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Solar Wireless Electric Vehicle Charging System

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Abstract

The major goal of a solar wireless EV charging system is to shorten EV charging times by utilizing the electromagnetic induction mechanism. This method uses a solar panel to produce power, which can then be utilized to charge an electric vehicle (EV) while it is moving. Battery, regulatory circuit, copper coils, Boost Converter, LED lights, and solar panel are also used. This model shows how charging for electric vehicles can be done while they are in motion, doing away with the need to pull over. As a result, a wireless solar-powered charging system for electric vehicles can be added to the road.

I. Introduction

We are all aware that the development of electric vehicles will be crucial to the future of automobiles in this current era of technological evolution. Fossil fuels like petrol, diesel and other such fuels are almost completely depleted due to the current trend of excessive use. And everyone now understands how crucial it is to protect these fossil resources as a result of this truth. Thus, the quest for an appropriate successor for these cars got underway. Electric vehicles are the most interesting and capable replacement we have. When purchasing an electric vehicle, the length of time needed to charge one, the few available charging station installations for the infrastructure, and the challenge of locating appropriate sites for charging electric vehicles in and around the roadways in India is the most common argument given for not doing so.

Solar wireless electric vehicle charging systems have been created to address this issue. This system uses wireless power transmission technology to wirelessly charge EVs using solar energy, offering an effective and ecological solution to the issue of EV. Here, we build a solar road made of transmitter coils and receiver coils that are integrated into the car so that an EV's battery can be charged while it is moving on the

road, cutting down on the amount of time needed to wait at charging stations while the battery is being charged, as is done with conventional EVs. Although electric vehicles represent an alternative, their charging infrastructure needs to be improved.
Dynamic charging systems should be created for this reason since they are more dependable, user-friendly, and time-effective. Additionally, the range can be increased while the battery size is decreased. The bus stations, traffic signals, and transit routes can all use this charging system.

II. Solar panels

Solar cells are another name for photovoltaic cells. They are a way to capture solar energy and transform it into power. Semiconductors absorb photons from the sun, and the photons then knock electrons along electrical lines until the current (flow of electrons) reaches a device that can be driven by electricity.
Photovoltaic cells made of crystalline silicon will convert 15% of the sun's energy into electricity, whereas newer, less expensive materials like amorphous silicon and gallium arsenide will only do so for 8% of the energy, making them just half as effective as silicon-based cells. However, photovoltaic technology is evolving quickly, and new research might result in a few years from now in better efficiency. Amorphous silicon and gallium arsenide, for example, could be used to create more affordable rigid crystalline flexible photovoltaic technologies that are just as dependable and effective as crystalline silicon.

Specifications

Open Circuit Voltage: 11.25 V
Short Circuit Current: 0.41 A
Peak Current: 0.34 A
Peak Voltage: 9 V
Maximum System Voltage: 1000 V_{DC}
Wind Resistance: 2400 P_a

Solar panel

III. Boost converter

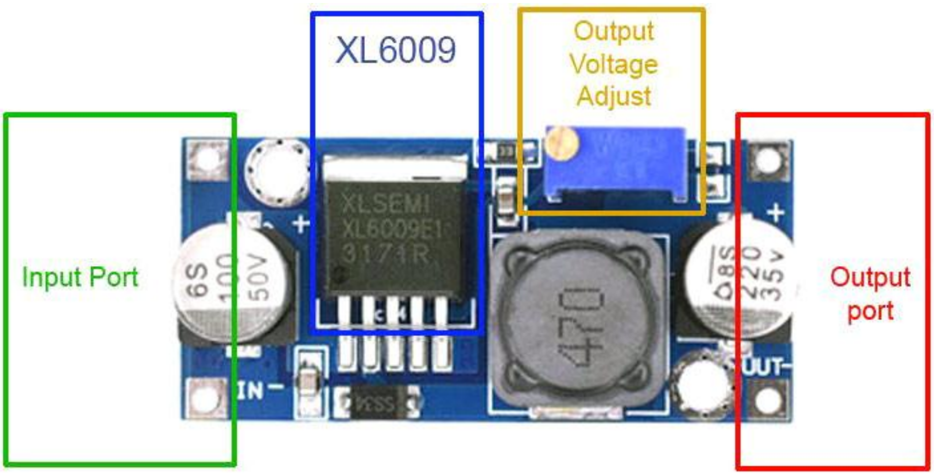
The boost converter, a type of DC-DC converter, is specifically designed to elevate or increase the applied DC input. It takes a fixed DC input and "boosts" it to generate a variable DC output voltage. The XL6009 module, which is a DC-to-DC buck-boost converter, operates at a switching frequency of 400kHz. This higher frequency allows for the use of smaller filter components compared to low frequency switching regulators. The XL6009 module is an enhanced version of the LM2577-based module.

