International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

Wireless Electric Vehicle Chargers Using Solar Energy

Mr.K.Trinadh Babu[1] , Mr.Nodagala Madhu[2] , Ms.Bammidi Navya[3] , Ms.Mallarapu Tejaswini[4] , Mr.Peethala Venkata Jaswanth Sai Yadav[5] , Mr.Podium Varsha[6]

[1]Mr.K.Trinadh Babu , M.E(Ph.D) , Assisstant Professor , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences[ANITS]

[2]Mr.Nodagala Madhu , Student , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences [ANITS]

[3]Ms.Bammidi Navya , Student , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences [ANITS]

[4]Ms.Mallarapu Tejaswini , Student , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences [ANITS]

[5]Mr.Peethala Venkata Jaswanth Sai Yadav , Student , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences [ANITS]

[6]Mr.Podium Varsha , Student , Department Of Electrical and Electronics Engineering , Anil Neerukonda Institute Of Technologies And Sciences [ANITS]

Abstract:- This study presents a novel wireless electric vehicle (EV) charger powered by solar energy, integrating wireless charging technology with renewable sources. Core components include solar panels, a wireless charging transmitter, and an EV-installed receiver. Solar panels harness sunlight, managed by a power system, and wirelessly transfer power to the EV via a transmitter-receiver setup. Safety features like overcharge protection ensure user safety, with real-time monitoring optimizing efficiency. The system reduces reliance on grid electricity, minimizing carbon emissions. Future research focuses on scalability, cost-effectiveness, and optimization for widespread adoption.

Key Words:- Aurdino, Relay, Solar Panel, Boost Converter, Wireless Power Transmission, I2C Display, Ultra Sonic Sensor

1.INTRODUCTION:-

1.1.Objective:-

The primary objective of this project is to design and implement a wireless electric vehicle (EV) charging system powered by solar energy. The project aims to integrate wireless charging technology with renewable energy sources to provide a sustainable and convenient solution for EV owners. Key objectives include developing the necessary infrastructure, such as solar panels, power management systems, and wireless charging transmitters, to enable efficient and reliable charging of EVs.

Furthermore, the project focuses on harnessing solar energy to reduce reliance on non-renewable sources and minimize carbon emissions associated with EV charging. Implementing wireless charging technology eliminates the need for physical connections during charging, enhancing convenience for EV owners. Safety features, such as overcharge protection and insulation, are incorporated to ensure safe operation, while real-time monitoring and control capabilities optimize charging efficiency and system performance.

By promoting sustainability and contributing to renewable energy adoption in transportation infrastructure, the project aims to provide an environmentally friendly and scalable solution for EV charging needs.

1.2.Description:-

This project aims to develop a wireless EV charging system powered by solar energy, integrating solar panels, power management systems, and wireless transmitters. Its objectives include reducing reliance on non-renewable energy sources, enhancing convenience through wireless charging, and ensuring safety with features like overcharge protection. Real-time monitoring will optimize charging efficiency, maximizing solar energy utilization. Ultimately, the project aims to promote sustainability in transportation infrastructure by offering an eco-friendly solution for EV charging, contributing to a cleaner and greener future.

1.3.Focus Of The Project:-

The central focus of this project is the development of a wireless electric vehicle (EV) charging system that operates on solar energy. This endeavor encompasses the integration of solar panels to harness sunlight and convert it into electricity, which serves as the primary power source for charging EVs. At the core of the project is the implementation of wireless charging technology, eliminating the need for physical connections and enhancing the overall convenience and accessibility of EV charging. Significant attention is directed towards infrastructure development, including the installation of solar panels, the design of power management systems, and the deployment of wireless charging transmitters.

Beyond mere technological innovation, the project prioritizes sustainability and environmental impact reduction, leveraging renewable energy sources to diminish reliance on non-renewable alternatives and mitigate carbon emissions associated with transportation. Safety and efficiency are paramount concerns, with stringent measures in place to ensure the secure operation of the charging system while optimizing energy utilization and charging performance. Ultimately, the project aims to catalyze the broader adoption of renewable energy in transportation infrastructure, thus contributing to a more sustainable and environmentally friendly future.

