# THE DESIGN OF WIRELESS POWER TRANSFER TECHNOLOGY FOR AUTONOMOUS ELECTRICAL VEHICLES USING CLASS E INVERTER CIRCUIT: AN INDUCTIVE APPROACH

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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**This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours**

**Faculty of Electronic and Computer Engineering**
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# DEDICATION

Appreciate My Father and Mother

# ABSTRACT

Electrical autonomous vehicle had been a trend in nowadays. However, transportable distance was one of the main concerns for the system. Although battery technologies had become more advanced, the distance covered by electrical vehicles were still be limited. In this project, a wireless power transfer technology using an inductive approach to power up the vehicle while moving had been proposed. Generally, this 'on the go' wireless charging or dynamic charging, had been archived by embedded the transmitter coil underneath the road and a receiver coil had placed at the vehicle i.e. car. A Class E Inverter had been designed with operating frequency 1 MHz to ensure the power loss was minimal in the IPT System. Furthermore, a LCCL Impedance Matching technique had been proposed to maintain the output power while a drastic change in alignment happens in the power transmission. At the end of the project, a prototype had been developed with a Line Follower Car which powered without battery. The efficiency of this system was 28.73 % with an output power of 3.1022 W.

# ABSTRAK

*Kenderaan autonomi elektrik telah menjadi trend pada masa kini. Walau bagaimanapun, jarak adalah salah satu faktor utama bagi sistem ini. Walaupun teknologi bateri telah meningkatkan, jarak yang diliputi oleh kenderaan elektrik masih terhad. Oleh itu, teknologi "pemindahan kuasa tanpa wire" dengan cara "induktif" telah diguna untuk menguatkan kenderaan semasa bergerak. Umumnya, teknologi "on the go" atau "dynamic charging" ini akan memasang gegelung pemancar di bawah jalan dan gegelung penerima akan diletakkan pada kenderaan. "Class E Inverter" telah direka dengan kekerapan operasi 1 MHz untuk memastikan kehilangan kuasa adalah minimum dalam Sistem "IPT". Selain itu, teknik "Impedance Matching" telah mencadangkan untuk mengekalkan kuasa output sementara perubahan drastik dalam penjajaran berlaku dalam penghantaran kuasa. Pada akhir projek, prototaip telah dibangunkan dengan Kereta Pengikut Baris yang berkuasa tanpa bateri. Kecekapan sistem ini adalah 28.73% dengan kuasa output 3.1022 W.*

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Third, thank you the INOTEK organisation verify my work is worthy by awarded this project with a Grand Prize. This would encourage me to continue to research in this field.

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# LIST OF SYMBOLS AND ABBREVIATIONS

| | | |
|---|---|---|
| WPT | : | Wireless Power Transfer |
| IPT | : | Inductive Power Transfer |
| CPT | : | Capacitive Power Transfer |
| ZVS | : | Zero Voltage Switching |
| DC | : | Direct Current |
| AC | : | Alternating Current |

# CHAPTER 1

# INTRODUCTION

This chapter will briefly introduce the concept of wireless power transmission (WPT) for electrical autonomous vehicles. The project background, project objectives, problem statement of the project, scope of work and the structure of report will also be involved.

## 1.1 Project Background

Electrical autonomous vehicles will be in demand in the future [1]. This is due to the battery technologies had become more advanced in term of capacity and cost. Since the electrical vehicles is driven by battery, so the charging process is unpreventable

In order to, backing the usage of electrical vehicles, the infrastructure of charging station must be ready to the society. Due to the huge capacity of the battery, the

changing period will be significant. People will need to wait minimum as 30 minute or maximum will be reach 12 hours for doing nothing. The waiting time will be a waste to the society. Even though, the car was fully charge, the distance travel is still be limited. Let's consider a circumstance, the electrical vehicle was running out of battery before it reaches any charging station. We can't guaranty this situation won't happen in real life. Although battery technologies become so advanced to realize the electric driven vehicle, the distance covered is still insufficient. The motive of this project is to propose wireless power transfer technologies using an inductive approach to power up the vehicle while moving. This 'on the go' wireless charging is also known as dynamic charging. Generally, in this work, the transmitter coil will be embedded underneath the road meanwhile the receiver coil will be placed at the vehicle i.e. car. A Class E inverter circuit will be designed at transmitter part to ensure the power loss is minimal as the operating frequency proposed here is 1 MHz. Furthermore, an impedance matching circuit will be also proposed to maintain the output power if some change happens in the load impedance. At the end of the project, a prototype is expected to be developed that can power up the mini autonomous car at the efficiency of at least 80%.