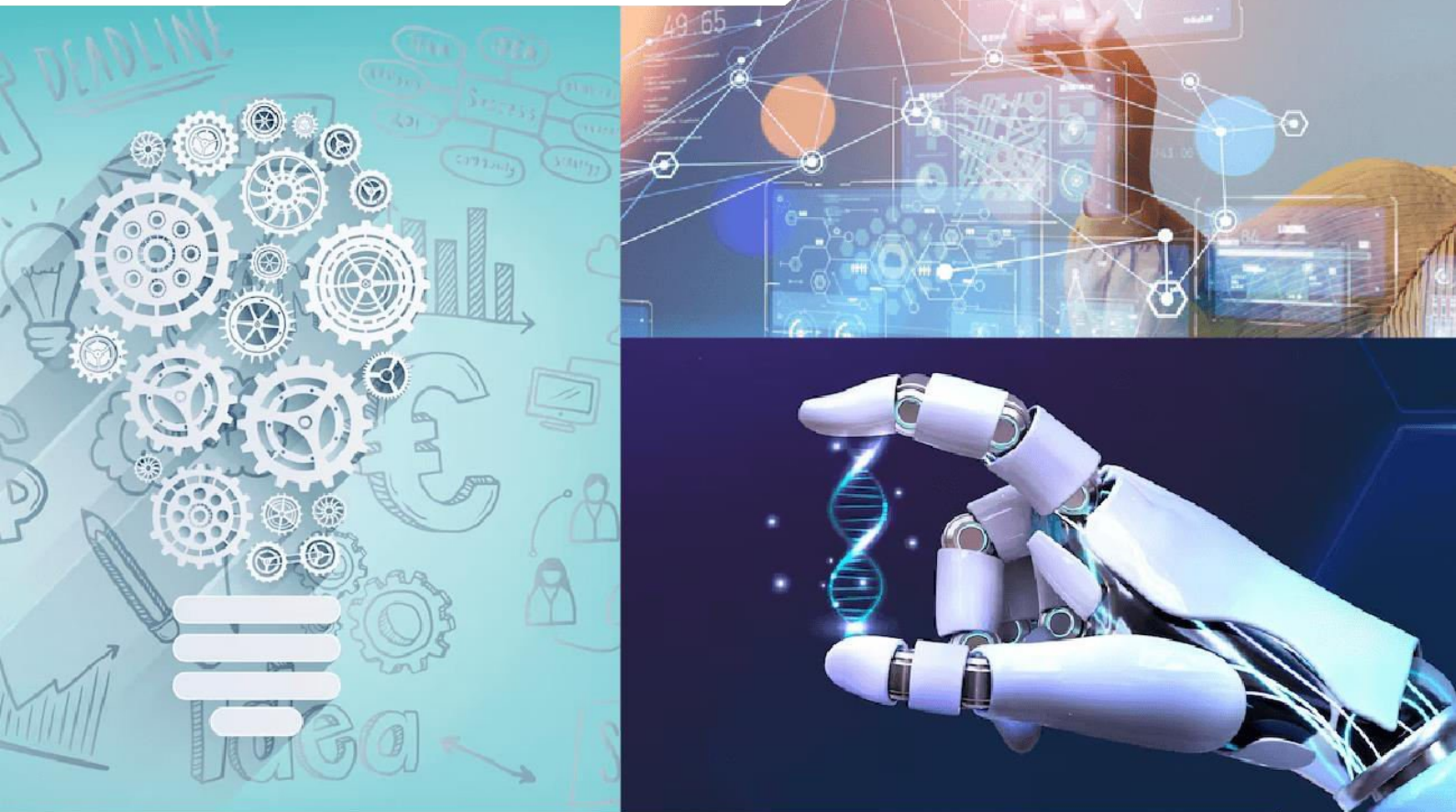




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IOT Solar Based Wireless Power Transfer on Roads for Electric Vehicle

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ABSTRACT: This project presents an IoT-based solar-powered wireless power transfer system for electric vehicles on roads. Solar panels are used to generate renewable energy, which is stored and transmitted wirelessly through embedded coils in the roadway. Electric vehicles receive power dynamically while moving, reducing the need for frequent charging stops. The IoT module monitors energy generation, transfer efficiency, and system performance in real time. This approach promotes sustainable transportation, improves energy efficiency, and supports the development of smart and eco-friendly infrastructure.

