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Solar Based Wireless Power Transfer on Roads for Electric Vehicles

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Abstract: The new electric roads will allow to recharge your EV while driving or even standing still and bring several benefits for both companies and the environment. Common implementations are overhead power lines above the road and ground-level power supply through conductive rails or inductive coils embedded in the road. Most of the world's electricity today comes from fossil fuels like coal, oil, and natural gas. These traditional energy sources face several challenges, including rising prices and security concerns. over dependence. We have designed solar roadways that harvest electricity using solar panels. On which the electric vehicles are running, which is being transferred from solar roadways using wireless power transmission concept. Wireless charging needs two kinds of coils named the transmitter coil and to the receiver coil. The receiver coil will gather power from the transmitter coil through mutual induction as it passes over it.

Keywords: AT Mega controller, LCD display, Transmitting and receiving coils, Transformer, Batteries, Voltage sensor, Arduino uno, Solar panel, PWM IC, TL494, L298N Motor Driver

I INTRODUCTION

Transport is crucial in contemporary life; however, the conventional combustion engine is quickly becoming outdated. Petrol and diesel vehicles, known for their high pollution levels, are swiftly being replaced by fully electric vehicles (EVs). EVs produce zero tailpipe emissions, making them much more environmentally friendly. Additionally, the operating cost of an electric vehicle is significantly lower than that of a petrol or diesel vehicle. Electric vehicles rely on electricity to charge their batteries, rather than fossil fuels like petrol or diesel, and are more efficient overall. This efficiency, combined with the lower cost of electricity, makes charging an electric vehicle cheaper than refueling with petrol or diesel.

The eco-friendliness of EVs can be further enhanced by using renewable energy sources for charging. Installing renewable energy systems at home, such as solar panels, can reduce electricity costs even more, making electric vehicles an even more sustainable option.

The integration of solar energy with electric vehicle (EV) charging is essential for significantly reducing our reliance on fossil fuels.

As electricity is generated from various sources, it is vital that electric vehicles be powered by renewable energy. With the growing popularity of electric cars, it is anticipated that in the coming years, nearly everyone with a solar energy system will also install a solar charging station.

Electric vehicles incur very low maintenance costs due to their fewer moving parts compared to internal combustion vehicles. Their servicing requirements are also less than those of conventional petrol or diesel vehicles, resulting in a significantly lower annual running cost.

Additionally, driving an electric vehicle helps reduce your carbon footprint as there are no tailpipe emissions. You can further lessen the environmental impact of charging your vehicle by opting for renewable energy sources for your home electricity.

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II. IMPLEMENTATION

A. Block diagram

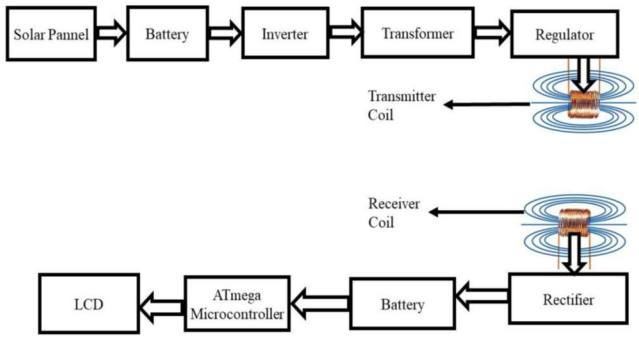

Fig 1 Block Diagram

The solar panel powers the battery via a charge controller, which charges and stores DC power. This DC power must now be converted to AC for transmission. For this purpose, we here use an inverter. The power is converted to AC using inverter and the regulated using regulator circuitry.

B. AT Mega controller

At mega 328-U IC Microcontroller At mega 328-U IC Microcontroller, The Atmel ATmega328/P is an 8-bit microcontroller utilizing low-power CMOS technology. the AVR-enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs nearing 1 MIPS per MHz, enabling system designers to optimize their designs effectively. Processing speed versus power consumption device. Feature Atmel AVR 8-Bit Microcontroller: High Performance and Low Power Family Advanced Reduced Instruction Set Computer Architecture–131 Powerful Instructions–Most Single-Cycle Clock Execution–32 x 8 General-Purpose Working Registers–Fully Static Operation–Up to a throughput of 20 MIPS at 20MHz–On-chip High-Endurance Non-Volatile Memory Segments with 2-Cycle Multiplier–32KBytes program Memory with In-System Self-Programmable Flash–1KBytes EEPROM–2KBytes Internal SRAM –Write/Erase Cycles: Navigation and Positioning.

