



**Faculty of Electrical and Electronic Engineering Technology**



**DEVELOPMENT OF AN IOT-BASED SMART AGRICULTURE  
USING ARDUINO AND GREEN TECHNOLOGY**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DANISH A/L MOHANA DAS**

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

**2022**

**DEVELOPMENT OF AN IOT-BASED SMART AGRICULTURE USING  
ARDUINO AND GREEN TECHNOLOGY**

**DANISH A/L MOHANA DAS**

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



اونيورسيتي تیکنیکل ملیسيا ملاک  
**Faculty of Electrical and Electronic Engineering Technology**  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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## DECLARATION

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## DEDICATION

*This devotion is heartfelt and meant to be for my cherished family, esteemed lecturers, and wonderful friends. Their loves, affections, advises, helps, and encouragements push me forward toward the finish line to accomplish what I set out to do. There are no words that can adequately express how much I appreciate the lovely spirits that you all are.*



## ABSTRACT

In today's world of contemporary agriculture, innovation is more crucial than it has ever been. This sector is confronted with significant difficulties, including rising prices of goods, a lack of available labour, and shifting tastes among customers toward openness and ecological friendliness. Agriculture has become a demanding need for many people in this era of technological progress. In standard agriculture, one must spend a lot of time tending to their plants to ensure that they develop properly, as there are several environmental elements that may impact the health and growth of a plant. IoT and other technologies are presented as solutions to the problem. As part of this research, an IoT-based Smart Agriculture using Arduino and Green Technology project is being proposed as a solution for good monetization of our agriculture. The health of the plant will be evaluated and assessed. Sensors installed in this system will provide data to the microcontroller through an application utilising the Internet of Things (IoT) concept. Green technology will be the main source of power to run this project with the use of solar energy as it is environmentally friendly since it makes use of a renewable natural resource that will never deplete and has a negligible influence on the surrounding environment. Additional actuators have been included in this project and will be activated in response to data from their respective sensors.

## **ABSTRAK**

*Dalam dunia pertanian kontemporari hari ini, inovasi adalah lebih penting daripada yang pernah berlaku. Sektor ini berhadapan dengan kesukaran yang ketara, termasuk kenaikan harga barangan, kekurangan tenaga buruh yang tersedia, dan peralihan cita rasa di kalangan pelanggan ke arah keterbukaan dan mesra ekologi. Pertanian telah menjadi keperluan yang mendesak bagi ramai orang dalam era kemajuan teknologi ini. Dalam pertanian standard, seseorang mesti meluangkan banyak masa menjaga tanaman mereka untuk memastikan ia berkembang dengan baik, kerana terdapat beberapa unsur alam sekitar yang boleh memberi kesan kepada kesihatan dan pertumbuhan tumbuhan. IoT dan teknologi lain dibentangkan sebagai penyelesaian kepada masalah tersebut. Sebagai penyelesaian ke arah pengewangan yang baik, Pertanian Pintar berasaskan IoT menggunakan Arduino dan projek Teknologi Hijau sedang dicadangkan sebagai sebahagian daripada penyelidikan ini. Kesihatan tumbuhan akan dinilai dan dinilai. Sensor yang dipasang dalam sistem ini akan membekalkan data kepada mikropengawal melalui aplikasi yang menggunakan konsep Internet of Things (IoT) dan teknologi hijau akan menjadi sumber kuasa utama untuk menjalankan projek ini dengan menggunakan tenaga solar kerana ia mesra alam kerana ia menjadikan penggunaan sumber semula jadi yang boleh diperbaharui yang tidak akan habis dan mempunyai pengaruh yang boleh diabaikan terhadap alam sekitar. Penggerak tambahan telah dimasukkan ke dalam projek ini dan akan diaktifkan sebagai tindak balas kepada data daripada penderia masing-masing*



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After that, my friends, particularly my classmates, deserved to also get my gratifications since they are the ones who prevent me from sliding into the pit of failure by consistently inspiring me. As a result, they deserved to receive my gratifications.