KEYWORDS: IoT, Solar Energy, Wireless Power Transfer, Electric Vehicles (EV), Dynamic Charging, Renewable Energy, Smart Roads, Inductive Charging, Energy Efficiency, Sustainable Transportation

I. INTRODUCTION

The rapid growth of electric vehicles (EVs) has created a strong demand for efficient and reliable charging infrastructure. However, conventional charging methods require frequent stops, long charging times, and large battery capacities, which limit the convenience and widespread adoption of EVs. To overcome these challenges, innovative solutions such as wireless power transfer and renewable energy integration are being explored.

This project focuses on developing an IoT-based solar-powered wireless power transfer system for electric vehicles on roads. The system uses solar panels to generate clean and sustainable energy, which is stored and supplied to inductive coils embedded beneath the road surface. These coils transfer power wirelessly to EVs while they are in motion, enabling dynamic charging without physical connections.

The integration of IoT technology allows real-time monitoring and control of energy generation, storage, and transmission. It helps in improving system efficiency, detecting faults, and optimizing power usage. This approach not only reduces dependency on conventional energy sources but also minimizes charging downtime and enhances the driving range of electric vehicles.

Overall, this project aims to contribute to the development of smart transportation systems by combining renewable energy, wireless charging, and IoT, promoting a cleaner, more efficient, and sustainable future.

II. PROPOSED SYSTEM

The proposed system is an IoT-based solar-powered wireless power transfer solution designed to charge electric vehicles (EVs) dynamically while they are in motion. In this system, solar panels are installed along or near the roadway to capture sunlight and convert it into electrical energy. This generated energy is stored in batteries and managed using a charge controller to ensure a stable power supply.

The stored energy is then supplied to transmitter coils embedded beneath the road surface. These coils create an electromagnetic field that enables wireless power transfer through inductive coupling. When an electric vehicle equipped with a receiver coil moves over the road, it receives power wirelessly and charges its battery without any physical connection.

An IoT module is integrated into the system to monitor parameters such as solar energy generation, battery status, power transfer efficiency, and overall system performance in real time. The collected data is sent to a cloud platform for remote monitoring and control. This helps in detecting faults, improving efficiency, and optimizing energy usage.

The proposed system reduces dependency on conventional charging stations, minimizes charging time, and enables continuous vehicle operation. By using renewable solar energy and smart monitoring, it supports an eco-friendly and sustainable transportation system.

III. METHODOLOGY

Solar panels installed along the roadside capture sunlight and convert it into electrical energy. This energy is regulated using a charge controller and stored in batteries to ensure a stable and continuous power supply. The stored energy is then delivered to transmitter coils embedded beneath the road surface, which generate an electromagnetic field for wireless power transfer through inductive coupling.

Electric vehicles equipped with receiver coils can receive this energy while moving over the road, enabling dynamic charging without any physical connection. An IoT module continuously monitors parameters such as energy generation, battery level, and power transfer efficiency. The collected data is sent to a cloud platform for real-time monitoring and analysis, helping to improve system performance, detect faults, and optimize energy usage for efficient and sustainable operation.

