
## Faculty of Electrical and Electronic Engineering Technology

# DEVELOPMENT OF AQUAPONIC SYSTEM WITH IOT



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**Bachelor of Electronics Engineering Technology with Honours**

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# DEVELOPMENT OF AQUAPONIC SYSTEM WITH IOT

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**A project report submitted**
**in partial fulfillment of the requirements for the degree of**
**Bachelor of Electronics Engineering Technology with Honours**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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Sesi Pengajian : 2021/2022

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**DEDICATION**

*To my beloved parents especially my mother, Suhaila Binti Mansor, and my father, Zabidi Bin Awang, that give their full support during my trip to complete this project in mostly term of encouragement and moral until complete my project,*

*and*

*To my dearest siblings and my friend that also helps by moral support in term of giving some ideas and opinions to fulfil the requirement to complete this project. Praise to TheGreater who a create the world, Allah S.W.T that I get supportive family and friend thatvery understand and always give me some idea that might help for this project. Thankful for all advised I am blessed.*

## ABSTRACT

In this era of globalization, the aquaponics system is a method of food production by combines aquaculture with traditional hydroponics in a relationship of symbiotic which facilitates to sustainable system with the necessary inputs because all water and nutrients in it are recirculated to increase land plants and aquatic life. This farming technique may take over other traditional methods if used efficiently. And when traditional Aquaponics meets technology, extraordinary results can be seen. An IoT-based Aquaponic Monitoring System has been carried out for monitoring pH values, level of temperature and level of humidity, water level are using certain sensors and after seeing these values from the sensors, these values are displayed via Liquid Crystal Display (LCD) and similar on the website with the application. Internet of Things. A new technology, Internet of Things has been introduced which bridges the gap between the world of being and the digital world and it starts with things. To connect sensors to the internet, database servers and application servers can be managed so that they can show data overwriting sensors. In order to bring technology to the traditional aquaponics system, the BLNYK APP microcomputer and the Internet of Things have been tried in the system.

## *ABSTRAK*

Dalam era globalisasi ini, sistem akuaponik adalah kaedah penghasilan makanan yang menggabungkan akuakultur dengan hidroponik tradisional dalam hubungan simbiotik yang memfasilitasi kepada sistem yang lestari dengan input yang diperlukan kerana semua air dan nutrien di dalamnya dikitar semula untuk meningkatkan tanaman tanah dan kehidupan akuatik . Cara penternakan ini boleh mengubah kaedah tradisional lama yang digunakan dengan lebih cekap. Dan ketika Aquaponics tradisional memenuhi teknologi, hasil yang luar biasa dapat dilihat. Sistem Pemantauan Aquaponic berasaskan IoT telah dilakukan untuk memantau nilai pH, tahap suhu dan kelembapan, paras air menggunakan sensor tertentu dan setelah melihat nilai ini dari sensor, nilai-nilai ini dipaparkan melalui Liquid Crystal Display (LCD) dan serupa pada laman web dengan aplikasi. Internet Perkara. Teknologi baru, Internet of Things telah diperkenalkan yang merapatkan jurang antara dunia makhluk dengan dunia digital dan bermula dengan perkara-perkara. Untuk menyambungkan sensor ke internet, pelayan pangkalan data dan pelayan aplikasi dapat dikendalikan sehingga mereka dapat menunjukkan sensor penimpaan data. Untuk membawa teknologi ke sistem akuaponik tradisional, komputer mikro BLNYK APP dan Internet of Things telah dicuba dalam sistem ini.

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| | | |
|---|---|---|
| % | - | Percentage |
| $^{o}$C | - | Degree Celcius |
| I/O | - | Input and Output |

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| $V$ | - | Voltage |
| Iot | - | Internet of Things |
| A | - | Ampere |
| Gnd | - | Ground |
| GMS | - | Global Message Service |
| Cm | - | Centimeter |
| Kg | - | Kilograms |
| Mm | - | Milimeter |

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Recently, a unique way of farming has emerged, combining fisheries and agriculture to create a stable ecosystem cycle, namely Aquaponics. Applying the aquaponic cultivation method itself is still relatively new because the rapid population growth causes the lack of land for cultivating these two types of cultivation. The aquaponics system is a food production process that combines traditional hydroponics with aquaculture in a symbiotic relationship that facilitates a long-term system with the necessary inputs because all the water and nutrients in it are recirculated to promote land plant and aquatic life. This farming method may replace existing traditional practices if used efficiently. And when traditional Aquaponics meets technology, extraordinary results can appear.

