



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF RF ENERGY HARVESTING IN
MULTI CONTROLLED FLOOR VACUUM CLEANER
USING WI-FI**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Telecommunications) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Teknologi mesra alam membawa kemajuan teknologi era baru ini. Penggunaan tenaga elektrik tidak mesra alam. Untuk mengatasi masalah ini, melaksanakan Radio Frekuensi Penuaian Tenaga untuk menukar ke elektrik dan menghidupkan peralatan elektronik. Terdapat banyak robot jualan bersih automatik di pasaran pada masa kini. Bagaimanapun kebanyakan penggunaan inframerah mempunyai liputan yang terbatas, robot menggunakan Wi-Fi mempunyai liputan yang lebih luas. Kegunaan aplikasi juga membawa liputan yang lebih luas yang boleh disambungkan di mana sahaja terdapat sambungan Wi-Fi atau data mudah alih. Faedah ini boleh membawa lebih mudah kepada pengguna yang boleh menyambung di mana sahaja mereka berada. Projek ini dimulakan dengan matlamat untuk membangunkan pembersih vakum lantai yang dikawal menggunakan Wi-Fi. Untuk menjadikan sistem pintar, modul Wi-Fi ESP8266 digunakan untuk mempunyai sambungan internet. Prototaip projek dibangunkan dengan menggunakan Arduino Uno bertindak sebagai pengawal utama, pemandu motor L293D, dan sensor ultrasonik. Selain itu, Arduino IDE digunakan untuk menulis program robot manakala aplikasi Blynk digunakan sebagai pelayan pengawal. Melalui projek ini, reka bentuk bersepadu ini mempunyai prestasi untuk tujuan pembersihan dari segi mesra pengguna, mudah dan mesra alam.

ABSTRACT

Eco-friendly technology brings advance to this new era of technology. The energy consumption of electric is not environmentally friendly. To overcome the problem, implementing Radio Frequency Harvesting Energy to convert in to electric and power up electronic appliances. There are many automatic cleaner robot selling in the market nowadays. However the mostly use of infrared had a limitation in coverage, the robotic using Wi-Fi has a wider coverage. The uses of application also brings the coverage wider which can connect wherever the place have Wi-Fi connection or mobile data available. This benefits can brings more convenient to user can connect wherever they are. This project is started with an objective of develop a multi controlled floor vacuum cleaner using Wi-Fi. In order to make the system smart, ESP8266 Wi-Fi module used to have the internet connection. The prototype of project is developed by using Arduino Uno act as the main controller, L293D motor driver, and ultrasonic sensor. Besides that, Arduino IDE was used to write the program of the robot while Blynk apps use as a controller server. Through the project, this integrated design has performance for cleaning purpose in terms of user-friendly, convenient and eco-friendly.

DEDICATION

This thesis is dedicated to:

My beloved parents,

My supervisors,

My respected lecturers,

And all my friends,

For their

Guidance, Support, Encouragement and Best Wishes.

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LIST OF SYMBOLS & ABBREVIATIONS

m	-	Meter
cm	-	Centimetre
Hz	-	Hertz
W	-	Watt
WSN	-	Wireless Sensor Network
Wi-Fi	-	Wireless Fidelity
RF	-	Radio Frequency
GSM	-	Global System for Mobile
LAN	-	Local Area Network
DTMF	-	Dual Tone Multi Frequency
IR	-	Infrared
DGS	-	Defected Ground Structure
LPF	-	Low Pass Filter
HPF	-	High Pass Filter
PIC	-	Peripheral Interface Controller
LED	-	Light Emitting Diode

CHAPTER 1

INTRODUCTION

1.1 Background

A definition of a wireless communication is the transmission of information or emits electrical power from a point to another or more point in distance without the uses of medium or wires (Tran, Cha and Park, 2017). The wireless technologies is uses radio waves which is an electromagnetic radiation with wavelengths in the electromagnetic spectrum. The radio waves can transfer by various types of devices and techniques in different frequencies as low as 3 kHz to 300 GHz.

A domestic robot is created as a service robot that used for convenience human, education or entertainment. Robotic floor cleaner was created around since 1996 for the purpose of household chores which cleaning and mopping floor automatically. It can save human effort and time to use the traditional sweeping tools. The robotic toys is a remote controlled robots which can entertain and relieve boredom. With the development of technology, the robotic can be control through mobile devices to replace joystick.

Wireless remote control is built by component of an electronic device to control a device from a distance. Wireless remote control also give a convenience to allow human to control or operate a device without get near to it or unable to reach.

