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Solar Wireless Charging For Electric Vehicle While Driving

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Abstract: *This paper presents a novel concept of solar wireless charging for electric vehicles (EVs) while driving. The idea is to integrate solar panels into the roads and use wireless charging technology to transfer energy from the solar panels to the EVs. . To overcome these challenges, several approaches have been proposed, including increasing battery capacity, improving charging infrastructure, and using alternative energy sources. One promising approach is to use solar energy to charge EVs while driving. Solar energy is abundant and renewable, and it can be harnessed using solar panels installed on the roads. However, traditional charging methods, such as plug-in charging, have limitations in terms of convenience and efficiency. Wireless charging technology, on the other hand, has the potential to overcome these limitations by enabling charging while driving without the need for physical connections. we propose a novel concept of solar wireless charging for EVs while driving. The proposed system integrates solar panels into the roads and uses wireless charging technology to transfer energy from the solar panels to the Evs.*

Key words: *Electric road system, wireless power transfer, transmitter and receiver coils, power lanes, e-vechile ,charging while driving, no battery drain, easy to use, get charge while running , future oriented.*

I.INTRODUCTION

Electric vehicles (EVs) have gained significant popularity in recent years due to their environmental benefits and potential to reduce the dependence on fossil fuels. However, one of the major challenges faced by EVs is the limited range and the need for frequent recharging. To overcome these challenges, several approaches have been proposed, including increasing battery capacity, improving charging infrastructure, and using alternative energy sources. One promising approach is to use solar energy to charge EVs while driving. Solar energy is abundant and renewable, and it can be harnessed using solar panels installed on the roads. However, traditional charging methods, such as plug-in charging, have limitations in terms of convenience and efficiency. Wireless charging technology, on the other hand, has the potential to overcome these limitations by enabling charging while driving without the need for physical connections.

II.MATERIAL AND METHODS

Involves two main components: solar panels and wireless charging technology. The solar panels are installed on the roads, and they generate electricity from sunlight. The wireless charging technology transfers the electricity from the solar panels to the EVs. The technical feasibility of the proposed system depends on several factors, including the efficiency of the solar panels, the power transfer efficiency of the wireless charging technology, and the compatibility of the charging system with different types of EVs. Recent advancements in solar panel technology have significantly improved their efficiency. For instance, some of the latest solar panels have an efficiency of up to 24%, which means that they can convert 24% of the sunlight they receive into electricity. This high efficiency makes solar panels a viable source of energy for charging EVs while driving. Wireless charging technology has also made significant progress in recent years. The latest wireless charging systems have a power transfer efficiency of up to 95%, which means that they can transfer up to 95% of the electricity from the solar panels to the EVs. Compatibility with different types of EVs is also an important factor to consider. The proposed system can be designed to be compatible with different types of EVs, including cars, buses, and trucks.

Hardware Components:

A. Power Supply

There are many types of power supply. Most are designed to convert Voltage AC Mains electricity to a suitable low voltage supply for electronic Circuits and other Devices. A power supply can by broken down into a series of blocks, each of which performs a particular function.

- Transformer – steps down high voltage AC mains to low voltage AC.
- Rectifier – converts AC to DC, but the DC output is varying.
- Smoothing –smoothes the DC from varying greatly to a small ripple.

- Regulator – eliminates ripple by setting DC output to a fixed voltage.

B. Wifi Module

The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability, produced by Express of Systems in Shanghai, China. The chip was popularized in the English-speaking maker community in August 2014 via the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes- style commands. However, at first, there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, the chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is a similar chip with a built-in 1 MiB flash memory, allowing the design of single-chip devices capable of connecting via Wi-Fi. These microcontroller chips have been succeeded by the ESP32 family of devices.

C. Solar Panel

A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

Types of PV Modules

Crystalline Silicon Modules

Most solar modules are currently produced from silicon photovoltaic cells. These are typically categorized as mono crystalline or polycrystalline modules.

Thin Film Modules

Third generation solar cells are advanced thin-film cells. They produce a relatively high-efficiency conversion for the low cost compared to other solar technologies.

Rigid Thin-Film Modules

In rigid thin film modules, the cell and the module are manufactured in the same production line. The cell is created on a glass substrate or superstreet, and the electrical connections are created in situ, a so-called “monolithic integration”. The substrate or superstreet is laminated with an encapsulate to a front or back sheet, usually another sheet of glass. The main cell technologies in this category are CdTe, or a-Si, or a-Si+uc-Si tandem, or CIGS (or variant). Amorphous silicon has a sunlight conversion rate of 6-12%.

