Smart Aquaculture Monitoring and Control System Using IoT

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Abstract - *Aquaculture faces tremendous problems because water quality changes because of variation in environmental conditions. Estimate water characteristics such as pH, turbidity, conductivity, and others, as fluctuations in these values are critical for aquatic life. At present, water parameters are detected by a chemical tester at the laboratories. As a result, it is a time-consuming manual method with a tiresome process. The quality of water should be monitored in real-time for that purpose Arduino based water quality monitoring has been proposed. The architecture of a smart aqua monitoring and control system that analyses water quality and adjusts water parameters in real-time is discussed in this report. This system consists of different sensors that measure water quality parameters such as pH, conductivity, the muddiness of water, and temperature. The measured values from the sensors are processed by a microcontroller and various control signals are given to maintain the best water parameters for the fish life. Then the measured values are given to the user's mobile app through the cloud. This system ensures there are perfect living qualities in water for fishes and maintains it by controlling the water parameters.*

***Key Words*: pH, Temperature, Internet of Things (IoT), Wi-Fi module, Turbidity**

1. INTRODUCTION

Wireless sensor networks are becoming popular among the research community for their low-cost design and simple bar form factor. Wireless technology developments have improved large-field data gathering and reliability in hostile environments. Internet of Things (IoT) is the combination of a physical object, controller, sensor, actuators, and the Internet .Industry 4.0 is dependent on the Internet of Things (IoT). Actuators and sensors are devices that interact with actual objects in the real world and collect data from their surroundings. Actuators and sensors process the electrical input and transform it into tangible action. IoT devices generate a large amount of important and useful data, which must be saved, categorized, and analyzed. The architecture is made up of three layers: The Physical Layer, Network Layer, and Application Layer are the three layers that make up the Internet. In the physical layer, sensors measure the data from the outside environment and turn it into valuable data. After data collection, time sensitive data got to be processed immediately. Otherwise, the info has got to be deeply processed and analyzed to be stored within the Cloud to avoid network clutter. In the network layer, the data are collected from various sensors to be aggregated and converted to digital streams for processing. For data processing, Data Acquisition System (DAS) is the most suitable process to sample the signals from the real world objects to convert the results into digital numeric values that can be manipulated with the computer. The working rule of knowledge acquisition is to convert analog waves into digital values for processing. Through Wi-Fi, WLANs, and other technologies, the Internet gateway gets aggregated and digitized data. As a result, the data is frequently safely kept on a server or in the cloud for analysis. When IoT is combined with sensors and actuators, it forms part of the Cyber-Physical Systems (CPS) category, which includes smart grids, virtual power plants, smart homes, smart classrooms, intelligent transportation, smart hospitals, smart traffic, and smart cities. Standard protocols and networking technologies are primarily used in IoT. RFID, NFC, low-energy Bluetooth, low-energy wireless, low energy radio protocols, LTE-A, and Wi-Fi-Direct are some of the technologies and protocols utilized in IoT. In addition, the expenses of chemical reagents are typically expensive, resulting in a rise in the test cost. The researchers are experts in building a real-time water quality monitoring system that can detect solvents and pollutants in real time and upload real-time data to a database utilizing the internet of things (IoT) for real-time water quality analysis.

2. LITERATURE SURVEY

2.1 Use of image processing technology for water quality monitoring system

The system was created utilizing image processing and auto recognition of fish gestures in water bodies using fuzzy inference. First the fixing of the image background model using W4 method was done, then deducted the background to acknowledge the fish profile. Once the centre gravity point of a fish profile is determined, real-time fish characteristics such as position, movement track, and speed can be retrieved. This information are going to be given because the input of fuzzy inference system, through appropriate rules in analyzing; the output value are often obtained. In this study, Zebra fish, Common Goldfish have been taken as the study objects via different devices into agent to observe the fish.

2.2 Smart sensors for real-time water quality monitoring using ZigBee

The system is skilled to live the physiochemical parameters of water quality, like flow, temperature, pH, conduction, red ox potential. These physiochemical parameters are wont to identify water pollutants in rivers, lakes etc. The sensors are connected to a microcontroller-based evaluation node that processes and analyses the data. ZigBee receiver and transmitter modules are utilized to connect the measuring and notification nodes in this design. ZigBee receiver and transmitter modules are utilized in this system to communicate between the measurement and notification nodes. When the parameters reach dangerous levels, the warning hub shows the sensors' readings and emits a sound. Each component of the monitoring system has been subjected to several qualification tests. The sensors operate within their precise parameters. The menstrual node sends data through ZigBee to the notification node, which displays the audio and visual data. The result shows that the approaches the power to read physiochemical parameters, and is capable of processing, transmission, and exhibiting the readings.

