Faculty of Electrical and Electronic Engineering Technology

SMART PLANT SEEDS INDOOR MONITORING & CONTROL SYSTEM VIA INTERNET OF THINGS (IoT)

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SMART PLANT SEEDS INDOOR MONITORING & CONTROL SYSTEM VIA INTERNET OF THINGS (IoT)

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A project report submitted
in partial fulfillment of the requirements for the degree of
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DEDICATION

Alhamdulillah.
In The Name Of Allah, The Most Gracious And The Most Merciful.
I dedicate this thesis to my parents, Anuar and Tumeeny, who being supportive throughout this journey. Thank you for the endless love.

ABSTRACT

In agriculture, weather and soil conditions have a large impact on crop productivity. Over time, climate change has resulted in more and more unpredictable weather, leading to changes in soil conditions. Thus with the use of the Internet of Things, this smart plant is proposed. Smart Plant Seeds Indoor Monitoring & Control System Via Internet Of Things (IoT) has been designed to monitor and control the parameters that will affect the seeds' growth. These parameters are; the height of the water solution that will detect by Ultrasonic sensor HC-SR04, temperature and humidity by DHT 22. While by adjusting the fan and dosing pump, the temperature and water level in the system are controlled. Data can be monitored using Thinger.io, which allows real-time access. This IoT technology will enable users to automatically monitor and maintain all of their system parameters even without their physical presence.

ABSTRAK

Dalam pertanian, cuaca dan keadaan tanah memberi kesan besar terhadap produktiviti tanaman. Seiring berjalannya waktu, perubahan iklim mengakibatkan cuaca yang semakin tidak dapat diramalkan, membawa kepada perubahan keadaan tanah. Oleh itu dengan penggunaan "Internet of Things", pokok pintar ini dicadangkan. Sistem Pemantauan & Kawalan Dalaman Biji Tumbuhan Pintar melalui "Internet Of Things" (IoT) telah dirancang untuk memantau dan mengawal parameter yang akan mempengaruhi pertumbuhan benih. Parameter ini adalah; ketinggian larutan air yang akan dikesan oleh sensor Ultrasonik HC-SR04, suhu dan kelembapan oleh DHT 22. Sementara itu, dengan menyesuaikan kipas dan pam dos, suhu dan paras air dalam sistem dapat di kawal. Data dapat dipantau menggunakan Thinger.io, yang memungkinkan akses masa nyata. Teknologi IoT ini akan membolehkan pengguna untuk memantau dan mengekalkan semua parameter sistem mereka secara automatik walaupun tanpa kehadiran fizikal mereka.

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LIST OF SYMBOLS

°C	-	Degree celcius
V	-	Voltage
A	-	Ampere
°F	-	Fahrenheit
%	-	Percentage
&	-	Ampersand
Hz	-	Hertz
±	-	Plus-minus
cm	-	Centimetre
L	-	Litre
m	-	Meter
mA	-	Milliampere
L/min	-	Litres per minute

LIST OF ABBREVIATIONS

FAMA	-	Federal Agricultural Marketing Authority
FELDA	-	Federal Land Development Authority
IoT	-	Internet of Things
WSN	-	Wireless Sensor Networks
DHT11/ 22	-	Digital-output relative humidity & temperature sensor
TMP 100	-	Digital temperature sensor
GSM	-	Short Messaging Service
SMS	-	Short Message Service
PC	-	Personal computer
GPRS	-	General Packet Radio Service
TCP/IP	-	Transmission Control Protocol/Internet Protocol
AWS	-	Amazon Web Services
EC2	-	Amazon Elastic Compute Cloud
MCU	-	Microcontroller unit
LED	-	Light Emitting Diode
TEC	-	Thermoelectric cooling
GUI	-	Graphical User Interface
PA	-	Precision Agriculture
IT	-	Information Technology
iOS	-	iPhone Operating System
pH	-	Potential of hydrogen
DC	-	Direct Current
NFT	-	Nutrient Film Technique
USB	-	Universal Serial Bus
PVC	-	Polyvinyl chloride
HTML	-	Hypertext Markup Language
PHP	-	Hypertext Preprocessor
PPM	-	Planned Preventive Maintenance
IDE	-	Integrated Development Environment
DNN	-	Deep Neural Networks
ANN	-	Artificial Neural Network
UART	-	Universal Asynchronous Receiver/Transmitter
CSV	-	Comma-Separated Values
HTTP	-	Hypertext Transfer Protocol
2FA	-	Two-Factor Authentication
RH	-	Relative humidity
VCC	-	Voltage Common Collector
NC	-	Normally closed contact
VDC	-	Volts of direct current
AI	-	Artificial Intelligence