Flexible Thin-Film Modules

Flexible thin film cells and modules are created on the same production line by depositing the photoactive layer and other necessary layers on a flexible substrate. If the substrate is an insulator (e.g. polyester or polyimide film) then monolithic integration can be used. If it is a conductor then another technique for electrical connection must be used. The cells are assembled into modules by laminating them to a transparent colorless fluoro polymer on the front side (typically ETFE or FEP) and a polymer suitable for bonding to the final substrate on the other side. The only commercially available (in MW quantities) flexible module uses amorphous silicon triple junction (from Unisolar). So-called inverted metamorphic (IMM) multi junction solar cells made on compound semiconductor technology are just becoming commercialized in July 2008. The University of Michigan's solar car that won the North American Solar Challenge in July 2008 used IMM thin- film flexible solar cells.

The requirements for residential and commercial are different in that the residential needs are simple and can be packaged so that as solar cell technology progresses, the other base line equipment such as the battery, inverter and voltage sensing transfer switch still need to be compacted and unitized for residential use. Commercial use, depending on the size of the service will be limited in the photovoltaic cell arena, and more complex parabolic reflectors and solar concentrators are becoming the dominant technology.

D. Smart Solar Modules

Several companies have begun embedding electronics into PV modules. This enables performing maximum power point tracking (MPPT) for each module individually, and the measurement of performance data for monitoring and fault detection at module level. Some of these solutions make use of power optimizers, a DC-to-DC converter technology developed to maximize the power harvest from solar photovoltaic systems. As of about 2010, such electronics can of a module causes the electrical output of one or more strings of cells in the module to fall to zero, but not having the output of the entire module fall to zero.

E. Mounting System Trackers

Solar trackers increase the amount of energy produced per module at a cost of mechanical complexity and need for maintenance. They sense the direction of the Sun and tilt the modules as needed for maximum exposure to the light.

F. Fixed Racks

Fixed racks hold modules stationary as the sun moves across the sky. The fixed rack sets the angle at which the module is held. Tilt angles equivalent to an installation's latitude are common. Most of these fixed racks are set on poles above ground.

G. Ground Mounted

Ground mounted solar power systems consist of solar modules held in place by racks or frames that are attached to ground based mounting supports. Ground based mounting supports include:

- Pole mounts, which are driven directly into the ground or embedded in concrete.
- Foundation mounts, such as concrete slabs or poured footings
- Ballasted footing mounts, such as concrete or steel bases that use weight to secure the solar module system in position and do not require ground penetration.

H. Roof Mounting

Roof-mounted solar power systems consist of solar modules held in place by racks or frames attached to roof-based mounting supports. Roof-based mounting supports include:

- Pole mounts, which are attached directly to the roof structure and may use additional rails for attaching the module racking or frames.
- Ballasted footing mounts, such as concrete or steel bases that use weight to secure the panel system in position and do not require through penetration. This mounting method allows for decommissioning or relocation of solar panel systems with no adverse effect on the roof structure.
- All wiring connecting adjacent solar modules to the energy harvesting equipment must be installed according to local electrical codes and should be run in a conduit appropriate for the climate condition.

I. Battery

The rechargeable backup battery provides power to Finger Tec terminals when the primary source of power is unavailable. With the right backup battery, your system won't have to be interrupted during a power failure. 12V, 1.5Ah Backup Battery Access Control System: The external Rechargeable Backup Batteries are almost always used in an access control system. The backup battery prevents intruders from disabling the access control by turning off power to the building, and continues locking the doors secured by the system. Time & Attendance System: For Time and Attendance System that records clocking-in and out data for employees, power failure might cause discrepancies in the payroll system. Thus, external rechargeable backup batteries are often used in Time & Attendance terminals as a backup power.

A battery charger is a device used to put energy into a cell or (rechargeable) battery by forcing an electric current through it. Lead-acid battery chargers typically have two tasks to accomplish. The first is to restore capacity, often as quickly as practical. The second is to maintain capacity by compensating for self-discharge. In both instances optimum operation requires accurate sensing of battery voltage. When a typical lead-acid cell is charged, lead sulphate is converted to lead on the battery's negative plate and lead dioxide on the positive plate. Over-charge reactions begin when the majority of lead sulphate has been converted, typically resulting in the generation of hydrogen and oxygen gas. At moderate charge rates, most of the hydrogen and oxygen will recombine in sealed batteries.

