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Wireless Charging for EV - Based on Parking Application

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***Abstract* - Petrol and diesel is a non-renewable source, it has a negative impact on the environment such as the greenhouse effect. As the usage of vehicles is increasing consumption of fuel is also increasing exponentially, and there may be a possibility that the non-renewable resources may get exhausted in the upcoming year. Nowadays finding a solution to an existing problem, an electric vehicle is currently a solution for non- resources. Many giant companies have started their campaign in the development of the electric vehicle sector. Various models has been designed and deployed in the market. Currently, there are lots of problems with the electric vehicle such as charging ports, charging stations, availability, port types, charging types, etc. In the current project, we have found a model for charging part of electric vehicles i.e (charging type) along with the solution of is application.**

Keywords: Electric Vehicle, (EV), Charging Mode, Wireless Charging, Parking.

I. INTRODUCTION

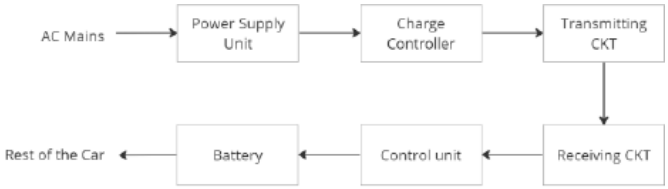
In this project, we are focusing on the charging types and methodology for implementation in electric vehicles. Electric vehicles (EV) can be charged through wired charging and wireless charging. In wired charging, it contains an adapter and a cable with a particular socket. We basically need to connect one end of the cable to the AC mains and another end of the cable is inserted into the charging port of the EV for charging. The adapter converts the AC (220V) to the required DC(24V/36V/48V, etc.) as per the requirement. To the current date, wired charging is functional in the EV.

In wireless charging, the charging is done over a contactless method. There is various methodology of Wireless Power Transfer(WPT) such as inductive resonance, capacitive resonance, etc. In this project, we are applying different types of WPT methods for wireless charging in EVs.

The major problem that arises in wired charging is the port type varies in different companies' EVs. To solve this problem wireless charging is the most preferred one. Though wireless charging has several disadvantages such as low efficiency, severer EMI issues, and heating problems, due to this the output efficiency is restricted.

In this project we are trying to improve the efficiency of wireless charging, trying different frequencies for wireless charging (for fast charging), and solving heating issues in the proposed methodology.

II. BLOCK DIAGRAM



The basic idea for the implementation of the WPT in electric vehicles is divided into the following blocks:

A. Power Supply Unit

In this section, the AC main voltage is converted to the required voltage for the operation of the working at the transmitter side.

B. Charge Controller

This section consists of the frequency variation in the designed circuit, for the conversion of the converted voltage and makes it suitable for the transmission of the charging i.e, AC voltage.

C. Transmitting Circuit (CKT)

In this block, a coil is present to transfer the power from the transmitter to the receiver.

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D. Receiving Circuit (CKT)

In this, the coil is present to receive the power transmitted from the transmitter section.

E. Control Unit

It rectifies the AC voltage into the DC voltage and further proceeds for the charging of the battery

III. DESIGN

In this section the parameters of the components used is discussed

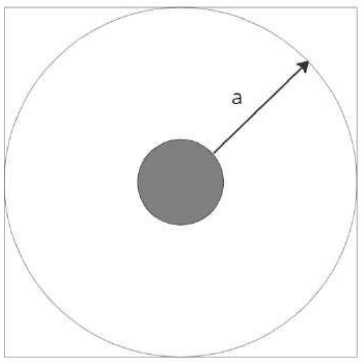
A. Wire for Coil

As for wireless charging, mostly Litz wire is used. But commercially it is not available for making custom projects, also it costs higher. Therefore for the selection of the wire for WPT, a standard magnetic-coated wire is used. As in this project, we are demonstrating up to 4A. We have selected a wire of 17 AWG which supports up to 6A current.

Litz wire

As AWG -> increases, Diameter -> decreases, Ohms/Km-> increases, Current -> decreases

B. Frame for Transmitter and Receiver



- For designing the frame acrylic sheet is used. As it is hard and can resist high temperatures.
- The size of the frame is 400 x 400 x 5 mm
- The space “a” is the area where the winding is to be done. The circle colored in black is to provide an offset for the proper winding.

