

DESIGN AND DEVELOPMENT OF AN INTELLIGENT WIRELESS EMBEDDED
SYSTEM

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

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

June 2017



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FACULTY OF ELECTRONICS AND COMPUTER ENGINEERING

IBRANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Design and Development of an Intelligent Wireless Embedded system

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*Dedicated to my beloved family, for your love and supports.
To my friends, for your wits, intelligence and guidance in life.*

ACKNOWLEDGEMENT

First and Foremost, I would like to express my sincere gratitude to my supervisor Dr. Wong Yan Chiew for her guidance, support and comment on the project. Her counsel and help during this project is important to me. Her guidance and support make my final year project can be done on time and successfully. Besides that, she also willing to take some of her time to listen the problems that I had meet in this project.

Besides that, I would like to thank to my fellow friends for their encouragement, commands on different aspects, and support on this project. Their commands make me have different ideas by considering on other aspects and field in order to completing this project.

Last but not least, I would like to show my greatest appreciation to my parents who supporting me throughout this project. They always comfy me and show their best effort for giving anything that I needed. This project cannot be done without them because they are the one who give birth to me and make my life going well in growing state.

ABSTRACT

Wireless charging system is a popular technology that had been developed in recent years. The demands for charging devices without cords or cable had brought this technology in trends. Nowadays, peoples usually own multiples device that leads to the collection of bulky chargers. This project is to design and develop an intelligent wireless embedded system. The work has been divided into two parts; wireless transfer between the mobile energy storage and smart phones, and wireless transfer between the mobile energy storage and AC power supply from the wall. The interface circuitries have been modeled and designed for proper wireless power transfer. A prototype has been developed to verify the functionality of the proposed system. Performance of the developed system in terms of transmitter coils placement, charging time and distance between transmissions have been analyzed and discussed. A customized pocket has been used to align the transmitter coils with the smart phone. Smart phone has been successfully charged while just left it in the designated pocket. Although the mobile energy storage in the developed system requires almost double the charging time compared to conventional wired charging, it fill up the energy in the mobile storage automatically. The proposed system demonstrates the effectiveness of the wireless charging, making a word without wires possible.

ABSTRAK

Sistem pengecasan tanpa wayar adalah teknologi yang paling popular yang telah dibangunkan dalam tahun kebelakangan. Permintaan untuk mengecas peranti tanpa wayar atau kabel telah membawa teknologi ini dalam trend. Pada masa kini, orang biasanya memiliki gandaan peranti yang membawa kepada pengumpulan pengecas besar. Projek ini adalah untuk mereka bentuk dan membangunkan sistem tertanam wayarles bijak .. Kerja-kerja ini telah dibahagikan kepada dua bahagian; pemindahan wayarles antara storan mudah alih tenaga dan telefon pintar, dan pemindahan wayarles antara penyimpanan tenaga mudah alih dan bekalan kuasa AC dari dinding. The circuitries antara muka telah dimodelkan dan direka untuk pemindahan kuasa tanpa wayar yang tetap. Prototaip telah dibangunkan untuk mengesahkan fungsi sistem yang dicadangkan .. Prestasi sistem maju dari segi gegelung pemancar penempatan, pengisian masa dan jarak antara penghantaran telah dianalisis dan dibincangkan. Poket disesuaikan telah digunakan untuk menyelaraskan gegelung pemancar dengan telefon pintar. telefon pintar telah berjaya dicaj manakala hanya meninggalkan ia di dalam poket yang ditetapkan. Walaupun penyimpanan tenaga mudah alih dalam sistem yang dibangunkan memerlukan hampir dua kali ganda masa pengecasan berbanding pengecasan berwayar konvensional, ia mengisi tenaga dalam simpanan mudah alih secara automatik. Sistem yang dicadangkan menunjukkan keberkesanan pengecasan tanpa wayar, membuat perkataan tanpa wayar mungkin.

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LIST OF ABBREVIATIONS

AC	Alternating Current
DC	Direct Current
USB	Universal Serial Bus
IOS	IPhone Operating System

CHAPTER 1

INTRODUCTION

In this chapter, we are explaining about the details of the project which is design and development of an intelligent wireless embedded system. Besides that, we also explained the background, problem statement, scope and chapter organization of this project.

