Faculty of Electrical and Electronic Engineering Technology

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DEVELOPMENT OF IOT-BASED AUTOMATED HYDROPONIC SYSTEM USING NODEMCU

MUHAMMAD ZULHILMI BIN FAZLI

Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

2022

DEVELOPMENT OF IOT-BASED AUTOMATED HYDROPONIC SYSTEM USING NODEMCU

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)
with Honours

Faculty of Electrical and Electronic Engineering Technology

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF IOT BASED AUTOMATED HYDROPONIC SYSTEM USING NODEMCU

Sesi Pengajian : 2022/2023

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I declare that this project report entitled “Development Of IoT-Based Automated Hydroponic System Using Nodemcu” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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ABSTRACT

Hydroponics is a way to grow plants that doesn't use soil. Instead, the roots of the plants are exposed to a particular nutrient-rich water solution. This field of study focused mostly on monitoring and controlling the nutrient, water level, and moisture of the plant growth. Increasing IoT and automation features in hydroponics will solve the issues associated with regulating these resources. In this project, the water solvent was equipped with sensors that were linked to a microcontroller, allowing the presence of nutrients to be monitored. This project utilized the TDS sensors, water level sensor as well as soil moisture sensor. All of the sensors are managed and controlled by a microcontroller, known as the NodeMCU ESP32 microcontroller. The data is transmitted to the server and will be viewed and accessible through smartphones. In addition, the acquired data will be evaluated for a variety of applications.

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ABSTRAK

Hidroponik ialah suatu kaedah atau cara menanam tumbuhan yang tidak memerlukan penggunaan tanah. Sebaliknya, akar tumbuhan tersebut akan terdedah kepada larutan air yang kaya dengan nutrien. Kajian di dalam bidang hidroponik ini kebanyakannya tertumpu kepada pemantauan dan kawalan nutrient, paras air, dan kelembapan yang menyumbang kepada pertumbuhan tumbuhan tersebut. Peningkatan ciri-ciri IoT dan automasi di dalam bidang hidroponik akan menyelesaikan isu yang berkaitan dengan mengawal sumber-sumber ini. Pelarut air yang dilengkapi dengan penderia yang dihubungkan dengan mikropengawal, membolehkan kehadiran nutrien dipantau secara sistematik. Projek ini menggunakan penderia paras air, penderia kelembapan tanah dan juga penderia TDS. Kesemua penderia ini diuruskan dan dikawal oleh mikropengawal dikenali sebagai NodeMCU ESP32. Data dihantar ke pelayan dan boleh dilihat dan dihubungkan kepada telefon pintar pengguna. Data yang diperoleh boleh dinilai untuk pelbagai aplikasi.

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ACKNOWLEDGEMENT

This thesis would not have been possible without the invaluable guidance, support, and encouragement of my supervisor, Encik Ahmad Idil Bin Abdul Rahman, from the Faculty of Electrical and Electronic Engineering Technology at Universiti Teknologi Malaysia Melaka (UTeM).

I would like to give a shout-out to my classmates, as well as my dear parents and siblings, who provided me with both emotional and financial support as I worked toward this goal. Finally, I'd like to express my gratitude to everyone who had an important role in the completion of this project, no matter how big or tiny it may have been.

