SMART GREENHOUSE WITH IOT AND CLOUD COMPUTING

By

WONG JUN JIE

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman in partial

fulfillment of the requirements for the degree of

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS)

COMPUTER ENGINEERING

Faculty of Information and Communication Technology (Kampar Campus)

MAY 2021

UNIVERSITI TUNKU ABDUL RAHMAN

REPORT STATUS DECLARATION FORM

Title: Smart Greenhouse with IoT and Cloud Computing

Academic Session: May 2021

I WONG JUN JIE

(CAPITAL LETTER)

declare that I allow this Final Year Project Report to be kept in
Universiti Tunku Abdul Rahman Library subject to the regulations as follows:

1. The dissertation is a property of the Library.
2. The Library is allowed to make copies of this dissertation for academic purposes.

Verified by,

(Author's signature)

(Supervisor's signature)

Address:
S-118, Mambang Di Awan
31950, Kampar,
Perak

Leong Chun Farn

Supervisor's name

Date: 1 September 2021

Date: 1 September 2021

FACULTY/INSTITUTE* OF _____INFORMATION AND COMMUNICATION TECHNNOLOGY_____

UNIVERSITI TUNKU ABDUL RAHMAN

Date: ___1 September 2021_____

SUBMISSION OF FINAL YEAR PROJECT /DISSERTATION/THESIS

It is hereby certified that _____***Wong Jun Jie***_____ (ID No: __***17ACB03681***___) has completed this final year project/ dissertation/ thesis* entitled "_____*Smart Greenhouse with IoT and Cloud Computing*_____" under the supervision of _____Mr. Leong Chun Farn_____ (Supervisor) from the Department of _____FICT_____, Faculty/Institute* of _____Information and Communication Technology_____ , and ____Dr, Chang Jing Jing_____ (Co-Supervisor)* from the Department of _____ FICT _____, Faculty/Institute* of _____Information and Communication Technology _____.

I understand that University will upload softcopy of my final year project / dissertation/ thesis* in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

Wong Jun Jie

DECLARATION OF ORIGINALITY

I declare that this report entitled "**SMART GREENHOUSE WITH IOT AND CLOUD COMPUTING**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature : 

Name : WONG JUN JIE

Date : 1 SEPTEMBER 2021

ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to my supervisors, Mr Leong Chun Farn and Dr Chang Jing Jing who has given me this bright opportunity to engage in this IoT based project. It is my first step to establish a career in IoT field. A million thanks to you.

Finally, I must say thanks to my parents and my peer groups for their love, support and continuous encouragement throughout the course.

ABSTRACT

This project is an IoT design project for academic purpose. It will provide students with the methodology, concept and design of semi-automated gardening system with IoT. This will be illustrated through the construction of automated smart greenhouse system. Since the function of microprocessor, Raspberry pi is suited for IoT projects, hence, a microprocessor of Raspberry pi 3 B+ model will be used in this project. In the project, Raspberry pi will be used as a microprocessor to control the output of the whole system in order to ensure the system perform task properly. A small succulent plant, Tradescantia Pink Lady was planted under the services provided by the smart greenhouse system in order to prove the functionality of the smart greenhouse system. The system built included the techniques of IoT, which will receive the data from the sensors to justify the surrounding condition of the plant and the output will be treated as a coping mechanism which could provide the suitable services to the plant. In the project, the system design could be separated to 2 parts, which is hardware part and software part. Hardware part is included all the circuity designed, input components, output components and Raspberry pi microprocessor which can directly provide water, ultraviolet light and etc. to the plant. On the other hand, the software part is the program deploy by using python 3 language and Ubidots IoT platform dashboard is acted as the user interface to check the surrounding condition of the plant and control the output of the system. Last but not least, the smart greenhouse system is designed to produce an optimal condition for the plant to grow.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

LDR	Light Dependent Resistor
IOT	Internet of Things
N-MOSFET	Negative Channel - Metal–Oxide–Semiconductor field-effect Transistor
ADC	Analog to Digital Convertor

Chapter 1

Introduction

In this chapter, we present the problem statement and motivation, project scope, project objective, project contribution and background information.

1.1 Problem Statement and Motivation

The problem statement for this project is lack of time and energy to take care of plant. Most of the people especially people live in urban are worst of wear after the whole day of work, and hence they are exhausted and don't have any extra time to plant some flowers, small plants and etc. When they went back home, they even don't want to cook and just called the food delivery, let alone gardening. However, with the automated smart greenhouse system, the people can plant whatever plants in good hands without spending a lot of time. This is because the automated smart greenhouse system can help them to take good care of their plants and save their time. Other than this, the motivation of this project is able to help every single people that worst of wear could have some time for gardening and enjoy the art of gardening. Gardening can help people alleviate their stress, as looking at the green plants or flowers, they will feel comfortable and the emotion will become good. When the plants grown up, they will a life satisfaction and become more energetic.

1.2 Project Scope

In this part, we will present the final product that has been built at the end of the project. In this project, a prototype of simple IoT based system has been built. This system can

help people to take care of the plants, so that, they no need to spend a lot of time to watering, put it to a place to get sunlight and etc. The system can be fully automated to carry out tasks in order to provide a suitable environment for the plant. Other than this, the user can also check the surrounding condition of the plant and monitor the outputs if that is needed. Lastly, the final product has been built in the end of the project is a simple and friendly user IoT based smart greenhouse system that is suitable for indoor gardening.

1.3 Project Objectives

In this part, we will present the objective to construct the project. The objective to do this project is to bring out a simple IoT based system that is easy to use which help user in gardening. With this system, user can plant some flowers or small plants that is not require much high requirements in good hands. As this system could help user to take responsible to water, provide sunlight and etc. to the plant, so, it could help user save a lot of time. However, this system could only use to plant some small plants or flowers that is easy to plant and don't need high requirements. Other than this, the system is available to a small number of plants or flowers, hence, a large number of plants is not suitable to use the system. Last but not least, the system is being built for the caring of the flowers and small plants which are suitable for indoor gardening.

1.4 Impact, Significance and Contribution

In this part, we are going to present the contribution the project can bring up. The project is about to deliver a simple and easy to use automated greenhouse system. It is a good

hand for user which could help user in gardening. In this case, people who are busy but like to plant some flowers or small plants could use it. Most of the time, people are worst of wear after daily work or some people even have to work over time, hence, there is no extra and free time to take care of their plants. However, with a smart greenhouse system, user could able to juggle both work and plants. As the smart greenhouse system could help them to take care of their plants although they are busy and don't at home that cause them to neglect their plants. Lastly, the system is worth for user who is keen in gardening but he or she is occupied by work and worry about they will forget and leave the plant alone, this system could help them to carry their responsibility.

