Control System for Aquarium Maintenance

P.Saraswathi[1], Matheswari.R[2], Dhivya.O[3], Krishnaveni.N[4]

[1]Assistant Professor-III, Department of Information Technology, Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India.

[2][3][4]Department of Information Technology, Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India

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Abstract-*Water quality affects the health level of fish, one of parameters that must be maintained is ammonia levels. Ammonia levels which are left high will be harmful to the health of fish. In this study, a control and monitoring system on ammonia level for fish cultivation has been designed that are also useful for measuring the quality of water in an aquarium. Measurements conducted on this study have two main variables, namely pH and ammonia levels. The sensors namely pH sensor, thermistor, MQ-137 gas sensor and TDS sensor are used equipped with Arduino microcontroller as a controller.*

Keywords- TDS Sensor, MQ-137, thermistor.

1. INTRODUCTION

Cultivation is one of the alternative activities in increasing fisheries production. To produce superior fish/shrimp commodities, the maintenance process must pay attention to internal aspects including the origin and quality of seeds; and external factors include aquaculture quality, feeding, technology used, and controlling pests and diseases. The main problems that are often found are poor water quality in ponds or artificial ponds during the maintenance period. Apart from the quality of water that must be maintained clean, another thing that is actually also very common and should be wary of is the increase in pH and ammonia levels in the pond or artificial ponds. Increasing ammonia and pH levels can be a poison for fish. Ammonia levels that are too high can cause fish to be unable to extract energy from feed efficiently so that it may cause death. This death will certainly harm fish farmers. Management of water quality during the maintenance process is absolutely necessary. Some water quality parameters that are often measured and affect the growth of shrimp and fish are dissolved oxygen (DO), temperature, pH, salinity, ammonia, and alkalinity. In this study a control system and monitoring are designed to maintain the pH and ammonia levels contained in a mini plane. One device that uses remote control technology with an ARM-based embedded system (Advanced RISC Machine) is the Raspberry. Raspberry is a mini computer that can work like a personal computer or Single Board Computer (SBC).To begin the research, information about the effects of ammonia on the fish cultivation and/or aquarium is required. The reference source obtained said that the increase in ammonia caused by overfishing of fish could increase ammonia levels in the waters. The concentration of ammonia itself must be maintained so that the value remains below 0.2mg/l. Besides the increase in temperature and changes in pH also affect the increase in ammonia levels.

2. EXISTING SYSTEM

One of parameters that must be maintained is ammonia levels. Ammonia levels which are left high will be harmful to the health of fish. In this study, a control and monitoring system on ammonia level for fish cultivation has been designed that are also useful for measuring the quality of water in an aquarium. Measurements conducted on this study have two main variables, namely pH and ammonia levels. Two sensors namely pH sensor and MQ-135 gas sensor are used equipped with Arduino microcontroller as a controller and data acquisition. RaspberryPi 3B as Single Board Computer is utilized as processor and serves as Internet of Things (IoT). In the system, the pH is kept neutral (6.5 - 7.5). When the value exceeds the limit, automatic control will channel the liquid acetic acid (CH_3COOH) to the aquarium to balance pH level. The results of the tests show that the system can perform controls automatically and manually.

3. PROPOSED SYSTEM

Many people feed the pet fish in the aquarium tanks that need to be properly set up and maintained, or the fish will be destined to an unpleasant and short life. Therefore, it is critical to monitor water conditions closely and improve the water quality for the mini aquarium tanks. By the smart solution, this paper proposes the Fish Talk system that utilizes the aquarium sensors to drive the actuators in real time. We describe the relationship between the aquarium sensors and the actuators and give concrete examples about the threshold settingThe monitoring of temperature, Ph value of water, ammonia, TDS value water will be measured. The temperature will be maintained in particular range by using heater for aquarium. The TDS also maintained by using water filter for aquarium. Both will be maintained automatically. The process will also give alert to the user if the values exceed limits

