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MAGNETIC WIRELESS VEHICLE CHARGING SYSTEM

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ABSTRACT

Wireless power transmission is the way to transfer power without using wire. Wireless power transmission helps to connect those area where people are unable to get a suitable power source. Everyone can get clean and green wireless power. In future all the devices will relate to the power supply source wirelessly. Wireless charging of electric vehicles (EVs) has been in development for several years in preparation for the growth in adoption of these vehicles. Wireless charging systems today offer an efficient, flexible means of charging EVs from multiple classes and at a range of power levels from a common ground source. Standardization activities are well under way to ensure compatibility between systems across vehicle makers and location In this paper we have presented the successful experimental attempts to transmit power wirelessly and future scope of wireless power transmission in Electric vehicles.

In today's drastically deteriorated environment, electric vehicles (EVs) are required. India's government intends to have only electric vehicles by 2030. Fast charging of electric vehicles and charging infrastructure are required to make EVs widely accepted, as charging time is the primary obstacle to EV adoption. Having an acceptable charging infrastructure is a crucial aspect of this change. With the widespread use of electric vehicles, the current power supply may experience significant instability. The "solar-based wireless EV charger" project uses renewable energy technology. Solar energy is converted to electrical energy, which is then stored in a lead-acid battery. With the battery management unit, a wireless charging system will be established. This stored energy is utilized to charge Electric Vehicles.

Index Terms: wireless power transfer module, reverse charging protection, ATmega328P

1. INTRODUCTION:

In the whole world electricity transfer from power station to everywhere is through wire. Wireless power transfer technology can potentially reduce or eliminate the need for wires and batteries. Wireless transmission is useful to power electrical devices where interconnecting wires are inconvenient, hazardous, or are not possible. Wireless power transfer technology reduces the use of electric wire which is made of copper and aluminum metal. The metal which are used to make electric wire will extinct in future. If we implement wireless power transfer technology the use of electric wire will reduce. It would be beneficial if in future, we can implement wireless power transfer technology to transfer power from power station to everywhere without the need of wire.

Autonomous vehicle fleets provide another compelling reason to deploy wireless charging. When there is no one to plug in, but the vehicle can drive itself to a charging spot, wireless charging becomes not a convenience but rather a necessity. This paper reviews the application of magnetic resonance based wireless power transfer to the charging of electric vehicles. It includes an overview of the technology for this application, some performance data from a state-of-the-art system, a review of activities in standardization of the technology, and a discussion of some remaining challenges to the technology, and a discussion of some remaining challenges to widespread adoption.

Electric vehicles have now hit the road worldwide and are slowly growing in numbers. Apart from environmental benefits electric vehicles have also proven helpful in reducing cost of travel by replacing fuel by electricity which is way cheaper. However electric vehicles have 2 major disadvantages:

1. Long charging time – 1-3 hours required for charging
2. Non availability of power for charging stations in off city and remote areas.

Well here we develop an EV charging system that solves both these problems with a unique innovative solution. This EV charging system delivers following benefits:

1. Wireless charging of vehicles without any wires
2. No need to stop for charging, vehicle charges while moving
3. Solar power for keeping the charging system going
4. No external power supply needed
5. Coils integrated in road to avoid wear and tear

The system makes use of a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, at mega controller and LCD display to develop the system. The system demonstrates how electric vehicles can be charged while moving on road, eliminating the need to stop for charging.

The solar panel is used to power the battery through a charge controller. The battery is charged and stores dc power. The DC power now needs to be converted to AC for transmission. For this purpose we here use a transformer.

The power is converted to AC using transformer and the regulated using regulator circuitry. This power is now used to power the copper coils that are used for wireless energy transmission. A copper coil is also mounted underneath the electric vehicle.

When the vehicle is driven over the coils energy is transmitted from the transmitter coil to ev coil. Please note the energy is still DC current that is induced into this coil. Now we convert this to DC again so that it can be used to charge the EV battery.