1.5 Background Information

In this project, the core technique used was IoT, IoT is very popular in nowadays. It is a technique that brings out a lot of benefits and make works to be done more efficient. First of all, it is a technique that make all things connected to the Internet and allow them able to communicate with each other. Every single thing that connected to the Internet has a sensor that collect data and send to the Internet. While on the Internet, there may have a program to compute the data and initiate the coping mechanism to perform certain tasks on the certain thing. Once the things receive the signal from the Internet, it will perform the task given by the program from the Internet. In this case, it shows the communication between the things and Internet. Other than this, user can access and control the things through the smart phone that connected to the Internet. They can get all the information about the things on the IoT based application and control the things by simply press the button on the dashboard of the app which will send out the control signals. It should be

convenient for them to do some works. The trendy and popular idea would be the smart home. In smart home, all the electrical appliances are connected to the Internet so that the home user can be easily control the smart things inside the home. For example, if the home user is outside and he or she wants to enjoy the cool condition when he or she go back home, so that he or she can turn on the air conditioner through the smart phone at outside, when he or she arrive at home, there is a cool condition right there. Hence, it is how IoT could bring a benefit, alleviate works and make life more comfortable.

Secondly, IoT technique also has been used in agriculture area. It is the greenhouse to plant the fruits and vegetables. Greenhouse could provide an optimal environment to the plants in order to maximize their crop and then increase the commercial revenues. The greenhouse is a house made of glass wall and glass roof which allow the sunlight to shine in and so that the plants in the greenhouse can get enough sunlight in all direction. Other than this, there is an automated irritation system to water the plant automatically. In this case, it seems like an unmanned big device that take care of the plants on its own.

Thirdly, since the project is decided to build a simple smart greenhouse system, hence, the material using in the project is included small numbers of sensors and output materials only. First of all, the project could be separated to two parts which is hardware part and software part. Hardware part includes the circuit design, the input sensors, output materials and a microprocessor. While the software part includes the program code writing and the IoT based application design. The sensors are used to collect the data around the plant, the output materials are used to perform certain tasks to maintain the optimal environment for the plant. The program is run to monitor the whole system while

the IoT based app provides the user interface for user to keep track of the surrounding condition of the plant and control the outputs as well.

Last but not least, this project is to develop a simple and friendly user system for user to have time in indoor gardening. All the things can be easily done by using smart phone. Hence, user can easily have a healthier grown up plant.

Chapter 2

Literature Review

In this chapter, we will present the literature review which cite the journal about the project of Smart Greenhouse with IoT and Cloud Computing, and the difference between the prior project and this project.

2.1 Literature Review

First of all, the report is taken from International Research Journal Engineering Technology (IRJET). The report is about the project complete by the students from Shivaji University Kolhapur, Maharashtra, India. In the project, a Smart Green House android app is use to observe and manage the microclimate variable inside the Green House. The app can easily get the sensor values, such as soil moisture value, humidity value, temperature value and etc. The sensors are set predefined threshold value, once the threshold value is triggered, it will be the notifications pop out on the app. In this case, user can know what the plant needs and give that to the plants by just pressing the button on the app. With this action, the motor that connect to the outputs, such as water sprayer, rooftop and focus light will be turn on, hence, the plants can get what they need and the plants in the green house can keep maintain in the optimal environment.

Secondly, in the project, the smart greenhouse system opposes an advanced function which is it has all datasheet about the horticulture plantation and season wise precaution material for controlling and monitoring. In this case, they can manage and plant the horticulture plantation with high requirements. The horticulture plantation might need highly care in order to survive, and if the green house undergoes an immediate microclimate change that cause by the outside weather change will lead to a massive

impaired to the plantation. However, with the season wise precaution material, it could use to cope with the sudden climate change that affect the condition in the green house.

Thirdly, we talk about the proposed method in the project. In the project, the system can be used to closely observe the microclimatic change in the green house. When arrived the crop yield season, the productions of the plantation in the green house can be vouched for maximum numbers as the growth of the plantations is smooth sailing under the condition provided by the green house. Other than this, this system can alleviate the human resource as the green house doesn't include the human intervention. Next, the sensors used are soil moisture sensor, dht11 sensor and light dependent sensor, which collect and send data to the microprocessor. The microprocessor, Raspberry pi are used as a heart of the system to manage the whole system. The outputs are act as the coping mechanism which provide the necessary things to the plantation when receive the control signals. Furthermore, there is including cloud computing technique which enable user to keep track the inner condition of green house and control the outputs through the app on smart phone.

Last but not least, the project is created because there are lots of agriculture activities carried out in India. The agriculture activities are expanded and bring up a lot of business activities which boost the economy of India. Thus, the creation of smart greenhouse system is fully satisfied and help the agriculture activities. With the smart greenhouse system, the people participate in agriculture activities can be more easily handle the plantation and may make a killing from the production of the crop yield.

2.2 Critical Remarks of Previous Works

In this part, the work to be discussed is the difference between my project and the previous works. First of all, the previous works' target is to help the massive agriculture plantation in order to alleviate the human resource to save cost and the smart greenhouse system can accurate to maintain the microclimatic variables in the greenhouse. Furthermore, the smart greenhouse system will use a large number of sensors and some output materials that suit the size of the plantation. It must make sure that the sensors can cover the area of the plantation in order to hold the inside condition of the greenhouse more accurately. Other than this, the outputs used are water sprayer, fan and focus light which can be provide the enough necessities to the plantation. Lastly, the cost of maintenance could be high in order to make sure the flaws of the system can be rectified. On the other hands, the project of mine is targeted the small indoor gardening activities. My project is to help the people who are keen on indoor gardening to take care of their plants. Because the people in nowadays are very busy and often occupied by works, hence, they may not have time to look after their plants. But with the system in my project, they can juggle both their works and plants. In the project, the system is designed with a small number of sensors and some simple and cheap output materials. The system is designed to take care the small plants and flowers indoors. Last but not least, the system is not as flashy as compare to the previous work, but it's enough for helping users to grow up their plants.

Chapter 3

Methodology

In this chapter, we present the system design of the system and clarify how is the system would work.

3.1 Design Specifications

First of all, a semi-automated smart greenhouse system is constructed in the project. The design of the system could be separated to two parts, which is hardware part and software part. Hardware part is considered the whole circuity design which connect all the input components and output materials. The input components include a 3.3V digital light dependent resistor sensor (LDR), a 3.3V soil moisture sensor and a 3.3V DHT11 sensor as well. The LDR collects the data of surrounding light of the plant. The soil moisture sensor collects the data of soil moisture of the plant. The DHT11 collects the data of surrounding humidity and temperature of the plant. Whereas, the output components include a 5V ultraviolet (UV) lights lamp, a 5V electrical fan and a 12V motor. The UV lights lamp provide UV lights for plant to carry out photosynthesis. The fan cools down the surrounding temperature of the plant. The motor pumps the water to the plant. There are three N-MOS (n-channel MOSFET) are used to work with the three output materials. They are connected with three materials, led growth lamp, motor, and fan respectively which could help in controlling the outputs. Moreover, there is a microprocessor, Raspberry pi 3 Model B+ was used in the design in order to run the program code controlling the system output and send the data collected to the IoT based application. Because of the raspberry pi's pin is only work with the digital signal, so, a hardware component, ADC MPC3008 (analog to digital converter) was connected with digital ldr

sensor and soil moisture sensor in order to convert the analog signal collected for ease of reading by the raspberry pi. On the other hands, the software part includes the program code writing on Raspberry pi which use to control the whole system workflow and also the IoT based application design by using UBIDOTS IoT platform which act as user interface and show the data of the surroundings of the plant. The IoT based application was used to control the output of the system as well. The workflow is that the program will schedule the daily output management in order to provide what the plant needs when the power of the raspberry pi is on. When the output button on the IoT based application is activated, the output materials will be turn on. Lastly, these are the design specification about the semi-automated smart greenhouse system which purposely provide the optimal environment for the plant to grow.