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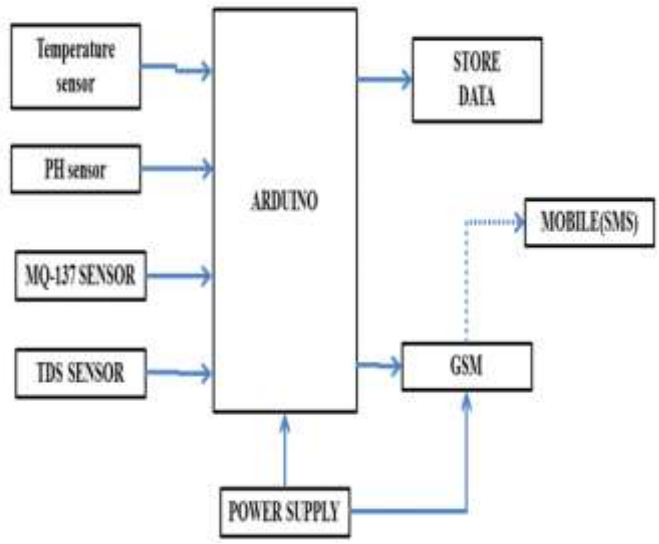
Flow Diagram



4. MODULES DESCRIPTION

4.1 pH SENSOR

4.2 Temperature SENSOR

4.3 MQ-137 SENSOR

4.4 TDS sensor

4.5 GSM

4.1 PH SENSOR

Any solution is like a small battery. It can generate voltage depending on Hydrogen ion (H+) concentration. Acidic solution has more Hydrogen ion concentration than alkaline solution. pH probes measure pH by measuring the voltage or potential difference of the solution in which it is dipped. By measuring potential difference, hydrogen ion concentration can be calculated using the Nernst equation which gives the relationship between Hydrogen ion concentration and Voltage or Potential. Hence, a pH probe measures the potential difference generated by the solution by measuring the difference in hydrogen ion concentration using the Nernst equation and displays the pH as output.

$$E_{cell} = E^{\circ} - \frac{RT}{nF}\ln(K_{eq})$$

The pH (always written little p, big H) of a substance is an indication of how many hydrogen ions it forms in a certain volume of water. There's no absolute agreement on what "pH" actually stands for, but most people define it as something like "power of hydrogen" or "potential of hydrogen." Now this is where it gets confusing for those of you who don't like math. The proper definition of pH is that it's minus the logarithm of the hydrogen ion activity in a solution (or, if you prefer, the logarithm of the reciprocal of the hydrogen ion activity in a solution). It's simpler than it sounds. Let's unpick it a bit at a time. Suppose you have some liquid sloshing about in your aquarium and you want to know if it's safe for those angelfish you want to keep. You get your pH meter and stick it into the "water" (which in reality is a mixture of water with other things dissolved in it). If the water is very acidic, there will be lots of active hydrogen ions and hardly any hydroxide ions. If the water is very alkaline, the opposite will be true. Now if you have a thimble-full of the water and it has a pH of 1 (it's unbelievably, instantly, fish-killingly acidic), there will be one million times (10 to the power of 6, written 106) more hydrogen ions than there would be if the water were neutral (neither acidic nor alkaline), with a pH of 7. That's because a pH of 1 means 101 (which is just 10), and a pH of 7 means 107 (10 million), so dividing the two gives us 106 (one million). There will be 10 million million (1013) more hydrogen ions than if the water were extremely alkaline, with a pH of 14.

4.2 TEMPERATURE

DHT 11 is used to Temperature sensor is a device, to measure the temperature through an electrical signal it requires a thermocouple or RTD (Resistance Temperature Detectors). The thermocouple is prepared by two dissimilar metals which generate the electrical voltage indirectly proportional to change the temperature. The RTD is a VARIABLE RESISTENCE , it will change the electrical resistance indirectly proportional to changes in the temperature in a precise, and nearly linear The working base of the sensors is the voltage that read across the diode. If the voltage increases, then the temperature rises and there is a voltage drop between the transistor terminals of base & emitter, they are recorded by the sensors. If the difference in voltage is amplified, the analogue signal is generated by the device and it is directly proportional to the temperature.measure temperature

4.3 MQ-137 SENSOR

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW.It can also detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm.

4.4 TDS SENSOR

PPM is calculated from the EC of a fluid, EC is the inverse of the electrical resistance of the fluid. We are estimating the EC or PPM of a fluid by measuring the resistance between two probes [The plug pins] when the plug is submerged in the liquid of interest. Ec measurement needs to be done using AC or the liquid of interest is polarised and will give bad readings. This has got to be a great example of asking why instead of just accepting a statement as fact, it turns out we can take a very fast DC reading without suffering polarisation. Temperature Compensation: Temperature has an effect on the conductivity of fluids so it is essential that we compensate for this.

