Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.

BY

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ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to my supervisors, Dr. Goh Hock Guan who has given me this bright opportunity to engage in this project which titled as disease detection using Raspberry Pi with sensor though wireless sensor network in vegetable. It is my first step to develop a system which related to agriculture. A million thanks to you.

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ABSTRACT

In traditional method of farming, human labours were required to visit the vegetable farm at specific time and need to check the humidity level and temperature level manually. This conventional method is considered time consuming and needs a lot of work and effort. Therefore this project is about designing a disease detection system using sensor with Raspberry Pi through wireless sensor network in vegetable farm. Using this system, user such as user would reduce manually work such as manually monitor crops. With the data get from sensor could help in making prediction of disease could happen.

In this system, all the data get from sensor will push a Cloud to store. User just required to install an Android application to their smart phone to retrieve the data. The Android application retrieve data from Cloud and it would compute some processes and show the risk level of diseases for user. User also can know current weather condition of their vegetable farm.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

GPS	Global Positioning System
GUI	Graphic User Interface
ARM	Advances RISC Machine
CPU	Central Processing Unit
GPU	Graphics Processing Unit
RAM	Random Access Memory
MB	Megabyte
GB	Gigabyte
SD	Secure Digital
SDHC	Secure Digital High Capacity
USB	Universal Serial Bus
HDMI	High Definition Multimedia Interface
GPIO	General Purpose Input Output
I^2C	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver-Transmitter
SPI	Serial Peripheral Interface Bus
OS	Operating System
TTL	Transistor-Transistor Logic
I/O	Input Output
IDE	Integrated Development Environment
PC	Personal Computer
PCB	Printed Circuit Board
MMC	Multimedia Card

LCD	Liquid Crystal Display
SMS	Short Message Service
A	Ampere
PIXEL	Pi Improved Xwindows Environment

LIST OF TABLES

Chapter 1: Project Background

1.1 Project Motivation and Problem Statement

As our country is on the way to the modern country, many things have been mechanizing. For example, bank encourages their user to do online banking to make transfer money, check balance or even pay utility bill through online in steed of queuing up at bank's counter (Myung Ko;Ruben Mancha, 2015). This makes our life more convenient. Ten years ago, technology in agriculture may not so advance and the price is not affordable (Izzat Din Abdul:Mohd Hilmi Hasan, 2009). But now as the agro technology become more advance the farming also slowly become mechanize to reduce manpower. Farm become mechanize also help the user to reduce human error. For example, a user tells their worker to spray pesticides at a certain volume. The worker may not follow and they could spray pesticides exceed or less than volume require. Although nowadays technology is so advance many users still having a problem which their vegetable will be infected by disease any time. This affects the productivity of vegetable. Even when user realize the disease infects the vegetable but still too late to kill or stop the disease. This kind of manual analysis of causes of disease would take time and it is impossible to conduct manual analysis on a large vegetable farm. If this problem cannot be resolve will cause user loss money and production of vegetable will be low. Therefore our country requires importing vegetable from another country to support the demand in our country.

The motivation of this project is to develop a disease detection system. This system not only suitable for the vegetable but also suitable for flower plantation, fruit plantation, tree plantation or paddy field plantation. Through sensor to collect humidity and temperature data can help to make the prediction of disease that could happen because vegetables' disease will happen under some condition of humidity and temperature. By implementing this system, the user can make prevention and timely monitoring of the vegetable. If any disease could happen can take a step ahead to prevent or stop the disease before it the serious problem.

1.2 Project scope

This is to develop a disease detection sensor node and vegetables' user using Android phone to perform detection process through an Android application. In order to perform disease detection, the wireless sensor is required. The sensor tools used in this project is SHT11 with the combination of Raspberry Pi 3 which is a platform to convert sensor data collected from SHT11 to more useful pieces of information which are environment's temperature and humidity information. This disease detection sensor node target to vegetable farm because it only requires them to using their Android phone to download an application to start the detection process and monitoring their vegetable plant.

1.3 Objectives:

To develop a disease detection sensor node that the user to perform detection and monitoring process through the phone.

1. To allow the farmer to monitor vegetable farm.
    - The variety size of vegetable farm makes farmer more difficult monitoring their vegetable plant. With the disease detection sensor, farmer not required to manually monitoring the vegetable farm.
2. To perform the prediction of plant's disease and provide indication to the disease.
    - The sensor node collects environment's temperature and humidity level and process to make the prediction of plant's disease could happen because under some circumstances of temperature and humidity level cause the disease started to spread.
3. To design an application for farmers remotely receive data collected from the sensor nodes.
    - The mobile application is where farmer needs to interact with to know the current condition of their vegetable farm.

1.4 Impact, Significance and Contribution

In this project, the disease detection sensor node provides the user a new way of monitoring the vegetable farm.

For the ordinary agriculture, farmer requires to manually monitor the vegetable plants. As the variety size of the vegetable farm might cause inconvenience to the user because user requires monitoring the crops one by one and need to move around the vegetable farm. Besides that, if the disease had happened it is a bit late for the user to take a step to stop it because those diseases could damage the crops in earlier of time. In order to prevent or stop disease happen user always require to spray as many as possible of pesticide.

In the proposed disease detection sensor node, it provides an alternative way for the user to monitor their crops. This project is mainly focused on monitoring and disease detection using sensors. In future, GPS technology can be merged with sensor node in order to the user to monitor the condition of the sensor node. For example, sensor damage and require to exchange the sensor. With GPS technology make the exchange hardware process more convenience and faster with location provided.

1.5 Organization of the Report

In this report will be organized from chapter 1 to 5. The first chapter of the report is Introduction. The following chapter two is Literature Review. In this chapter will be separate into two which are Review of Technologies and Review of Existing Systems or Applications. The third chapter is about System Methodology. In that chapter is talking about what is system model available and which model has been selected. System and functional requirement of the project also included in chapter three. Besides that, Expected system testing and performance plan will be design and put into chapter three. The project challenges, project milestone and an estimated cost of the project are also subpart in chapter three. The next part of the report is chapter four regarding system design of the project. In chapter four mainly focus on system architecture design, functional modules in the system, system flow, database design and GUI design of the project. The System Implementation is in chapter 5. The hardware and software setup is explained in this chapter. Setting and configuration is also provided in this chapter and the system operation is shown. The next chapter of the repost is chapter 6 regarding system evaluation and discussion. In this chapter, system testing is carried out and the result is shown in this chapter. A brief explanation of project challenges is include in the chapter 6. Lastly, the project objective are evaluated in this chapter. The last chapter of the report is the conclusion and the project recommendation.

Chapter 2: Literature Review

2.1 Review of the Technologies

2.1.1 Hardware Platform

2.1.1.1 Raspberry Pi

Initially, Raspberry Pi Foundation is founded to promote the teaching of basic in computer science in school (Wiki, 2016). The Raspberry Pi become a popular micro-computer in the market within two years after first Raspberry Pi Model B developed. After that multiple models of Raspberry Pi had been released from 2012 until 2018. All models had an integrated ARM-compatible CPU and GPU. Raspberry Pi contains 700MHz to 1.2GHz processor speed and RAM memory ranges from 256 MB to 1 GB. The operating system of Raspberry Pi requires storing in an SD which is SDHC or MicroSDHC sizes. Raspberry Pi board had 4 USB ports, 3.5 mm phono jack for audio and HDMI for video output. Raspberry Pi contains GPIO pins to support common protocols like I2C, UART or SPI.

Raspberry Pi have three categories of the model which are Raspberry Pi Model B. Follow by the cutdown version of Model B is Raspberry Pi Model A. Lastly is the low cost and small size Raspberry Pi Zero. Raspberry Pi use of Raspbian, a Debian-based Linux OS. Besides that, Raspberry Pi also support other OS such as Ubuntu MATE, RISC OS, and many others OS. The main programming languages used by Raspberry Pi are Python and Scratch.

2.1.1.2 Arduino

The Arduino project was started to create simple, low-cost tools for creating digital projects by people with were not having engineer background. Arduino is an open source hardware (Wiki, 2015). Most of the Arduino boards consists of Atmel 8-bit AVR microcontroller and pre-programmed with a bootloader to simplifies the program to upload to on-chip flash memory. The different board has the different bootloader. For example, Arduino Uno using optiboot bootloader which load program using the serial connection to a computer. Some Arduino using level shifter circuit to convert between Rs-232 logic levels and TTL level signals. Arduino board has most the microcontroller's I/O pins.

Arduino board provide 14 digital I/O pins, 6 of the pins use to produce pulse-width modulated signals another 6 pins as analog or digital I/O pins.

Arduino originally produced by Italian Company. Americal companies like Adafruit or SparkFun Electronic also designed some Arduino-branded boards. Until 2016, 17 different version of Arduino hardware had been developed for the public such as Arduino RS232, Arduino Diecimila, Arduino Duimilanove, Arduino Uno R3 and many others. In order to upload programs to Arduino board require install Arduino IDE into PC or laptop. Arduino IDE supported in Windows, macOS or Linux. The main programming languages use in Arduino IDE and C and C++.

2.1.1.3 BeagleBoard

BeagleBoard was designed by a company called Texas Instruments and alliance with Newark element14 and Digi-Key. BeagleBoard was developed by a team of engineers for educational purposes (Wiki, 2016). This board was designed using Cadence OrCAD for schematics and Cadence Allergro for PCB manufacturing and no simulation software used. BeagleBoard act like a small basic computer. The board using ARM Cortex-A8 CPU which had capability run different types of OS such as Linux, Minix, OpenBSD or Symbian. BeagleBoard used TMS320C64x+ DSP to accelerate video and audio decoding. Besides that, this board had Imagination Technologies PowerVR SGX530 GPU to support 2D and 3D rendering through separate S-Video and HDMI connection. BeagleBoard also had an SD/MMC card slot, USB port, RS232 serial connection port, and 3.5mm jacks for audio.
From 2008 until 2015, there were 6 BeagleBoard invented. The first model is BeagleBoard follow by BeagleBoard rev.C. In 2009, third version BeagleBoard came out which call BeagleBoard-XM. BeagleBone was developed in the following year 2011. After 2 years, BeagleBone Black was invented and the latest board was developed call BeagleBoard-X15 in 2015. BeagleBone mainly using Debian-based Linux OS. In order to do programming in BeagleBoard, it supports remote login or full access login into BeagleBoard OS or using Cloud9 IDE to start programming. BeagleBoard support multiple programming languages such as C, C++, Python, Perl, Ruby, Java, or even a shell script.

2.1.2 Summary of the Technologies review

	Arduino	**Raspberry Pi**	**BeagleBone-Black**
CPU	ATmega328P 16MHz	Quad Core 1.2GHz Broadcom BCM2837 64bit CPU	Cortex-A8 + Dual PRU (200Mhz)
GPU	None	Broadcom VideoCore IV	PowerVR SGX530
RAM	2KB	1GB	512B
OS Supported	None	• Linux (Raspbian)	• Linux (Stretch)
Price	Below RM 25	Below RM200	Below RM 250

Table 2.1.2: Summary of the Technologies review

2.2 Review of Existing Systems/Applications

2.2.1 Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS)

A similar project has been done in the past. Izzat Din Abdul Aziz (2009) and his teammate conducted a project to build monitoring system in agriculture using wireless sensor and short message service to notify the user about plant status. The project model is using an EZ430-RF2500 sensor to regularly check environment's temperature. The data collected is then sent through radio frequency to EZ430-RF2500 access point which connected to laptop Furthermore, there also using D-link 3.5G Express card that equipped with a SIM card to access the internet to send a notification to the user (Figure 1.1). For the software part, they used MSP430 Application Universal Asynchronous Receiver-Transmitter (UART) to convert input data in volt then convert to temperature reading in Celsius and Fahrenheit. Data collect also store in the database for further analysis purpose. They choose a laptop as the control panel, it archives there purpose but choosing microcontroller would be better because microcontroller allows connecting sensor through wired instead of wireless. A microcontroller can directly store the data collected without sensor transmit data through radio frequency and receive at other side and the cost of the laptop is higher compared to a microcontroller.

