UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF IOT BASED-MINI HYDROPONIC SYSTEM

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (AUTOMATION AND ROBOTICS) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical and Electronic Engineering Technology (AUTOMATION AND ROBOTICS) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor: DR. MOHD BADRIL BIN MOR SHAH

ABSTRAK

Hydroponik merupakan kaedah tanaman moden yang diguna pakai dalam sektor tanaman pada zaman kini. Konsep tanaman yang kurang dalam penggunaan tanah atau tanpa tanah ini sesuai di aplikasi tidak kira kawasan dimana pun. Kaedah dengan cara merendamkan sebahagian akar pokok bagi meresap nutrisi yang ada pada baja cecair memberi kesan yang baik untuk pertumbuhan pokok. Tanaman berkonsep hydroponic ini juga sesuai untuk dalam dan luar rumah memandangkan ia lebih mudah dikendalikan berbanding tanaman biasa. Pencapaian kepada rcvolusi industry 4.0, menghasilkan teknologi yang canggih seperti Internet of Things (IoT). IoT merupakan teknologi moden yang mengawal peranti dengan perantaraan internet ini diterapakan dalam tanaman hydroponik. Manfaat dari teknologi ini membantu pengguna mengawal peranti dari jarak jauh justeru menjimatkan masa pengguna. Kombinasi antara hydroponik dan Internet of Things menjadikan projek ini sebagai satu projek inovasi dalam menerajui revolusi industry 4.0.

ABSTRACT

Hydroponic is a modern crop method which it became popular to use nowadays. The concept is soilless or less use of soil. It's can apply either indoor or outdoor at any place without limitation area. The method of hydroponic is needed to immerse the part of roots in fertilizer as a nutrient for the tree to grow and it becomes well known seems hydroponic easy to handle. The revolution of industrial 4.0 is becoming viable to produce high technology like the Internet of things (IoT). One of the functions of IoT is to control or monitor devices by interconnection with internet. An amenity of IoT in the Hydroponic system helps user to monitor and control their plant especially when they are far from home or they had a packed schedule.

DEDICATION

To my beloved parents

To my kind supervisor

To my irreplaceable family

Thank you for all their love, sacrifice, and encouragement throughout my life.

ACKNOWLEDGMENTS

I would like to express my special thanks of gratitude to my supervisor, Dr. Mohd Badril Bin Shah who gave me the golden opportunity to complete my final year project, development of IoT based mini hydroponic system. He also guided me until the end progress of my project. Through this session, I learned so many new things and polish my skills. Secondly, I am thankful to my family who is my biggest supporter in achieving my dream. They motivate me to be thoughtful women in facing the real world. Special thanks to my colleagues' friends who help me a lot in finishing this project within a limited time. Most thankful where this final year project increases my knowledge and trains me to be a more punctual and dedicated person.

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IoT	Internet of things

CHAPTER 1

INTRODUCTION

1.1 Background

The word of hydroponics comes from Greek, “hydro” means water, and “ponos” means labor. Hydroponics is the plants that are growing by “nutrient solution” which is nutrient-enriched water. This nutrient solution is circulated around the roots by either the passive force of gravity or by the active force of the mechanical device pump.

Like natural gardening, hydroponics also has its own consideration on the growth issue. Humidity, light intensity, temperature, and water level are some parameters important for plant growth. To optimize the plant growth, these parameters are monitor and control by implementation with internet of things (IoT) technology.

All the receiving signals are collected and stored in the cloud. The cloud is accessed using internet to interpret the signal. Therefore IoT-Based automation system is not only for data storage, but it also can be used as remote to monitoring and controlling devices via smartphone or website.

1.2 Problem Statement

With the world's population nearing 7.5 billion, for world prosperity need for a lot of resource-intensive foods to cover this value. Farming needs to produce a lot of food. A way of meeting future food production is continuing farming with minimal area and less use of soil, with employing a nutrient-rich solution to deliver water and minerals to their roots. It is already getting used to extend farming outputs and grow plants. (Plants, 2016).

This new system (hydroponics) is formed in term to growing techniques are often less problematic and yield higher results compared to traditional soil gardening (Anonymous, 2018). Besides this method is applicable for user particularly whose are keep in the circle of town that is lack area for agriculture.

A busy life and pack schedule make users lack time to take care of their plants. This system is very strict in terms of nutrient solution for fertilization; if users are not concern about this, it is affecting the growth of plants. Due to overcome this problem, internet of things (IoT) is contributed to this project to monitor and control the system. To make sure the plants are receiving nutrients as what require.

1.3 Objective

Based on the problem statement stated above, the objectives are as follows:

i. To develop of the gardening platform (hydroponics) which are suitable for indoor with minimal area.

ii. To develop an IoT-based automated system in hydroponics in terms to monitor and control the system with minimal monitoring by users

1.4 Scope

Scopes of the project are:

1. **Hydroponics platform design.**

   In the development, the hydroponics system, this platform is designed with applicable IoT-base automated operation for one plant.

