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Solar Wireless Electric Vehicle Charging System: A Review

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Abstract: ***Pollution is one of the big problems in the present condition. Road transport currently accounts for 20-30% of urban air pollution. Electric Vehicles are a better alternative to curb the ongoing pollution. It is vital to make amendments in the battery charging process of Electric Vehicles (EVs) to attain greater reliability. Electric Vehicles battery charging can be done by plug in charging at charging station or by Wireless Charging System (WCS). This paper presents the solution for Battery charging of EVs by wireless charging system from renewable energy source (Solar PV System) and prepare a prototype working model of static wireless charging system. The principal element of wireless charging is to transmit power by an electromagnetic field across the space. Wireless power transfer is based on the principle of Faraday's Law of Electromagnetic Induction. Wireless charging system can be implemented as static or dynamic wireless charging system. Static charging system can be implemented to charge the vehicle when it is in stationary mode and Dynamic charging system can be implemented to charge the vehicle even when it is in motion. By using inductive power transfer the power can be transferred from source to chargeable battery through the transmitter coil and receiver coil. This will not only increase the use of EVs but also make them efficient and reliable for large distances as well.***

Keywords: Wireless charging system (WCS), Static and Dynamic charging system, Electric Vehicles (EVs) Renewable energy source (Solar PV System).

I. INTRODUCTION

The cost of the energy sources like petroleum and diesel has been increasing due to rising number of vehicle and excessive fuel consumption. The ongoing climatic condition and cost of energy sources like petroleum and diesel have led to the research and development of EVs over past decades. The increasing global warming has caused an awareness among the people to switch to EVs. Although the usage of plug-in-charging electric vehicles is increasing,there is a need for further advancements to overcome the current limitations of battery technology of EVs. Moreover,
charging-related issues have prevented many consumers from choosing plug-in electric vehicles.

To address this problem, this proposed project uses Faraday's law of electromagnetic induction to transfer power without any physical connection. The coil of wires in the base unit or charging station act as a transmitter coil and create a magnetic field when current passes through it. The coil of wires in the electric vehicle act as a receiver coil. The magnetic field created by transmitter coil is linked with the receiver coil when the receiver coil (electric vehicle arrive at charging station) come in contact with transmitter coil and emf is induced in the receiver coil and wireless charging is obtained. The power used for charging is taken from solar pv system. When solar pv system is unable to provide required power in that case power is taken from grid or the power used for charging is taken from hybrid solar system. If power is taken from grid in that case additional AC/DC Converter is required to centralized cloud or edge systems for real-time analytics and decision-making.

This review aims to:

1) Fast Charging and Time saving
2) Reduce the Consumption Of Electricity
3) Reduces the battery size of EVs and reduces the cost of EVs.

II. LITERATURE REVIEW

Matjaz Rozman, Augustine Ikpehai (2019) et. al. This paper presents a novel localization method for electric vehicles (EVs) charging through wireless power transmission (WPT). With the proposed technique, the wireless charging system can self determine the most efficient coil to transmit power at the EV's position based on the sensors activated
by its wheels. To ensure optimal charging, our approach involves measurement of the transfer efficiency of individual transmission coil to determine the most efficient one to be used.

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This not only improves the charging performance but also minimizes energy losses by autonomously activating only the coils with the highest transfer efficiencies. Jaime Garnica, Raul A. Chinga and Jenshan Lin (2020) et. al. Wireless power has been a topic of interest from the early 20th century until today. This paper traces the history of wireless power transmission starting with Nikola Tesla, continuing on to experiments with beaming power using microwaves. Examining the difference between near-field and far-field techniques, this paper continues into modern times explaining why near-field technique is more suitable for consumer electronic devices and exploring the near-field transmission of power via the magnetic field. Examples of short-range and midrange wireless power systems are explored.

