THE INVESTIGATION OF MICROCONTROLLER BASED AQUAPONICS CONTROL SYSTEMS

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For my supervisor, family and friends

ABSTRACT

The aim of this project is to design an aquaponics system that can be monitor and control automatically. Aquaponics system is implemented with sensors and Internet of Things (IoT) that help user to save their time and worry on the stabilisation of the system. This system is developed by using Node MCU as microcontroller to interact with sensors, software and application. Node MCU have ESP 8266 chips that give user easily to connect it with Internet. User also get a real time monitoring system and automatically control of the project. This system is built by one big blue plastic drum as fish tank at the bottom and vases for plant at top. It also has water pump to circulate the water. Furthermore, three sensors are used which is pH sensor, soil moisture sensor and fluid level sensor. Moreover, auto feeding system is built to give food on time. Then, this system is combined with Thingspeak software and Virtuino application to give live viewing data for user. So, this system can increase the food production and this system been auto control by the aid of Node MCU and sensors. Thus, user get benefit to saving their time from manage their production every day. They also can save their energy and worry because of auto control system has been implemented.

ABSTRAK

Tujuan projek ini adalah untuk mereka bentuk sistem akuakultur yang boleh memantau dan mengawal secara automatik. Sistem akuakultur dilaksanakan dengan sensor dan Internet Perkara (IoT) yang membantu pengguna untuk menjimatkan masa dan bimbang terhadap penstabilan sistem. Sistem ini direka dengan menggunakan Node MCU sebagai mikrokontroler untuk berinteraksi dengan sensor, perisian dan aplikasi. Node MCU mempunyai cip ESP 8266 yang memberi pengguna kemudahan untuk menghubungkannya dengan Internet. Pengguna juga mendapat sistem pengawasan masa nyata dan mengawal projek secara automatik. Sistem ini dibina oleh satu bekas plastik biru besar sebagai tangki ikan di bahagian bawah dan pasu untuk tumbuhan di atas. Ia juga mempunyai pam air untuk mengedarkan air. Selain itu, tiga sensor digunakan iaitu sensor pH, sensor kelembapan tanah dan sensor tahap cecair. Lebih-lebih lagi, sistem pemakanan automatik dibina untuk memberi makanan tepat pada waktunya. Kemudian, sistem ini digabungkan dengan perisian Thingspeak dan aplikasi Virtuino untuk memberikan data tontonan secara langsung kepada pengguna. Oleh itu, sistem ini dapat meningkatkan penghasilan makanan dan sistem ini telah dikendalikan oleh bantuan oleh Node MCU dan sensor. Oleh itu, pengguna mendapat manfaat untuk menjimatkan masa mereka daripada menguruskan pengeluaran mereka

setiap hari. Mereka juga boleh menjimatkan tenaga dan kebimbangan kerana sistem kawalan automatik telah dilaksanakan

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LIST OF SYMBOLS AND ABBREVIATIONS

WIFI	:	Wireless Fidelity
USB	:	Universal Serial Bus
pH	:	Potential of Hydrogen
IoT	:	Internet of Things
LCD	:	Liquid-Crystal Display
Rx	:	Receiver
Tx	:	Transceiver

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CHAPTER 1

INTRODUCTION

This chapter will give overview of the whole project that related with Internet of Things (IoT). Overall of this project can be controlled and monitored with internet and android system. This integration is beneficially for future plantation and aquaculture.

Aquaponics is a system that combining aquaculture and plant development. Both crops are joining in a recycling system that uses less water than the conventional cultivating. Nutrients contained in fish tanks are reused into plant biomass with the existence of nitrifying bacteria that change over the ammonia to nitrite and after that to nitrate. In this investigation, one set of aquaponics system were produced to study the development of Tilapia fish and a few kinds of plants. The mix of aquaculture and hydroponic gives another idea into increasing the effectiveness of food production which regards standards of sustainable cultivation.

