IOT BASED AUTOMATED FISH FARM AQUACULTURE MONITORING SYSTEM

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Abstract — **In this paper, a smart fish biofloc system for modern fish farming is proposed. Biofloc is an innovative and cost-effective technology in which toxic materials to the fish and shellfish such as Nitrate, Ammonia can be converted to useful product, *ie*., proteinaceous feed. It is the technology used in aquaculture system with limited or zero water exchange under high stocking density, strong aeration and biota formed by biofloc. The culture of biofloc will be productive in the case of culture tanks exposed to sun. The system applies the internet of things (IoT) concept to monitor and control water quality in fish ecosystem. The system equipped with temperature, pH, turbidity, and water level sensors to monitor biofloc parameters. Environmental parameters are uploaded to the cloud and monitored via a smart phone application. The smart phone application equipped with features that support catfish farmers to collaborate in meeting market needs. The cost of making the system is designed to be as minimal as possible so can be applied by a middle-low scale catfish farmer. The implementation of the proposed system provides ease in monitoring biofloc conditions, improving fish quality, and farmer's income.**

Keywords — Biofloc, Internet of Things(IoT), Sensors,

INTRODUCTION

Fish is one of people's favorite foods all over the world. Fish taste is strongly influenced by water quality. The farmers need a system to manage water quality and support the stability of fish stocks in the market. Based on data from the Malang Regency Marine and Fisheries Service, two commodities of freshwater fish, namely catfish and tilapia, are still the favorite consumption of the current poor district community .Fisheries management relies totally on water quality monitoring. Yields are also often affected by fish disease. Optimal fish production is very dependent on the physical, chemical, and biological qualities of water. Therefore, good fisheries management depends on good water quality. Variables that determine water quality are temperature, turbidity, carbon dioxide, pH, alkalinity, ammonia, nitrite, nitrate, etc. Among the most important are pH, temperature, and turbidity. Catfish will growth optimal in water temperature of 27°C - 31°. Water quality needs to be monitored and controlled to keep fish growing well.

A lot of researchers have developed water quality monitoring and control systems. Related research has conducted monitoring and controlling of water quality, but not included fish marketing. The proposed system equipped with the ability to display the number of fish stocks per farmer based on smart phone applications. Farmers must log in using an existing account to use the application. When the farmer run out of stock to meet market need the farmer can see the stock of other users. They can collaborate to meet market demand on the application's market page. The proposed system provides convenience for farmers to maintain pond water quality and fish marketing. Fish stocks in the market will be more stable, and the fish quality and farmers' income will increase. In this paper, a new smart fish pond which involves the farming and marketing process based on IoT via a smart phone application proposed.

Recently IoT is reaching the ground level with its application to farmers. Papers In several literature surveys focuses on how the aquatic life will effect due to change in water quality parameters and how IoT technology is used to overcome the problem [1]. Some work uses Arduino as micro controller for monitoring the aqua field ,but Raspberry Pi-3 is more advanced when compared to Arduino as it has inbuilt Wi-Fi module [2]. Many of the works concentrates on few type sensors like DO, pH, Turbidity etc and a solution to those problems, but the growth of aquatic life depends on many parameters of water like Ammonia, Nitrate, Carbonates, Bi-Carbonates, salt etc [3]. The quality of water is monitored continuously with the help of sensors to ensure growth and survival of aquatic life. The sensed data is transferred to the aqua farmer mobile through cloud [4]. All these parameters are sensed using multiple sensors and a feasible solution was given to the aqua farmer. The sensed data will be sent directly to the aqua farmer. But storing the data in cloud database helps us for analyzing the data using data analytics parameters [5]. Most of the models concentrates on sending the sensor data to the farmer but our model mainly concentrates on providing the solution such as which medicine should be applied or necessary action to be taken in the form of an alert message when the water quality parameters changes [6].