1.1 Project Background

An embedded system is designed to perform a specific function which it consists of computer software and hardware. Since the embedded system only performs a certain function, thus the embedded system usually is small size and cheap in order to increase its performance [1][2]. Wireless handsets such as mobile phones are one of the examples of embedded system have become part and parcel in our life. It is the fastest and the easiest medium of communication amongst people. However, it brings some advantages as well as disadvantages. The lifespan of mobile phone's battery has always a problem for the users. Cables are required for power transmission between power outlets and mobile phones [3]. In order to solve this kind of problem, inductive charging method is introduced to charge up the Smartphone.

Inductive charging operates when two power systems are placed close to one another. There is no any connected cable required for the power transmission. Each of these power systems contains an electrical coil that stores electricity for the device's use [4]. This system consists of a transmitter and a receiver, where the transmitter is installing at the

power supply and receiver is installing the devices [5]. This inductive charging system is electrically safe, waterproof and low maintenance. However, they have a weakness which is they consume more power that leads to more heat is generated, low efficiency, and the high cost of construction due to their complex circuit [6].

This project is to design and develop a wireless power system for charging a mobile phone and illustrate how magnetic induction is used to transfer the energy wirelessly. This wireless power system will be implementing inside a bag for the worker.

1.2 Problem Statement

Nowadays, users have more than one handheld device which resulting collection of bulky chargers. However, charging the device when away from the plug has turned into frustration for peoples. This is due to the device requires power outlets with wires. It is inconvenient for users to charge multiple devices with lots of wires whenever they go. Wireless inductive charging system has brought convenient for users to charge portable devices wirelessly. The wireless power transmission was done by applying the concept of magnetic induction. The aim of this project is to design and develop a wireless power system for charging a mobile phone and illustrate how magnetic induction is used to transfer the energy wirelessly.

1.3 Objective

1. To design a wireless charging system that can use to charge the mobile phone
2. To modify a wireless charging system into a customize compartment
3. To illustrate the principle of the wireless charging system
4. To evaluate the functionality the wireless charging system

1.4 Scope

Knowledge in electromagnetic induction is applied in the induction charging method. Transmitter and receiver are used in order to perform inductive charging. For making all the mobile phone can using this application, two different types of receiver were use, which is IOS and Android. For users to charge up their mobile phone at anytime and anywhere, there is a power storage have to be install inside the bag. In order to allow the mobile phone to charge automatically, the power bank is installed with a voltage controller, so that it will charging up once its power is lower than the threshold voltage and disable to charging when it passes the certain voltage. A prototype will be developed for the wireless charging system.

There are some parts not including in this project which increases the performance of wireless charging as efficient as contact with the wires and speed up the wireless charging. The cost of the applications also depends on the power storage, which means a higher power storage will costly the prototypes.

1.5 Thesis Structure

This thesis will include five main chapters which are an introduction, literature review, methodology, result and discussion and the conclusion and recommendations. Generally, chapter one will introduce the project background, objectives, problem statements, scopes of the project and the thesis structure.

Chapter 2 is describing the literature review of the project. We explained about every topology of components from the previous journal or articles which are related to the development of this project. Besides this, comparisons between the components have been included in this chapter.

Chapter 3 is the methodology of this project. We explained about every steps and guideline, such as flowchart and method to implement this project. It will describe the process flow of the intelligent wireless embedded system.

Chapter 4 is the result and discussion for this project. All the results obtained from both hardware and software will be observed and recorded. Besides that, the output obtained from the experimental is comparing with the theoretical result.

Chapter 5 is conclusion and recommendations, which will conclude all the results of the project. We recommended some of the future works for further research to enhance the quality and performance of this project.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the comparison between different types of method charging, such as inductive charging, resonance charging and microwave charging are discussed. The required transmitter, receiver, power bank required is compared based on their properties and prices.

2.1 Introduction

Nicolas Tesla in the year 1899 was the first who gave the idea of energy transmission through experiment. He tried to transfer the electromagnetic energy using the principle of electrodynamics induction without the need of wires. In order to do so, he constructs the Wardencllyffe tower to transmit the power between America and Europe [7]. Later, the concept of wireless transfer is employed in telecommunications, such as wireless charging. Radio waves, cellular transmission and Internet Wi-Fi are the examples of wireless transmission.