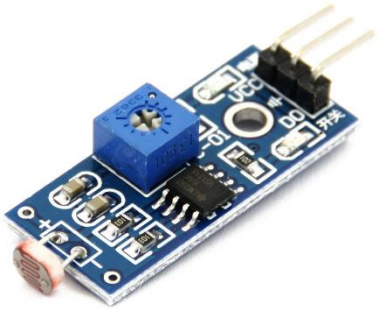


Figure 3.1

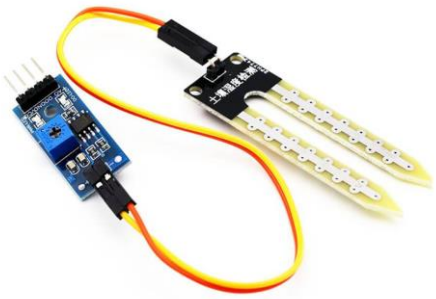


Figure 3.2

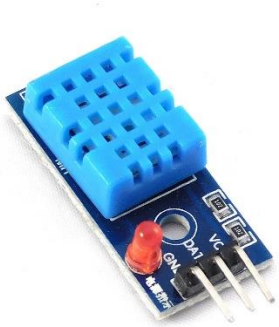


Figure 3.3

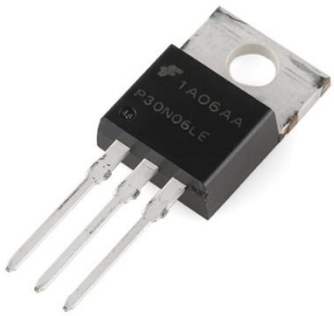


Figure 3.4

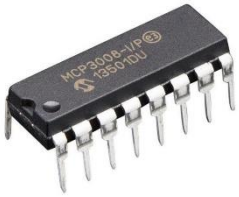


Figure 3.5

Figure 3.6

Figure 3.7

Figure 3.8

Figure 3.9

3.2 System Work Flow Clarification

In this part, it is explained how the system would work. First of all, the system is designed and implemented to help in indoor gardening for taking care of the indoor plants. The work flow of the system is mainly controlling by the program in the raspberry pi. While the program runs, it reads the surrounding data from the input sensors continuously. The input data read from the input sensors are updated to the IoT dashboard of Ubidots platform. For the temperature and humidity, they are read by the dht11 sensor, if the temperature value is reached the threshold value set, the program would send an email to tell the user that he/she should turn on the fan in order to cool down the surrounding temperature of the plant. For the output of the fan, he/she could turn on the fan by just clicking the on off button on the IoT dashboard, once the button was clicked, it turned to on status and the program could read the on status and send a binary 1 signal to the output, when the signal reach the N-MOS, it

released the current that are blocked from flowing to the output, and eventually, the pass through the fan and the fan is powered on. Whereas for the light intensity and soil moisture, the output signal pin of ldr sensor and soil moisture sensor are connected to the ADC MPC3008 in order to read the analog signal for the raspberry pi, the analog signals were read as the threshold value that might trigger the activation of the outputs. When the data collected had reached the threshold level, it would straight forward trigger the outputs to activate and send an email to tell the user that the data collected has reached the threshold level and the output was powered on automatically. These two variables set to be worked automatically because the user couldn't turn on the light or the motor on time, it might cause some negative impacts to the growth of the plant. While the design of the system to let user turn on the fan manually is to make the system more interactive. Last but not least, the system was designed to be a semi-automatically which the light and motor were triggered by the threshold level and powered on automatically, the fan was powered on manually by the user when they receive the email notifications.

Chapter 4

Hardware Design and Implementation

In this chapter, it talks about the hardware design and implementation.

4.1 System Architecture

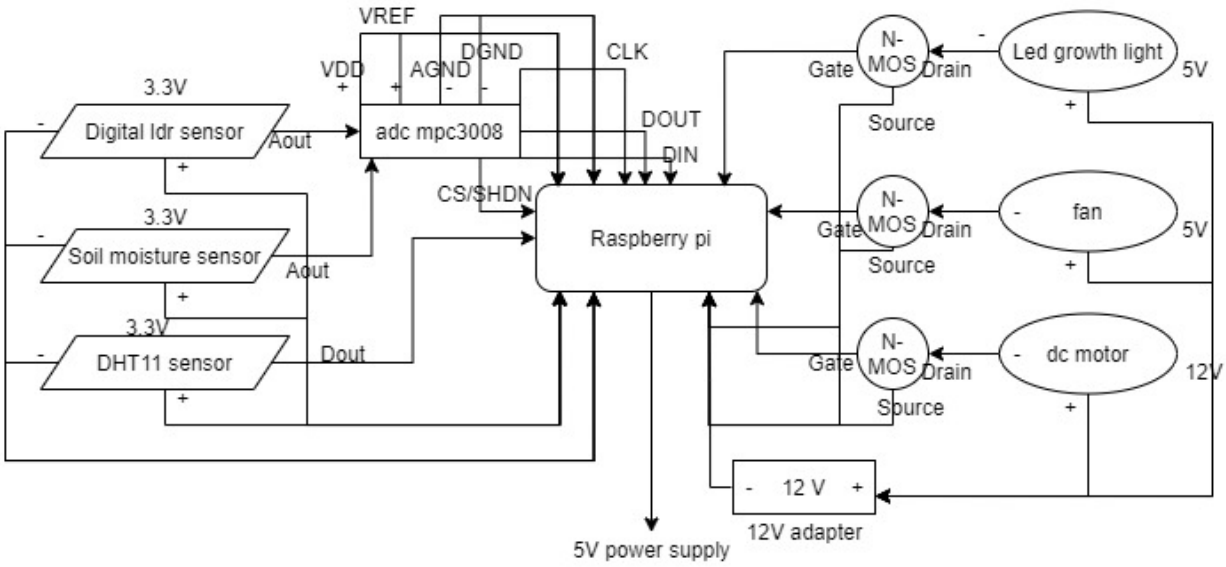


Figure 4.1

First of all, the digital ldr sensor and soil moisture sensor were connected to the adc mpc3008 in order to read the analog signal collected. Because of raspberry pi pin is only able to read digital signal, so, the adc mpc3008 is critical to help raspberry pi to read the analog signal. The adc mpc3008 is connected to raspberry pi through hardware SPI connection which the raspberry pi has enable the SPI connection. The connections of adc mpc3008 to raspberry pi are,

MCP3008	Raspberry Pi
VDD	3.3V
VREF	3.3V

AGND	GND
DGND	GND
CLK	SCLK
DOUT	MISO
DIN	MOSI
CS/SHDN	CE0

Table 4.1.1

While the output materials are connected to a N-MOSFET respectively. The connections are,