I. EXISTING MODEL

In the existing method of the aquaculture field all the parameter such as the water monitoring, quality of   water checking and temperature monitoring all are done using the manual method so the labour cost will increase and at the same time continuous monitoring can't be done. Manual labour is mandatory in the field .To avoid this, in our proposed system we are using the Automotive & IoT technology which continuously updates to the user. In this all the monitoring noticed by Iot and workout by manually and we can the block diagram of existing model as shown in figure 1.
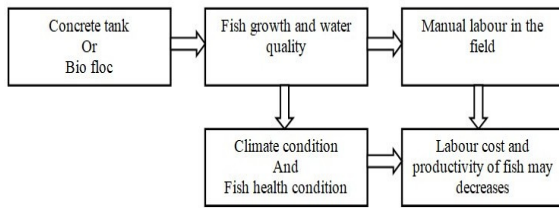

Fig. 1 Block diagram of existing model

II. PROPOSED MODEL

The proposed system consists of pH level sensor, temperature sensor, Oxygen Saturation Sensor, Turbidity Sensor as well as water level sensors. Hence, this proposed system makes more efficient and accurate information and this fetched reduced worker. Based on IoT and Automotive Control to monitor the Fish growth at any time can be monitoring. Figure 2 shows block diagram of proposed system and all the value are monitored and control automatically.
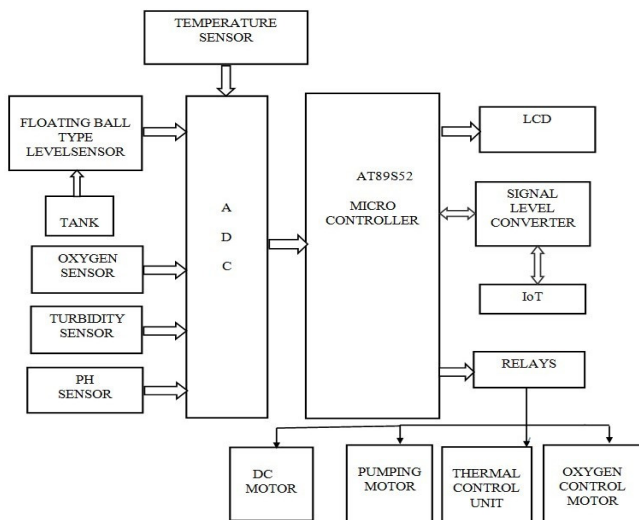

Fig. 2 Block diagram of proposed system

III. HARDWARE DESCRIPTION

A. Temperature Sensor

Temperature sensors with a relatively high degree of in smart antenna systems for ground-based

applications (e.g., cellular antennas) and airborne applications (e.g., airplane or satellite antennas). Smart antenna systems, such as adaptive or phased array antennas, combine the outputs of multiple antenna elements with signal processing capabilities to transmit and/or receive communications sign. With temperature sensors, such antenna systems can vary the transmission or reception pattern of the communications signals in response to the signal environment to improve performance characteristics. Temperature sensors are utilized to monitor a variety of automotive systems, including for example coolant temperature and exhaust gas temperature. These sensors (figure 3) typically utilize a wire-type thermistor, which is generally soldered to hard-wired leads.
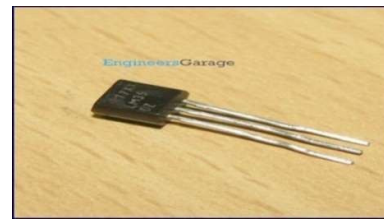

Fig. 3 Temperature sensor

B. Level Sensor

Level sensors (figure 4) detect the level of substances that flow, including liquids, slurries, granular materials, and powders. All such substances flow to become essentially level in their containers (or other physical boundaries) because of gravity. The substance to be measured can be inside a container or can be in its natural form (e.g. a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point.

Fig.4   Level sensor

C. PH SENSOR:

PH is measured using a setup with two electrodes: the indicator electrode and the reference electrode. These two electrodes are often combined into one - a combined electrode. When the two electrodes are immersed in a

solution, a small galvanic cell is established. The potential developed is dependent on both electrodes. Ideal measuring conditions exist when only the potential of the indicator electrode changes in response to varying pH, while the potential of the reference electrode remains constant.