This system will be controlled by microcontroller to keep the pH stable and give food on time. Data will be update in live monitoring, thus it will become advantages and innovation of farming.

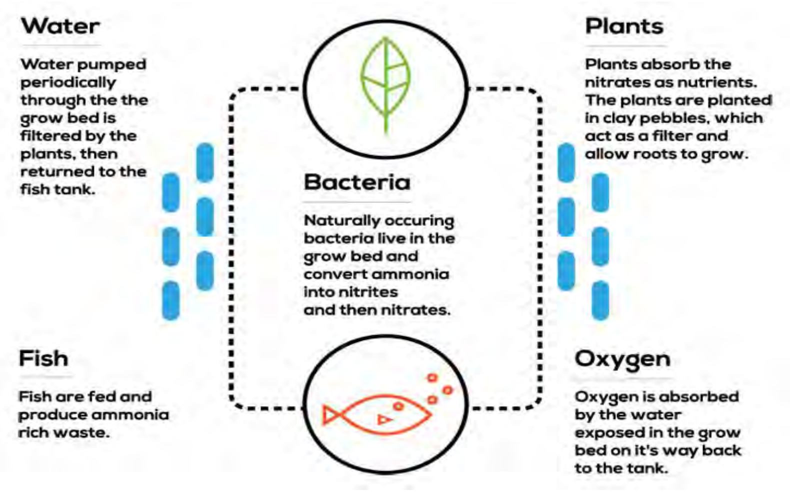

Figure 1.1 Function of The Circulation of Water

From Figure 1.1, it shows that fish and plant are depends on each other. That how the aquaponic is better from others. Fish waste will become fertilizer for plant in form of nitrate that have been converted by bacteria that live in the grow bed. The nitrate become as nutrient for the plant and the water will be filter naturally by the plant. So, the water is clean and will returned to the fish tank and contains oxygen.

1.1 AQUAPONICS

The nutrients are physically provided either made by cultivators or produced using market accessible nutrient solutions. Be that as it may, in aquaponics the water is provided from an aquaculture tank or cellar. This water is rich in water and after separating has impressive sustenance for hydroponic culture. The plants are developed in unique develop beds dodging the utilization of soil. Residential models for home and indoor culture is additionally accessible with the assistance of an aquarium a current hydroponic system. The system is a self-feasible model. The water from aquaculture is not wasted through this consolidation and in the meantime free nutrient rich water can be gotten for hydroponics too.

Focal Points of Aquaponics:

- 90% less water is required for the natural plant culture alluding to ordinary cultivating.
- Extremely productive in water reusing perspective.
- Self-reasonable model to an extent as the two areas feed each other.
- Indoor strategy is conceivable in consolidation with a traditional aquarium. Less space required as the plants grow over the arrangements of aquariums.
- Fish nourishment yield and self-sustained quickly developing vegetables for home needs.

Effects in Natural Culture:

- People are pulled in toward the indoor strategy because of its aesthetics.
- Automation is conceivable, and less water is required.
- Great and guaranteed natural yield.

1.2 BACKGROUND

From journal [1] it described aquaponic is a system that commonly combine aquaculture and plant development (by methods for hydroponic). Both crops are joined in a recycling system that uses less water than the conventional cultivating. Nutrients contained in fish tanks are reused into plant biomass with the existence of nitrifying microbes that change over the excreted ammonia to nitrite and after that to nitrate. In this section, fifteen arrangements of aquaponic system were created to study the growth of African catfish (Clarias gariepinus) and three sorts of plants, the red and green-red amaranth (Amaranthus spp.) and water spinach (Ipomoea aquatica). The combination of aquaculture and hydroponic gives another knowledge into expanding the proficiency of sustenance creation which regards standards of maintainable horticulture.