We use AC to DC conversion circuitry to convert it back to DC current. Now we also measure the input voltage using an at mega microcontroller and display this on an LCD display. Thus the system demonstrates a solar powered wireless charging system for electric vehicle that can be integrated in the road.

1.1 Introduction to Electric vehicle

Electric vehicles are not a new and have been around since the beginning of early 19th century. However with the advent of internal combustion engine and cheap oil in the early 20th century, the EVs went out of mass production. The EVs also grew unpopular because of their very limited driving range. But the idea of an environment friendly, and affordable EV has not vanished. Limited range and cost have been major obstacles that limit the use of EVs on a large scale. However, with the development of Li-ion batteries, fast charging infrastructure and lower cost of production, EVs can become a realistic alternative to conventional vehicles.

Charge replenishment of EVs has been traditionally done via conductive charging

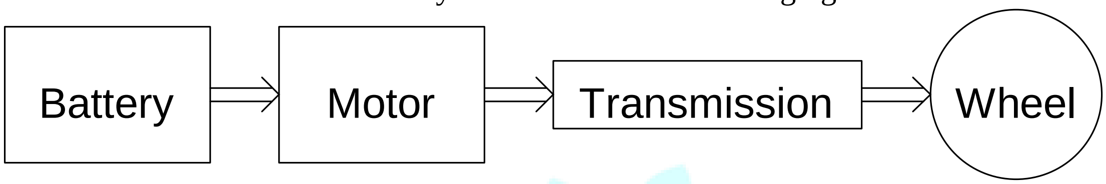


Fig.1: Schematic diagram of EV system

In present years, a good improvement in electric vehicle (EV) has arisen globally due to the stressing of the environmental concerns and increasing price of oil. These vehicles with on-board energy storage devices and electric drives allow power to be recovered, thus improving fuel economy and reducing pollutants. As a product of advanced design philosophy and component technology, maturing and commercialization of EV technologies demand extensive research and developments.

2.METHODOLOGY:

Solar power has increasingly become popular over the past year. With its uncountable improvement and cost-effective ways, more and more people are opting to switch over to solar energy rather than their regular form of energy. Solar charging is based on the use of solar panels for converting light energy into electrical energy (DC). The DC voltage can be stored battery bank. There is Reverse charging protection circuit is provided for the backflow of energy from the battery to a solar panel. The transfer coil is located at charger side and receiver coil is placed on vehicle side. A wireless power transfer module (WPT) is used for transferring electric power which is generated from the solar panel to the Electric vehicle by using the principle of Electromagnetic Induction. To measure battery voltage, a voltage sensor is used.

The battery voltage will be measured by microcontroller & showed on a 16x2 LCD. It will also display battery low status, whenever battery voltage falls below a certain level. L239D is the motor driver which is used for movement of wheels of that vehicle.

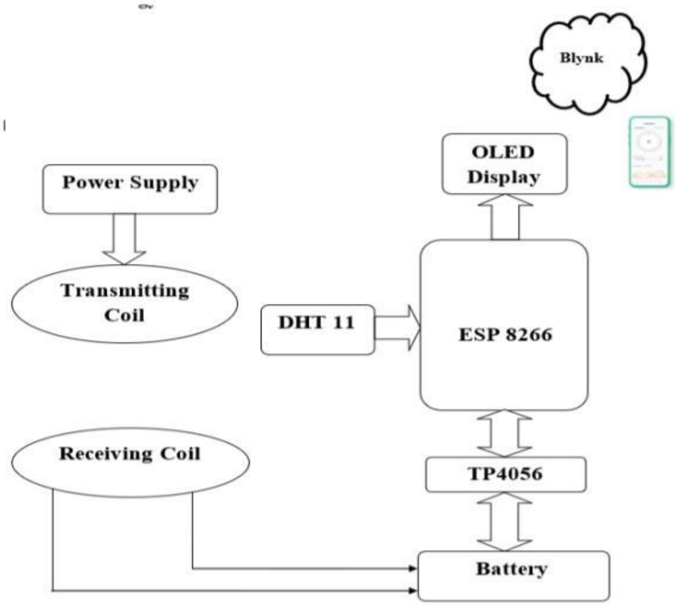


Fig 2. Overview of the proposed system

Wireless power transfer module (WPT): In electric vehicles charging of battery through a charger and wire is inconvenient, dangerous, and expensive. The existing gasoline and petrol engine technology vehicles are responsible for air, and noise pollution as well as for greenhouse gases.

