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Wireless Renewable Energy Powered Public Transport System

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Abstract: *The paper presents a Wireless Renewable Energy Powered Public Transport System designed to operate without the use of fossil fuels or grid electricity. The proposed system utilizes solar energy as the primary power source, which is converted into electrical energy and stored in a rechargeable battery. Wireless Power Transfer (WPT) technology is employed to transfer energy from a transmitting coil installed at the tram station to a receiving coil mounted beneath the tram, enabling efficient charging without physical electrical connections. A microcontroller-based control unit manages the overall operation of the system, including movement control, station detection, automatic door operation, and safety functions. Magnetic sensors are used to detect reference stations and stop the tram automatically for passenger boarding and wireless charging. A seven-segment display provides a countdown timer for door operation, while a buzzer alert is activated before the door closes. In addition, IR sensors are used to detect obstacles on the track to ensure passenger safety. The developed prototype demonstrates an efficient, intelligent, and eco-friendly transportation solution suitable for future smart city mobility systems powered by renewable energy*

Keywords: Wireless Power Transfer, Solar Energy, Public Transport System, Microcontroller, Smart Transportation, Renewable Energy

I. INTRODUCTION

Transportation systems are one of the major contributors to global energy consumption and environmental pollution due to their heavy dependence on fossil fuels and conventional electricity sources [1]. The increasing demand for sustainable mobility has encouraged the development of renewable energy based transportation systems that can reduce carbon emissions and environmental impact [1]. Among various renewable sources, solar energy is considered one of the most abundant and clean energy resources capable of powering electric transportation systems through photovoltaic energy conversion and battery storage [1], [4]. Wireless power transfer (WPT) technology has emerged as an effective method for charging electric vehicles without the need for physical connectors, thereby improving safety, reliability, and user convenience [2]. Inductive and resonant coupling based wireless charging systems have demonstrated high efficiency and are increasingly being explored for electric mobility applications and public transport infrastructure [2], [3]. In addition, modern transportation systems widely utilize microcontroller-based embedded control systems to process sensor data, control motors, and implement safety mechanisms such as obstacle detection and automatic stopping [5].

In this context, the proposed **Wireless Renewable Energy Powered Public Transport System** presents a prototype model of a driverless tram that operates between two stations using solar energy as the primary power source. The system incorporates wireless power transfer for automatic battery charging at stations while sensor-based control mechanisms ensure safe and autonomous operation. The integration of renewable energy generation, wireless charging, and intelligent control technologies makes the system a promising solution for sustainable smart city transportation systems [4]–[6].

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II. LITERATURE SURVEY

Recent research has focused on integrating renewable energy technologies with electric transportation systems to improve energy efficiency and environmental sustainability. Solar-powered transportation systems utilize photovoltaic panels to generate electrical energy that can be stored in batteries and later used to operate electric vehicles, thereby reducing dependency on fossil fuels and conventional power grids [1], [4].

Wireless power transfer technology has been widely investigated for electric vehicle charging applications due to its capability to deliver energy without physical electrical connections [2]. High-efficiency wireless charging systems based on resonant inductive coupling have been developed to improve power transfer efficiency and operational reliability in electric mobility systems [2], [3]. Furthermore, advanced wireless charging topologies have been proposed to support both stationary and dynamic charging of electric vehicles, making them suitable for modern public transportation infrastructure [3]. Embedded control systems using microcontrollers are commonly employed in automated transportation systems to manage sensor inputs, motor control, and safety functions [5]. These intelligent systems enable autonomous vehicle operation by integrating sensing technologies such as obstacle detection sensors and positioning sensors for accurate vehicle control [5]. Additionally, recent studies have explored the integration of renewable energy generation and wireless charging infrastructure to develop sustainable electric public transport networks for future smart cities [4], [6]. Although significant research has been conducted on renewable energy powered vehicles and wireless charging systems individually, limited work has focused on combining solar energy generation, wireless power transfer, and automated control in a unified transportation system. Therefore, the proposed system integrates these technologies to demonstrate an eco-friendly, energy-efficient, and automated public transport prototype suitable for smart city environments [4]–[6].