Outputs that connected to MOSFET	**Gate**	**Drain**	**Source**
Led growth lamp	Pin 16	Negative site of output	GND
12V DC motor	Pin 18	Negative site of output	GND
Fan	Pin 22	Negative site of output	GND

Figure 4.1.2

4.2 Schematic Diagram

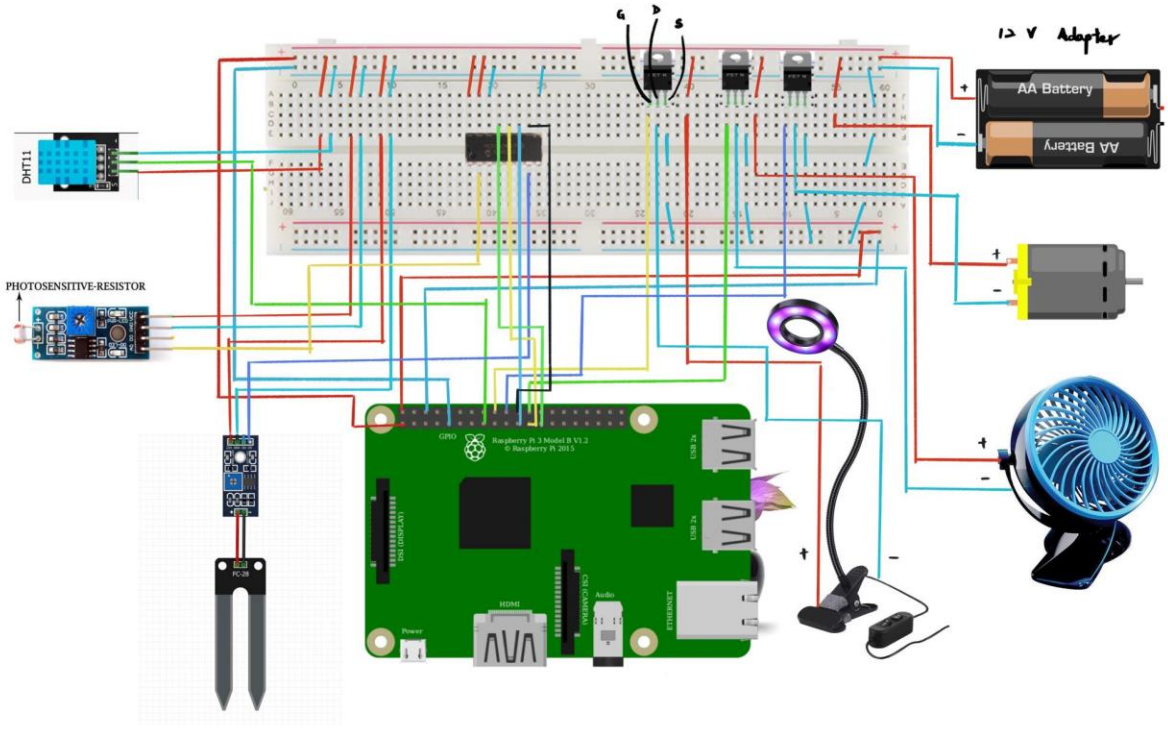


Figure 4.2

4.3 Hardware setup

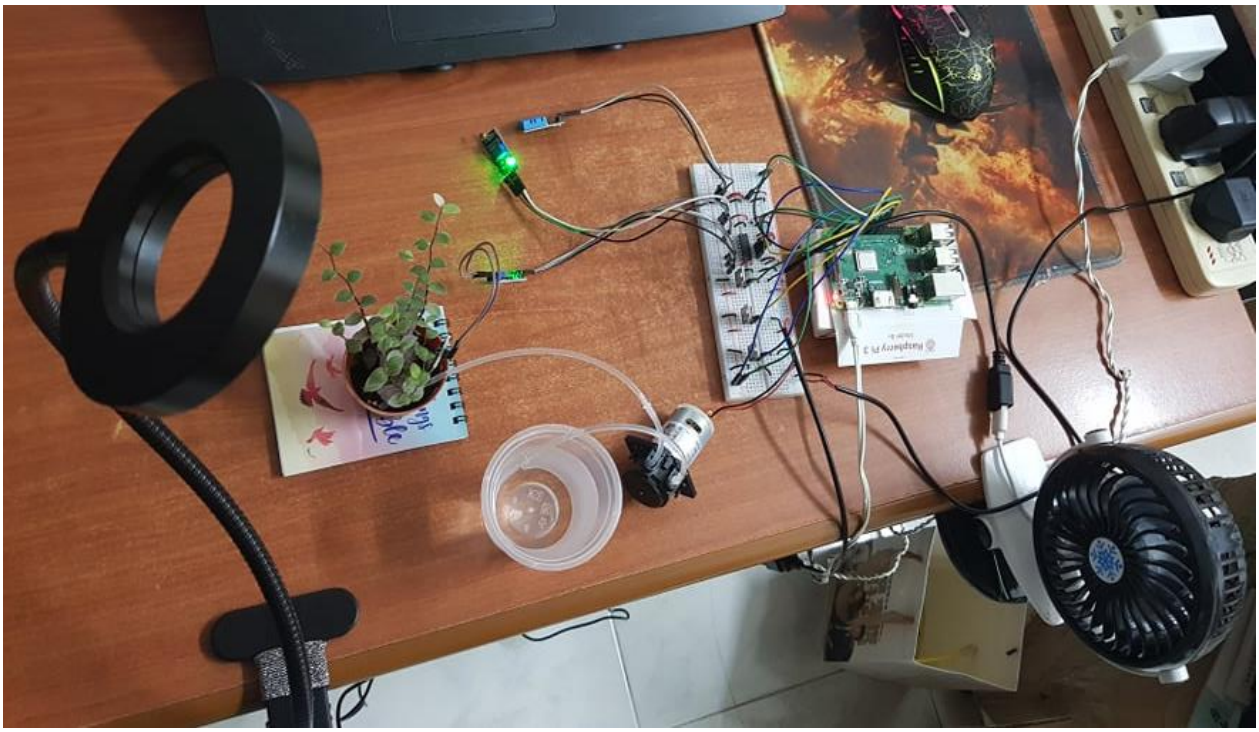


Figure 4.3

Chapter 5

Software Design and Implementation

In this part, the software that built the program is using python3 in Raspberry pi. Python3 was used to write the program in order to monitor the whole system. The program will run to manage the outputs which will provide what the plant needs daily based on the surrounding condition of the plant. This can ensure that the plant has an optimal environment to grow. Other than this, an IoT based application was designed in order to construct a user interface to easier interact with the IoT devices of the system. UBIDOTS IoT platform was used to develop the IoT based application. Through the IoT dashboard, the data of the surrounding of the plant can be easily check out and the outputs can be easily control as well. Lastly, the software part is used to monitor the whole system and make sure it can work properly to provide a good care to the plant.

