Smart Aquarium

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Abstract- Fish keeping in our homes is one of the popular trends in worldwide. Every age group peoples are like to keep aquarium in their home and office as for a decoration purpose or as hobby. We know that fish keeping is not of the easy job as well as it requires space for to place it. Commercial or ornamental fish farming has become very popular nowadays. While the ornamental fishes are generally placed in the fresh water because it is easy to handle them. We know that to check the aquarium manually is one of the difficult methods as of the water needs to be changed in periodic intervals; the fish needs to be fed in time. At regular intervals the Temp level, pH value and water mark of the aquarium needs to checked and maintained. The project "Smart aquarium" has been designed while the problems are keeping in mind. Our project is used to automatically control and maintain the temperature, pH, water level, dissolved oxygen level and feeding with the help of PLC (programmable logic controller) and SCADA (Supervisory Control and Data Acquisition).

Keywords- Smart Aquarium, Temperature level, pH value, automation.

I. INTRODUCTION

The last 20 years has been making a widely increasing in the pet ownership which has a major breakthrough in the worldwide. Nowadays the one of the most popular pet after cat and dog is freshwater fish. We know that the maintenance of the aquarium is one of the different tasks for the human. There is lot of things should be keep in mind while we are going to clean up of our aquarium or while feeding them. We have to turn off the power of the aquarium while cleaning and after it the power should be ON. Feeding is taking placed as manually for them. The atmosphere of the winter seasons which makes a bad environment to the fishes in the aquarium which makes a huge death rate in it. For reducing this we consider to place a heater to make the environment back to normal.

Here we introduce the Smart Aquarium in order to reduce this difficulty. Generally these kinds of home pets require a special care and sometimes the need of their pets cannot meet by their respective owners. It helps to make a better environment to keep the health of the fishes in a better condition with respect to the seasons. The regular updating of the aquarium environment and health of the fishes makes this device as much interesting to the customers to buy. While considering in the case of aquarium fishes they need a special care because their environment is much different from other pets and the death rate is much higher from other animals. In normal in all aquariums it consist of water filter, water heater and oxygen pump also. But these are not enough to make a natural environment to them. A lot of researchers are working behind it to make a better environment to them for keeping their death rate as much low. The death cause of the fishes in the farm and aquariums are cannot be take are. From this project the customers can increase their farming process as much well as. Overall the efficiency of this device is much better than other devices which are available in the market.

Smart aquarium is an automation device is used to care of fishes while no one is there at home. The manual maintenance of the aquarium will be automatically taking placed by this device. Here, the device will check out the physical changes of the aquarium and respective changes will be maintained into an ideal condition with at regular intervals of time. The project makes a better decreasing in the death rate of the aquarium fishes. This device makes an efficient cleaning without the presence of any humans. The Smart aquarium performs the following features like:

- Feeding
- Water renewal
- Temperature control
- pH value

The main advantage of this device is well be of lower cost. Generally, the interested peoples which do not have time to take care of the aquarium fishes in at their home or at office can be use our device and worried about for keep on asking to their friends, neighbors to look out of it due to their absence can be stopped. While using this smart aquarium we can give a better environment to the fishes which equivalent to their natural habitat and while we can much reduce the death rate as much as low.
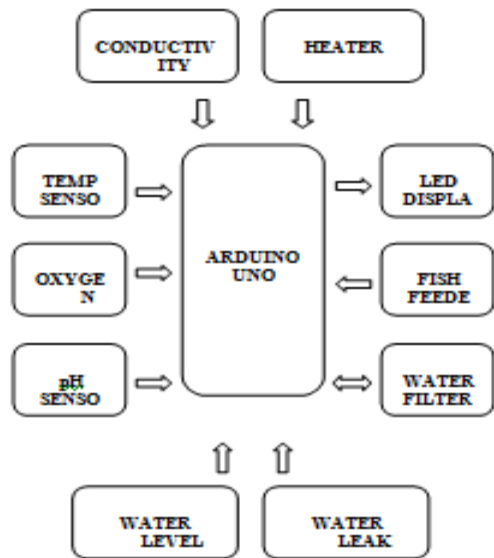
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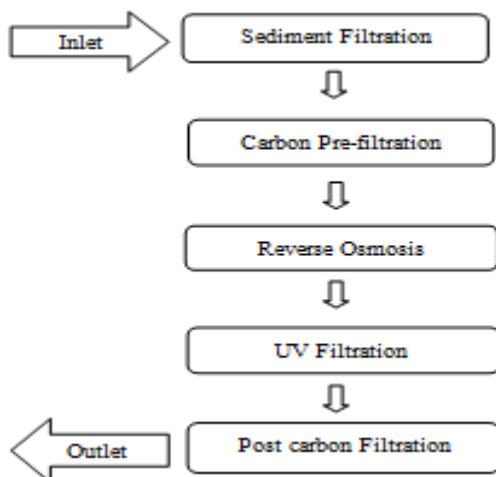