This project aims to develop the aquaponic system with Arduino's IoT monitoring system. Generally, an aquaponic system that measures and displays parameters like pH level, water level, humidity, temperature, etc., continuously to the user or farmer. Sensors are the hardware components used to acquire information to and from the Internet of Things (IoT). With the application of the Internet of Things (IoT) in Aquaponics systems, it can bring remarkable changes in aquaponic by simply monitoring and maintaining the system parameters for the effective growth of the plants. The use of Wi-Fi of ESP8266 ESP-01Serial wireless WIFI helped to connect the system to read the values of system parameters like pH of water value, the water level in aquarium, temperature and humidity of soil. With the application of the Internet of Things in the Aquaponics Monitoring

system, the data from the sensor can display the values of the system parameters and information continuously on a smartphone.

## 1.2 Problem Statement

Aquarium care and gardening are fun beneficial activities that help relieve stress but aquarium members face some problems to maintain a healthy fish life in the aquarium and also gardeners face some problems to maintain healthy plants.

Changing the aquarium water can be a difficult task because we know it requires a lot of work as much as the gardening need to water the plants as a working person it quite difficult to do. also feeding fish is a messy task for fish keepers during their absence or at any time they vacation.

A combination of these two issue can solve by the system it call aquaponic system. But this old system has face same problems which it still need a person to handle the system by manually and also it quite difficult task to do.

In addition, water temperature and salinity are necessary checked periodically for healthy fish life. Fish suspended particles are necessary removed if it exceeds the limit then the water needs to be changed if it exists in that condition high turbidity.

The system inspired by aquaponics and with little adjustment needs to be developed to control, monitor and feed the fish continuously as well as water the plants all by smartphone.

## 1.3 Project Objective

Specifically, the objectives are as follows:

a) To design an aquaponic system using Arduino as microcontroller.

b) To develop aquaponic system that allow user to control and monitor by smartphone.

c) To evaluate aquaponic system that a smartphone can monitor and control.

## 1.4 Scope of Project

The purpose of this project is to control and monitor for aquaponics system with smartphone by using internet. This aquaponics system project is based on Internet of Things (IoT) application that promotes the control and monitoring of aquaponics appliances using the internet. This system uses three loads to demonstrate as water pump, feeding fish and level water tank. IoT is the combination of electronic devices connected with sensors, actuators, software's and a Wi-Fi that allow these objects to exchange information. The project of scope is using Arduino Uno microcontroller work as a brain to control all of activity the components used for this project. Additionally, WIFI module was used for wireless connection between the microcontroller and smartphone developed using the Blynk App. The mobile application based on Blynk App will be developed to control electrical appliance for aquaponics and to monitor water tank level at tank by using smartphone. Aquaponics system has two water pumps for changing water in aquarium or tank, timer for feeding fish and soil moisture sensor by control using smartphone.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

In this chapter, the researcher will survey all research about the previous project work that related to project and express and clarify on objective of the project, problem statement of the project and the innovation that have done towards the projects. Other than that, there also will be content of researcher own such as history about system of project and the search databases that can be used for the literature review such as ScienceDirect, Google Scholar and Web searches. “Aquaponics system”, “Iot Technologies”, “Smart aquaponics system”, and “IoT based Aquaponics Monitoring System” are some of search phrases word. In addition, this study is limited to research papers starting in 2013 to 2020 (8 years) only and is also limited to English language only for research papers.



## 2.2 History of Aquaponics

The history of aquaponics dates back to Asia and South America. It is known that this system dates back to the ancient Aztec civilization that lived in South America. At that time they had the idea to make an island out of mud that was drained by canal water where fish lived. The water and nutrients in the canal water are used to irrigate the plants grown on the artificial island. Not only in South America, the ancient Chinese people were accustomed to simple aquaponic systems although at that time the term had not been

invented. They raise ducks on the fish pond and the water of the fish pond will then be used to irrigate the rice fields and vegetable gardens that they plant.

From this simple aquaponic system, researchers in the field of agriculture and science began to research about this planting system. Some of the studies recorded include the following:

In 1969, American scientists John Todd and Nancy founded an institute that later initiated the development of a planting system called the Ark system. The institute that they established, Alchemy institute, further continues to conduct research on fish and vegetable cultivation, especially those that require energy or a continuous supply of electricity. They also built an electrical panel system that used lighting and the needs of fish and plant farming.

