Smart Aquarium based on IoT

[1]Ashiq V M, [2]Kripal K,
[1]Student, [2]software Engineer
[1]Departmet of Computer Science,
[1]IHRD College of Applied Science,Palakkad,India

Abstract : The IoT is recognized as one of the most important areas of future technology and is gaining vast attention from a wide range of industries. The objective of this article is to design and construct an automatic aquarium for those who cannot take care and keep an eye on their fish and aquarium daily and minimize the manual factor as much as possible. The aquarium will perform all the steps automatically like temperature control, oxygen control, feeding, etc. and would send all the information to the user via IoT. Bridging between wireless sensor networks with traditional communication networks or the Internet, IOT Gateway plays an important role in IOT applications, which facilitates the seamless integration of wireless sensor networks and mobile communication networks or Internet, and the management and control with wireless sensor networks

Index Terms **– IoT, Sensor networks, IOT Gateway**

I. INTRODUCTION

Aquarium keeping is a fun and rewarding activity that can provide years of enjoyment, education, and even stress relief. In normal aquarium Water changes of 10-20% every other week, vacuuming the gravel, and rinsing the filter cartridges will do in most cases. The tap water contains chlorine/chloramine, both substances should be removed by a water conditioner also
The vital water parameters such as pH, hardness, ammonia, and nitrate, (salinity for marine) should be tested before every water change. These values can indicate a problem before it becomes visible.
Neglecting tank maintenance can have serious long term problems. As only pure water evaporates, water changes are necessary not just to remove substance build-up, but also to replenish minerals that are diminished...
Fish always look hungry. In nature, they search for food all day long. Fish should be fed only as much as they can eat within 2 minutes. This amount can be fed at once, or stretched out to 2-3 feedings per day.
Overfeeding is the leading source of accumulating waste and related to many aquarium problems

In this busy world, it is very difficult to maintain all these features in a proper way. This article is an automated system to take care of fishes. It will replace the manual maintenance of a fish aquarium with its automated functions. It will monitor the physical changes in the water and will maintain it to the ideal conditions, with required changes.

II. FUNCTIONALITY

The main principle of the article is to sense the changes via sensors. These changes will be then processed by the Controller. The microcontroller installed in the circuit will be performing the main task of controlling. The controller will send commands to the actuators where the output part will be observed working to sustain the ideal conditions. There will be a temperature sensor, PH level sensor, heater, feeder, an LCD and an ESP module for communication. They all will be interfaced with the controller. If anything happens or changes, the controller will start working to reach back to the ideal state. The normal temperature of a freshwater aquarium is considered to be 28-30 degree Celsius. If the temperature goes down, the heater will be on until the temperature reaches the normal temperature. After every 24 hours, the controller would turn on the feeder for feeding purpose. If the pH level has increased/decreased from the required level then the controller will change the water. The ongoing process and situation like temperature, feeding, changing water, etc. will be shown on the LCD. The user can access and control the current status of the aquarium at anywhere, anytime via IoT.

III. DESIGN OBJECTIVES, ISSUES, AND THEIR ANALYSIS

The objective of the article is to build an automatic aquarium for those who cannot keep an eye on their aquarium regularly. It will be fully automatic so there will be no need to see the aquarium again and again. The short term goal of our article is to make a low cost but automatic aquarium so that it could be in the reach of everyone. The long term goal is to extend it to the version where it can be fully automated Our main objective was too limited to our short term goals and to achieve those, a lot of research was done and finally, we were able to produce the desired output

The main issue was to decide the dimensions and design of the mechanical structure of the aquarium. Our objective was to design a light weighted and low-cost aquarium. The circuit and the sensors that we had to select should not be so heavy and that they could not create any trouble for the fish in the aquarium or fish could not damage them.

When we are to structure our own fish tank, we need to know about the following information.

- Aquarium Volume
- Glass Thickness: A glass thickness that will hold under the pressure of your fish tank.
- Glass Area: The sum of areas of the six sides of your aquarium.
- Glass Weight: The weight of your fish tank when empty
- Glass+Water Weight: The weight of your fish tank when filled with water.

- You will also get your glass surfaces dimensions. Notice the sides surfaces are reduced by the glass thickness.