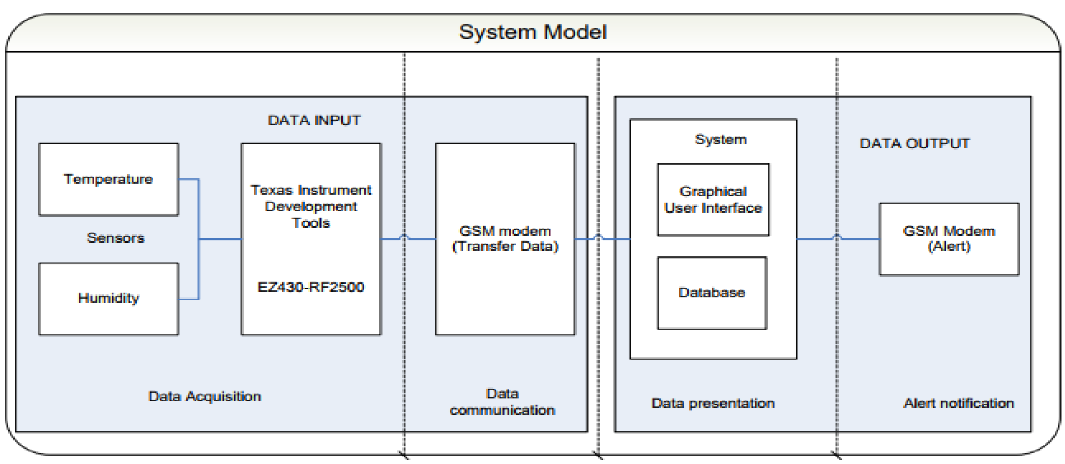


Figure 2.2.1: The system model of the monitoring system in agriculture (Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS), 2009, p.4)

2.2.2 Leaf disease Detection and Climatic Parameter Monitoring of Plants Using IoT

Dr. G. H. Agrawal, Prof. S. G. Galande and Shalaka R. Londhe in a group and proposed a solution for monitoring plants and disease classification of plants which using the sensor to collect environment's temperature, humidity, soil moisture and pH of the soil. Block diagram of the system (Figure 2.2) having 4 type of sensor, two ZigBee modules, one Arduino board, LCD display, laptop, web camera, and crop. There is a wireless communication between two ZigBee modules. Sensors sense climatic parameters and give information to the Arduino which process on that further and displays values on LCD display. Using this solution plants can predict whether plants infected with the disease. The laptop will also be connected to a webcam in order to capture the image of crop automatically in a certain period of time. The strong advantages of the system were using machine learning to do image classification to identify what disease were infect the plants. Through building a neural network for the system to learn the type of diseases for particular plants. The more dataset provided for the system to learn the more accurate the result gets. Unfortunately, after the disease recognized user may know or does not know how to stop or kill the disease. This problem can be solved by giving guideline or suggestion to the user on which type of pesticides and what is the volume of pesticide required to mix together. User easily can follow the suggestion given to prevent or kill the disease before it becomes more serious.

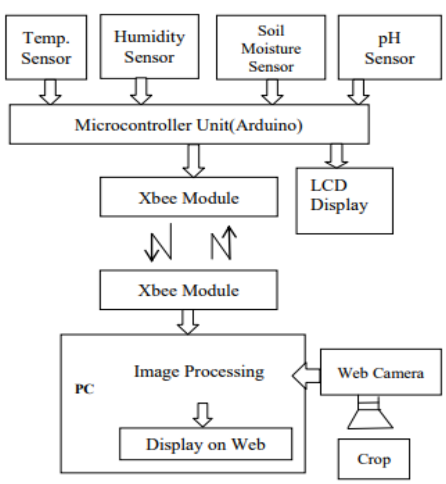


Figure 2.2.2: The block diagram of the system (Leaf disease Detection and Climatic Parameter Monitoring of Plants Using IoT, 2015, p.3)

2.2.3 Application of Sensor Networks for Monitoring of Rice Plants: A Case Study

Suman Kumar and his teammate having a project which is real-time monitoring rice plants system. The project basically focuses on providing a real-time information from the paddy field to the user so that the user can base on the information to make the strategies more efficiently. This project experimented about 4 months in a greenhouse before really implement in a paddy field. Through the deployment of sensor nodes in the greenhouse to measure the temperature, ambient light intensity, and humidity. Analyze those parameters which affect the growth of rice. The advantages of the project are having a low-cost and efficient monitoring system. A big coverage of sensing area is also an advantage of the project because user not needs to manually monitor the paddy field themselves. In this project mica2 chosen as the sensor note to collect the data because the battery life can last for 2 months with just 2x AA batteries.

2.2.4 Summary of the Existing Systems

Existing System	Advantages	Disadvantages	Critical Comments
Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS)	• Using SMS to alert the user	• Using radio frequency to transmit data	• Store data to Cloud allow the user to access through laptop or smartphone when they access to internet.
Leaf disease Detection and Climatic Parameter Monitoring of Plants Using IoT	• Using laptop connect with a webcam to capture the crop and using Matlab to do image recognition for disease detection	• Does not provide a guideline for the user to stop or kill the disease that found	• Microcontroller and laptop could be replaced by Raspberry Pi because Raspberry Pi could direct connect with sensor and camera.

			• Raspberry Pi also has the ability to do image recognition.
Application of Sensor Networks for Monitoring of Rice Plants: A Case Study	• The high coverage area of sensor network	• Real-time monitoring of crop field may cause loss of data communication. • The sensor data store locally in the sink note which is on a laptop.	• Cloud can help in this project since the data can be stored in the Cloud and the local database use for backup purpose when there is no internet access to push data to the Cloud.

Table 2.2.4: Summary of the Literature Review

2.3 Conclusion Remark

In this chapter, few hardware platforms and existing plant disease detection systems were discussed and studied. Every hardware and systems had their advantages and disadvantages. After review of hardware and existing system, they were helpful in the project which during the selection of hardware requirement and planning of the system architecture and flow.

Chapter 3: System Methodology

3.1 System Development Models

3.1.1 System Development Model 1: Waterfall Model

Water model states that phases are organized in a linear form which means that output of the phase becomes the input for other phases.

Below are the phases of Waterfall Model:

- Proposal Definition
- Feasibility Study
- Requirement Analysis
- System Design
- Coding & Testing
- Implementation
- System Maintenance

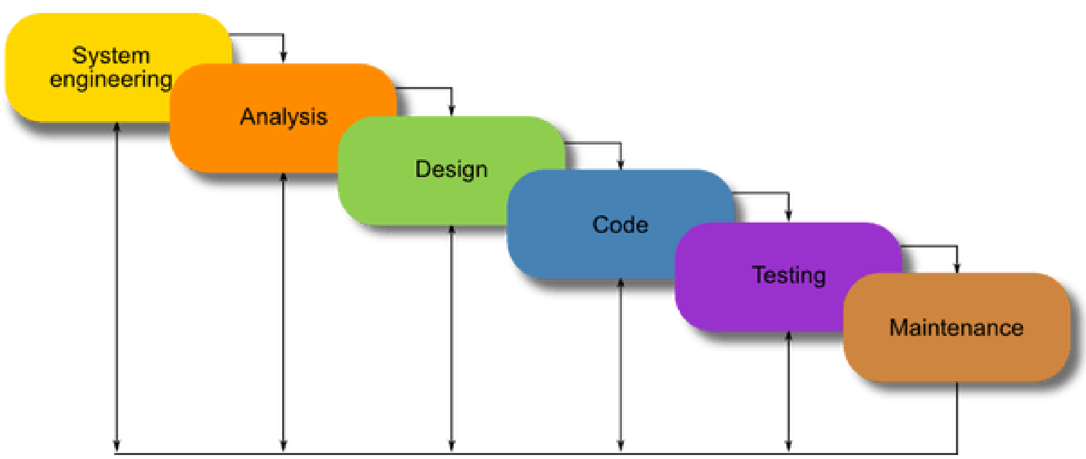


Figure 3.1.1 Waterfall Model

3.1.2 System Development Model 1: Prototyping

Instead of development full system, a prototype is developed for a user to testing because of user hard to identify their requirements or users' requirement could be changed during the development process. With this model, the user can have to test the system and give their feedback. All the phases in the model would be repeated until full system develop that meet user requirements. This model is suitable for the user which had the uncertainty of requirement.

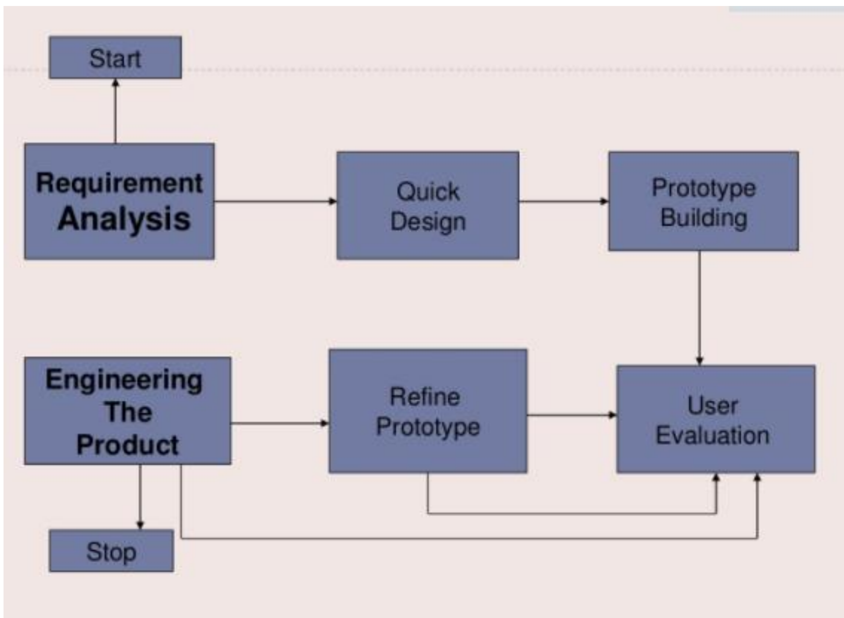


Figure 3.1.2: Prototyping Model

3.1.3 System Development Model 1: Iterative enhancement Model

Iterative enhancement model focus on development system based on increment and each increment could be added new functions to the system until full system developed.

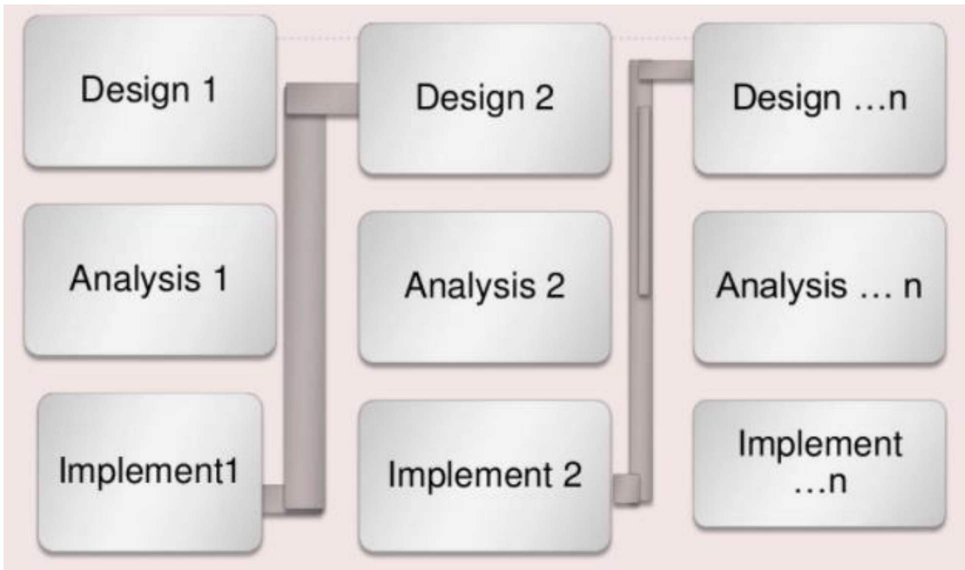


Figure 3.1.3: Iterative Enhancement Model

3.1.4 System Development Model 1: Spiral Model

Spiral Model is a combination of Waterfall Model and Iterative Enhancement Model. Spiral Model using the development process in Iterative Enhancement Model which allows the increment of added new function based on evaluation and risk analysis until full system developed. This model is more suitable for the larger project with is high risk and implement this model require longer time and high cost.