In 1971 a researcher from the University of the Virgin Islands discovered difficulties in growing vegetables and fish farming on an island called Semiarid in Australia and then he developed a study on the technique of growing both at once. This research is the basis of commercial aquaponics systems that are currently widely used by farmers who cultivate fish and vegetables. Although researchers' efforts in developing this system still encountered many obstacles, researchers found that the organic elements found in these farms are environmentally friendly and more energy efficient. Because of this, the aquaponic system is suitable to be called organic farming that uses green technology.

In 1980, a student from the University of North Carolina, Mark Mc Murtry and his teacher Professor Doug Sanders began construction of their aquaponic system known as the loop aquaponics system. They grow crops such as tomatoes and cucumbers and then cultivate fish in ponds. The water in the tank used to accommodate the fish is then used to irrigate the plants planted on the sand medium. This sand planting media acts as a filter media or

water bio filter which will then be returned to the fish tank. It is this principle of circulation that later became the basis of aquaponic agriculture today.

In the 1990s, two farmers, Paula Speraneo and her Missouri colleague Tom, managed to build a more effective aquaponic system that is used for household scale or small scale aquaponics today. They use planting media in the form of gravel and under the plants they plant, there is a tank containing tilapia whose water is drained to irrigate the plants.

## 2.3 Internet of Things (IoT)

The Internet of Things (IoT) refers to a technologies that allow various appliance, device, and things to exchange data or collecting data by using internet connection. It has an ability to transfer a data without requiring human to human or human to computer interaction. An ecosystem of an IoT will be consist web enable smart device that use embedded system such as sensor, processor, and hardware to collect information from the environment. In this 21st century IoT become the most important technology in all country around the world. This because the cost of sensor is low, the connectivity is simple and easy, have more availability of cloud services platform, and it has conversational AI technology which make human easy to collect data and process a data.



With that the internet of things (IoT) can minimize the human effort and save every minute of the day by performing a lot of task for us. This can cause this device can complete most of the work without human intervention. Figure 2.1 shows Internet of Things.

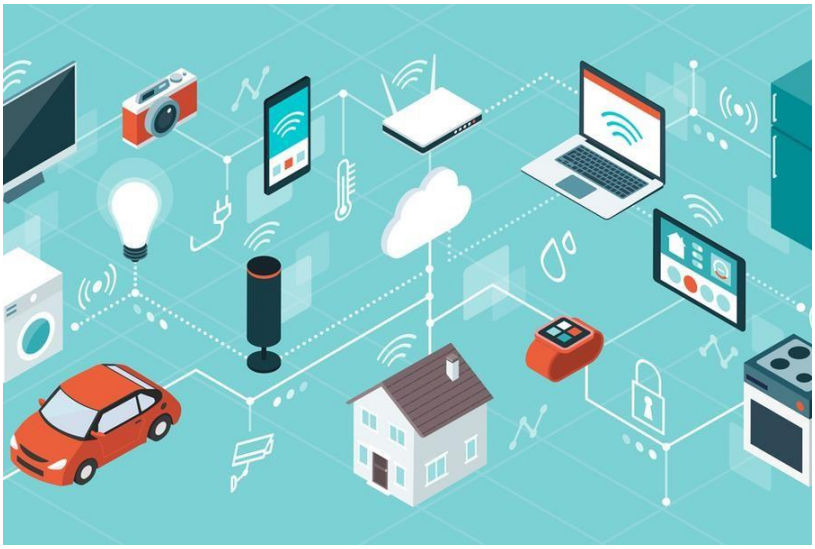

Figure 2.1Internet of Things

## 2.4 Previous aquaponics system with Iot

In this study, several theories and the results of previous research were used, which later became the basis of the work of this research.

### 2.4.1 Automated Indoor Aquaponic Cultivation Technique



This research was proposed by Saaid, Fadhil, Megat Ali, and Noor in 2013 entitled "Automated Indoor Aquaponic Cultivation Technique". This study discusses a system to maintain the growth and survival rate of fish and plants by monitoring the desired water level; the temperature monitored in the fish tank, the temperature monitored in the plant area and the desired amount of food. At the same time, Arduino functions as a brain used to receive information from sensors and provide a response as feedback [1].