2.AURDINO:-

Engineers, designers, artists, amateurs, and anybody else who tinkers with technology now have access to low-cost, easy-to-use technologies to build their creative, interactive creations, etc. Now it is possible to create an entirely new category of computer-managed projects. Built on modular, user-friendly hardware and software, Arduino is an open-source platform for electronic prototyping. Everyone who has an interest in creating interactive products or environments, such as artists, designers, hobbyists, etc., should read it. It consists of a development environment for writing software for the board and is an open-source physical computing platform built on a microcontroller board.

An Arduino, to put it simply, is a little microcontroller board with a USB connector for connecting to your computer and a number of connection ports for connecting to other devices, such motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Both a 9V battery and a USB port on a computer can be used to power them. They can be connected to a computer, programmed, or controlled, and then set up to operate independently. Since the entire project is open source, anyone can create and market Arduino- compatible goods. In order for the Arduino project to be financially successful, branding is essential.

3.COMPONENTS:-

3.1.Relay:-

Relay driver ICs are essential when using a low-voltage circuit to control a high-voltage device, like turning on and off a 220V light bulb. Integrated circuits like Op-Amp cannot provide the required current to drive the relay coil. Relays are preferred over solid-state switches due to their high current capacity, endurance, and ability to isolate the drive circuit.

To drive a relay using a transistor, a small amount of power is sufficient. When the base lead of the transistor receives enough current, it amplifies and allows current to flow from the emitter to the collector, turning on the relay. The transistor's emitter-to-collector channel remains open even without input current, and it closes when enough current or voltage is applied to the base lead, allowing current to pass through the relay's coil.

Relays act as electromagnetic components, enabling low-power circuits to control high-current switching devices through an armature moved by an electromagnet. This provides a safe and efficient method to control high-voltage devices using low-voltage circuits.

3.2. 0.9-5V to 5V USB Boost Converter:-

A 0.9V to 5V to 5V USB boost converter is a device designed to take input voltage ranging from 0.9V to 5V and boost it up to a stable 5V output suitable for charging USB-powered devices. This converter is particularly useful in scenarios where the input voltage is lower than the standard USB voltage of 5V, such as in low-power applications or when using energy harvesting sources like solar panels or thermoelectric generators. The converter employs boost converter topology, which steps up the input voltage to a desired level using inductors, capacitors, and switching components. It typically includes a control circuit to regulate the output voltage and ensure stable operation across various input voltage ranges and load conditions.

Key features of a 0.9V to 5V to 5V USB boost converter may include:

- **Wide input voltage range:** Capable of accepting input voltages from 0.9V to 5V, making it versatile for various applications and energy sources.
- **USB output**: Provides a stable 5V output, compatible with USB-powered devices like smartphones, tablets, and other gadgets.
- **Efficiency:**Designed to maximize efficiency in converting input voltage to output voltage, minimizing power loss and maximizing battery life or energy utilization.
- **Protection features**:Incorporates safeguards such as overcurrent protection, overvoltage protection,

and thermal shutdown to protect both the converter and the connected devices.

- **Compact size and lightweight design**: Ideal for portable and space-constrained applications, suitable for integration into small electronic devices or wearable technology.

Overall, a 0.9V to 5V to 5V USB boost converter enables efficient and reliable charging of USB-powered devices from low-voltage sources, extending the usability of energy harvesting systems and enhancing the versatility of low-power electronics.

3.3.UltraSonic Sensor:-

An ultrasonic sensor is a device commonly employed in a multitude of applications across various industries, harnessing sound waves with frequencies beyond the range of human hearing to detect the presence of objects or measure distances. These sensors typically operate by emitting ultrasonic waves from a transmitter, which propagate through the air until they encounter an object. Upon encountering an object, these waves are reflected back towards the sensor, where they are detected by a receiver. By measuring the time it takes for the waves to travel to the object and return, the sensor can accurately calculate the distance to the object using the speed of sound in air.

Ultrasonic sensors come in different configurations, including single transducer sensors, dual transducer sensors, and multi-element array sensors, each tailored to specific applications. Common uses of ultrasonic sensors include distance measurement in robotics and industrial automation, object detection in smart devices and security systems, as well as level sensing and flow measurement in industrial settings. Overall, ultrasonic sensors provide a versatile and reliable solution for a wide range of distance measurement and object detection tasks, contributing to increased efficiency and automation in numerous industries.