Frame design

Frame after winding

C. Generating Frequency

For generating the frequencies i.e. for converting DC to AC various ICs are there for converting DC into AC. Generally, this converts the DC voltage into varying PWM signals. By changing the components like resistors and capacitors the output frequency of the PWM signal can be varied.

D. Inverter

Its function of it is to convert the DC into an AC signal. The electronic component used for making inverters is mosfets and IGBT.

IV. OPERATION

Following is the block diagram of the project model.

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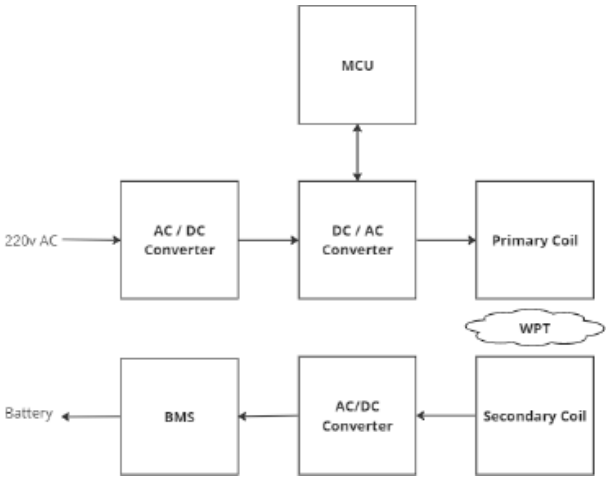
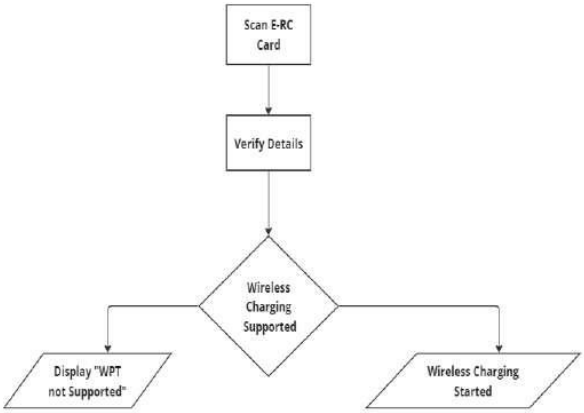


The working of the model is as follows

- The AC main voltage is converted to the DC voltage with the help of a transformer, rectifier, and voltage regulator.
- Then the generated DC voltage is fed to the DC to AC inverter circuit.
- This is a PWM signal circuit generator, of required PWM frequencies.
- For converting the DC voltage to the AC voltage, IGBT is used in the making of the inverter.
- The pulses obtained from the PWM signal is fed to the inverter and dc voltage is given to the inverter externally.
- The MCU monitors all the processes at the transmitter side.
- The primary coil and secondary coil consist of 50 turns of 17 gauge wire for transmitting and receiving power.
- The received power is in the form of AC voltage, it is then converted to DC voltage with the help of a rectifier.
- Further it is given to the BMS circuit for the smooth charging of the battery.

The block diagram for the proposed model for the application as a parking model is:



In the application of the WPT model as a parking application. In this, the user scans the E-RC card. The card consists of the details like the normal RC card, as the details are stored by the manufacturer.

If the vehicle supports wireless charging the system gets turned on and the wireless power transfers are turned on.

Features like timmer and manual turning of ON and OFF of switch can be done.

V. RESULT

The circuit was performed on the breadboard as a prototype model. The model ran successfully as per the expected result.

The above circuit was tested at 71Khz and the accuracy of the WPT was around 70 percent.

VI. FUTURE WORK

- In this circuit, a compensation circuit was not used, but using a compensation circuit can increase the efficiency of WPT.
- In the frame ferrite core was not used, when the ferrite core is used in the frame it can reduce the EMI effect, and increase efficiency up to 10-15 percent from the existing WPT efficiency.
- By adding more IGBT in the DC to AC inverter circuit the pattern of the sine wave generated can be improved.

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