SOLAR WIRELESS CHARGING STATION FOR ELECTRIC VEHICLES

Charging station for EV's using wireless charging technology

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Abstract: The human society continuously making advancement in all the life areas with the help of knowledge, technology and research for the best civilization. Important part of economic growth & globalization is transport, but most of its types cause air pollution, health issues & shortage of conventional energy sources. To reduce the fossil fuel degradation & greenhouse gas emission the Electric Vehicles (EVs) are introduced. Hence efficient battery charging plays an important role for success of EV's commercial adoption. This paper presents the solar energy powered charging stations for EV's. The proposed system enables EV charging with prominent cost which enhances user convenience and economy. Thus it contributes in development of electric power management infrastructure, an energy management system which then help regulate supply-demand variance and optimal energy usage. The advanced charging station is the vital and intrinsic component of the EV & its user's life cycle while transportation. As EVs are evolving the transportation industry & getting commercialized in the society worldwide, smart charging stations then become next crucial part of the process. Explained advance charging station for EV can be deployed according to user's necessity. Hence, these can be installed in the apartment, parking slots of a home, a company or parking near shopping malls. Also, this system can be independently deployed on the ways of the vehicle routes by which the user can charge their EVs on the way.

Index Terms **- Wireless power transfer, Charging Station, Electric Vehicle, Renewable Energy Sources, Solar Energy**

I. INTRODUCTION

Climate changes and extreme weather conditions are eminently related to the Greenhouse Gases (GHGs) emission, have been a critical issue across the globe. Data collected recently indicate that transportation and electricity generation are two of the major contributors to the GHGs and also have an increasing impact.

Electric Vehicles (EVs) are a significant way to encourage the sustainable energy development and address the air quality and climate change issues. Solar energy is a renewable energy source, clean and green, so using Photovoltaic Power (PV) to charge EVs is promising, especially for the workplace parking lots thanks to their large space for installing the PV system and long available daytime for EVs to get charged. Using solar energy alone may not satisfy the EV charging requirements due to its fluctuations and limited amount. To fulfill the EV charging requirements, the combination of the solar energy and the power grid, namely the PV–Grid, becomes essential. The productive economic operation objective of the domestic or parking lot charging station is to increase the utilization of solar energy. As it is a low cost and smooth approach to the load on the power grid to avoid the peak load penalty. However, because of the time varying EV charging requirements and the inconsistent solar energy the management of charging processes become more difficult.

It is required to design an optimal charging scheduling scheme based on real-time information of the EV charging requirements and the solar energy availability. The charging scheduling obstacles with various goals for the charging system, powered by the power grid with or without renewable energy sources, have been widely studied, such as reducing the cost and guaranteeing system stability, maximizing total benefit, smoothing the charging load on the power grid, improving operational efficiency, and other objectives. These outcomes are generally based on a combination of the current data and the estimated data in future. Thus the highly dynamic EV charging requirements and discontinuous renewable energy sources, how to optimize the scheduler to respond quickly to real-time information remains an open and critical issue.

II. LITERATURE REVIEW

In this thread of related works firstly there are mentioned various technologies and projects in the EV industry and then stated the researches that have been similar to this topic.

2.1 OLEV: OLEV stands for on-line electric vehicle. This smart and useful technology is introduced by Korea Advanced Institute of Technology (KAIST). It is a new type of electric transit bus (ETB) system that uses the innovative wireless power transfer technology which is used to charge the transit bus. In this ETB system, there is a wireless-charging infrastructure installed under the road to save space and time at the same time which charges the active bunch of electric buses that are travelling over that path. As the power transfer for charging ETB happens while the vehicle is on the way moving over charging infrastructure, this revolutionary technology is the achievement. To intertwine the two main components of an automobile industry i.e. the vehicle and the road to form a road–vehicle integrated system. Here the conventional EV electric vehicle system is remodeled to perform efficiently. Since charging occurs while the vehicle is operational, the tight coupling between charger and vehicle infra will be beneficial.

2.2 ROUTE OPTIMIZATION OF EV's: Driving range of an electric vehicle becomes a noticeable barrier for the adoption of electric vehicles (EVs) and hence it is the anxiety around the limited driving range. There is ongoing a research and also proposed ways of charging EVs on the move, using dynamic wireless charging which enables power exchange between the vehicle and the grid while the vehicle is travelling. In this methodology, we consider to make most efficient use of the so-called mobile energy disseminators (MEDs) which operate as mobile charging stations to provide power to the EV's by intelligent routing. Here we present a method for routing EVs around MEDs on the road network, which is based on the constraint logic programming and their optimization using a graph-based shortest path algorithm. Hence the stated method builds inter-vehicle communications in order to eco-route electric vehicles.

