UNIVERSITI TEKNIKAL MALAYSIA MELAKA

WIRELESS POWER TRANSFER

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electronics Engineering Technology (Telecommunications) (Hons.)

by

MUHAMMAD TAUKHID BIN MOHAMMAD

B071110167

900512-14-6059

FACULTY OF ENGINEERING TECHNOLOGY

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ABSTRAK

Kuasa tanpa wayar adalah apa-apa pemindahan antara dua tempat tenaga ke atas jurang dalam ruang yang tidak boleh mempunyai laluan sambungan konduktif untuk memindahkan tenaga elektrik secara langsung. Biasanya, ini dicapai dengan pelbagai cara induksi elektromagnetik, di mana kuasa ditukar dari medan elektrik kepada medan magnet dan medan magnet ini meningkat dan dipindahkan semula kepada bekalan elektrik di tempat lain.

ABSTRACT

Wireless power is any transfer between two places of energy over a gap in space that cannot have a conductive connection path to transfer electricity directly. Typically, this is achieved by various means of electromagnetic induction, in which power is changed from the electric field to a magnetic field, and this magnetic field is picked up and transferred back to electricity elsewhere.

DEDICATION

I dedicate this final report to my many friends and Faculty of Technology Engineer family who have supported me throughout the process. I will always appreciate all they have done, especially En. Md Ashadi for helping me in this project.

ACKNOWLEDGE

Every project big or small is successful largely due to the effort of a number of wonderful people who have always given their valuable advice or lent a helping hand. I sincerely appreciate the inspiration support and guidance of all those people who have been instrumental in making this project a success. My name is Muhammad Taukhid Bin Mohammad, the student of Faculty Technology Engineer, is extremely grateful to UTeM for the confidence bestowed in me and entrusting my project entitled Wireless Power Transfer with special reference to En. Md Ashadi as my supervisor. At this juncture, i feel deeply honoured in expressing my sincere thanks to En. Md Ashadi for making the resources available at right time and providing valuable insights leading to the successful completion of my project. I would also like to thank all the faculty members of FTK for the critical advice and guidance without which this project would not have been possible. Last but not the least i place a deep sence of gratitude to my family members and my friend who have been constant source of inspiration during the preparation of this project work.

DECLARATION

I hereby, declared this report entitled "Wireless Power Transfer" is the results of my own research except as cited in references.

Signature : .....

Author's Name : MUHAMMAD TAUKHID BIN MOHAMMAD

Date : 14 January 2015

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology Electronic (Telecommunication) with honours. The member of the supervisory is as follow:

(Md Ashadi Bin Md Johari)

MD ASHADI BIN MD JOHARI
Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan
Universiti Teknikal Malaysia Melaka

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

In 1897, Nikola Tesla discovered that he could transmit up to 20MV or more power wirelessly. This was done by sending a signal into the upper stratosphere of a frequency of 925Hz to distance thousands of miles away from the transmitter, as stated in his "System of Transmitting Electrical Energy" patent. Wireless Power Transfer receivers are devices that cab wirelessly transmit power to electrical devices. This is proof of concept technology that paves the way for charging cell phones, laptops, and many other electronic devices wirelessly. Wireless power technology is in high demand because of its convenience to consumer and industrial marketplaces. The goal of the device prototype is to eventually cost less than $100.00 and be a fully operational and completely independent of any other device.

There are many different methods to transmit power wirelessly but the most well-known techniques include sending the signal by using the Tesla effect, microwaves, or by resonant coupling. According to patents and technical literature, each of these methods has worked and show promise to be used in mainstream applications but one problem arises. Is it safe for humans to be in the vicinity of these devices while they are in operation? The researchers at MIT successfully tested a method of

transmitting power wirelessly by using the technique of resonant coupling. Since this was done at midrange distances, this technique could be applied to power hand held mobile electronics in the near future. Keeping this application in mind, MIT researchers devised a more safety conscious design that will pass the IEEE standard for human exposure to Radio Frequency.

- Wireless transmission is useful in cases where interconnecting wires are inconvenient, hazardous, or impossible.
- Wireless power or wireless energy transmission is the transmission of electrical energy from a power source to an electrical load without man-made conductors.
- The most common form of wireless power transmission is carried out using direct induction followed by resonant magnetic induction.
- Wireless electricity is quite literally the transmission of electrical energy without wires.
- Wireless electricity is a relatively new area of technology but one that is rapidly being developed.

1.2 PROBLEM STATEMENT

By using a wireless power transfer, some problem or major problem can be solving which is:

- Increasing demand of wireless technology
- High cost of wires today
- Copper losses on the transmission and distribution of electrical power
- High cost on grid maintenance.
- Danger of faulty wirings
- As advanced and powerful as phones, tablets and laptops are, when that bar hits 0%, they are as good as worthless without an outlet.
- Malaysia today has no more technologies that involve wireless power transfer.