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CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture remains a vital sector of Malaysia's economy. Growing Malaysian agricultural produce has made farming management organizations like FAMA and FELDA successful. As the rapid economic growth, the concept of modern farming needs to be implemented so that Malaysian Agricultural products will maintain the authority of a comprehensive international market in the long run. With the practice of contemporary farming techniques, this proposed work presents Hydroponic farming. This technique is an environmentally friendly method that does not use soil and sunlight as a medium of its planting but ensures the plant gets all essential nutrient elements from the water solution. This indoor hydroponic system requires special attention in monitoring the temperature, humidity, and water level that can be regulated by the use of the Internet of Things (IoT). The rapid development of the intelligent lifestyle, the Internet of Things (IoT) network, was created so that the systems will help control the necessary conditions required for the plant to grow hydroponically. With the help of this Internet of Things (IoT) technology, these modern farming techniques was automated using sensor and connected to the microcontroller to allow the user to control and monitor changes from a distance. Human interference will be kept to a bare minimum in this process. This study focused on a smart plant seed indoor monitoring and control system that uses the Internet of Things (IoT) to enable users to control the necessary conditions for the plant to grow hydroponically. This

system provides benefits for the product development of being more accurate and better control to give real-time data to maintain the parameters and promote healthy plant growth.

1.2 Problem Statement

In the traditional farming method, after place the seed into the soil, farmers need to place the water, make sure the seed got enough sun then waiting for some time before ready to harvest. That is always how it's always been. The whole monitoring and regular watering, digging, seed sowing, fertilizing, and spraying required more extra time to look after. People often forget to monitor plant growth in their busy schedules continuously.

It is hard to accurately monitor the planting performance like the temperature, humidity, and water level when people engage with their work. Research by (Miles and Brown., 2007), states that seeds usually "wake up" and germinate when soil conditions are right for them to develop. Warm soil is needed for seedling growth because the temperature is a critical factor. Seeds will germinate slower or not when they are not in the temperature between 55–75℉ range. A minor change in seed moisture content also has a significant impact on seed storage life. For good germination, seeds require a moisture content of 20% to 30%. It was essential for seeds to be held in the correct humidity range between 65 and 70 percent. For root development to occur, these high humidity levels of water are needed. It can be measured by conventional means using a hygrometer, the ice cube method, or the indicator paper method, depending on which is most appropriate. Keeping the correct levels of humidity during the plant life cycle is challenging. Water is also one of the vital elements when starting plants from seed. Too much water is drowning or rotting the seeds. Too little, and it will not germinate or die when it is over. Not every plant has the exact watering needs.

When human intervention is used to monitor the parameters, errors increase; thus, accuracy is reduced.

With the advances in technology and the improvement of people's living standards, where everything can be controlled and operated automatically, people need to implement an Internet of Things (IoT) technology. In this paper, a smart plant seeds indoor monitoring & control system via the Internet of Things (IoT) will be developed. The smartest lifestyle of this innovative plant would make it easy to monitor the temperature, humidity, and water level accurately. Not to forget that this system also makes sure that all the parameters necessary, like temperature and water level, can be controlled for healthy indoor plant growth.

1.3 Project Objective

The main aim of this project is to propose a smart plant seeds indoor monitoring & control system via Internet of Things (IoT). Specifically, the objectives are as follows:

a) To design and develop the smart plant seeds indoor monitoring & control system using microcontroller based on IoT.
b) To analyse the temperature, humidity and water level using monitoring system via IoT.
c) To construct the seeding system using controller, fan and dosing pump based on IoT.
d) To evaluate the smart plant seeds system by testing on the various type of plants.

1.4 Scope of Project

This project involved the development of plant seeds indoor system. The humidity and temperature inside the system are monitored via IoT using DHT 22. The fan is controlled automatically to compensate for the temperature inside the system. The water level inside the plant seed container is monitored by using ultrasonic sensor, and the DC water pump is controlled automatically to maintain the water level. The LED grow light is used as a light source for the plant seed and turned ON according to the time assigned. ESP32 is used as the main controller, while Thinger.io as an IoT platform.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Smart plant seeds indoor monitoring is an IoT-based intelligent system that will provide real-time seedbed information to help people identify potential risks during the seed breeding phase. This paper focuses primarily on various factors that need to be monitored and control, including humidity, temperature, and water level, so that people can maintain their indoor plants with minimal manual intervention. So this chapter will discuss the concept and method based on the previous related article about the smart plant seeds indoor monitoring. All the study articles and journals relevant to this project field that include analysis and concept are also explained in a clear way.

2.2 Previous Project Research

IoT smart plant systems are a kind of device that uses sensors including light, humidity, temperature, and soil moisture to track the crop seedbed and automate the irrigation method, allowing people to minimize waste and increase yield. People may still keep an eye on the seed breeding conditions from wherever they are. This paper analysis written by (Bandekas et al., 2016), proposes a practical, affordable, and environmentally friendly controlled seedbed based on WSN and IoT technologies. Within the principles of the Internet and WSN technology, this case study demonstrates how real-time seedbed awareness will assist farmers in making the best seed breeding decisions. This study used 48 seeds inside the monitored seedbed to compare the breeding process, while another 47 seeds using a seedbed in indoor conditions.