Wireless Charging System for Electric Vehicle

V.SWATHI [1], B.SUJATHA [2], B.V.V.S BHARGAV [3], CH.G.V.PRASANTH [4], D.ANAND SAIKUMAR [5],G.KAMAL DAS [6]

1. Assistant Professor, Sir C R Reddy College of Engineering
2. UG Scholars, Sir C R Reddy College of Engineering

ABSTRACT

The majority of electric vehicle systems are built around a number of modules that are intended to guarantee the high power and stability of the car on the track. Most of these parts are connected to the charging system. Dynamic wireless power transfer can help alleviate range anxiety in electric vehicles and lower the price of onboard batteries in this regard. Pure electric vehicles have long used wireless recharging, which enables charging even while the car is moving. Yet, due to the complexity of this method's working philosophy and the presence of numerous variables and parameters, analysis is challenging. Also, whether the vehicle is moving or not specifies a number of other factors, including the speed of the vehicle. as well as the coil receivers' sizes and characteristics. The dynamic wireless recharging system's performance can be enhanced using the unique technique presented in this study. By providing a dynamic mathematical model that can describe and measure source-to-vehicle power transfer even while it is in motion, receiver coils have been added to the proposed system to maximise charging power. All of the physical parameters of the model were presented and addressed in the suggested mathematical model. The outcomes demonstrated the viability of the suggested model. Additionally, by placing two coil receivers under the car, the simulation results were validated by experimental testing.

KEYWORDS

Battery, Copper Coil, Solar Panel, Inductive Power Transfer, Charging, Lcd Display

---

I. INTRODUCTION

Electric vehicles (EVs) are a novel idea in the global transportation industry. Electric vehicles will be the future of transportation, helping to increase the effectiveness of charging stations. Throughout the beginning of time, people have travelled between locations utilising automobiles. Internal combustion (IC) engines are used to power electric cars. Due to an increase in automobiles, IC engines are causing more environmental pollution and using fewer fossil fuels and [1]. The emphasis will be on clean, green energy that emits no emissions in the future. Many now use electric automobiles with wired charging. even though wired charging has some drawbacks as well, such as plug points, station spacing taken up, a wire's restricted range, and a vehicle's need to change direction. All of these are utilised by a vehicle's wired charging system. The vehicle's charge inlet and the electric supply are connected during charging. through the wiring. The tangled wires and safety concerns when charging in a damp environment are a huge disadvantage. Compared to its wired

counterpart, wireless charging of EV batteries has a number of benefits, including
the absence of any plugs, cables, or outlets and the ability to transfer energy without worry of interference from the surroundings. WPTSs are anticipated to be a key compo-
nent of EV charging in the future[2]. These technologies transmit power using coils, which create a small magnetic field when a second coil is added.

Electric vehicles (EVs) and photovoltaic generation (PV) have both been produced, and their performance has been examined. A linear optimisation model is implemented in the model to evaluate the effect on the energy system. The design standards, configuration, control methods, and experimental tests apply to a DC microgrid power arrangement for quick charging of fully electric and plug-in hybrid automobiles[3]. The suggested charging architecture is the result of a comparison of the key traits of well-known architectures. The analysis of the suggested power conversion architecture's charging/discharging power, efficiency, energy flux management, and primary grid influence are the main areas of investigation. Also, appropriate control mechanisms are assessed and put into practise, enabling the suggested design to add here to the necessary operations. The activity Using renewable energy sources to power electric vehicles is an environmentally favourable technique. Based on DC link voltage detection, a smart charging station for Plug-in Hybrid Electric Vehicles (PHEVs) was created[4].

A specific set of electric vehicles and photovoltaic systems that are mostly utilised for home-to-work or home-to-school transportation and are powered by grid-connected photovoltaic systems have been documented. Two methods for the intelligent charging of electric scooters are examined for this application. The study came to the additional conclusion that this application allows for the cheaper and lower-emission operation of electric scooters compared to fuel-powered scooters. For electric vehicles (EVs) in vehicle-to-grid applications, a capacity fading model and an electric circuit-based battery were developed. The development of a control algorithm for the battery to determine the state of charge limitations, charge or discharge rate, and processed energy of the battery. The measured properties and the resulting battery characteristics agreed quite closely.