C. LCD display

LCD, or Liquid Crystal Display, operates primarily by utilizing liquid crystals and is a type of flat panel display. LEDs, with their extensive range of applications for both consumers and businesses, are prevalent in smart phones, televisions, computer monitors, and instrument panels. LCDs marked a significant advancement over the technologies they replaced, such as light-emitting diodes (LEDs) and gas-plasma displays.

D. Transmitting and receiving coils

A typical WPT-MRC system utilizes two coils - a transmitting coil and a receiving coil - to facilitate power transfer in accordance with Faraday's law of induction. Through the incorporation of compensation capacitors, these coils are engineered to resonate harmoniously at the same frequency, thus optimizing energy transfer efficiency. When the transmitting coil is energized with alternating current (AC), it generates a magnetic field. This fluctuating magnetic field induces an AC voltage in the receiver coil, subsequently rectified to provide power to the endoscopic capsule. Typically, the transmitting coil is situated on the patient's skin, while the receiving coil is housed within the capsule. The distance between the coils is variable and depends on the instantaneous position of the endoscopic capsule during its travel through Throughout the entirety of intestines and on the anatomical conformation of the patient's body. These distances can be very different, from about 2 cm to more than 10.

E. Transformer

Transformers, devices that transfer electric energy from one alternating current circuit to one or more other circuits, can either increase (step up) or decrease (step down) the voltage. They are utilized across a wide range of applications. purposes; e.g., To operate, conventional power circuits have their voltage reduced low-voltage devices, such as doorbells Toy electric trains and the elevation of voltage from electric generators serve the purpose of enabling the transmission of electric power over extensive distances. Transformers change voltage through electromagnetic induction.

F. Batteries

The electric motors of electric vehicles or hybrid electric vehicles are primarily fuelled by a rechargeable

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battery, commonly referred to as an electric vehicle battery or a traction battery. These are crafted specifically with high electric charge (or energy) capacity lithium -ion batteries. Mainly lighter and smaller batteries the preference lies with those that decrease the vehicle's weight and also its performance. Electric vehicle batteries can be distinguished by their high power-to-weight ratio, energy density, and specific energy.

G. Voltage sensor

A voltage sensor constitutes device that measures in many applications, voltage sensors are utilized to measure the voltage of an electrical circuit applications including monitoring and controlling equipment and machinery. Different voltage sensors come in various types work in various ways; here is an example: An electromagnetic field is utilized by this type to sense voltage alterations. When exposed to an electric current, the sensor generates a magnetic field, inducing currents in nearby conductors like wires or circuit boards, sensitive to detecting these alterations. This type of sensor is often used with microcontrollers since they can easily measure changes in electromagnetic fields around them with the help of built-in analogy-to-digital converters (ADCs).

H. Arduino UNO

The Arduino UNO, which houses the ATmega328P microcontroller, boasting 14 digital input/output pins (with 6 configurable as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, USB connection, power jack, ICSP header, and reset button. It provides all necessary components for microcontroller support. To Connect it effortlessly to a computer using a USB cable or power it with an AC-to-DC adapter or battery to initiate operations. Feel free to experiment with your UNO worry-free; in the unlikely event of errors, chip replacement is inexpensive, allowing for a fresh start.

I. Solar panel

Solar panels transform solar energy into electrical energy. They make advantage of the photoelectric effect theory that is when light strikes a solar panel, electrons are emitted. Solar panels are crafted using silicon cells. With an atomic number of 14, silicon possesses two outermost electrons. Upon illumination, these electrons initiate the flow of electricity, igniting the process I initiated. Silicon boasts two distinct sales structures, catering to both single-crystalline and multi-crystalline formats. Monocrystalline solar panels are fashioned in silicon wafer form, originating from the ultimate silicon block.

J. PWM IC, TL494

The TL494 device incorporates all the functions necessary for pulse construction. A single-chip control circuit for pulse-width modulation (PWM) is designed primarily for power-supply control. This device provides the flexibility to customize power-supply control circuitry for specific applications. The TL494 incorporates two error amplifiers, an adjustable on-chip oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5-V, 5%-precision regulator, and output-control circuits. The common-mode voltage range of the error amplifiers spans from –0.3 V to VCC – 2 V. The deadtime control comparator includes a fixed offset, offering approximately 5% dead time. The on-chip oscillator can either be bypassed by terminating RT to the reference output and providing a sawtooth input to CT or can drive the common circuits synchronously multiple- rail power supplies.