2.3 EVCS system (Electric Vehicle Charging Station): For making the transportation sector use sustainable energy sources, it is mandatory to take the step toward electrification i.e. electrical energy by renewable energy sources. This will have an advantageous impact on this industry, such as: minimize the oil consumption, reduce gas emissions and integrate renewable energy resources into the power grid. This work proposes, an optimal design of the electric vehicle charging station which integrates renewable distributed generation will be designed for cost cutting and emission reduction. Both an isolated micro grid EVCS and an EVCS connected to the grid were studied in different cases, where energy sources such as PV, wind, and diesel generator are considered to supply the EVCS demand. The model is designed using HOMER software and designed based on realistic input dataset in terms of physical, operational and economic characteristics.

2.4 Dynamic Wireless Charging system (DWC): Dynamic wireless charging (DWC) technology is a new technology of supplying vehicles with electric energy which allows the vehicle battery to be recharged remotely while it is travelling over the power tracks, which are actually the charging infrastructures installed below these roads. DWC systems try to remove the range limitation of electric vehicles by using the power tracks as additional sources of the electric energy. By using this concept we are able to build a real model and algorithm for optimally designing (EV) with DWC electric vehicle systems, specifically which are operating in a multiple-route environments. Multiroute system is basically made up of few single routes that share common road segments, and those vehicles operating on that specific route are installed with batteries having same specifications. Here a general model is developed to optimally allocate power tracks and determine the vehicle battery size for each route. Then, we applied the particle swarm optimization algorithm to solve the given multi-route DWC-EV system optimization problem.

III. SYSTEM DEVELOPMENT

The proposed system for the theory of this idea can be definitely explained by using following block diagram.

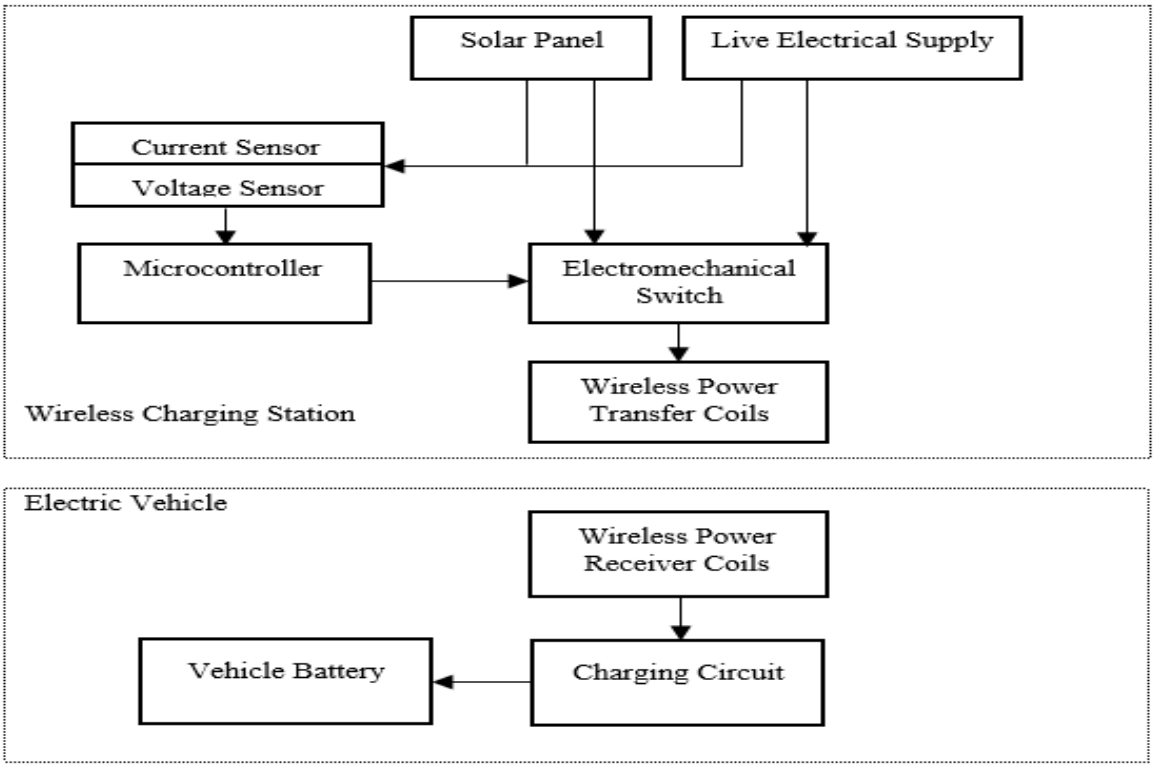

Fig. 1 Proposed system block diagram

3.1 Vehicle: An electric vehicle is the key part of this system as it is proposed to wirelessly charge the EV. Here the EV is installed with a charging circuit along with a set of wireless power receiver coils. The receiver coils and charging circuit are interfaced together to enable the wireless charging process. Charging circuit is connected to vehicle battery for further transfer of power.

