# DESIGN AND DEVELOPMENT WIRELESS SWITCH POWERED BY ALOE VERA

YEO WEI CHENG

This Report is Submitted in Partial Fulfillment of Requirements for The Bachelor Degree of Electronic Engineering (Telecommunication Electronic)

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

May 2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
**PROJEK SARJANA MUDA II**

**Tajuk Projek** : DESIGN AND DEVELOPMENT WIRELESS SWITCH POWERED BY ALOE VERA

**Sesi Pengajian** : 1 6 / 1 / 7

Saya YEO WEI CHENG
(HURUF BESAR)

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan ( √ ) :

| | | |
|---|---|---|
| ☐ | **SULIT*** | *(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972) |
| ☐ | **TERHAD**** | **(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan) |
| ☑ | **TIDAK TERHAD** | |

Disahkan oleh:

(TANDATANGAN PENULIS)

PROF. MADYA DR. KOK SWEE LEONG
Profesor Madya
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Hang Tuah Jaya
76100 Durian Tunggal, Melaka
(COP DAN TANDATANGAN PENYELIA)

Tarikh: 23/5/17

Tarikh: 23/5/2017

"I admit that this report is the result of my own work except summaries and excerpts that each of them I have explained the source."

Signature :
Student's Name : YEO WEI CHENG
Date : 30 MAY 2017

"I / we hereby declare that I have read this in my / our work is sufficient in scope and quality for the award of the Bachelor in Electronic Engineering (Telecommunication Electronic)."

Signature :
Supervisor's Name : DR. KOK SWEE LEONG
Date : 30 MAY 2016

# ACKNOWLEDGEMENT

First, I am grateful to the God for the good health and wellbeing that were necessary to complete this final year project.

Foremost, I would like to express my sincere gratitude to my main supervisor Dr. Kok Swee Leong and my core supervisor Dr. Soo Yew Guan for their patience, support, directions, enthusiasm, motivation and commentators. Their counsel and help were vital in completing this project. Without their guidance and support, my final year project would not be so successful.

My sincere thanks also go to my fellow friends for encouragement, insightful comments, and hard questions especially BENT colleagues who have given support and shared brilliant ideas throughout the whole year. Great appreciation goes to the FKEKK staffs who have given a nice environment to conduct the experiment.

Furthermore, I would like to acknowledge with much appreciation of the Engineer from Research Lab2, Goh Siew Yun, Bong Yu Jing and Ali Mohammed Abdal Kadhim who gave the help when I have trouble on my project.

Last but not least, I would like to thank my parents for giving birth to me at the first place and supporting me spiritually throughout my life and my family members for their bread and butter.

## ABSTRACT

Nowadays, electronic devices have become common in applications. All the electronic devices require energy to function. The chemical energy of the Aloe Vera can be converted to the useful energy. Electrolysis is a process which converts chemical energy into electrical energy. In this project, the electrical energy will be used to power up a wireless switch. Firstly, electrical power generation is characterized from the Aloe Vera with different number of copper-zinc electrode pair. Electrical power from the Aloe Vera is measured and plotted in graph. This mechanism is referred to as self-powering whereby the RF transmitter is powered by the Aloe Vera without battery. A wireless automated watering system for plants will be developed. The copper-zinc electrode pair is inserted into the Aloe Vera to generate output voltage. Power conditioning and storage circuit is designed for storing electrical energy generated by Aloe Vera. The power conditioning circuit is designed to trigger the storage voltage and discharge the voltage to power up the RF wireless switch. After RF transmitter is being turned on, 1 bit RF signal will be send to RF receiver within 10 meter. The RF receiver contains temperature and humidity sensor and automated watering system. Once the RF receiver received 1 bit RF signal, this will trigger the microcontroller unit with WIFI module to read the data from the sensor and send to IoT monitoring system. The watering system will water the plants if the humidity is less than 50%.