The measured voltage can be expressed by the Nernst equation in the following way:

$$E = E_{ind} - E_{ref} = E'_T - R \bullet T/F \bullet a_{H+}$$

where

E   =   Measured voltage (mV)

E_{ind} =   Voltage of indicator electrode (mV)

E'_T =   Temperature dependent constant (mV)

R   =   Gas Constant (8.3144 J/K)

T   =   Absolute Temperature (K)

F   =   Faraday's Constant (96485 C)

Fig. 5 PH sensor

D.OXYGEN SENSOR:

Grove - Oxygen Sensor (ME2-O2-Φ20) is a kind of sensor to test the oxygen concentration in air, which is based on the principle of the electrochemical cell to the original work. You can know clearly the current oxygen concentration when you output voltage values proportional to the concentration of oxygen and refer to the oxygen concentration linear characteristic graph. It's very suitable for detecting oxygen concentration in the environment protection. Grove - Gas Sensor (O2) is an organic reaction module, it can provide a little current while putting it in the air, we don't need to provide an external power to it, and output voltage will change as time current changes.

Fig. 6 Oxygen sensor

IV.   SOFTWARE DESCRIPTION

A. EMBEDDED C

During infancy years of microprocessor based systems, programs were developed using assemblers and fused into the EPROMs. There used to be no mechanism to find what the program was doing. LEDs, switches, etc. were used to check for correct execution of the program. Some 'very fortunate' developers had In-circuit Simulators (ICEs), but they were too costly and were not quite reliable as well. As time progressed, use of microprocessor-specific assembly-only as the programming language reduced and embedded systems moved onto C as the embedded programming language of choice. C is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, etc. are prime requirements. As assembly language programs are specific to a processor, assembly language didn't offer portability across systems. To overcome this disadvantage, several high level languages, including C, came up. Some other languages like PLM, Modula-2, Pascal, etc. also came but couldn't find wide acceptance. Amongst those, C got wide acceptance for not only embedded systems, but also for desktop applications. Even though C might have lost its sheen as mainstream language for general purpose applications, it still is having a strong-hold in embedded programming.

B. PROTEUS

Proteus is an interpreted language: programs are loaded into memory, pre-compiled and run; since the number of built-in functions is large, execution speed is usually very good and often comparable to that of compiled programs. One of the most interesting features of Proteus is the possibility of running scripts as services or ISAPI scripts. This is very useful to protect critical processes in industrial environments (data collection, device monitoring), or to avoid that the operator inadvertently closes a utility (keyboard emulation).

The ISAPI version of Proteus can be used to create scripts run through Internet Information Services and is equipped with specific functions to cooperate with the web server.

C. 51- C51 C Compiler

The Keil C51 C Compiler for the 8051 microcontroller is the most popular available today. The C51 Compiler allows you to write 8051 microcontroller. The 8051C Compiler translates C source files into locatable object modules, which contain full symbolic information for debugging with the micro Vision Debugger or an in-circuit emulator. In addition to the object file, the compiler generates a listing file, which may optionally include symbol table and cross-reference information.
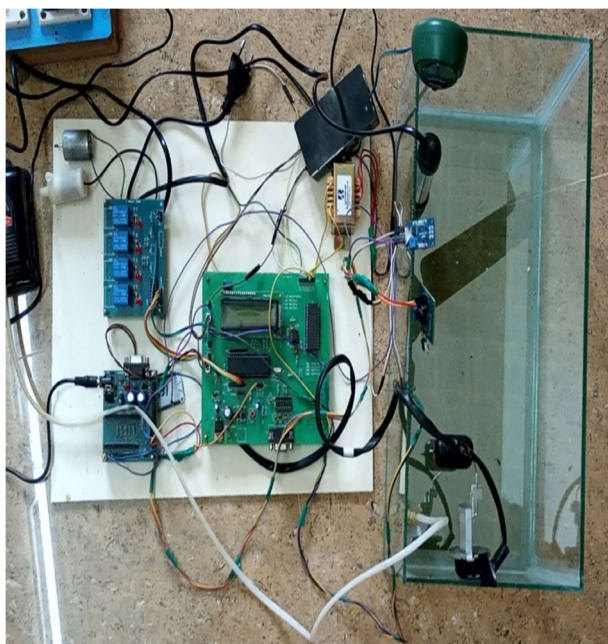
V.HARDWARE PROTOTYPE MODEL