III. PROPOSED SYSTEM

The proposed system consists of a solar powered driverless tram prototype that operates between two stations using wireless charging technology. Solar panels generate electrical energy which is stored in a battery. This stored energy powers the wireless charging transmitter located at the station.

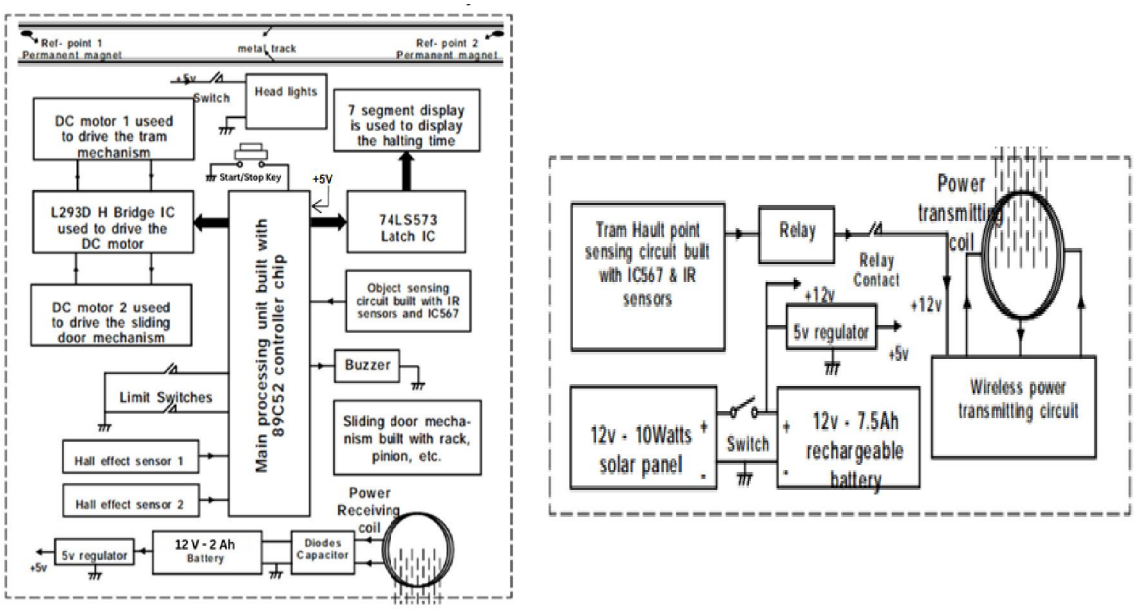

Fig. 1: Block of Diagram Wireless Renewable Energy Powered Public Transport System

When the tram reaches the station, the wireless charging system transfers energy to the onboard battery through electromagnetic induction. Hall Effect sensors are used to detect reference points and determine when the tram reaches

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a station. Infrared sensors are used to detect obstacles on the track and stop the tram automatically if any obstruction is detected. The entire system is controlled by an AT89C51 microcontroller, which processes sensor inputs and controls the motor driver and other system components.

IV. RESULTS AND DISCUSSION

The prototype system successfully demonstrates the operation of a wireless renewable energy powered public transport system. The solar panel effectively charges the battery which powers the wireless charging transmitter. Wireless power transfer was successfully achieved when the tram stopped at the designated station position. The voltage readings confirmed that energy transfer occurred between the transmitter and receiver coils. The obstacle detection system successfully stopped the tram when an object was placed on the track. The automatic door system and countdown display also operated correctly. The results confirm that renewable energy powered wireless transportation systems can be implemented for smart city transportation with improved energy efficiency and automation.