CALCULATION

EC = EC25*(1 + a (T - 25))

R=(1000/(EC*K)) +Ra

Min temp=0 [we arnt going to care about EC if the pond is frozen]

Max Temp = 40 *C [I doubt a pond should be above this]

Minimum EC 25=0.3 EC= 0.3*(1+0.019*(0-25) Min EC= 0.16 S/sm

Maximum EC 25= 3 EC= 0.3*(1+0.019*(40-25) Max EC = 3.9 S/cm

Min Resistance = 1000/(MaxEC*K)+25 = 1000(3.9*2.88) =114 ohms

Max Resitance = 1000/(MinEC*K)+25 = 1000/(0.16*2.88) = 2195 ohms

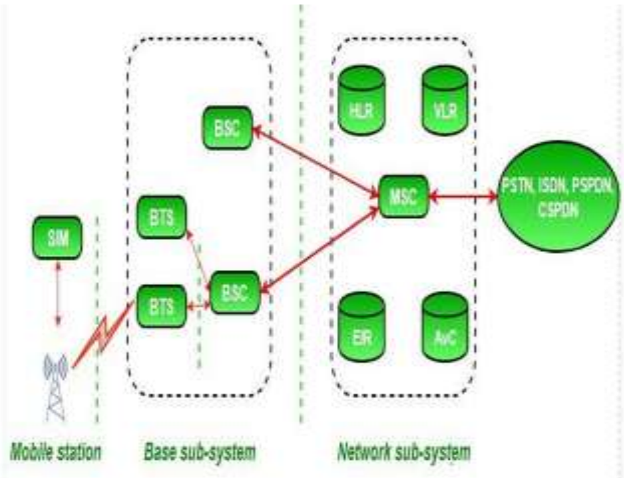
R1

Now we have enough information to calculate a good value for R1 to get the best resolution over our intended measuring range. We could sum it all up mathematically and differentiate to find the peak, but that hurts my head so I just did a quick excel spreadsheet for the Voltage divider for the EC I expect to see:

R1 ohm	V-Drop @114 ohm	V-Drop @ 2195 ohm	Vout Range
300	1.30	4.36	3.06
400	1.06	4.19	3.13
450	0.97	4.11	3.14
500	0.89	4.03	3.14
550	0.83	3.96	3.13
600	0.77	3.89	3.12
650	0.72	3.82	3.10
700	0.68	3.76	3.08
750	0.64	3.70	3.05
800	0.61	3.63	3.03
850	0.58	3.57	3.00
900	0.55	3.52	2.97
950	0.52	3.46	2.94
1000	0.50	3.41	2.91

4.5 GSM MODULE

GSM stands for Global System for Mobile communication. Today, GSM is used by more than 800 million end users spread across 190 countries which represents around 70 percent of today's digital wireless market. So, let's see how it works.In GSM, geographical area is divided into hexagonal cells whose side depends upon power of transmitter and load on transmitter (number of end user). At the center of cell, there is a base station consisting of a transceiver (combination of transmitter and receiver) and an antenna.GSM is combination of TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access) and Frequency hopping.



Working:

GSM is combination of TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access) and Frequency hopping. Initially, GSM use two frequency bands of 25 MHz width: 890 to 915 MHz frequency band for up-link and 935 to 960 MHz frequency for down-link. Later on, two 75 MHz band were added. 1710 to 1785

MHz for up-link and 1805 to 1880 MHz for down-link. Up-link is the link from ground station to a satellite and down-link is the link from a satellite down to one or more ground stations or receivers. GSM divides the 25 MHz band into 124 channels each having 200 KHz width and remaining 200 KHz is left unused as a guard band to avoid interference.

5. CONCLUSION

We showed how to intelligently monitor and maintaining the fish through a automate mechanism such that the ammonia, pH level, temperature, and TDS. Our solution allows the designer to quickly deploy intelligent control for various water conditions. We have developed model to daily monitoring experiments to investigate the effects of daily changes in aquarium and loss on the water condition. Though we are able to achieve all the goals but still we think that lots of advancement can be done for this project. It is mainly helpful in hobby in fish keeping. Our project is the combination of aqua phonics and IoT technology.

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