# ABSTRAK

Pada masa kini, peranti elektronik amat penting dalam kehidupan kita. Semua peranti elektronik memerlukan tenaga untuk berfungsi. Tenaga kimia Aloe Vera boleh ditukarkan kepada tenaga yang berguna. Elektrolisis adalah proses yang menukarkan tenaga kimia kepada tenaga elektrik. Dalam projek ini, tenaga elektrik akan digunakan untuk memberi tenaga kepada suis tanpa wayar. Pertama sekali, ciri-ciri tenaga elektrik dari Aloe Vera dengan nombor yang berbeza tembaga-zink pasangan elektrod diukur. Kuasa elektrik dari Aloe Vera diukur dan diplotkan dalam graf. Mekanisme ini dirujuk sebagai penjana kerana tenaga elektrik untuk RF transmitter adalah dikuasakan oleh Aloe Vera tanpa menggunakan bateri. Automatik sistem penyiraman tanpa wayar dicipta. . Beberapa pasangan tembaga-zink elektrod dimasukkan ke dalam Aloe Vera untuk menjana keluaran voltan. Selepas itu, litar penyaman kuasa dan penyimpanan direka untuk menyimpan tenaga elektrik yang dihasilkan oleh Aloe Vera. Litar penyaman kuasa direka untuk mencetuskan voltan penyimpanan dan pelepasan voltan kuasa kepada RF suis tanpa wayar. Selepas RF transmitter dihidupkan, 1 bit RF isyarat akan dihantar kepada RF penerima dalam 10 meter. Penerima RF mengandungi sensor suhu dan kelembapan dan sistem penyiraman automatik. Apabila RF penerima menerima 1 bit RF isyarat, ini akan mencetuskan micro-kawalan unit dengan modul WIFI untuk membaca data dari sensor dan menghantar kepada sistem pemantauan IOT. Sistem air akan menyiram tumbuh-tumbuhan jika kelembapan kurang daripada 50%.

# TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

# CHAPTER I

# INTRODUCTION

In this chapter, design and development wireless switch powered by Aloe Vera, objectives, problem statement, scope of project and chapter organization will also be elaborated in detail.

## 1.1 PROJECT BACKGROUND

Wireless switch is a popular control device which can remotely controlled like the TV, fan, light or temperature and humidity monitoring system instead of walk to the switch board to open or off a switch.

Nowadays, the advancement of technology makes human life easier and comfort. Multiple devices switches can be control by microcontroller unit (MCU) or either radio frequency (RF) technology.

Energy harvesting system consumed with low power and low cost are demanded nowadays. This project is to design and development wireless switch powered by Aloe Vera.

Energy Harvesting is the process to obtain energy from another external source. It provides very small amount of power for low power electrical consumption appliances. The external source for energy harvesting is free for example the electromagnetic energy in the environment [1]. In this project, Aloe Vera will be focus to provide power for RF transmitter and no other power supply will use to power up the RF transmitter.

Living plants has been proven can produce weak energy. By embedding pairs of electrodes into it, the ions will flow and hence generate electricity. According to Choo Ying Ying, the weak energy is able to power up low power electrical consumption for example light emitting diode (LED), digital clock and calculator [2].

DC-DC converter is an electronic circuit or device to converts either from one voltage level to another level or one current level to another level. Energy storage system is to save the energy captured at a time and use thereafter [3]. Capacitor can be used as an energy storage system. Capacitor stores the charge until certain level of voltage and releases it for the system as a power supply. The voltage will be used to power the RF transmitter with one trigger signal sent from transmitter to receiver.

Environmental temperature and humidity monitoring system use temperature and humidity sensor to detect the environment temperature and humidity. The data can send to webserver by using IoT devices like ESP-201, ESP-8266 and others.

This project will focus on designing and developing wireless switch. The wireless switch is powered up by Aloe Vera with the power conditioning and storage system. Characterization of the Aloe Vera will be done to analysis the output power. The output voltage will be stored in storage circuit.

The circuit will supply the power for the RF transmitter and send a signal to the RF receiver. The RF receiver will give a signal to the Microcontroller unit with WIFI module (ESP-201). The Microcontroller unit with WIFI module (ESP-201) and temperature/humidity sensor (DHT-22) is powered by power supply. The environmental temperature and humidity monitoring system uses temperature/

humidity sensor to detect and send the data to the cloud let user able to monitor the environmental temperature and humidity. The data will be saved in the cloud as a record.

If the humidity not reaches certain level, the microcontroller unit will send a signal to water the plants. The developed monitoring system should be effective that fulfils the features required in the fruit industry and plantation.

## 1.2 PROBLEM STATEMENTS

According to the conservation of energy, the energy can be neither created or destroyed, but it can transform from one form to another form [4]. Thus, chemical energy can transform to electrical energy by electrolysis process.

Electrolysis process used two different material electrode plate to transform chemical energy to electrical energy. Aloe Vera can provide power but the output power is not sufficient to power low power electrical consumption appliances. Therefore, powers conditioning circuit and storage system is designed and developed to power some low power electrical consumption appliances and RF transmitter.

## 1.3 OBJECTIVES

There are few objectives that should be focused in this project in order to achieve the design of project:

- To characterize a series of Aloe Vera with different number of copper-zinc electrode pair for electrical power generation.
- To design a power conditioning circuit and storage system for electrical energy by Aloe Vera.
- To develop wireless automated watering system for plant.

