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WIRELESS ELECTRIC VEHICLE CHARGING SYSTEM

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Abstract:

The rapid adoption of electric vehicles (EVs) worldwide has created a pressing need for efficient and user-friendly charging methods. Conventional plug-based charging systems, while effective, come with in hornet challenges such as cable wear and tear, user inconvenience, and safety concerns. To overcome these limitations, wireless power transfer (WPT) has emerged as a viable solution. WPT uses electromagnetic induction to transfer energy from a transmitter coil to a receiver coil without requiring any direct physical connection. This project employs the H-Bridge topology for driving the transmitter coil and uses the IRFZ44N MOSFETs for switching operations.

Keywords — Electric vehicle, IRFZ44N MOSFET, WPT

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INTRODUCTION:

Electric vehicles have now hit the road worldwide and are slowly growing in numbers. Apart from environmental benefits electric vehicles have also proven helpful in reducing cost of travel by replacing fuel by electricity which is way cheaper. However electric vehicles have 2 major disadvantages: Long charging time – 1-3 hours required for charging Non availability of power for charging stations in off city and remote areas. Well here we develop an EV charging system that solves both these problems with a unique innovative solution. This EV charging system delivers following benefits: Wireless charging of vehicles

without any wires No need to stop for charging, vehicle charges while moving Solar power for keeping the charging system going No external power supply needed Coils integrated in road to avoid wear and tear The system makes use of a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, ATMEGA controller and LCD display and also MOSFET, bridge rectifier, TFT display to develop the system. The system demonstrates how electric vehicles can be charged while moving on road, eliminating the need to stop for charging. The solar panel can also be used to

power the battery through a charge controller or bridge rectifier. The battery is charged and stores dc power. The DC power now needs to be converted to AC for transmission the ac from the adopter is sent to MOSFET and received by transmitter coil and also it can be done like. The power is converted to AC using transformer and the regulated using regulator circuitry. This power is now used to power the copper coils that are used for wireless energy transmission. A copper coil is also mounted underneath the electric vehicle. When the vehicle is driven over the coils energy is transmitted from the transmitter coil to receiver coil. Please note the energy is still DC current that is induced into this coil. Now we convert this to DC again so that it can be used to charge the EV battery. We use AC to DC conversion circuitry or bridge rectifier to convert it back to DC current. Now we also measure the input voltage using an ATMEGA microcontroller. Thus the system demonstrates a solar powered wireless charging system for electric vehicle.

II.DESIGN AND CONSTRUCTION:

Design Considerations:

1. Coil Design: The design of the transmitter and receiver coils is critical to the efficiency and effectiveness of the wireless charging system. 2. Power Electronics: The power electronics system must be designed to handle the high power requirements of electric vehicle charging. 3. Safety Features: The system must include safety features to prevent electrical shock, overheating, and other hazards.

4. Efficiency: The system must be designed to maximize efficiency and minimize energy losses.

Construction:

1. Transmitter Coil Construction: The transmitter coil is typically constructed using a copper wire or other conductive material.

2. Receiver Coil Construction: The receiver coil is typically constructed using a copper wire or other conductive material.

3. Power Electronics Construction: The power electronics system is typically constructed using a combination of electronic components, such as MOSFETs, diodes, and capacitors.

4. Control System Construction: The control system is typically constructed using a microcontroller or other electronic control device.

III.WORKING PRINCIPLE:

Wireless charging allows an electric vehicle (EV) to be charged by parking it over a wireless charging pad containing an electrical coil that generates an alternating electromagnetic field when an electric current flows through it. The EV is equipped with a secondary coil, typically mounted underneath the vehicle.

The AC supply from the mosfet which acts as switching device. The ac power is received in transmitter coil. Now the coil generates magnetic field.

Now, the receiver coil receiver the ac power the power is transferred wirelessly by electromagnetic induction. The bridge rectifier converts the ac power into dc power and connected to Arduino pins. From the switch the battery is connected.

The battery now stores the dc power. The tuft display connected to Arduino pins which shows the wave forms.

Fig 2.1

IV. COMPONENTS:

· **ARDUNIO UNO:** The ATMEGA controller is a microcontroller that serves as the brain of a wireless power transfer (WPT) system. It plays a crucial role in ensuring the efficient and reliable operation of the system by monitoring, controlling, and optimizing various parameters. Its advanced processing capabilities and versatile features make it an indispensable component in modern WPT systems.

Fig 4.1

· **TRANSMITTER COIL:** The transmitter coil is a core component of the wireless power transfer system. Using the regulated AC power, it generates an oscillating magnetic field. This magnetic field acts as a medium for transferring energy wirelessly. The design and efficiency of the transmitter coil directly influence the effectiveness of the energy transfer process. he magnetic field around the transmitter coil is generated by the electric current passing through the coil, following Ampere's law. When an electric current flows through a conductor, it generates a magnetic field around the conductor according to Ampere's law. In the case of the transmitter coil in electronics, an electric current passes through the coil, creating a magnetic field around it. This magnetic field is essential for the operation of the transmitter as it interacts with other components to transmit signals wirelessly.

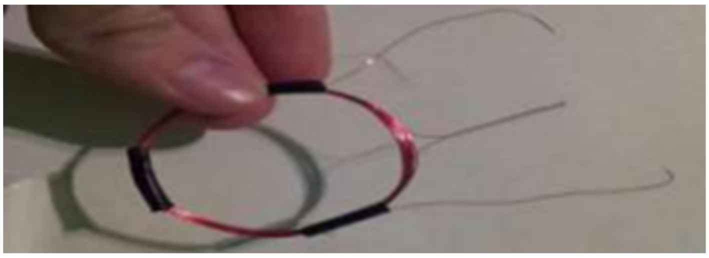

Fig 4.2

· **RECEIVER COIL:** The receiver coil is installed under the electric vehicle (EV). Its primary function is to capture the magnetic field generated by the transmitter coil and induce an electric current. This induced current is the first step in converting the transmitted energy back into a usable form for the EV. The positioning and alignment of the receiver coil with the transmitter coil are crucial for maximizing energy transfer efficiency.