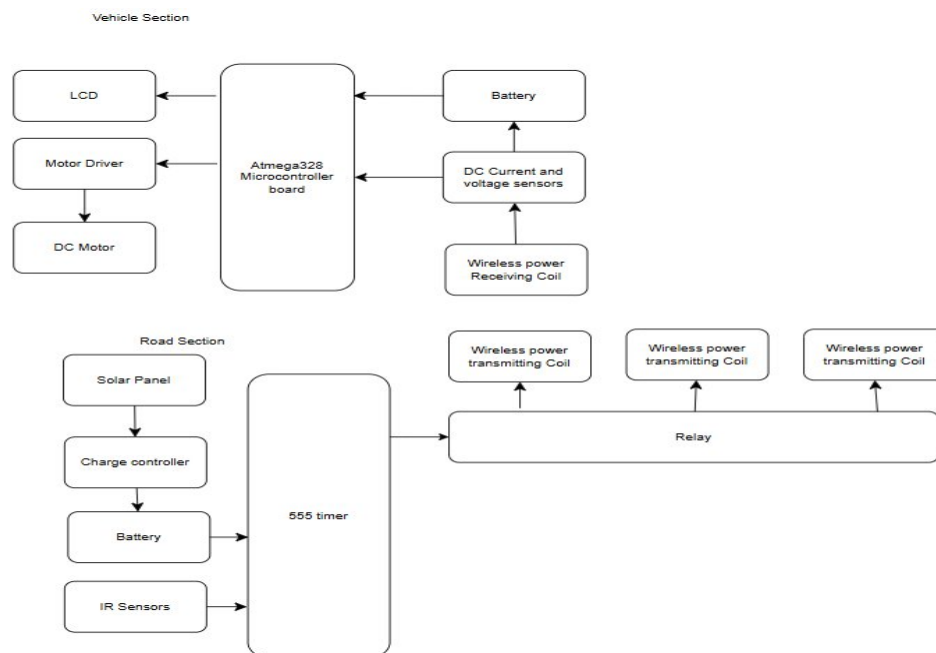


Fig 1: Block Diagram

IV. PROBLEM STATEMENT

Electric vehicles (EVs) are gaining popularity as a sustainable alternative to conventional fuel-powered vehicles, but they still face major challenges such as limited battery capacity, long charging times, and insufficient charging infrastructure. Current charging methods require vehicles to stop at fixed stations, causing inconvenience, increased waiting time, and reduced efficiency in long-distance travel. Additionally, dependency on grid electricity for charging increases energy demand and may not always be environmentally friendly.

To address these issues, there is a need for an innovative solution that enables continuous, efficient, and eco-friendly charging of electric vehicles while in motion. Integrating solar energy with wireless power transfer technology on roadways can help reduce dependency on stationary charging stations, minimize range anxiety, and promote the use of renewable energy sources. However, designing such a system involves challenges related to energy efficiency, infrastructure cost, and real-time power management, which need to be effectively addressed.

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V. HARDWARE AND SOFTWARE

The system requires both hardware and software components to function effectively. The hardware includes a solar panel to generate electricity, a battery to store energy, and a charge controller to ensure safe power management. Wireless power transfer is achieved using transmitter and receiver coils, while a microcontroller like Arduino controls the overall operation. An IoT module such as ESP8266 or ESP32 is used for monitoring and communication.

On the software side, Arduino IDE is used to write and upload the code using Embedded C. An IoT platform like Thing Speak or Blynk helps in monitoring the system data in real time, and a mobile or web application is used to view and track the performance of the system.

Hardware Requirements:

- Solar panel for power generation
- Battery for energy storage
- Charge controller for safety
- Transmitter and receiver coils for wireless charging
- Microcontroller (Arduino) to control the system
- IoT module (ESP8266/ESP32) for monitoring

Software Requirements:

- Arduino IDE for programming
- Embedded C for coding
- IoT platform (like Thing Speak or Blynk) for data monitoring
- Mobile or web application to view system status

VI. DESCRIPTION

An advanced system is designed to enable wireless charging of electric vehicles using solar energy and IoT technology. Solar panels installed along the roadside capture sunlight and convert it into electrical energy, which is stored in rechargeable batteries. A charge controller regulates the power and protects the battery from overcharging or damage. The stored energy is supplied to transmitter coils embedded beneath the road surface, creating an electromagnetic field for wireless power transfer.

