Faculty of Electrical and Electronic Engineering Technology

Development of Smart Wireless Battery Charging With Charge Monitor System

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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Development of Smart Wireless Battery Charging With Charge Monitor System

VENOSHA D/O RAMAN

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

APPROVAL

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Date : 24/03/2023

DEDICATION

I want to thank both of my parents very much for all the love, support, and sacrifices they have made for me my whole life. Without their hard work and help, I wouldn't have been able to get to this point. Additional special thanks Dedicated to all of my siblings, who have always supported and guided me in all of my endeavours. I would especially want to thank all of the lecturers who have helped me learn and develop during my studies. I won't forget any of my friends who have supported me the whole way on this happy adventure. No words can adequately explain how grateful I am to each and every one of you.

ABSTRACT

The concept is a gadget that can wirelessly transmit electricity and assess battery charge instead of utilising standard copper connections and current carrying wires. It also wirelessly charges the battery till it reaches 100 percent capacity. This power is intended for short-distance transmission, including when charging battery packs. For demonstration reasons, we have a battery that operates on wireless power. AC 230V 50Hz is converted to AC 12V high frequency using an electrical circuit, which is then supplied to the primary coil of an air core transformer. The transformer's secondary coil provides 12V at a high frequency. The device also monitors the battery's charge and charges it until it reaches 100 percent capacity. Therefore, we employ a microcontroller from the AVR family that continuously monitors battery charges and mechanically charges the battery until it reaches 100 percent capacity, at which point it ceases charging the battery. As a consequence, power is passed from the main coil to the secondary coil, which is roughly 4cm apart. Through increasing the coil size, the range may be expanded. The main coil transmits electricity, while a secondary coil receives it to power a load. This project may be used to charge and monitor batteries in a number of devices and purposes, including battery-powered scooters and cars.

ABSTRAK

Projek ini adalah peranti untuk memindahkan kuasa secara tanpa wayar dan bukannya menggunakan kabel tembaga konvensional dan wayar pembawa arus dan juga mengukur cas bateri. Ia juga mengecas bateri menggunakan konsep pemindahan kuasa tanpa wayar sehingga mencapai kapasiti 100%. Kuasa ini dibuat untuk dipindahkan dalam julat yang kecil sahaja contohnya mengecas bateri boleh dicas semula dsb. Untuk tujuan demonstrasi kami mempunyai bateri yang beroperasi dengan menggunakan kuasa tanpa wayar. Ini memerlukan litar elektronik untuk penukaran AC 230V 50Hz kepada AC 12V, frekuensi tinggi dan ini kemudian disalurkan kepada gegelung utama pengubah teras udara. Gegelung sekunder pengubah menghasilkan frekuensi tinggi 12V. Sistem ini juga mengukur cas dalam bateri dan mengecasnya sehingga ia mencapai kapasiti 100%. Untuk tujuan ini kami menggunakan pengawal mikro keluarga Avr yang sentiasa mengukur cas bateri dan mengecas bateri secara automatik sehingga mencapai kapasiti 100% dan berhenti mengecas bateri sebaik sahaja cas mencapai 100%. Oleh itu dengan cara ini kuasa akan dipindahkan melalui gegelung primer ke gegelung sekunder yang dipisahkan oleh jarak tertentu sekitar 4cm. Julat boleh ditingkatkan dengan meningkatkan saiz gegelung dengan sewajarnya. Di sini gegelung primer bertindak sebagai penghantar dan gegelung sekunder menerima kuasa untuk menjalankan beban. Projek ini boleh digunakan untuk mengecas bateri pelbagai peranti dan aplikasi seperti skuter dan kenderaan yang dicas bateri tanpa memasang serta mengukur casnya.

