ARDUINO MICROCONTROLLER BASED AUTOMATED FEEDING AND EBB-FLOW WITH RADIAL FLOW FILTER AQUAPONICS SYSTEM FOR *OREOCHROMIS NILOTICUS* AND *IPOMOEA AQUATICA*

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ABSTRACT: *Aquaponics is a bio-integrated system that deals with aquaculture and hydroponic fruits or vegetables. It is a soil-less system for crop production, to raise edible plants and fish. In aquaponics, nutrient-rich effluent from fish tanks which is used for fertigation of the hydroponic production beds. The goal of the system is to design an aquaponics system that can function autonomously and compare it on existing models that works manually. The system being designed will be able to grow for at least 54 Kangkong seeds and 35 Kangkong stalks and the water tank can be filled for at least 80 pieces of fishes (Tilapia). The elimination of maintenance and manpower gives the system an edge and more advantageous. The system will compose of a microcontroller, sensors, water pumps and valves. This will monitor key variables, such as pH levels, temperature, ammonia levels, and water quality. The study would also provide a user-friendly navigation control for the feeding system.*

Keywords: aquaponics, automation, aquaculture, ammonia, pH level, water quality, feeding system

I. INTRODUCTION

As the population of the world continues to increase, so does the demand for clean water and high yield farmland. These resources are unfortunately finite, and in especially high demand in cities and underdeveloped areas. As time progresses, both individuals and companies will be looking for more efficient ways to produce food for human consumption that conserve space and water [1] but maintains its nutrient contents.

As reflected in the records of the Philippine Statistics Authority [2], the agriculture industry in the Philippines grew by 6.18 percent in the second quarter of 2017. Wherein, the crops and poultry subsectors recorded an output increase of 11.72 percent and 8.36 percent, respectively. However, livestock production went down by 1.38 percent while the fisheries subsector posted a 2.93 percent cut in production. With the current prices of the commodities, agriculture grossed amounting to P422.36 billion or 11.41 percent higher than the previous year's record. Moreover, during the first half of 2017, the gross output in agriculture expanded by 5.71 percent. With the above information, the proponents believed that there is a need to introduce a system that will not only help increase the production growth of fisheries sector but maintains the quality as well.

As cited by Love, Uhl and Genello [3], aquaponics is the integration of agriculture and hydroponics, a soil-less system for crop production, to raise edible plants and fish. In aquaponics, nutrient-rich effluent from fish tanks which is used for fertigation of the hydroponic production beds. This is good for the fish because plants utilize some of the nutrients and in the process filter the water in the system. These nutrients, generated from fish manure, algae, and decomposing fish feed, which are contaminants that would otherwise build up to toxic levels in the fish tanks, but instead serve as liquid fertilizer to hydroponically grown plants [4].

Electronically monitored aquaponics offers the ability to produce fish and vegetative growth for human consumption in a highly efficient, sustainable ecosystem, thus contributes to the solutions of some environmental problems. Organically filtered water leads to healthy fish and, as long as high-quality fish food and lighting systems are used, fast growing and high-quality produce will be produced [1].

Aquaponics systems in the Philippines are used to culture fishes like tilapia or any other local fish and to grow vegetables such as cabbage and lettuce. This system will help in the generation of more fish and vegetables production.

II. REFERENCES, CITATIONS, FIGURES AND TABLES

References and Citations

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[4] Diver (2010)

The proponent came up with this design. It is a common type of Aquaponics container, which is an IBC (Intermediate Bulk Container) container.

Oreochromis Niloticus and *Ipomoea Aquatica* were seen at a glance. As soon as the system starts, the microcontroller sends signal to the LCD (Liquid Crystal Display) and the relay module. The LCD part will display the next feeding time for the fish, the pH level and the