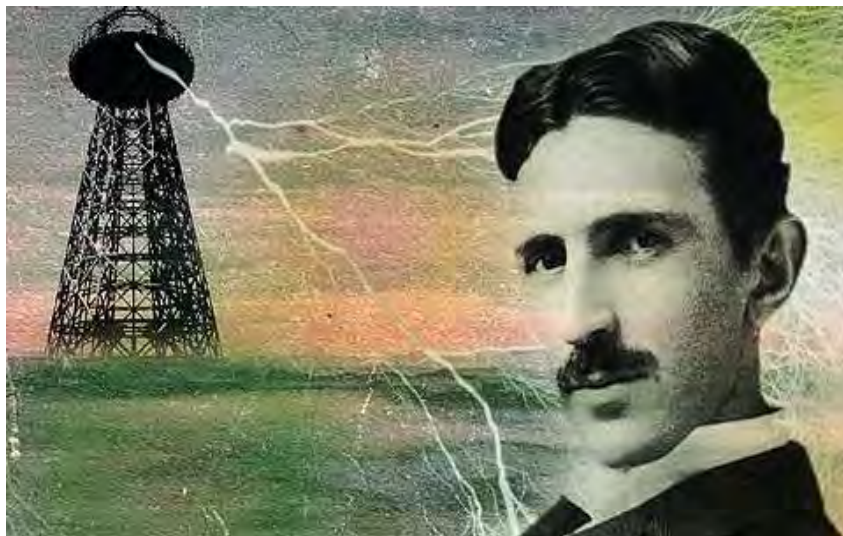


Figure 2.1: Nikola Tesla and the Wardenclyffe tower

The wireless charging can be dividing into two major fields, which is near field and far field. The near field wireless charging method consists of inductive charging and resonance charging where areas the far field consists of the microwave charging [8]. These three types method of charging have different ways to operate as well as their specification.

Inductive charging used to transfer energy between two objects by using an electromagnetic field. Energy sent from the charging station through an inductive coupling to an electrical device [9]. This enables batteries of the mobile phone to be charge or the device to operate. The primary coils and the secondary coils in proximity combine to form an electrical transformer.

Resonance charging method is used for charging the device or items that required a large amount of power, such as an electrical car, laptop, or vacuum cleaner. In order to transfer the energy from one point to another point, both coils must be tuned into the same electromagnetic frequency.

Microwaves charging are the radio waves in which their high frequencies allow broad bandwidth and high data transmission rates. Nowadays, our surroundings are full of the radio waves, this method of charging can allow the mobile phone to be charging when there is calling from the other people. The microwave signal together with the

message signal is transmitted through an antenna called slotted wave guide antenna. Then the receiver in the mobile phone will convert the microwave into power to charge the phone [10] [11]. The comparison between Inductive Charging, Resonance Charging and Microwave Charging are shows in Table 2.1.

Besides that, there are some pros and cons amongst these charging methods. The common advantages of these charging method are to eliminate the use of cables, while the disadvantages are different depends on the charging method. The details of their advantages and disadvantages are shows in Table 2.2.

Table 2.1: Comparison between Inductive Charging, Resonance Charging and Microwave Charging

Name of technology	Induction Charging[9]	Resonance Charging[12]	Microwaves[13]
Technique used	Electromagnetic	Resonant inductive coupling	Rectenna convert microwave energy into DC electricity.
Working Principle	Changing current of the primary coil creates a magnetic flux in the transformer's core. A varying magnetic field through the secondary coil is creating.	Generate oscillating magnetic field. The coil is highly resonant, thus energy placed in the coil dies away. When a secondary coil place near to it, the coil can pick up most of the energy before it lost.	Elements are arranged in a mesh pattern. It is constructing by placing a diode between the antenna and dipoles. The diodes will rectify the current induced in the microwaves.
Operating Distance	Millimeters to Centimeters	Centimeters to Meters	Meters to Kilometers
Power Transfer(Watt)	5-3000W	5-50W	5W
Efficiency	High	Medium	Low
Diagram			

Table 2.2: Comparison of advantages and disadvantages for inductive charging, resonance charging and microwave charging

Name of technology	Advantages	Disadvantages
Induction Charging [14][15]	1) Connection is protected 2) Convenient 3) Wireless, elimination of cables 4) User friendly	1) Slow charging 2) High heat dissipation 3) Expensive costs 4) Low efficiency which depends on the distance between transmitter and receiver
Resonance Charging [14][15]	1) Safe to human beings 2) Power transfer in unidirectional 3) Flexibility provides 4) Single source transfer energy to multiple devices	1) Power transfer depends on the distance 2) Power transfer is interrupted when obstacles in between the sender and receiver 3) Problem of overheating 4) Proper control of voltage is required
Microwaves [14][15]	1) Use of separate chargers are eliminated 2) Less wastage of power 3) Power is available at rectenna as long as the Power Wireless Transfer is operating 4) Transmitter can server to all service providers in the specific area	1) Harmful effects to human body 2) Use of Antennas is costly 3) Network traffic cause problems in charging 4) Radiation problems may occur