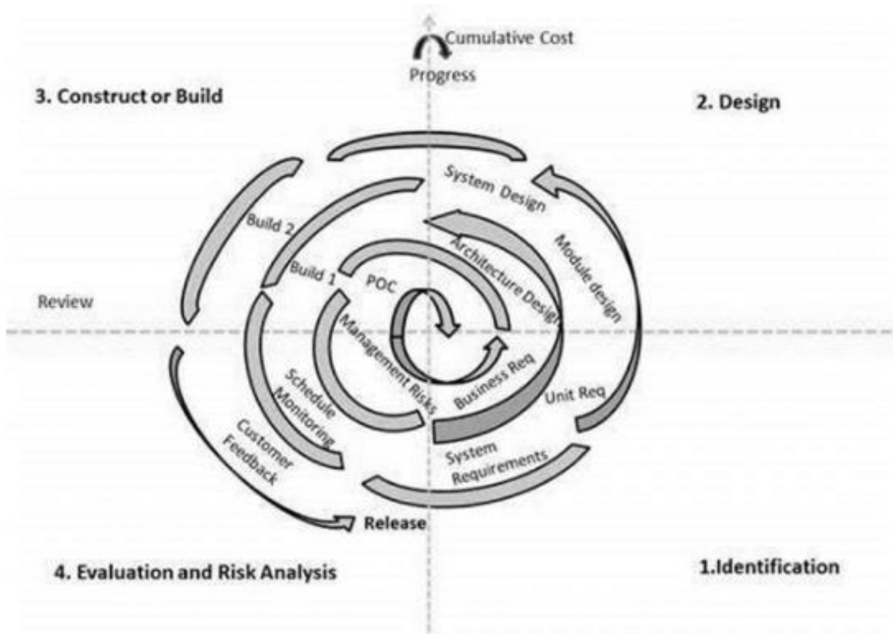


Figure 3.1.4: Spiral Model

3.1.5 Selected Model

In this project, Prototyping model is selected as system development model because this system is fully developed based on user requirement. The user is in the agriculture field, they may not know their requirement clearly. A prototype system is developed for the user to do testing so that they can identify their requirement and give feedback to future enhance the system. With this model, the user can fully participate in the project and finally get the ideal product they require.

3.2 System Requirement (Technologies Involved)

3.2.1 Hardware

1) Raspberry Pi 3 Model B

Raspberry Pi 3 board is the most important hardware in the project. It uses to connect to a sensor to collect data. Besides that, Raspberry Pi will also connect to the internet to send collected data to a Cloud database.

Figure 3.2.1: Raspberry Pi 3 Model B

2) 8GB Micro SD card

Micro SD is used to store OS of Raspberry Pi board and the program files of Raspberry Pi board. With 8GB SD card is enough to store those sensor's data.

Figure 3.2.2: 8GB micro SD card

3) SHT11 humidity and temperature sensor

An SHT11 sensor is another main component of this system. It used to collect environment temperature and humidity data with temperature accuracy is ±0.4 Celsius and humidity accuracy is ±3.0 percentage of Relative Humidity.

Figure 3.2.3: SHT11 sensor

4) Micro USB Power cable with output 2.5A

To power up, Raspberry Pi 3 board require a micro USB power cable with output 2.5A. In the project is only develop a prototype for demonstration without deploy in the vegetable farm. A power cable is chosen instead of the rechargeable power supply

Figure 3.2.4: Micro USB Power cable with output 2.5A

3.2.2 Software

1. Firebase

   Firebase provide a real-time database. When the Raspberry Pi get the sensor data, the data will be uploaded to the database and allow user to retrieve data from an Android application

Figure 3.2.5: Firebase

2. Android Studio

   Android Studio is an IDE developed by Google use to design Android application. Android studio support in Windows, MacOs and Linux environment.

Figure 3.2.6:Android Studio

3. Raspbian OS

   Raspbian OS is a Debian-based OS for the Raspberry Pi. In 2015, Raspbian officially provided by Raspberry Pi Foundation as primary OS for Raspberry Pi to optimize Raspberry Pi low-performance ARM CPUs. Raspbian use PIXEL as the desktop environment.

Figure 3.2.7: Raspbian OS

4. SQLite

SQLite is a free and in-process lightweight library. SQLite does not need to have separate server process, it reads and writes from ordinary disk files. With low processing power suitable to use in embedded devices.

Figure 3.2.8: SQLite

5. Python Language

Python language is a powerful language that widely used in Raspberry Pi because it is easy to read and write. The syntax of Python is clean and uses of Standard English keywords to increase the readability.

Figure 3.2.9: Python

6. MQTT

MQTT is a lightweight protocol that provide connectivity for machine to machine or IoT. MQTT is a simple protocol that transport light weight message through broker subscribe to one or few topic and client send message to specific topic.

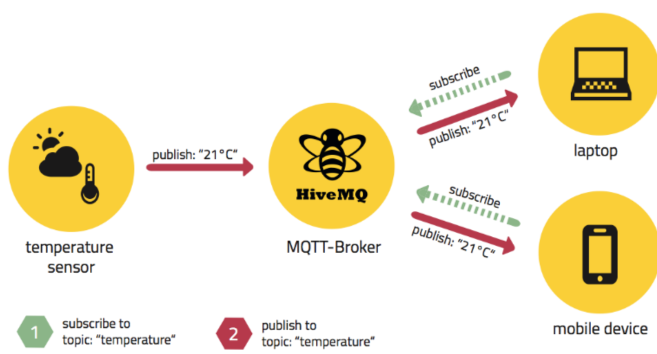


Figure 3.2.10: MQTT

3.3 Functional Requirement

3.3.1 Collect temperature and humidity data

Define the functionality of the SHT11 sensor that will be connected to the Raspberry Pi. The SHT11 sensor is used to sense environment temperature and humidity. The SHT11 is also set to sense temperature and humidity in every 1 hours. SHT11 has the accuracy of ±0.4 Celsius and humidity accuracy is ±3.0 percentage of relative humidity. With the accuracy of SHT11 make that the prediction of disease can get high accuracy. This could help farmers to make strategies according the prediction result.

3.3.2 Push data to Cloud

Raspberry Pi has limited storage, the storage depends on the size of SD card using. In order for the user to retrieve data remotely. The sensor data required to store in a Cloud. The Cloud that selected is Firebase. Firebase provides a real-time database which allows freedom to use 1GB storage and allow 100 users connect to the database simultaneously.

3.3.3 Make prediction of vegetable's disease

Prediction of vegetable's disease is the core function of the whole system. The user uses an Android application to retrieve data from the Cloud. After retrieving data, the application will calculate some calculation then an Android application will display the risk level of disease that could happen to the user.

3.6 Project Milestone

Task	**Project Week**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Collection of Data	■													
Define project objective and scope	■													
Review of Technology		■												
Analysis for literature review		■												
*Report with supervisor current progress		■												
Determine functional requirements			■											
Define technologies involved			■											
Determine system development model				■										
*Report with supervisor current progress				■										
Planning the system architecture					■	■								
Planning the system flow							■	■						
Documentation									■					
*Report with supervisor current progress									■					
Making protype system										■	■	■		

*Report with supervisor current progress														
Presentation of FYP 1														
Hardware setup														
Software setup														
*Report with supervisor current progress														
Testing the prototype system														
*Report with supervisor current progress														
Fixed error of system														
Documentation														
Presentation of FYP 2														

Note: Task with * is the project milestone

FYP 1

FYP 2

Table 3.2: Gantt chart show the project milestone (FYP 1 + 2)

3.7 Estimated Cost

Items	For FYP Development	For Commercialization
Raspberry Pi 3	RM190	RM168
MicroSD card 16GB	RM26	RM26
Power cable with output 2.5A	RM36	RM26
SHT11 sensor	RM90	RM78
Firebase	RM0	RM100
Android Studio	RM0	RM0
Python	RM0	RM0
SQLite	RM0	RM0
Raspbian OS	RM0	RM0
Total	RM342	RM398

Table 3.3: Estimated Cost Table

3.8 Concluding Remark

Different system development model was evaluated and prototype model was selected for the development of the project. To ensure the progress of the project in on correct path the functional requirement was stated. Besides that, system requirement also listed. The hardware and software requirement depended on the project scope and type of project. The expected challenge of the project was identified. Gantt chart shows the project milestones for project 1 and 2 and it shows the time planning of the whole project. Finally, the cost for development and commercialization was shown and explained.

Chapter 4 System Design

4.1 System Architecture

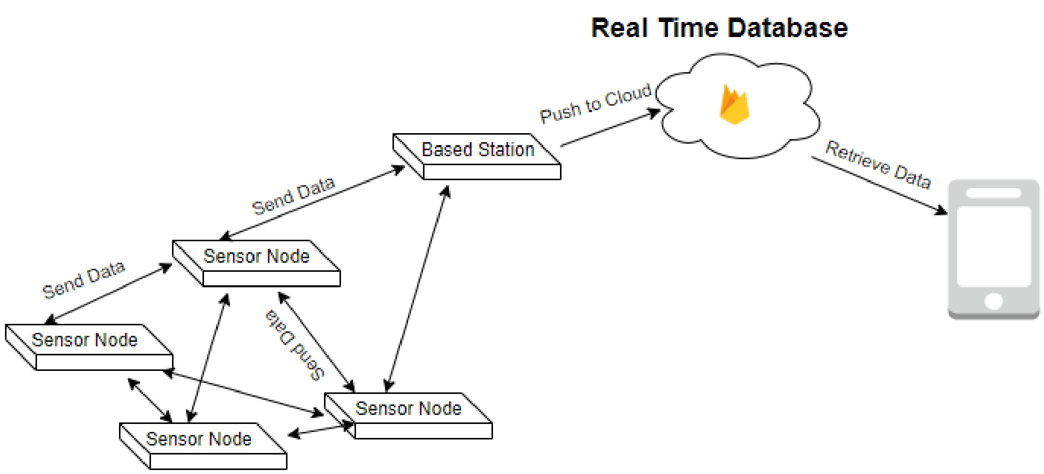


Figure 4.1.1: System Architecture of System

SHT11 humidity and temperature sensor and the microcontroller which is Raspberry Pi will be connected together. The SHT11 sensor will be collect the environment's humidity and temperature data. Sensor nodes send data to base station through MQTT. Base station receive the sensor data and push the sensor data to Firebase Cloud when it has internet connection. If there is not internet connection the base station will store the received data to local database. User is required to install an Android application to retrieve data from Firebase. Then the Android application will do the prediction module and show the user the risk level of diseases.

4.2 Functional Modules in the System

4.2.1 Collect temperature and humidity data module

In this module, the main responsible for this module is to collect environment's temperature and humidity data and control the timer to start the sensor. The setting of the sensor and the collaboration of sensor with Raspberry Pi board is written in a python script. The python script will automatically run when Raspberry Pi has booted.

4.2.2 Push data to Cloud Module

In this module main is to push sensor's data to the Cloud. Whenever Raspberry Pi board get the temperature and humidity data, it will push those data to the Cloud. In the Cloud will the date, time, place, temperature and humidity data.

4.2.3 Make prediction of vegetable's disease module

This module is responsible for making the prediction of vegetable's disease that could happen. When an Android application receives the temperature and humidity data, it will calculate the average temperature and humidity of the day. Then it will compare the data with the database. If the average temperature and humidity data match certain threshold, the Android application will show the risk level of disease that could happen to the user. If the high or medium risk occurs, the Android application will straight away alert user to take action.

