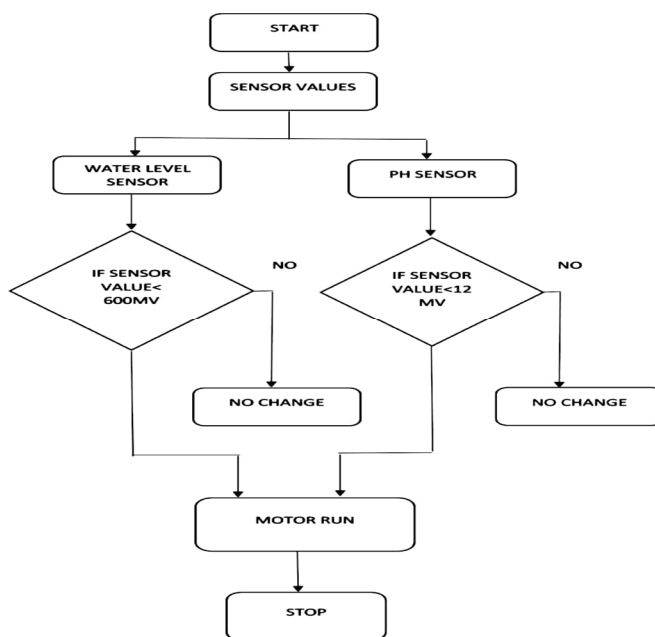
The proposed system can be used for efficient Crop Management, Irrigation Control, Environment Warnings and Guidance, Optimal usage of fertilizers, insecticides and pesticides. In our proposed system we have water level sensor, ph sensor and temperature sensor. That is if the water level of the tank is not upto the level, sensor will pass the signal to the Raspberry pi board and the message from Raspberry board is passed to the relay. The relay will be activated and the motor will be turned on according to the purpose needed. That is the motor will be started to run and the water will be pumped in to the system. Then the ph sensor in the system will be sensed if there is any abnormal changes in the water. That is if the acid level of the water is in high amount means the sensor will be sensed and the signal from the ph sensor is passed to the raspberry pi board. Then the relay will be turned on and the motor connected to that will be turned on. Then the motor will add needed amount fertilizer to the water from the tank. The hardware components and software components present in our project is raspberry pi board, temperature sensor, water level sensor, pH sensor, motor, HTML and Python.

The water quality monitoring system employs sensors such as pH, temperature and water level sensor to get the data parameters. These sensors are positioned in the water will analyse the quality of the water resources. The verified content is used to examine the quality of water.



System Block Diagram

C. Data Flow Diagram

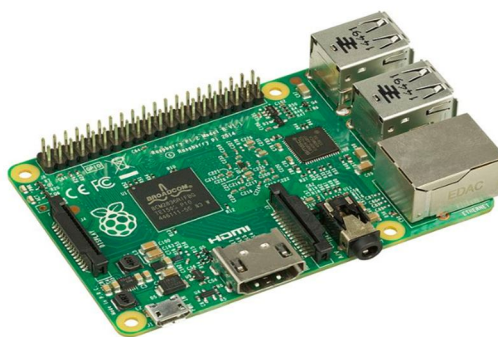


The proposed system consist of three sensors namely temperature sensor, water level sensor and pH sensor for the monitoring and maintenance process of aquaculture. When the power is led into the circuit , the sensors work as per their conditions and the datas are passed to the raspberry pi board and used for future purpose. When the water level sensor reaches a value less than the threshold value (600mV), the motors starts functioning and water is pumped out in the tank.

The required pH value required for the growth of fish should be neutral , when the acid level of the water in the tank changes the fish fertility decreases. When the threshold voltage for the pH reaches 10mV, the motor starts functioning and the fertilizers for the required quantity is pumped out into the tank.

II. WORKING

A. Raspberry PI



The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) and cases. However, some accessories have been included in several official and unofficial bundles.

The organization behind the Raspberry Pi^[1] consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries.