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## TABLE OF CONTENTS

|   | <b>PAGE</b> |
|---|-------------|
| <b>DECLARATION</b>                        |             |
| <b>APPROVAL</b>                           |             |
| <b>DEDICATIONS</b>                        |             |
| <b>ABSTRACT</b>                           | <b>i</b>    |
| <b>ABSTRAK</b>                            | <b>ii</b>   |
| <b>ACKNOWLEDGEMENTS</b>                   | <b>iii</b>  |
| <b>TABLE OF CONTENTS</b>                  | <b>i</b>    |
| <b>LIST OF TABLES</b>                     | <b>iii</b>  |
| <b>LIST OF FIGURES</b>                    | <b>iv</b>   |
| <b>LIST OF SYMBOLS</b>                    | <b>viii</b> |
| <b>LIST OF ABBREVIATIONS</b>              | <b>ix</b>   |
| <b>LIST OF APPENDICES</b>                 | <b>x</b>    |
| <b>CHAPTER 1 INTRODUCTION</b>             | <b>11</b>   |
| 1.1 Background                            | 11          |
| 1.2 Problem Statement                     | 12          |
| 1.3 Project Objective                     | 13          |
| 1.4 Scope of Project                      | 13          |
| <b>CHAPTER 2 LITERATURE REVIEW</b>        | <b>14</b>   |
| 2.1 Introduction                          | 14          |
| 2.2 Agriculture Issues                    | 14          |
| 2.2.1 Factors Influencing Plant Health    | 15          |
| 2.2.2 Effect of Light                     | 16          |
| 2.2.3 Effect of temperatue                | 18          |
| 2.2.4 Effect of water and soil moisture   | 19          |
| 2.3 Monitoring system in past and present | 21          |
| 2.4 Summary                               | 26          |
| <b>CHAPTER 3 METHODOLOGY</b>              | <b>27</b>   |
| 3.1 Introduction                          | 27          |
| 3.2 Experimental Setup                    | 29          |
| 3.3 System Hardware Development           | 30          |
| 3.3.1 Microcontroller and Wi-Fi Module    | 31          |
| 3.3.2 Light Intensity Sensor              | 33          |
| 3.3.3 Temperature and Humidity Sensor     | 34          |

|   |   |           |
|---|---|-----------|
| 3.3.4   | Soil Moisture Sensor                                      | 34        |
| 3.3.5   | SDC Water Pump and Single Channel 5V Relay Breakout Board | 35        |
| 3.3.6   | IP68 LED  | 36        |
| 3.3.7   | Battery   | 37        |
| 3.3.8   | Solar Panel and Controller                                | 37        |
| 3.3.9   | LM2596 Buck Converter and Voltage Regulator, 5V to 3.3V   | 39        |
| 3.4   | System Development with a Variety of Software             | 39        |
| 3.4.1   | Proteus 8 Professional                                    | 39        |
| 3.4.2   | Fritzing  | 40        |
| 3.4.3   | Arduino IDE   | 41        |
| 3.4.4   | Development of Android Application                        | 42        |
| 3.4.5   | Blynk IoT platform  | 42        |
| 3.5   | Flowchart   | 44        |
| 3.6   | Analysis Approach   | 44        |
| 3.7   | Data collecting   | 44        |
| 3.8   | Data Analysis   | 45        |
| 3.9   | Summary   | 45        |
| <b>CHAPTER 4 RESULTS AND DISCUSSIONS</b>        |   | <b>47</b> |
| 4.1   | Introduction  | 47        |
| 4.2   | Agriculture Monitoring System                             | 48        |
| 4.2.1   | System  | 48        |
| 4.2.2   | Circuit   | 50        |
| 4.3   | IoT Android Application Software                          | 51        |
| 4.4   | Performance Analysis                                      | 52        |
| 4.4.1   | Plant Growth Analysis                                     | 55        |
| 4.4.1.1   | Plant Growth Analysis Setup                               | 55        |
| 4.4.1.2   | Plant growth Data analysis                                | 57        |
| 4.4.1.3   | Plant Growth Analysis For Day 1                           | 58        |
| 4.4.1.4   | Plant Growth Analysis for Day 2                           | 68        |
| 4.4.1.5   | Plant Growth Analysis For Day 3                           | 78        |
| 4.4.1.6   | Plant Growth Results                                      | 88        |
| <b>CHAPTER 5 CONCLUSION AND RECOMMENDATIONS</b> |   | <b>92</b> |
| 5.1   | Conclusion  | 92        |
| 5.2   | Project Summary   | 92        |
| 5.3   | Objective Achievement                                     | 92        |
| 5.4   | Recommendation for Future Work                            | 93        |
| 5.5   | Project Potential   | 93        |
| <b>REFERENCES</b>                               |   | <b>95</b> |
| <b>APPENDICES</b>                               |   | <b>97</b> |