5.1 Flow Chart

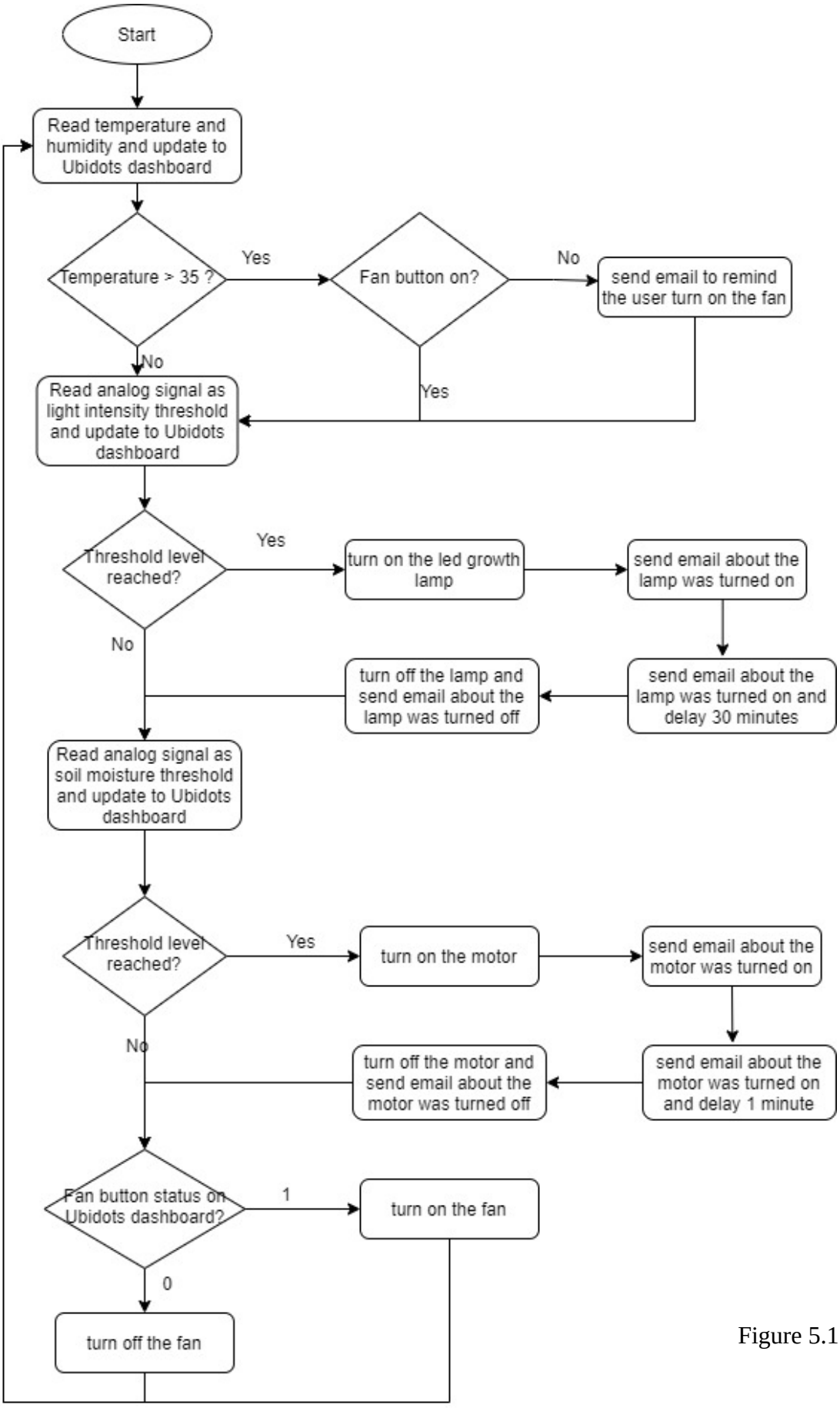

Start
Read temperature and humidity and update to Ubidots dashboard
Temperature > 35 ?
Yes
Fan button on?
No
send email to remind the user turn on the fan
No
Yes
Read analog signal as light intensity threshold and update to Ubidots dashboard
Threshold level reached?
Yes
turn on the led growth lamp
send email about the lamp was turned on
No
turn off the lamp and send email about the lamp was turned off
send email about the lamp was turned on and delay 30 minutes
Read analog signal as soil moisture threshold and update to Ubidots dashboard
Threshold level reached?
Yes
turn on the motor
send email about the motor was turned on
No
turn off the motor and send email about the motor was turned off
send email about the motor was turned on and delay 1 minute
Fan button status on Ubidots dashboard?
1
turn on the fan
0
turn off the fan

Figure 5.1.1

The program runs and read the surrounding data from the input sensors,

Input sensor	**Data collected**
DHT11	Temperature Humidity
Digital LDR sensor	Light intensity threshold
Soil moisture sensor	Soil moisture threshold

Table 5.1

The data read from the input sensors are updated to the Ubidots dashboard from time to time,

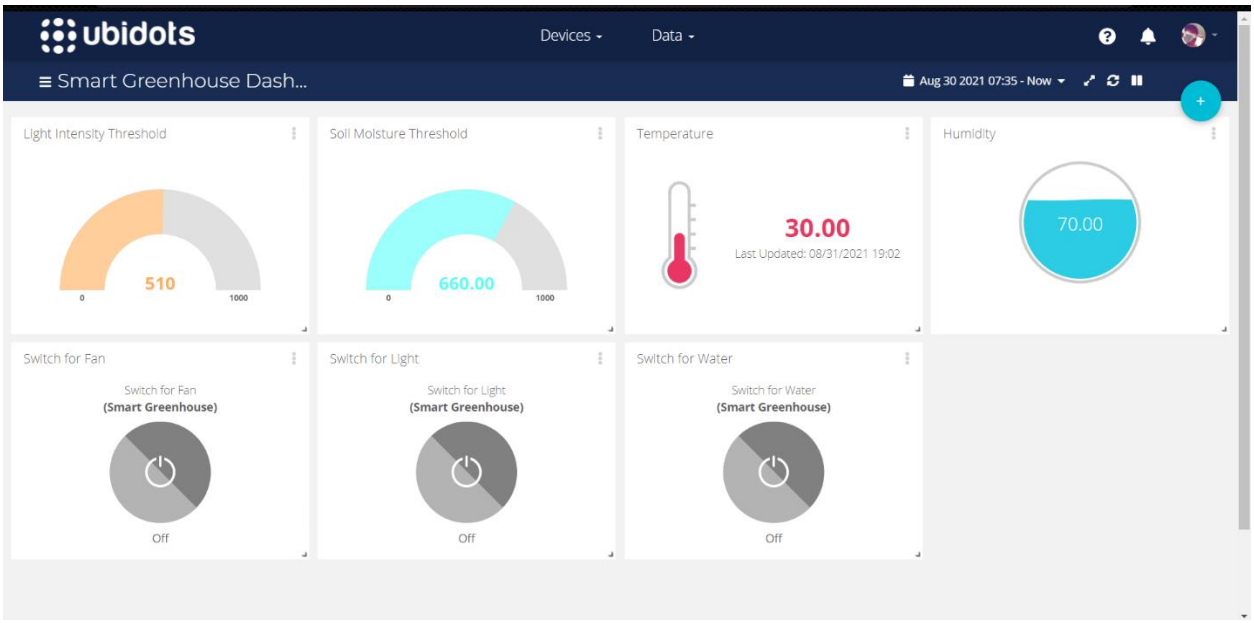


Figure 5.1.2

When the temperature value is over the threshold set, the program will send an email to the user to tell he/she to turn on the fan by clicking the switch button on the Ubidots dashboard. Whereas the motor and led growth lamp is triggered when the light intensity threshold and soil moisture threshold are hit, the motor and led growth lamp will turn on automatically when the light intensity threshold over 650 and soil moisture threshold over 1000. After the outputs turned on,

the program will send an email to notify the user that the outputs have turned on. The led growth lamp will only trigger when there is on light in the morning 8.00 to 8.30 a.m., once it is triggered and turn on, it will keep turning on for 30 minutes. For the motor, when it turns on, it will maintain 1 minutes as the time is enough for it to pump enough water to the plant.

