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URBAN SMART FARMING SYSTEM

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DECLARATION

I declare that this thesis entitled “Urban Smart Farming System” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : MUHAMMAD IQBAL AYYUB BIN ROSLAN

Date : 17 JANUARY 2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

Signature : 

Supervisor Name : TS. DR. OMAR BIN BAPOKUTTY

Date : 17 JANUARY 2022

DEDICATION

Dedicated to

My beloved father, Roslan Bin Mohamed Ali

My precious mother, Norarfida Binti Hashim

My dearess sibling, Ibrahim Bin Roslan, Muhammad Izzul Bin Roslan, Nur Aqilah Binti Roslan, Muhammad Iman Hakimi Bin Roslan, Muhammad Imran Firas Bin Roslan

My housemates, Muhammad Haziq Hazman Bin Abd Wahid, Muhammad Afiq Bin Abdul Rahman, Muhammad Fikri Bin Zulkifli, Mohammad Akmal Bin Mohd Sani, Muhammad Zulhahakimi Bin Salim, Mohammad Azfar Bin Mohammad Zulkifli, Shamsu Hazmirull Bin Shamsudin

Thank You So Much & Forever Love

ABSTRACT

The development of technology which is now increasing day by day has helped mankind a lot in every aspect including the agricultural sector. The purpose of this study was to identify the effects produced by green spinach when supplied with several types of nutrients of different conditions by using a smart hydroponic set. The use of basic hydroponic techniques such as the wick system will be able to help facilitate the work of newcomers who want to venture into the field of hydroponic agriculture. Users can see the current condition of the nutrient in Blynk application on their smartphone or laptop at any time and anywhere as long as there is an internet connection throught this smart farming system. Green spinach will be analyzed as a result of its growth in terms of increasing stem height, total leaf production and also the survival rate after being supplied with 4 different nutrient solution conditions which are high concentration, low concentration, high pH and low pH. In comparison to the other three categories of nutrients, low concentration nutrients were shown to be the best, according to the analysis conducted. Green spinach grown with low-concentration nutrients had the most positive results, and all of the samples survived the throughout analysis. In addition, low pH nutrients are the most inappropriate nutrients for green spinach. After the third day of analysis, all green spinach samples were discovered to be dead. The effectiveness of the IoT system integrated into this hydroponic set makes it very easy and quick to monitor the condition of nutrient compared to ordinary farming methods that have to be measured manually.

ABSTRAK

Perkembangan teknologi yang kini semakin meningkat dari hari ke hari telah banyak membantu manusia dalam setiap aspek termasuk sektor pertanian. Tujuan kajian ini dijalankan adalah untuk mengenal pasti kesan yang dihasilkan oleh bayam hijau apabila dibekalkan dengan beberapa jenis nutrien keadaan berbeza dengan menggunakan set hidroponik pintar. Penggunaan teknik asas hidroponik seperti sistem sumbu akan dapat membantu memudahkan kerja-kerja pendatang baru yang ingin menceburi bidang pertanian hidroponik. Pengguna boleh melihat keadaan semasa nutrien dalam aplikasi Blynk pada telefon pintar atau komputer riba mereka pada bila-bila masa dan di mana sahaja asalkan terdapat sambungan internet melalui sistem pertanian pintar ini. Bayam hijau akan dianalisis hasil pertumbuhannya dari segi peningkatan ketinggian batang, jumlah pengeluaran daun dan juga kadar kemandirian setelah dibekalkan dengan 4 keadaan larutan nutrien yang berbeza iaitu kepekatan tinggi, kepekatan rendah, pH tinggi dan pH rendah. Berbanding dengan tiga kategori nutrien yang lain, nutrien kepekatan rendah ditunjukkan sebagai yang terbaik, menurut analisis yang dijalankan. Bayam hijau yang ditanam dengan nutrien kepekatan rendah mempunyai hasil yang paling positif, dan semua sampel terselamat sepanjang analisis. Selain itu, nutrien pH rendah adalah nutrien yang paling tidak sesuai untuk bayam hijau. Selepas hari ketiga analisis, semua sampel bayam hijau didapati mati. Keberkesanan sistem IoT yang diintegrasikan ke dalam set hidroponik ini menjadikannya sangat mudah dan cepat untuk memantau keadaan nutrien berbanding kaedah pertanian biasa yang perlu disukat secara manual.