When an electric vehicle equipped with a receiver coil passes over or stops on the charging section, power is transferred through electromagnetic induction without any physical connection. A microcontroller, such as Arduino, controls the overall operation, including power flow and switching. An IoT module like ESP8266 or ESP32 monitors system performance in real time, tracking voltage, current, and energy usage, and sends the data to a cloud platform for analysis.

This approach reduces the need for traditional charging stations and minimizes charging time, making electric vehicles more efficient and user-friendly. It also promotes the use of renewable energy, reduces environmental pollution, and decreases dependency on fossil fuels, while ensuring better energy management and system efficiency.

VII. RESULT AND DISCUSSION

The proposed solar-powered wireless charging road system for electric vehicles (EVs) was successfully implemented and tested to evaluate its performance in terms of energy generation, wireless power transfer, automation, and system efficiency. The integration of solar energy, IR sensor-based activation, and wireless charging demonstrated a practical and sustainable solution for dynamic EV charging.

1. Solar Energy Generation and Storage

The solar panel effectively converted sunlight into electrical energy, which was regulated using a charge controller and stored in the 8.4V battery. The system was able to maintain a stable power supply for the transmitting coils under normal sunlight conditions. The charge controller prevented overcharging and ensured efficient battery management.

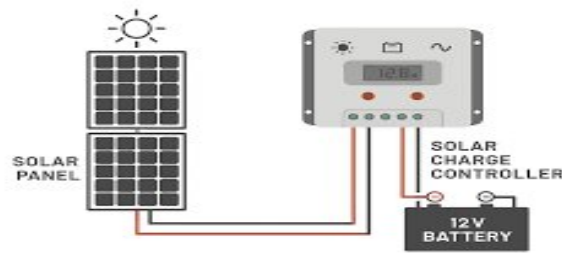


Fig 2: Solar Panel with Charge Controller setup

2. Charging Zone Detection using IR Sensors

IR sensors are used to detect the presence of a vehicle in the charging zone. When a vehicle enters or stops in this area, the sensors identify it and send a signal to the system. Based on this detection, wireless power transfer is automatically activated, ensuring that energy is supplied only when required and improving overall efficiency.

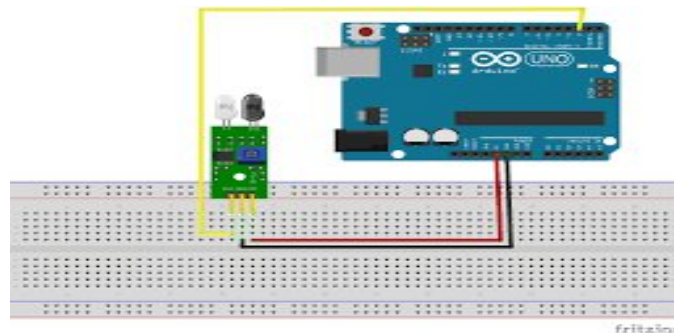


Fig 3: IR Sensor Detection at Entry and Exit Points

3. 555 Timer Bistable Control Performance

A 555 Timer configured in bistable mode is used to control the switching operation of the system. It has two stable states (ON and OFF), which are triggered by input signals such as those from sensors. When a signal is received, the timer changes its state and controls the activation or deactivation of the wireless power transfer.

This improves system performance by providing stable and reliable switching, reducing unnecessary power usage. It also ensures quick response and better control over the charging process, making the system more efficient and effective.