Figure 1: Block diagram of Smart Aquarium.

Figure 2: Block diagram of Water filtration process.

III. SYSTEM REQUIREMENTS

The vision of the smart aquarium is to have a good environment to the fish species in the aquarium. When the environment makes suitable to the fishes, then the death rate of the fishes will become into lower level. So firstly we should understand the nature of the water and their parameters like pH value, temperature range, ions present in the solution etc which they living. Then only we can achieve a good environment which is suitable to them. The feeding of food, filtering and filling up of water are take placed automatically in this device.
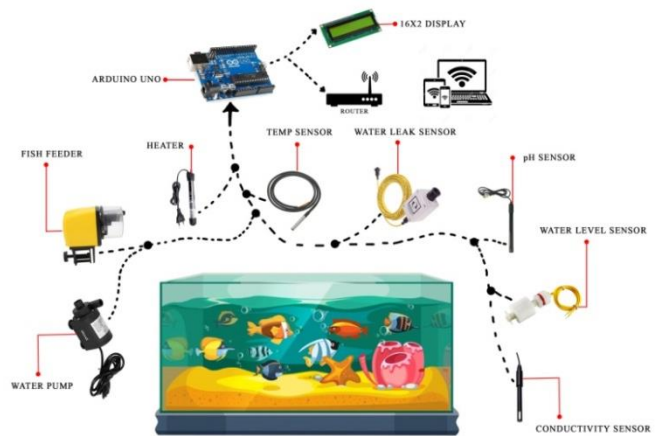

Figure 3: Architecture design of smart aquarium

Smart aquarium which consists of following parts which is shown on the above diagram (figure 3). Here we use the components like:

- **Fish feeder**: The fish feeder is an automatic feeder is used to feed the fishes in the aquarium. This feeder can be preprogrammed or it can be manually controlled by humans through smart phone.

- **Water pump:** It is used for passing the aquarium water to the water filter. Here the waste water from the aquarium and filtered water into the aquarium is taking placed through it.

- **Arduino UNO**: Arduino is an electronic device used to control the software and hardware components like heater, water pump, fish feeder etc with the help of the output values of the sensors like Temperature, conductivity, pH and water leak sensors**.**

- **Heater**: Heater is used to maintain the water temperature inside the aquarium with the help of temperature sensor. Generally the normal temperature range of the aquarium is 25°C to 27°C.

- **Router**: Here Router is used to help out to get the information of the aquarium as fastly through to our smart phones.

- **16x2 Led display:** It is used to show up the output result of corresponding sensors like Temperature, conductivity, pH and water leak sensors**.**

It consist of the follwing sensors like:

1. **Temperature sensor**: Here we use the temperature sensor DS18B20 which provides all around off 9 to 12-bit temperature readings. In the wet condition this digital temperature sensor will also precisly measures temperature. It consist the following features like:

   ▪ 3.0 to5.5V Input voltage
   ▪ Its waterproof
   ▪ Temp range of -55°C to +125°C
   ▪ Accrucy range - ±0.5°C

2. **Oxygen sensor**: Dissloved oxygen sensor is used to detect the oxygen level which is dissolved in the aquarium water. We use the AZ 8403 oxygen sensor for this purpose. It consist to detect in the range of 0~199.9%.