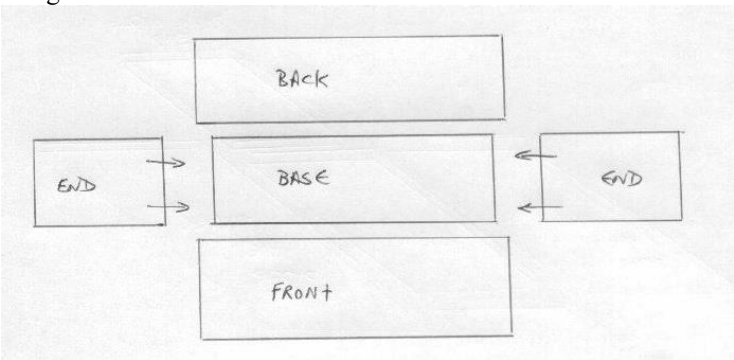

Fig.1 Dimension of Glass

IV. SYSTEM OVERVIEW

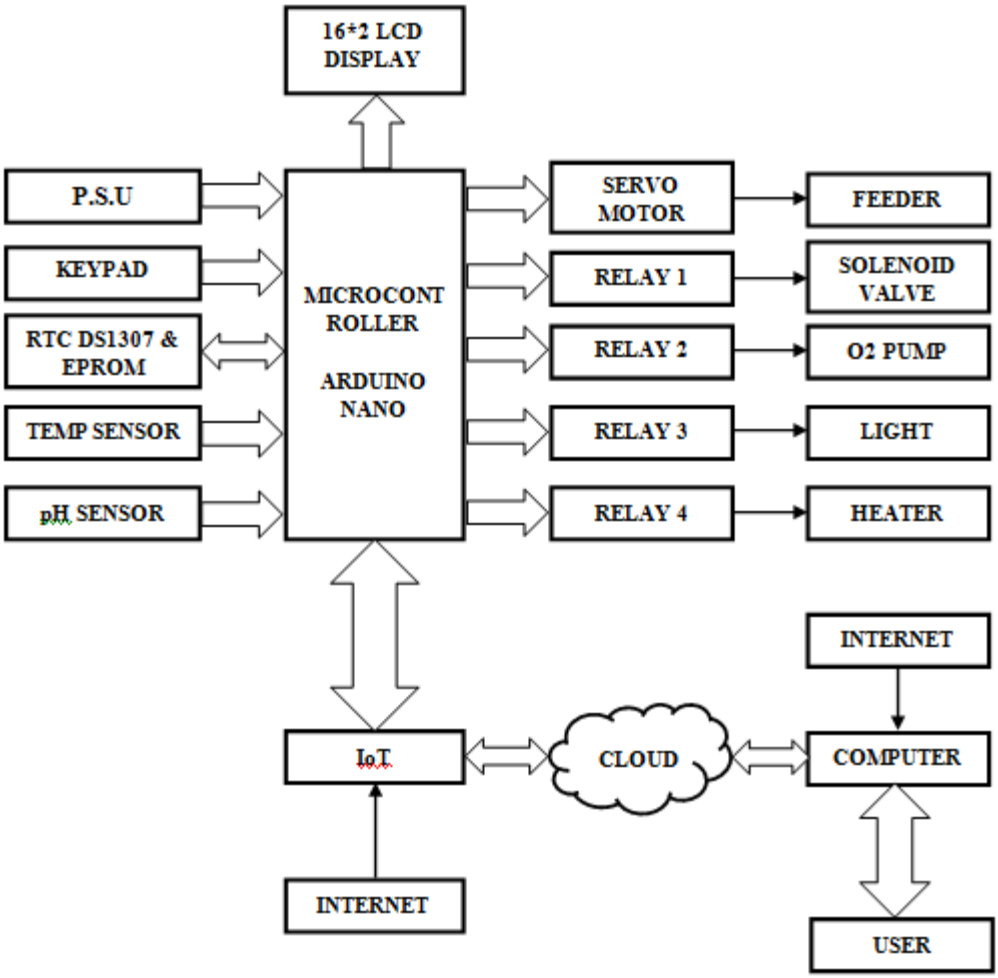

Fig 2 Block Diagram

a) **Power supply section**

It has got three sections – rectifier section, filter section, and regulatory section, and also two output voltage levels - +12v, +9V and +5v. +12v is given to the relay board, +9v is given to pH module and +5v is given to the main board..

