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Steady State Stability Analysis using Solar as Renewable Sources of Energy for Vehicle to Grid Energy Transfer

Mr. Milind Rode[1], Mr. H S Dalvi[2]
[1,2]Department of Electrical Engineering G.H.Raisoni college of engineering, Nagpur, India

Abstract: ***Nowadays, peoples are more attracted towards the Electric Vehicles (EVs) due to environmental pollution, its decreasing resources and also increasing prices of fossil fuel. But there should be new load occur on power system. The new challenges caused on power system i.e., frequency control and stability of power system. To avoid these problems, batteries are used in EVs to stored the energy. The PV panels are connected to batteries to charge. EVs batteries are stored in Grid when necessary. It is known as Vehicle to Grid (V2G) concept. This concept is used to improve State of Charge (SOC) of batteries.***
Keywords: Smart grid, Deregulated grid, Vehicle to grid, Renewable energy.

I. INTRODUCTION

The concept, vehicle to grid creates the interest in customers to attract through electric vehicle. Due to these, peoples are aware about pollution issues, decreasing fuel, etc. These methods are very useful for utilize the remaining state of battery charging.

Nowadays, EVs have gained renewed interest in global and industrial areas. It's pollution and emission free vehicle. It's maintainance and running cost is low. But due to required source for battery in EVs, there are again problems occurs on power system. To charge the battery of various EVs the load increases on power system. So, the PV panel is connected the vehicle to charge the battery. Due to these, the SOC of battery is maintained at default level at all time. The aim of project is the extra power of battery feed to grid when grid requires energy which is the main topic in the thesis which is called vehicle to grid concept. In this thesis we design V2G system for improving Voltage stability in the system.

Vehicle to Grid technology can be expressed as, the system in which possibility to control Bi-directional electrical energy flow between the EV and Power Grid. The electrical energy flow to battery from grid, when power is required to battery. It also flow in another direction when grid is required extra power from battery. By utilizing V2G network, the public can utilizes provide better-control and more stable services to stored energy for future when supply is High.

II. ECONOMIC OF V2G

The cost required for these concept are more when installing, but after installing it's maintenance cost is very less. We get benefits after the days, years and also it is useful for utility. Some disturbance also creates like power losses and also required different costly components.

III. METHODOLOGY

PV Panel is used to charge battery of electric vehicle. PV panel convert sunlight into electricity, which is stored in battery. Battery bank is an important component for the EV.

It has been generated 12V DC supply to the electric motor. The battery is connected to Inverter. The 220V, single phase, AC supply goes to Grid. Here the AC load is connected to Instead of grid.

Two EVs are connected parallel to inverter. The solar PV panel are connected to both the battery of electric vehicle. The extra source of batteries feed to grid. The source of battery convert DC into AC by inverter and goes to grid. Those vehicle produce more voltage, the bus voltage gain that voltage and the current is increase due to parallel connection of EVs to inverter.

The Arduino micro-controller is connect to both battery of electric vehicle to handled the process. If voltage of battery is less than 11V, then the relay 1 which is connected to battery 1 is trip. If voltage of battery 2 is less than 11V then relay 2 connected to battery 2 is trip. The LCD is connect to micro-controller to show the result.

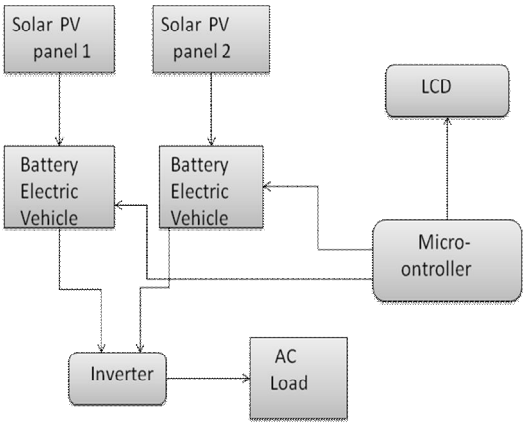


Fig.1. Block diagram

IV. PROPOSED SYSTEM

Two electric vehicles are parked in parking slot. The 6V battery put on vehicle and 2W solar panel connected with battery. Both the vehicles are connected parallel to inverter. The LED bulb is connect to inverter as AC load.