The implemented wireless charging system of batteries for Electric vehicles by the inductive coupling method has been studied in this paper

2.1 BATTERY STORAGE SYSTEM

In foreign countries, European and American are promoting the construction of electric vehicle charging facilities with direct or indirect preferential subsidy policies. By 2020, China is expected to than 12,000 centralized charging and replacement power stations and more than 4.8 million decentralized charging piles to meet the charging demand of 5 million electric vehicles in China. It is self-evident that in the next few years, the global electric vehicles and supporting charging facilities will mushroom to usher in the golden age of their development. However, due to the aging of the charging line, the complexity of operation and the entanglement of the charging pile, the safety and user experience are greatly compromised in actual use.

Transition away from fossil fuel burning internal combustion engines has left somewhat of a gap between the high power demands of combustion engine applications and the power that battery technology is able to supply. Specifically in current electric vehicles, the size of the battery is frequently determined by the maximum power handling requirement, rather than the minimum range that vehicle must be capable of between charges, making this component of the vehicle the most expensive individual part.

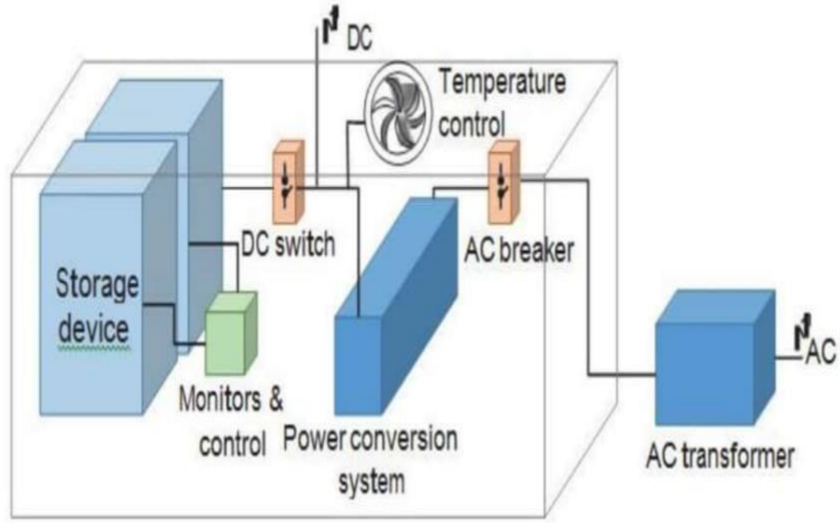
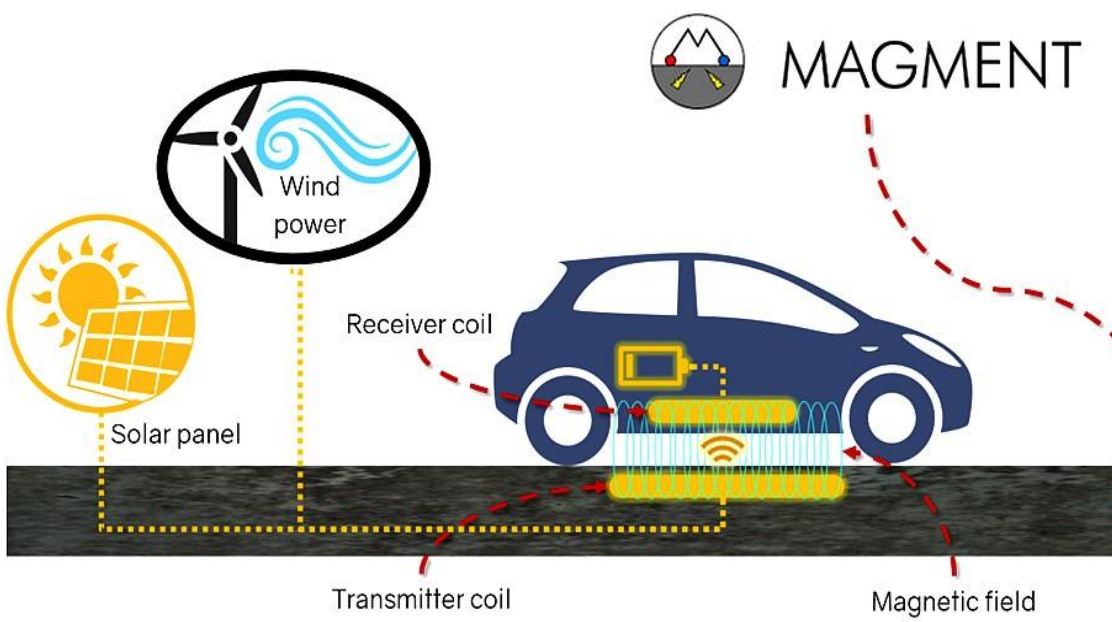