b) **Microcontroller**

The brain of our article is microcontroller ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove but in a different package. It lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one.

c) **DS1307 - RTC**

Here used an RTC or Real Time Clock DS1307 is a Timekeeping device, usually in the form of an Integrated Circuit (IC). An RTC is battery powered and keeps track of the current time even when there is no power. Real Time Clock ICs are present in computers, servers, and many embedded systems and in fact, they are used wherever it is required to keep accurate time.

d) **ESP8266 - WI-FI module**

Here used the ESP8266 processor from Express if is an 80 MHz microcontroller with a full WiFi front-end (both as a client and access point) and TCP/IP stack with DNS support as well, have an onboard 500mA 3.3V regulator or level shifting.

e) **DS18B20 - temp. Sensor**

Here the DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device..

f) **Ph sensor**

This sensor allows you to monitor water pH. This ability is directly related to the concentration of hydrogen ions in the water. The pH of a solution indicates how acidic or basic (alkaline) it is.

- Very Acidic= low pH
- Very Basic = high pH

A neutral solution such as water has a pH of approximately 7.

g) **Servomotor**

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.

h) **Feeder**

It is an electronic device that are designed to feed aquarium fish at regular intervals. They are often used to feed fish when the user is too busy to maintain a regular feeding schedule.

i) **Solenoid valve**

A solenoid valve is an electromechanical device in which the solenoid uses an electric current to generate a magnetic field and thereby operate a mechanism which regulates the opening of water flow in a valve.

j) **Oxygen pump**

An air pump or oxygen pump is used to provide a pond with oxygen. An oxygen pump will supply oxygen to the water whereas it will discharge harmful gases.

k) **Heater**

An aquarium heater is a device used in the fish keeping hobby to warm the temperature of water in the quarium. If the temperature decreases it will automatically turn on the heater.

V. PRINTED CIRCUIT BOARD DESIGN

A printed circuit board (PCB) is an electronic circuit used in devices to provide mechanical support and a pathway to its electronic components. It is made by combining different sheets of non-conductive material, such as fibreglass or plastic that easily holds copper circuitry. PCB is also known as printed wiring board (PWB) or etched wiring board (EWB).

PCB fabrication involves the following steps:

1. Preparing the circuit diagram using Fritzing Software.
2. Taking print in a low-cost paper.
3. Placing the elements into the PCB, making sure it goes in the correct way around.
4. Twists the leads a little to secure the part.
5. Making sure the soldering iron has warmed up and used the moist sponge to clean the tip when required.
6. Placing the soldering iron on the component of the pad and feeds the solder's end onto the board.
7. Taking away the solder and the soldering iron from the board and leaves the terminal for a few seconds for cooling.
8. Using a couple of cutters for neat the excess component terminal.

VI. ADVANTAGES

- No need of maintenance
- Time consuming
- Hygienic
- Waste management system
- Low cost
- Easy to implement
- Commercial purpose