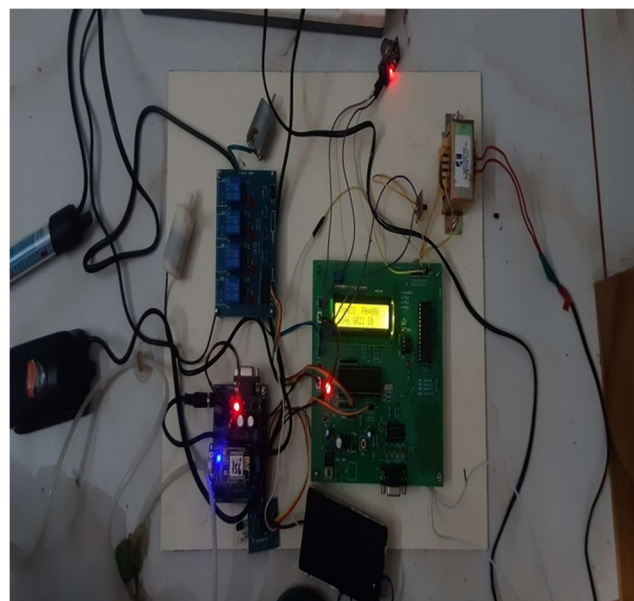Fig. 7 Complete hardware model of proposed system

Fig. 8 Display unit and control board of proposed system

S.No	Water Quality Parameters	Range
1	Dissolved Oxygen (DO)	(4-10) ppm
2	Ammonia	(0-0.1) ppm
3	pH	(7.5-8.5) ppm
4	Temperature	21^0C-33^0C
5	Salt	(0-2)ppt
6	Carbonates (CO_3^{2-})	(20-40)ppm
7	Bicarbonates(HCO_3^-)	(150-500)ppm
8	Nitrates(NO_2)	(0-0.3)ppm
9	Sour gas (H_2S)	(0-0.4)ppm

Fig. 9 Standard range of values of water quality parameters for aquaculture

Figure 7 shows the complete prototype system model of automated aquaculture setup. In this automated process we using the pH level sensor, temperature sensor, Oxygen Saturation Sensor, Turbidity Sensor as well as water level sensors. If PH value goes beyond the threshold value (refer figure 9) means we are using DC Motor will Switch ON automatically to maintain the PH level. If temperature of water is low (refer figure 9) then we will Switch ON Heating Sensor to maintain the Temperature.

If water content is very high in the field, Ordinary motors will switch ON to remove the excess water from the field. If the Oxygen level is low (refer figure 9), then we will Switch ON Oxygen Saturation Sensor to maintain the oxygen level. Then the Turbidity sensors measure the amount of light (refer figure 9) that is scattered by the suspended solids in water. And all these parameters can be control and monitor using IoT. Figure 8 shows display units and control units of proposed prototype system model.

VI. HARDWARE RESULTS

SENSOR	FUNCTIONS	THRESHOLD VALUE	APPLICATION
Temperature sensor	It is used to heat the water, When the water level degree Celsius is less in the water	(30'C-33'C)	If the degree value is less than 30 degree Celsius, the heater is connected to the water tank and it is turned ON and the water gets heated to the required degree Celsius.
Level sensor	It is used to detect the level of the water in the tank.	Value - (125(mm)height)	If the water level is 125 ranges, the level sensor is connected to the pumping motor and it gets turned ON fills the water in the tank.
PH sensor	It is used to detect the acidic nature of the water in the tank.	Value PH range (4)	If the ph value is above the (4) the AC motor gets turned ON
IR sensor (Turbidity sensor)	It is used to detect the clarity (clean water) of the water in the tank.	Value (1 or 0)	If the water clarity is too dark it shows the value (1),And the water clarity(clean water) is correct in nature it shows the value (0)
Oxygen (Gas) sensor	It is used to detect the dissolved oxygen in the water in the tank.	Value - (140)	If the oxygen quantity is less than (140) in the water, The oxygen sensor is connected to the oxygen motor and it gets turned ON.

