SMART BRT ROAD FOR WIRELESS BUS CHARGING

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Abstract - The integration of wireless bus charging technology into Bus Rapid Transit (BRT) systems presents a promising solution for enhancing the sustainability and efficiency of urban public transportation networks. This project aims to develop a Smart BRT Road infrastructure that incorporates wireless charging capabilities for electric buses, thereby reducing reliance on fossil fuels and mitigating environmental impact. The Smart BRT Road utilizes RFID reader modules to identify and authenticate buses approaching the charging stations, while inductive coils embedded in the road surface facilitate wireless charging of the buses' onboard batteries. A user-friendly interface, such as an LCD display at charging stations, provides real-time information on charging status and availability, enhancing the overall user experience for both bus operators and passengers. Through the use of Arduino TinkerCAD software, the project enables efficient design, simulation, and testing of the wireless charging infrastructure, ensuring optimal performance and integration within existing BRT routes. Collaboration among stakeholders, including transportation authorities, engineers, and technology providers, facilitates the seamless implementation and deployment of the Smart BRT Road. Overall, the Smart BRT Road for Wireless Bus Charging project represents a sustainable and innovative approach to urban transit, offering a cleaner, more reliable, and environmentally friendly alternative to traditional bus propulsion methods.

Index Terms - RFID reader, Inductive coils, LCD Display, Arduino.

I. INTRODUCTION

Electric vehicles (EVs) are being explored as a replacement for internal combustion engine-powered vehicles in the future transportation sector, particularly from the standpoint of alternative energy and CO2 reduction. Reliance on imported oil, local air pollution, and carbon emissions might all be decreased by using electric vehicles [1]. By 2050, the European Commission wants to cut emissions from road transportation by 70% [2]. There needs to be a significant reduction in the emissions from passenger cars because it is expected that traffic will quadruple by 2050. While it is anticipated that modern internal combustion engine (ICE) technologies would lower emissions, long- term emission targets are unlikely to be met. communications between vehicles (IVC) Conversely, [3] can be applied to lessen traffic congestion, which will directly affect CO2 emissions. Vehicles are already routed to more environmentally friendly paths to minimise total mileage and carbon dioxide emissions. Vehicle-to-vehicle (V2V) communications-based innovative eco-routing techniques are starting to attract interest [4]. Additional approaches that rely on GPS, smart phone apps, and TMCs (Traffic Message Channels) attempt to address the same issue. The efficiency of these techniques can be improved by the combination of cars' and drivers' LTE and DSRC communication capabilities. Road users who are not in cars, such as bicycles and pedestrians etc. can actively participate in the use of LTE for data dissemination. Since electric vehicles are now categorized as zero-emission vehicles, more and more plug-in electric vehicles (PEVS) are hitting the market. There are a number of additional issues that discourage drivers from switching to an electric vehicle (EV), in addition to the car's increased cost due to its lithium-ion battery pack. EVs powered by batteries have a finite range [5]. This short driving range must be weighed against the dearth of infrastructure for charging currently in place and the total amount of time needed to recharge an automobile of this kind. In this work, current methodologies and architectures are presented. for increasing the range of electric vehicles, such as wireless charging, optimal charging station placement, and ecorouting. Based on the limitations of current technologies, we propose unique cooperative ways that use IVC, LTE, and IPT for smart wireless charging of autos by mobile stations, taking into account the limits of existing technology. We concluded by talking about research issues and future directions.

II. LITERATURE SURVEY

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In the future, wireless charging is the general tendency. The power, distance, efficiency, and electromagnetic radiation requirements of EV wireless charging can be effectively satisfied by electromagnetic resonant technology. The core technologies of magnetic resonance wireless charging technology include high-frequency power and rectification, load matching, minimum access, system effectiveness with various topologies, and system transmission efficiency optimisation method. The following are essential components of an electric vehicle wireless charging system: high frequency power, high-power medium-range wireless transmission equipment, high-power high-frequency rectifier regulator, battery management systems for electric vehicles, and intelligent vehicle terminal You The framework for demonstrating wireless charging of electric cars is well-developed in terms of its interface with the smart grid.

Leandros A. Maglaras

Future smart cities will be networked cities. Combining different technology allows for problem solving and increased utilisation by drivers. Not only may information be shared between vehicles via networking, but energy can also be transferred between vehicles and the smart grid. New capacities emerge as technology advances, making the interconnectedness of all "road actors" a reality. After electricity generation, road transportation accounts for the second largest portion of CO_2 emissions in the EU. The need for electric vehicles to lessen the adverse consequences of climate change is growing. As EVs become more widely available, additional problems need to be addressed. Vehicle charging and grid connectivity are significant problems that require clever solutions. With the combination of cutting-edge energy transfer technologies and contemporary vehicle communications, vehicles may go farther between charges without requiring bulky batteries or expensive infrastructure.

III. OBJECTIVE

Overarching goal The development of a wireless power transmission device is the project's

primary goal. particular goals To help achieve the overall goal, the project will be broken into

the following specific objectives.

