

## IoT based Smart Aquaculture Monitoring System

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**Abstract:** Water Quality monitoring is required for the growth and rearing of fishes. If water quality can be monitored at an early stage many healthy fishes can be produced and thus, we can overcome critical conditions which cause threat for rearing of fishes. Temperature, dissolved oxygen, pH are important parameters that should be monitored and controlled in an aquaculture system. These parameters affect animal health, feeding utilization, carrying capacity and growth rates. Fishes generally experience stress and disease breakout when temperature is chronically near their maximum tolerance or fluctuate suddenly. Rearing in artificial ponds traditionally required manual food giving on time, thus here comes our project which solves the manual tension, replacing with automatic feeder which can be controlled easily from android application.

**Keyword:** Aquaculture, IoT, PH, water quality monitoring.

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### I. Introduction

Aquaculture is one of the most reliable and low environment impact process producing high quality protein for humans. Aquaculture has become famous all over the world due to its higher food convergence. Parameters like temperature, pH and dissolved oxygen are essential factors for the growth and development of fishes. Farmers often face difficulties while growing and rearing of fishes as many fishes die due to the change in desired values of the above-mentioned water quality parameters. Thus, a continuous monitoring to the fishes should be done. Now, only monitoring is not enough. If the desired value changes then there should be a way of changing it automatically. This should be done in order to obtain healthy fishes even if the farmers forget to change the water, the system will automatically work upon it. Sometimes, fishes often eat something which is harmful for their lives, or sometimes the farmer often forgets to give food to the fishes time to time. Right quantity and right quality of food is important for the fishes to grow healthy and also their carrying capacity increases.

So, there should be a system which manage the quantity of food in proper interval of time.

The dissolved oxygen is important for fish respiration and for the survival of phytoplankton, the organism which breaks down toxic ammonia into harmless forms. Thus, dissolved oxygen plays an important role. The acceptable range of pH for fish culture is usually between pH 5.5 to pH 9.0 [1]. When water is very alkaline (> pH 9), ammonium in water is converted to toxic ammonia, which can kill fish. On the other hand, acidic water (< pH 5) leaches metals from rocks and sediments. These metals have an adverse effect on the fish's metabolism rates and if they take in that water through their gills it can be fatal for them. Here, it is seen that failure of any component can cause catastrophic losses within a short period of time. So, the system must be reliable and constantly monitored. Thus, precise measurements and controls are necessary for the success of an intensive aquaculture system. We have decided to choose "Smart Aquaculture Monitoring" as our project. It will be able to detect and control water quality parameters like temperature, pH value, and dissolved oxygen of water in real-time. The sensor nodes will collect the water quality parameters and will display it to the mobile application using Wi-Fi. An alarm will ring and LED will blink if the water quality parameters value change from the desired value. Two water pumps will be attached. To provide food to the fishes we will attach one device which will be controlled anytime from our mobile application. This will help the fishes to take in the right quality and quantity of food in a day and thus their health, growth rates and carrying capacities will be better.

It is seen that already projects have been done in this concern. One of the projects proposed IoT based aquaculture System where there is no automatic fish feeder [1]. And it is discussed earlier automatic fish feeder is very much important. Farmers will buy one single device which will be able to monitor all water quality parameters as well as able to provide food automatically from the android application. Another proposed project is based on cloud storage [2] but cloud storage is a very costly project and for a farmer it is not possible to buy at high price. Moreover [2] has also not proposed any automatic fish feeder. Now, our project shows the data in the android application – "Remote-XY" which is easy to use and only works on Wi-fi

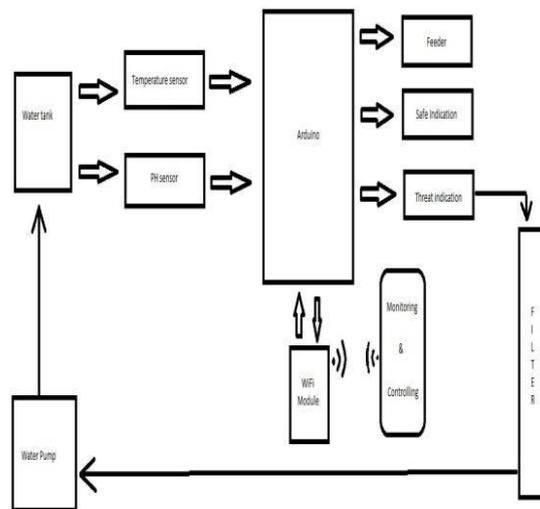
network, thus it becomes cheaper in price and farmers can buy it. Another project [3] has used less sensors and less sensors will not be able to measure all types of water qualities and thus will give error values. Our project has exact number of fully working sensors and it will be able to measure right parameter value.

Thus, our “IoT based Smart Aquaculture Monitoring System” will be beneficial for the farmers related to the growing and rearing of fishes.