Shashank Prakash Naidu (2022) et. al. In this paper we are introducing an updated version of charging of batteries through renewable energy grids. The major sources of this charging by solar panels and wind turbine. A voltage regulator is used to produce a constant voltage at the output side. Buck-Boost converter is used to convert the low voltage DC[LVDC] to high voltage DC[HVDC]. A rectifier circuit is used only at the output of wind turbine which rectify the harmonics produced. This power is stored in the battery. The output of this battery can be used for any type of electrical components. However, we are using a switching mechanism used at the battery side which makes sure that output from the batteries will be continuous. Gautham Ram Chandra Mouli, Peter Van Duijsen, Francesca Grazian (2019) et. al. If electric vehicles have to be truly sustainable, it is essential to charge them from sustainable sources of electricity, such as solar or wind energy. In this paper, the design of solar powered e-bike charging station that provides AC, DC and wireless charging of e-bikes is investigated. The charging station has integrated battery storage that enables for both grid-connected and on grid operation. The DC charging uses the DC power from the photovoltaic panels directly for charging the e-bike battery without the use of an AC charging .Seyed Ali Kashani, AlirezaSoleimani, Ali Khosravi (2021) et. al. Within the past decade, since impediments in nonrenewable fuel sources and the contamination they cause, utilizing green energies, such as those that are sun-oriented, in tandem with electric vehicles, is a developing slant. Coordinating electric vehicle (EV) charging stations with sun-powered boards (PV) reduces the burden of EV charging on the control framework. This paper presents a state-of-the-art literature review on remote control transmission frameworks for charging the batteries of electric vehicles utilizing sun-based boards as a source of power generation. The goal of this research is to advance knowledge in the wireless power transfer (WPT) framework and explore more about solar-powered electric vehicle charging stations

III. IMPLEMENTATION OF WIRELESS CHARGING

Wireless charging is useful in eliminating the need of conductive wires and thus copper losses (conduction losses) which can take place through wire can be eliminated. Also, the human handling of wires during the charging process for plug-in and plug-out can sometimes be hazardous if not done correctly. Thus, the human intervention can be avoided for safety purposes. Even though wireless charging seems to be time saving and effective,it comes with certain limitations. The main aspect of implementation is the development in infrastructure which needs to be done to suit the purpose. This will require a huge investment of capital during all stages of the work and hence it is a costly affair. The first wireless charging technology to be developed was static, the system having been designed to charge EVs in garages or public parking spaces, when the vehicle is not operating for some period. Because a physical connection is not required, there has been major interest in the possibility of charging EVs while they are in transit.

A. Static Wireless Charging System.

Static wireless electric vehicle charging system can easily replace the plug-in charger with minimal driver participation, and it solves associated safety issues such as trip hazards and electric shock. Figure Shows the basic arrangement of static wireless charging system. The receiving energy is converted from AC to DC using the power (AC/DC) converter and is transferred to the battery bank. The charging time depends on the source power level, charging pad sizes, and air-gap distance between the two windings. The average distance between lightweight duty vehicles is approximately 150–300 mm. Static wireless charging system can be installed in parking areas, car parks, homes, commercial buildings, shopping centres

B. Dynamic Wireless Charging System.

As the name suggests Dynamic wireless charging system is the system in which EVs is charged while it's in motion. The main concern for electric vehicles deployment is the power and range. For improving the range of the electric vehicle dynamic wireless charging will be beneficial. The dynamic wireless charging system is also termed as “on road charging”. If the charging is done at proper interval a large capacity battery is not required and this makes the vehicle lighter and more economical. Dynamic wireless charging system provides a better option for the charging of electrical vehicles to improve its range. The base unit will be placed below the roads on predefined routes and the electric vehicles will have the battery bank.

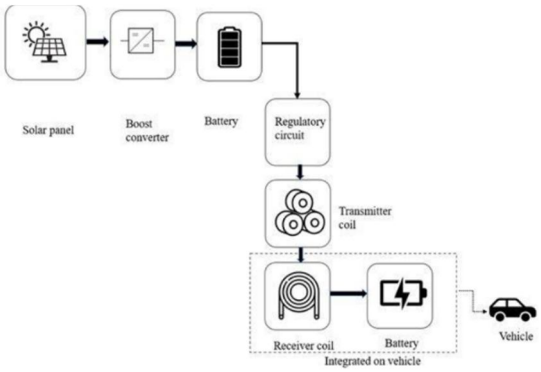
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The electric vehicles will pass over the road and charging will be done when the car is in motion. This will require a lot of investment and infrastructure modification at the initial stages.