3.4.Solar Panel:-

Photovoltaic solar panels are composed of solar cells organized in patterns of 32, 36, 48, 60, 72, or 96 cells. The voltage produced by the cells depends on their configuration. For instance, a 32-cell panel may output 14.72 volts (0.46 volts per cell). The power generated by a solar panel is determined by the equation P (power) = V (voltage) x I (current). Solar panels come in various sizes for commercial and residential installations.

Solar panels absorb energy from the sun's rays, and the energy is transferred to the semiconductor, creating an electric field that generates voltage and current. The voltage remains relatively constant, but the current can vary based on the amount of light. To increase solar power capacity, multiple solar panels can be connected in series, raising the system's voltage. Series connections are used when a grid-connected inverter or charge controller requires 24 volts or more. To wire panels in series, connect the positive terminal of one panel to the negative terminal of the next panel. In conclusion, using solar energy for homes is a sustainable and efficient way to harness the sun's power and increase our reliance on renewable energy sources.

3.5.Transmission and Receiver Coils:-

Transmission and receiver coils are key components of inductive charging systems, such as wireless electric vehicle (EV) chargers. These coils work together to transfer electrical energy wirelessly from a charging station to the receiving device, typically located in the EV. The transmission coil, also known as the primary coil, is part of the charging station or pad. It generates an alternating magnetic field when an alternating current (AC) is passed through it. This magnetic field extends into the surrounding space, creating a zone where energy can be transferred wirelessly to the receiver coil.

The receiver coil, also known as the secondary coil, is located in the device being charged, in this case, the EV. When the receiver coil comes within the magnetic field generated by the transmission coil, it induces an alternating current in the coil through electromagnetic induction. This current is then used to charge the battery of the EV.The design and placement of these coils are crucial for efficient energy transfer. They must be carefully aligned to ensure maximum coupling between the transmission and receiver coils, minimizing energy losses and optimizing charging efficiency. Additionally, the coils are often shielded to protect against electromagnetic interference and to enhance safety during charging.

Overall, transmission and receiver coils play a vital role in inductive charging systems, enabling the wireless transfer of electrical energy and facilitating convenient and efficient charging of devices like electric vehicles.

3.6. 2N2222 Transistors and Resistors:-

Wireless power transmission typically involves the use of resonant circuits and coils to transfer electrical energy wirelessly. The 2N2222 transistor is a common NPN bipolar junction transistor (BJT) that can be used in electronic circuits for amplification or switching purposes. NPN1 is configured as an oscillator. The oscillator generates a high-frequency alternating current (AC) at the resonant frequency of the transmitter coil (L1).NPN2 is used in the receiver circuit. It amplifies the weak signal induced inthe receiver coil and drives the next stage.

3.7. I2C Display:-

An I2C display, such as an I2C LCD or OLED display, uses the I2C communication protocol to interface with microcontrollers. It consists of a screen, a controller chip, and an I2C interface, requiring only two wires for communication. This simplicity makes it suitable for projects with limited pins on the microcontroller. Commands sent via the I2C bus control functions like clearing the screen, setting cursor position, and displaying text or graphics. I2C displays come in various sizes and types, offering flexibility for different projects. Overall, they provide an easy way to add visual output to microcontroller-based systems.

3.6. Battery:-

A battery is an electrochemical device that stores chemical energy and converts it into electrical energy when needed. It typically consists of one or more cells, each containing two electrodes (an anode and a cathode) separated by an electrolyte. When connected to an external circuit, a chemical reaction occurs within the battery, causing electrons to flow from the anode to the cathode, generating electricity.

Batteries are available in various types, including alkaline, lithium-ion, lead-acid, nickel-metal hydride, and lithium polymer, each with unique characteristics suited for specific applications. Alkaline batteries, for example, are commonly used in household devices, while lithium-ion batteries power portable electronics like smartphones and laptops. Rechargeable batteries, such as lithium-ion and nickel-metal hydride, can be recharged multiple times, offering cost-effective and environmentally friendly energy solutions.

Batteries are essential for powering a wide range of devices, from small consumer electronics to electric vehicles and renewable energy storage systems, driving innovation in many industries as research continues to improve battery performance, safety, and sustainability.