## LIST OF TABLES

| <b>TABLE</b> | <b>TITLE</b>                                   | <b>PAGE</b> |
|--------------|--|-------------|
| Table 2.1    | Comparison of Wi-Fi, Bluetooth, and ZigBee     | 24          |
| Table 4.1    | Real Time Data from 8.30 AM to 9.30 AM         | 53          |
| Table 4.2    | Day 1 Real Time Data from 8.30 AM to 9.30 AM   | 59          |
| Table 4.3    | Day 1 Real Time Data from 5.30 PM to 6.30 PM   | 62          |
| Table 4.4    | Day 1 Real Time Data from 10.30 PM to 11.30 PM | 66          |
| Table 4.5    | Day 2 Real Time Data from 8.30 AM to 9.30 AM   | 69          |
| Table 4.6    | Day 2 Real Time Data from 5.30 PM to 6.30 PM   | 72          |
| Table 4.7    | Day 2 Real Time Data from 10.30 PM to 11.30 PM | 75          |
| Table 4.8    | Day 3 Real Time Data from 8.30 AM to 9.30 AM   | 79          |
| Table 4.9    | Day 3 Real Time Data from 5.30 PM to 6.30 PM   | 82          |
| Table 4.10   | Day 3 Real Time Data from 10.30 PM to 11.30 PM | 85          |
| Table 4.11   | Plant height in two different conditions       | 89          |

## LIST OF FIGURES

| FIGURE      | TITLE   | PAGE |
|-------------|---|------|
| Figure 2.1  | Periods of rapid vegetative growth                              | 16   |
| Figure 2.2  | Plant growth in high and low temperatures                       | 19   |
| Figure 2.3  | Plant Photosynthesis Equation                                   | 20   |
| Figure 2.4  | Cell structures in the epidermis of plants for stomas           | 21   |
| Figure 2.5  | GSM-based agriculture monitoring system                         | 22   |
| Figure 2.6  | Agricultural Management   | 23   |
| Figure 2.7  | Block Diagram of Microcontroller monitoring system              | 25   |
| Figure 3.1  | Flowchart of project development                                | 27   |
| Figure 3.2  | Block diagram of hardware development                           | 30   |
| Figure 3.3  | Arduino Uno Board   | 32   |
| Figure 3.4  | ESP-01 8266 WIFI module board                                   | 32   |
| Figure 3.5  | Photoresistor Module KY-018                                     | 33   |
| Figure 3.6  | DHT22 Temperature and Humidity Sensor                           | 34   |
| Figure 3.7  | Capacitive Soil Moisture  | 35   |
| Figure 3.8  | DC Water Pump and Single Relay Breakout Board                   | 36   |
| Figure 3.9  | IP68 LED  | 37   |
| Figure 3.10 | Lead Acid Battery, 12 V, 7.2 Ah, and Lithium Ion Battery        | 37   |
| Figure 3.11 | The monocrystalline solar panels of 30 watts and the controller | 38   |
| Figure 3.12 | LM2596 Buck Converter and Voltage Regulator, 5V to 3.3V         | 39   |
| Figure 3.13 | Proteus 8 Professional  | 40   |
| Figure 3.14 | Fritzing layout   | 41   |
| Figure 3.15 | Arduino IDE layout  | 42   |
| Figure 3.16 | Blynk Web IoT Platform Interface                                | 43   |