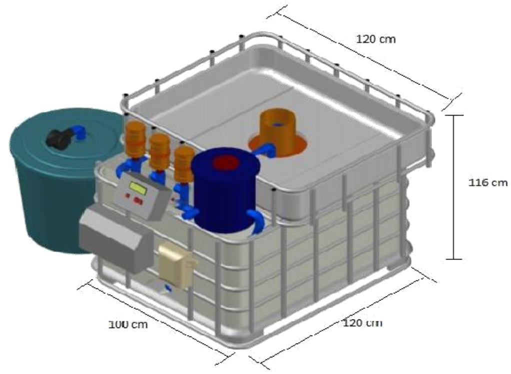

Figure 1. Initial design of the project

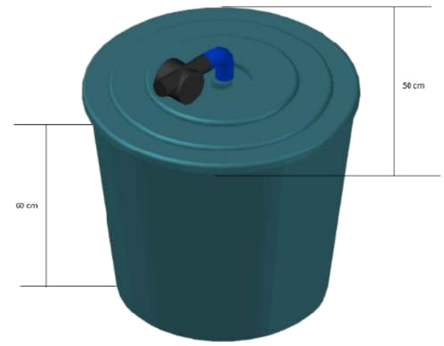

Figure 3. Placement of the sensors inside the system reserve container for refill

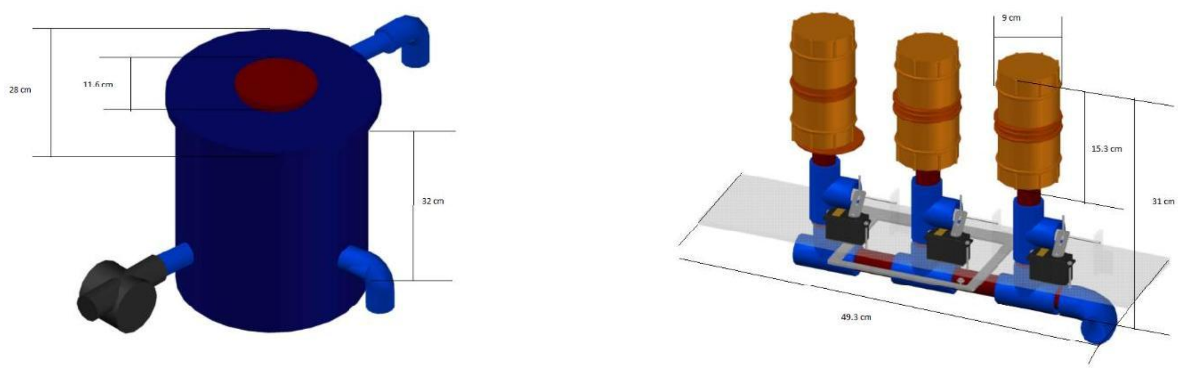

***Figure 2.* Placement of the sensors inside the system radial flow filter**

water temperature. The relay module part will trigger the water pump, the feeding fan and the two solenoid valve. As soon as the system detects hazardous amount of ammonia, it will trigger one solenoid valve to drain water from the container.

The system includes a water flow sensor to measure the amount of water to be drained and a water pump that will be triggered to refill the container after draining. Another water flow sensor was installed in the reserve container to refill the required amount of water in the tank through water pump. Then, the relay module will trigger another solenoid valve to refill the reserve container. Sensors are placed in different parts of the system. The pH meter and the water temperature sensors are placed directly inside the container for accurate water pH and temperature measurement. Two separate water flow sensors were placed in the system: One was placed in the radial flow filter to directly drain the dirt out of the system; and the other water flow sensor was placed after the water pump to measure the water to be refilled to the

container. The automatic feeding system is placed directly above the container and beside the radial flow filter. It is composed of PVC (Polyvinyl Chloride) pipes, PVC containers, servo motors and fan. Once the RTC (Real-Time Clock) module triggered the microcontroller, the servo motors will also be triggered and will feed the fish with the specific amount of feeds.

Figure 13. Placement of the sensors inside the system (a) radial flow filter (b) reserve container for refill