4.3 System Flow

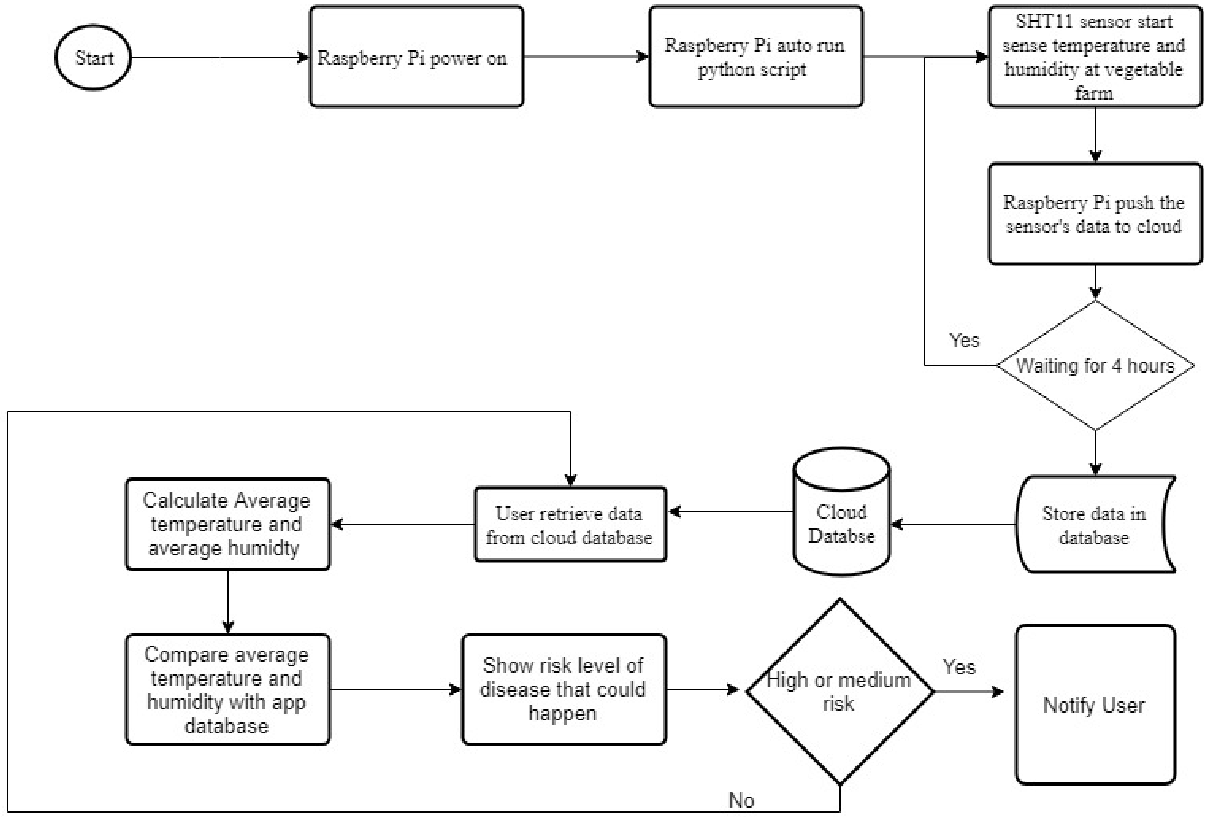


Figure 4.3.1: Flow chart of the system

In figure 4.2 show the flow diagram of the project. At first the Raspberry pi will boot and after it boot the pre define python script will automatically run. Then the SHT11 sensor start sense environment's humidity and temperature. When Raspberry Pi receive the data, it will push those data to the Firebase Cloud. After that the python script will sleep for 4 hours and repeat the process again.

User use the Android application which connect with Firebase Cloud to retrieve the data. When Android application get those data, it will calculate average temperature and average humidity. If the average temperature and average humidity match the condition that cause disease happen. The Android application will notify user if not the Android application will back to retrieve data from Firebase Cloud.

4.4 Database Design

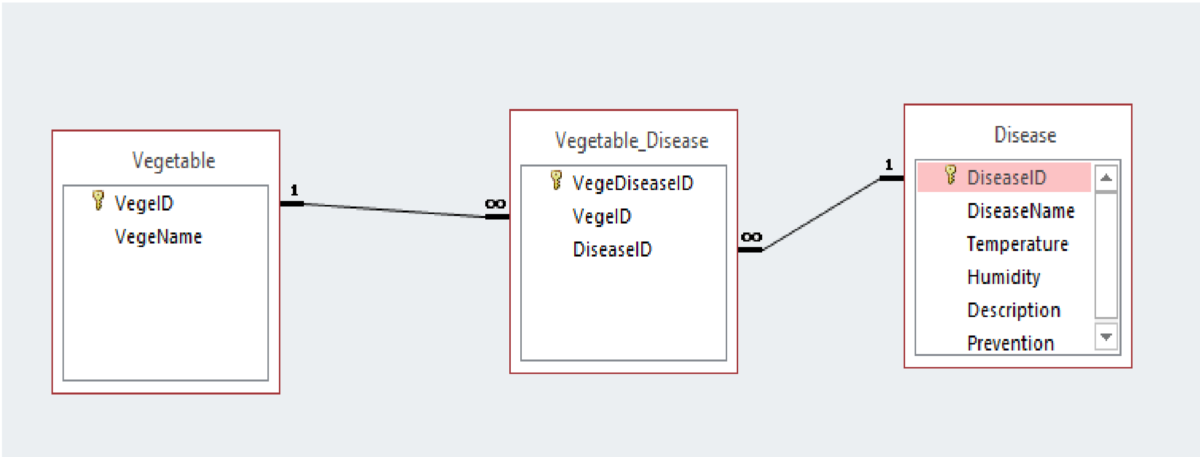


Figure 4.4.1: Database design of the system

This is a database design that using SQLite which store in the Android application. In this database would store the types of vegetables and the disease of the vegetables. The database contain three table which were Vegetable table, Vegetable_Disease table and Disease. The Vegetable table had a relationship with Vegetable_Disease table was one to many and Disease table also had one to many relation with Vegetable_Disease.

4.5 GUI Design

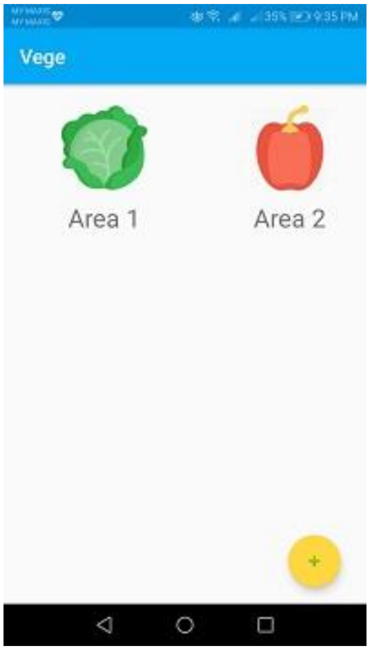


Figure 4.5.1: GUI Design

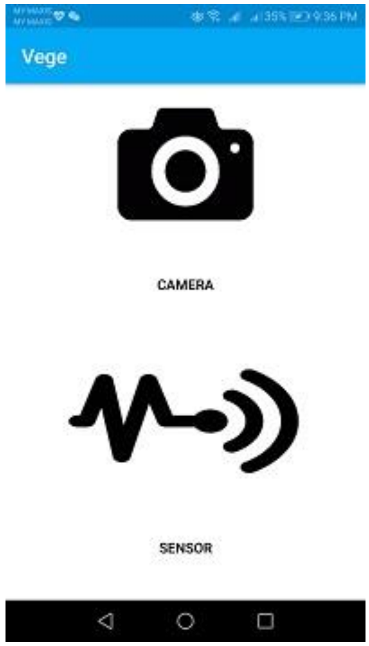


Figure 4.5.2: GUI Design

Figure 4.5.3: GUI Design

Figure 4.5.4: GUI Design

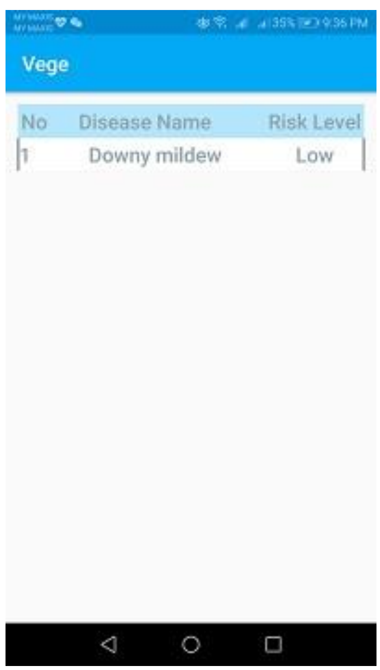


Figure 4.5.5: GUI Design

Figure 4.5.1, Figure 4.5.2, Figure 4.5.3, Figure 4.5.4 and Figure 4.5.5 show the full GUI design for the Android application. Figure 4.5.1 is the main page in the Android application. User can use this application to view the forecast weather for the vegetable farm. With this Android application user also can know the current temperature and current weather information. In order to view the risk level of disease, user is required to click the alert button the risk level of diseases in a table form.

4.6 Concluding Remark

The system design was explained in this chapter. System architecture was illustrated by using a diagram and with an explanation to know the how the whole system works. Functional modules were listed and state the modules' functionality in the system. Besides that, system flow of the system as illustrated. Lastly, the GUI design is shown.

Chapter 5 - System Implementation

5.1 Hardware Setup

5.1.1 Raspberry Pi connect with SHT11 sensor

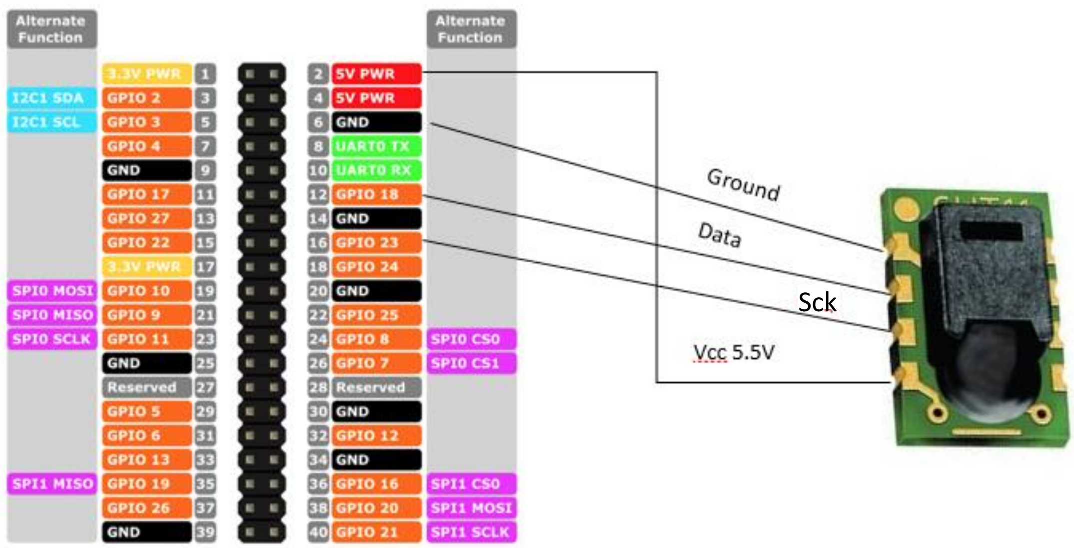


Figure 5.1.1: Raspberry Pi connect with SHT11 sensor

Above figure 5.1.1 shows that the Raspberry Pi 3 Model B connects with SHT11 sensor. GPIO pin 6 from Raspberry Pi 3 connects to Ground pin at SHT11 sensor. GPIO pin 18 will connects to Data pin at SHT11 sensor and GPIO pin 23 will connects to Sck pin at SHT11. Lastly, Raspberry Pi 3 uses GPIO pin 2 which can supply 5V power to power up STH11. GPIO pin 2 will connect to VCC pin at SHT11 sensor.

5.2 Software Setup

5.2.1 Android Studio Installation

In this project, an Android application will be used to retrieve data from the Cloud. Data stored in the Cloud are used for the prediction model in the Android application. The usage of prediction model is to list out all the risk level of diseases that could happen for a specific type of vegetable plant. In order to develop this Android application, Android studio is required to install in laptop or PC. The Android studio executable file is required to download from the Android official website and follow the guides in the website to complete the installation.