II. LITERATURE SURVEY

Nikola Tesla was the first who invented Wireless Power Transmission [WPT] technology in 1890.He wanted to create the supply system without use of the wire thus he invented inductive and capacitive coupling system for WPT. he invented coil known as Tesla Coil. Erhuvwu Ayisire has given the idea related charging system for Electrical vehicle [EV]. N. Uthaya Banu[5], U. Arunkumar, A. Gokulakannan, M. K. Hari Prasad and A. B. Shathish Sharma has given the knowledge about the battery charging by using solar energy and it also analysed primary and secondary side in detail .The most difficult and important part while designing wireless charging system that is designing part of the coil. This paper gives knowledge about the Wireless Charging in Electrical Vehicle by using Solar Energy Abhijith Nidmaretal (2019), has given the idea related wireless charging by using solar. Solar panel is used for the supply. The direct current by using 555 timers. Inductive coupling method is used for power transfer.Adel El-shahat et al. (2019) has given knowledge about essential requirements of electric vehicle charging and the various types of wireless charging methods compare to other methods, inductive power transfer has great power transfer efficiency prototype for inductive wireless power transfer is detailed. A.M.Alsomali[6] et al (2017) has detailed the strategies of charging electric vehicles pulse width modulation isused to step down the voltage to a constant level. To reduce the charging time, time multiplexing method is used. Time multiplexing method is a successful charging method by simulation. Bhuvanesh Arulrajetal (2019) has given the idea of charging electric vehicle by using solar and wind system. Two separate batteries are used to store solar energy and wind energy. By comparing this two through voltage sensor, arduino decides which gives power to charge a vehicle by wireless charger. Dynamic charging method is the fastest charging method was the idea given by CarlosA.et al (2016). This charging method helps to charge the vehicle battery while it is moving.

III. METHODS AND MATERIALS

Because there are no conductive wires required with wireless charging, conduction losses that can occur with wires can be fully eliminated. Moreover, incorrect human handling of wires during the plug-in and plug-out charging procedure might occasionally be dangerous. Hence, for reasons of safety, human intervention can be eliminated. Wireless charging has some drawbacks despite appearing to be efficient and time-saving. Infrastructure development is a key component of implementation that must be done to meet the objectives. This will involve a significant financial outlay at every level of the project, making it expensive. The system is intended to charge electric vehicles (EVs) when they are immobile, such as in parking garages or open spaces. There has been a lot of interest in the idea of charging EVs while they are in transit because a physical connection is not necessary. Dynamic wireless charging is the process of recharging an EV while it is moving[7].

A. STATIC WIRELESS ELECTRIC VEHICLE CHARGING SYSTEM

For electric cars (EVs), the term "static charging" describes the procedure of recharging an EV's battery using a fixed charging point. Because to its accessibility and convenience for the majority of use scenarios, this is the most popular charging method for most EV drivers[8].
Static charging stations come in a variety of varieties, including Level 1, Level 2, and DC fast chargers. Level 1 charging is appropriate for overnight charging or low daily mileage consumption because it uses a regular household outlet and can take many hours to fully charge an EV battery. An EV battery can be charged significantly more quickly than at Level 1 using Level 2 charging, which usually just takes a few hours[9]. This style of charging is perfect for use at home The quickest static charging method available, DC fast charging, can charge an EV battery to 80% capacity in as little as 20 to 30 minutes, making it ideal for long-distance travel or drivers who need a quick top-up.
Depending on the make and type of the car, static charging for EVs normally employs either the CCS (Combined Charging System) or CHAdeMO (Charge de Move) charging protocols. These guidelines guarantee the dependability, efficiency, and safety of the charging procedure[10].
In order to use a static charging station, electric vehicle (EV) owners must plug their car into the port, at which point the charging procedure will start immediately. Charges can be paid for in a number of ways, including with credit card, smartphone app, or subscription to a charging network.

B. DYNAMIC WIRELESS CHARGING SYSTEM [DWCS]

The technique of charging an EV's battery while it is moving, often using an electric road system, is referred to as dynamic charging for electric vehicles (EVs). Although this technology is still in its infancy, it has the potential to dramatically extend the range of electric vehicles since it allows for in-motion charging, which eliminates the need for frequent pauses to recharge.
Several techniques, such as wireless charging and conductive charging, can be used to provide dynamic charging. In wireless charging, a receiver that can wirelessly receive power from a charging pad mounted on the road surface is installed in the vehicle. electrical charging nonetheless, delivers energy to the vehicle's batteries through an overhead wire system or conductive rail[11].
Although wireless dynamic charging is still in its infancy, it has the potential to completely alter how EVs are charged. This idea includes placing charging stations beneath the surface of the road so that electric vehicles with receivers can charge as they pass over them. Even though this dynamic charging technique is still under testing, it has the potential to make EVs more practical and convenient.
A more widely used technology in electric trains and trams is conductive dynamic charging. In this approach, the vehicle's battery is powered by an overhead wire system or conductive rail. This technique may be modified for use in EVs, although doing so would need a substantial infrastructural investment.
Dynamic charging has the potential to completely change how EVs are charged, making them more useful and practical for daily use. It is an exciting new technology. Yet because it is still in the early stages of development, it will take some time before the infrastructure and the technology are extensively used[12].