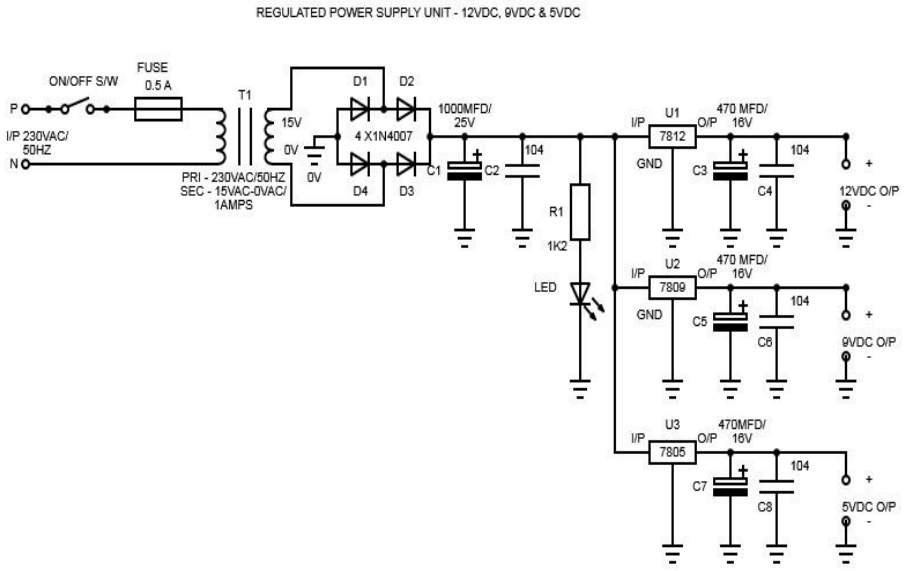

Fig 3. Power supply unit

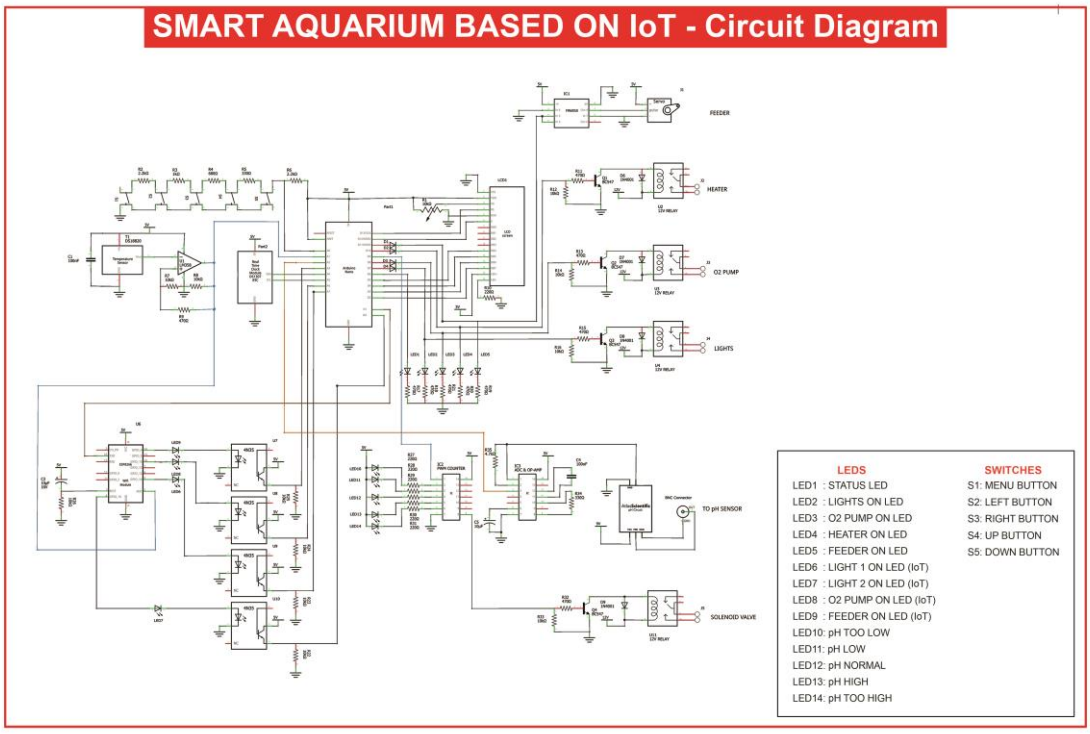

Fig 4:Circuit Diagram

VII. TEST RESULTS

Different test were conducted to investigate, troubleshoot and test different sensors and modules. Before any hardware was investigated, the following components requirements were set:

- The normal temperature of the water of aquarium was set as 28 degree Celsius.
- If the temperature level decreases the heater turned ON.
- Sets the pH level of Dil. HCl as 1 and NH4OH as 11. If the PH level increases or decreases from the neutral the each solenoid valves were opened (inlet and outlet).