1.3 OBJECTIVE

Wireless power transfer was achieved via resonant inductive coupling between the transmitting and receiving coils in the near field. To demonstrate that power was successfully transferred wirelessly, an incandescent LED. The device was able to transmit 0.18 W of power over a distance of 1.27 mtherefore transferring the maximum amount of power.

The overall goal of this project is to design and successfully implement a wireless power transmission system to be used in a conference room. The system will work by using resonant coils to transmit power from an AC line in the ceiling to a pad on the table. The pad will output DC voltages in order to charge computers and cell phones.

- Elimination of cords on the ground that make tripping hazards.
- Allows no wire installation.
- A necessary step towards consumer wireless power.
- Feedback control for driving frequency to maximize efficiency.

1.4 WORK SCOPE

- **DC source**

  The DC source takes in the input from the wall voltage which is a 60Hz sinusoid. Using diodes, the voltage is rectified and passed through a P1 filter. The original design specified a 1% voltage ripple, but this ripple requirement was excessive and difficult to meet at such a low frequency. The final design chosen had a voltage ripple of less than 5% and was more than suitable.

- **DAC/VOC**

  The output of the DAC is a voltage between 0 and 5 V. This voltage is an input to a Voltage Controlled Oscillator (VCO), which produces a square wave that increases in frequency as the input voltage increases. The range of frequencies is determined by a bias voltage and an external capacitor, and is set around our expected resonant frequency.

- **Coils and Air Gap**

  The coils are each made out of 100 turns of 20 AWG magnet wire. They are separated by about 2 m and have a diameter of about 1 m. The power transfer between them is done through resonant magnetic coupling.

1.5 CONCLUSION

This concept offers greater possibilities for transmitting power with negligible losses and ease of transmission than any invention or discovery here before made. The transmission of power without wires is not a theory or a mere possibility, it is now a reality. Many researchers have established in numerous observations, experiments and measurement, qualitative and quantitative. Dr. Neville of NASA states "You don't need cables, pipes or copper wires to receive power. We can send it to you like a cell phone call". We can expect with certitude that in next few years, wonders will be brought by its applications if all the conditions are favorable. It is presumed that wireless energy would be really accomplished with advantage of easy implementation and cost effective. Cost of transmission and distribution overhead would become less and moreover it is important that the cost of electrical energy to the consumer would also be reduced compared to existing systems.

CHAPTER 2
LITERATURE REVIEW

2.1 WIRELESS TECHNOLOGY

The word wireless is dictionary defined as "having no wires". In networking terminology, wireless is the term used to describe any computer network where there is no physical wired connection between sender and receiver, but rather the network is connected by radio waves and/or microwaves to maintain communications. Wireless networking utilizes specific equipment such as NICs, APs and routers in place of wires (copper or optical fiber) for connectivity.

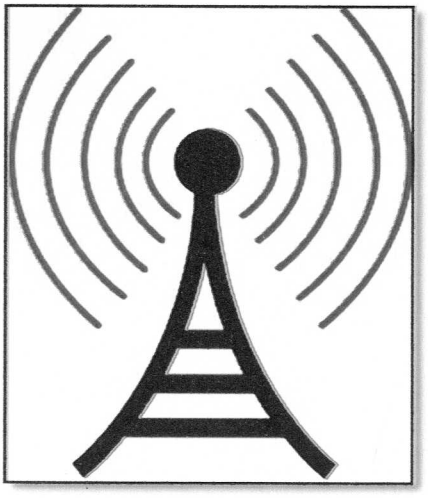

Figure 1.1: Logo of wireless

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. The most common wireless technologies use radio. With radio waves distances can be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of applications of radio wireless technology include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

2.2 HISTORY OF WIRELESS

2.2.1 Photophone

The photophone (later given the alternate name radiophone) is a telecommunications device which allowed for the transmission of speech on a beam of light. It was invented jointly by Alexander Graham Bell and his assistant Charles Sumner Tainter on February 19, 1880, at Bell's laboratory at 1325 L Street in Washington, D.C. Both were later to become full associates in the Volta Laboratory Association, created and financed by Bell.

On June 3, 1880, Bell's assistant transmitted a wireless voice telephone message of considerable distance, from the roof of the Franklin School to the window of Bell's laboratory, some 213 meters (about 700 ft.) away.