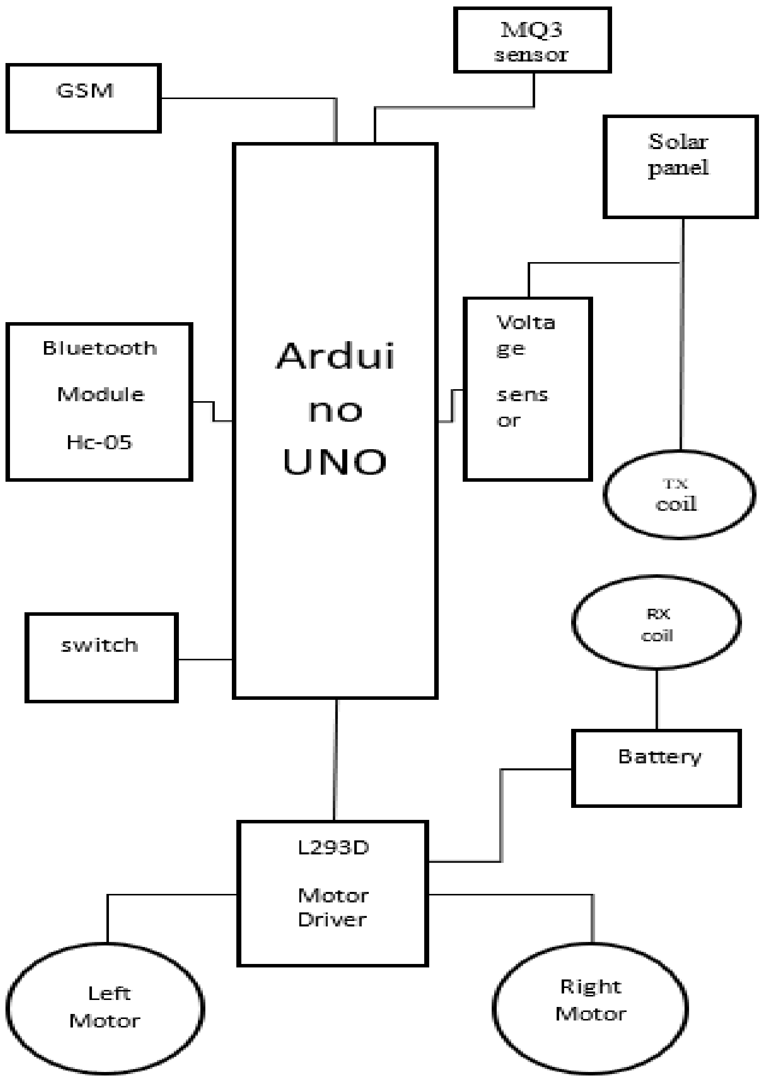
C. PRINCIPLE OF OPERATION

The usual operating principle of an embedded solar wireless charging system for an electric car utilising Arduino is as follows:
1) Solar panel array: The system has one or more solar panels, which take in solar energy and transform it into electrical energy. The vehicle's roof is covered with solar panels, which are linked to a charge controller.
2) Charge controller: A charge controller controls how much electricity is sent from solar panels to batteries. Both reverse current flow and overcharging of the battery are avoided.
3) Battery: The electrical energy produced by the solar panels is stored in the battery. It is an essential part of the system and supplies the energy required to run the electric motor in the car.
No. 4 Wireless charging system: The wireless charging system transfers electrical energy from the charging pad on the ground to the receiver coil on the car via inductive power transfer (IPT). A wireless charging controller connects the receiver coil to the vehicle's battery and the charging pad to a power source.

5) Wireless charging controller: The wireless charging controller controls the passage of electrical energy from the charging pad to the vehicle's battery, managing the wireless charging process. In order to control the charging process, it also connects with the Arduino board.
6) Arduino board: The system's brain is the Arduino board. To govern the flow of electrical energy to and from the device, it communicates with the charge controller and the wireless charging controller. a battery. Additionally, it keeps an eye on the battery's condition and the wireless charging procedure, managing the charging pace to guarantee peak charging efficiency.

