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Revolutionizing E-Mobility - Unlocking the Potential of Breaking the Tether

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ABSTRACT:The transportation industry is rapidly shifting towards electric mobility as a sustainable and environmentally friendly solution. However, the adoption of electric vehicles (EVs) is hindered by the limited range of batteries and the lack of charging infrastructure. To overcome these challenges, this project proposes revolutionizing e-mobility by unlocking the potential of breaking the tether. The concept of breaking the tether involves designing EVs that are not limited by the range of their batteries or the availability of charging infrastructure. This can be achieved through the use of wireless power transfer technology. The project aims to explore the feasibility of breaking the tether and its potential impact on the transportation industry. It will involve designing and prototyping an EV that utilizes wireless power transfer technology. In addition to wireless charging technology, the project will explore the use of electromagnetic induction between coils to enable efficient charging of the EVs. Moreover, the project will investigate the integration of both solar panels and the grid to further enhance the energy efficiency of the EVs. The use of solar panels can provide a renewable source of energy for the vehicle, while the grid can be used as a backup source of energy when solar power is insufficient. Thus, this project can be more revolutionizing when it comes to the use of WPT for E-vehicles.

KEYWORDS:Wireless Power Transfer, Electromagnetic induction, Solar panel, Grid.

I. INTRODUCTION

Increasing adoption of electric vehicles (EVs) has led to a growing demand for more efficient and sustainable charging solutions. Wireless power transfer (WPT) technology, which eliminates the need for physical connections between the charging infrastructure and the EV, is emerging as a promising alternative to traditional wired charging methods. When combined with renewable energy sources such as solar power and the grid, WPT offers numerous advantages, including reduced carbon footprint, lower energy costs, and improved grid stability. This combination also has the potential to enhance the reliability and availability of power, while offering load management and peak shaving benefits. This paper provides an overview of wireless power transfer (WPT) technology for charging electric vehicles, with a focus on its integration with solar and grid energy. It covers the different WPT technologies available, factors that affect efficiency, and optimization methods for solar and grid integration. The benefits of using solar power for WPT, such as reduced carbon emissions and lower energy costs, are discussed, along with the challenges of variability and energy storage. Grid integration is also examined, highlighting increased reliability and load management potential. Overall, this paper offers a comprehensive understanding of WPT technology and its potential for sustainable transportation.

The paper concludes with a discussion of the current state of WPT for EV charging using solar and grid energy, including the progress made in developing standards and regulations, the commercial availability of WPT charging systems, and the future prospects for this technology. Overall, the combination of WPT with renewable energy sources such as solar and grid power has the potential to significantly improve the sustainability and efficiency of EV charging.

II. RELATED WORK

Wireless charging of electric vehicles while driving is an emerging research area, and there have been a number of recent studies on this topic. Some of the notable works include:

"Dynamic Wireless Charging of Electric Vehicles on Highways: A Review of Technologies and Applications" by A. Khaligh, O. Onar, and L. Zhang (2015): This paper provides a comprehensive review of dynamic wireless charging technologies and their applications for electric vehicles on highways.

"Design and Analysis of a Wireless Power Transfer System for Electric Vehicles on Highways" by H. Gao, S. Huang, and S. Liu (2018): This paper proposes a wireless power transfer system for electric vehicles on highways, which is based on magnetic resonance coupling and is optimized for efficiency and reliability.

"Dynamic Wireless Charging of Electric Vehicles: Technologies, Standards, and Challenges" by M. Stieneker, D. Grundel, and H. Wertz (2018): This paper provides an overview of the current state of dynamic wireless charging technologies, standards, and challenges, and discusses potential solutions for future development.

"Dynamic Wireless Charging of Electric Vehicles: A Comparative Review of Static and Dynamic Wireless Charging Technologies" by R. M. da Silva, V. FernãoPires, and J. F. Martins (2019): This paper compares static and dynamic wireless charging technologies for electric vehicles, and evaluates their advantages and disadvantages in terms of efficiency, cost, and reliability.

"Wireless Charging of Electric Vehicles on Highways: A Feasibility Study" by S. K. Saha, J. N. Chamola, and M. K. Tiwari (2020): This paper presents a feasibility study of wireless charging of electric vehicles on highways, and evaluates the technical and economic viability of this technology.

Overall, these studies highlight the potential benefits and challenges of wireless charging of electric vehicles while driving, and provide valuable insights for future research and development in this area.

The work in this paper uses the electromagnetic induction which is used to transfer the power wirelessly without any contact between the e-vehicle and transmitter infrastructure.