4.WIRELESS POWER TRANSMISSION:-

Wireless power transmission (WPT) stands as a cutting-edge technology revolutionizing the way electrical energy is transferred from a source to a load, eliminating the need for traditional physical connectors. It operates on the fundamental principles of electromagnetic induction or resonance coupling, allowing energy transfer over varying distances without direct contact. Inductive coupling, for instance, involves the close alignment of two coils – a transmitter and a receiver. When an alternating current (AC) passes through the transmitter coil, it generates a magnetic field. This field induces an alternating current in the receiver coil, enabling energy transfer. Resonant inductive coupling enhances this process by incorporating resonant circuits in both coils, increasing efficiency and allowing for greater distances between the transmitter and receiver.

Microwave and laser power transmission represent more advanced forms of WPT, often employed for longer distances. Microwave transmission converts electrical energy into microwaves, which are then wirelessly transmitted to a receiver, where they are converted back into electrical energy. Laser transmission utilizes focused laser beams to transmit power over extended distances, making it suitable for applications such as space exploration or powering remote sensors. The applications of WPT are vast and diverse, ranging from consumer electronics, medical devices, electric vehicles, to space exploration. Wireless charging pads for smartphones and electric toothbrushes are everyday examples, showcasing the convenience and safety that WPT offers. Moreover, electric vehicles benefit from WPT technology, enabling seamless charging without the need for plug-in connectors.

Despite its promising advantages, WPT faces challenges such as efficiency optimization, overcoming distance limitations, and mitigating electromagnetic interference. Continuous research and development endeavors focus on addressing these challenges, aiming to improve efficiency and extend the range of WPT systems. With ongoing advancements, the future holds the promise of increased mobility, reduced reliance on physical cables, and widespread adoption of wireless power transmission across various industries.

5. AUTOMATIC VEHICLE DETECTION USING ULTRASONIC SENSOR:-

In this project, the integration of automatic vehicle detection using ultrasonic sensors enhances the functionality and convenience of the wireless EV charger. Strategically placed at entry and exit points, the sensors accurately detect the presence of vehicles, ensuring efficient charging operations. Through the careful integration of ultrasonic sensors with the charging station's control system, a sophisticated detection algorithm is developed to process sensor data and initiate charging when a vehicle enters the designated area. This algorithm sets thresholds based on distance measurements, effectively distinguishing between vehicles and other objects to prevent false positives.

Moreover, the system is designed to provide real-time feedback to users, indicating charging status and spot availability through intuitive user interfaces. Rigorous testing and optimization validate the reliability and performance of the vehicle detection system under various conditions, ensuring safety and efficiency in real-world scenarios. Overall, the incorporation of ultrasonic sensors enhances the user experience, streamlining the charging process and facilitating seamless interaction between EV owners and the charging infrastructure.

6.SYSTEM ANALYSIS AND DESIGN:-

System analysis and design (SAD) is a critical phase in the development lifecycle of any complex system, including projects such as the wireless EV charger with automatic vehicle detection. This process involves a thorough examination and understanding of the system's requirements, functionalities, and constraints before proceeding to its design and implementation. Initially, stakeholders' requirements are gathered and analyzed using various techniques like interviews and surveys, with priorities established to determine essential system features. A feasibility study follows, assessing technical, economic, and operational aspects to ensure the viability of the proposed system.

Subsequently, system architecture is defined, outlining its structure, components, and interactions, while data and process analysis help identify data entities, relationships, workflows, and algorithms. User interface design is crucial, ensuring intuitive interaction and usability. System modeling and simulation aid in validating the design before integration and testing, where subsystems are combined and evaluated for functionality, reliability, and performance. Documentation of the system design, along with maintenance procedures, is essential for supporting deployment and ongoing operations. Through systematic analysis and design, developers can create systems that meet stakeholder needs, perform effectively, and facilitate successful implementation.

7.ARCHITECTURE OF PROJECT:-

The architecture of the wireless EV charger project with automatic vehicle detection integrates physical components like solar panels, ultrasonic sensors, and wireless charging coils. These components are controlled by a central microcontroller, managing vehicle detection and charging initiation. Software includes algorithms for vehicle detection and charging control, with a user interface providing real-time feedback. Interfaces connect physical and software components, while safety measures prevent overcurrent and unauthorized access. Overall, this architecture enables efficient and user-friendly charging services with solar energy integration and autonomous vehicle detection.