2.3 Water quality monitoring for rural areas-a sensor cloud based economical project

This paper highlights the whole water quality monitoring methods, sensors, embedded design, and knowledge dissipation procedure, role of state, network operator and villagers in ensuring proper information dissipation .It can explore the Sensor Cloud-domain. While automatic water quality improvement is not yet possible, smart use of technology and cost-effective approaches can help enhance water quality and public awareness.

3. PROPOSED METHOD

The proposed system consists of 3 major stages. Sensing stage, Computing and controlling stage, Communication stage.

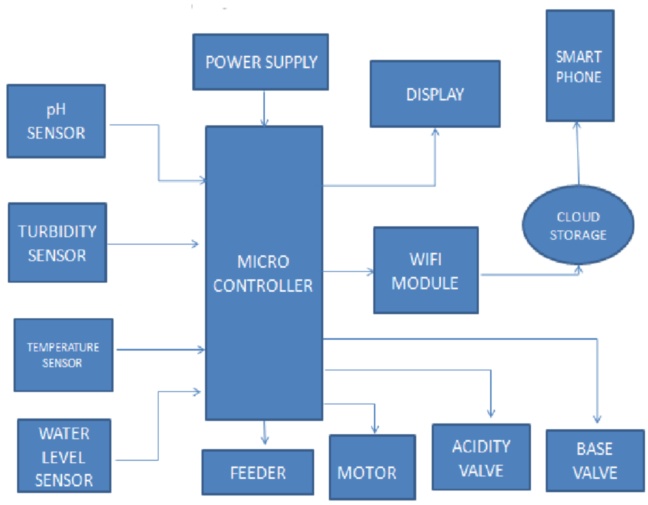


Fig -1: System Architecture

The Sensing stage consists of following sensors.

1. **pH sensor**: If chemical effluents from the industries are let into water bodies the pH value of the water changes counting on sort of chemical i.e. Acidic or basic. The pH sensor measures the extent of pH in water by measuring the activity of hydrogen ions in water. Normally, the fishes can live in a pH range of 6.5 to 8.5. If the value of the pH goes below 6.5, the solution becomes acidic and opens the base valve. If the value of pH goes above 8.5, the water becomes basic and therefore the acidity valve are going to be open and make it to the range which is suitable for aquatic life.

2. **Temperature sensor**: Microbial activities can cause the temperature of water to rise, which is one of the factors that determine cleanliness. The water temperature is measured by the temperature sensor. Fishes survive within the temperature range of 21°C to 33°C. If temperature goes beyond threshold range, motor gets activated and pumps the water.

3. **Turbidity sensor**: It measures the quantity of sunshine that's scattered by suspended solids within the water. As the amount of total suspended solid increases, the waters turbidity level increases

4. **Water level sensor**: It determines the extent of water. If water level is low; motor gets activated to pump the water to the specified level.

5. **Feeder**: feeder is used for maintaining the diet of fishes.

The signal received by these sensors is applied to Arduino board which is that the controlling and computing a part of the system. The computing stage entails comparing the sensor's sensed data to a predetermined threshold value. When the sensed value differs from the edge value, the communication stage sends a message to the authorized person. Communication stage involves Wi-Fi module. supported the messages received the concerned person can initiate the working of motor from anywhere for changing the water, or the circuit will automatically take actions like adding acid/base and feeding the fish.

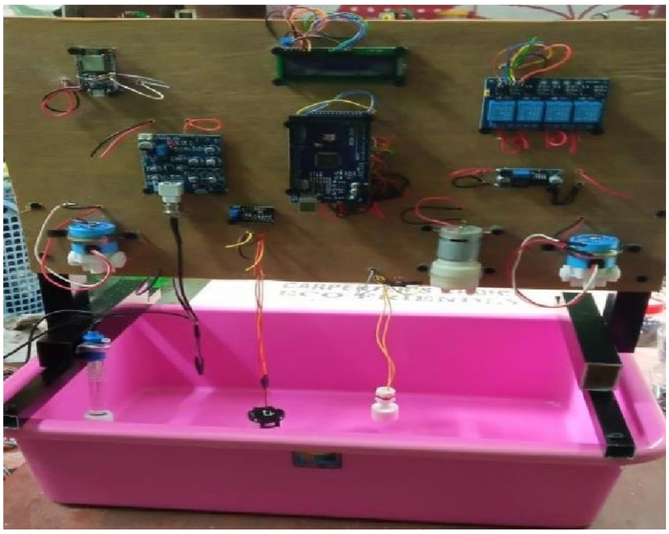


Fig -2: Hardware Implementation

4. SIMULATION

For the simulation purpose, we've used Proteus 8 professional. we will test our circuit after drawing it using Proteus's simulation feature. Many of the components in Proteus are often simulated. Simulating can be done in two ways: run the simulator or advance frame by frame. The "Run simulator" option simulates the circuit at a traditional speed (If the circuit isn't heavy). "Advance frame by frame" option advances to subsequent frame and waits till you click this button for subsequent time. this will be useful for debugging digital circuits. You'll also simulate microcontrollers. The microcontrollers which may be simulated include PIC24, dsPIC33, 8051, Arduino, ARM7 based microcontrollers. You'll either download the proteus compilers or use the special compiler to dump the hex files into proteus.