3. **pH sensor**: Its an instrument used to measure the hydrogen-ion activity in the water based solutions, which indicate the acidity or basiciity present in the water and experessed in the terms of pH. It measrue in the range of 0~14pH and applicable to the temperature in the range of 0~60°C. At last we get an anlaog ouptut from this device.

4. **Conductivity sensor:** It measures the ablitiy to conduct the electrical current through the solution. Generally used to find out the presence of the ions in the solution which is ingreator or smaller in range.it applicable in the temperature range of 0~60°C.

5. **Water leak sensor:** It used to check out the leakage of water while its pumping through water filter. When it sense the leakage it stops the filter process and alert the user. Generally lead alloy and permalloy are used off and it can withstand at a temperature of 75°C.

6. **Water level sensor:** It is a floating type water switch sensor used to check out the water level inside the aquarium. If the water level is below the preset level, then the water filter add more water to its outlet and maintain the water level inside the aquarium.

Here all the sensors are connected to the Arduino to maintain the corresponding components. Temperature sensor is used to control the heater. The ph, water leak, water level and conductivity sensor is used to control the water pump and water filter.

IV. WORKING

The working of the smart aquarium which is mainly divided into 4 stages:

1. WATER FILTRATION PROCESS

The water filtration process is one of the main processes in this Smart aquarium. It is used to generate the fresh water from the water which is dissolved by the excretion wastes of the fishes in the aquarium. Generally it consists of 5 steps to generate the fresh water from it and they are:

Step 1: **Sediment Filtration:** Sediment filter are used to filter the suspended solid materials like pebbles and small fish waste. They also remove materials like sand and organic substance. It is the first filtration process in this project. It should be done in a perfect manner to reduce large particles from the water. If these contaminants are not removed properly then it causes cloudiness and turbidity.

The filtration process is carried out by using cartridge filters which are used to remove contaminants. This filtration process is same as the filtration process of drinking water. There are some materials that can't be removed using sediment filtration process like heavy materials, nitrates, by-product of some water treatment process.

Step 2: **Carbon Pre-Filtration:** Carbon Pre-Flirtation is a process of removing impurities form water using activated carbon. The main principle behind the process is adsorption, in which the impurities get trapped inside the porous structure of carbon filters using adsorption. Periodic replacing of this carbon filters are required. Carbon filtration is used in many applications to remove toxic and organic waste.

One gram of activated carbon has a surface area of 32000 sqft.

Step 3: **Reverse Osmosis:** It is the third and most important step during filtration. Reverse Osmosis is the opposite of Natural Osmosis in which the solvent material if forced to move through a partially permeable membrane which removes large and unwanted molecules to be separated from the water. RO process can be done to remove both chemical and organic (bacteria) from water. In natural osmosis the solvent moves naturally to an area of low concentration, but for reverse osmosis we should provide a pressurized chamber. During filtration external pressure is provided to move the solvent to the other side of the membrane. The solute (impurities) is retained in the pressurized side of the chamber and the solvent is allowed to pass through the membrane. Also, essential

minerals can be separately added to the water during the process of Post Carbon Filtration.

Step 4: **UV Filtration:** UV rays can kill small micro organisms from water because the wave length of the UV rays can scramble the DNA of these small organisms in water. This is one of the important steps in the filtration process. Due to some bacteria the aquarium fish get infected and get sick.

UV rays of wave length of 254-nm can break the DNA in micro-organism so they cannot reproduce the damaging nucleic acid of their DNA. In the UV filtration the measured energy will kill the bacteria, if the amount of energy is more the more purified water can be obtained. After this filtration process most of the water gets purified in the aquarium and for the next step the water is transferred to the Post carbon filtration chamber.