7.1.Input Design Of The Proposed System:-

The input design of the wireless EV charger project with automatic vehicle detection emphasizes intuitive interfaces for user interaction and system control. This includes a touchscreen display, LED indicators, and physical buttons or keypad. Ultrasonic sensors detect vehicles, with algorithms triggering charging initiation upon detection.

A robust interface facilitates communication between user interfaces, sensors, and the control system. Safety features like an emergency stop button ensure swift halting of charging operations. User inputs are validated, with confirmation prompts for critical actions. Accessibility considerations, such as user-friendly design and multilingual support, are incorporated. Through thoughtful input design, the project aims to deliver an efficient, user-friendly charging experience for electric vehicle owners.

7.2.Output Design Of The Proposed System:-

The output design of the wireless EV charger project with automatic vehicle detection aims to offer clear feedback to users and convey essential system status information efficiently. LED indicators and digital display panels communicate charging status, while the touchscreen display provides interactive guidance and detailed charging data. Auditory feedback may supplement visual cues for enhanced user experience.

Vehicle detection status is conveyed through LED indicators and display messages, ensuring users know if charging will begin. System status indicators and error messages alert users to malfunctions or faults, guiding necessary actions. Safety feedback includes confirmation messages for emergency stop actions and alerts for hazardous situations. Through streamlined output design, the project optimizes user experience, ensuring reliable charging for electric vehicle owners.

8.FUTURE SCOPE:-

- Enhance solar panel efficiency and integrate smart grid capabilities.
- Explore advanced sensor technologies and implement optimized charging schedules.
- Research higher efficiency and longer-range wireless charging.
- Enable vehicle-to-grid (V2G) capabilities and integrate with smart grid infrastructure.
- Develop features for remote fleet monitoring and standardize communication protocols.
- Design mobile applications for remote control and implement AR/VR interfaces.
- Integrate carbon footprint tracking and collaborate for EV adoption programs.

9.CONCLUCION:-

In conclusion, the wireless electric vehicle (EV) charger project with automatic vehicle detection holds significant potential for revolutionizing the EV charging landscape. By combining innovative technologies such as solar energy harvesting, wireless charging, and advanced vehicle detection, the project addresses key challenges in EV infrastructure while paving the way for sustainable transportation solutions.

The integration of user-friendly interfaces, smart grid capabilities, and fleet management features ensures an efficient and seamless charging experience for both individual EV owners and commercial fleet operators. Looking ahead, the project's future scope encompasses further enhancements in efficiency, integration with smart grid systems, and user experience innovations. By continuing to innovate and collaborate with stakeholders, the project stands poised to play a pivotal role in accelerating the adoption of electric mobility and promoting environmental sustainability on a global scale.

10.REFERENCES:-

[1] K.N Mude, "Battery charging method for vehicle," in IEEE Access, vol. 10, pp. 62879-62892, Dec 2018.

[2] S. Singh, P. Chauhan and N. J. Singh, "Feasibility of Grid-connected Solar-wind Hybrid System with Electric Vehicle Charging Station," in Journal of Modern Power Systems and Clean Energy, vol. 9, no. 2, pp. 295-306, July 2020, doi: 10.35833/MPCE.2019.000081.

[3] A. Mahesh, B. Chokkalingam and L. Mihet-Popa, "Inductive Wireless Power Transfer Charging for Electric Vehicles–A Review," in IEEE Access, vol. 9, pp. 137667-137713, 29 sep 2021, doi: 10.1109/ACCESS.2021.3116678.

[4] Philip OLUFEMI babalola, EMMANUEL opemipo Atib.Solar power car –a review in IOP Conference Series Materials Science and Engineering.1107:1-11 DOI:10.1088/1757-899x/1107/1/012058 on June 2021.

[5] Hamadi, A., Arefifar, S., and Alam, M., "EV Battery Charger Impacts on Power Distribution Transformers Due to Harmonics," SAE Technical Paper 2022-01-0750, on Jan 2022.

[6] Bugatha Ram Vara Prasad, T. Deepthi, N. Satyavathi, V. Satish Varma, R. Hema Kumar, A Comprehensive Review on Photovoltaic Charging Station for Electric Vehicles, World Academics Journal of Engineering Sciences, Vol.8, Issue.2, pp.45-49, 2022