DEVELOPMENT OF REMOTE MONITORING HARDWARE ARCHITECTURE FOR AGRO-FARMING APPLICATION

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DECLARATION

I declare that this thesis entitled "DEVELOPMENT OF REMOTE MONITORING HARDWARE ARCHITECTURE FOR AGRO-FARMING APPLICATION is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

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Date : 3/7/2021

APPROVAL

I hereby declare that I have checked this report entitled "DEVELOPMENT OF REMOTE MONITORING HARDWARE ARCHITECTURE FOR AGRO-FARMING APPLICATION" and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Mechatronics Engineering with Honours

Signature : .....

Supervisor Name : ASSOCIATE PROFESSOR DR. MUHAMMAD HERMAN JAMALUDDIN

Date : 5 JULY 2021

DEDICATIONS

To my beloved mother and father

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ABSTRACT

Monitoring system for agriculture is a system which will help farmer to monitor their crops land area without any difficulties. Internet of Things (IoT) can be used to send all sensor data to the cloud service for easier plant monitoring. However, existing monitoring system cannot be place in remote location and required constant electrical power outlet to operate. This project monitoring system can be used to collect from various types of sensor data such as humidity, temperature, and soil moisture. Then cloud services is used to managing all the data for easier monitoring. Aims for this research is to develop a working hardware which can be place at remote land area to collect sensors reading data. As this system will be place in remote area, solar panel with battery packs is used to power on the systems throughout the day. Since there are no WIFI or any router which connect the microcontroller to the Internet in the remote area. Therefore, a General Packet Radio Service (GPRS) module is used to replace both services which enable microcontroller to connect to the Internet. GPRS module used 2G/2.5G network sim card data to transmit information to the Internet. Besides, android based application can be used for easier access of sensor data to the user. Several test will be conducted to determine the accuracy and reliability of the system. This project is expected to provide low-cost remote monitoring system for agriculture sector.

ABSTRAK

Sistem pemantauan pertanian adalah sistem yang dapat membantu para petani memantau kawasan tanah tanaman mereka tanpa sebarang kesulitan. Teknologi Internet of Things (IoT) dapat digunakan untuk mengirim semua data sensor ke layanan awan untuk pemantauan tanaman yang lebih mudah. Walau bagaimanapun, sistem pemantauan yang sedia ada tidak dapat ditempatkan di lokasi terpencil dan memerlukan saluran elektrik tetap untuk beroperasi. Sistem pemantauan untuk projek ini dapat digunakan untuk mengumpulkan dari berbagai jenis data sensor seperti kelembapan, suhu, dan kelembapan tanah. Kemudian, perkhidmatan awan dapat digunakan untuk menguruskan semua data untuk pemantauan yang lebih mudah. Tujuan penyelidikan ini adalah untuk mecipta perkakasan pemantauan yang berfungsi dan boleh diletakkan di kawasan terpencil untuk mengumpulkan data bacaan sensor. Oleh kerana sistem ini akan diletakkan di kawasan terpencil, panel solar dengan pek bateri digunakan untuk operasi sistem sepanjang hari. Oleh kerana tidak ada WIFI atau penghala yang menghubungkan mikrokontroler ke Internet di kawasan terpencil. Modul Perkhidmatan Radio Paket Umum (GPRS) digunakan untuk menggantikan kedua-dua perkhidmatan yang membolehkan mikrokontroler sambung ke Internet. Modul GPRS menggunakan data kad sim rangkaian 2G untuk menghantar maklumat ke Internet. Selain itu, aplikasi berasaskan android dapat digunakan untuk akses data sensor yang lebih mudah kepada pengguna. Beberapa ujian akan dilakukan untuk menentukan ketepatan dan kebolehpercayaan sistem. Projek ini diharapkan dapat menyediakan sistem pemantauan jarak jauh yang lebih murah untuk sektor pertanian.

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LIST OF SYMBOLS AND ABBREVIATIONS

IoT	-	Internet Of Things
GSM	-	Global Service for Mobile Application
ICT	-	Information and Communication Technologies
RFID	-	Radio-frequency identification
M2M	-	Machine to machine
LCD	-	Liquid Crystal Display
EC	-	Electrical Conductivity of A Solution
PC	-	Personal Computer
SOC	-	System On Chips
GPRS	-	General Packet Radio Services
A	-	Ampere
V	-	Voltage
W	-	Watt
USB	-	Universal Serial Bus
°C	-	Degree Celcius
Rh	-	Relative Humidity
%	-	Percentage

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, it will explain the development of remote monitoring hardware architecture for Argo-farming application. This system can be use collect data for Argo-farming application such as soil moisture, humidity, and temperature. Moreover, this chapter also include project background, objective, scope, and problem statement.

