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Original Research Article

Automatic Aqua Monitoring System for Integrated Fish Forms

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Abstract

Aqua forms are increasing year on year with increase in the demand of fish foods. Maintaining fish farms is of greater challenge since the growth of fish is related with quality of water. Monitoring the quality of water in each tank becomes difficult and includes interference that is much more human. In this proposed research work, an intelligent automatic aqua monitoring system is introduced where the sensors and the inlet monitor the quality of water and outlet of fresh water is controlled through Arduino micro controller. Since the components used are cheap and Arduino is very simple to program the proposed method finds efficient and promising results in maintaining aqua farms.

Keywords: Aqua form, Ph sensor, Arduino, Water temperature.

I. INTRODUCTION

During the past twenty years' aqua forms has increased considerably. Currently fish foods are considered as one of the most favorite dish. Therefore, it is important to take care of the aqua culture in order to monitor their living conditions. It is difficult for some people to maintain the water quality in addition to cleaning it. In addition, maintaining the temperature and feeding the fishes on right time involves manual care. Aqua Species such as (shrimp, fish and so forth) that are lived in ponds or water tanks are affected by low dissolved oxygen in water, temperature, salinity and pH level of the water [1]. One of the relevant continual issues faced by aqua culture for efficiently monitoring the water quality of their fishponds is the capability to monitor and adjust too many operations independently and simultaneously [2]. Existing monitoring systems use micro controller to sense and control the related components. It is very complex and expensive [3].

Due to these reasons, it is proposed to develop a smart automated system to monitor the operation of aqua culture to simplify the manual interference. The proposed system consists of suitable sensors for monitoring water quality and automated pumping system for the removing and restoring the water at required levels.

The idea behind the project is to convert an existing aquarium into an intelligent aqua farm that would take care of the fish automatically rather than manually. The proposed system ensures proper monitoring and the appropriate living conditions of the fishes by maintaining the quality of water. The smart system will automatically fulfil all requirements such as pH control, temperature control, and feeding and water regeneration using Arduino programming [1].

II. LITERATURE SURVEY

Water is a necessary component in the aqua culture that essentially influences by many changes in the environment. In the aquarium the yields (fish, shrimp, forth…. etc.) depend up on the water quality of the aquaculture, for fish yields the parameters which are to be keep at certain ideal levels in water are oxygen, temperature, saltiness, turbidity, pH level, alkalinity and hardness. These parameters can differ during the time of a day and can quickly change because of the outside conditions. So it is important to control these parameters within possible range this need access information of aquarium to post their potential [1].

For that, many countries pursued to end this problem, and that start with analysing the reasons of the problem. The important reason is that the parameters mention above need to be maintained at certain level that becomes very difficult task for some people to take care of all these parameters every day, at the same time clean it, and feed fish. Therefore, they start to develop the aquarium by using electronic circuit to control the

different parameters affect it. However, the design of electronic circuit is difficult also, if one component is defective all other components the whole circuit will not work. Moreover, in electronic circuit the inputs and outputs of the components cannot be control depending up on outside condition. Besides that, most of the methods do not have fish feeder [2].

Later the system was developing by using microcontroller. This system is difficult in programming as well as it is hard to modify any program and to expand new features. However, such system is considered as easier system than electronic circuit because it is easy to control the components inputs and output. In addition, the size of the circuit becomes smaller [3].

The most proper solution to such problem is developing a smart aquarium monitoring system using Arduino mage. This system will be more effective than other system presents in the market [3].

III. DESIGN BLOCK DIAGRAM

Block diagram of this work is divided into two categories namely power supply diagram and main circuit diagram.

2.1 Power supply block diagram

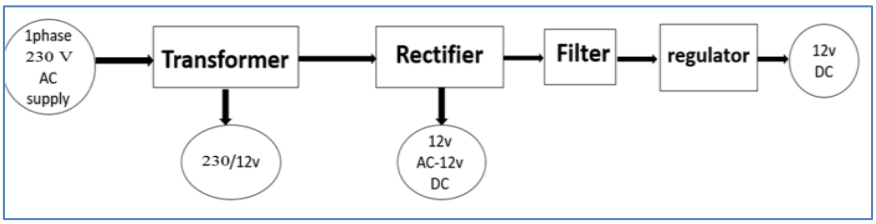

Fig-1: Power supply block diagram

Power supply blocks Diagram Description. The power supply block diagram of project consists of transformer, rectifier and filter. Step down transformer: It is used for reducing voltage from 230V AC to 12V AC. Bridge rectifier: It is used to convert voltage from 12V AC to 12V DC. Filter: It is used to convert the pulsating 12V DC to constant 12V DC. Regulator: Regulator is used to cut off the voltage at 12V if any high voltage comes as input.