K. L298N Motor Driver

The L298N stands out as a straightforward and efficient chipset solution for DC motor control. Operating as a two-channel motor driver, it grants command over both speed and direction of DC motors. This high-power motor driver module serves as a versatile component for driving both DC and stepper motors. Comprising the L298N motor driver IC, a 78M05 5V voltage regulator, resistors, capacitor, power LED, and a 5V jumper, this integrated circuit embodies comprehensive motor control capabilities. When the jumper is placed, it enables the 78M05 Voltage regulator. When the power supply is less than or equal to 12V, the voltage regulator will power on the internal circuitry. When the power supply is more than 12v, then the jumper should not place and should give a separate 5v to power the internal circuitry. Here, ENA & ENB pins are speed control pins for Motor A, and Motor B. Direction control pins for Motor A are IN1 & IN2, and for Motor B, they are IN3 & IN4.

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L. Flowchart

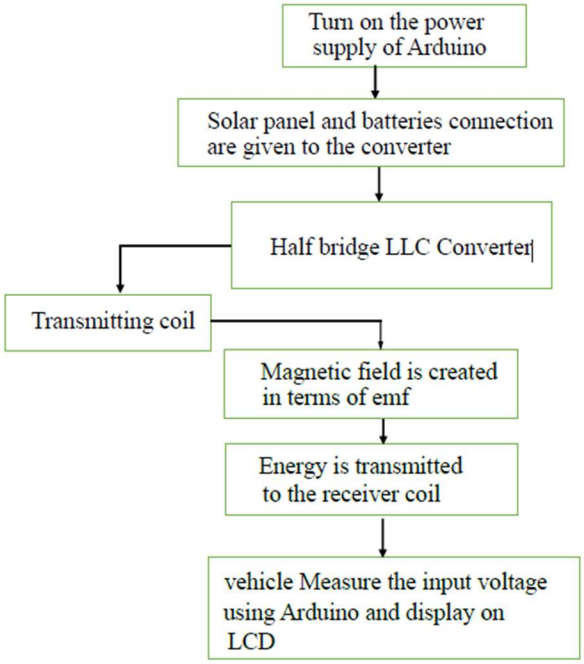

Fig 2: Flowchart

The solar-based wireless power transfer system on roads for EV vehicles is implemented using a solar panel and battery as power input. We have constructed a half-bridge LLC circuit by utilizing 2 MOSFETs and 2 AC capacitors. To activate the half-bridge LLC circuits, Clock pulses, generated by an Arduino UNO, are supplied and further connected to a buffer IC integrated with driver circuits.

III. SIMULATED RESULTS

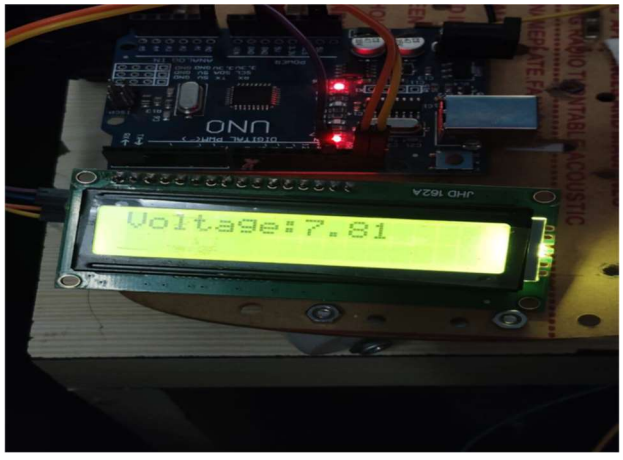

Fig 3: LCD Display of the vehicle

IV. CONCLUSION

In this project we study and demonstrated about the development of a wireless electric vehicle charging system using solar panel. This simple and more practical method reduces fuel consumption. They are eco-friendly, affordable, and simple to install and maintain. A lead-acid battery stores the electricity generated from the sun. This saved power is used to refuel Electric vehicle system. In today's deteriorating environment, electric cars (EVs) have become indispensable. The government is planning to completely phase out diesel cars by the year 2030. Because waiting for an electric vehicle to charge is the biggest drawback to EV adoption, rapid charging technology and charging stations are essential to the widespread acceptance of EVs. A reliable charging network will be essential for the success of the shift. The broad adoption of EVs has the potential to significantly disrupt the reliability of the power grid. At the heart of the "solar-based wireless EV charging" initiative is a renewable energy system.

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