1.2 Background

Agriculture based exporter countries are increasing its own Agro farming capacity and crop as demand of food in the world predicted to increases between 59% to 98% by 2050. This is because agriculture sector provides basic necessities to humankind and also stimulate economic growth[1]. Moreover, as demand of food increases so does the efficiency of crops yield that need to be achieved in limited land area. To overcome this issue, most farmer resorted to plant their crops on remote land area to increase their crops yield. High commodities crop such as durian, pomegranate, etc required regulated environment to thrive and produce significant yield. Water waste also need to be reduced primarily in dry land area[2]. Therefore, a monitoring system is needed for agriculture to ensure all plant in good condition.

Nowadays, many industries sector integrate electronics devices in their system. Internet of Things (IoT) technologies enable embedded system to connect to the internet and interact user seamlessly[3]. In agriculture, embedded sensors can accurately measure surrounding farm environment and with the help of IoT infrastructure enable data to be easily monitor around the world. Thus, it will improve farm efficiency, increasing crops yield while reducing waste discharge. Data collected from crops surrounding are necessary for the farmer to quickly identify the condition of the crops planted. Data parameter that may be useful for agriculture sector includes temperature, soil moisture and surrounding humidity. These data are very useful for

the farmers as it was not only making it easier to identify the farm condition, but it also help farmer to quickly determine plant health condition.

1.3 Motivation

Agriculture sector in Malaysia was identifies as 12 National Key Economic Areas that can stimulate economic growth by increasing farmer income. Agriculture modernization and transformation able to ensure food securities while increasing productivities[4]. IoT in Malaysia from various sector are gaining momentum in past several years. IoT implementation can be integrated to many types of industries and application such as smart homes, healthcare, agriculture etc. IoT infrastructure can be used to collect, process, and do analysis of various set of data. However, IoT adoption for agriculture sector in Malaysia is still quite low although keep increase yearly.

Agriculture is such a risky industry as it was very dependent on many factors such as environment condition, soil condition and weather. Agriculture sector also prone to outside intrusion such as pest, wild animals, flash flood and drought which will decrease number of crops that can be yield by the farmer. As reported by Bernama on 1st of July 2020, district in Sabah suffers monetary loss of RM29 million after paddy crop was destroyed in floods. Thus, because of natural disaster, Sabah paddy crops yield decrease at that time. Therefore, an IoT implementation on monitoring system able to monitor plant and farm condition that have been cultivated to continue maintain crops yield produced.

Moreover, if farmer decided to cultivate their crops in remote area, farmer unable monitor their farm condition daily. IoT implementation also cannot be done because there is no internet connectivity at that land area. Valuable data such as soil moisture, temperature and humidity also cannot be determined by farmer. Therefore, a development of low-cost remote monitoring system able to help farmer to monitor their farm much easier.

1.4 Problem Statement

Food crops plantation and farming are increasing over time as demand of food source around the world are increasing rapidly. This could lead to problem faced by farmer or agriculture organization on how to monitor their plant condition in the farmland area very easily. Sometimes, farmer will plant their crops on land area in remote to increase crops yield capabilities. Therefore, farmer will have difficulties to monitor the plant condition especially farmer with huge farming land area. Unable to monitor the crops condition could lead huge monetary loses in which it will impact farmer quantities of crops yield per yield season.

Therefore, a cheap and reliable monitoring system with built in IoT integration and notification system need to be developed to help farmer monitor surround condition more easily. Thus, data parameter such as soil moisture, humidity, C02 concentration and rain detection are necessary in determine the crops health condition. Furthermore, farmer also need to be quickly notified if there are any parameter changes that could influence plant growth. These problems need to be address carefully and a solution are needed to help farmer to monitor their plant condition easily.

1.5 Aims and objectives

This project aims to develop a remote monitoring hardware architecture for Agro-farming application and has several objectives that must be achieved successfully. These objectives include:

1. To design and develop hardware prototype of agriculture monitoring system.

2. To develop a working agro-farming monitoring system with IoT integration from developed hardware prototype.

3. To evaluate the performance of the prototype agro-farming monitoring system by testing the accuracy of the sensor and real world monitoring system test.

1.6 Work Scope

1. ESP 32 with integrated GPRS microcontroller is used to collect sensor data and sent data to the Internet.

2. Temperature, humidity, and soil moisture sensor is used to monitor plant surrounding condition.

3. Air quality sensor is used in order to measure surrounding C02 concentration. Additional rain sensor is used to detect rain presense

4. Blynk and ThingSpeak IoT platform can be used to monitor all sensor data for monitoring and data analysis.

5. PCB board is developed and fabricate based on electrical circuit design from agro-farming monitoring system hardware.

6. Automatic farm control, irrigation and automation is not included in this study.

7. This system is only running continuously for two hours in order to mimic live data visualization for the users.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In chapter, it will discuss the relationship between this project reliability with another research as to determine if there are any identical research based on this project. Moreover, in this chapter, it will help to ensure there are no repetitive research study based on the same case area. This project title development of remote monitoring hardware architecture for Agro-farming application will provide necessary system which help farmer to monitor their plantation.