2.2 Main block diagram

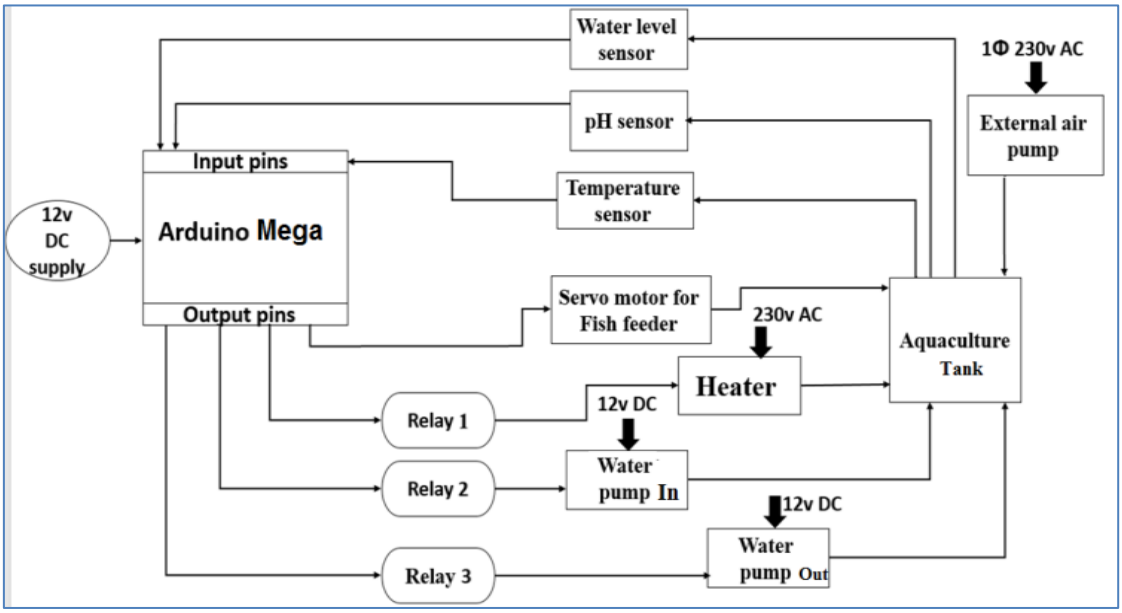

Fig-2: Main block diagram

A. *Main block Diagram Description*

The main block diagram of project as whole consists of Arduino mega, aquarium, I2C LCD display, temperature sensor, water level sensor, Ph. Sensor, relays, servo motor for fish feeder, heater, solenoid valve, water pump, external air pump.

Arduino: It is an open-source hardware and software control. It will receive the signs comes from different sensors and read it, after that send to the output components.

Aquarium: It is a container with water where the fish are grown, provided with all functional requirement needed by the fish to post their potential.

I2C LCD display: The liquid crystal display is an output device used to print the required information as output for the user to understand the process.

Water level sensor: It used to measure the highest and lowest levels of water. PH sensor: It is a tool to measure the pH of the water through a probe connected with control circuit. It can sense the water content as a base, acidic and normal liquids. The suitable ph. for fish tank is between 7-8.3.

Temperature sensor: It is device used to measure the coolness and hotness of water. Relay: Relay has a coil with control pin. The relays have two contacts normally open and normally close. It is used to operate the water pump and heater when required.

Heater: It is an electrical device that changes the electricity into heats, so whenever the temperature of the Aquarium reduces to 23 degrees the heater will heats the water up to required limits (the proper temperature for fish is 23-30 degree).

Inlet water pump: It is used to add water to the aquarium whenever the water level decreases below the required value. Outlet Water pump: It is an external water pump used to remove the wasted water from the tank whenever water ph changes from normal value.