5.2 Program Code

```
import RPi.GPIO as GPIO
import Adafruit_DHT
from ubidots import ApiClient
from time import sleep
import smtplib
import Adafruit_GPIO.SPI as SPI
import Adafruit_MCP3008
from datetime import datetime

AUTH_TOKEN = 'BBFF-q7w2MceylUpHNW84aJSt0dZBTNJ7g1'
MY_EMAIL = "<EMAIL>"
MY_PASSWORD = "<PASSWORD>"
SLEEPTIME = 1
switch_is_on = False
now = datetime.now()
hour = now.hour
minute = now.minute

class Email:

    global MY_EMAIL
    global MY_PASSWORD

    def __init__(self, subject, message):
        self.subject = subject
        self.message = message

    def send_mail(self):
        with smtplib.SMTP("smtp.gmail.com", 587) as connection:
            connection.starttls()
            connection.login(MY_EMAIL, MY_PASSWORD)
            connection.sendmail(
```

```
                from_addr=MY_EMAIL,
                to_addrs=MY_EMAIL,
                msg=f"Subject:{self.subject}\n\n{self.message}"
            )

class Switch:
    global switch_is_on

    def __init__(self, pin_number, authentication_token, variable_id):
        self.pin_number = pin_number
        GPIO.setwarnings(False)
        GPIO.setmode(GPIO.BCM)
        GPIO.setup(self.pin_number, GPIO.OUT, initial=0)
        self.api = ApiClient(token=authentication_token)
        self.my_switch = self.api.get_variable(variable_id)

    def turn_on(self):
        GPIO.output(self.pin_number, 1)

    def turn_off(self):
        GPIO.output(self.pin_number, 0)

    def event_trigger(self):

        try:
            status = self.my_switch.get_values(1)
            if status[0]['value']:
                GPIO.output(self.pin_number, 1)
                print("status: %d" % status[0]['value'])
                switch_is_on = True
            else:
                GPIO.output(self.pin_number,0)
                print("status: %d" % status[0]['value'])
                switch_is_on = False
        except KeyboardInterrupt:
            GPIO.cleanup()
            exit()

# Inputs
SPI_PORT   = 0
SPI_DEVICE = 0
mcp = Adafruit_MCP3008.MCP3008(spi=SPI.SpiDev(SPI_PORT, SPI_DEVICE))

sensor = Adafruit_DHT.DHT11
```

```
gpio = 22
lightChannel = 1
soilmoistureChannel = 6

api = ApiClient(token=AUTH_TOKEN)
my_temp = api.get_variable('60ead7fc4763e70d90e9c0c3')
my_humi = api.get_variable("60ead80f4763e70f95bf2687")
my_light = api.get_variable('60edee0e4763e71443b24498')
my_water = api.get_variable('60ededd94763e7147da07a77')


# Outputs
light = Switch(23, AUTH_TOKEN, "60eba05e4763e71a684bd96c")
fan = Switch(25, AUTH_TOKEN, '60edee4c4763e7178d48e93b')
water = Switch(24, AUTH_TOKEN, '60edee3f4763e7175e78b261')


# Emails
fan_turn_on = Email("Turn on the fan", "The temperature is over 35 degree Celsius
, the fan should be turn on.")
light_is_on = Email("Light is on", "The light intensity is too low, the light is
turned on for the plant.")
light_is_off = Email("Light is off", "The plant has gotten enough uv light, the
led growth light is off.")
water_provided = Email("Water is provided", "The soil is dry, so, the motor is tu
rned on to pump the water to the plant.")
water_stopped = Email("Water is stopped", "The plant is gotten enough water, the
motor is stopped to pump the water.")


# main loop
def mainloop(sensor, gpio, lightChannel, soilmoistureChannel):
    global light, fan, water, SLEEPTIME, light_is_on, water_provided, now, hour,
minute

    while True:
        fan.event_trigger()

        humidity, temperature = Adafruit_DHT.read_retry(sensor, gpio)
        if humidity is not None and temperature is not None:
            print('Temp={0:0.1f}*C  Humidity={1:0.1f}%'.format(temperature, humid
ity))
            new_temp = my_temp.save_value({"value": temperature})
            new_humi = my_humi.save_value({"value": humidity})
```

```
            if temperature > 32 and not switch_is_on:
                fan_turn_on.send_mail()
        else:
            print('Failed to get reading. Try again!')

        light_intensity_threshold = mcp.read_adc(lightChannel)
        print(f"Light intensity threshold: {light_intensity_threshold}")
        new_light = my_light.save_value({'value': light_intensity_threshold})
        if light_intensity_threshold > 650 and hour == 8 and minute <= 30:
            light.turn_on()
            light_is_on.send_mail()
            sleep(1800)
            light.turn_off()
            light_is_off.send_mail()

        soil_moisture_threshold = mcp.read_adc(soilmoistureChannel)
        print(f"Soil moisture threshold: {soil_moisture_threshold}")
        new_water = my_water.save_value({'value': soil_moisture_threshold})
        if soil_moisture_threshold > 1000:
            water.turn_on()
            water_provided.send_mail()
            sleep(60)
            water.turn_off()
            water_stopped.send_mail()

        sleep(SLEEPTIME)



mainloop(sensor, gpio, lightChannel, soilmoistureChannel)
```

The program code could be classified to three parts which are inputs, outputs and emailing system. The inputs part included temperature and humidity value collected by dht11 sensor and the two analog signals, light intensity threshold and soil moisture threshold that collected by digital ldr sensor and soil moisture sensor, the value are collected and updated to Ubidots dashboard time by time. For the output parts, a Switch class is created in order to easily coding and managing by using the light, water and fan object. Through the function of the object, the

code will become readable and clear. For the emailing system, an Email class is created in order to easily coding and managing by using the email object for three different outputs. The email object fan_turn_on is to send email to tell the user to turn on the fan as the surrounding temperature of the plant is high. The email object light_is_on is to send email to notify the user that the led growth light has on and the email object water_provided is to send email to notify the user the motor was on to pump water to the plant. Last but not least, the mainloop function is to keep the program run and update the information to the Ubidots dashboard.