5.2.2 SQLite Installation

SQLite is required to be install in the Raspberry Pi to prevent data loss. In the system, sensor node will send data to base station and base station is required to push the data to Cloud when it has internet access. If there is not internet access the base station will be storing the received data into SQLite database.

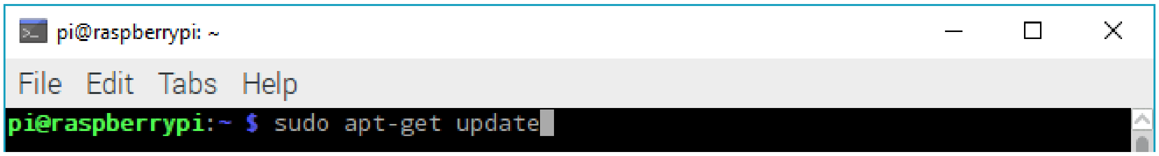


Figure 5.2.2.1: Sqlite installtion

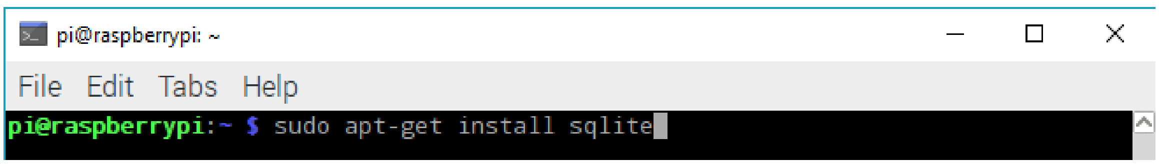


Figure 5.2.2.2: Sqlite installtion

In order to install SQLite in Raspberry Pi, follow the steps below:

1. Open terminal in Raspberry Pi.
2. Type in *sudo apt-get update*.
3. After success update, type in *sudo apt-get install sqlite*.

5.2.3 MQTT Installation

In this system, sensor nodes are required to send data to base station in every 4 hours. In order to establish the connection between sensor nodes and base station, sensor nodes and base station are required to install MQTT.

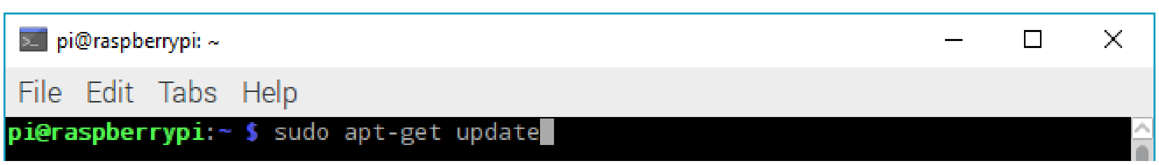


Figure 5.2.3.1: MQTT installation

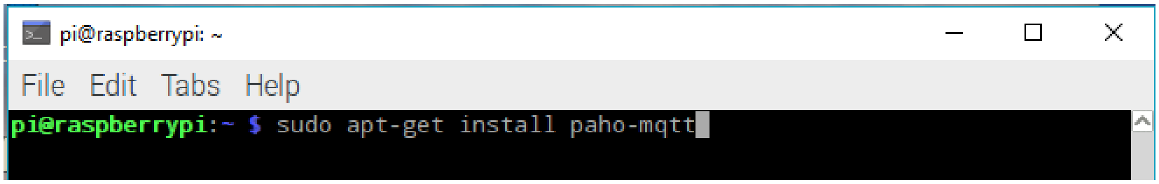


Figure 5.2.3.2: MQTT installation

In order to install MQTT in Raspberry Pi, follow the steps below or refer figure above.

1. Open terminal in Raspberry Pi.
2. Type in *sudo apt-get update*.
3. After success update, type in *sudo apt-get install paho-mqtt*.

5.2.4 SHT11 Sensor Library Installation

In this system, each sensor node is required to connect with a SHT11 sensor which will be used to collect environment's temperature and humidity data. Before the SHT11 sensor can be used in Raspberry Pi, the SHT11 sensor library must be installed in each sensor node.

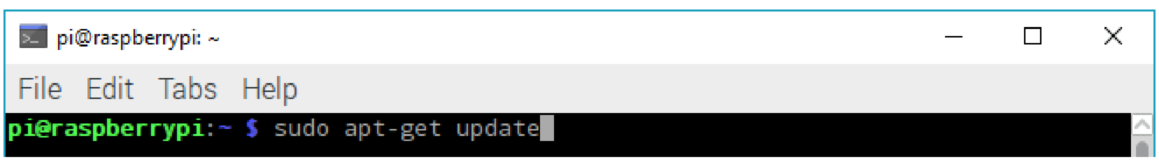


Figure 5.2.4.1: SHT11 Sensor Library installation

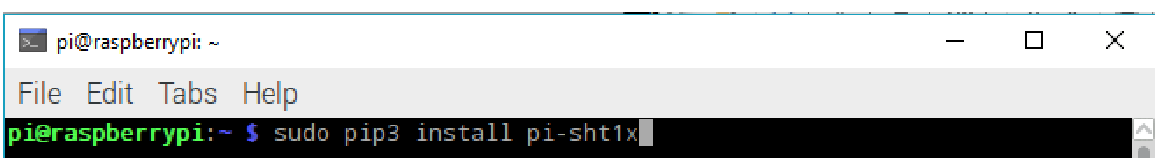


Figure 5.2.4.2: SHT11 Sensor Library installation

In order to install SHT11 sensor library in Raspberry pi, follow the steps below:

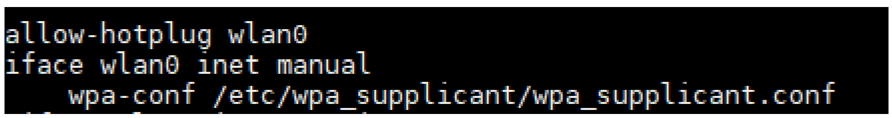
1. Open terminal in Raspberry pi.
2. Type in *sudo apt-get update*.
3. After success update, type in *sudo pip3 install pi-sht1x*. (Note: **pi-sht1x is run in python 3 only**)

5.3 Setting and Configuration

The CD contains three folders which is called sensor, base and mobile app. In those folders contain all the necessary source codes to program the sensor nodes, base station and the mobile application.

First, each sensor node and base station are required to setup into a mesh network. In order for sensor nodes and base station to form mesh network, each sensor node and base station are required to be assign an unique static IP address before joining the mesh network. These are the configuration that required for each sensor node and base station:

