Design and Development of Solar Powered Wireless Charging Station for Electric Vehicle

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Abstract:
The low popularity of electric cars is largely attributed to the problems encountered in its charging and maintenance. Long distance travel using electric vehicles is largely limited because of these issues. This paper proposes the design of solar-powered charging station for electric vehicles using wireless power transmission, thus overcoming the problems with the quotidien conventional technologies. Wireless power transfer method is incorporated in transferring the solar power from the Photo-Voltaic (PV) cell to the battery used in the electric vehicle. Solar panels are considered in order to build a standalone power station, thereby minimizing its dependence on conventional energy resources. The solar panels generate electrical energy by the use of the light energy emitted by the sun. The energy obtained from the panel is fed to a battery, via a solar charge controller which maximizes the power output from the PV cell. The transmitter circuit converts the DC supply obtained from the source side battery into a high-frequency AC output, which is then transmitted with the help of transmitting coil, to the load side in the form of Electromagnetic (EM) waves. The receiver circuit, with a receiving coil placed inside the electric vehicle, then decodes the received wave and produces corresponding DC output for charging the battery used in the electric vehicle. This whole setup is made compact, thereby reducing its space occupancy and thus resulting in its easy installation and maintenance.

Keywords: Wireless power transmission, quotidien, high-frequency AC, Electromagnetic wave, coil.

I. INTRODUCTION
Wired Technology has emerged in the engineering domain as early as the 1850s by the pioneering works of Nikola Tesla. There have been several problems associated with the wired charging such as power loss during transmission owing to the impedance of the conductors. Thus a wireless mode of charging an electric vehicle is proposed. Solar energy is incorporated into the system in order to make it an independent power source, thereby making it installable almost anywhere there is abundant solar radiation.

II. TYPES OF WIRELESS POWER TRANSFER
Over the years, there has been a phenomenal increase of methods in which power is transmitted wirelessly over a range depending upon the components used.

1. NEAR NON-RADIATIVE FIELD:

A. INDUCTIVE COUPLING:
It is a short range power transmission method wherein two coils are separately wound and placed at a short distance. In short distances, this mode of power transfer is the most appropriate method owing to the minimal radiation effects. The frequency range that is used for coupling is from few kHz to MHz. In order to increase the range of transmission, Resonant Inductive coupling is used which involves Usage of LC circuits for achieving the resonance phenomenon. This increases the frequency range up to GHz.

B. CAPACITIVE COUPLING:
It uses metal plates for transmitting power and is much similar to a parallel plate capacitor. It is also a short range power transmission mode which uses the electric field for power transfer. The frequency of transmission ranges from kHz to MHz.

C. MAGNETO-DYNAMIC COUPLING:
It is a very basic form of magnetic power transfer. It involves a rotating magnet which is simply coupled magnetically to another rotating armature. It operates in the frequency range of Hz and is used only in biomedical implants.

2. FAR RADIATIVE FIELD:

A. MICROWAVE TRANSMISSION:
It is used for long distance transmission ranging from few metres to several kilometres. It is the method by which satellites transfer the solar power generated in them to the base stations. It is a radiative field and may cause harm to humans if not handled properly.

B. LASER TRANSMISSION:
The power is converted into a laser beam and is then transmitted over a very long range since LASER beam is coherent and does not scatter much thereby increasing the efficiency of power transfer.

III. HARDWARE USED:

A. SOLAR PANEL:
Solar cells convert the solar radiation into electrical energy and thereby serves as a standalone source of electrical energy. The solar panel serves as an energy input to the transmitter coil via a charge controller.

B. CHARGE CONTROLLER:
This serves as a constant current source to the battery which is placed on the source side that powers the transmitter coil. This
produces a steady current irrespective of the solar radiation incident on it. The most commonly used type is the constant current type, the other one being constant voltage type.

C. OSCILLATOR:
Wireless transmission is possible by means of an alternating flux. The output from the battery is a DC output. In order to generate a low-power high-frequency signal, an astable multivibrator is used and tuned to 85 kHz as specified by the SAE for Electric vehicle charging. The frequency of oscillation depends upon the RC values and is related to the frequency as

$$f = \frac{0.69}{RC}$$

\[ R_1 = 10k\Omega, \quad R_2 = 100k\Omega, \quad C_1 = 82 \text{ pF} \]

IV. VEHICLE CHARGING SIMULATION

The ripples are noted across the battery in its voltage waveform which is the result of the switching in the rectifier. A capacitor is connected across the output in order to reduce the ripples in the output thereby ensuring proper charging and better battery life. It should be noted that the battery discharge solely depends upon the load.

V. HARDWARE RESULTS

The hardware used is a demonstration of the wireless charging station using solar energy. The oscillator powers the transmitter coil which is inductively coupled to the receiver coil in the vehicle model. An indicator (LED) is used to demonstrate the wireless transmission coupling. The current output is enough to recharge the battery of the vehicle.
VI. CONCLUSION

The use of Wireless power transmission proves to be useful and efficient when compared to wired transmission, furthermore, as demonstrated in the model, large scale setup of a wireless power station is possible in the near future. The usage of solar power reduces the dependence of the station on the government or private players for the power input. This increases its versatility and makes it applicable for installation over all terrain which receives ample solar radiation.

VII. REFERENCES


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