Battery Size

This is pretty straight forward, Lead acid batteries don't get much smaller than C-cell batteries. Coin cells don't get much larger than a quarter. There are also standard sizes, such as AA and 9V which may be desirable. Weight and power density. This is a performance issue: higher quality (and more expensive) batteries will have a higher power density. If weight is an important part of your project, you will want to go with a lighter, high-density battery. Often this is expressed in Watts-hours per Kilogram. Price Price is pretty much proportional to power-density (you pay more for higher density) and proportional to power capacity (you pay more for more capacity). The more power you want in a smaller, lighter package the more you will have to pay. Voltage The voltage of a battery cell is determined by the chemistry used inside. For example, all Alkaline cells are 1.5V, all lead-acid's are 2V, and lithiums are 3V. Batteries can be made of multiple cells, so for example, you'll rarely see a 2V lead-acid battery. Usually they are connected together inside to make a 6V, 12V or 24V battery. Likewise, most electronics use multiple alkalines to generate the voltage they need to run. Don't forget that voltage is a 'nominal' measurement, a "1.5V" AA battery actually starts out at 1.6V and then quickly drops down to 1.5 and then slowly drifts down to 1.0V at which point the battery is considered 'dead'. Re-usability Some batteries are rechargable,'usually they can be recharg'd 100's'of times.

Power Capacity and Power Capability

Power capacity is how much energy is stored in the battery. This power is often expressed in Watt-hours (the symbol WH). A Watt-hour is the voltage (V) that the battery provides multiplied by how much current (Amps) the battery can provide for some amount of time (generally in hours).

Voltage * Amps * hours = Wh.

To get WH, multiply the Ah by the nominal voltage. For example, lets say we have a 3V nominal battery with

1Amp-hour capacity, therefore it has 3 Wh of capacity. 1 Ah means that in theory we can draw 1 Amp of current for one hour, or 0.1A for 10 hours, or 0.01A (also known as 10 Ma) for 100 hours. However, the amount of current we can really draw (the power capability) from a battery is often limited. It's like saying a human has the capability to travel up to 30 miles: of course running 30 miles is a lot different than walking! Likewise, a 1Ah coin cell has no problem providing a 1Ma for 1000 hours but if you try to draw 100Ma from it, it'll last a lot less than 10 hours.

J. Bridge Rectifier

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier. Smoothing is performed by a large value electrolytic capacitor connected across the DC Supply to act as a reservoir, supplying current to the output when the varying DC Voltage from the rectifier is falling.

The diagram shows the unsmoothed DC (Dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the Peak of the varying DC, and then discharges as it supplies current to the output.

Note that smoothing significantly increases the average DC voltage to almost the peak Value (1.4-× RMS value). For example, 6V RMS AC is rectified to full wave DC of about 4.6V RMS (1.4V is lost in the bridge rectifier), with smoothing this increases to almost The peak value giving 1.4 × 4.6 = 6.4V smooth DC. Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, Giving a small ripple voltage. For many circuits a ripple which is 10% of the supply Voltage is satisfactory and the equation below gives the required value for the Smoothing capacitor. A larger capacitor will give fewer ripples. The capacitor value must be doubled when smoothing half-wave DC.

K. Regulator

Voltage regulators Ics are available with fixed (typically 5, 12 and 15V) or variable Output voltages. They are also rated by the maximum current they can pass. Negative Voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and Overheating ('thermal protection').

Many of the fixed voltage regulator Ics has 3 leads and look like power transistors, Such as the 7805 +5V 1A regulator shown on the right. They include a hole for attaching a heat sink if necessary.

The regulated DC output is very smooth with no ripple. It is suitable for all electronic circuits.

L. Multi Output Power Supply

Multi output power supply outputs are +5V, +12V and –12V. Input AC signal is applied to primary of transformer, transformer secondary is two outputs; one is 0-9V AC and another is 18-0-18V. Transformer secondary output is connected to regulator through Full bridge rectifier and filtering capacitor. Diode is used for convert the AC voltage to DC Voltage with AC ripples; capacitor is used for remove the AC ripples. Regulator output is regulating the DC output voltage

Transformer

Primary Voltage	-	230V AC
Secondary Voltage	-	0-9V AC and 18-0-18V AC

Regulator

IC – 7805 and 7812	-	Positive Voltage Regulator (+5v and +12V).
IC – 7812	-	Negative Voltage Regulator (-12V).
Diode	-	1N4007.
Capacitor	-	4700µf/16V, 4700µf/25V and 10µf/63V.

M.H-Bridge Circuit Diagram

To synthesize a multilevel waveform, the ac output of each of the different level H-bridge cells is connected in series. The synthesized voltage waveform is, therefore, the sum of the inverter outputs. The number of output phase voltage levels in a cascaded- inverter is defined by

$M=2s+1$

Where 'M' is no of levels of o/p voltage Where's'is the number of dc sources

Because zero voltage is common for all inverter outputs, the total level of output voltage waveform becomes $2s+1$. Each inverter bridge is capable of generating three different levels of voltage outputs. When the positive group switches are turned on, the voltage across that particular bridge is positive. When the negative group switches are turned on the voltage across that particular bridge is negative.