|  |    |
|--|----|
| Figure 3.17 Blynk Android Application Interface                    | 43 |
| Figure 3.18 System Flowchart                                       | 44 |
| Figure 4.1 System Flowchart  | 47 |
| Figure 4.2 System Block Diagram                                    | 49 |
| Figure 4.3 System Hardware   | 49 |
| Figure 4.4 Complete Circuit  | 50 |
| Figure 4.5 Solar power supply circuit                              | 51 |
| Figure 4.6 Blynk Interface   | 52 |
| Figure 4.7 Temperature reading from 8.30 AM to 9.30 AM             | 53 |
| Figure 4.8 Light intensity reading from 8.30 AM and 9.30 AM        | 53 |
| Figure 4.9 Moisture reading from 8.30 AM to 9.30 AM                | 54 |
| Figure 4.10 Humidity reading from 8.30 AM to 9.30 AM               | 54 |
| Figure 4.11 Pots Measurement                                       | 56 |
| Figure 4.12 Agriculture Grid                                       | 56 |
| Figure 4.13 Long Bean Seed and Floatation of the Seed              | 56 |
| Figure 4.14 Plant A, Plant B, Plant C and Plant D Setup            | 57 |
| Figure 4.15 Real-Time Blynk Datastream from 8.30 AM to 9.30 AM     | 58 |
| Figure 4.16 Blynk Mobile App Data from 8.30 AM to 9.30 AM          | 58 |
| Figure 4.17 Day 1 Temperature reading from 8.30 AM to 9.30 AM      | 59 |
| Figure 4.18 Day 1 Light intensity reading from 8.30 AM and 9.30 AM | 60 |
| Figure 4.19 Day 1 Moisture reading from 8.30 AM to 9.30 AM         | 60 |
| Figure 4.20 Day 1 Humidity reading from 8.30 AM to 9.30 AM         | 60 |
| Figure 4.21 Real-Time Blynk Datastream from 5.30 PM to 6.30 PM     | 61 |
| Figure 4.22 Blynk Mobile App Data from 5.30 PM to 6.30 PM          | 62 |
| Figure 4.23 Day 1 Temperature reading from 5.30 PM to 6.30 PM      | 63 |
| Figure 4.24 Day 1 Light intensity reading from 5.30 PM and 6.30 PM | 63 |