XL6009 Technical specifications

Total voltage given as input	3V to 32V
Total Voltage received at output end	5V to 35V
Output Current	4A
Efficiency	<94%
Load Regulation	0.5%
Voltage Regulation	0.5%
Dimensions	45*20*14 mm (L*W*H)

Overview of XL6009

The DC-DC step-up module XL6009 offers a rated current of 4A, accepting input voltages ranging from 3V to 32V. By adjusting the potentiometer on the power module, you can modify the output voltage according to your requirements. Higher input voltages allow for increased load current capacities, although it is recommended to employ an additional heat sink if the output power exceeds 15W, even when utilizing a PCB-based heat sink. This module is particularly suitable for audio electronics due to its high conversion efficiency, which is less than 94%, and a load regulation of 0.5%. Additionally, the improved conversion efficiency enables the use of battery-powered applications.



Boost converter

The XL6009 module has an easy-to-use interface. By connecting the load directly to the OUT+ and OUT- pins and the regulated or unregulated input to the IN+ and IN- pins, you may adjust the output voltage using the potentiometer.

IV. Lithium-ion battery

Rechargeable lithium-ion batteries are composed of a protective circuit board and one or more lithium-ion cells. Once placed inside a device along with the protective circuit board, these batteries are referred to as cells. Within a lithium-ion battery, lithium-ions (Li+) move internally between the cathode and anode, while electrons flow in the opposite direction through the external circuit. This migration generates the electrical current that enables the battery to supply power to the device. During discharge, the battery's anode releases lithium ions to the cathode, facilitating an electron flow that drives the device. Conversely, when the battery is being charged, the cathode releases lithium ions that are then absorbed by the anode.

Lithium-ion battery

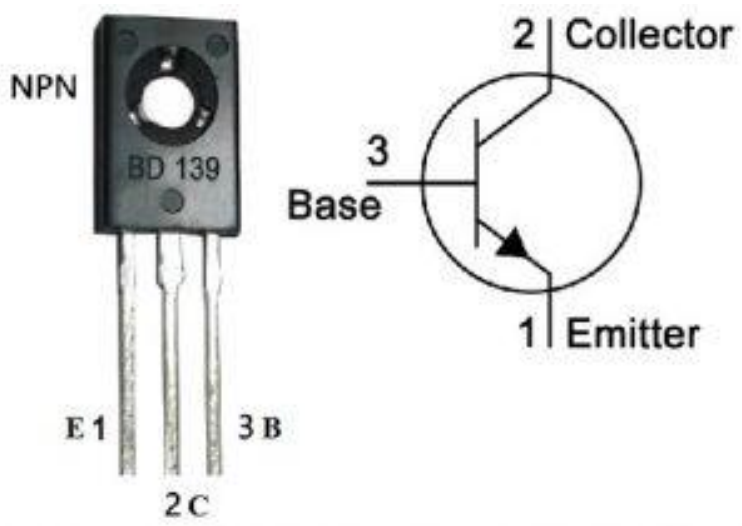
18650 Cell Features and Technical Specifications

- Nominal Voltage: 3.6V
- Nominal Capacity: 2,850mAh
- Minimum Discharge Voltage: 3V
- Maximum Discharge Current: 1C
- Charging Voltage: 4.2V
- Charging Current:0.5C
- Charging Time: 3 hours(approx.)
- Charging Method: CC and CV
- Cell Weight: 48g (approx.)
- Cell Dimensions: 18.4mm (diameter) and 65mm (height)

V. Transistor

The SOT-32 plastic box contains a bipolar NPN transistor, similar to the BD139. Because of its low cost and high collector current, this type of transistor is utilised in

many different electrical circuits. This transistor can drive loads such as motors, high-power LED relays, etc. up to 1.5 A. It may easily be used in an electrical circuit due to the exceptionally high VCE (collector-emitter) and VCB (collector-base) voltages. The 12.5W dissipation current of the collector terminal makes it ideal for usage in audio amplifier circuits. Just 0.5V is the transistor's saturation voltage.
Currently, lithium-ion technology is the most commonly employed type of rechargeable battery. It is responsible for energizing our everyday devices such as electric vehicles and cell phones.