N. Driver Unit

The IR2110 is a high voltage, high speed power MOSFET driver with over-current limiting protection circuitry. Logic inputs are compatible with standard CMOS or LSTTL outputs, down to 2.5V logic. The output driver features a high pulse current buffer stage designed for minimum driver cross-conduction. The protection circuitry detects over-current in the driven power transistor and limits the gate drive voltage. Cycle by cycle shutdown is programmed by an external capacitor which directly controls the time Interval between detection of the over-current limiting conditions and latched shutdown. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high or low side configuration which operates up to 500 volts.

O. OPTO Coupler

The function of Opto Coupler is isolate to the control circuit from power circuit. Pulse width modulation signal (PWM 1 to PWM 12) comes from pic Processor. This signal is not directly fed through a power circuit. Suppose Control Circuit is connected to power circuit without isolation circuit, the control circuit may get affected. So we need to isolation circuit interface between power circuit and control circuit.

P. Digital Signal Pic30f2010 Controller

Microchip Technology's Motor Control & Power Conversion family of DSPIC Digital Signal Controllers provides an easy-to-use solution for applications requiring motor control. Microchip Technology introduced 20 16-bit Flash micro controllers that provide the industry's highest performance.

The DSPIC family of Digital Signal Controllers features a fully- implemented digital signal processor (DSP) engine, 30 MIPS non-pipelined performance, C compiler friendly design, and a familiar Microcontroller architecture and design environment. The 20 new dsPIC30F2010 devices form three product families targeting motor control and power conversion, sensor, and general-purpose applications.

The DSPIC core is a 16-bit (data) non-pipelined modified Harvard machine that combines the control advantages of a high-performance 16-bit Microcontroller with the high computation speed of a fully implemented DSP to produce a tightly coupled, single-chip single-instruction stream solution for embedded systems designs. The initial 20- dsPIC30F2010devices feature 12 Kbytes to 144 Kbytes of on-chip secure Flash program memory space and up to eight Kbytes of data space Operating voltage appeals to many Microcontroller applications that remain at 5 volts, while many DSPs are restricted to 3.3-supply V maximum. Devices are planned in 40-pin package.

Q. Motor Control PWM Module in Dspic

The DSPIC motor control PWM module is optimized for applications, such as 3-phase AC induction motors, 3-phase brushless DC motors, and switched reluctance motors. The motor control PWM module has either 6 or 8 output pins and 3 or 4 PWM generators, depending upon the device. The output pins may be configured as complementary output pairs or as independent outputs.

Critical PWM operating parameters, such as output polarity, are programmed in non-volatile memory for safety. The non-volatile options reduce the risk of placing the PWM outputs in a state that might damage the power devices connected to Peripheral

R. Dspic Micro Controller Features

High Performance Modified RISC CPU

- Modified Harvard architecture
- C compiler optimized instruction set architecture with flexible addressing modes
- 24-bit wide instructions, 16-bit wide data path
- 48 Kbytes on-chip Flash program space (16K Instruction words)
- 2 Kbytes of on-chip data RAM
- 1 Kbytes of non-volatile data EEPROM

S. Motor Control PWM Module Features

- Six PWM output channels
  - Complementary or Independent Output modes
  - And Center Aligned modes
- Three duty cycle generators
- Dedicated time base
- Programmable output polarity
- Dead-time control for Complementary mode
- Manual output control
- Trigger for A/D conversions

T. Peripharal Features

- High current sink/source I/O pins: 25 Ma/25 Ma
- Timer module with programmable presale
- Five 16-bit timers/counters; optionally pair
- 16-bit timers into 32-bit timer modules
- 16-bit Capture input functions
- 16-bit Compare/PWM output functions
- 2 UART modules with FIFO Buffers
- 1 CAN modules, 2.0B complain

U. Input Capture Module

This section describes the Input Capture module and associated operational modes. The features provided by this module are useful in applications requiring frequency (Period) and Pulse measurement.