|  |    |
|--|----|
| Figure 4.25 Day 1 Moisture reading from 5.30 PM to 6.30 PM           | 63 |
| Figure 4.26 Day 1 Humidity reading from 5.30 PM to 6.30 PM           | 64 |
| Figure 4.27 Real-Time Blynk Datastream from 10.30 PM to 11.30 PM     | 64 |
| Figure 4.28 Blynk Mobile App Data from 10.30 PM to 11.30 PM          | 65 |
| Figure 4.29 Day 1 Temperature reading from 10.30 PM to 11.30 PM      | 66 |
| Figure 4.30 Day 1 Light intensity reading from 10.30 PM and 11.30 PM | 66 |
| Figure 4.31 Day 1 Moisture reading from 10.30 PM to 11.30 PM         | 67 |
| Figure 4.32 Day 1 Humidity reading from 10.30 PM to 11.30 PM         | 67 |
| Figure 4.33 Real-Time Blynk Datastream from 8.30 AM to 9.30 AM       | 68 |
| Figure 4.34 Blynk Mobile App Data from 8.30 AM to 9.30 AM            | 69 |
| Figure 4.35 Day 2 Temperature reading from 8.30 AM to 9.30 AM        | 70 |
| Figure 4.36 Day 2 Light intensity reading from 8.30 AM to 9.30 AM    | 70 |
| Figure 4.37 Day 2 Moisture reading from 8.30 AM to 9.30 AM           | 70 |
| Figure 4.38 Day 2 Humidity reading from 8.30 AM to 9.30 AM           | 71 |
| Figure 4.39 Real-Time Blynk Datastream from 5.30 PM to 6.30 PM       | 71 |
| Figure 4.40 Blynk Mobile App Data from 5.30 PM to 6.30 PM            | 72 |
| Figure 4.41 Day 2 Temperature reading from 5.30 PM to 6.30 PM        | 73 |
| Figure 4.42 Day 2 Light intensity reading from 5.30 PM to 6.30 PM    | 73 |
| Figure 4.43 Day 2 Moisture reading from 5.30 PM to 6.30 PM           | 73 |
| Figure 4.44 Day 2 Humidity reading from 5.30 PM to 6.30 PM           | 74 |
| Figure 4.45 Real-Time Blynk Datastream from 10.30 PM to 11:30 PM     | 74 |
| Figure 4.46 Blynk Mobile App Data from 10.30 PM to 11.30 PM          | 75 |
| Figure 4.47 Day 2 Temperature reading from 10.30 PM to 11.30 PM      | 76 |
| Figure 4.48 Day 2 Light intensity reading from 10.30 PM to 11.30 PM  | 76 |
| Figure 4.49 Day 2 Moisture reading from 10.30 PM to 11.30 PM         | 76 |
| Figure 4.50 Day 2 Humidity reading from 10.30 PM to 11.30 PM         | 77 |

|   |    |
|---|----|
| Figure 4.51 Real-Time Blynk Datastream from 8.30 AM to 9.30 AM      | 78 |
| Figure 4.52 Blynk Mobile App Data from 8.30 AM to 9.30 AM           | 79 |
| Figure 4.53 Day 3 Temperature reading from 8.30 AM to 9.30 AM       | 80 |
| Figure 4.54 Day 3 Light intensity reading from 8.30 AM to 9.30 AM   | 80 |
| Figure 4.55 Day 3 Moisture reading from 8.30 AM to 9.30 AM          | 80 |
| Figure 4.56 Day 3 Humidity reading from 8.30 AM to 9.30 AM          | 81 |
| Figure 4.57 Real-Time Blynk Datastream from 5.30 PM to 6.30 PM      | 81 |
| Figure 4.58 Blynk Mobile App Data from 5.30 PM to 6.30 PM           | 82 |
| Figure 4.59 Day 3 Temperature reading from 5.30 PM to 6.30 PM       | 83 |
| Figure 4.60 Day 3 Light intensity reading from 5.30 PM to 6.30 PM   | 83 |
| Figure 4.61 Day 3 Moisture reading from 5.30 PM to 6.30 PM          | 83 |
| Figure 4.62 Day 3 Humidity reading from 5.30 PM to 6.30 PM          | 84 |
| Figure 4.63 Real-Time Blynk Datastream from 10.30 PM to 11.30 PM    | 84 |
| Figure 4.64 Blynk Mobile App Data from 10.30 PM to 11.30 PM         | 85 |
| Figure 4.65 Day 3 Temperature reading from 10.30 PM to 11.30 PM     | 86 |
| Figure 4.66 Day 3 Light intensity reading from 10.30 PM to 11.30 PM | 86 |
| Figure 4.67 Day 3 Moisture reading from 10.30 PM to 11.30 PM        | 86 |
| Figure 4.68 Day 3 Humidity reading from 10.30 PM to 11.30 PM        | 87 |
| Figure 4.69 Plant A and Plant B Height                              | 88 |
| Figure 4.70 Plant C and Plant D Height                              | 88 |
| Figure 4.71 Plant Height vs. Number of Days                         | 89 |