Sunlight is absorbed by the solar panel array, which then transforms it into electrical energy. To avoid overcharging the battery, the charge controller controls the voltage and current. The battery stores the electrical energy produced by the solar panels. The wireless charging system transmits electrical energy wirelessly from the charging pad on the ground to the receiver coil on the car using IPT technology. The wireless charging controller controls how much electricity travels from the charging pad to the car's battery during wireless charging. The wireless charging controller and the charge are communicated with by the Arduino board. a controller to control the electricity's passage to and from the battery. To achieve the best charging performance, the Arduino board continuously checks the battery's condition and the wireless charging procedure. The solar energy captured by the solar panels may now be used to wirelessly charge the electric vehicle[13-17].
In general, the built-in solar wireless charging system for an electric car powered by Arduino functions by utilising solar energy to recharge the car's battery. Electricity produced by the solar panels is stored in the battery and utilised to drive the car's electric motor. The vehicle can now be charged wirelessly without a physical connection to the charging station thanks to the wireless charging system. With the Arduino board, you can: control centre that manages the charging procedure and makes sure the battery is charged effectively and safely[18-22].

D. Block Diagram



IV. Results

Electrical, electronic, and mechanical engineering technologies were all used in the project to design a solar charging system for electric automobiles.

The goal of this study was to offer a framework for the design and creation of a solar charging system that would give students a chance to learn about both the theoretical and practical applications of solar energy. The suggested solar charging system will be one of the steps done to make the campus environmentally friendly.

Details of the design factors and calculations for various components are offered. According to the proposed system's economic analysis, the project's payback period is 3.5 years makes it abundantly clear that the proposed solar-based vehicle charging system is superior to the current one.

Both in terms of functionality and cost considerations, an electrical charging system. Researchers working on this project gain a fundamental understanding of solar PV system design and construction for a variety of practical applications, such as electric car systems. Many new works will be created based on the suggested project to establish an effective system for more applications.

To increase the effectiveness of the pilot project, a performance analysis of the solar-charged vehicle system will be carried out.
as a strategy to lessen carbon emissions in order to produce electricity

Fig. (a) system model

Fig. (b) Output result 1

Fig.(c) Output result 2

From the above figures (b) and (c), we observed that the voltage is rising due to high sunlight. when there is less sunlight the voltage is nearly 2V and when there is high sunlight the voltage is nearly 6V accident is detected it shows value 1 and when it is not detected it shows value 0. when ‘A’ value is greater than or equal to 300 then alcohol is detected then engine stops.

V. CONCLUSIONS

Although they may have already made an impact in the market for passenger cars, trucks, vans, buses, and other types of vehicles are still far behind. Autonomous vehicles that run on electricity have also not yet been properly introduced to the market. To encourage consumers to choose electric vehicles over vehicles powered by internal combustion engines, the right infrastructure and reliable technology are urgently required. According to the Global EV Data Explorer, annual sales of EVs in the United States have increased dramatically since 2010, rising from just 1,191 vehicles sold in 2010 to 231,088 in 2020. These figures demonstrate that new technologies in the wireless charging sector and other areas of electric power.
automobiles are trustworthy and reliable in terms of their performance, compatibility, etc. As a result, I can envision a time in the not-too-distant future when electric cars will entirely rule the automotive industry and be just as dependable as they are right now.

Table.1 comparison between existing model and proposed model.

S.no	parameters	Existing system	Proposed system
1	Solar panel	Beside road	On system
2	Copper coils	On road	In system

3	Separate lane	In use	No use
4	Charging system	On road	On road

VI. REFERENCES

[1] J. M. Miller et al., “Demonstrating Dynamic Wireless Charging of an Electric Vehicle: The Benefit of Electrochemical Capacitor Smooth ing,” IEEE Power Electron. Mag., vol. 1, no. 1, pp. 12–24, Mar. 2014

[2] Zaheer, A., Neath, M., Beh, H. and Covic, G. (2017). A Dynamic EV Charging System for Slow Moving Traffic applications. IEEE Transactions on Transportation Electrification, 3(2), pp.354-369.

[3] W. Zhang and C. C. Mi, “Compensation Topologies of High-Power Wireless Power Transfer Systems,” IEEE Trans. Veh. Technol., vol. 65, no. 6, pp. 4768–4778, Jun. 2016.

[4] M. Moghaddami, A. Anzalchi, and A. Sarwat, “Single-Stage Three- Phase AC-AC Matrix Converter for Inductive Power Transfer Systems,” IEEE Trans. Ind. Electron., pp. 1–1, 2016.