1. Open terminal in Raspberry Pi.
2. Type *sudo nano /etc/network/interfaces* to configure the wireless card of Raspberry pi.
3. In the terminal look for *allow-hotplug wlan0* which same as the figure 5.3.1.



```
allow-hotplug wlan0
iface wlan0 inet manual
    wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```

Figure 5.3.1.1: Configure wireless card of Raspberry Pi

4. Delete the *iface wlan0 inet manual* and *wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf*
5. Below the allow-hotplug wlan0 type in :

   iface wlan0 inet static

   address 172.16.1.21

   netmask 255.255.0.0

   wireless-essid my-mesh

   wireless-channel 1

   wireless-ap 02:12:34:56:78:9A

   wireless-mode ad-hoc

6. In the end, the network configuration file should look same as figure 5.3.1.2

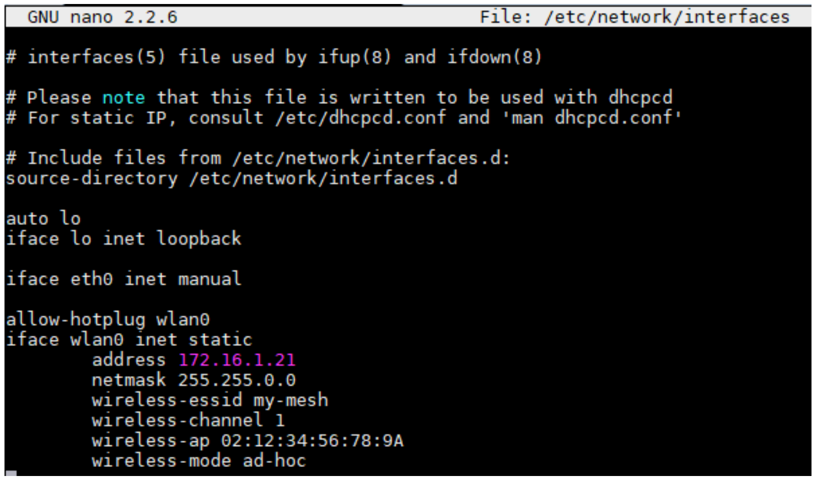


Figure 5.3.1.2: Interfaces Setting in Raspberry Pi

7. Then click ctrl+o to save the file
8. To quit the file click ctrl+x
9. Type *sudo reboot* to restart the Raspberry pi in order for Raspberry Pi to run in ad-hoc mode and joined the mesh network.
10. Repeat step 1 until 8 for other sensor nodes or base station. **(Note: Please use different IP address for each nodes and base station.)**
11. In order to ensure each sensor nodes and base station are joining to the mesh network. Try to ping each other.

After completing the setup for each node to ad-hoc mode. The sensor nodes are required to put in the necessary python script before it can be operate. Those are instruction required to be done in sensor node:

1. First, open the folder named 'Sensor' in the CD.
2. In the folder contain a file called 'mqtt_publisher.py'. Copy the file to Raspberry Pi and put the file in the Desktop of Raspberry Pi.
3. Repeat the step 1 and 2 for other sensor nodes.
4. In Desktop of Raspberry Pi create shell script which name as launch.sh.
1. Open the launch.sh and type:

   cd /

   cd /home/Desktop /launch.sh

   sudo python3 mqtt_publisher &

Note: the directory could be change as script may save to other directories

2. Return to terminal and type *sudo crontab –e*. The terminal will show crontab file which is same as figure 5.3.2.3.

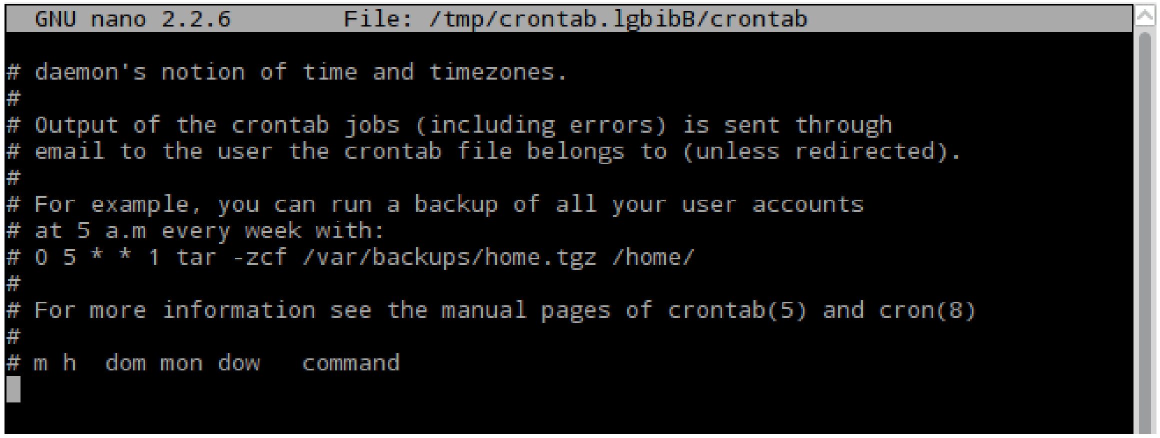


Figure 5.3.2.3: Crontab –e terminal in Raspberry Pi

3. In the contrab file type in *@reboot 30 sh /home/pi/Desktop/launch.sh &* **(Note: The 30 means 30 seconds and it can be change to any value because it is to delay the shell script to run after Raspberry Pi boot up)**
4. Press ctrl+o to save the setting and press ctrl+x to exit the file.
5. In the terminal of Raspberry Pi type *sudo reboot*.
6. After Raspberry Pi boot up open terminal and type *ps aux | grep python* to ensure python script is running in background.

After all the setting and configuration for sensor nodes are done. The base station is also required to put in the necessary python script before the whole system can work. Those are instruction required to be done in base station.

1. First, open the folder named 'Base in the CD.
2. In the folder contain a file called 'mqtt_broker.py'. Copy the file to base station and place the file in the Desktop of base station.
3. In order to run the python script open the terminal and type in *sudo python3 mqtt_client.py*.

Next, proceed to install Android application to the Android phone. In order to install Android application to phone, these are the instruction required to follow:

1. Inside the CD has a folder named 'Mobile App'. Inside the folder contains the source codes of the Android application and an apk file.
2. Copy the apk file to the phone.

3. Ensure the option for unknown sources is turned on in the Setting -> Privacy -> Unknown sources.
4. Open the apk file in the phone and install the apk file to the phone.

5.4 System Operation

After completed all the setting and configuration in the sensor nodes and base station. The system should be able to execute automatically. When the sensor nodes are sending data to base station. The base station should able to display the data received from each node. The base station either push received data to Cloud when it has internet connection or store the data locally when it has not internet connection.

After the base station push data to Cloud, open the Android application and click area that sensor node implement. The area indicate that current the system is monitoring which type of vegetable in the farm. After user selected the area, the Android application will show two buttons which are camera button and sensor button. When user click the sensor button, the Android application should able to show the forecast weather information. Then, user required to click the current date to view the current weather information. In order to view the risk level of the diseases, user is required to click on the alert button and the Android application will the risk level of diseases in a table form. When user click on the diseases in the table, the application will show the control method for that specific diseases.

Finally, the Android application able to run in background to do the prediction module periodic. The notification will appear if the prediction model found that the certain diseases have high risk or medium risk.

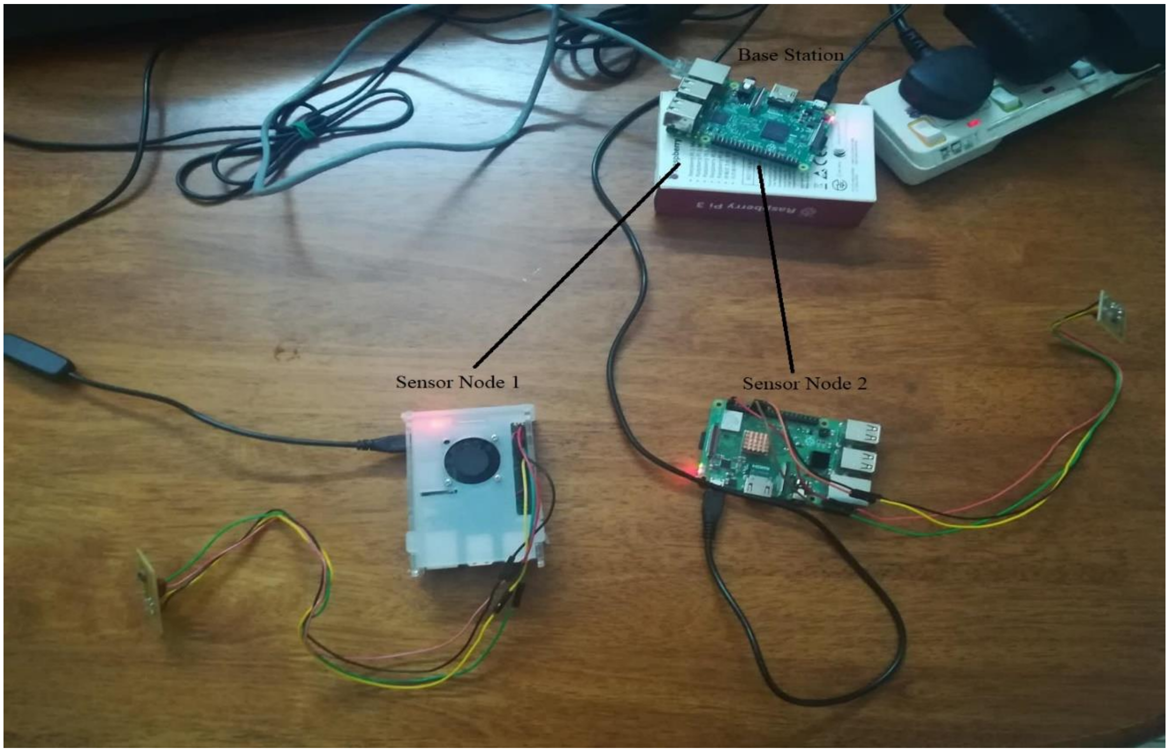
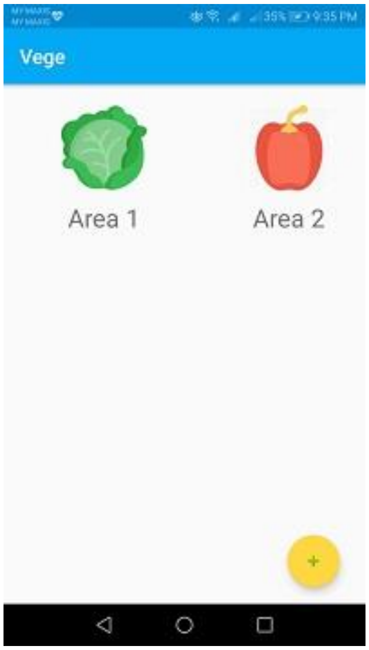


Figure 5.4.1: System Setup



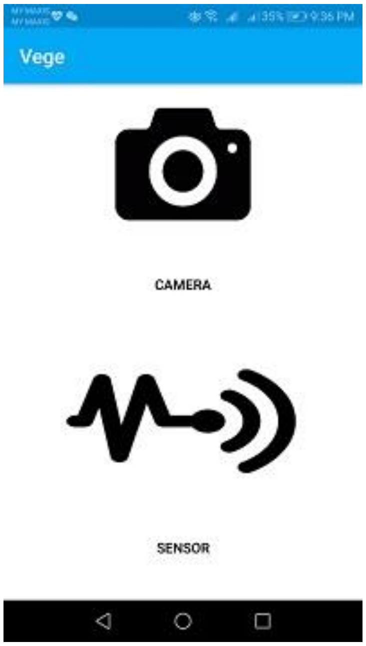


Figure 5.4.2: GUI Design *Figure 5.4.3: GUI Design* *Figure 5.4.4: GUI Design*

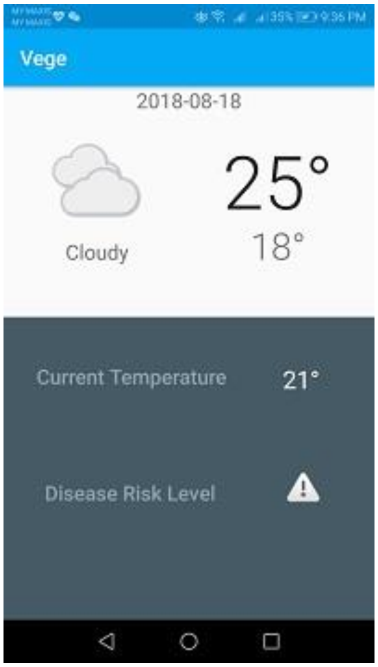


Figure 5.4.5: GUI Design

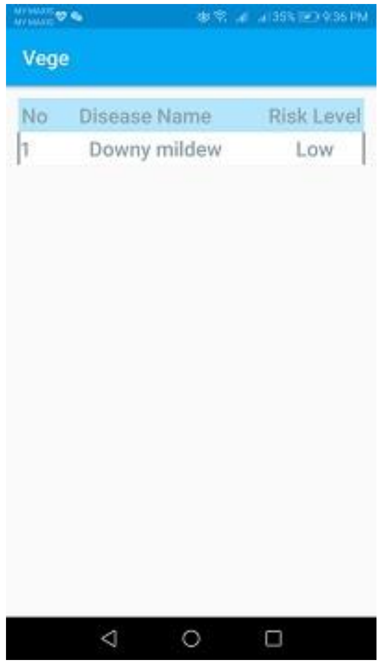


Figure 5.4.6: GUI Design

5.5 Conclusion Remark

In order to ensure the sensor nodes and base station to function correctly. The guides for the hardware setup and the software setup are listed in this chapter. Each sensor nodes and base station are required to follow the guideline to do setup. After the sensor nodes and base station successfully setup, they are required to make some setting and configuration. Under setting and configure had listed the step to do setting and configuration in sensor nodes and base station. Lastly, the whole system operation is shown in this chapter to explain how the whole system operate.

Chapter 6- System Evaluation and Discussion

6.1 System Testing and Performance Metrics

A series of testing are carried out in order to ensure the accuracy of data collected from the sensor nodes. In order to ensure that the prediction model can have a high accuracy of prediction, the data collected from the sensor nodes must be compared. In the testing, the data collected from the sensor nodes will be compared to Acurite (digital temperature humidity device). This test will be tested in an indoor environment. There will be consist of 4 sensor nodes in this testing. The acceptance requirement for this testing is temperature can has ±1 ℃ and humidity can has ±3.0 %RH when doing comparison with the Acurite.

Besides that, network reliability also will be tested. This testing is to ensure that sensor nodes have reliable transmission of data to base station and reliable handling of incoming data by the base station. In the testing, 4 sensor nodes will be sending 200 data to base station and the base station should be receiving total of 800 incoming data from these 4 nodes. The acceptance requirement for this testing is that the number of data received by base station must be more than the number of data that not received by base station.

Testing
Sensor node test in indoor
Network Reliability

Table 6.1.1: Table show the system testing and performance

6.2 Testing Setup and Result

6.2.1 Sensor node in indoor

In this testing, 4 sensor nodes will be running for 20 times to collect the temperature and humidity data. Those data will be recorded in the Table 6.2.1-N1, Table 6.2.1-N2, Table 6.2.1-N3, and Table 6.2.1-N4. The recorded data will compare with data from the Acurite (digital temperature humidity device).

Acurite

Temperature (℃)	Humidity (%)
33	66

Table 6.2.1.1: Data from Acurite

Node 1

Run	Temperature (℃)	Humidity (%)
1	33.34	67.32
2	33.38	67.32
3	33.44	67.27
4	33.45	67.24
5	33.49	67.19
6	33.49	67.16
7	33.53	67.13
8	33.53	66.10
9	33.54	67.07
10	33.56	67.01
11	33.56	66.77
12	33.64	66.75
13	33.60	66.65
14	33.61	66.62
15	33.62	66.39
16	33.61	66.36
17	33.66	66.69
18	33.66	66.8
19	33.66	66.78
20	33.66	66.75

Table 6.2.1-N1: Result of testing

Acurite

Temperature (℃)	Humidity (%)
33	64

Table 6.2.1.2: Data from Acurite

Node 2

Run	Temperature (℃)	Humidity (%)
1	33.03	64.22
2	33.11	64.23
3	33.20	64.19
4	33.20	64.95
5	33.21	64.82
6	33.22	64.67
7	33.20	63.96
8	33.28	64.15
9	33.28	64.05
10	33.20	64.21
11	33.62	63.72
12	33.69	63.70
13	33.72	63.65
14	33.71	63.58
15	33.74	63.55
16	33.75	63.49
17	33.74	63.46
18	33.48	63.92
19	33.72	63.46
20	33.58	63.90

Table 6.2.1-N2: Result of testing

Acurite

Temperature (℃)	Humidity (%)
33	63

Table 6.2.1.3: Data from Acurite

Node 3

Run	Temperature (℃)	Humidity (%)
1	32.96	63.49
2	33.11	63.49
3	33.13	63.40
4	33.14	63.21
5	33.17	63.03
6	33.21	62.85
7	33.21	62.75
8	33.22	62.63
9	33.22	62.57
10	33.22	62.66
11	33.21	62.50
12	33.22	62.53
13	33.16	62.46
14	33.19	62.50
15	33.24	62.51
16	33.21	62.47
17	33.24	62.47
18	33.17	62.46
19	33.21	62.50
20	33.20	62.53

Table 6.2.1-N3: Result of testing

Acurite

Temperature (℃)	Humidity (%)
32	63

Table 6.2.1.4: Data from Acurite

Node 4

Run	Temperature (℃)	Humidity (%)
1	32.69	63.11
2	32.72	62.92
3	32.75	62.80
4	32.74	62.68
5	32.77	62.59
6	32.79	62.56
7	32.83	62.50
8	32.83	62.50
9	32.84	62.38
10	32.83	62.41
11	32.84	62.35
12	33.32	62.50
13	32.94	62.58
14	32.99	62.43
15	33.00	62.60
16	32.99	62.67
17	32.96	62.20
18	32.96	62.20
19	32.98	62.27
20	32.79	62.50

Table 6.2.1-N4: Result of testing

	Average Temperature (℃)	Average Humidity (%)	Comparison Result (± ℃)	Comparison Result (±%)	Result
Node1	33.55	66.87	+0.55	+0.87	Pass
Node 2	33.43	63.99	+0.43	-0.99	Pass
Node 3	33.18	62.75	+0.18	+0.25	Pass
Node 4	32.88	63.54	+0.88	+0.54	Pass

Table 6.2.1.5: Result of each node

The table 6.2.1-R1 shows the average temperature and the average humidity data from node 1 until node 4. The average temperature and humidity data will be compared with the Acurite to get the comparison result. After carried out the testing, the results show that the SHT11 sensor can get high accurate temperature and humidity data because all the results from 4 nodes meet the acceptance requirements which are ±1 ℃ for the temperature and ±3.0 % for the humidity.

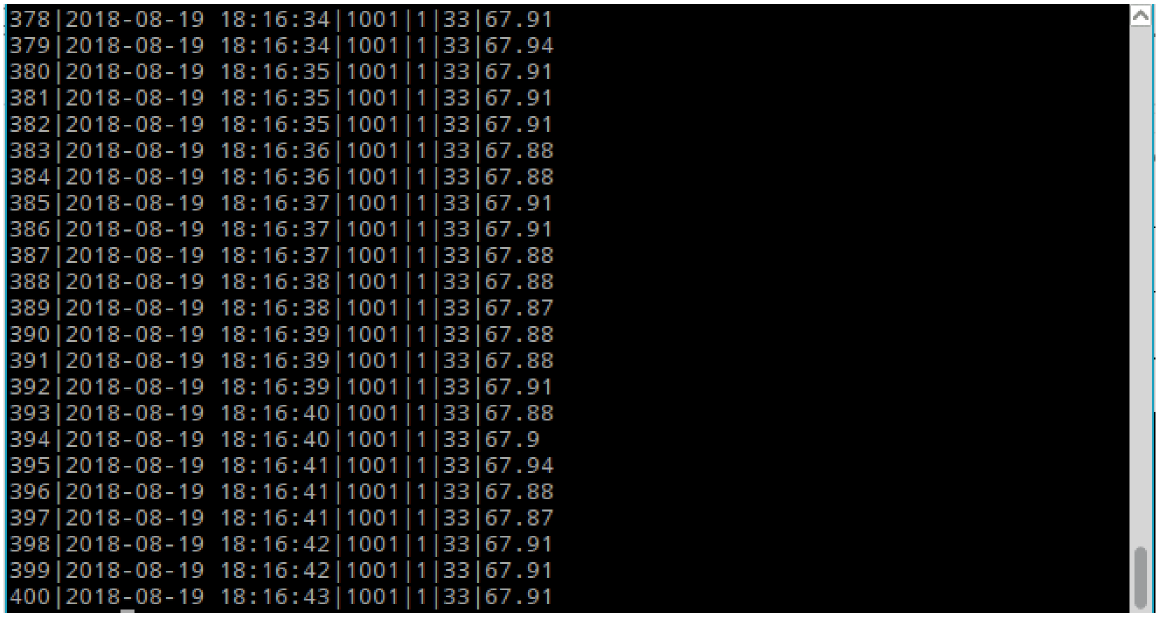
6.2.2 Network Reliability

In this testing, 4 sensor nodes will send data to base station at the same time. Each node will be sending 200 data to base station. The reason that this testing is carried out is to shown that how the base station handle the incoming data from multiple nodes and whether the base station is able to push all received data to Cloud.

Base Station

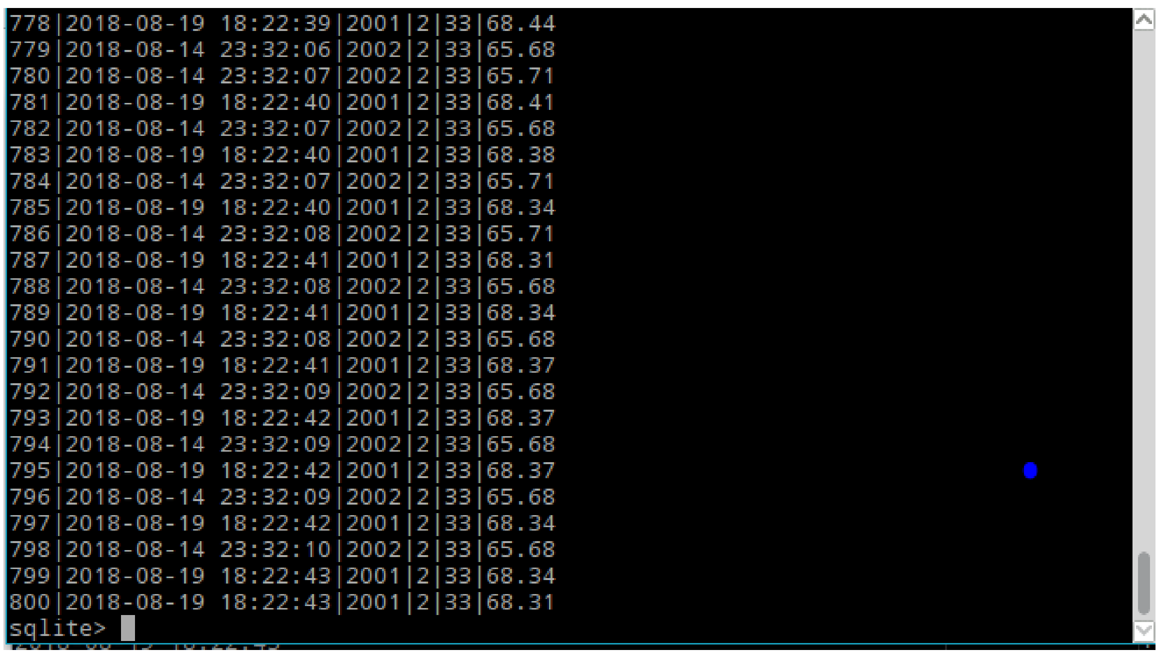
	Number of data received by Base Station	Number of data not received by Base Station	Result
Data from Node 1	200	0	Pass
Data from Node 2	200	0	Pass
Data from Node 3	200	0	Pass
Data from Node 4	200	0	Pass

Table 6.2.1.6: Result of network reliability test