BD139 transistor

BD139 Transistor Pin Configuration

Pin Number	Pin Name	Description
1	Emitter	Emitter, which is often connected to ground, allows current to drain out.
2	Base	controls the transistor biasing, which is used to switch the transistor to ON state as well as OFF state
3	Collector	Through a collector that is typically attached to a load, current enters.

Features

- It is mounted in a plastic case and comes in the To-225 box.
- This transistor's collector current (IC) is 1.5A.
- This transistor has an 80V collector base voltage and a 5V breakdown voltage from the emitter to the base.
- This transistor's DC gain (hfe) ranges from 40 to 160, and its breakdown voltage from emitter to base (VBE) is 5 volts.
- Collector has a dissipation factor of 12.5 W

- The junction's operating and storage temperature spans the range of -55 to +150°C.
- This transistor can be found in PB-Free packages as well.

VI. Coils

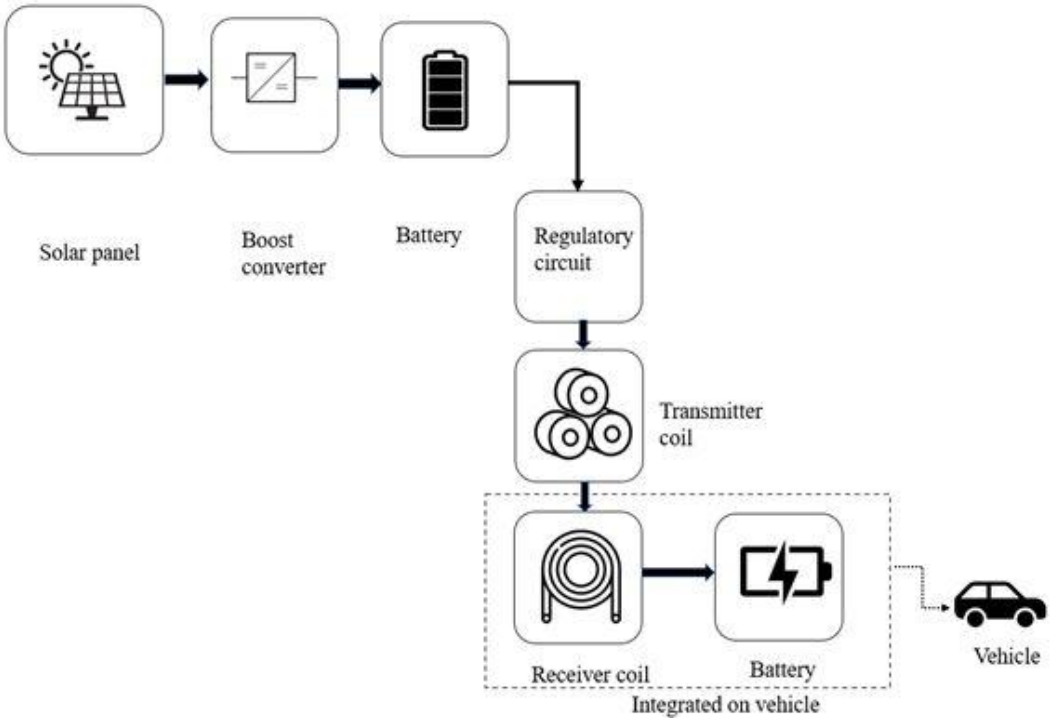
Transmission coils, also known as the High-voltage, high-frequency alternating current (AC) is generated using Tesla coils, which are electrical resonant transformer circuits. Two essential parts make up the fundamental design: a primary coil and a secondary coil. The primary coil produces high-frequency alternating current by being linked to a power source. currents. The secondary coil, with a significantly higher number of turns, is tuned to resonate at the same frequency as the primary coil.