[5] Li, Z., Zhu, C., Jiang, J., Song, K. and Wei, G. (2017). A 3-kW Wireless Power Transfer System for Sightseeing Car Supercapacitor Charge. IEEE Transactions on Power Electronics, 32(5), pp.3301- 3316.

[6] F. Akar, Y. Tavlasoglu and B. Vural, "An Energy Management Strategy for a Concept Battery/Ultracapacitor Electric Vehicle With Improved Battery Life", IEEE Transactions on Transportation Electrification, vol. 3, no. 1, pp. 191-200, 2017. Available: 10.1109/tte.2016.2638640.

[7] Y. Mou, H. Xing, Z. Lin and M. Fu, "Decentralized Optimal Demand-Side Management for PHEV Charging in a Smart Grid",IEEE Transactions on Smart Grid, vol. 6, no. 2, pp. 726- 736, 2015. Available: 10.1109/tsg.2014.2363096.

[8] R. Tavakoli and Z. Pantic, "Analysis, Design, and Demonstration of a 25-kW Dynamic Wireless Charging System for Roadway Electric Vehicles", IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 6, no. 3, pp. 1378-1393, 2018. Available: 10.1109/jestpe.2017.2761763.

[9] "Electric Vehicle Charging Guide | ChargeHub", Chargehub.com,2019.[Online].Available:https://chargehub.com/en/electric-car- charging-guide.html.

[10] Capasso, C. and Veneri O. 2015. Experimental study of a DC charging station for full electric and plug in hybrid vehicles. J. Applied Energy, 152: 131-42.

[11] Chandra Mouli, G.R., Bauer, P. and Zeman, M. 2016. System design for a solar powered electric vehicle charging station for workplaces. J. Applied Energy,168(15):434-443. doi.org/10.1016/j.apenergy.2016.01.110.

[12] Choe, G.Y., Kim, J.S. and Lee, B.K. 2010. A Bi-directional battery charger for electric vehicles using photovoltaic PCS systems. In: IEEE Vehicle Power Propuls Conf., IEEE, pp. 1-6.

[13] Fattori, F., Anglani N. and Muliere G. 2014. Combining photovoltaic energy with electric vehicles, smart charging and vehicle-to-grid. J. Solar Energy, 110: 438-51.

[14] Goli, P. and Shireen, W. 2014. PV powered smart charging station for PHEVs. J. Renewable Energy, 66: 280-7.

[15] Mesentean, S., Feucht, W., Mittnacht, A. and Frank, H. 2011. Scheduling methods for smart charging of electric bikes from a grid-connected photovoltaic-system. In: UKSim 5th Eur Symp Computer Modeling Simulation, IEEE; p. 299-304.

[16] Singh, M., Thirugnanam, K., Kumar, P. and Kar, I. 2015. Real-time coordination of electric vehicles to support the grid at the distribution substation level. J. IEEESyst.,9:1000-10. doi.org/10.1109/JSYST.2013.2280821.

[17] Thirugnanam, K., Ezhil Reena, JTP., Singh, M. and Kumar, P. 2014. Mathematical modelling of Li-ion battery using genetic algorithm approach for V2G applications. IEEE Trans. Energy Convers., 29: 332-43.

[18] Miranji Katta, Sandanalakshmi R et.al, "Microcantilever geometry analysis for array sensor design", Materials Today: Proceedings, Volume: 50, Issue:5, Pp:1496-1501,Year:2022, https://doi.org/10.1016/j.matpr.2021.09.071.

[19] M., Rapaka, S., Adireddi, R. and Emandi, J.R., 2020. A preliminary review on Novel coronavirus disease: COVID-19. *Coronaviruses*, *1*(1), pp.90-97.

[20] Katta, M., 2021. Sandanalakshmi R, M Vamsi Krishna Allu, P. *Srinivasulu, M Greeshma. Review on Novel Coronavirus (nCoV-19): Defensive Measures and Natural Medicine IJCMCR*, *12*(3), p.003.

[21] M. Katta and R. Sandanalakshmi, "MEMS Piezoresistive Cantilever Fabrication And Characterization," *2021 2nd Global Conference for Advancement in Technology (GCAT)*, Bangalore, India, 2021, pp. 1-6, doi: 10.1109/GCAT52182.2021.9587807.

[22] Katta, M., Sandanalakshmi, R., Srilakshmi, G., Adireddi, R. (2022). An Efficient Learning Model Selection for Dengue Detection. In: Mishra, D., Buyya, R., Mohapatra, P., Patnaik, S. (eds) Intelligent and Cloud Computing. Smart Innovation, Systems and Technologies, vol 286. Springer, Singapore. https://doi.org/10.1007/978-981-16-9873-6_40