Fig.3: Battery Storage System and Primary Power Components

Furthermore, continued high power charging and discharging of batteries is known to reduce their life span from around a few thousand cycles, to only hundreds. Conversely, super capacitors are super bat high power handling, typically withstanding power loads up to 100times that of lithium based batteries, and importantly without damaging the unit or reducing its lifecycle, which is generally rated at a minimum of 500,000 cycles for existing commercial products.

3.MAIN DIAGRAM:



4.WORKING PRINCIPLE :

Wireless EV charging is based on Inductive Power Transfer (IPT)technology, which transfers power between two coupled coils; a primary coil at a wireless charger is connected to the electrical grid, while a secondary coil is located at the EV such that there is a reasonably air gap between them, In such near-field charging technique, a transmitting coil of the wireless charger produces a magnetic field that transfers energy via induction to a nearby receiving coil of the EV. Some fraction of the magnetic flux generated by the transmitting coil that penetrates the receiving coil contributes to the power transfer. And the transfer efficiency depends on the coupling between the coils and their quality factor. Mainly, there are two types of IPT for the wireless charging:1. Static IPT is deployed when the vehicle is spotted in a parking lot.2. Dynamic or Quasi-dynamic IPTs are deployed when the vehicle is either on move or a brief stop at the traffic red light respectively. It should be noted that as the wired charging would be impossible while the EVs are in the motion, thus the WPT would be the only solution for the dynamic or quasi-dynamic charging.

Stationary Charging: Wireless inductive EV charging transfers alternating current (AC)through a coil in the charging plate via a magnetic field to the car's inductive 'pick-up A voltage converter in the car then turns the alternating current into direct current (DC) with, which in turn charges the battery pack. A charging pad sits on the ground, connected to a wall-mounted power adapter. The car is parked over it. On the backside of the car there is are receiver when charger detects the receiver within range, it automatically starts charging.

Dynamically Charging: Similar to the Stationary charging system the EV's are charged through the resonant coil but, here the vehicle can be charged while moving on the road. A Charging lane will be provided alongside the roads where the people can move to charge their vehicles while driving. Dynamically charging system cannot be provided through wired system and their by the WPTs is required to provide this method of charging. Every electric bus has a wireless charging receiver. According to Figure Wireless chargers are embedded in the hard surface of a road or under the road surface at regular intervals. When the bus is stopped no need to plug in or no need to connect with wireless chargers. It will automatically have charged. It's a motion bus. These kinds of buses are already tested in the UK, Italy, the Netherlands, and South Korea.