Step 5: **Post Carbon Filtration:** This is the final step in our filtration process. The water after all the above filtration process gets purified and clean, but most of its mineral content gets lost. Post Carbon Filtration is a process of adding necessary minerals into the water. Post Carbon Filters are also called as the polisher. Mineral cartridges are used to replenish essential minerals. In this chamber the minerals cartridge is like small sack of bags. After this process the water is purified and will be rich in minerals. This treated water is transferred to the collector tank through the outlet.

2. TEMPERATURE SENSING AND MAINTAINING

Here we use the temperature sensor DS18B20 to check out the temperature in the aquarium. The output of the temperature sensor is connected to the Arduino. From this output the temperature is maintained by the help of heater which is dipped inside in the aquarium. Generally the temperature range of the aquarium is in the range of 25°C to 27°C and this value will be the preset value in the Arduino. If the temperature sensor sensed the temperature value in the aquarium which is below in the range of this preset value then the heater get increase its temperature until it maintain the normal range and while it sense higher than the preset value then the heater decrease its temperature and maintain to the normal range.

3. WATER CONSERVATION AND MAINTAINING

Generally the water environment is one of the most important factors for an aquarium which make a healthy life to the fishes. The ph value, conductivity value and the temperature makes a better environment to them. The normal range of the ph value for aquarium is to have in between 6.8 to 7.6 and the

7 is the neutral point and while the normal range of conductivity is 200to800µs/cm. These normal values are preprogrammed into the arduino, while if there any changes occurs in the water, it will maintained into normal range through the water filter processing as mentioned earlier.

Water level is keep maintained through the water pump. The water leak sensor is also used to check out any leakage in the water filter, while if any leakage is founded through in the process it gets stopped and the user will get alert.

4. FISH FEEDING

The fish feeder is used here as an automatic feeder which provide the food to the fishes in regular interval of times. The feeding program is taken by the arduino itself while the fish feeder is connected into it or it can be manually take place by humans through their smart phones.

V. FUTURE WORK

In the future we will provide the user a Full Time observation and Controlling System with the help an Android app .In which we can include a full view camera visual from different angles of the Aquarium. There will be an option of user customized ph level, water level and temperature levels. Defects in any part of the process can also be determined. Mood lighting can be also implemented. User Customized scheduled timing for the cleaning process to be carried out.

With Artificial Intelligence will be used to determine the health of the plants and fish and with the help of a GSM module we can also send periodic reports to the users. A Theft Monitoring system will be implemented .A robotic system will be used for the removal of dead plants and Fish. Micro Electro Mechanical Systems will be used. Our Main Challenge is to reduce the power consumption for which solar cells will be used for its working.

VI. CONCLUSION

The main focus of our project was to design a time saving and user friendly Smart Aquarium. Several servo motors and electronic devices are used in this project. It was not an easy task to complete our project with the limited time interval and cost, but we were able to finish the project by achieving our goals well satisfied. By using lighting moods and scheduled food feeding system will reduce the periodic checks. The controlled cleaning process will help the users not to be worried about cleaning that is cleaning of an ordinary aquarium at least require two people, but with the help of

smart aquarium this process is minimized to no human assist. There are separate filters to do different cleaning process. We are also planning to use the fish waste after filtering can be used as manure for small plants. The controlled cleaning can be functioned all day which will keep the aquarium free from dirty and also many bacteria's. Smart aquarium also helps in improving the health of plants and fish in the aquarium the project is focused on both home aquarium and large scale fish cultivation industries, which will reduce the work load and save much time. Our project also helped us to study more about the proper condition for aquaponics. We also plan for a lot of advancement for our project in the future which require much time and cost. With the help of a Smart Aquarium we will save much time and need not to be worried of cleaning the aquarium for a long period of time.

VII. ACKNOWLEDGMENT

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