2.2 Overview of Agro farming sector in Malaysia

Based on Collins English Dictionary, agro means soil or fields while farming means activities related of growing crops or keeping animals in farms. Therefore, agro-farming can be categorized as an agricultural branch which modernize agricultural sector from its traditional method. Agricultural industries consistently continue to innovate as technologies become more and more integrated with agricultural sectors. Hence, with the used of heavy machine such as harvester in 1800's, mass crops plantation and ever increasing in harvesting efficiency mark a new era for Argo-farming method.

In the last decades, as human population continues to grow rapidly around the world, it also creates a pressing issue regarding the increase need for agricultural output. Agriculture sector around the world can keep up with the increase demands of food crops in the early 1800's to late 1900's. However, in 20th centuries, global warming, pest such as grasshoppers, drought and flash flood can reduced global food supplies very significantly.

The Malaysian Agriculture sector can be categorised with two distinct sectors, the plantation sector and the smallholders' sector[5] . Major crops planted are oil palm, rubber, rice, mixed horticulture, coconut, and orchard. In Malaysia, Department of Statistic Malaysia reported that agricultural sector gross output increases from RM79.3

billion from 2015 to RM91.2 billion in 2017 [6] as shown in Figure 2.1. An increase of 11.1% gross output in just two years which indicate Argo-farming industries in Malaysia will continue to grow every year. Agriculture sector in Malaysia primarily exports its high yield major crops such as palm oil, rice grains, rubber, and sugar to other countries. Valuable and seasonal fruits such as durian also being export to other countries such as China and Singapore. Other than providing economics benefits for Malaysia, agriculture sector also provides jobs for Malaysian people even though decreasing yearly.

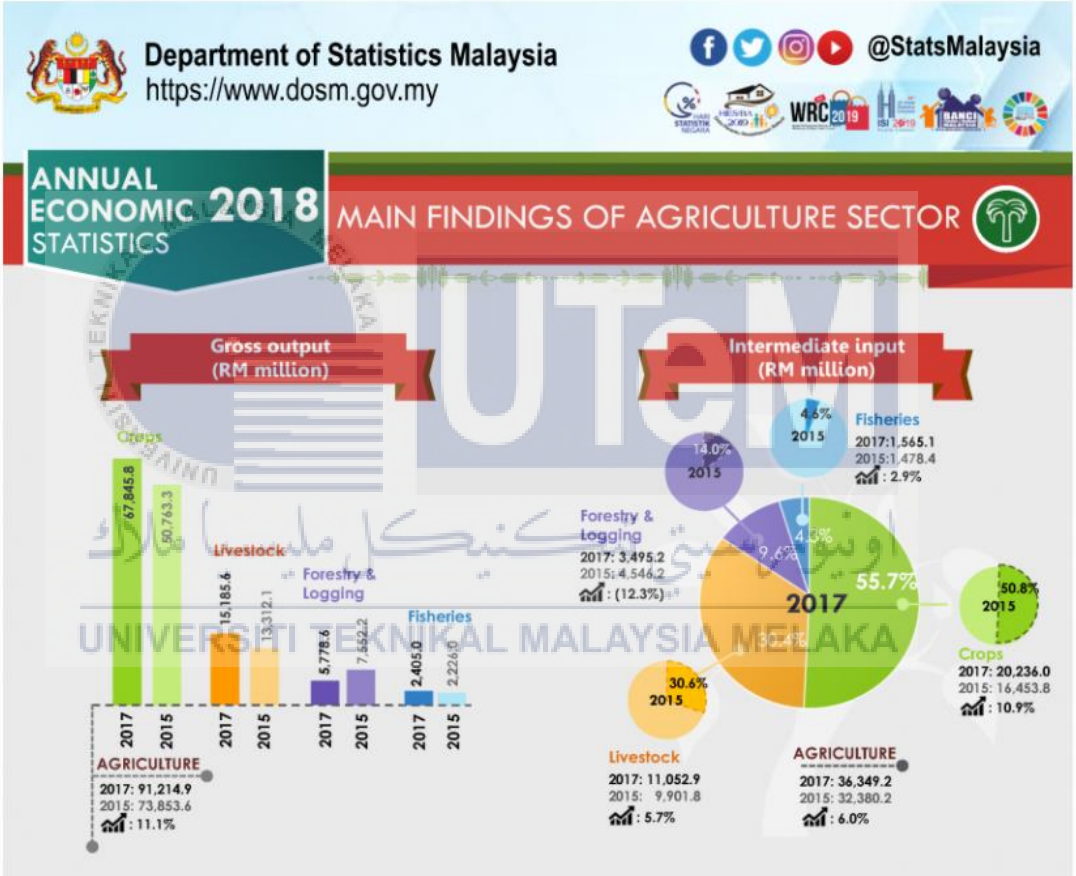

Figure 2.1 : Malaysia Annual Economics Statistic 2018 [6]