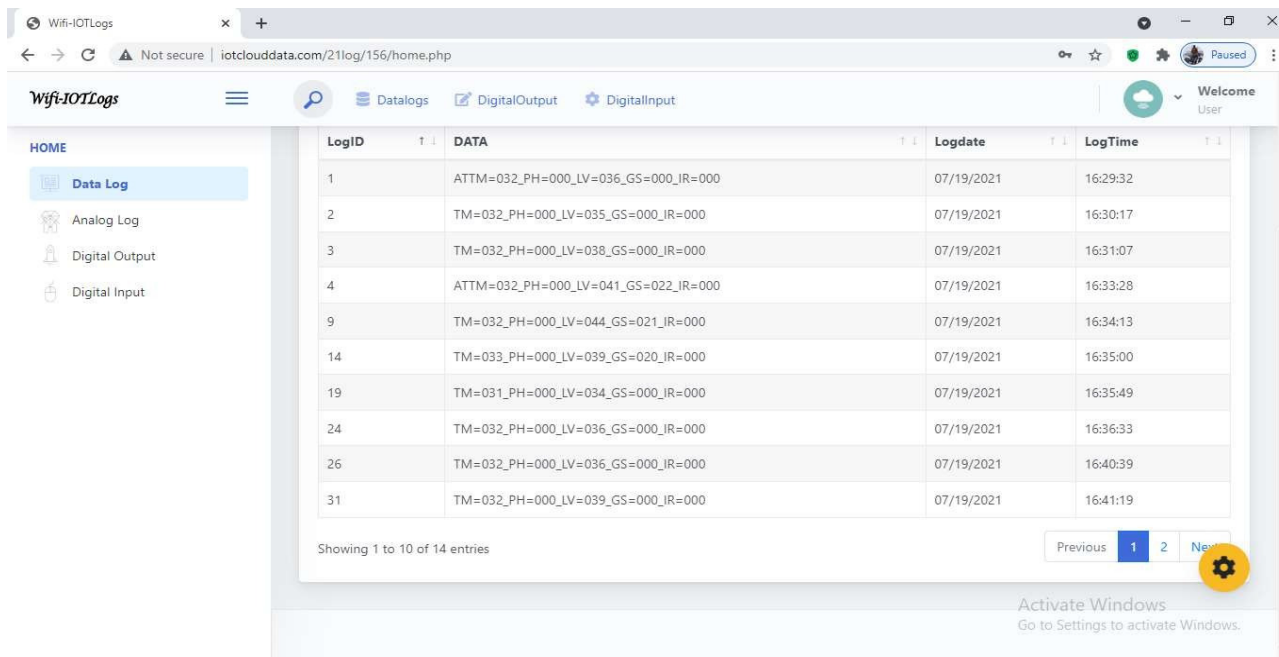Table 1 Results obtained from hardware
prototype model

Fig. 10 IoT data output results

VI CONCLUSION

This work help the farmers for accurate and reliable monitoring of water quality parameters because manual testing can consume time and water quality parameters may alter with time being and it helps to take pro-active measures before necessary damage was done. Though the initial cost is high, there will be no additional cost and maintenance once it gets installed. Further, there is no need for manual testing periodically. It saves time and energy. Thus, IoT has reached the farmers for reducing the risk from climatic fluctuations and ensures growth and health for aquatic life. This increase productivity and helps for improving the foreign trade and increases the GDP of the nation. Further, the collected data can be analyzed using big data analytics and preventive measures can be taken before the water quality parameter crosses the threshold range. The aqua system can be made automation using internet of things, which reduces the energy consumption, and labor cost.

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