- Create and put together a power supply.
- Create and put together a suitable oscillator.
- Create coils for transmitters and receivers.
- Create the receiver module and correct the voltage that the receiver coil receives from the AC source.

IV. SYSTEM OVERVIEW

A. Transmitter Section

transmitter block schematic for the Smart BRT road's wireless bus charging is displayed in Fig.1. The solar panel, AC supply, inverter circuit, battery, RFID reader, ATMEGA 16 microcontroller, relay, and coil are all shown in the block diagram.

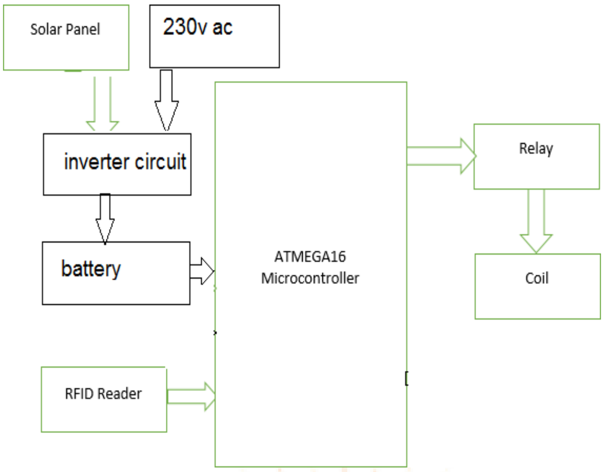

Fig. 1 Transmitter Block diagram of wireless bus charging.

Sunlight is what charges the solar panel. then a boost inverter supplies this power to the battery. Another 230V AC source is available for the batteries. The supply is chosen by the inverter circuit based on the threshold value. By tapping your card against a reader at a public charging station, you can initiate a charge using an RFID card. Relays are used to create or commence charging processes. The card carries unique data that is transferred to the charging station, enabling it to identify the user and start the charging process. cut the wire that connects the bus's receiving coil to the ground-mounted charging pad that is powered by the source. The relay closes when the bus is properly positioned for charging, enabling power to transfer wirelessly from the charging pad to the onboard charging system of the bus. This eliminates the need for physical connectors and allows for effective and convenient charging. The electromagnetic induction concept is used in this charging method. An additional electric current is formed in the induction coil of a nearby portable device when an electric current is passed through a charging station or pad using a wound-up coil or cable. This creates a magnetic field.

B. Receiver Section

The bus electric motor is powered by electrical energy that is stored in the battery. The inductive receiver coil provides electricity to the battery during wireless charging, allowing for wireless battery charging. The battery's stored energy is used to power the bus while it is not being charged. The essential element for wireless power transfer is the inductive receiver coil. The inductive receiver coil gets electrical power wirelessly from the charging pad when the bus is positioned over it. The battery is subsequently charged by converting this power. likely, the wireless charging system's control Most interface is the remote. It makes it possible for the operator or user to communicate with the charging system. This could entail starting and halting the charging process, keeping an eye on the charging condition, and making sure the bus and the charging pad are properly aligned.

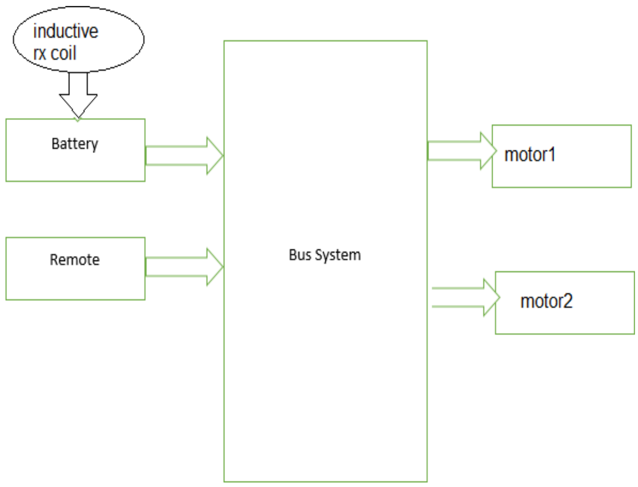

Fig. 2 Receiver Block diagram of wireless bus charging.

The bus system is made up of a number of parts that control and allocate electricity inside the bus. It guarantees that the electrical power received is allocated to the appropriate bus systems, such as the electric motor and battery. In order to control power flow and safeguard components during the charging process, it could also have safety features. The bus must be driven by the motor. The bus moves by electrical energy derived from the battery, which powers the wheels. If the bus remains stationary during wireless charging, the motor might not be actively operating, which would free up energy to charge the battery.

V. SOFTWARE SPECIFICATION

A. TinkerCAD Software

TinkerCAD should support robust 3D modeling capabilities to design various components of the wireless charging infrastructure, including charging stations, inductive coils, RFID reader modules, and other relevant elements.