3.2 Charging station: A wireless charging station has the following blocks in it.

3.2.1 Wireless Power Transfer Coils: These are the key element to wireless power transfer. It is connected to electromechanical switch which will convey the energy to the coil. Then coils will transfer the power through electromagnetic induction to the receiver coils placed in the EV.

3.2.2 Solar Panel module: The solar panels are used to collect the solar energy from the sun as a renewable energy source to charge EVs.

3.2.3 Live electricity supply: The mains electricity supply is used as a backup energy source if needed.

3.2.4 Sensor node (Current, Voltage): A current sensor and a voltage sensor take signals input from solar panel and mains supply to examine according the energy availability. The data collected together is then given to the microcontroller for decision making.

3.2.5 Relays: The relays are interfaced with both energy sources and the microcontroller to switch between solar energy and mains supply with the help of sensor's feedback collected at microcontroller.

IV. SYSTEM DESIGN FLOW

As the process of implementing a theoretical concept for a technology into the reality needs a methodology to characterize the particular components. Thus to utilize most of the available resources to obtain a sustainable system that works efficiently on the described concepts is the desired aim of every project. Most important part of this project development cycle is to start with the flow of the development process. Here we have stated the flowchart to indicate the function executed in each and every step. So the entire logical activities become clearer and it will help to design the module easily.

Solar panels and the wireless charging coils are the key elements of this wireless charging station. To examine the efficiency and performance measures we have developed this system on a small scale initially. The efficiency of the wireless charging station can be improvised by using latest versions of solar cells such as thin film, organic solar cells, nanowire tandems junction solar cells or inverted polymer solar cells etc. The better the wireless coils winding material and also induction process the charging will get faster, reliable and convenient.

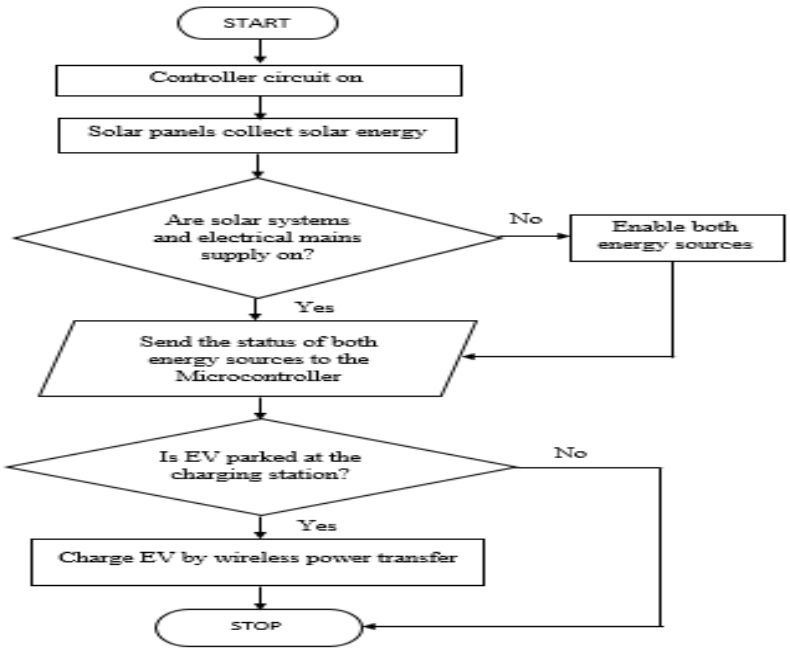

Fig. 2 Design flowchart

V. RESULTS AND DISCUSSION

5.1 Results of the solar wireless charging station

Table 5.1: Descriptive Statics of solar energy received

Sr. No.	Day Time	Efficiency
1.	Morning	64%
2.	Afternoon	91%
3.	Evening	45%

Table 5.1 shows that we have analyzed efficiency of solar charging system throughout the various sections of the whole day with approximate 1365 W/m^2 irradiance.

The Solar energy powered charging station for EV's is an exceptional way to improve the energy resource capability for charging EV and also minimizing the dependency on conventional energy sources.

This concept will help commercialization of the use of electric vehicles due to use of solar energy and wireless technology. As the system seems deployable on the multiple platforms such as workplace parking lots, parking area of shopping malls, apartments etc.

Hence this proposed system will be beneficial to reduce the greenhouse effects, air pollution, noise pollution, thermal pollution which cause environmental degradation, human health issues, global warming.

VI. ACKNOWLEDGMENT

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