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RESEARCH ARTICLE OPEN ACCESS

Wireless Power Transfer for E-Vehicle

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ABSTRACT

Wireless energy transmission is the transmission of electrical energy from a power source to an electrical load like electrical power grid. Wireless power refers to a number of different power transmission technologies that use time-varying electric, magnetic or electromagnetic fields. Wireless transmission is useful to power electrical devices. Inductive coupling is the most widely used wireless technology.Its applications include electric toothbrush chargers, RFID tags, smartcards, and chargers for implantable medical devices. A current focus is to develop wireless systems to charge mobile and handheld computing devices. Proposed applications for this type are solar power satellites, and wireless powered drone aircraft.

I. INTRODUCTION

Electric vehicles (EV) represent acleareco-friendlymobility solution. Firstly, it is able reduce CO2 emissions. On the other hand, it also helps for the integration of renewable energy sources. Despite these potential benefits, the proliferation of electric vehicles must be carefully controlled as a big number of them stands out for a considerable aggregated load to the grid. Market-driven solutions aim at prompting the charge of the vehicles in those times when it is more convenient for the grid, avoiding the periods with a high demand too.[1]

WPT technology has numerous inherent advantages over conventional means of power transfer, thus has received much attention in the past decade and has been proposed to apply to a wide range of applications, ranging from low power biomedical implants electrical vehicle charger to railway vehicles with efficiency up to 95% or higher in some prototype systems. Resonant WPT systems rely on magnetic field coupling to transfer electric power between two or more magnetically coupled resonant coils across relatively large air gap. In this paper, a wireless charging system for lightweight electric vehicle is designed, built and tested.

Wireless power transfer (WPT), wireless energy transmission, or electromagnetic power transfer is the transmission of electrical energy from a power

Source to an electrical load, such as an electrical power grid or a consuming device, without the use of discrete human-made conductors. Wireless power is a generic term that refers to a number of different power transmission technologies that use time-varying electric, magnetic, or electromagnetic fields. In wireless power transfer, a wireless transmitter connected to a power source conveys the field energy across an intervening space to one or more receivers, where it is converted back to an electrical current and then used.

Wireless transmission is useful to power electrical devices in cases where interconnecting wires are inconvenient, hazardous, or are not possible. Wireless power techniques mainly fall into two categories, non-radiative and radiative. In near field or non-radioactive techniques, power is transferred by magnetic fields using inductive coupling between coils of wire, or by electric fields using capacitive coupling between metal electrodes. Inductive coupling is the most widely used wireless technology; its applications include electric toothbrush chargers, RFID tags, smartcards, and chargers for implantable medical devices like artificial cardiac pacemakers, and inductive powering or charging of electric vehicles like trains or buses. A current focus is to develop wireless systems to charge mobile and handheld computing devices such as cell phones, digital music players and portable computers without being tethered to a wall plug. In far-field or radiative techniques, also called power beaming, power is transferred by beams of electromagnetic radiation, like microwaves or laser beams. These techniques can transport energy longer distances but must be aimed at the receiver. Proposed applications for this type are solar power satellites, and wireless powered drone aircraft.

II. OBJECTIVE OF THE INVENTION

The object of the invention is to develop a high efficiency wireless power transfer system for charging an electric vehicle.

Generally a wireless power system consists of a transmitter connected to a source of power such as a mains power line, which converts the power to a time-varying electromagnetic field, and one or more "receiver" devices which receive the power and convert it back to DC or AC electric current which is used by an electrical load. At the transmitter the input power is converted to an oscillating electromagnetic field by some type of "antenna" device. The word "antenna" is used loosely here; it may be a coil of wire which generates a magnetic field, a metal plate which generates an electric field, an antenna which radiates radio waves, or a laser which generates light.

A similar antenna or coupling device at the receiver converts the oscillating fields to an electric current. An important parameter that determines the type of waves is the frequency f in hertz of the oscillations. The frequency determines the wavelength $\lambda = c/f$ of the waves which carry the energy across the gap, where c is the velocity of light.

III. BACKGROUND BEHIND THE SYSTEM

Wireless power transfer uses different technologies for transmitting energy by means of electromagnetic fields. The technologiesdiffer in the distance over which they can transfer power efficiently, whether the transmitter is directed at the receiver and in the type of electromagnetic energy they use in time varying electric fields, magnetic fields, radio waves, microwaves, or infrared or visible light waves shown in figure 1.[5]