In this project, robotic floor cleaner is develop with multifunction which can move automatically and manually. Parents can allow their children to control as a robotic car besides to carry on some household chores. For the activation and motion, Wi-Fi module is chosen because it is suitable to be used to control the robotic floor cleaner. Wi-

Fi has a wide coverages compare to others wireless system such as Bluetooth with small coverage and cannot radio wave cannot pass through the walls.

To complete the multi-function robotic vacuum cleaner, ultrasonic sensor, Arduino Uno and motor driver are used in this project. Ultrasonic sensor is able to detect and measure the object or walls in front of the robot to prevent it from colliding. The Arduino based robot can be controlled wirelessly connected with ESP8266 Wi-Fi module and enabled smart phone to control. The input of the robot such as motion of robot from mobile device and the response of ultrasonic sensor is control by the Arduino Uno. It also control the output which is the motor driver to carry move of robot and the cleaning parts.

The Radio Frequency are flow through surrounding us that produce by the wireless communication such as GSM, 3G, 4G and so on to transfer data. The energy consumption is to replacing the uses of batteries by using the RF energy harvesting. The concept use to capture the RF energy surrounding convert into the DC energy. This is one of the new technology with recycle purpose such as solar, wind energy and so on which without harmful and can save the environment.

1.2 Problem Statement

Nowadays human are getting busy with their working and self-improvement life. They are getting less time and lazy to complete the household chores such as sweeping and mopping floor although it is easy but tiring task. Robotic floor cleaner can help them to clean up their floor wherever they want.

People sometimes may outstation for a few weeks, the floor will cover with dust. In this case, the mobile device can activate via Wi-Fi connect to the robot and robot can clean it automatically. For some of the robot available in market, robotic floor cleaner

will have the problems of colliding objects and stopped with a distance from walls or objects that causes small areas couldn't clean.

Environment nowadays is getting worst because of evolution of technology that bring harms and pollute to the earth. In order to produce new energy, energy harvesting from ambient source is a good way to save environment. Radio Frequency (RF) energy harvesting is one of the process which energy derived from external sources. It is a technique of capturing the electromagnetic waves from various type of sources such as satellite stations and radio stations and convert into a usable direct current (DC) voltage. This process can replace batteries, increasing the lifespans and achieve recycle terms.

1.3 Objective

The objectives of this project are:

1. To design a robotic with embedded system and applications with multi controlled of automatically and manually.
2. To develop a robotic vacuum cleaner that controlled remotely with wireless technology.
3. To implement a RF energy harvesting technologies for self-sustaining to power up robotic vacuum cleaner

1.4 Scope

In this project, ESP 8266 Wi-Fi module will be used to allow the microcontroller access to the network. With this Wi-Fi module, an application Blynk with mobile device can connect using Wi-Fi connection and through Wi-Fi module to send information to

the microcontroller. The Blynk application is used as a remote control which can active and monitor the movement of the robot.

The microcontroller use in this project is Arduino Uno based on the ATmega328P. This microcontroller besides connect with Wi-Fi, it also used to connect the DC motor driver L293D to drive and control speed of motor. The other function of the microcontroller is use to connect with ultrasonic sensor to obtain the input response of the sensor. The ultrasonic sensor is use for detect the obstacles and bring direction to the robot when move automatically.

RF harvesting energy to replace the use of battery will use circuit of rectenna which mainly consists of antenna, multiplier, filter and rectifier. This RF harvesting energy technique is to capture the radio frequency in ambient and convert into a DC supply.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Automatic floor cleaning is not a new project of remote robot anymore. In this project, the Development of RF Energy Harvesting in Multi Controlled Floor Vacuum Cleaner using Wi-Fi which focused on the wireless technology. The operation and concept of Wi-Fi module, ultrasonic sensor, and Arduino Uno will be study and apply to this project in order to develop and wireless technology that with a remote control of the robot. It is too expensive for the existing products in the market. This robot not only help man detect obstacles or object to clean but can allow children to learn cleaning (Yiming *et al.*, 2007). This robot can be control manually or move automatically depends on the user's need.

2.2 Comparison of Infrared, Bluetooth, ZigBee and Wi-Fi

The Wireless Sensor Network (WSN) is categories as important technologies in the 21st century (Yiming *et al.*, 2007). There are different kind of WSN which has its own specialties and features function in various ways. Table 2.1 below shows the comparison of different wireless technology suitable as a remote control of this project.