III. METHODOLOGY

Wireless power transfer (WPT) technology for charging electric vehicles (EVs) while driving works by using magnetic fields to transmit electrical power wirelessly from a charging coil on the road to a receiver on the bottom of the EV. The WPT system consists of two main components: a transmitting coil embedded in the road, and a receiving coil attached to the underside of the EV. When the EV is positioned over the transmitting coil, the coil generates an alternating magnetic field, which induces an electrical current in the receiving coil attached to the EV. This current is then converted into direct current (DC) power, which is used to charge the EV's battery. To optimize the efficiency of the charging process, the WPT system must be carefully designed to match the power requirements of the EV, as well as the charging speed and range of the system.

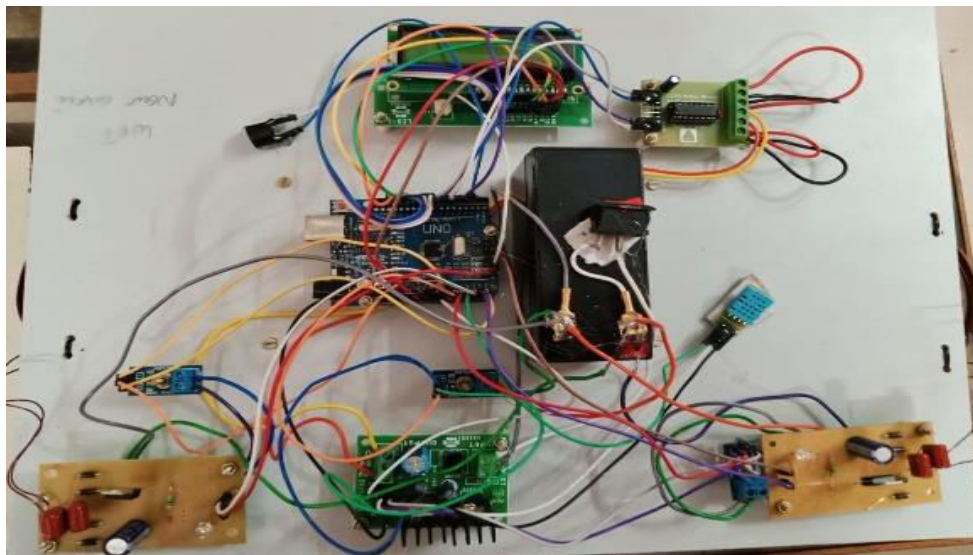
IV. EXPERIMENTAL RESULTS

- Wireless power transfer Transmitter side :

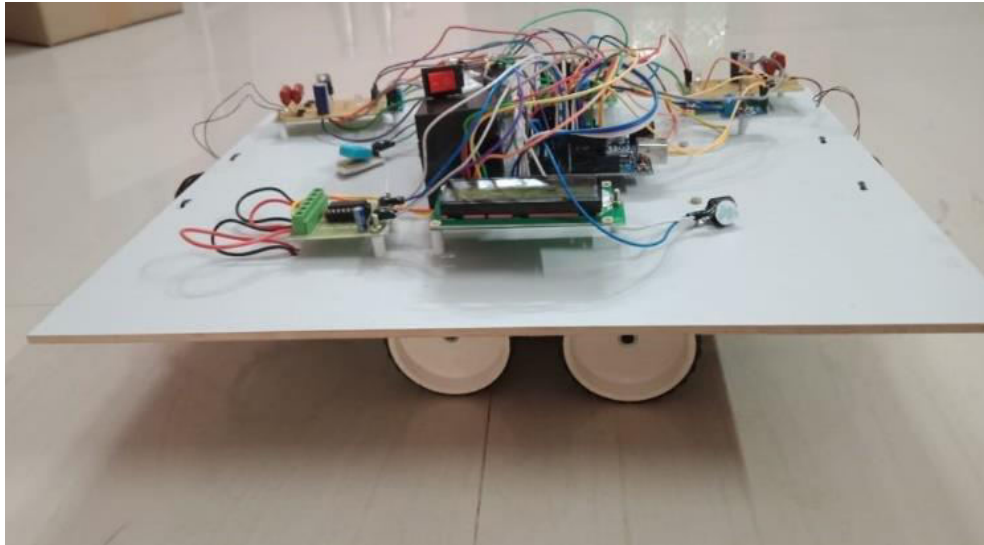


(a)

- Wireless power transfer Receiver side :