Servomotor for fish feeder: It is a bottle that contains food for fish at the end of the bottle there will be servo to open and closed it. External air pump: A device works to neutralize the lack of oxygen inside the aquarium.

IV. DESIGN DETAILS

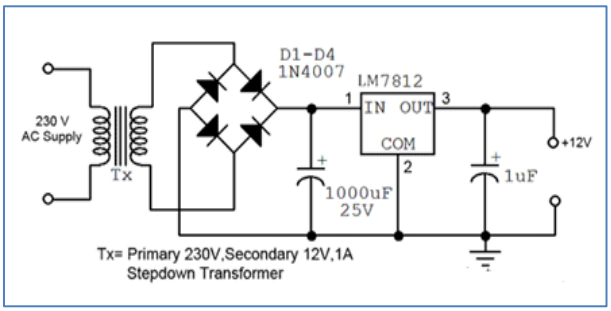

Fig-3: Power Supply Circuit

The proposed circuit operates with three levels of voltage. 5V DC, 12V DC and Single Phase 230V AC supply. In order to obtain 12V DC supply the power supply circuit shown in figure is used. The input 230V AC supply is stepped down to 12V AC. Using diode bridge rectifier 12V AC is converted to 12V DC. Capacitors are used as filter for smoothing. Voltage regulator LM7812 is used to regulate the output voltage to 12V in case of increased DC voltage at input of regulator.

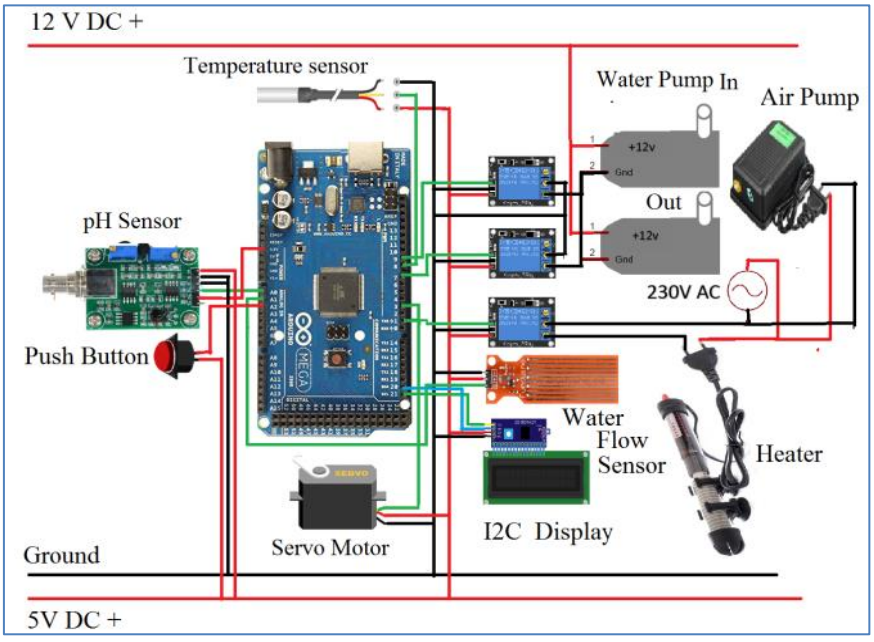

Fig-4: Main Circuit Diagram of Aqua monitoring system

The 12V DC supply obtained from the power supply circuit is given to the VIN pin of the Arduino and to the two water pumps connected with relay.

The main circuit diagram of the developed system is as shown in figure 4.3. The main circuit received 12V power supply from the power supply circuit. Sensors are connected to 5V supply terminal

from Arduino board. The input sensing pins are connected at appropriate digital/Analog pins of Arduino. Relays and Servo are connected as output pins from Arduino. Air pump is connected independently to 230V AC supply to give oxygen for the aqua water tank. Heater is connected through the relay to 230V AC supply.

A. Water Level checking

The operation of the circuit starts with the water level sensor. Arduino reads the water level sensor. If the level of the water is below the required level, then the Arduino sends HIGH signal to relay that operates the input water pump to fill water. During this process, the water level sensor continues to check the water level. On reaching the required level, relay is made LOW to switch off the pump.