2. **Plantation type.**

   The plant to use for the experiment is suitable for indoor condition and suit to embed in mini-prototype design.

3. **Circuit development**

   In term to control and monitor the parameter of hydroponics system, several sensors are use and other devices too as to accomplish panel circuit of the prototype.

4. **Program development**

   Development of Arduino IDE software in programmed the circuit and all data are sending to cloud hosting for analysis.

5. **Software development**

   Use of Android-based software for control and data display.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is learning on the previous investigation that interconnected with the project. The aim of the chapter is to gain more information, to provide the present of the knowledge, skill to develop the project and important findings as well as concept and outcome related to the same field on the automation system integrated with vision. Furthermore, theoretical and methodological improvement to the previous research in the automation system integrated with hydroponics is analysed.

2.2 Agriculture System

Agriculture is the network of relations between farmers, the environment, geology, soil, air, pesticides and water natural systems, and the political, planning and infrastructure, land use, law, finance, and marketing systems for human systems. These systems and their relationships inform the production of food, agricultural products, and other commodities. This web of complex links is occasionally called the' agricultural system.' The viability and durability of an agricultural system depend on farmers ' ability to make money (Cald-well, 2015).

2.3 Hydroponic System

In order to attractive full genetic of foliage, flowers or fruits, the plant should be supplied with everything plant need in mere the proportions at the simply proper time. With apply hydroponics system; it is potential by applying correct watering and feeding regimens, environmental management and lots of quality lighting. In a natural growing method, we are able to see that hydroponics is all concerning enriching the water with the exact same nutritious salts found in nature. It's regarding making and maintaining a "nutrient solution" that's utterly balanced for plants. Most hydroponic systems contain a nutrient solution that may be a closed system. This helps shield it from evaporation and from discharging into our surroundings as will the runoff from exposed, fertile soil (Roberto, 2000).

Gericke (1936) as cited in Roberto (2000) mentioned that the cultivation of each edible and decorative plants in a very solution of water and dissolved nutrients. The title of hydroponics comes from Greek, "hydro" means water, and "ponos" means labor. During this solution plants are growth by "nutrient solution" which solely water been enriched with nutrients. In a very husbandry garden, this nutrient solution is circulated around the roots by either the passive force of gravity or by the active force of the associate mechanical device pump.

The hydroponic system could be a new cultivation technology that applies nutrient solutions while not the soil substrates, however with the presence of artificial supporting medium (Bhattarai et al., 2008 as cited in Chow et al., 2017). It offers the flexibility to utilize water and nutrients, easy environmental variability management, higher

production yield, and serial interference of soil-borne diseases and pests (Molitor, 1990 as cited in Chow et al., 2017) (Table 2.1).

Table 2. 1 : Advantage and limitation of hydroponic systems in comparison to soil-based culture

Issues	Hydroponic system	Soil culture	References
Water	- Efficient water usage - Irrigation water can be recycled or reused - No nutrient waste due to water runoff - Irrigation water is supplied directly to root areas - Possibility of controlling-water holding ability by using different kinds of medium	- Insufficient water usage - Irrigation water cannot be recycled or reused - Eutrophicastion of the environment due to surface run-off - Difficulties of the control of water-holding capacity	Midmore and Deng-lin (1989)
Land usage and effect of environment	- Less affected by soil and external factors - Indoor system and ease of nutrient control - Excellent control of environment temperature, humidity and lighting time	- Limited by different soil types - Subjected to the changing external environment	Gibeaut *et al.* (1997); Jones (1997); Norén *et al.* (2004); Norström *et al.* (2004)
Fertilizers and nutrient solution	- Even distribution - Efficient use of fertilizers and cost saving - Ease of pH control	- Uneven distribution - Excessive use of fertilizers - Variation of pH with the changing weather and external factors	Rolot (1999); Resh (2013)
Quantity and quality of crop	- Stable and even amount of crop production	- Unstable crop production, and subjected to pests/soilborne pathogens	Cornish (1992); Sarooshi and Cresswell (1994); Rolot (1999); Resh (2012)

Hydroponic farming is very effective as the nutrient in the soil decreases. This revolution has a system of providing plants with nutrients directly to the roots, as well as creating an optimal growing environment for plant growth (Chadirin, 2007).

Hydroponics is additionally used as an alternative to agriculture on restricted land and permits the cultivation of vegetables in less fertile areas or slender areas that are densely inhabited. Hydroponics is going to be maximized if in a much-closed space or usually referred to as a greenhouse. Lately, greenhouse users inland are increasing as a result of hydroponics will be Associate in Nursing export chance. Budi Luhur University has taken