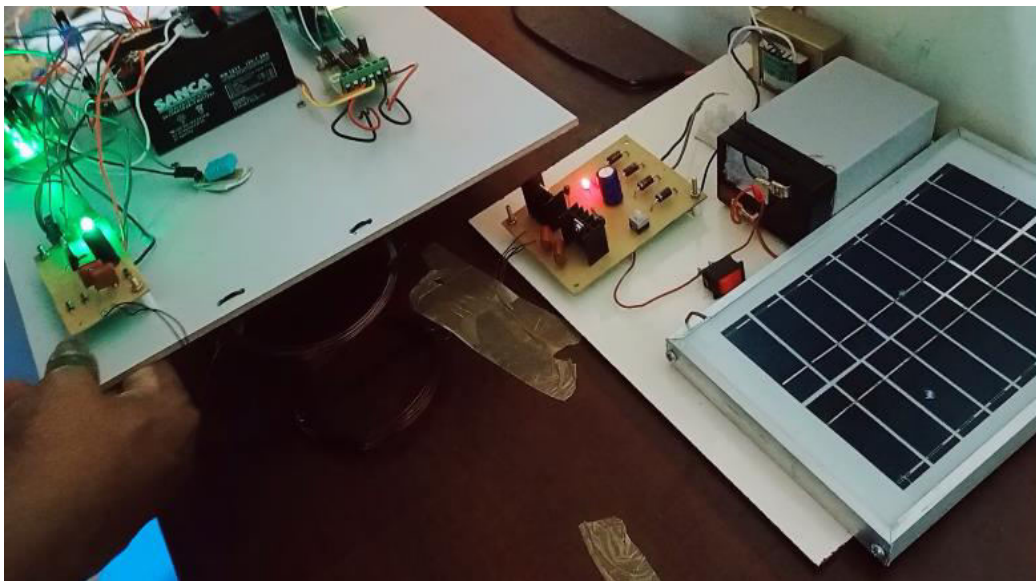


(b)

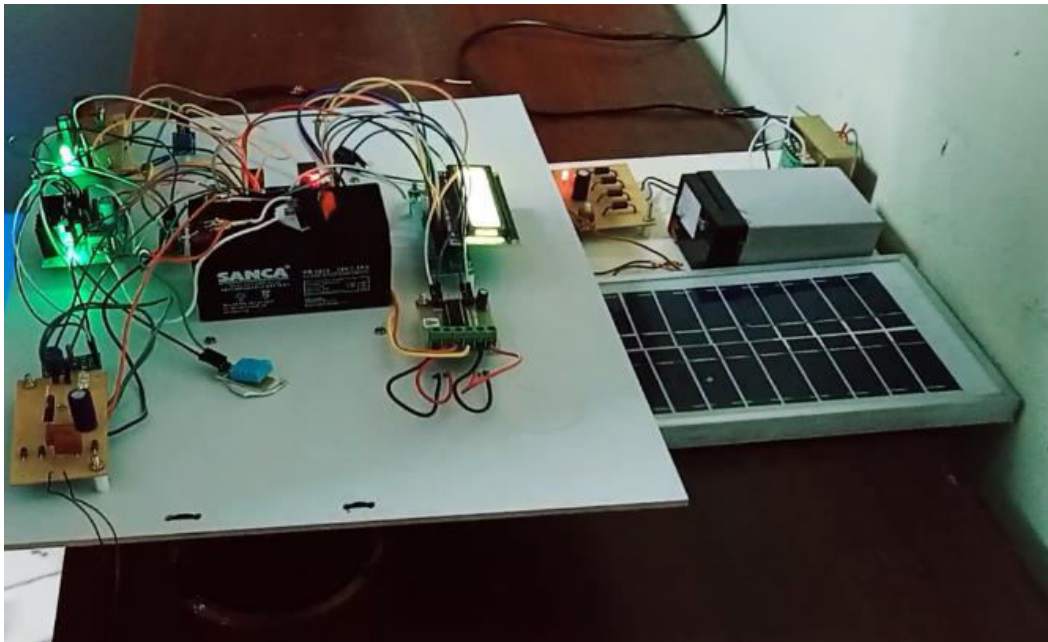


(c)

- Transmitter and receiver coils coincide and dynamic wireless power transfer occurs :

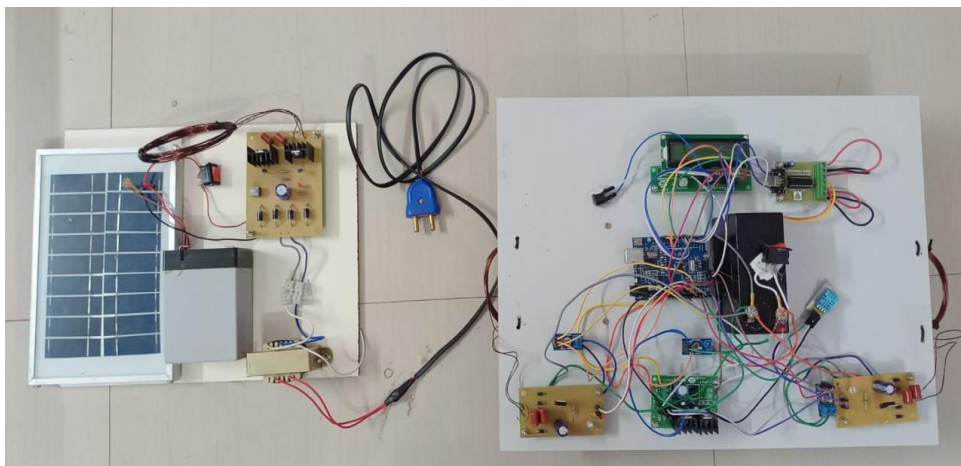


(d)