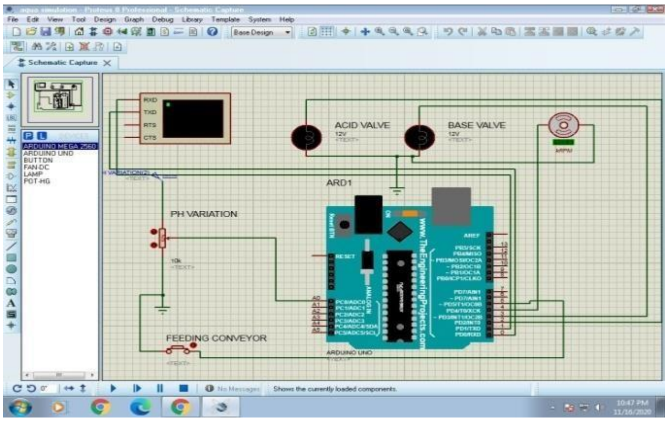
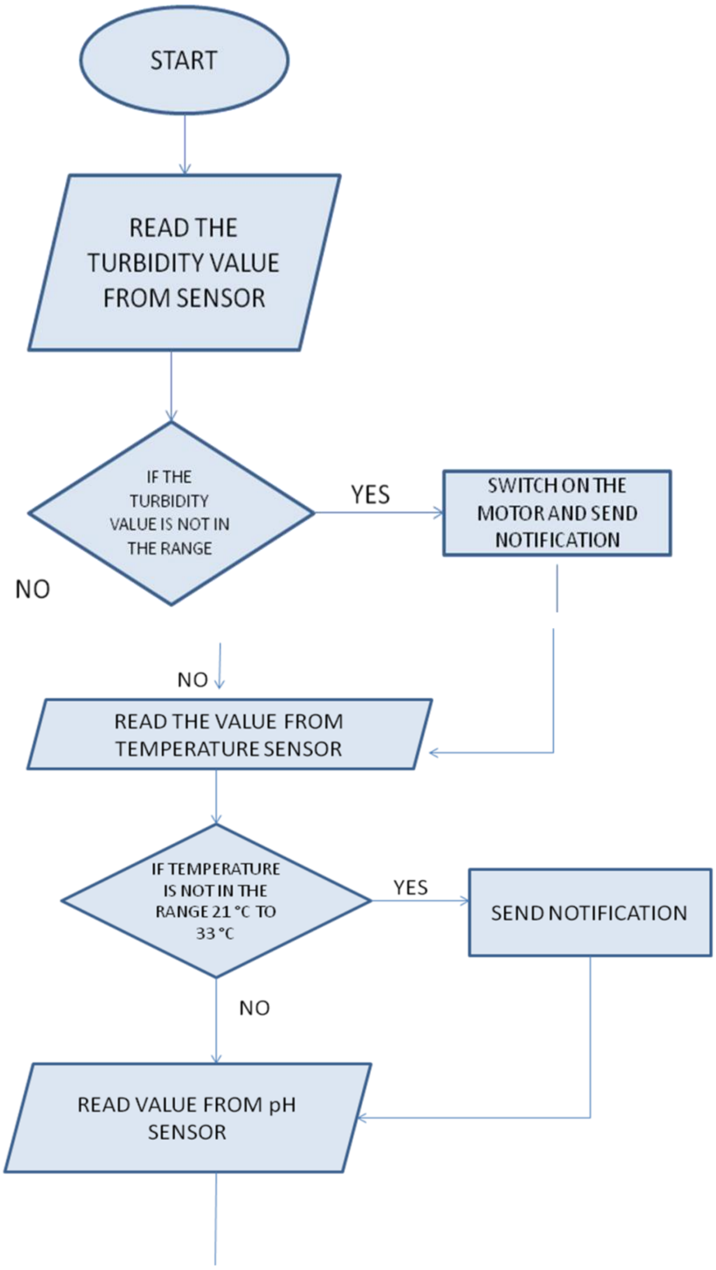