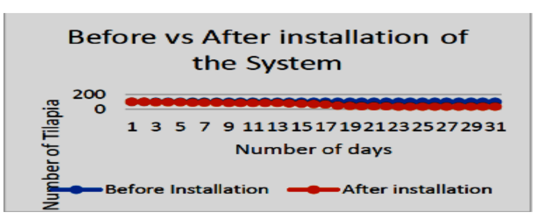

Figure 4. Design of the Automatic feeding system

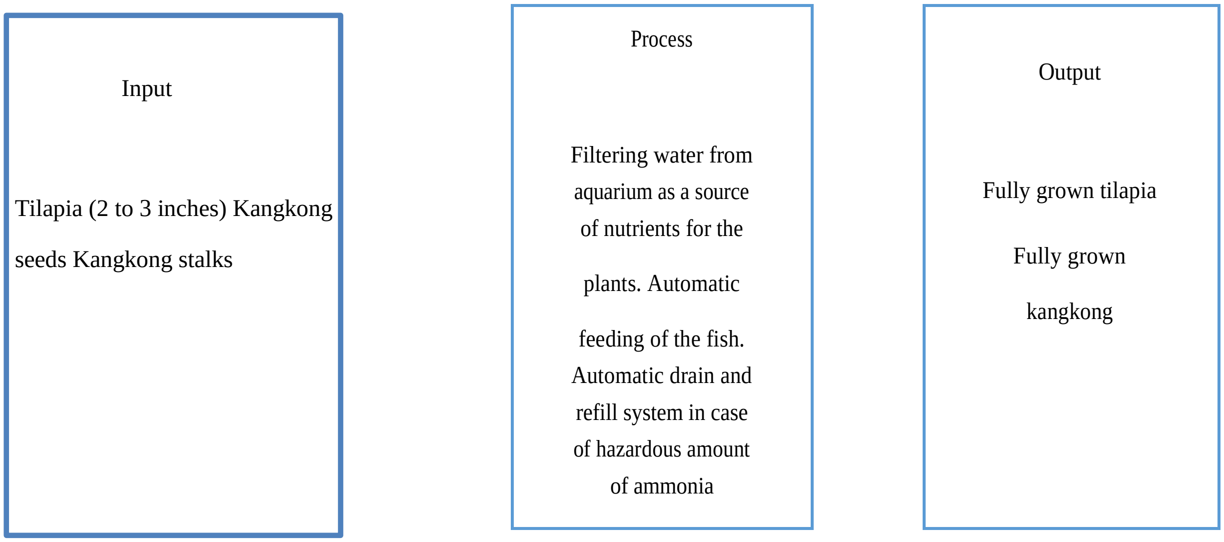

Figure 5. Conceptual Framework

III. MATH

To interpret the data effectively, the proponents will employ Pearson Product Moment of Correlation Coefficient, T-test, and Analysis of Variance (ANOVA). These will help the proponents to identify the effect of the independent variable to the dependent variable which is the temperature and the two parameters respectively.

Pearson Product Moment of Correlation Coefficient

The Pearson product-moment correlation coefficient (or Pearson correlation coefficient, for short) is a measure of the strength of a linear association between two variables and is denoted by r.

T-Test

$$r = \frac{\sum xy - \frac{\sum x \sum y}{N}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{N}\right)}\sqrt{\left(\sum y^2 - \frac{(\sum y)^2}{N}\right)}} \qquad (1)$$

T test is used to compare two different set of values. It is generally performed on a small set of data.

T test is generally applied to normal distribution which has a small set of values. This test compares the mean of two samples. T test uses means and standard deviations of two samples to make a comparison. The formula for T test is given below:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}} \qquad (2)$$

IV.

IV. RECOMMENDATIONS

The system is powered by AC. Therefore, the system will break once power interruption occurs. Various UPS techniques can be implied in this system. Installing a solar panel and battery to power up the system can be considered. Adjusting the size of the feeding container can decrease\ the maintenance of the feeding system. Three-stage filters can be used to further filter the water going back to the tank. Improvement of the feeding system can also be taken in consideration. Robotic arms can be built to feed the Kangkong to the Tilapia. This means less maintenance to the system.

V. CONCLUSION

Comparison between traditional aquaponics and the system were taken in consideration. Both cultured Nile Tilapia and planted Kangkong in their system. In the span of 4 months, traditional aquaponics accumulates an Average Body Weight (ABW) of 7.14 grams per fish, but the system planted Kangkong in traditional aquaponics decayed, a mortality rate of 100%. Instead of feeds, the Nile Tilapia in the traditional system were given green leafy vegetables such as Kangkong as their food. The automatic system's Kangkong, produced a mortality rate of 5.55% percent to the seeds and 0% to the stalks. Both systems pH were stabilized.

VI. REFERENCES

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