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Wireless Electric Vehicle Charging while Driving

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Abstract: *Static wireless charging is becoming popular all over the world to charge the electric vehicle (EV). But an EV cannot go too far with a full charge. It will need more batteries to increase its range. Dynamic wireless charging is introduced to EVs to capitally increase their driving range and get rid of heavy batteries. Some modern EVs are getting off this situation. But with Dynamic WPT the need of plug-in charge and static WPT will be removed gradually and the total run of an EV can be limitless. If we charge an EV while it is driven, we do not need to stop or think for charging it again. Eventually, in the future the batteries can be also removed from EVs by applying this method in everywhere. Wireless charging needs two kinds of coils named the transmitter coil and the receiver coil. The receiver coil will collect power from the transmitter coil while going over it in the means of mutual induction. But the variation of distance between two adjacent coils affects the wireless power transfer (WPT). The idea is to build special charging systems into the road itself. These systems use magnetic fields to send power to vehicles as they drive over them—similar to how wireless phone chargers work, but on a much larger scale. Cars equipped with the right technology can receive this power without having to stop or plug in, Our work focuses on how to make this system efficient, safe, and affordable. We look at how well it works at different speeds, how the vehicle needs to be aligned over the charging coils, and how the system can be integrated into existing roads. We also explore what it would take to bring this to cities and highways around the world..*

Keywords: Electric Vehicle, Wireless Power Transfer, Transmitter- Receiver Coils, Charging Lane

I. INTRODUCTION

Basic principle of wireless charging is same as transformer working principle. In wireless charging there are transmitter and receiver, 220V 50Hz AC supply is converted into low voltage, High frequency alternating current and this high frequency AC is supplied to transmitter coil, then it creates alternating magnetic field that cuts the receiver coil and causes the production of AC power output in receiver coil. Then finally, this AC power at receiver side rectified to DC and fed to the battery to charge battery effectively. Here we implement static wireless charging stations. Here vehicle get charged while it is in parking. The power transfers over the air from a stationary transmitter to the receiver coil in a stationary vehicle. It reduces the need for large energy storage which further reduces the weight of the vehicle. Inductive Wireless Charging System (IWC) :- The basic principle of IWC is Faraday's law of induction. Here wireless transmission of power is achieved by mutual induction of magnetic field between transmitter and receiver coil. When the main AC supply applied to the transmitter coil, it creates AC magnetic field that passes through receiver coil and this magnetic field moves electrons in receiver coil causes AC power output. This AC output is rectified and filtered to Charge the EV's energy storage system. The amount of power transferred depends on frequency, mutual inductance and distance between transmitter and receiver coil. Wireless charging is becoming popular all over the world to charge the electric vehicle. But an EV cannot go too far with a full charge. It will need more batteries to increase its range. Dynamic wireless charging is introduced to EVs to capitally increase their driving range and get rid of heavy batteries. Some modern EVs are getting off this situation. But with Dynamic WPT the need of plug-in charge and static WPT will be removed gradually and the total run of an EV can be limitless. If we charge an EV while it is driven, we do not need to stop or think for charging it again. Eventually, in the future the batteries can be also removed from EVs by applying this method in everywhere. Wireless charging needs two kinds of coils named the transmitter coil and the receiver coil.

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The receiver coil will collect power from the transmitter coil while going over it in the means of mutual induction. But the variation of distance between two adjacent coils affects the wireless power transfer (WPT). To see the variation in WPT, a system of two Archimedean coils of copper designed and simulated for vertical and horizontal misalignment in Ansys Maxwell simulation Software.

Need of Project:

The project provides a seamless charging experience by eliminating the need for physical connections or plugging in vehicle. EV owners can simply drive over specially designed road surface and have their vehicle automatically and wirelessly charged. This eliminates the hassle of manually connecting and disconnecting charging cables. By enabling electric vehicle to charge while driving, the project significantly extends the effective range of electric vehicle. It reduced the anxiety and allows for longer journeys without worrying about running out of battery charge.