B. PH Checking

Following the water level checking, Arduino reads the PH value of the water through PH sensor. If the PH value is within the allowable range, then the Arduino continues to next sensor reading. If the PH water is not within the range, then the Arduino sends HIGH signal to relay that will operate the water out pump to remove water from the tank. Water is removed for the time duration that is already predetermined according to the size of the tank. After removing the required water, the Arduino sends HIGH signal to relay for operating water input pump.

C. Temperature sensing

Arduino checks the temperature of the water using temperature sensor connected. If the temperature is within the range, then the Arduino will switch over to fish feeder to activate feeding of the fish. If the temperature of the water is less than the normal value, Arduino sends HIGH signal for the relay to activate heater to operate. Arduino continues to check the temperature of the water until a required temperature is achieved. After reaching the correct temperature range Arduino will send LOW signal to relay to switch off the heater.

D. Air Pump

Air pump is connected independently to the aqua tank without any control of Arduino circuit or program. Air pump needs to be operated all 24 hours since oxygen is the important source of living for the aqua species.

A. RESULTS AND DISCUSSIONS

The developed design is operated with two levels of DC voltage 12V and 5 V respectively. Also single-phase 240V AC supply is required for some external devices like heater. The 12V DC voltage is obtained using transformer, bridge rectifier and voltage regulator. 12V DC supply is given as input for Arduino, Water in and out pumps.

5V DC supply required for PH Sensor, temperature sensor and Servomotor is obtained using Arduino 5V terminal. The following table illustrates the type of sensor with their range of allowable values used in the program.

Table-1: Range of values maintained for Aqua farm

S. No	Sensor	Analog reading range	Level	Controlling device	Voltage of controlling devices
1	Water Level sensor 5V DC	0 to 330 Ohm	220 to 320 Ohm	Water in Pump (operated by relay)	12V DC
2	Ph. Sensor 5V DC	0 to 14 PH Value	7 to 8.3 PH Value	Water out pump and Water in Pump (operated by relay)	12V DC
3	Temperature sensor 5V DC	0 to 50 degree C	24 to 30 degree	Heater (operated by relay)	1 phase AC 240V,50Hz
4	Fish feeder 5V DC		Switch operated	Servo motor	5V DC

V. CONCLUSIONS

A smart monitoring and controlling system for aqua culture has been developed successfully. The difficulties in maintaining the water quality, feeding and changing water in aqua tanks can be reduced significantly using the developed model. In addition, the sensors, devices and programming techniques used in this system are not complex in comparison with micro controller based systems. Arduino has been used as programming language to develop the smart system. Arduino is easy to learn and easy to extend in future. The developed design is capable of monitoring the water level using water level sensor that can operate a water pump to in case of falling of water level. The important parameter to ensure the growth and health of the fish is the water ph value. Ph value is effectively monitored using Ph sensor. In case of change in ph value above required value water is removed using a pump and fresh water is added. Automatic fish feeding is taken care of servo based feeder mechanism. Temperature control is done using temperature sensor that can enable heater operation in case of temperature

falling below the required value. The developed model can be used to any existing aqua culture system to benefit easiness in maintenance and increase productivity.

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REFERENCES

1. Wang, D., Zhao, J., Huang, L., & Xu, D. (2015, July). Design of a smart monitoring and control system for aquaponics based on OpenWrt. In *5th International Conference on Information Engineering for Mechanics and Materials*. Atlantis Press.
2. Adarsh, K., Rinu, J., Santha, V., Sunitha, A. Smart Aquarium, National Conference on "Emerging Research Trends in Electrical, Electronics.& Instrumentation
3. Shafeena, T. (2016). Smart aquaponics system: Challenges and opportunities. *European Journal of Advances in Engineering and Technology*, *3*(2), 52-55.
4. Mahalik, N., & Kim, K. (2014). Aquaculture monitoring and control systems for seaweed and fish farming.
5. Nelson, Latap, Dr. Chiemela, F., Anyanwu, Dr. Ricardo., L. Ildefonso. (2015). Assessment of Agrochemicals Residue in Fish Ponds in Agricultural Areas of Ifugao Province, *International Journal of Advanced Research*, *3*(7), 1476-1481.