Copper coil

When the primary coil is energized, it creates a rapidly changing magnetic field around the coils. This changing magnetic field induces a high amounts of the voltage in the secondary side of the coil through electromagnetic induction. The primary and secondary coils are designed to have a resonant frequency, which allows for efficient energy transfer between them. This resonance is achieved by using capacitors and inductors in the circuit, which store and release energy in a cyclical manner.

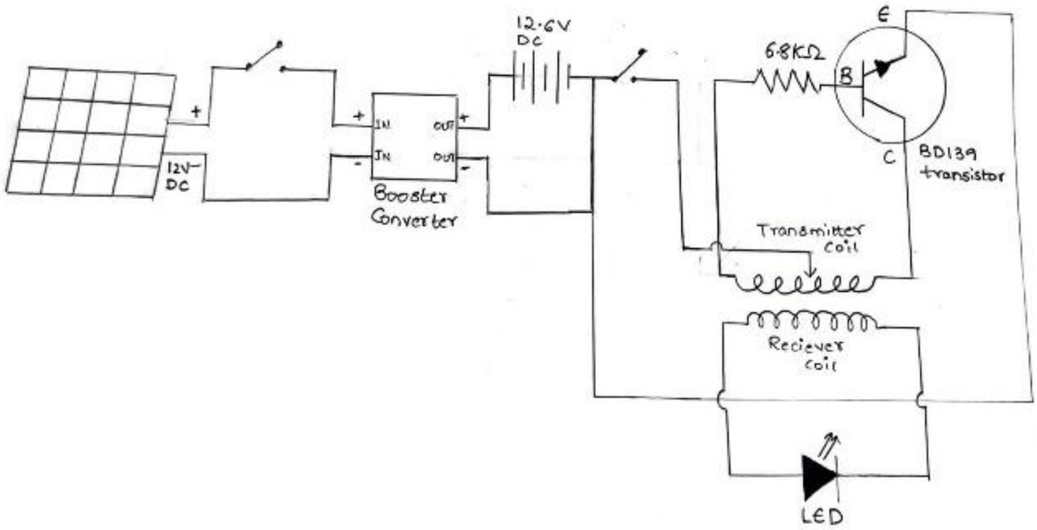
VII. Block diagram

Block diagram of Solar Wireless Electric Vehicle Charging System, consists of Solar panel, Boost converter (xl6009), Lithium-Ion batteries of 3.7V each. These batteries are connected to a regulatory circuit through a two-pole switch. Transmitter coils are connected in regulatory circuit, which are of 30 turns and receiver coil is integrated onto the vehicle. An LED is used for indication of the current generated.



Block diagram

VIII. Circuit diagram



Circuit diagram

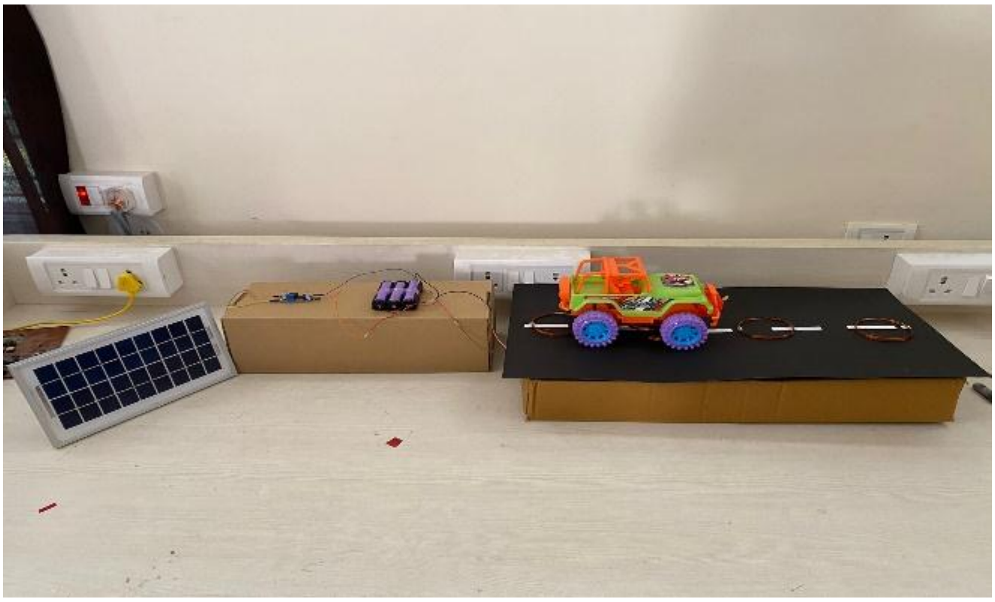
The development of the project involves the utilization of a solar panel, battery, boost converter, regulator circuits, copper coils, and LED. This innovative creation enables the charging of electric cars while they are in motion, eliminating the necessity to make stops for recharging. The solar panel, facilitated by a charge controller, supplies power to the battery, which in turn stores the received DC power for later use. For gearbox, the DC power must now be changed to AC or pulsating DC. Here, we employ a transistor to this end. A transistor is then used to convert the power into pulsing DC, and regulator circuitry is used to regulate it. Now, the copper coils are energised using this electricity. Here, we employ a transistor to this end. A transistor is then used to convert the power into pulsing DC, and regulator circuitry is used to regulate it. The copper coils that are utilised for wireless energy transfer are now energised using this power. The electric car also has a copper coil fitted underneath it. When the automobile drives over the transmitter coil, energy is transferred to the EV coil. The transmitter coil transmits energy to the EV coil when the car is driven over it. DC current is induced into this coil to provide the energy. The wireless power transmission is indicated by an LED. The technology therefore exhibits an integrated solar-powered wireless charging solution for electric automobiles.