```
378|2018-08-19 18:16:34|1001|1|33|67.91
379|2018-08-19 18:16:34|1001|1|33|67.94
380|2018-08-19 18:16:35|1001|1|33|67.91
381|2018-08-19 18:16:35|1001|1|33|67.91
382|2018-08-19 18:16:35|1001|1|33|67.91
383|2018-08-19 18:16:36|1001|1|33|67.88
384|2018-08-19 18:16:36|1001|1|33|67.88
385|2018-08-19 18:16:37|1001|1|33|67.91
386|2018-08-19 18:16:37|1001|1|33|67.91
387|2018-08-19 18:16:37|1001|1|33|67.88
388|2018-08-19 18:16:38|1001|1|33|67.88
389|2018-08-19 18:16:38|1001|1|33|67.87
390|2018-08-19 18:16:39|1001|1|33|67.88
391|2018-08-19 18:16:39|1001|1|33|67.88
392|2018-08-19 18:16:39|1001|1|33|67.91
393|2018-08-19 18:16:40|1001|1|33|67.88
394|2018-08-19 18:16:40|1001|1|33|67.9
395|2018-08-19 18:16:41|1001|1|33|67.94
396|2018-08-19 18:16:41|1001|1|33|67.88
397|2018-08-19 18:16:41|1001|1|33|67.87
398|2018-08-19 18:16:42|1001|1|33|67.91
399|2018-08-19 18:16:42|1001|1|33|67.91
400|2018-08-19 18:16:43|1001|1|33|67.91
```

Figure 6.2.1.1: Data store in local database by base station