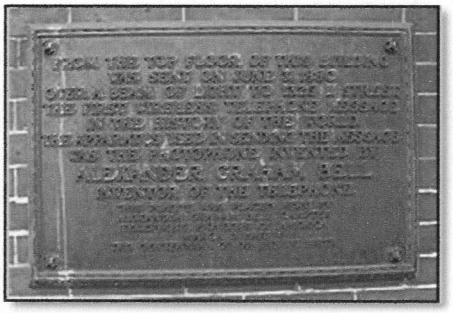

Figure 1.2: Franklin School in Washington, D.C

Bell believed the photophone was his most important invention. Of the 18 patents granted in Bell's name alone, and the 12 he shared with his collaborators, four were for the photophone, which Bell referred to as his **'greatest achievement'**, telling a reporter shortly before his death that the photophone was **"the greatest invention ever made, greater than the telephone"**

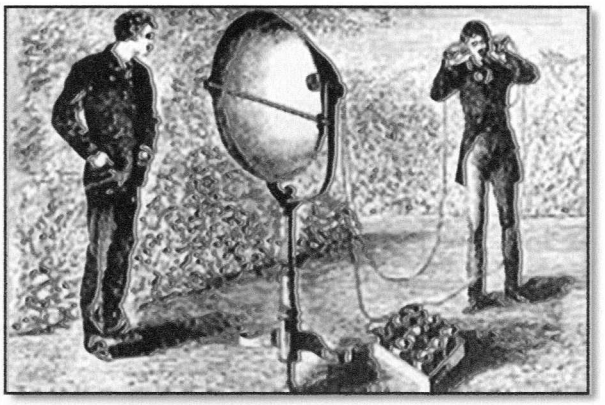

Figure 1.3: Bell and Tainter's optical telecommunication system of 1880

2.2.2 Wireless Telegraphy

Wireless telegraphy is electric telegraphy that does not have wires connecting the endpoints. It is now used as a historical term for early radio telegraphy systems which communicated with radio waves, although when the term originated in the late 1800s it was also used for a variety of other experimental techniques for communicating telegraphically without wires, such as photoelectric and induction telegraphy.

Figure 1.4: radio operator receiving a wireless telegraphy.

Wireless telegraphy came to mean Morse code transmitted with electromagnetic waves, initially called "**Hertzian waves**" and by 1910 universally referred to as "radio", leading to these systems being called "radiotelegraphy". The transmission of speech (radiotelephony) began to displace wireless telegraphy by the 1920s for many applications and was the basis of public broadcasting. Wireless telegraphy continued to be used for point-to-point business, governmental, and military communication, and evolved into radio teletype networks.

2.2.3 Radio Technology

The idea of wireless communication predates the discovery of "**radio**" with experiments in "**wireless telegraphy**" via inductive and capacitive induction and transmission through the ground, water, and even train tracks from the 1830s on. In 1873 James Clerk Maxwell showed mathematically that electromagnetic waves could propagate through free space. It is likely that the first intentional transmission of a signal by means of electromagnetic waves was performed in an experiment by David Edward Hughes around 1880, although this was considered to be induction at the time. In 1888 Heinrich Rudolf Hertz was able to conclusively prove transmitted airborne electromagnetic waves in an experiment confirming Maxwell's theory of electromagnetism.

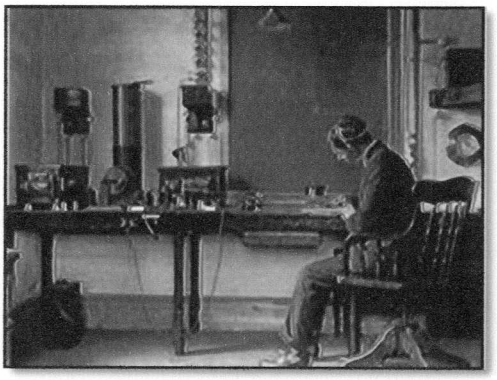

Figure 1.5: Marconi Company (England, 1906)

After the discovery of these "Hertzian waves" (it would take almost 20 years for the term "radio" to be universally adopted for this type of electromagnetic radiation") many scientists and inventors experimented with wireless transmission, some trying to develop a system of communication, some not, some intentionally using these new Herzian waves, some not. Maxwell's theory showing that light and Hertzian electromagnetic waves were the same phenomenon at different

wavelengths led "Maxwellian" scientist such as John Perry, Frederick Thomas Trouton and Alexander Trotter to assume they would be analogous to optical signaling and the Serbian American engineer Nikola Tesla to consider them relatively useless for communication since "light" could not transmit further than line of sight. In 1892 the physicist William Crookes wrote on the possibilities of wireless telegraphy based on Hertzian waves and in 1893 Tesla proposed a system for transmitting intelligence and wireless power using the earth as the meduim. Others, such as Amos Dolbear, Sir Oliver Lodge, Reginald Fessenden, and Alexander Popov. Were involved in the development of components and theory involved with the transmission and reception of airborn electromagnetic waves for their own theoretical work or as a potential means of communication.

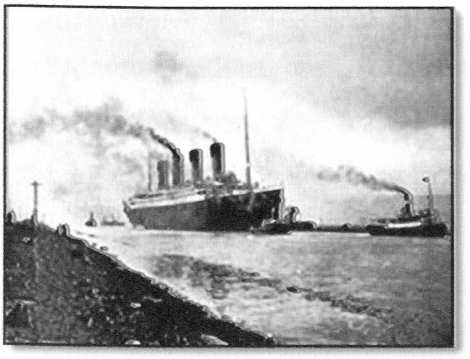

Figure 1.6: RMS Titanic (April 2, 1912).