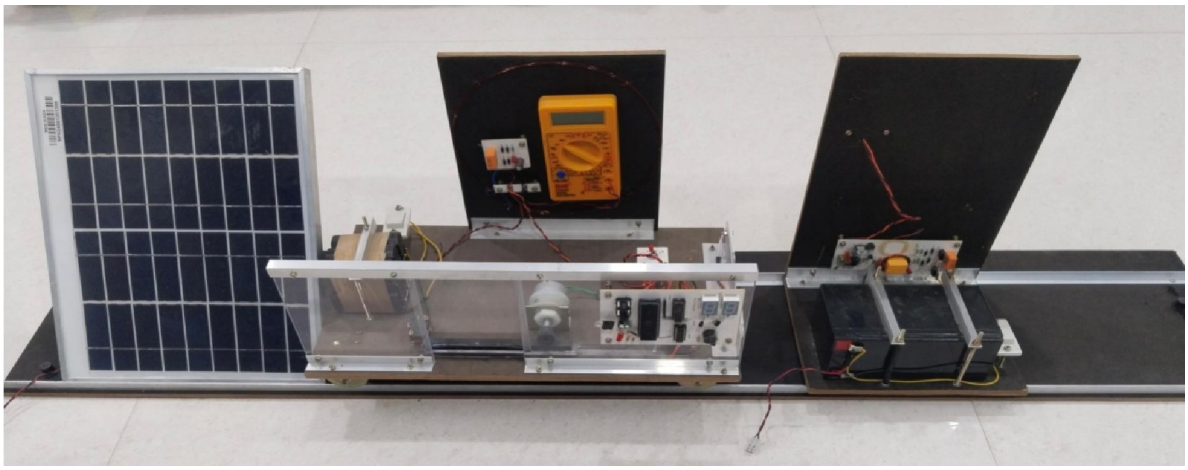
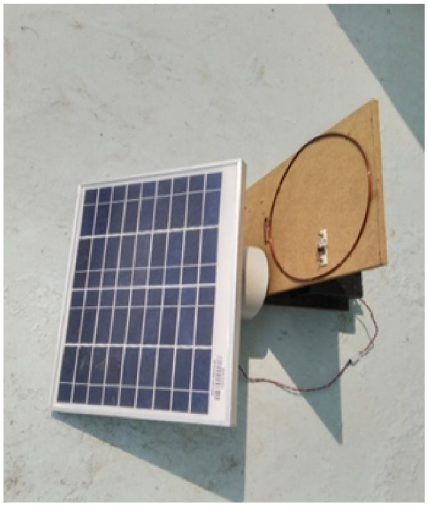
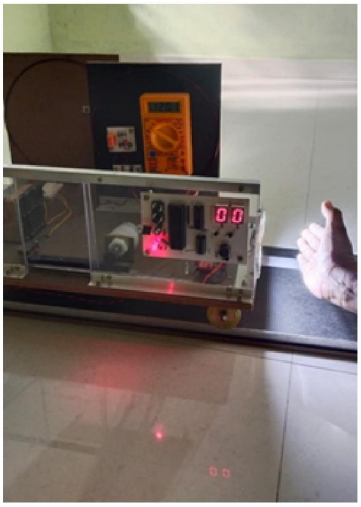


Fig. 2:Prototype of wireless renewal energy powered public transport system





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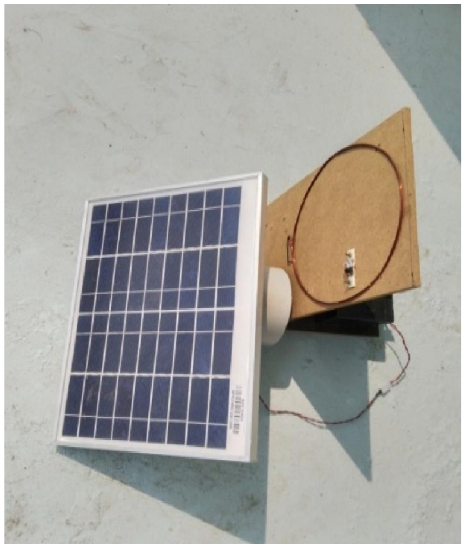
Fig. 3: Solar-powered wireless charging system

Fig.4: Battery charging status


Fig.5: Obstacle detection

V. CONCLUSION

This project demonstrates a prototype wireless renewable energy powered public transport system that integrates solar energy, wireless power transfer, and automated vehicle control. The system successfully operates as a driverless tram moving between stations while charging wirelessly using renewable energy. Safety features such as obstacle detection, automatic door operation, and alarm alerts improve system reliability. The results demonstrate the feasibility of implementing eco-friendly, automated transportation systems for future smart cities.

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