Chapter 6

Experimental Result

In this chapter, it is clarified the experiment result of the function of the semi-automatic smart greenhouse. In the experiment, a small succulent plant, Tradescantia Pink Lady is given to the semi-automatic smart greenhouse to take care of it.

Figure 6.1

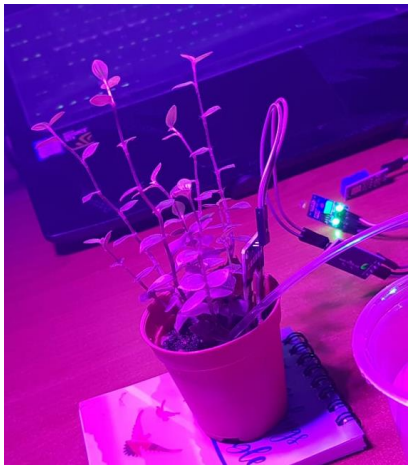
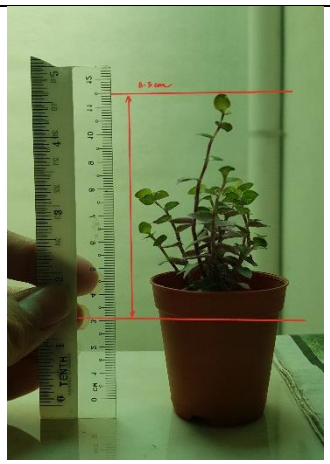
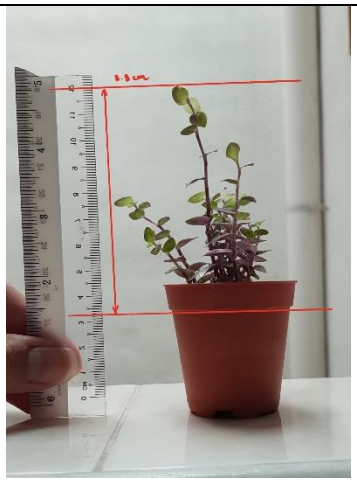


Figure 6.2

During the period of experiment, the growth of Tradescantia Pink Lady under the care of smart greenhouse is observed. The height of Tradescantia Pink Lady was recorded daily in one week. The result was,

Day	Height (cm)	Condition

1	7.0	
2	8.5	

3	8.5	
4	8.8	
5	8.8	

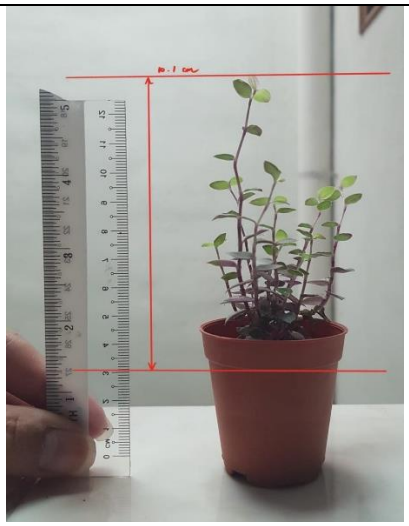
6	9.2	
7	10.1	

Table 6.1

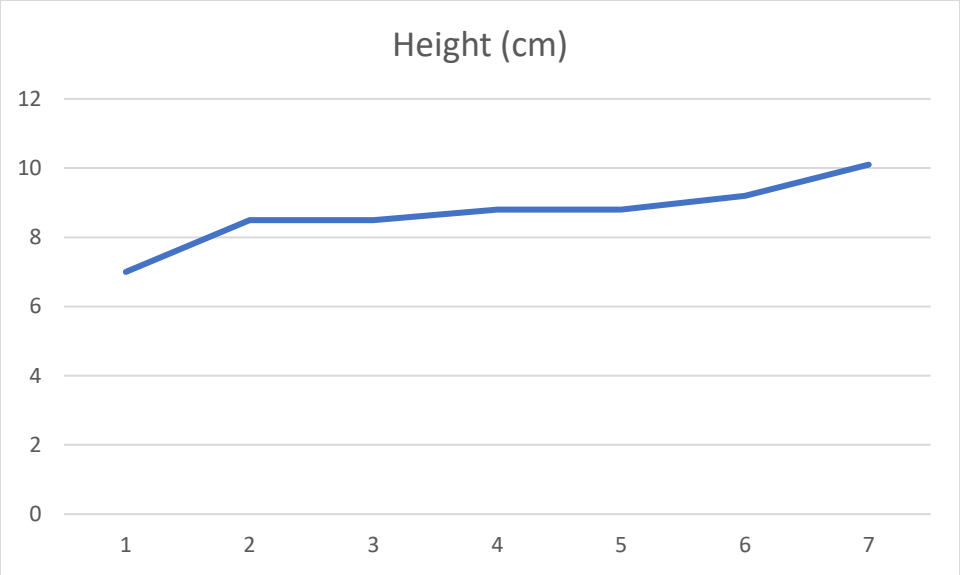


Figure 6.3

Chapter 7

Conclusion

As a conclusion, the problem statement for this project is lack of time and energy to take care of plant. Most of the people especially people live in urban are worst of wear after the whole day of work, and hence they don't have any extra time to plant some flowers, small plants and etc. but with the semi-automated smart greenhouse system, the people can plant whatever plants in good hands. This is because the semi-automated smart greenhouse system can help them to take good care of their plants. Other than this, the motivation of this project is able to help every single people that worst of wear have some time for gardening and enjoy the art of gardening. Gardening can help people alleviate their stress, as looking at the green plants or flowers grown up, they will feel a satisfaction in life and the emotion will become good. Last but not least, the semi-automated greenhouse system is very easy to get around. As people can direct access the system through the smart devices. Through the IoT based application, user can directly check the surrounding condition of the plant and monitor the outputs if they receive any notifications sent from the program through email.