IV. SYSTEM ARCHITECTURE OF SOLAR WIRELESS ELECTRIC SYSTEM

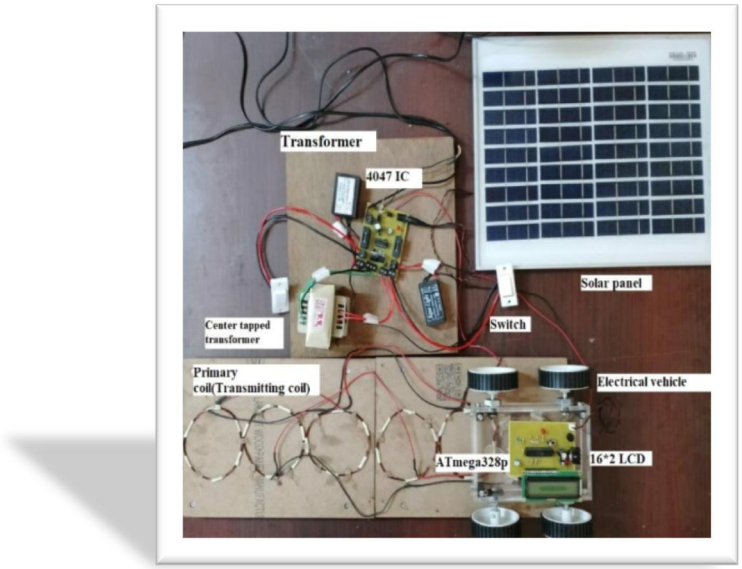
A. General Architecture

A typical Solar Wireless Electrical Vehicle System Consist of following parts:-



Block diagram

B. Visual Architecture



V. COMPONENTS OF SOLAR CHARGING SYSTEM

HARDWARE COMPONENTS:

1) Solar PV Module
2) Rechargeable Battery
3) Transistors
4) Resistors
5) 26 SWG Enamelled Copper Wire
6) 5V Relay
7) L7805CV IC Voltage Regulator
8) LED
9) Arduino Uno R3
10) IR Sensor
11) LCD Display
12) Remote Control Car (Toy Car)
13) Jumper Wires and Connector

1) SOFTWARE REQUIREMENT:
- Autocad , PVsyst , C language

VI. WORKING

The circuit consists of an Arduino Uno R3, Solar PV Module, Rechargeable Battery, IR Sensor, Relay, Transmitter and Receiver Coil, BMS and Battery Bank, LCD Display. IR sensor is installed at a charging station or where transmitter coil is placed. If electric vehicle is arrived at charging station, then IR sensor sense and send the signal to the Aurdino Uno R3. Based on signal received from IR sensor, the Arduino controller sends the
signal to Relay and LCD Display. Relay is used as a switch and relay is connected between the Rechargeable Battery and Transmitter coil (Transmitter coil and compensation network). LCD Display show the status of charging is on/off. Transmitter coil is installed at a base unit or charging station, garage, parking areas and Receiver coil is installed EVs. Receiver coil output terminal is connected to compensation network and then connected to AC/DC Converter and output terminal of AC/DC Converter is connected to BMS and Battery Bank of EVs. Power required for Arduino
Uno R3, LCD Display, Relay, IR Sensor is taken from rechargeable battery through L7805CV IC (Voltage Regulator). Transmitter coil and Receiver coil is properly insulated and protected by protective and supportive layers. The total power required for operating the static wireless charging system (station) is taken from renewable energy source (Solar PV System). Electrical energy is generated from many renewable energy sources such
as wind, solar, tidal, hydro, bioenergy, etc. But compared to Solar PV System, all other electrical energy generation system from renewable sources is costly and complexity in design. Static wireless charging station is fully automated and charging of EVs is start automatically by only parking a EVs at charging station, parking areas, garage, home or
where static wireless charging system is installed

VII. ADVANTAGE

1) Reduces the battery size of EVs and reduces the cost of EVs.
2) Reduces pollution and environmental hazards by accepting this system for EVs charging.
3) Petroleum or diesel vehicles is replaced by EVs and due to that reason, the cost of petroleum and diesel is decreases.
4) Fuel cost of EVs is less as compared to fuel cost of petrol or diesel vehicles.
5) Static wireless charging system is best for installing at home, garage, parking areas, traffic signals.
6) Ecofriendly by using renewable energy source (Solar PV System) as a power source for wireless charging system.
7) Static wireless charging system is fully automated that means no manpower is required
8) Human Safety from Electricity

VIII. DISADVANTAGE

1) Airgap between transmitter and receiver coil for small passenger electric vehicles is 150 to 300 mm.
2) Efficiency is depending on coil misalignment and distance between transmitter and receiver coil.
3) Implementation of dynamic wireless charging system in India is difficult and costly because old infrastructure is not suitable.