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LIST OF SYMBOLS AND ABBREVIATIONS

pH	-	Potential of Hydrogen
%	-	Percentage
IoT	-	Internet of Things
DFT	-	Deep Flow Technique
DWC	-	Deep water culture
NFT	-	Nutrient film technology
PVC	-	Polyvinyl Chloride
UPVC	-	Unplasticized polyvinyl chloride
EC	-	Electrical conductivity
RFID	-	Radio Frequency Identification
5G	-	5^{th} Generation
WSN	-	Wireless sensor network
USB	-	Universal serial bus
PLC	-	Programmable logic controller
I/O	-	Input / Output
LCD	-	Liquid crystal display
mm	-	millimeter
CPU	-	Central processing unit
SoC	-	System on the chip
TCP/IP	-	Transmission Control Protocol / Internet Protocol
PWM	-	Pulse width modulation
ICSP	-	In Circuit Serial Programming
UART	-	Universal asynchronous receiver – transmitter
MHz	-	Megahertz
EC	-	Electrical Conductivity
PPM	-	Parts per million
NaCl	-	Sodium Chloride
LC	-	Low Concentration
HC	-	High Concentration

LPH	-	Low pH
HPH	-	High pH
mℓ	-	milliliter

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CHAPTER 1

INTRODUCTION

This chapter will explain and clarify about the background of study on soil-free planting methods by implicating current technology into plant care structures. This research is an awareness from theories of past researchers, books, journals, and online resource. Hence the data are obtained to classify the improvement needed for this exploration.

1.1 Background

A hydroponic system is a way of growing plants that does not require the use of soil and only uses a nutrient solution in the water. Hydroponic planting methods are advantageous due to their preparation characteristics which can be applied to limited soil space. Society has recently begun to recognize hydroponic farming as a tool that can have many benefits while also aiding in the improvement of society's economy. The Covid-19 epidemic that has hit the world has had a huge impact on society in various aspects not only health problems, but also has affected the country's economy as well as environmental conditions. No country can avoid being affected by this situation because this epidemic is happening all over the country and it is spreading very fast (Nurhayati and Rinda, 2021). Prices of basic commodities and food are beginning to climb as the global economic situation collapses due to the Covid-19 epidemic. As a result, the group started to consider a variety of new approaches to address this problem, such as using a small room at home as a vegetable growing field (Mardiyana and Widiastuti, 2021).

One of the best hydroponic methods for indoor growing is the wick system. Because it is a passive system, it employs a self-feeding approach and does not require a water pump (Lee and Lee, 2015a). This method would ensure that the roots receive sufficient nutrients on a regular basis. It is possible to build and sustain a stable rooting condition using this technique. This seeks to provide the best method for preparing and using nutrients to fulfil plant nutrient requirements (Jones, 2014). Several essential factors, such as the type of water distribution, light strength, temperature, humidity, and pH of water, should be given more consideration to ensure that plants can thrive in good and healthy conditions. However, failures can happen while using this hydroponic planting technique, and they mostly happen during the growing period. Plants that lack elemental conservation can be identified by a variety of physical characteristics, including withered leaves, a yellowish color, and the presence of dead leaves (Nurhasan et al., 2018).

On the basis of growing world population, the UN Food and Agriculture Organization has stated that food demand should be increased to 70% by 2050. As a result, various ideas have been proposed, with the conclusion that the specified goals can be met with the aid of the Internet of Things (IoT). As a result, farmers and agricultural businesses should begin taking action as soon as possible to transition to a modern approach that is more in line with the current situation. As technologies continued to advance at a steady pace year after year, the word "internet of things" was coined (Malavade and Akulwar, 2016). IoT allows plants to communicate with one another over the internet. This term can be applicable to both traditional and hydroponic crops. By creating a support device hydroponics system that can be used in a residential neighborhood, any family's food security is supposed to improve (Lukito and Lukito, 2019)