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LIST OF SYMBOLS

δ	-	Voltage angle
%	-	Percentage
°	-	Degree

LIST OF ABBREVIATIONS

V	-	Voltage
WPT	-	Wireless Power Transfer
USB	-	Universal Serial Bus
Ah	-	Ampere hours
PCB	-	Printed Circuit Board
AC	-	Alternating Current
DC	-	Direct Current
Hz	-	Hertz
UNO	-	One in Italian
RF	-	Radio Frequency
mm	-	Millimetre
SAR	-	Specific Absorption Rate
IDT	-	Interface Design Tool Interrupt Descriptor Table
cm	-	Centimeter
PMA	-	Power Matter Alliance
A4WP	-	Alliance for Wireless Power
LG	-	Lucky Goldstar
WPC	-	Wireless Power Consortium
COVID 19	-	Coronavirus Disease
PDAs	-	Personal Digital Assistants
USD	-	United States Dollar
RLC	-	Resistor, Inductor and Capacitor
RFID	-	Radio-Frequency IDentification
FDA	-	Food and Drug Administration
LCD	-	Liquid-crystal display
I/O	-	Input/Output
IDE	-	Arduino Integrayed Development Environment
MHz	-	Megahertz
kB	-	Kilobyte
mA	-	Milliampere
BJT	-	Bipolar Junction
MOSFET	-	Metal Oxide Semiconductor Field Effect Transistor
LED	-	Light emitting diode
VSS	-	Voltage Source Supply
VCC	-	Common Collector Voltage
VEE	-	Voltage (at) emitter

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This part of chapter will go over the project's background, problem statement, objectives, project scope, and thesis outline.

1.2 Project Backround

Electronics gadgets (such as wearables, wireless earbuds, and smartphones) increasingly have wireless battery charging, which is a feature that is highly wanted in public spaces all over the globe. Wireless power transfer (WPT) technology could use a magnetic field instead of a wire to send electricity from a high frequency power source to a load. Nikolas Tesla invented the idea of wireless power transfer. This power is designed to be transferred over a short distance, such as when charging rechargeable batteries.

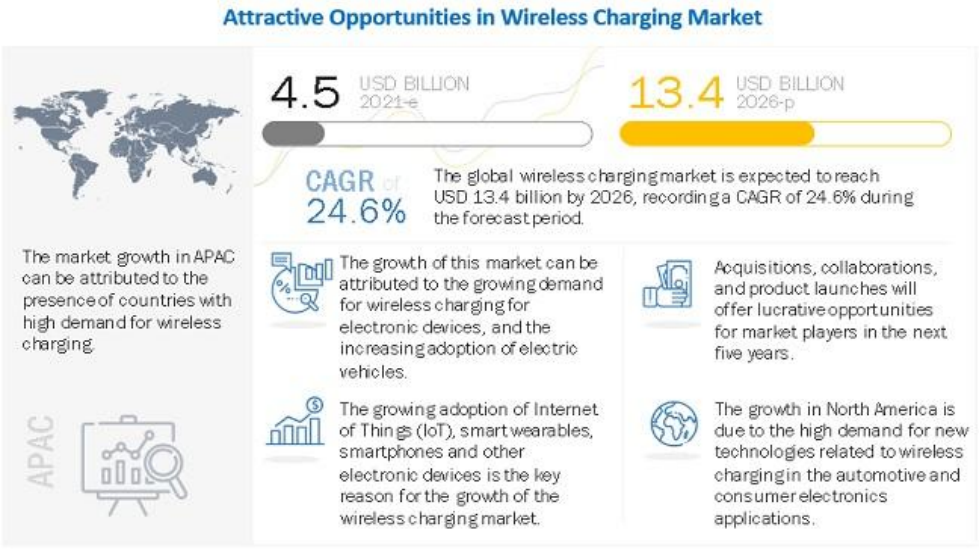

Figure 1.1: Wireless Power Associations, Magazine, Expert Interviews, and Markets Analysis (Wireless Charging Market Forecast to 2026)

The Nokia 920 was the first smartphone to support Qi wireless charging. It came out in 2012. Instead of using a wired charger, people could charge their phones wirelessly (Mearian 2018). Powermat and Powerkiss plan to put wireless chargers in more than 1,000 places in Europe and 1,500 places in the U.S. by 2013. These places include hotels, airports, coffee shops, and restaurants (Mearian 2013).

Wireless charging is becoming increasingly popular, owing primarily to the increased convenience it provides. Wireless charging may be desirable in certain cases, such like action cameras (e.g., GoPros) and wearable fitness trackers (e.g., Fitbits) , because it enables for thus watertight and hermetic sealing form factors. Samsung, Apple, Sony, One Plus, LG, Huawei, oppo, and Vivo are among the businesses that actually wireless charging capabilities for cell phones (without even an aftermarket product) (MobileFun 2018b).