II. LITERATURE SURVEY

This chapter contains the existing and established theory and research in this report range. This will give a context for work which is to be done. This will explain the depth of the system. Review of literature gives a clearness and better understanding of the exploration/venture. A literature survey represents a study of previously existing material on the topic of the report. This literature survey will logically explain this system.

Several studies have been conducted to investigate the feasibility of wireless charging of EVs while driving. A study by 1) Gao et al. (2019) proposed a dynamic wireless power transfer system for electric buses based on inductive power transfer. The system consisted of a charging pad on the road and a pickup coil on the bottom of the bus. The results showed that the system could achieve a power transfer efficiency of over 90%, making it a promising solution for wireless charging of EVs while driving.

2) Another study by Zhang et al. (2021) proposed a dynamic wireless charging system for electric vehicles based on resonant magnetic coupling. The system consisted of a charging pad on the road and a pickup coil on the vehicle. The results showed that the system could achieve a power transfer efficiency of 95%, making it a promising solution for wireless charging of EVs while driving.

3) A study by Wang et al. (2020) proposed a novel wireless power transfer system for EVs based on magnetic resonance coupling. The system consisted of a charging pad on the road and a pickup coil on the vehicle. The results showed that the system could achieve a power transfer efficiency of 97%, making it a promising solution for wireless charging of EVs while driving.

4) A study by Lee et al. (2020) proposed a wireless charging system for electric buses based on magnetic resonance coupling. The system consisted of a charging pad on the road and a pickup coil on the bottom of the bus. The results showed that the system could achieve a power transfer efficiency of 95%, making it a promising solution for wireless charging of EVs while driving.

5) Dr. K. Shivarama Krishna, Creative Research Thoughts International Journal (IJCRT). ELECTRICAL VEHICLE WIRELESS POWER TRANSMISSION. It has been built with features that integrate all of the hardware components that are used. Each module's presence has been thoughtfully considered and arranged to enhance the unit's overall performance. Second, the project has been executed successfully employing extremely sophisticated integrated circuits (ICs) made possible by developing technology. Consequently, the project's design and testing were successful. The suggested method used low values for the de link and filter capacitance, respectively, and reduced input/output voltage and current ripple.

6) International Journal of Creative Research Thoughts (IJCRT), Mohammed Aleem. Wireless Power Transmission Coupled For Electric Cars. An electric vehicle (EV) can be wirelessly charged with the help of this research.

7) International Journal of Creative Research Thoughts (IJCRT) article by Dr. V. Raveendra Reddy." SOPHISTICATED AUTOMOBILAR CHARGING SYSTEM". One of the most practical methods for charging electric cars is wireless charging infrastructure. Researchers are drawn to it despite its high cost. Electric cars are effectively autonomous since they can travel for extended periods of time without needing to stop and recharge. The possibility of substantially smaller batteries for electric cars with wireless charging technology on the fly is perhaps the most

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interesting feature. Because of this, introducing electric vehicles has a smaller financial and environmental impact thanks to technology.

8) "STATIC WIRELESS CHARGING STATION FOR ELECTRIC VEHICLES," by Akash Kharpude, International Journal of Creative Research Thoughts (IJCRT). To overcome the drawbacks of conventional charging methods, this study suggests a wireless charging system for electric cars (EVs).generation.