XI. Working

Solar panels absorb the sunlight and converts the light energy in to electrical energy. This is then given as input to xl6009 boost converter, the main aim of this converter is to step-up the input voltages to required level. The output of the boost converter xl6009 can be varied by varying the potential divider of it. The output terminals of the xl6009 is connected to series of Lithium Ion batteries each of 3.7V capacity. The Overall battery capacities after connecting in series is around 12V, this battery arrangement is connected to regulatory circuit through a two-pole switch. The regulatory circuit consists of several circuit elements such as resistors and transistors connected to transmitter coils of 30 turns. The transmitter coils are integrated on the road. The receiver coil which is of 30 turns is integrated on to the vehicle. The vehicle when passes on the road where transmitter coils are located, due to the principle of electromagnetic induction, Current will be induced on the receiver side coil. This current generation is indicated using an LED.

X. Results

A solar panel, battery, boost converter, regulator circuits, copper coils, and LED are used in the development of the project. The technology will render it practicable to charge battery-powered cars while they are moving forward minimising the need to stop. The storage device is powered by the solar panel through the use of a charge controller. The battery takes in and stores DC electricity. The DC power for the gearbox must now be transformed to AC or pulsating DC. Here, we use a transistor to achieve this. The electrical current is then converted into pulsing DC by a transistor, which is subsequently regulated by regulator circuitry. This electricity is now used to excite the copper coils that are used for wireless energy transfer. The electric car additionally features a copper coil equipped underneath it. When the automobile drives over the transmitter coil, energy is transferred to the EV coil. The energy is generated by injecting DC current into this coil. An LED indicates the wireless power transmission. The design therefore demonstrates the implementation of a wireless, on-road, solar-powered charging system for electric automobiles. This model's output voltage is displayed through an LED.



Output working model

Conclusion

This concept provides a creative framework for quick charging for next electric automobiles. It is a charging element that practises solar-powered boards. Finding a different source of energy is appealing from the standpoint of public transport in order to reduce the by-product of fossil fuels. Electric vehicles offer a way to reduce fossil fuel by products without using petrol. A remote charging framework might be a very practical solution to make the charging of electric vehicles more innovative, simple to use, and hassle-free. Solar roads can eventually replace conventional ones, but this will require a substantial initial investment. With such a higher energy return and without having to replace the current infrastructure, the solar-powered roadway may very well be constructed for less money. The circle of sun-oriented street placement could function smoothly because it is expected that old streets will be maintained. Sun-oriented streets will address our nation's concerns about energy, pollution, coal contamination, waste contamination, and transportation subsidies. When implemented, this novel remote charging method for electric vehicles will significantly reduce CO2 emissions. Comparing an electric vehicle to a gas-powered vehicle, carbon dioxide emission is reduced from 60 to 30 metric tonnes of discharge, or by 50%. This will help bring about a noble shift in nature while reducing environmental change.