## LIST OF SYMBOLS

|             |   |                |
|-------------|---|----------------|
| $V$         | - | Voltage        |
| $A$         | - | Ampere         |
| $W$         | - | Watt           |
| $^{\circ}C$ | - | Degree Celsius |
| $nM$        | - | Nano Meter     |
| $\%$        | - | Percentage     |



## LIST OF ABBREVIATIONS

|             |   |                       |
|-------------|---|-----------------------|
| <b>IoT</b>  | - | Internet Of Things    |
| <b>CAD</b>  | - | Computer-aided design |
| <b>Volt</b> | - | Voltage               |
| <b>Amp</b>  | - | Ampere                |



## LIST OF APPENDICES

| APPENDIX   | TITLE                     | PAGE |
|------------|---------------------------|------|
| Appendix A | Arduino Uno Specification | 95   |
| Appendix B | Blynk Coding              | 96   |



# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Agriculture encompasses both the art and the science of working the land to harvest food. It covers the process of preparing crops so that they can be used by humans as their source of food. Vegetables and fruit are just a few of the many plant varieties that are being harvested in agriculture. Agriculture can be done on a small or large scale, depending on the size of the land and crop demand.

The development of plants depends heavily on the availability of water, especially moisture in the soil. This is since water is essential to photosynthesis since it serves as a reagent. Also, cell development and expansion depend on it. It is also useful as a solvent for minerals. However, if the soil is too wet or too dry, the roots will rot, and the plant will eventually die. Photosynthesis is how plants produce their own nourishment. This vital process relies on the energy provided by the sun. As a result, the quality, duration, and intensity of light energy may alter the development of plants. In addition to temperature, several other factors play a vital role in plant development. To begin with, the potential to influence a plant's metabolic rate. A plant's cells may be damaged by high temperatures, while those damaged by low temperatures become dormant. Because of this, the plant's well-being is in danger.

Sensors including light intensity, temperature, soil quality, and air humidity were included in the IoT-based smart agriculture to keep tabs on the plant's health and development. Monitoring is inadequate on its own to properly manage the plant's health and

development. Thus, IoT-based smart agriculture includes a pump for watering and fertilizing.

When the soil moisture is too low, the water pump kicks on to keep the plant adequately watered. A light intensity sensor is attached to the artificial sunshine, so it will switch on when there is not enough light energy. As a key part of the Internet of Things, sensor networks give us a new way to look at and interact with the real world that we didn't have before. Connecting the real world to the Internet of Things (IoT) with sensor networks will give us new ways to get, organize, and use information, as well as the chance to create new applications in agriculture. Water, light, and warmth are all essential for the health of a plant. Soil moisture, light intensity, temperature, and humidity were all factors that needed to be carefully managed so that plants would have a healthy environment.

## 1.2 Problem Statement

Plants can't survive or thrive without adequate amounts of water, light, and temperature. This is not just a statement but has been proven scientifically by Dr. HR Agalave in her published journal title, "Effect of environmental factors on productivity of crops" in the International Journal of Botany Studies. Environmental factors have an impact on crop productivity. Water is essential as a solvent for minerals, a photosynthetic reagent, and an essential component of cell development. Light, on the other hand, is essential because it provides the plants with the energy, they need to produce their own food via photosynthesis. The plant's metabolic process may be influenced by temperature. The cells will die if the temperature is too high or too low. In other words, keeping an eye on all these variables is critical. However, in today's fast-paced world, even the most dedicated farmers