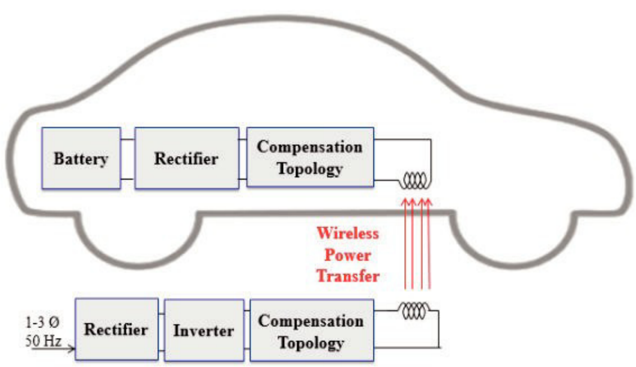

Figure 1:Wireless Power System

Electric and magnetic fields are created by charged particles in matter such as electrons. A stationary charge creates an electrostatic field in the space around it. A steady current of charges (direct current, DC) creates a static magnetic field around it. The above fields contain energy, but cannot carry power because they are static. However time-varying fields can carry power.[4]

Accelerating electric charges, such as are found in an alternating current (AC) of electrons in a wire, create time-varying electric and magnetic fields in the space around them. These fields can exert oscillating forces on the electrons in a receiving "antenna", causing them to move back and forth. These represent alternating current which can be used to power a load. The oscillating electric and magnetic fields surrounding moving electric charges in an antenna device can be divided into two regions, depending on distance Drange from the antenna. The boundary between the regions is somewhat vaguely defined. The fields have different characteristics in these regions, and different technologies are used for transferring power.

- Near-field or nonradiative region
- Far-field or radiative region

The methodologies used to implement these techniques are inductive, capacitive andMagneto dynamic coupling methods.[2]

IV. EXISTING SYSTEM

As per the existing systems solar based mobile were designed. As advance wireless charger particularly for small load system was implemented recently. Furthermore, a prototype of the whole system, consisting of a commercial panel, the thermal and electrical circuits and an innovative wireless remote data acquisition system has been setup. [8]The latter, based on an open-source electronic platform, has the necessary accuracy, and remote data capture and flexibility features. The model has been carefully calibrated and the simulated results, based on the solar irradiance, the ambient temperature and the wind speed, have been compared with experimental data. The results are analyzed and discussed in the paper. Such a validated model can be used to establish if and when it is more convenient to use a hybrid structure rather than two separate devices. There are some limitations of existing systems like high complexity in switching process.andhigh power losses.[3]

V. BLOCK DIAGRAM OF SYSTEM

In this proposed system, ARDUINO microcontroller based wireless power charging methodology in electric vehicles will be implemented. This system consists of ARDUINO microcontroller, inductive coils, vehicle prototype module.

Solar panel system is implemented to transfer the power to the primary coil. Solar panel is connected to the battery directly. Then it can drive into the rectifier circuit through an inverter. In inverter circuit is connected by ARDUINO micro controller to switching the power supply. The switched power is fed into the inverter through driver circuit. The coil has high capacity of inductance which can able to transfer the power with high frequency. It is named as the high frequency coil. Those power input are connected to the high frequency primary coil which is laid under the road segment.The block diagram of wireless power transfer system is as shown in figure 2.

The vehicle has receiving coil segment. The receiver section consisting of the receiver coil, rectifier and regulator. When the vehicle move along the primary coil, receiver coil in vehicle receives the power from the primary coil by the electromagnetic induction technique. That received power is driven to the regulator through rectifying circuit. Then the power is stored in the battery. The battery power is given to the controller and the motor driver circuit. Motor driver is used for control the motor of vehicle.

The vehicle can charge automatically when it cross over the primary coil connected to the battery. By this, we can able reduce the pollution of air and demand in petroleum products.

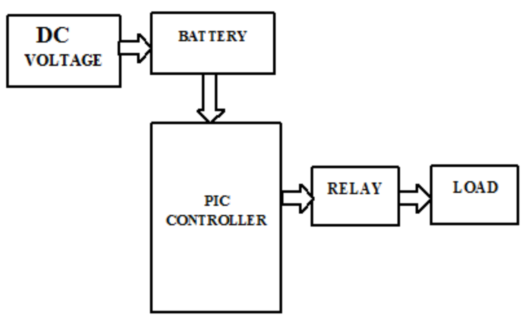

Figure 2: Block Diagram of Proposed System

In this system, transmitter block as shown in figure 3 consists of battery, inverter, rectifier, and High frequency wireless transmitting coil. The power supply is given from the solar panel. A solar panel power is stored in battery then delivers its power to the inverter circuit. The power is rectified by the rectifier circuit and rectified power is transferred to high frequency transmission coil. In transmitter circuit PIC microcontroller has been connected with the inverter circuit to switch the transmission power. The transmission power efficiency has been increased by switching the power. Then the switching power is transferred to the inverter circuit through the driver circuit.