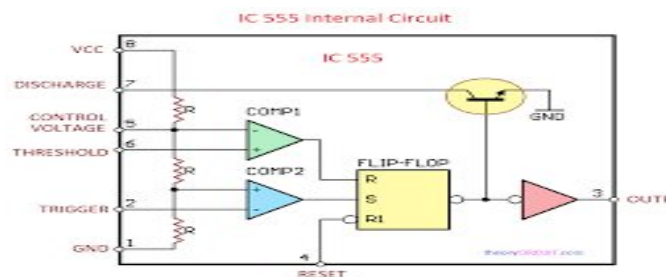


Fig 4: 555 Timer Bistable Circuit with Relay Control

4. Wireless Power Transmission Efficiency

Wireless power transmission efficiency refers to how effectively electrical energy is transferred from the transmitter coil to the receiver coil. It depends on factors like coil alignment, distance between coils, and operating frequency. Improving these factors helps reduce energy loss and ensures better performance of the charging system.



Fig 5: Wireless Power Transmission between Coils

5. Receiver Side Performance and Monitoring

On the vehicle side, the charge controller effectively regulated the received energy and stored it in the battery. The Arduino microcontroller successfully read battery voltage using the voltage sensor and displayed real-time information on the LCD.

The system accurately indicated different states such as:

- Charging
- Battery level increasing
- Fully charged (when applicable)

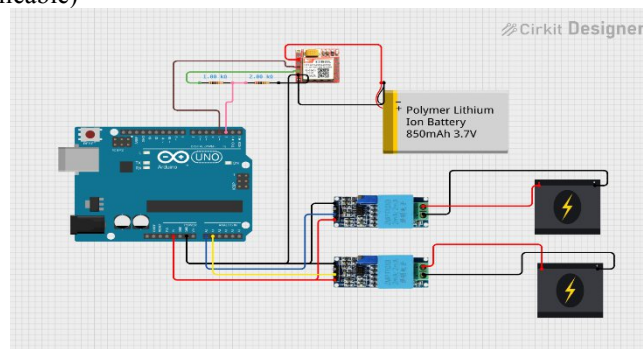


Fig 6: Receiver Circuit with Arduino and Voltage Monitoring



Fig 7: LCD Display Showing Charging Status and Battery Voltage

6. Vehicle Operation Using Stored Energy

The stored energy in the battery was successfully used to power the BO motors, enabling the vehicle to move. This demonstrated the practical applicability of the system, showing that the received wireless energy can be effectively utilized for vehicle operation

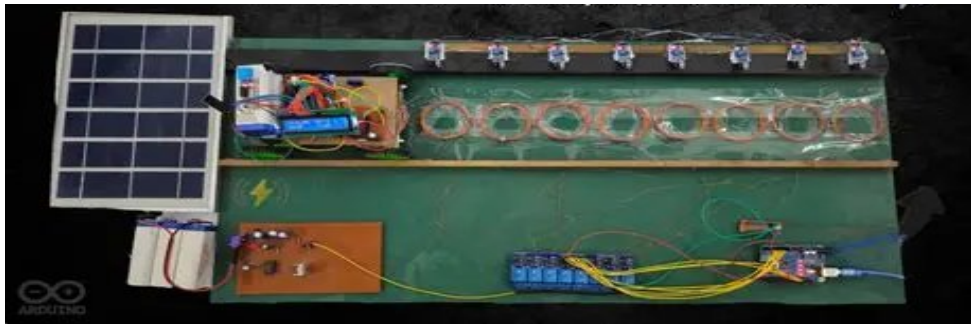


Fig 8: EV Model Powered by Stored Energy

7. Energy Efficiency and Automation

The system showed improved energy efficiency due to:

- Solar energy utilization (renewable source)
- Automatic activation of coils only when required
- Immediate deactivation after vehicle exit

This reduced power wastage and improved overall system performance. The combination of IR sensors and bistable control ensured seamless automation without manual intervention.

VIII. CONCLUSION

The system provides an innovative solution for charging electric vehicles using solar energy and wireless power transfer technology. By enabling charging without physical connections, it reduces dependency on traditional charging stations and minimizes charging time. With the integration of IoT for monitoring and efficient power management, the system ensures better performance and energy utilization. Overall, it promotes the use of clean energy, improves convenience for users, and supports the future development of sustainable transportation.

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