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LIST OF SYMBOLS

V – Voltage

t – Time

ℓ - Liter

s – seconds

°C – Degree Celsius

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LIST OF ABBREVIATIONS

AC - Alternating Current

AM - Ante Meridiem

DC - Direct Current

EC - Electrical Conductivity

GPIO - A general-purpose input/output

I2C - Inter-Integrated Circuit

IOT – Internet Of Things

LCD - Liquid crystal display

PM - Post Meridiem

USB - Universal serial bus

SCL - Serial clock

SDA - Serial data

WIFI - Wireless fidelity

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CHAPTER 1

INTRODUCTION

1.1 Background

Hydroponics is a method of growing plants without using soil. Instead, the technique is by using a mineral nutrition solution dissolved in water. The first commercial usage of hydroponic cultivation occurred in the 1920s or the 20th century due to American research works. According to the first approach, plant roots were nourished via a perforated support in a single container. The regulated atmosphere of hydroponics makes it easier to cultivate plants that are not typically grown in specific climates, resulting in a recent surge in the popularity of hydroponics as a method of plant cultivation. Hydroponic systems consume less water, allow for greater control of fertilizer levels, produce healthier plant growth, and are easier to keep pest- and disease-free. Despite these benefits, hydroponic require substantial supervision. Pumps, pipes, lights, filtration, water levels, all of these need to be monitored and adjusted accordingly to promote plant growth. If the plants are left to fend for themselves in their dry, plastic homes, the results can be catastrophic. If certain plant disease appears, all plants in the system will be affected. Not only that, two major factors in hydroponic farming are electricity and water. Hence, unless it has adequate water or stable electricity, the hydroponic system will not thrive as well. While growing plants in this system, it also needs the requirement to ensure proper safety precautions to be carried out so that the plant growth will not be affected at any stage.

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Figure 1.1 Hydroponic Plants

The advancement of IoT has fortunately become one of the most essential technologies of the 21st century in recent years. Nowadays, users can connect commonplace objects such as plants to the internet via embedded devices using low-cost computing, analytics, and mobile technologies that can able to share and gather data with minimal human intervention, as such users can connect such objects to the internet. With the installation of many sensors and transducers, such as water level, soil moisture, temperature and humidity sensor, it is possible to develop a device for regulating, monitoring, and ensuring the safety of hydroponic plants. Using the Arduino software, the NODEMCU microcontroller will be utilized for controlling and monitoring purposes, where the information will then be shown and displayed on a mobile phone via a Wi-Fi connection.

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1.2 Problem Statement

The pressure on the agriculture industry lead to the introduction of hydroponics production method as a potential solution for the growing the populations' own food. However, there are several problems with hydroponics that may encounter such as nutrient deficiency, plant growth, dehydration, diseases, and low quality plants. In the conventional hydroponic system, the farmer needs to monitor the water's tank level, nutrient, and moisture of the plant manually. Meanwhile the current existing automated hydroponic system is quite expensive and required a large amount of electricity to fully operated the system itself with different setting for various kind of plants.

Thus, it is necessary to design and develop an Automated Hydroponic System Using NodeMCU microcontroller that is affordable and functionable to detect, monitor and control the nutrient, water level and moisture of the plant systematically.

1.3 Project Objectives

The objectives of this study are as follows:

a) To design a hydroponic system by using microcontroller.
b) To develop an automated hydroponic system that can control EC, water level and moisture with the implementation of IoT-based integration.
c) To analyze the performance of the Automated Hydroponic System.

1.4 Scope of Project

The scope of the project is applicable for agriculture industries that using hydroponics production method. This device can help the farmer to control the EC, water level and moisture of the plant hydroponic system via the user's phone application, using various type of sensors that have been programmed into the particular microcontroller.

Thus, the scope of this study is as follow:

a) The design of the system is using low cost and accurate components.
b) The parameters of the system such as EC, water level and moisture can be manually adjusted by the user.
c) The component of the system need to setup in a right place and the information of the parameters can be viewed through the user's phone apps.

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CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This section examines and summarizes the overall concept and philosophy of the project's automated hydroponic system. The primary argument of this chapter was elaborated using prior research and current research. This chapter explored the philosophy and concept utilised to overcome the difficulty posed by this project. Journals, articles, and case studies are the primary sources of information, and these sources were chosen based on their resemblance to the project's purpose.

2.2 Current Hydroponic System's Technology

Hydroponics is a form of horticulture in which plants are grown in nutrient-rich water without soil. In this technique, water containing minerals and nutrients is exposed directly to the plant's roots, which can be supported by a variety of media such as coco-peat, perlite, etc. Environmental and nutrient control, water conservation, and labour reduction are the primary advantages of it. This method utilises a number of technologies to which the concepts of automation can be used to increase yield and consistency.

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2.2.1 A Nutrient Film Technique

The Plants are cultivated in a grow tray that is slightly inclined and positioned over a water-nutrient mix reservoir. This allows a thin trickle of water to pass through plant roots, providing enough water, nutrients, and aeration for the plants, before being drained back into the reservoir. Today's most popular hydroponic system is the nutrient film technology. It is used to grow lettuce, spinach, and other leafy greens, Plenty and Bowery. It is easy to build and maintain but If the flow of nutrient solution stops, the roots will dry out and become stressed quickly.