Wireless charging is becoming more common in laptops, but not as much as in smartphones. The Dell Latitude 7285, shown in Figure 1.2, was the first laptop that could be charged wirelessly. It came out in the summer of 2017. 2017 (Luciano) (Luciano). Also,

18 car companies already have wireless charging as a standard feature or an option in their cars (FoneSalesman 2018).

(a) (b)

Figure 1.2: Example of products that use wireless chraging. (a): MobileFun 2018a. (b):Portnoy 2016.

Figure 1.3 depicts our findings using all mid-case assumptions, broken down by material type and operational mode. Across all product categories, charging and maintenance consume the most energy. No-battery mode accounts for the majority of smartphone and mobile phone power consumption, is due to type of product with the highest global energy consumption.

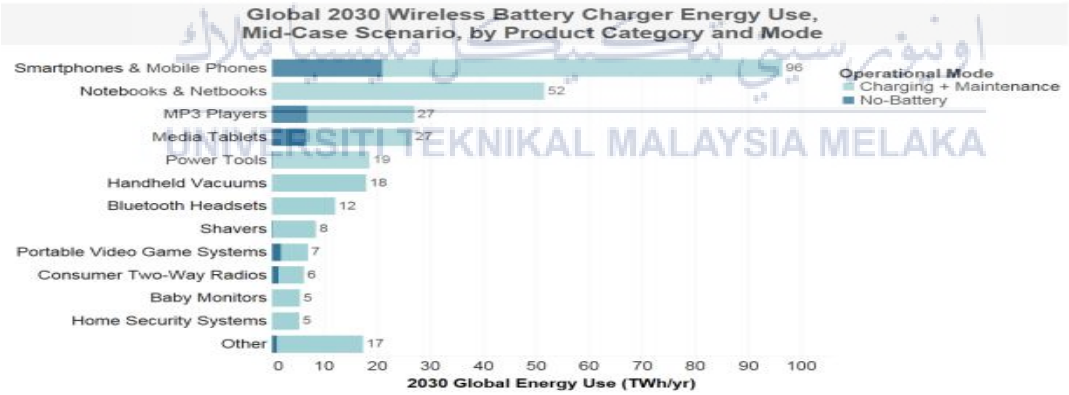

Figure 1.3: Wireless energy consumption in the worst-case scenario by product category and mode(Wireless Charging Market Forecast to 2026)

They didn't have enough data to prove switching from wired to wireless no-battery mode.(up or down). More data is designed to determine whether wireless phone chargers normally draw more power in no-battery mode than wired phone chargers**.**

1.3 Problem Statement

Many people nowadays face the problem of not being able to start charging their own mobile devices due to a lack of charger cables. Carrying a getting charged not the most common choice because the wire wear and tear can cause a loss in its wire life (John Lim 2016). Some mobile people experience power loss in battery while having a conversation instead using their phone for other reasons. All mobile devices rely on their own manufacturers and battery designs to recharge their batteries, making all users reliant on a specific type of charging cable. The charging cable is the weakest link in your phone's charging system. USB cables can be damaged internally, even if they are not visibly frayed, kinked, or damaged. This reduces the amount of current they can carry. Unsurprisingly, cables are the most common reason for abandoning wired charging technology. Cables are inconvenient and can wear out over time.

Furthermore, a charging cable can cause a major accident, as happened in Singapore, where an iPhone charging cable caused a major four-car accident (John Lim 2016). The main cause of this latest highway accident involving four cars in our neighbouring country Singapore has been attributed to an iPhone charging cable becoming tangled in a car's steering wheel.

1.4 Objectives

I. To develop the system that will automatically charge battery and control the capacity of battery when the battery reaches 100 percent charge, it stops charging.

II. To design and produce a hardware of wireless charging with charge monitor to charge battery.

III. To analyse the performance of the wireless under actual project prototype implementation.

1.5 Project Scope

The project's job scope is to design the circuit. by using Proteus 8 Professional with come out with PCB layout. This project uses both coils to make a wireless battery charger. The first coil acts as a transmitter, and the second coil gets the power to run the load. At the secondary coil will develops a high frequency AC 12V. An AC 230V and 50Hz source will be supplied to the primary coil as an input.

An AC current is rectified through the bridge rectifier by converting AC to DC. The DC voltage regulator will keep giving the constant DC supply of 12V to the auto gate battery. The coding in Arduino IDE using a Arduino Uno that consist of Atmega328p microcontroller to display voltage and monitor the battery charges.