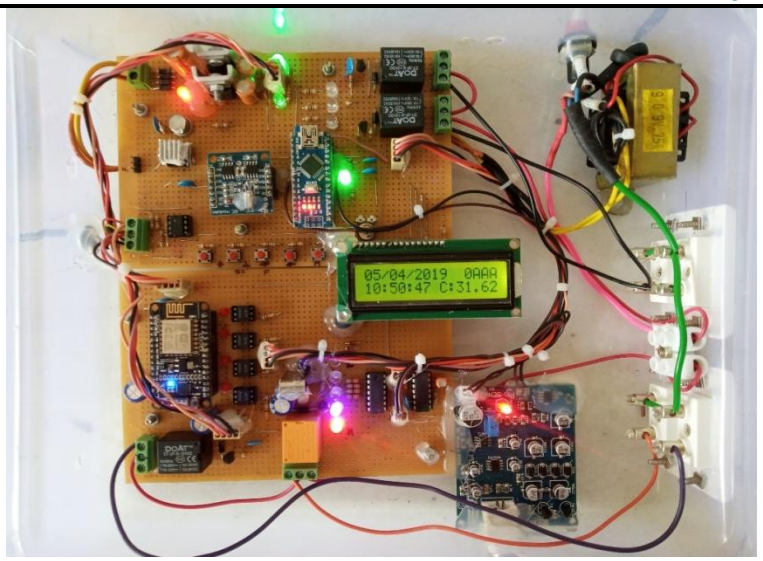

Fig.5 Smart aquarium based on IoT

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IV. FUTURE ADVANCEMENTS

After implementing and detailing the article, still it has many future advancement possibilities of whichare stated as below:

a) **Air cooler**

Sometime the temperature of inside the aquarium or we can say the temperature of waterincreases in summers that's why fish die because of the sudden increase in the temperature. Asthere is nothing in the aquarium that could reduce the temperature when it has increased so asmall air cooler or a fan can be used to decrease the temperature in case the temperatureincreases up.

b) **Solar cell**

As the aquarium needs 24/7 constant power in order to work so lots of power is consumed. Lots of power is utilized and it can be a burden onyour pocket so in order to reduce this, solar cells or panels can be used to get the constant power.So that there will be no issue of over billing and burden on your pocket. If in case of powerfailure, the aquarium would not stop its work.

c) **Turbidity sensor**

A turbidity sensor can be used to detect the water quality by measuring level of turbidity. It is able to detect suspended particles in water by measuring the light transmittance and scattering rate which changes the amount of total suspended solids in water. Turbidity sensors can be used in measurement of water in aquarium

V. CONCLUSIONS

We started off this article with an aim to accomplish the simple looking task of designing an automatic aquarium (SMART Aquarium). But with time and experiences, it was learned that this was not at all an easy task, especially interfacing the sensors with the controller. Though we are able to achieve all the goals of our article still we think that lots of advancement can be done on this article. We have provided the platform and the platform is ready for everyone to work on it. For advancements, we need more time, money and hard work. The money would remain the critical issue cause in order to upgrade the article many of the stuff would need gradation. Nevertheless, this article has been a success as far as learning and practical implementation of Electronics Engineering concepts is concerned. The basic idea proposed in this article works well and can be implemented on large scale industries like agriculture etc. Having a SMART Aquarium, will save our time and we would not have to be worried for our fish and their aquariums for a long time.

REFERENCES

[1] Home automation using cloud and mobile devices by Nicholas Dickey; Darrell Banks; SomsakSukittanon 2012 Proceedings of IEEE Southeastcon.

[2] Toward continuous push-based P2P live streaming by DongniRen; Wangkit Wong; S. -H. Gary Chan 2012 IEEE Global Communications Conference (GLOBECOM).

[3] Home Automation using Cloud Network and Mobile Devices Sirsath N. S, Dhole P. S, Mohire N. P, Naik S. C &Ratnaparkhi N.S.

[4] An Analysis of Live Streaming Workloads on the Internet KunwadeeSripanidkulchai, Bruce Maggs, International Journal of Advanced Research (2015), Volume 3, Assessment Of Agrochemicals Residue In Fish Ponds In Agricultural Areas Of Ifugao Province Nelson Latap, Dr. Chiemela F. Anyanwu, Dr. Ricardo L. Ildefonso.

[5] Aquarium Water Parameters For A Balanced Fish TankAlgone(2016,December15).Available:Http://Www.Algo ne. Com/Aquarium-

[6] Development of Automatic Fish Feeder By Md. NasirUddin, Mm Rashid, Mg Mostafa, Belayet H, Sm Salam, Na Nithe, Mw Rahman& A Aziz, International Islamic University Malaysia

[7] Ubiquitous Aquarium Management System". Published by SangeethaRajesh,SaurabhJadhav,Nehasingh in IOSR Journal of Computer Engineering (IOSR-JCE) Jan-2017