## 1.4 SCOPE OF THE PROJECT

The scope of the project is to focus on Aloe Vera (Pot with diameter 15cm) is used for power supply the wireless switch. Temperature and Humidity sensor (DHT22) and microcontroller with WIFI module (ESP-201) are being used for the application part. The RF transmitter and receiver will be used as wireless switch. In this project, Copper and zinc electrodes are being used to connect to the Aloe Vera. Characterization the Aloe Vera will be carry out at lab with air condition (25-30°C). Watering system will be developed from an existing Air Purifier. The application will be used in indoor with a range 10m.

There are two parts of circuit design, which are RF transmitter part and RF receiver part. The electrical energy that generated by Aloe Vera is used to power up RF transmitter module. While, the RF receiver module and application is powered by external DC power supply. The material and equipment are Aloe Vera, copper-zinc electrode pair, RF module, RX-2B (RF encoder), TX-2B (RF-decoder), Multimeter, and perfume sprayer.

## 1.5 CHAPTER ORGANIZATION

This thesis comprises of five chapters. Generally, chapter one is more to introduction of project. In this section, objectives, problem statements, scopes of project and chapter organization will be explained.

Chapter 2 is describing about literature review of project. In part of that, output voltage of different living plants and type of electrode pairs from previous research will be explained. Besides that, comparison and differences of every living plants and electrode pairs have been stated in this chapter.

Chapter 3 is the overall of methodology of project. In this chapter, the project schedule such as workflow and method that used will be explained.

Chapter 4, the result obtain from the project should present clearly and neatly. The results are clearly explained and will compared between current system and previous research. The results of the present invention will be described and compared to the past research.

Chapter 5, report concludes with the overall summary of the studies based on the objectives and achievement. Other than that, suggestion and improvement approach concerned with the topic.

# CHAPTER II

# LITERATURE REVIEW

In this chapter, electrical energy of different living plants and type of electrode pairs from the journals and articles that related to this project will be discussed. In this chapter, comparison and differences of every living plants, electrode pairs, voltage detector and RF transmitter and receiver have been stated.

## 2.1 ELECTRICITY HARVESTED BY LIVING PLANTS

Figure 2.1.1 Harvested from living plants

Figure 2.1.1 shows the living plants has been proven have potential to harvest electricity. The electricity can be harvested by electrolysis process. The process includes generating oxidation and reduction between a pair of electrodes and the living plants. Embedding the electrode pairs into the living plants to allow flow of ions and generate electricity[2], [5], [6].

## 2.2 SELECTION OF LIVING PLANTS

This project involves multiple steps for generation of potential difference from either the living plants or trees. The plants can classify into many types like Cactus, Almus, Acer, Yuca, Ficus, Pinus and so on[7],[8] .

Cactus type is selected out of the other types due to it is easily available from the world, cheap, can grow in extreme environment conditions, large surface area of leafs and trunks, contain large amount of minerals and easy to plant it.

The living plants itself can absorb many types of organic and inorganic chemicals and minerals by their root systems. These chemicals and minerals have been utilized that the electrolysis process occurs due to electrolyte mineral[9].

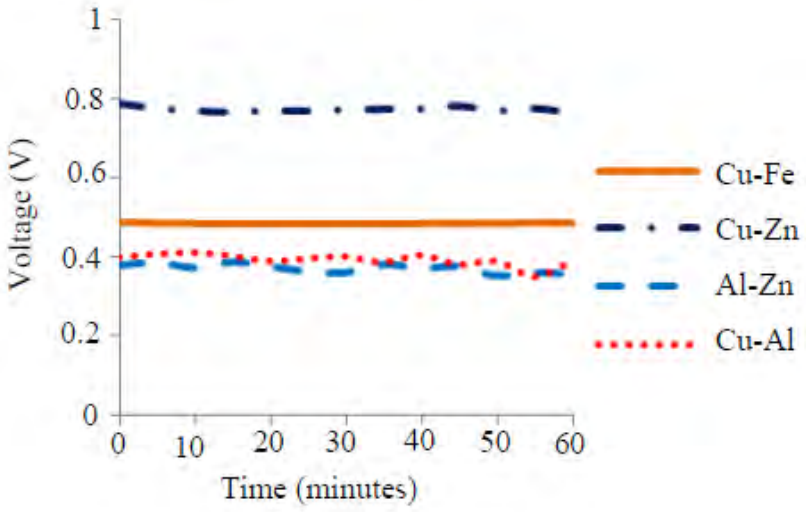


Figure 2.2.1 Voltage profile over time obtained from pulai tree, scientific name as Alstonia Sp by using different pairs of electrodes[10].

The Figure 2.2.1 shows the open circuit from the pulai trees (Alstonia Sp). From the figure, the copper-zinc electrode pair produces the highest voltage approximately 0.80V. Then is followed by copper-iron electrode pair (0.50V), copper-aluminium electrode pair (0.40V) and aluminium-zinc electrode pair gives the lowest voltage which is 0.38V. The figure also shows the harvested voltage able to stable up for 60 minutes.