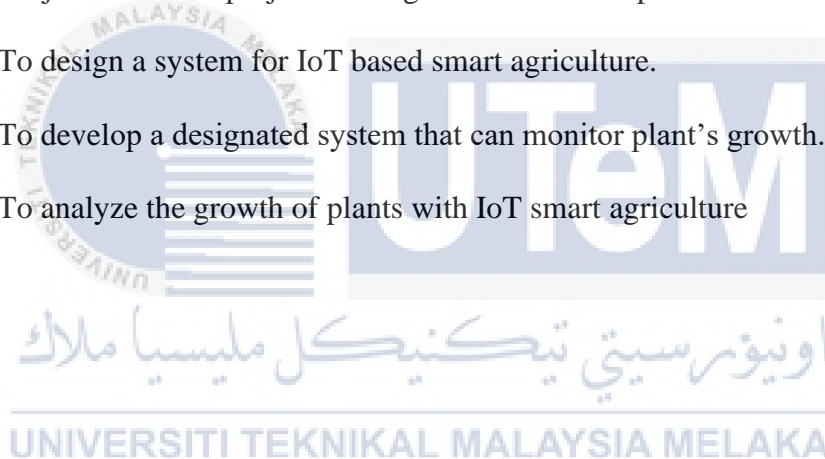
may find themselves short on time to tend to their plants. Farmers will be aided by "IoT Smart Agriculture" in the following ways:

1. Track the light level, temperature, soil moisture, and humidity in the air.
2. Make some of the actuators move based on what the sensors detect.
3. Grow healthy plants.
4. Taking care of the health of the plant.

### **1.3 Project Objective**

The objective of this project is categorized into three points:

- a) To design a system for IoT based smart agriculture.
- b) To develop a designated system that can monitor plant's growth.
- c) To analyze the growth of plants with IoT smart agriculture



### **1.4 Scope of Project**

The scope of this project are as follows:

- a) The "IoT Smart Agriculture" uses the Arduino Uno as a microcontroller.
- b) Monitoring the system with an Android app.
- c) Using a sensor for soil moisture, temperature, and humidity, and a sensor for light.
- d) The microcontroller will receive data from sensors for monitoring the plants.
- e) The microcontroller will be run with the help of solar energy.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

In nations like Malaysia that rely on agriculture for their economy, without proper management of our agriculture, it will effect the production of staple foods like vegetables. This means that if there is any type of disruption to the plants, the pace of output may fall. One of the major points to remember is to keep water management methods and technology up-to-date so that they can boost water consumption efficiency without effecting crop output. This may be accomplished without reducing overall crop production. The goal of the project is to make smart agriculture possible, which means reducing the amount of work and problems on farms that grow crops with the Internet of Things and having the data go straight to where it needs to be (IoT).

#### 2.2 Agriculture Issues

For people who care about agriculture and food production, a changing climate will make old problems more important and create new ones. To begin with, there is insufficient exposure to sunshine. According to the College of Engineering at Nanjing Agricultural University, Nanjing 210031, China, every plant has its own unique demand for light to continue living by using the process of photosynthesis. However, not everything receives an adequate amount of sunshine. Therefore, the use of artificial light is required to solve the issue. The presence of dampness and humidity has also been cited as one of the challenges that have been faced. The quantity of humidity that each plant requires varies, but it is

important to note that fluctuations in humidity levels can ultimately result in the death of the plant. It is possible to fight it by spraying water mist over the leaves of the plants. This will help. The issue of watering is another one that must be kept in mind. The amount of water that a plant receives depends on several factors, including the temperature differential, the amount of airflow that is present within the area of agriculture, the size of the container, and the presence or lack of light. Therefore, determining the moisture content of the soil was necessary to offer effective hydration.

### **2.2.1 Factors Influencing Plant Health**

According to the research that was done by VanDerZanden (2008) on the elements that impact healthy plant growth, the environment has a significant effect on the development of plants. It is possible for it to impede the development of the plant if any of the environmental elements are not optimal for its growth. It is possible to say that environmental stress is the primary cause of most of the plant's health problems. There are situations in which a plant is weakened by the stress of its surroundings, thereby making it more susceptible to disease. Light, temperature, water, humidity, and nutrition are just a few of the environmental elements that have the potential to influence the development of a plant. It is essential to have a good grasp of the role that these factors play in the development of plants. This is because knowing about these parts will help us to figure out what's wrong with the health of the plant and how to fix it.