III. SYSTEM DESIGN

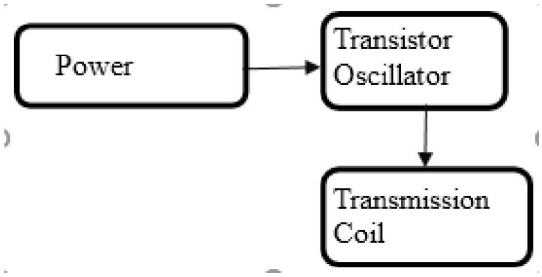

Fig. 1. Transmitter Section

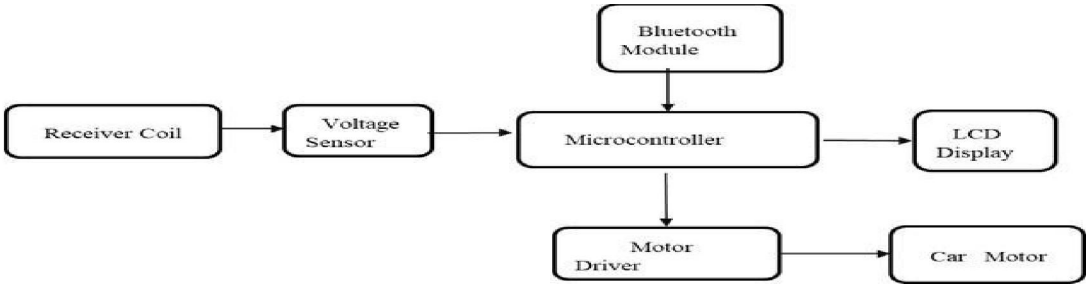

Fig. 2. Receiver Section

Transmitter section circuit diagram

When power (VCC) is supplied, current flows through R1 to the base of the transistor (Q1) this turns on the transistor, allowing current to flow from the collector to the emitter, energizing the coil (L2). The coil produces an electromagnetic field, generating radio waves. The transistor quickly switches on and off, creating oscillations in the coil, which transmits the signal wirelessly.

Receiver section circuit diagram

The Bluetooth module (HC-05) receives commands from a smartphone or remote device. The Arduino Nano processes these commands and controls the L293D motor driver. The motor driver controls the speed and direction of two DC motors. The voltage sensor monitors power levels and sends data to the I2C LCD for display. The inductive receiver (L1) can be used to wirelessly receive power. The power supply unit will provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units. A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

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IV. METHODOLOGY

Component Description

A. Arduino Nano

The Arduino boards are widely used in robotics, embedded systems, and electronic projects where automation is an essential part of the system. These boards were introduced for the students and people who come with no technical background. Any kind of support and help is readily available by the Arduino community that is too easy to approach and sets you free from depending on others that may cost you bunch of dollars. Arduino Nano is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p (Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x).It comes with exactly the same functionality as in Arduino UNO but quite in small size.It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V.

Arduino Nano Pin out contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output.They are acted as input pins when they are interfaced with sensors, but if you are driving some load then use them as output. Functions like pin Mode () and digital Write () are used to control the operations of digital pins while analog Read() is used to control analog pins.

Fig. 3. Arduino Nano

B. Gear Motor

Almost every mechanical movement that we see around us is accomplished by electric motor. Electric machines are a means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are used to power hundreds of devices we use in everyday life. Motors come in various sizes. Huge motors that can take loads of 1000's of Horsepower are typically used in the industry. Some examples of large motor applications include elevators, electric trains, hoists, and heavy metal rolling mills. Examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders. Micro- machines are electric machines with parts the size of red blood cells, and find many applications in medicine.

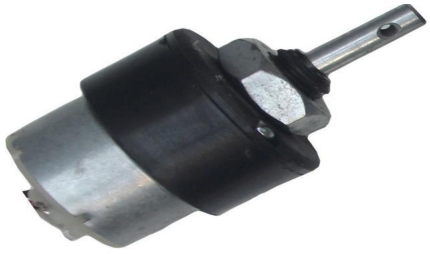

Fig. 4. Gear Motor

C. Voltage Sensor

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a

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current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider.

This sensor includes input and output. The input side mainly includes two pins namely positive and negative pins. The two pins of the device can be connected to the positive & negative pins of the sensor. The device positive & negative pins can be connected to the positive & negative pins of the sensor. The output of this sensor mainly includes supply voltage (Vcc), ground (GND), analog o/p data.