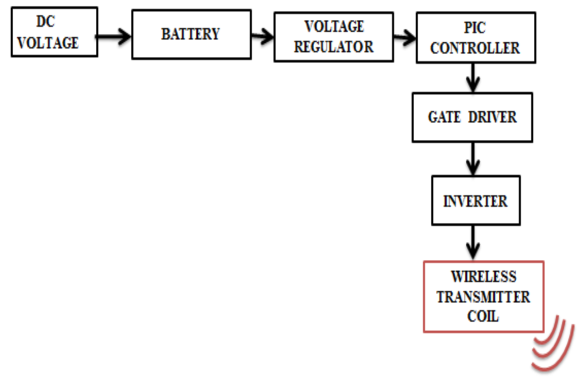

Figure 3: Transmitter Block

The receiver block as shown in figure 4 has receiving coil which receives the power from the transmitter coil. Then the power is fed into the rectifier circuit and drive to the regulator circuit and battery. The regulated power is given to the controller to drive the motor of the vehicle. LED indicated the charging status and LCD shows the information about power transfer and charging. Motor drier is used to controls the 12V motor by the controller. Also it can control the rotation of each motor.

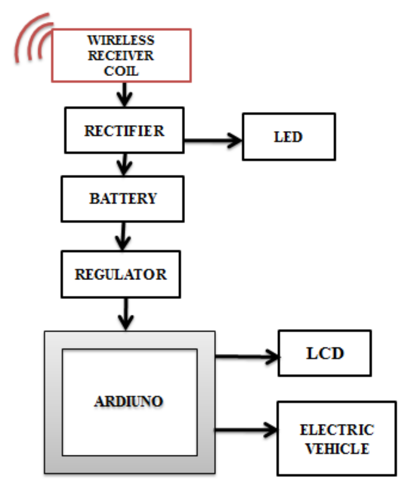

Figure 4: Receiver Block

VI. HARDWARE ANDSOFTWARE REQUIRMENTS

Hardware requirements are fulfilled with the help of different components like Microcontroller, DC motor, LCD Display, DC power supply. Also to run the system some software development tools are used. ARDINO IDE is used for program development. Proteus simulator incorporates many functions derived from several other languages like assembly and C.

VII. RESULTS& CONCLUSION

A high efficiency wireless power transfer system for electric vehicle charging application is proposed. System configuration and design considerations were analyzed and discussed in details through following figure 5. The popular renewable sources of energy, solar energy source is individually modeled and then combined together to represent a distributed generation system in the Simulink model. A prototype is designed, built and tested with solar panel to verify the circuit performance of the developed WPT charging system is shown in figure6.

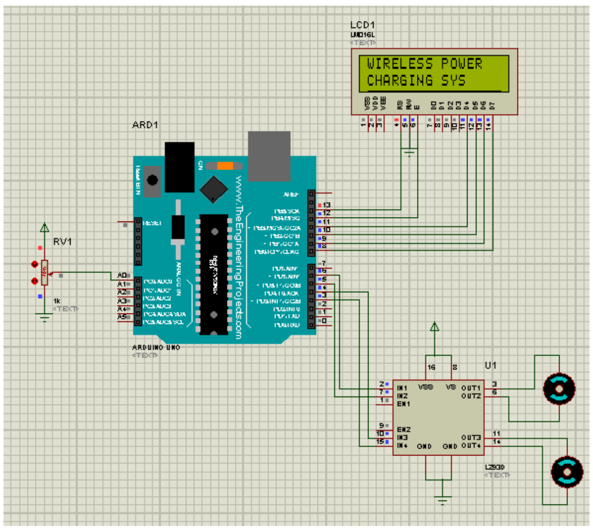

Figure 5: Introducing Wireless Power System

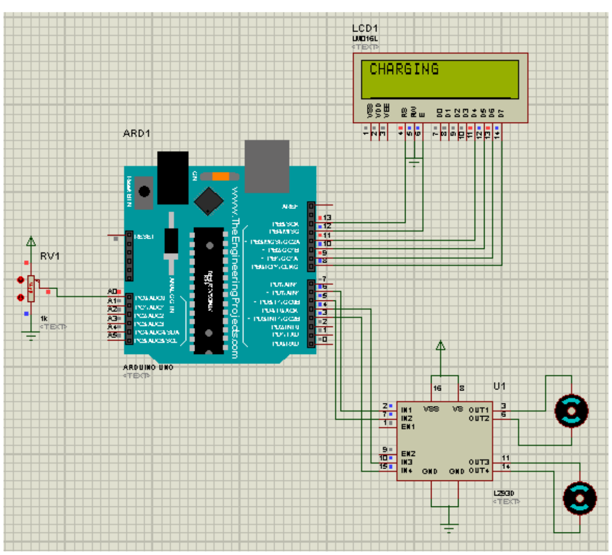

Figure 6: Charging Status of Wireless Power System

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