B. Sensors Used

A sensor gives a corresponding electrical data by discovering the events or modifications in its environment. A sensor is a transducer device. The Performance of the sensor is increased by the sensor calibration. Speed, accuracy, resolution and linearity are the most important quality of the sensor. The activities can be enhanced & removing of errors due to frame are deleted in the sensor results which makes it enhance. The difference between the wanted output and the obtained output of the sensor makes way to identify the mistakes due to structure. During the real time measures in the sensor, the repeatable mistakes are compensated during the measured standards.

1) *Temperature Sensing Module*: To analyze the coldness or hotness of a product, the Temperature sensor^{[4][5][6]} is designed. The output of an IC temperature sensor is with proper value to the temperature (°C). The precision of the temperature is more accurate than the thermistor. This sensor does not possess more than 0.1 °C temperature rise in the air which is still. It has the low self-heating. The range for operating temperature is from -55°C to 150°C.

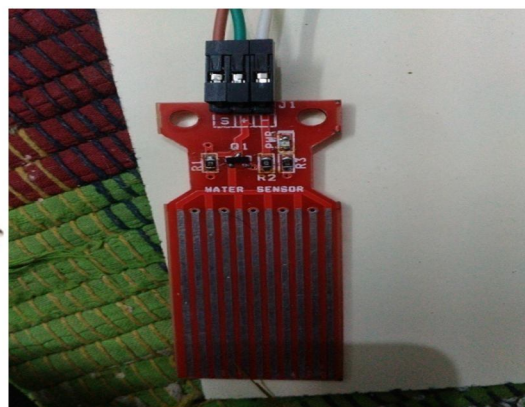
2) *pH Sensing Module*



It measures the acidic & basic alkaline in the water. It can be defined by using the hydrogen ion concentration with the negative logarithmic. The pH scale range is from 0 to 14, it is logarithmic. The concentration of hydrogen ion values is translated using pH. The hydrogen ion concentration is small for acidic and if it shows high it is for alkaline solutions. The pH around 7 is the natural source water. The water becomes less acidic as the concentration of hydrogen ion decreases for ten-fold for the increases in the number of pH^{[1][2]}. A reference electrode & a measuring electrode are enclosed in the pH sensor. The measuring electrode is connected to the positive end of the battery where the reference electrode is connected to the negative terminal. When the pH sensor is immersed in the solution, the reference electrode has its fixed potential. The change in the hydrogen ion concentration does not change the reference electrode.

A potential is developed when hydrogen ion concentration is related to the hydrogen ions which is sensitive to the measuring electrodes. The temperature sensor is necessary to correct any variations in the voltage, as the electrodes differential voltage changes with the temperature.

3) *Water Level Sensing Module*



Water Level sensors^{[1][2][3][4]} are used to monitor and regulate levels of a particular free-flowing substance within a contained space. These substances are usually liquid, however level sensors can also be used to monitor some solids such as powdered substances. Level sensors are widely used industrially. Cars use liquid level sensors to monitor a variety of liquids, including fuel, oil and occasionally also specialist fluids such as power steering fluid.

They can also be found in industrial storage tanks, for slurries, and in household appliances such as coffee machines. Basic level sensors can be used to identify the point at which a liquid falls below a minimum or rises above a maximum level. Many sensors can detail the specific amount of liquid in a container relative to the minimum/maximum levels, to provide a continuous measurement of volume. The prototype contain water level sensor for the monitoring of water level in the tank. If the level is not of needed value the is passed from sensor to raspberry pi board for contolling process and is controlled by the functioning of the motor.

C. Motor Supply and Control

- 1) *Motor Supply:* A DC motor is usually supplied through slip ring commutator as described above. AC motors' commutation can be either slip ring commutator or externally commutated type, can be fixed-speed or variable-speed control type, and can be synchronous or asynchronous type. Universal motors can run on either AC or DC.
- 2) *Motor Control:* Fixed-speed controlled AC motors are provided with direct-on-line or soft-start starters. Variable-speed controlled AC motors are provided with a range of different power inverter, variable-frequency drive or electronic commutator technologies. The term electronic commutator is usually associated with self-commutated brushless DC motor and switched reluctance motor applications.