V.USART

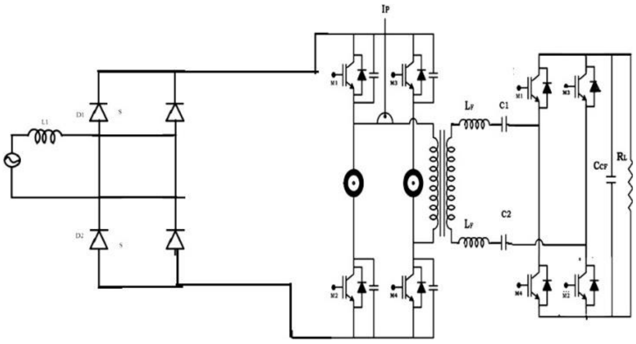
USART stands for the Universal Synchronous/Asynchronous Receiver/Transmitter. It may sound mysterious, but actually, this is the most frequent communication device used today throughout the computer world: micro controllers, (some) cell phones, barcode readers, PCs…First, let us see what all those words stand for:

- Universal means that it can be used with a wide scope of devices
- Synchronous/Asynchronous shows whether the devices that communicate with each other require an external synchronization line (the clock). This device, present in most PICs, can do it both ways. The Asynchronous mode (without the common clock) is easier to implement, although it is generally slower than the synchronous

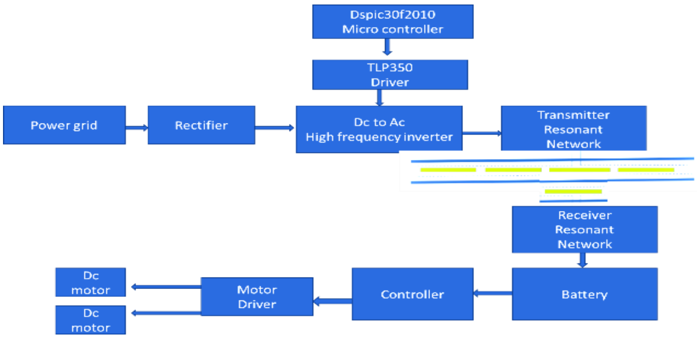
Receiver/Transmitter means that this device can receive and transmit (send) data simultaneously. It is also called the two- way or duplex communication.

III.RESULT

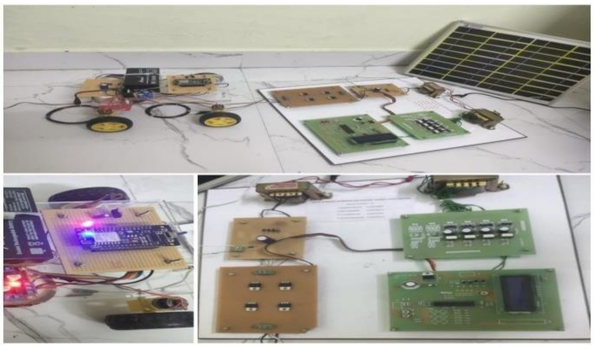
Electric Road System with wireless power transfer technology can result in significant energy saving due to reduction in battery capacity. However, for this technology to have commercial application, enhancement of the efficiency of the dynamic wireless charging system is required. This paper has not considered the reduction of the tractive power demand due to reduction of the battery size of the vehicle. The hardware results ensure the soft switching of both the switches, thus eliminating switching losses, conduction losses, electric stresses & EMI. Proper design of inductor must be taken for appropriate soft switching as the inductor plays a very vital role in the design of Boost converter. The wireless mobile charger distance is maximum of 10cm. This soft switching method not only eliminates the losses but also increase the overall efficiency of systems thus making the overall system to cost-effective & reliable to use.



Ciruit diagram



Block diagram



Output

IV.CONCLUSION

Although wireless power transfer technology is not yet commercialized, it has promising future applications. Electric Road System with wireless power transfer technology can result in significant energy saving due to reduction in battery capacity. However, for this technology to have commercial application, enhancement of the efficiency of the dynamic wireless charging system is required. This paper has not considered the reduction of the tractive power demand due to reduction of the battery size of the vehicle. Studying the mass-decompounding effect resulting from the reduction of the battery size of the vehicle , and associated impact on the feasibility of the dynamic wireless power transfer system is another 8mportantt area for further investigation. An auxiliary resonant circuit ensuring Soft switching high frequency inverter along with the synchronous rectifier has been discussed in this project. The hardware results ensure the soft switching of both the switches, thus eliminating switching losses, conduction losses, electric stresses & EMI. Proper design of inductor must be taken for appropriate soft switching as the inductor plays a very vital role in the design of Boost converter. A proper difference can be perceived in the effectiveness of Hard Switching & Soft Switching converters. This method of soft switching can be used for low power DC equipment mainly in telecom services. The wireless mobile charger distance is maximum of 10cm. This soft switching method not only eliminates the losses but also increase the overall efficiency of systems thus making the overall system to cost-effective & reliable to use.

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