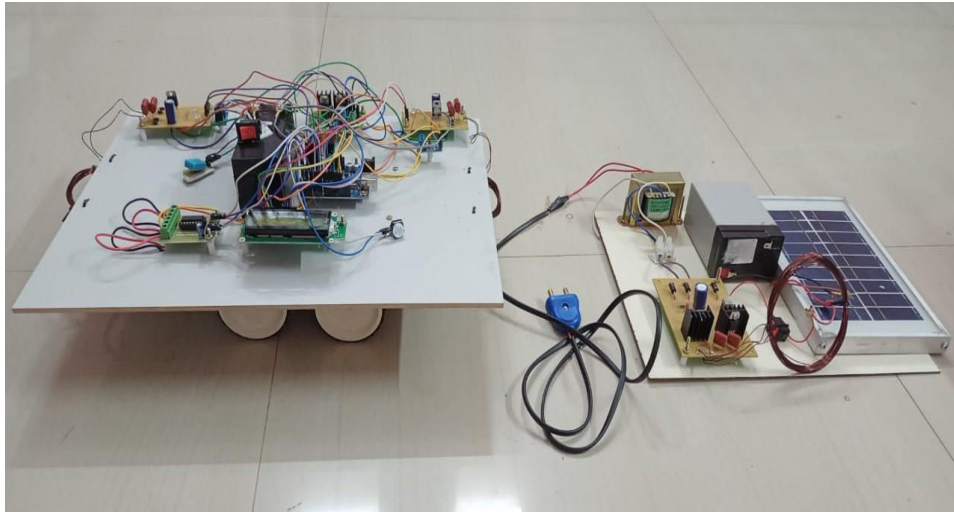


(e)

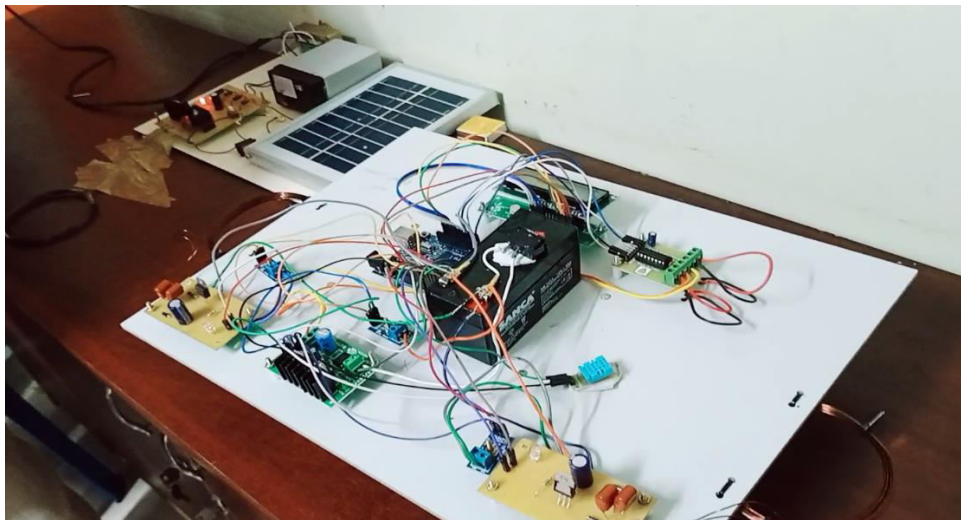
- Revolutionizing E-mobility – Unlocking the potential of Breaking the Tether : Wireless charging of e-vehicles while driving.



(f)



(g)



(h)

V. CONCLUSION

This paper presented a review of wireless charging of electric vehicles. A high efficiency wireless power transfer system for electric vehicle charging application is proposed. System configuration and design considerations were analyzed and discussed in details. It is clear that vehicle electrification is unavoidable because of environment and energy related issues. Wireless charging will provide many benefits as compared with wired charging. WPT for EVs has the potential to overcome the drawbacks of wired chargers and eliminate some hurdles towards vehicle electrification and sustainable mobility. Aside from its convenience compared to wired chargers, WPT can enable significant downsizing of the onboard EV battery. A prototype was designed, built and tested with the popular renewable sources of energy, solar energy. With technology development, wireless charging of EV can be brought to fruition. Further studies in topology, control, inverter design, and human safety are still needed in the near term.

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