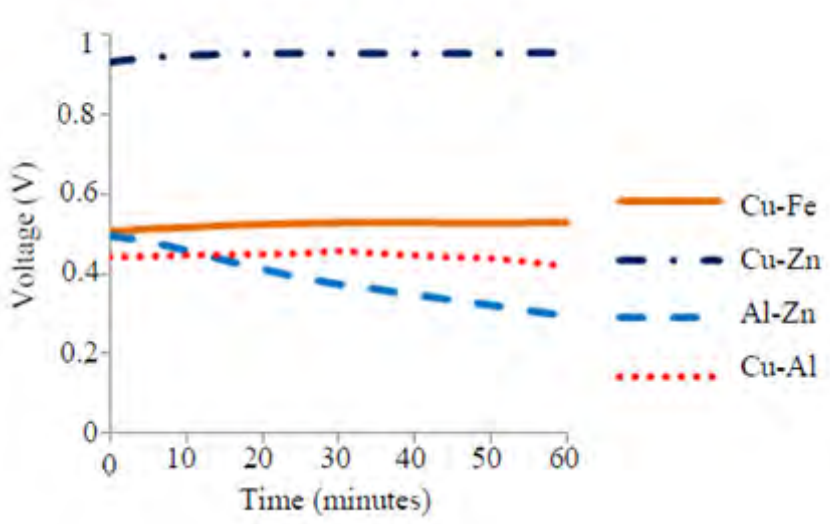


Figure 2.2.2 Voltage profile over time obtained from banana trees by using different pairs of electrodes[10].

The Figure 2.2.2 shows the open circuit from the banana trees. From the figure, the copper-zinc electrode pair produces the highest voltage approximately 0.91V. Then is followed by copper-iron electrode pair (0.50V), copper-aluminium electrode pair (0.45V) and aluminium-zinc electrode pair gives the lowest voltage which is 0.30V. The figure also shows the harvested voltage able to stable up for 60 minutes.

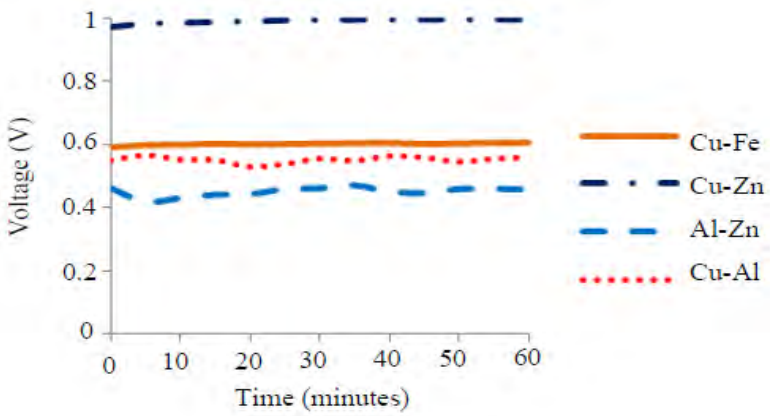


Figure 2.2.3 Voltage profile over time obtained from Aloe Vera by using different pairs of electrodes[10].

The Figure 2.2.3 shows the open circuit from the Aloe Vera. From the figure, the copper-zinc electrode pair produces the highest voltage approximately 0.95V. Then is followed by copper-iron electrode pair (0.60V), copper-aluminium electrode pair (0.57V) and aluminium-zinc electrode pair gives the lowest voltage which is 0.48V. The figure also shows the harvested voltage able to stable up for 60 minutes [11].

Table 2.2.1 Comparison of output voltage generation by different plants with similar volume, same distance separation between electrodes (1cm), same electrodes pair (Zn-Cu).

| **Type of Living Plants** | **Output Voltage, V** |
|---|---|
| Pulai tree | 0.80 |
| Banana tree | 0.91 |
| Aloe Vera | 0.95 |

From the Table 2.2.1, it was found that the Aloe Vera produces the highest voltage with copper-zinc electrode pair then followed by banana tree and pulai tree. From these results, it shows the combination of the type of living plants and electrode pair is important in determining the harvested output voltage.

## 2.3 SELECTION OF ELECTRODE PAIR TYPES

There have many types of electrodes, the best electrode pair that produce the highest harvested output power has to be investigated and determined prior for any further optimization attempts[6].

The example of electrodes like copper, zinc, aluminium, iron, platinum, steel, silver, carbon and lead. However, in this project copper, zinc, aluminium and iron are selected because they are locally abundant and more easily available.