Journal [2] focuses on economic analysis. Traditional treatment choices for phosphorus in wastewater, regardless of whether they utilize synthetic precipitation, physical evacuation, or land application innovations, speak to a critical extra cost to the proprietor of an aquaculture task. Plant-based removal of nutrients can possibly create extra incomes, which can counterbalance treatment costs. The goal of this investigation was to portray the economic connection between a 22,680 kg for each year recycling rainbow trout (Oncorhynchus mykiss Walbaum) production system and a hydroponic treatment unit, developing 'Ostinata' lettuce (Lactuca sativa L.) and sweet basil (Ocimum basilicum L.), fit for decreasing phosphorus concentration levels in the fish cultivate profluent to under 0.1 mg/L. The combination of the fish and plant production system (aquaponics) produces financial cost savings over either system alone. Shared cost investment savings originate from spreading out working expenses (e.g., management, water, nutrients, and overhead charges) and capital expenses (e.g., backup generator, used truck, and office hardware) over the two systems. The speculation examination shows the productivity of this consolidated system over its 20-year expected life. Net present qualities are certain for an extensive variety of rebate rates. Interior rate of return examination demonstrates that for an aggregate speculation of $244, 720 this system can possibly give a return of 12.5%. The hydroponic system drives the potential benefit of the combined system with 67% of yearly returns got from plant production.

Meanwhile in journal [3] describes about innovative farming. The further design choice is normal extensively enhance water quality, along these lines emphatically influencing fish growth and production. Food security represents an undeniable and genuine danger on the world today. What makes aquaponic food production so appealing is its potential to address these issues of asset preservation and access to a dependable and quality food source. Likewise, the straightforwardness of an aquaponic system makes it attainable and easy to use so it can possibly help families who are most needing it.

Journal [4] described aquaponic for developing countries. Aquaponics process gives huge advantages in prior and faster plant yield production from cold atmosphere green-houses, to catch more beneficial local markets. This kind of farming may mean a ventured-up speculation; however it is one that makes another income stream (from fish) connected with more gainful plant production. That implies more prominent monetary strength for a business and expanding dollar comes back to investors can be an effective power force far rapid change.

Lastly, journal [5] discussed about vegetable production from aquaponic system using tilapia with and without freshwater prawn. Two recirculating aquaponics systems were introduced in a controlled environment greenhouse to investigate about the growth and yield of lettuce (Lactuca sativa), Chinese cabbage (Brassica rapa pekinensis) and pac choi (Brassica rapa) utilizing Nile tilapia (Oreochromis niloticus) culture with and without freshwater prawn (Macrobrachium rosenbergii). Culture water was lifted by a 40 W submersible pump from a 220 L bio-filtration tank to a 250 L fish tank and permitted to flow by gravity to a 2.44 × 4.88 m raceway in a closed loop. Water was kept up at 20 cm depth permitting rafts to float. Hydroponically sprouted seedlings in rockwool squares were planted on the rafts at 15 cm dispersing 30 days subsequent to stocking 22 kg of blended sex Nile tilapia in the fish tanks while 295 prawns were included one of the raceways. Ecological conditions were kept up and water quality parameters were observed in a tradeoff between the ideal necessities of fish, prawn and vegetables including the gainful microorganisms all through the 108-day culture period. Two set of data for the three vegetables and one for tilapia and prawn were assembled after the 35 day growing periods of vegetables. Results demonstrated that normal dissolved oxygen of 5.6 ppm at 98% immersion and 21°C temperature, and a pH of 7.1–7.7 were set up by the systems that gave a good environment to tilapia, prawn and nitrifying microscopic organisms. But, the pH was disadvantageous to vegetables. With a low concentration of total dissolved solids of under 330 ppm which was far underneath the requirement, the high pH hindered the ordinary growth of the vegetables bringing about chlorotic and necrotic leaves. Results additionally uncovered that the vegetables showed significantly better growth in the system with prawns. Among the three vegetables, pac choi had the most outstanding growth, yield, and productivity took after by Chinese cabbage and lettuce. It was resolved that incorporating prawn culture balanced out and expand the system which