Fig 4.3

· **THIN FLIM TRANSISTOR TFT DISPLAY:** A thin-film-transistor liquid-crystal display (TFT LCD) is a type of liquid-crystal display that uses thin-film-transistor technology to improve image qualities such as addressability and contrast. A TFT LCD is an active matrix LCD, in contrast to passive matrix LCDs or simple, direct-driven (i.e. with segments directly connected to electronics outside the LCD) LCDs with a few segments.

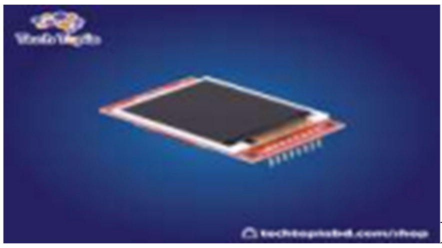

Fig 4.4

· **BRIDGE RECTIFIER:** Rectifier is an electronic component that converts alternating current (AC) into direct current (DC), ensuring a unidirectional flow of electric charge. As we know, electricity reaches our homes from power grids in the form of AC, but most commonly used electric appliances, such as mobile phones, computers, televisions, fridges, etc operate on direct current (DC). Therefore, the rectifier becomes a very useful component in electronics.

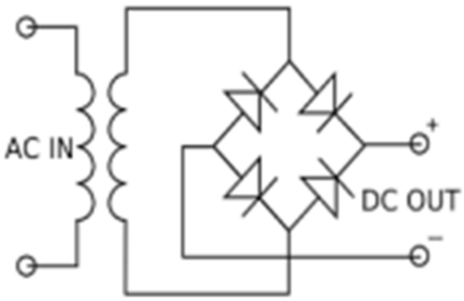

Fig 4.5

V. DEVELOPMENT :

Electric vehicle (EV) charging systems are rapidly evolving to meet the growing demand for efficient and fast charging solutions. Here are some key developments:

1. Fast Charging Techniques

- Inductive Charging: Wireless charging that uses electromagnetic fields to transfer energy between a transmitter and receiver, eliminating the need for physical cables. Ultra-Fast Charging: High-power charging that can charge batteries to 80% in under 30 minutes.

DC Fast Charging: Direct current charging that enables faster charging speeds and higher power transfer capabilities. Tesla Superchargers: Proprietary fast charging stations developed by Tesla for their electric vehicles.

Bidirectional Charging: Allows power to flow in both directions, enabling vehicle-to-grid (V2G) integration and energy optimization.

2. Advanced Infrastructure:

DC Fast Charging Stations: High-power charging stations that can charge multiple vehicles simultaneously.

Smart Charging Systems: Intelligent charging algorithms that optimize energy efficiency and grid stability.

Energy Storage Systems: Integration of energy storage systems to aid grid integration and reduce costs. 3. Charging Standards and Protocols

SAE J1772: Standard for electric vehicle charging connectors and charging stations.

IEC 61851: International standard for electric vehicle charging systems.

CHAdeMO: Fast charging standard developed by Japanese automakers.

4. Challenges and Future Directions

Standardization: Need for universal standards and interoperability among charging systems.Infrastructure Development: Expansion of charging infrastructure to support widespread EV adoption.Battery Technology Advancements: Research on improving battery efficiency, range, and lifespan. Energy Optimization: Development of smart charging systems and energy storage solutions to optimize energy efficiency and reduce costs.

VI. CONCLUSIONS :

The proposed wireless power transfer (WPT) system using the H-Bridge concept presents a forward-thinking and practical solution for the growing needs of electric vehicle (EV) charging. This innovative system eliminates the need for traditional physical connectors like charging cables, offering a more convenient, safer, and reliable method for powering electric vehicles. By utilizing H Bridge circuitry, the system ensures efficient power conversion, optimizing the flow of electrical energy from the source to the vehicle's battery, while minimizing losses during the transfer process.

One of the key advantages of this wireless approach is the enhanced user **c**onvenience. Traditional EV charging requires users to manually connect the vehicle to a charging station, often dealing with cumbersome cables and connectors. With the wireless system, EV owners can charge their vehicles simply by parking over a designated charging pad or station, removing the need for physical interaction with the system. This feature is especially beneficial in scenarios where users may have limited mobility or when weather conditions make handling cables inconvenient.

In addition to convenience, safety is a significant consideration in the design of the system. The wireless nature of the charging process eliminates the risks associated with exposed connectors, such as electrical shock or damage from water ingress. The H-Bridge circuit ensures that power is efficiently and safely delivered to the vehicle, with built-in protection mechanisms to prevent overvoltage, overcurrent, and other potential hazards.

Moreover, the system's reliability is a critical factor. The H-Bridge concept allows for stable and continuous power delivery, ensuring that the charging process is not interrupted due to minor fluctuations in power. The integration of feedback mechanisms, such as real-time data monitoring via an LCD display, enhances the system's reliability by providing users with up to date information on the charging status and identifying any issues that may arise.

As demand for electric vehicles continues to rise and the push for sustainable energy solutions grows, this wireless power transfer system is well-positioned to play a major role in the future of EV charging. The system not only supports the transition to cleaner energy by making EV charging more accessible and efficient, but it also aligns with broader goals of reducing our dependence on fossil fuels and minimizing environmental impact.

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