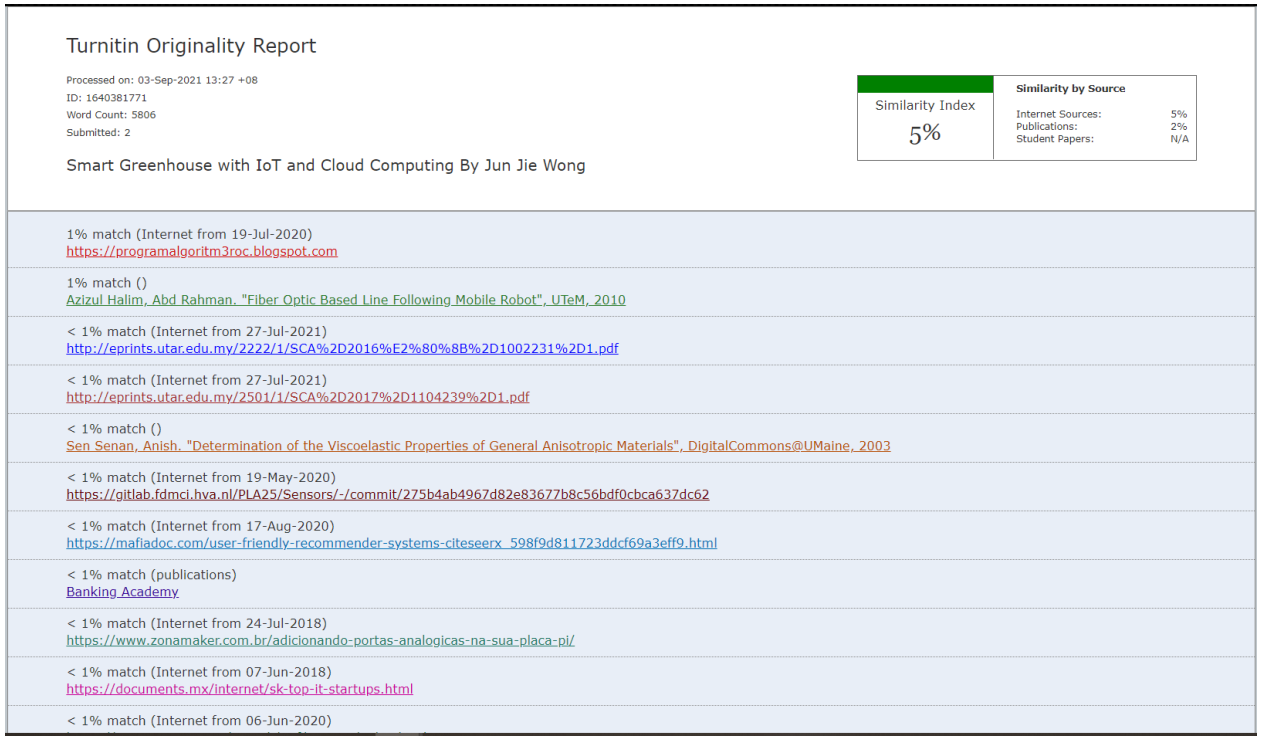
References

1. Somnath D. Bhagwat1, Akash I. Hulloli2, Suraj B. Patil3, Abulkalam A. Khan4, Mr. A.S. Kamble5 2018, 'Smart Green House using IOT and Cloud Computing', International Research Journal of Engineering Technology, vol. 05, no. 03, pp. 2330-2333.
2. Smart Green House using IOT and Cloud Computing 2018, International Research Journal of Engineering Technology. Available from: < www.irjet.net> [April 2020]
3. 01_Getting started with Raspberry Pi using Python programming, 2019, lecture notes distributed in Mini Project, UCCE2513 at University Tunku Abdul Rahman on October 2019
4. 03_General Purpose Input_Output, 2019, lecture notes distributed in Mini Project, UCCE2513 at University Tunku Abdul Rahman on October 2019
5. 04_IoT Protocol and Platform, 2019, lecture notes distributed in Mini Project, UCCE2513 at University Tunku Abdul Rahman on October 2019

Poster


Smart Greenhouse with IoT and
Cloud Computing
Introduction
✓ A semi-automated greenhouse that help to take care the plant
✓ Could easily monitor the data of the surrounding of the plant through IoT dashboard
✓ Could remotely control the outputs, such as led growth light, motor and fan
Objective and Scope
✓ Provide everyone who is interested in indoor gardening a convenient tool to look after the plant
✓ When they are busy and occupied and have no time to take care of the plant, the plant still could thrive under the caring of the system
✓ Ease of interact with the system
✓ User could see the surrounding data of the plant and control the outputs through the IoT app dashboard
✓ The system could provide light and water to the plant automatically
✓ Save time
✓ User could spend less time on looking after the plant as the system could help in that
✓ User could spend minimum time by just clicking a button on the IoT app dashboard
Conclusion
The semi-automated smart greenhouse is feasible and user-friendly. It is easily interacted with the user and it could help user save the time spent on indoor gardening. As a conclusion, t could help the user that keen to do indoor gardening to take care of a plant and make sure it could thrive.
Bachelor of Information System (HONS)
Computer Engineering
UTAR
By Wong Jun Jie
Final Year Project

PLAGIARISM CHECK RESULT



Turnitin Originality Report

Processed on: 03-Sep-2021 13:27 +08
ID: 1640381771
Word Count: 5806
Submitted: 2

Smart Greenhouse with IoT and Cloud Computing By Jun Jie Wong

Similarity Index	Similarity by Source	
5%	Internet Sources:	5%
	Publications:	2%
	Student Papers:	N/A

1% match (Internet from 19-Jul-2020)
https://programalgoritm3roc.blogspot.com

1% match ()
Azizul Halim, Abd Rahman. "Fiber Optic Based Line Following Mobile Robot", UTeM, 2010

< 1% match (Internet from 27-Jul-2021)
http://eprints.utar.edu.my/2222/1/SCA%2D2016%E2%80%8B%2D1002231%2D1.pdf

< 1% match (Internet from 27-Jul-2021)
http://eprints.utar.edu.my/2501/1/SCA%2D2017%2D1104239%2D1.pdf

< 1% match ()
Sen Senan, Anish. "Determination of the Viscoelastic Properties of General Anisotropic Materials", DigitalCommons@UMaine, 2003

< 1% match (Internet from 19-May-2020)
https://gitlab.fdmci.hva.nl/PLA25/Sensors/-/commit/275b4ab4967d82e83677b8c56bdf0cbca637dc62

< 1% match (Internet from 17-Aug-2020)
https://mafiadoc.com/user-friendly-recommender-systems-citeseerx_598f9d811723ddcf69a3eff9.html

< 1% match (publications)
Banking Academy

< 1% match (Internet from 24-Jul-2018)
https://www.zonamaker.com.br/adicionando-portas-analogicas-na-sua-placa-pi/

< 1% match (Internet from 07-Jun-2018)
https://documents.mx/internet/sk-top-it-startups.html

< 1% match (Internet from 06-Jun-2020)

Universiti Tunku Abdul Rahman			
Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1of 1

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	WONG JUN JIE
ID Number(s)	17ACB 03681
Programme / Course	Bachelor of Information Technology (HON OURS) Computer Engineering
Title of Final Year Project	Smart Greenhouse with IoT and Cloud Computing

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
Overall similarity index: 5 % **Similarity by source** Internet Sources: 5 % Publications: 2 % Student Papers: 0 %	Nil
Number of individual sources listed of more than 3% similarity: 0	

Parameters of originality required and limits approved by UTAR are as follows:

(i) Overall similarity index is 20% and below, and

(ii) Matching of individual sources listed must be less than 3% each, and

(iii) Matching texts in continuous block must not exceed 8 words

Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.

Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor
Signature of Co-Supervisor
Name: MR. LEONG CHUN FARN

Date: 1 SEPTEMBER 2021

Name: _____

Name: _____

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	17ACB03681
Student Name	Wong Jun Jie
Supervisor Name	Leong Chun Farn

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
	Front Plastic Cover (for hardcopy)
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
	All references in bibliography are cited in the thesis, especially in the chapter of literature review
	Appendices (if applicable)
	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report. _____ _____	Supervisor verification. Report with incorrect format can get 5 mark (1 grade) reduction. _____ _____ (Signature of Supervisor)

(Signature of Student) Date: 1 September 2021	Date: 1 September 2021