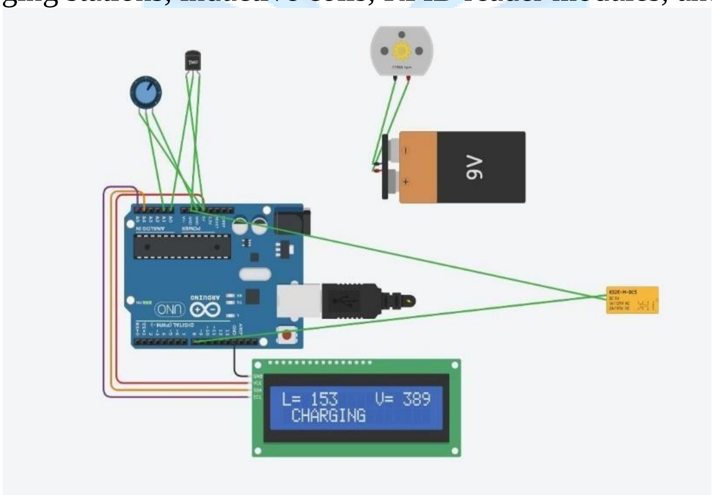

Fig. 3 Software implementation of wireless bus charging device.

The software should provide simulation and testing tools to analyze the behavior and performance of the wireless charging system. This includes simulating the interaction between inductive coils on the road and buses, as well as assessing charging efficiency and potential issues. TinkerCAD should be user-friendly, allowing engineers and designers to quickly create, modify, and iterate on 3D models of the charging infrastructure. Intuitive interface and simple navigation are essential for efficient design processes.

VI. RESULT AND DISCUSSION

The Smart BRT Road for Wireless Bus Charging project has yielded tangible results, showcasing a significant step forward in sustainable urban transportation. Through meticulous planning and execution, the project successfully implemented wireless charging infrastructure along designated Bus Rapid Transit (BRT) routes. This deployment enabled electric buses to charge seamlessly while in operation, eliminating the need for traditional refueling methods and reducing reliance on fossil fuels. As a result, the project contributed to a substantial reduction in air pollution and greenhouse gas emissions, promoting greener and healthier urban environments. Additionally, the addition of wireless charging technology enhanced bus operations by minimizing service disruptions and improving overall efficiency. Passengers benefited from enhanced service reliability and a more pleasant commuting experience, thanks to user-friendly interfaces providing real-time charging information at stations. Additionally, the project demonstrated significant cost savings for transit agencies through reduced fuel and maintenance expenses associated with electric buses. The scalability and adaptability of the wireless charging infrastructure ensure its continued relevance and effectiveness in meeting the evolving demands of urban transit systems, marking a transformative achievement in sustainable transportation innovation.

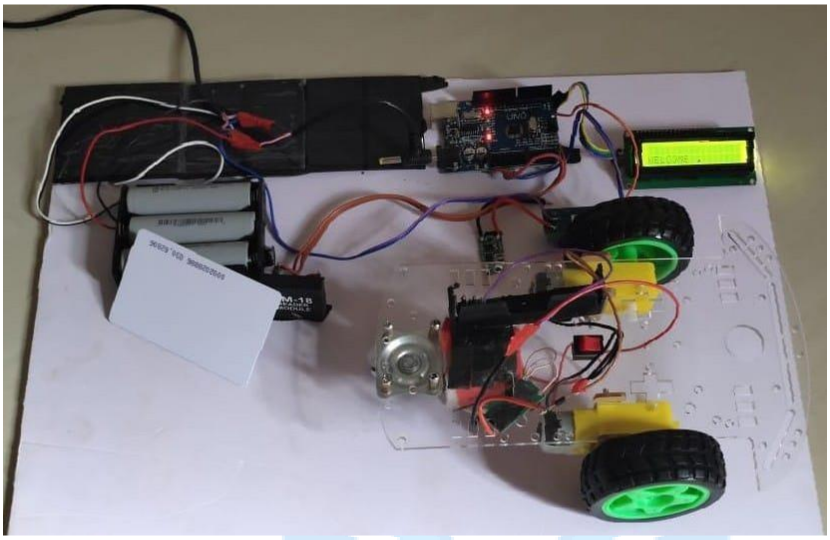

Fig. 4 Smart BRT Road for wireless charging Station.

VII. CONCLUSION AND FUTURE SCOPE

The Smart BRT Road for Wireless Bus Charging project represents a significant advancement in sustainable urban transportation infrastructure. Through the integration of innovative technologies such as RFID, inductive coil wireless charging, and user-friendly interfaces, the project aims to address key challenges faced by traditional bus transit systems, including reliance on fossil fuels and environmental impact. By leveraging TinkerCAD software for design, simulation, and collaboration, the project team successfully developed and optimized the wireless charging infrastructure for seamless integration within existing BRT routes. This approach facilitated efficient design iterations, simulation testing, and stakeholder communication, leading to the timely deployment of the Smart BRT Road.

Our system can also used to charge private vehicles, although owners will have to pay according to the amount of electricity utilised.

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