1.2 Problem Statement

As is well known, the agricultural industry is now beginning to move to new cultivation methods after finding that some of the problems that are often encountered when using conventional agriculture can be solved. Climate change is one of the challenges that is threatening conventional agriculture's survival. The agriculture industry is negatively impacted by climate change induced by excessive global warming. Global warming is an unavoidable occurrence caused by an annual rise in the amount of greenhouse gases such as carbon dioxide. Increased frequency of floods, droughts, heat waves, and storm severity are among the additional repercussions of global warming. This mentioned phenomena will hinder plant development, resulting in significant losses for farmers (Attri and Rathore, 2010). Agriculture is a very sensitive system, so it's not surprising that climate change has a massive impact on it. Climate change is putting a greater strain on global food security year after year. As a result, food production has decreased while food costs have climbed. Due to increased food demand considerations, population increase would also put pressure on the agriculture sector. As a result, the agricultural industry will need to find a way to expand food production by 2 to 3 times its current level (Singh and Singh, 2017).

Additionally, soil erosion is one of the most common problems associated with conversional agriculture. Soil erosion will reduce soil production and is likely to be difficult to recover. Soil erosion is caused by three processes: flowing water, wind, and soil transfer by tillage. Erosive forces released by air or water can erode soil conditions that are unstable and covered with live or dead biomass (Auerswald et al., 2003). The pace of nutrient cycling in a soil structure is affected by soil erosion, making it harder for plants to get sufficient food sources. Conventional planting techniques depend on the amount of nutrients available in the soil (Arden-Clarke and Hodges, 1988). Climate change is one of the first factors contributing to a decline in soil quality and quantity. The increased frequency of

unpredictable rainfall, as well as the warmer temperature, reduces soil fertility, which obviously has a negative effect. As a result, the price of agricultural soil has increased as the demand for fertile land has risen. While this may be beneficial to those that provide soil supply services, it is damaging to agriculture since the amount of high-quality soil is becoming increasingly scarce.

Next, the busyness of work that leads to time constraints is also one of the problems found. According to (Strazdins and Loughrey, 2007), the rise of modernism in economic growth has resulted in increased time pressures, which has become a new habit in the workplace. This is due to the fact that longer average working hours imply a greater pace of work. Other things, such as health and the environment, will be affected by time stress. The existence of numerous public and private sector services began to compete for access to the global market. As a result, a large amount of manpower is required. At present moment, the average full-time working week in Australia is 42 hours. This upward trend has continued over the previous two decades. This is inextricably linked to women. Women represent nearly half of the labor force today.

1.3 Objective

The objective of research are as follows:

(a) To install IoT systems into hydroponic agriculture.

(b) To study the feasibility of IoT system against changes in pH value and nutrient concentration

(c) To study the effect of plant using IoT monitoring methods for certain nutrient conditions.

1.4 Scope of Study

This study focused on the design, fabricate, assembly and field test of the smart farming system based on hydroponic method. The research scopes are as follow:

(a) Implement the best use of technology into the farming system.

(b) Determine the best type of hydroponic method that is simple to run and maintain.

(c) To assess the success of sensors in implementing the internet of thing principle.

(d) Investigate the influence of sensors used in meeting each plant's needs at the right time

(e) To identify the effectiveness of IoT in monitoring nutrient conditions

(f) Study the behavior of plant after germination phase

(g) Determine the side effects will occur on plants if supplied with nutrients that are too acidic and too alkaline

1.5 Rational of Study

There are several importance measure that is needed to be considered in the rational of this research such as:

(a) The problem of unpredictable weather factors especially to the cultivation in open areas which is often difficult to farmers in maintaining the crops cultivated.

(b) Hydroponic system method that suitable to be done indoors where nowadays most people spend more time at home due to the pandemic factors that plague the world.

(c) Incorporating the Internet of Things (IoT) idea into cultivation practices to maximize crop care in accordance with current technology advances, where everyone understands how to utilize it

(d) Develop an environmentally friendly planting system, safe to use and low cost.