4.1 Need of wireless Charging system:

1. Charging process is simple and automatic.

2. It doesn't require any human input.

3. It is small in size and compact compared to a wired system.

4. Compared to a wired system, it requires less space and can be installed underneath the surface.

5. As it does not have any contact, there are no exposed electric connections.

6. It can avoid electrocution risk typically arising from power cords.

4.2 Wireless Power Transfer system

- Wireless power transfer (WPT), wireless power transmission, wireless energy transmission (WET), or electromagnetic power transfer is the transmission of electrical energy without wires as a physical link.
- In a wireless power transmission system, a transmitter device, driven by electric power from a power source, generates a time-varying electromagnetic field, which transmits power across space to a receiver device, which extracts power from the field and supplies it to an electrical load.
- The technology of wireless power transmission can eliminate the use of the wires and batteries, thus increasing the mobility, convenience, and safety of an electronic device for all users. Wireless power transfer is useful to power electrical devices where interconnecting wires are inconvenient, hazardous, or are not possible...

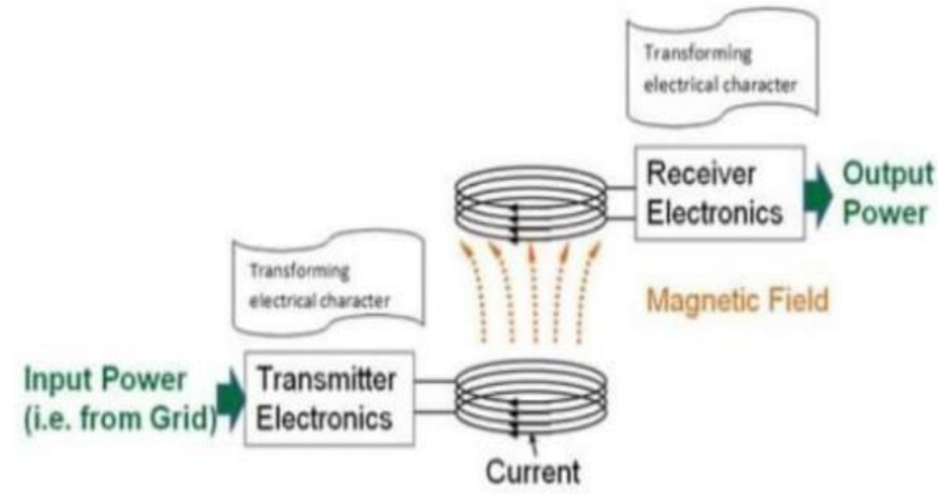


Fig.4: Basic elements of power transfer system

5. Advantages of Wireless power Transfer system:

1. Charging process is simple and automatic.
2. It doesn't require any human input.
3. It is small in size and compact compared to a wired system.
4. Compared to a wired system, it requires less space and can be installed underneath the surface.
5. As it does not have any contact, there are no exposed electric connections.
6. It can avoid electrocution risk typically arising from power cords.
7. Newer WPT designs are getting better in efficiency.

CONCLUSION:

This project has dealt with Wireless Charging Systems for Electric Vehicle Batteries. An Inductive Power Transferd (IPT) system for an E-bike battery charging has been designed and assembled. The target is a 36 V 10 Ah LiFePO4 battery and the power level ranges from 100 W to 250 W. After the magnetic design of the IPT coils, the electric model of the coupling structure has been gained and acquired from an electronic simulation tool, in order to complete the design of the whole system. A series-series (SS) compensation topology has been chosen for the capacitive network that has been connected to the coupled coils. In the assembled open-loop prototype, a half-bridge converter in the transmitter side and a four-diode rectifier in the receiver side have been designed. From the experimental results, a 79 % coupling efficiency for an about 100 W level arises. A magnetic characterization of the region surrounding the assembled prototype has been made as well. According to the magnetic field exposure guidelines, by ICNIRP, a minimum 25 cm distance from the center of the system is suggested as safety distance. After the experimental measurements on the power efficiency, alternative solutions of power electronics and coupling structures have been investigated. A Bi-Directional IPT system has been analyzed and an algorithm for its efficiency optimization has been proposed. Mathematical analysis has been validated through power electronics simulations. For this system, an investigation has been carried out on different magnetic coupling structures, all compliant with an E-bike wheel, and the best option in terms of system efficiency and tolerance to lateral misalignments has been defined. The investigation has been made according to the results of 3D magnetic simulations and their elaboration.

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