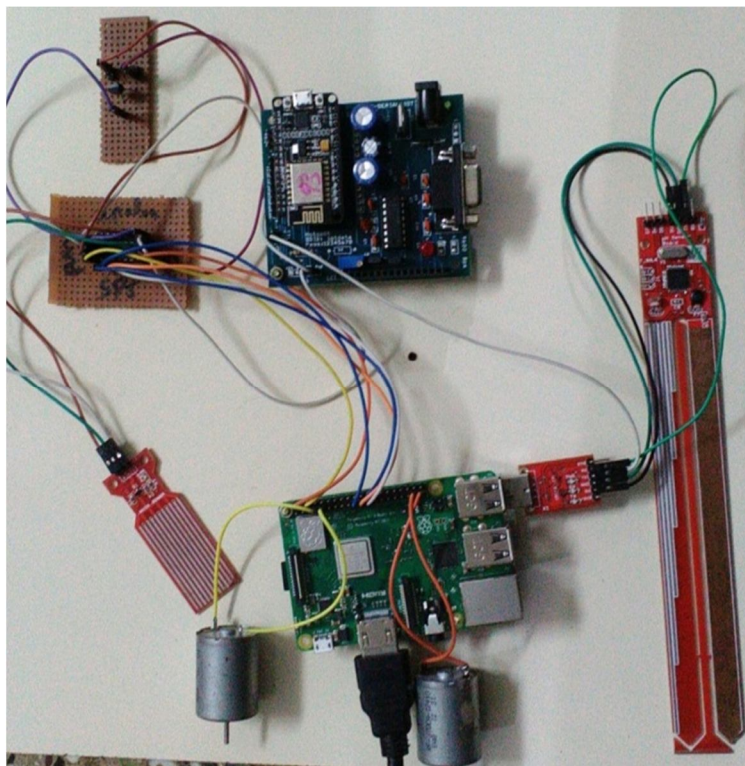


Photo of the model

In this experiment, we are using Water level sensor^{[6][7][8]}, pH sensor^{[4][5][7][9]}, Temperature sensor and data's are monitored and controlled by Raspberry Pi and the data's are stored in the storage for featured purpose. The Water level sensor senses any decrease in water level in the tank and the data will be sent back to the Raspberry board^[1] for controlling process and the motor start pumping out of water into tank and increases the water level, by this way water level in the tank can be increase up to the needed level.

Temperature sensor^{[1][2][3]} helps us to monitor the temperature around the area. The PH sensor helps to monitor water fertility in the tank. Neutral PH value will increase fish fertility in the tank, if the acidic level in the water detected is more than the needed level for fish growth then the fertilizer will be added with needed quantity by the functioning of the motor. this is controlled by the Raspberry pi board, these data's are stored for future purpose.

Data Logs ⤴ ⤵ ✖

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LogID	DATA
306	Wat_lvl:_10
307	Temp_:_25.33333333333332_Deg_C_
308	Wat_lvl:_10
309	Temp_:_25.33333333333332_Deg_C_
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313	Temp_:_25.33333333333332_Deg_C_
314	Wat_lvl:_11
315	Temp_:_25.33333333333332_Deg_C_

Showing 261 to 270 of 272 entries

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	Logdate	LogTime
	02/19/2019	14:09:18
:33333332_Deg_C_	02/19/2019	14:09:23
	02/19/2019	14:09:25
:33333332_Deg_C_	02/19/2019	14:09:30
	02/19/2019	14:09:32
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	02/19/2019	14:09:46
:33333332_Deg_C_	02/19/2019	14:09:51

Showing 261 to 270 of 272 entries

Output shown in the storage

III. CONCLUSION

This experiment is still in the development process for monitor and control of fish fertility. This system is low cost, low power consumption, scalable, versatile, distributed, mobile and accurate. This prototype is still under development, in the next section of future work the stage of the system is mentioned in detail i.e., the control of alkalinity level and comparison of water quality in different period with this storage using Internet Access can be done.



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