IX. CONCLUSION

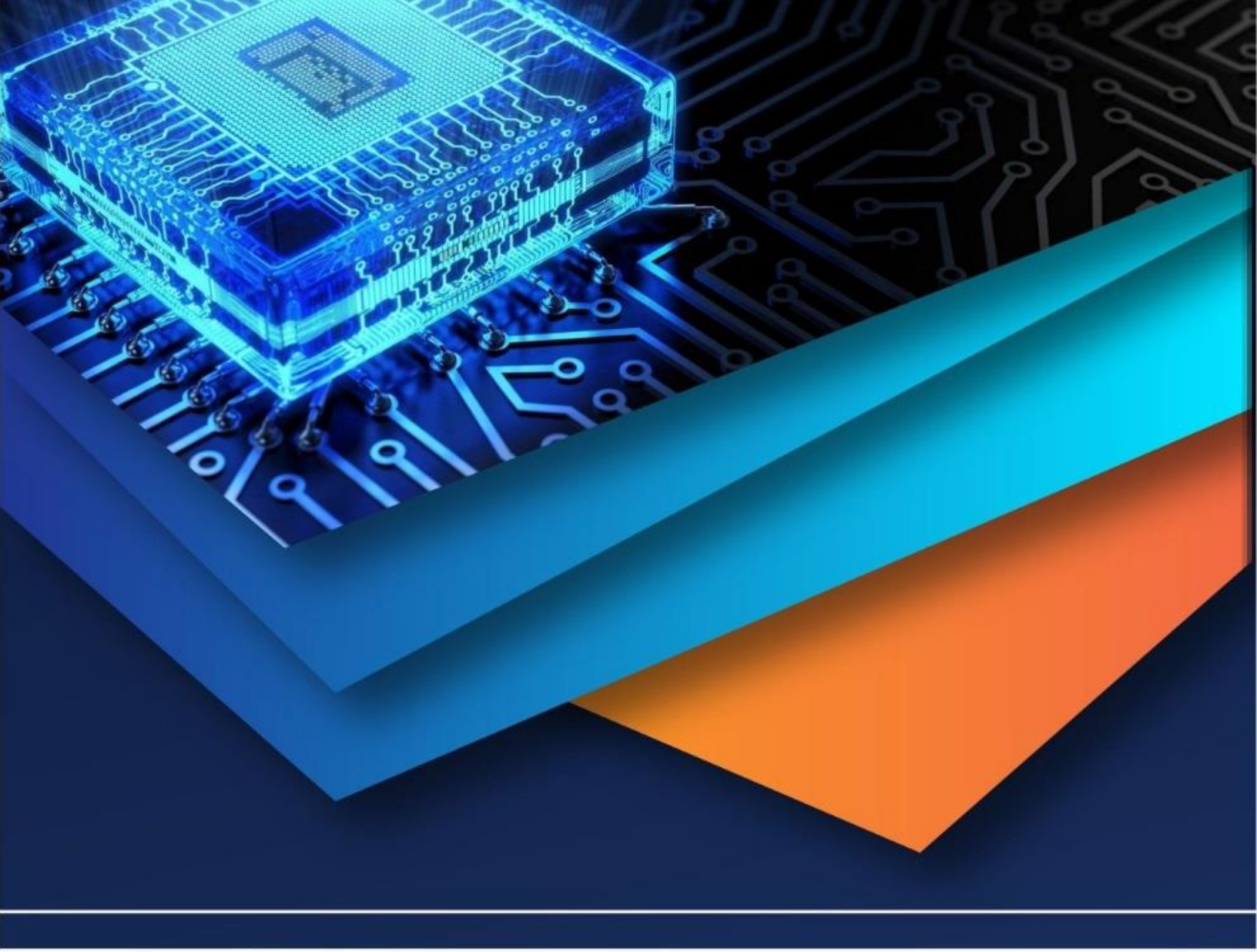
Dynamic wireless charging system is a solution to charge the battery of EVs when the EVs is in motion and to reduce the time of charging. Time is saved by installing a static wireless charging system in garage, parking areas, traffic signals, home. Battery size and cost of EVs is reduced by using dynamic wireless charging system. It will be beneficial to consumers as well as environment, society and government. This concept provides a creative framework for quick charging for next electric automobiles. It is a charging element that practises solar-powered boards. Finding different source of energy is appealing from the standpoint of public transport in order to reduce the by-product of fossil fuels. Electric vehicles offer a way to reduce fossil fuel by products without using petrol. A remote charging framework might be a very practical solution to make the charging of electric vehicles more innovative, simple to use, and hassle-free. Solar roads can eventually replace conventional ones, but this will require a substantial initial investment With such a higher energy return and without having to replace the current infrastructure, the solar-powered roadway may very well be constructed for less money. The circle of sun-oriented street placement could function smoothly because it is expected that old streets will be maintained. Sun-oriented streets will address our nation's concerns about energy, pollution, coal contamination, waste contamination, and transportation When implemented, this novel remote charging method for electric vehicles

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will significantly reduce CO2 emissions. Comparing an electric vehicle to a gas-powered vehicle, carbon dioxide emission is reduced from 60 to 30 metric tonnes of discharge, or by 50%. This will help bring about a noble shift in nature while reducing environmental change.

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