However, much of original land area used for farming will eventually become full and packed. Therefore, farmer or agriculture organization purchased additional land area to expand their crops yields capacities. Generally, they will be purchased land area which are located remotely from public population because it much cheaper compared to land area that are highly populated. Malaysia land area used for agriculture sector increases from 73,893sq feet in 2010 to 86,270sq feet in 2016 and

predicted to continuously increase as demand for food crops increases as shown in Figure 2.2.

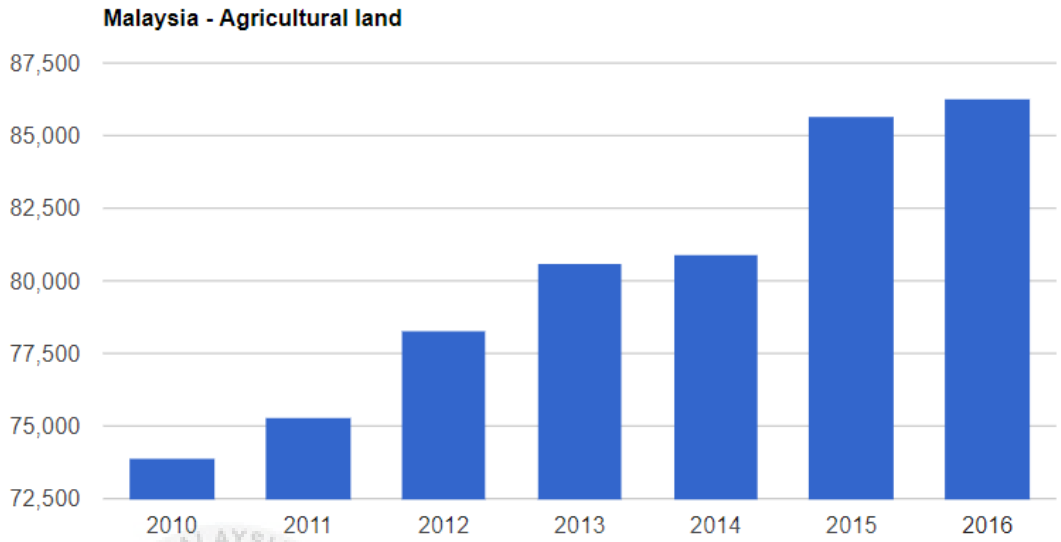

Figure 2.2: Malaysia Agriculture Land Area from 2010 to 2016

2.3 Overview of Internet of Things

Nowadays, Internet has become synonymous around the world, connecting people and effecting our daily life significantly[7]. Thus, open a new era of computation technologies besides traditional personal computer that only be used for storing data. Internet of Things is a network connection which can connect us and multiple electronics object seamlessly[8]. In 1999, the terms Internet of Things was first introduced by Kevin Ashton in form of supplies chain management system which integrated with RFID technologies that quite new during that time[9]. Hence, as Internet technologies getting worldwide adoption during the 20th centuries, IoT terms are also expending which allows communication and data exchanged between electronics devices and application. IoT enable system able to complete the task automatically after an intelligence system has been incorporated to the object.

Basic IoT architecture can be split into 3 layers, perception layers, network layers and application layers[7] as shown in Figure 2.3. Perception layers consist of physical object such as sensors which collect information from its surrounding. Then, network layer is a layer which connect network devices and servers via Internet or local network. Its primary purpose is to transmit sensor data to the application layer.

Lastly, application layer was used to deliver application reading for various sensors to the end users.

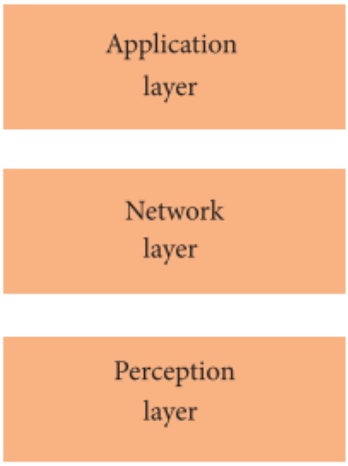

Figure 2.3: Internet of Things Architecture [7]

IoT has been prove useful in connecting wide area of industries and application. From smart home, agriculture, smart cities, healthcare services, transportation, and analytics application etc as shown in Figure 2.4. User can easily use IoT platform to navigate around various services and system which provide the infrastructure. Internet enable the transmission of data between IoT infrastructure easily and seamlessly.

Figure 2.4: Internet of Things Application