Parameter	Acceptable Range
Temperature	20 – 30 C
PH	5.5 – 9.0
Dissolved Oxygen	>5mg/L

**Abbreviations:** IoT, internet of things, PH, DO, Dissolved Oxygen

**BLOCK DIAGRAM**



**Fig – 1 (Block diagram representation)**

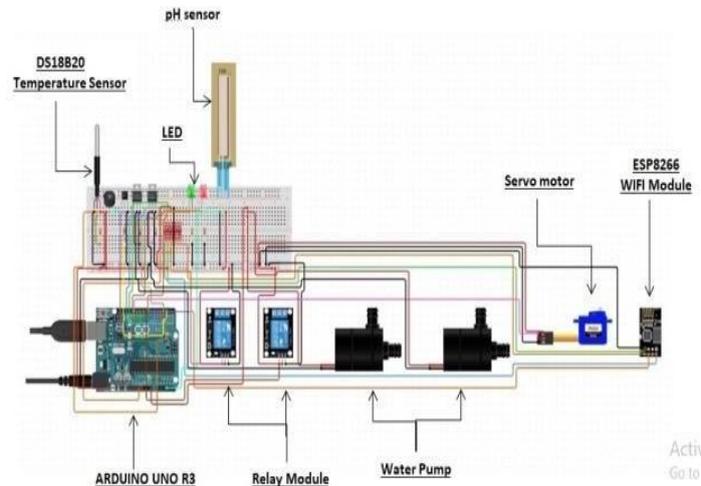
The Block diagram above depicts the basic working of the system . Wherein this is a monitoring system to provide assistance to the farmers to maintain at just one time investment . Here , from the fish tank we will take the real time data of Temperature and the PH of the water and will be shown on the application while having a safe indication but when the situation will get worse the threat indication will go on and the water of the tank will be automatically changed . Also we have an automatic feeder which helps the farmer to feed the fishes on time with an ease without reaching to the fish tank in person . The filter here is used to recycle water , so that we can reduce chances of water shortage.

**CIRCUIT DESCRIPTION**

**COMPONENTS REQUIRED :-** Arduino Uno, pH sensor, DS18B20 temperature sensor, ESP8266 Wi- Fi Module, Servo Motor, Piezo Buzzer, 2 LED (1 green and 1 red), Water pump and water filter.

**Arduino UNO R3** is the main microcontroller

**pH sensor** connected to analog pin A1 of Arduino Uno. **Servo Motor** is connected to digital pin 9 of Arduino Uno. **DS18B20 sensor** is connected to digital pin 2 of Arduino Uno. **Piezo Buzzer** is connected to digital pin of 5 of Arduino Uno. **LED** is connected to digital pin 7 and 8 of Arduino Uno. **Water Pump** is connected to digital pin 12 of Arduino Uno via **Relay Module**. **Esp8266 Wi-fi module** is connected to digital pin 0 and 1 (Rx-0 and Tx- 1).



**Fig – 2 (Circuit Diagram)**

## **II. METHODOLOGY**

Our project “IoT based Smart Aquaculture Monitoring System” will be able to manage all the problems mentioned above. If water quality parameters changes from desired value, LED will blink red and a buzzer will ring making the water automatically coming out from the tank with the help of a pump. As the water comes out, another water pump will make fresh water to come into the water tank. Now, the dirty water will go the water filter and after filtration it will again get into the tank when the water will get dirty afterwards. Farmer can observe the values of the pH, dissolved water and temperature sensor from our android application. Our application will continuously monitor the water quality parameters. Green LED will be there if the value remains correct. From, our application farmer can directly give food to the fishes.

## **III. RESULTS AND DISCUSSIONS**

We have made our Project “IoT based Smart Aquaculture Monitoring System”. In our model we reduce internet consumption and also creating a cost effective model and cannot use cloud database because of internet consumption but some of studies uses a cloud database [2]. Some of the models are cost efficient [3] but it cannot fulfil the demand of water quality because system use less amount of sensor It is able to sense pH value, water temperature and dissolved oxygen. LED are blinking at safe condition as well as for threat indication. Buzzer is rings at threat condition. The automatic fish feeder can be accessed directly from our android application.



**Fig - 3 ( Prototype )**



**Fig – 4 ( Application )**

#### **IV. MERITS AND LIMITATIONS**

**Merits:** This “IoT based Smart Aquaculture Monitoring System” is very easy to access.

Price of this system is also less as fewer components is required for making it. Hence, it is economical. For one fish tank one system is enough. And all the systems of the fish tank can be accessed from a single android application. As it does not require battery, only electricity is required for its working, so one system can be used for many years.

This system carries less weight. Hence, they can be fitted at anywhere at the tank.

As water is filtered when it gets dirty, so one tank of water can be used again and again. Water gets reused and thus we are able to save water. Water filter is there to filter the water and is poured directly into the tank by the pump itself.

**Limitations:** Farmers should have at least one android mobile for accessing this “IoT based Smart Aquaculture Monitoring System”.

#### **SCOPE FOR FUTURE DEVELOPMENT**

By a small scale of development can make a change in huge scale.

IOT based automated smart aquaculture monitoring system can be the solution for monitoring fishes & to increase fish production inside tanks.

**DISSOLVED OXYGEN:** -Dissolved Oxygen depends on the water temperature still we can use external Oxygen pumps in the tanks to add more Oxygen.

**WATER CHANGING:** -Changing the water is done by an automated pump system, for the future bigger and more powerful pumps can be used.

**IOT BASED DEVICE:** -Warnings & readings can be seen in the mobile-app, so it's easy to track and monitor the fish tanks, the app is free and has a huge scope in future developments.

**RANGE:** -Mainly our device reduces human effort and increases efficiency.

The mobile range can be increased by using better wi-fi module.

**AUTOMATIC FEEDER:** -Automated feeder will feed the fishes in scheduled time. Feeder speed and amount of food can be adjusted for different size of the tanks.

**WATER FILTRATION:** -Water filter added to filter the water before pouring in can be modified more and can be attached directly to the pump itself.

## **V. CONCLUSION**

A successful implementation of Aquaculture Monitoring, recycle of pure water and feeding of fishes automatically are illustrated in this project. This system will be very beneficial for the farmers. As the price of the system is low and its durability is also high farmers will be able to buy it in their budget. Thus, using this system can save the fishes and their production will increase rapidly.

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