Fig -3: Simulation window



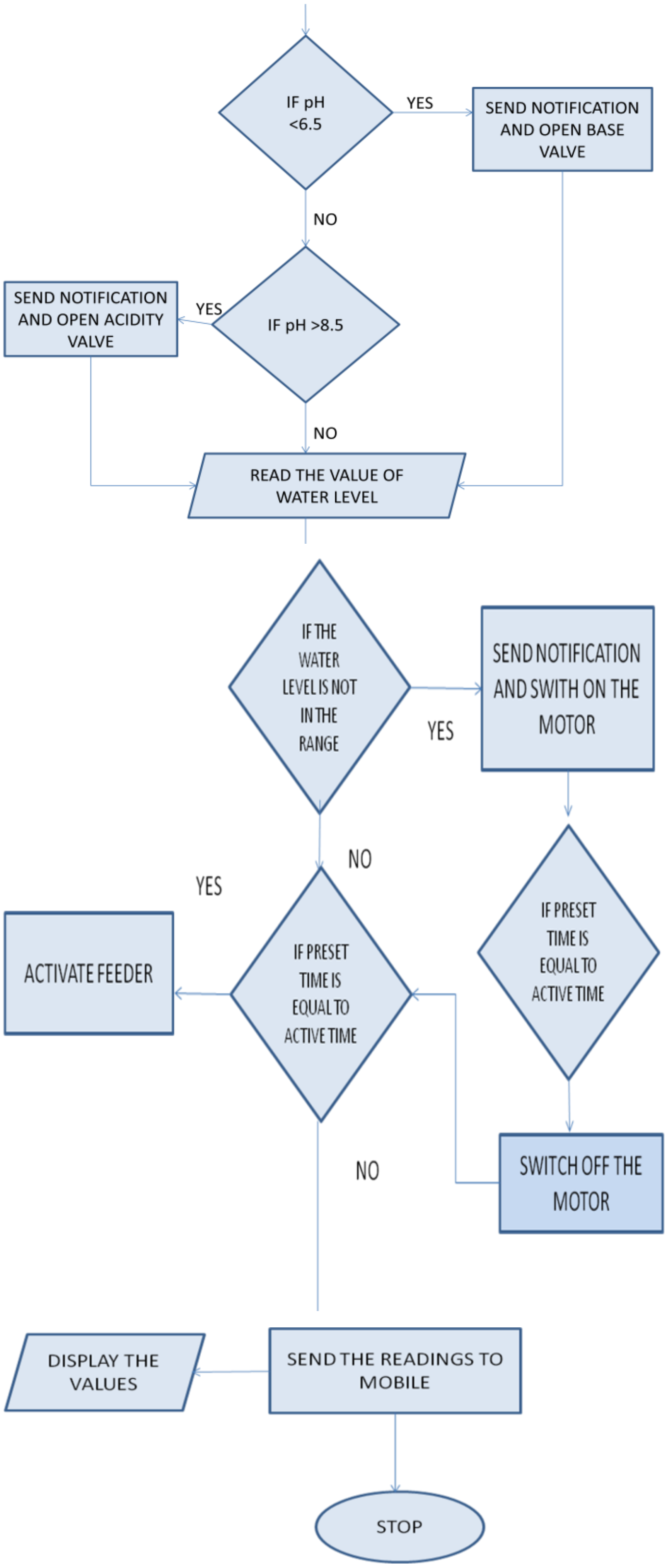


Fig -4: Flowchart for proposed model

5. RESULT

We've found a good implementation model that includes a variety of sensor devices and other modules, as well as their functionalities. During this implementation model we used ATMEGA 2560 with Wi-Fi module. The embedded gadget is connected to the internet via an ADC and Wi-Fi module built in. Sensors are attached to an Arduino UNO board for monitoring; an ADC converts the sensor reading to a digital value, and the relevant environmental parameter is calculated from that value .After sensing the info from different sensor devices, which are placed especially area of interest. When a proper connection with the server device is established, the sensed data will be automatically delivered to the online server.

6. CONCLUSION

Smart aquaculture monitoring and system is predicated on Internet of Things. The technology is extremely adaptable and cost-effective. It's a real-time system that measures numerous parameters concerning the water and makes sure the water maintains the standard for the lives of fishes. The system gives the knowledge of the standard parameters measured to user through cloud. The system can monitor water quality automatically, and it's low in cost and doesn't need individuals on duty. It's a flexible system, due to which just by replacing the sensors and by making some changes within the pc code, the system are often wont to measure another parameters of water . The system is reliable and straightforward to take care of and it are often extended to live pollution also. By effectively using the proposed system, one can save time and price also can be reduced.

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