```
778|2018-08-19 18:22:39|2001|2|33|68.44
779|2018-08-14 23:32:06|2002|2|33|65.68
780|2018-08-14 23:32:07|2002|2|33|65.71
781|2018-08-19 18:22:40|2001|2|33|68.41
782|2018-08-14 23:32:07|2002|2|33|65.68
783|2018-08-19 18:22:40|2001|2|33|68.38
784|2018-08-14 23:32:07|2002|2|33|65.71
785|2018-08-19 18:22:40|2001|2|33|68.34
786|2018-08-14 23:32:08|2002|2|33|65.71
787|2018-08-19 18:22:41|2001|2|33|68.31
788|2018-08-14 23:32:08|2002|2|33|65.68
789|2018-08-19 18:22:41|2001|2|33|68.34
790|2018-08-14 23:32:08|2002|2|33|65.68
791|2018-08-19 18:22:41|2001|2|33|68.37
792|2018-08-14 23:32:09|2002|2|33|65.68
793|2018-08-19 18:22:42|2001|2|33|68.37
794|2018-08-14 23:32:09|2002|2|33|65.68
795|2018-08-19 18:22:42|2001|2|33|68.37
796|2018-08-14 23:32:09|2002|2|33|65.68
797|2018-08-19 18:22:42|2001|2|33|68.34
798|2018-08-14 23:32:10|2002|2|33|65.68
799|2018-08-19 18:22:43|2001|2|33|68.34
800|2018-08-19 18:22:43|2001|2|33|68.31
sqlite>
```

Figure 6.2.1.2: Data store in local database by base station

Table 6.2.1.1 shows the result of network reliability test. From the results, it shows that the system has high network reliability because 4 sensor nodes can send data to base station simultaneously without any data drop or loss. Besides that, the base station is tested under no internet access. Base station able to store all received data into local database.

6.3 Project Challenges

There are many challenges happened in the process of developing this project. The first challenge is to know the characteristic of each targeted vegetable in the project. Each vegetables has their own characteristic and under different environment will caused different diseases to happen. There is limited information found online and required more time to be spend to do research in the agriculture field.

Besides that, making a high accurate prediction model in this project. The usage of prediction model is to predict possible diseases that could happen in the vegetable farm. Without an accurate prediction, the user cannot take the precaution steps to stop the disease before it spread to whole vegetable farm. The data accuracy is crucial as those data will affect the result of prediction model.

Another challenge is network reliability. In this project, each sensor node and base station are required to form a mesh network. Each sensor nodes must able to send data to the base station with minimal data loss or without any data loss. Every data collected from sensors are very important because those data are used in prediction model. If the network is not reliable will caused the inaccurate prediction in the system.

6.4 Objective Evaluation

The first objective is to allow the user to monitor vegetable farm. This objective is successfully achieved as the sensor node and base station is developed to allow the user to implement this system in their vegetable farm to perform monitoring process automatically.

The second objective is to perform the prediction of plant's disease and provide an indication to the disease. This objective also successfully achieved. The sensor node collects environment temperature and humidity data and send it to the base station. Then the base station will push the data to the Cloud. The Android application will be automatically perform prediction of disease that could happen and show the user the ways to stop or kill the disease.

The last objective is to design an application for users to remotely retrieve data collected from the sensor nodes. This has been accomplished as an application had been developed for the user. The Android application will show the system currently monitor what vegetable on the farm. The Android application will retrieve the data from the Cloud and perform prediction of disease that could happen and alert the user when certain diseases are in high-risk level which indicates that that disease may happen.

6.5 Concluding Remark

The system testing and performance metric for the system are stated in this chapter. The testing result also included to shown. In this chapter also listed the project challenges and lastly the evaluation of project's objective are included in this chapter.

Chapter 7: Conclusion and Recommendation

7.1 Conclusion

The purpose of this project is to develop a disease detection system for farmers to monitor their farm. Currently, most of the farmers are relied on manually monitor their through observation or their experiences. Manual monitoring may be efficiently if the size of vegetable farm is small. If the size of vegetable is big, the manual monitoring farm is not a practical way.

At the end of this project, a well functioned prototype system was developed. The functions include in the prototype system are sensor nodes that connected with SHT11 sensor are able sense current humidity and temperature data in every 4 hour. Each sensor nodes in this system are also required to send data to base station. When the base station received the sensor data it will push the data to the Cloud when there is an internet connection. If the base station is no internet access it will store the data to the local database so that it can push the data to the Cloud when internet access.

Besides that, an Android application would be design to retrieve the sensor data from the Cloud and perform prediction module. The prediction module is sum up all the data from a specific date and calculate the average value in order to do comparison with data stored in the Android application. If the average value meets the threshold means that certain diseases will have high-risk to happen. Other than prediction module, the Android application also allows the user to get the forecast weather information. With forecast weather information could help the user to make the decision quickly because some of the vegetable farms may not have the cover. If heavy rain coming they need to find some cover to cover the crop so that the crops were not damaged by the heavy rain.

The project objectives are able to convert into deliverables such as develop a disease detection system for farmers, allow farmers to use an Android application to monitor their vegetable farm and a reliable prediction model is develop to help farmer perform precaution steps based on the result of prediction model.

Although in the end, a full system was developed. In the real implementation could be difficult to achieve as the different farm had the different condition such as the size of the farm or the internet connectivity in that farm. In the real implementation, the accurate temperature and humidity data sense by sensor nodes could be good enough to make the prediction model work properly. The proposed system in the project was helpful for the user and it can be further enhanced.

7.2 Recommendation

There are still many improvements and enhancements can be done in this project. Firstly, in the prototype system the sensor node just using 1 type of sensor. The accuracy of the prediction model may not reliable. This is because some disease could also affect by the PH value of soil or moisture of the soil. In order to increase accuracy sensor node, more sensor need to be added to collect more data that will used by the prediction model.

Furthermore, the system is used to make the future prediction. The user do not know the current situation of the vegetable plants. In order to solve this problem this system can include a camera to allow the user to capture or do streaming to view their farm. The system also can include an image classifier to classify the captured image from the camera whether it is in healthy state or unhealthy state or even can classify the unhealthy plant is infected by what disease. With the camera, it allows the user to know the current situation of their farm and they could make the decision faster.

Besides that, the recommendation to include the camera in the system could be further enhance with the help of servo. With the servo, the camera can capture the images from different angels instead of one. Images from different angel increase the accuracy of disease detection in the system so that it can prevent blind spot issue.

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,

Appendix 1 – Bi Weekly Report

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Trimester 1, Year 3	**Study week no.: 2**
Student Name & ID: Choong Jian How 1605821	
Supervisor: Dr Goh Hock Guan	
Project Title: Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Reorganize the proposal's content. Then reuse back some contents into FYP 2 report. I had complete list out the system setup and configurat5ion. Besides that, I also done research of the targeted vegetable that need to be in the system.

2. WORK TO BE DONE

Based on the research of technology platform that I had done. I will review those platform. For example, review those platform specification and make a summary of those platform in a table. I also will reuse back the literature review that done on proposal and put inside FYP 1 report as the literature review.

3. PROBLEMS ENCOUNTERED

- Research of targeted vegetable in the system.
- Find suitable software for the sensor node.

4. SELF EVALUATION OF THE PROGRESS

Follow the guideline of FYP to complete each chapter in the report. As I follow the guideline make the progress preparing the report easier and faster because I know what content should include inside the report.

___________________________ ___________________________

Supervisor’s signature Student’s signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Trimester 1, Year 3	**Study week no.: 4**
Student Name & ID: Choong Jian How 1605821	
Supervisor: Dr Goh Hock Guan	
Project Title: Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

I had done setting and configuration for the sensor nodes and base station. The sensor nodes able to send data to base station and the base station able to push the received data to Cloud. The sensor nodes send data to base station through the MQTT protocol.

2. WORK TO BE DONE

In the following week, the prediction model required to be completed. How to prediction model analyse the data in the Cloud and make reliable prediction to show to the user.

3. PROBLEMS ENCOUNTERED

- Set the payload of MQTT that required to send to broker.
- If base station no internet access, how base station store the data to local database and when it has internet access push back the data from local database to Cloud

4. SELF EVALUATION OF THE PROGRESS

I do not organize time wisely and finally need to rush for report in last minutes. In the few week, I will try to plan a timetable to do work. So that I am not rushing to done work again.

__________________________ __________________________

Supervisor's signature Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Trimester 1, Year 3	**Study week no.: 7**
Student Name & ID: Choong Jian How 1605821	
Supervisor: Dr Goh Hock Guan	
Project Title: Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

I had done the Chapter 5 which contain the full setup of the system. In that chapter, I list out all the necessary steps that required to be followed in order to ensure the sensor node and base station can function properly. I also had referred back the functional requirements of the project to ensure the project included all the listed functional requirements.

2. WORK TO BE DONE

In the following week, I will start redraw the system architecture because currently the sensor nodes and base station will form a mesh network. I plan to use online tool like drawIO to draw out the system architecture.

3. PROBLEMS ENCOUNTERED

- In this week, I did not face any problem as the project go smoothly.

4. SELF EVALUATION OF THE PROGRESS

I do not organize time wisely and finally need to rush for report in last minutes. In the few week, I will try to plan a timetable to do work. So that I am not rushing to done work again.

____________________________ ____________________________

Supervisor's signature Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Trimester 1, Year 3	**Study week no.: 9**
Student Name & ID: Choong Jian How 1605821	
Supervisor: Dr Goh Hock Guan	
Project Title: Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.	

1. WORK DONE

I had drawn out system architecture. System architecture is descript how system work. At first, sensor nodes and base station will form a mesh network. Then, sensor nodes are able to start sense environment's humidity and temperature and send those data to base station. Android application to retrieve back the data. Besides that, the full system flow chart had been done.

2. WORK TO BE DONE

Start to develop the prediction model inside the Android application. Currently the hardware part is completed as the sensor nodes able to sense data and send to the base station. Then, the base station is also able to push received data to Cloud. The prediction model is use to retrieve data from Cloud and make prediction of diseases that have high or medium risk to happen in vegetable farm.

3. PROBLEMS ENCOUNTERED

- Selection best prediction model for the Android application

4. SELF EVALUATION OF THE PROGRESS

Progress of the report was work according to my planning. Everything run very smoothly in this few week. I will keep planning the time table before do anything as table really helpful for me to do things smoothly without rushing like before.

____________________________ ____________________________

Supervisor's signature Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Trimester 1, Year 3	**Study week no.: 11**
Student Name & ID: Choong Jian How 1605821	
Supervisor: Dr Goh Hock Guan	
Project Title: Disease Detection using Sensors with Raspberry Pi through Wireless Sensor Network in vegetable farms.	

1. WORK DONE

The FYP report had been done partially. I had check the format of report so that all the format was follow the requirement. Besides that, I completed the system testing and the results of testing is listed in Chapter 6.

2. WORK TO BE DONE

Focus more on report as the prototype system had been running properly. The report left out the Chapter 7 with contain conclusion and recommendation for future enhancement.

3. PROBLEMS ENCOUNTERED

- Check the format of report

4. SELF EVALUATION OF THE PROGRESS

As everything run smoothly I would continue to maintain current progress. Everything do earlier so that does not rush in last minutes.

______________________________ ______________________________

Supervisor's signature Student's signature

Appendix 2- Turnitin Originality Report

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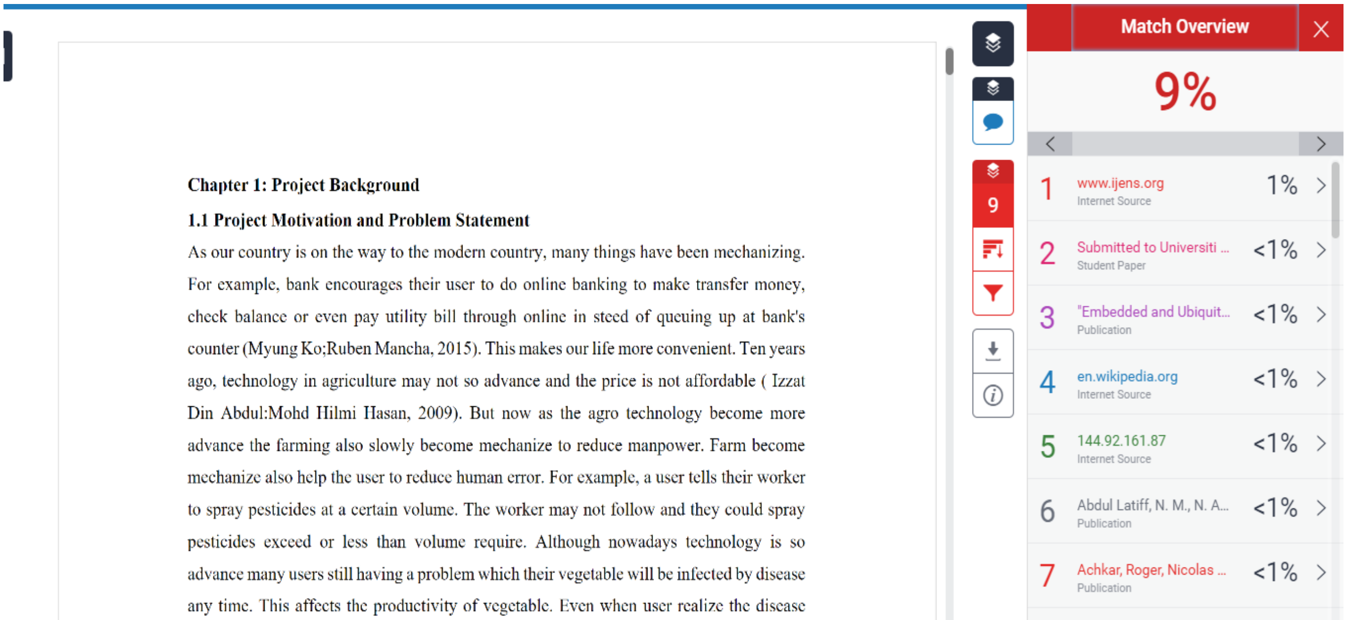

Chapter 1: Project Background

1.1 Project Motivation and Problem Statement

As our country is on the way to the modern country, many things have been mechanizing. For example, bank encourages their user to do online banking to make transfer money, check balance or even pay utility bill through online in steed of queuing up at bank's counter (Myung Ko;Ruben Mancha, 2015). This makes our life more convenient. Ten years ago, technology in agriculture may not so advance and the price is not affordable (Izzat Din Abdul:Mohd Hilmi Hasan, 2009). But now as the agro technology become more advance the farming also slowly become mechanize to reduce manpower. Farm become mechanize also help the user to reduce human error. For example, a user tells their worker to spray pesticides at a certain volume. The worker may not follow and they could spray pesticides exceed or less than volume require. Although nowadays technology is so advance many users still having a problem which their vegetable will be infected by disease any time. This affects the productivity of vegetable. Even when user realize the disease

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Poster

Disease Detection uisng Sensors with Raspberry Pi through Wirless Sensor Network in vegetable farm

Description

For the ordinary agriculture, farmer requires to manually monitor the vegetable plants. Sensor node, it provides an alternative way for the farmer to monitor their crops smartly and reduce manpower.

Objective

- To allow the farmer to monitor vegetable farm.
- To perform the prediction of plant's disease and provide indication to the disease.
- To allow the farmer to remotely retrive data

Methodology

Sensor auto collect vegetable farm temperature and humidity → Raspberry Pi push data to cloud → User uses an Android application to retrieve data from the cloud → Android application show the rish level of disease that could happen → Sensor auto collect vegetable farm temperature and humidity

Project Developer

Choong Jian How

Project Supervisor

Dr Goh Hock Guan

Universiti Tunku Abdul Rahman			
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Full Name(s) of Candidate(s)	Choong Jian How
ID Number(s)	1605821
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______________________________ Signature of Co-Supervisor

Name: __________________________

Date: ___________________________

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FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (PERAK CAMPUS)

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Supervisor Name	Dr Goh Hock Guan

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	Poster
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