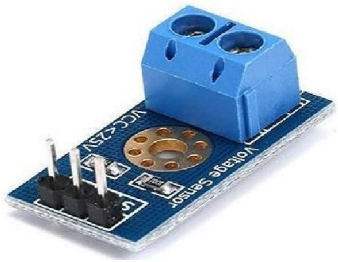

Fig. 5. Voltage Sensor

D. HC05 Bluetooth Module

HC 05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04 - External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as12.7mmx27mm.

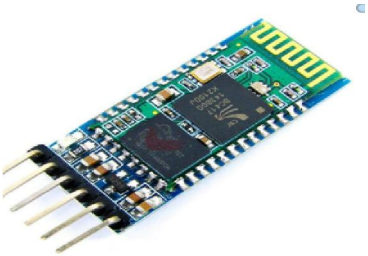

Fig. 6. Bluetooth Module

E. 16x2 LCD Display

This is I2C interface 16x2 LCD display module, a high-quality 2 line 16 character LCD module with on-board contrast control adjustment, backlight and I2C communication interface. For Arduino beginners, no more cumbersome and complex LCD driver circuit connection. The real significance advantages of this I2C Serial LCD module will simplify the circuit connection, save some I/O pins on Arduino board, simplified firmware development with widely available Arduino library.

Fig. 7. 16x2 LCD Display

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F. Copper Coils

At a basic level, wireless charging works by creating a wireless transfer of energy between two coils, tuned to resonate at the same frequency Based on the principles of electromagnetic resonance, resonant-based chargers inject an oscillating current into a coil to create an oscillating electromagnetic field. A second coil with the same resonant frequency receives power from the electromagnetic field and converts it back into an electrical current that can be used to power and charge devices.

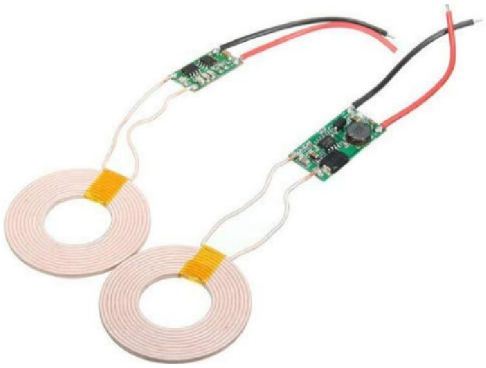

Fig. 8. Copper Coils

V. CONCLUSION

Transformer EV experts and futurists expect electromagnetic induction and coils to be built into roadways worldwide, creating innovative and efficient wireless EV charging while driving. Wireless EV charging while driving eliminates the time currently needed for an EV to charge at a station.

Wireless charging of electric vehicle has the potential to revolutionize the road transportation from the automotive industry. With the advancement of electric vehicle technology, wireless charging technique is expected to increase significantly by next decade. The main agenda of this paper is to give an overview of various wireless charging techniques out of which inductive wireless transfer has proven to be the best method of wireless charging.

The electric vehicle batteries which were to take quite a lot time to charge up to the rated value will be charged within less time comparatively as their battery capacity is reduced . However, simplicity and minimum driver intervention are key features that win out time-and time again and when these features are coupled with high power transfer efficiency, wireless charging of electric vehicle is a winning combination

VI. FUTURE SCOPE

• The city and country should prepare to have electricity in the future. It is based on the instructions of the authorities and the latest technology. Offering the best performance, safety, and economy, electric vehicles have the potential to change the way transportation.

• Dynamic electric car charging is essential; The technology could also power biomedical implants, enable supersonic hyper loop travel, and create humanoid robots. The opportunities offered by business problems are limitless.

• Today, the electric vehicle market is growing rapidly. WEVC may become more competitive as new technologies and equipment are developed.

• Power electronics can also benefit from advanced equipment. In addition to leakage currents, switching losses are another important energy waste in WEVC systems. Static WEVC can release workers after removing the job from the ledger, but not the pay change.

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