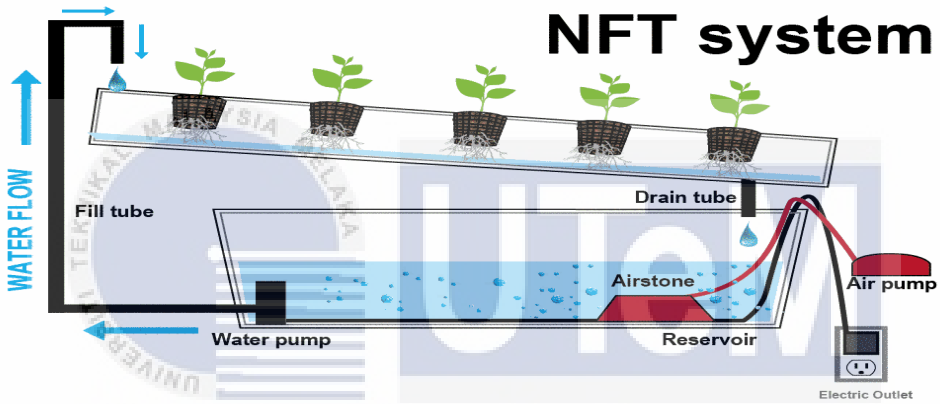

Figure 2.1 Nutrient Film Technique

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2.2.2 Ebb and Flow System

The Ebb and Flow technology allows plants to be flooded with nutrient-rich water, and then the water is aggressively drained back into a reservoir to be reused when the plant roots have absorbed the nutrients. The system is reasonably inexpensive to set up and maintain, although it does need some advanced competence. This strategy allows to simply change the look of the garden by adding or removing plants without damaging the surrounding crops. The fundamental premise is similar to other systems in that plants are placed in a tray that is periodically supplied with nutrient-rich water pushed from a reservoir below. Gravity is employed to return the water to the reservoir so that it can be reused. A submersible pump attached to a timer is typically used for this task. Depending on the size and type of plants, temperature, humidity, and the type of growing medium used, the timer is set to come on

multiple times throughout the day.

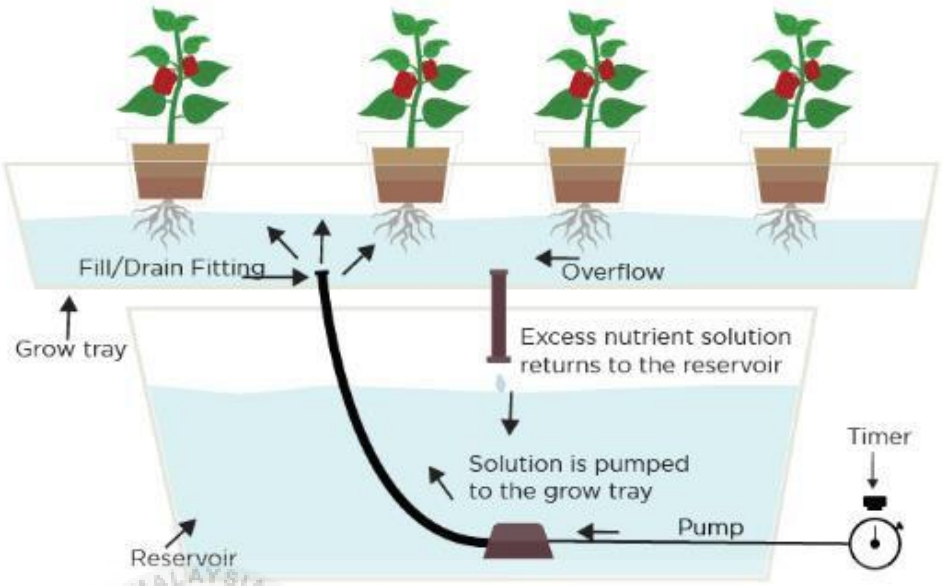

Figure 2.2 EBB And Flow System

2.2.3 Wick system

The wick system is the most basic of them all, as nutrients are passively delivered to the plant via a wick or piece of string that runs up from the water reservoir to the plant. Plants are cultivated in this manner in an inert growing media like sand, rock, wool, or clay balls, which helps anchor the plant roots. In essence, the wick system works in the same way that an oil lamp does. A wick system is passive, which means it has no moving parts, unlike most other hydroponic systems. That means it's not only cheap to put up, but also easy to maintain and less prone to malfunctions.

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