The Arduino micro-controller is connect to the system to operate the process. The relays also connected the system. The 6V battery used for each electrical vehicle. When voltage of battery 1 is fall i.e., less than 4V then relay 1 is trip. If voltage of battery 2 is fall i.e less than 4V, the relay 2 is trip. These all process handled by Arduino micro- controller in which Arduino language program burn. The results display in LCD which connect to micro-controller. Voltage level of battery shown in LCD.

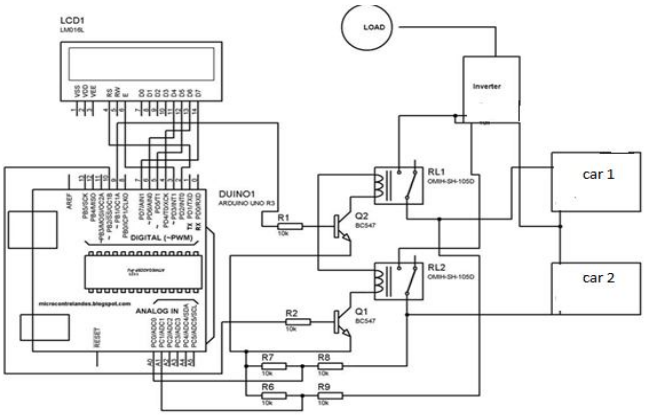


Fig.2. System Diagram

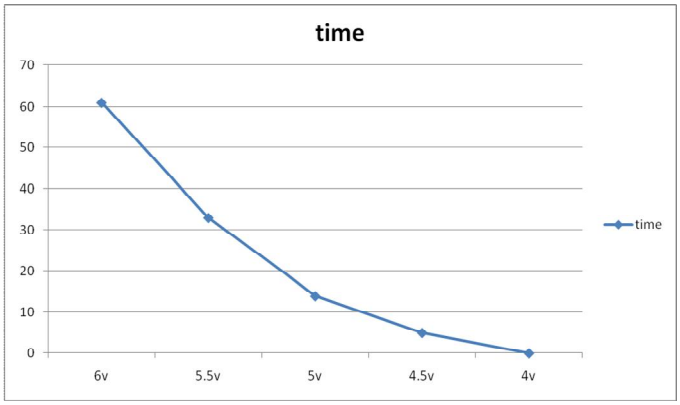
A. Arduino Micro-Controller

It is micro-controller board based on ATmega 328. It's operating voltage is 5V and input voltage is 7-12 V also input voltage limits is 6-20V. It's digital I/O pins are 14 out of which 6 provides PWM O/P and analog input pins are 6. It has 40 ma DC current per I/O pin and 50 ma DC current for 3.3V pin. It has 2KB SRAM and 1KB EEPROM and 16 mHz clock speed.

V. OBSERVATION STUDY

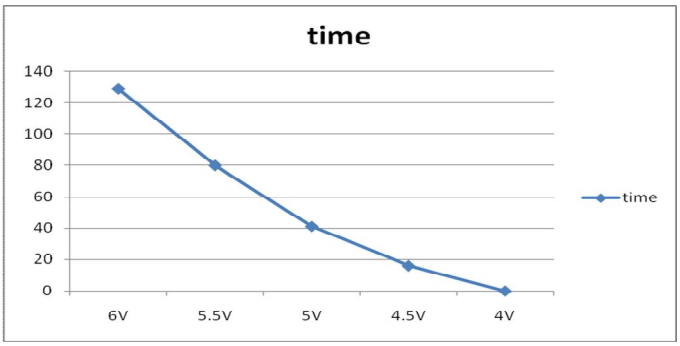
From the above system, we observed battery charging and discharging time of EVs. First we used one vehicle to transfer energy to load. After that we used two vehicle to transfer energy to load. We also study charging time of battery.

By using one vehicle we observed discharging time of battery of electric vehicle. The 6V, 5A battery used in EV which we connect to system in parking slot. The battery discharge vs time graph shown below by using one vehicle. The battery required 61minutes to discharge upto 4V. But according to Arduino programming relay is trip. The time is shown in minutes.



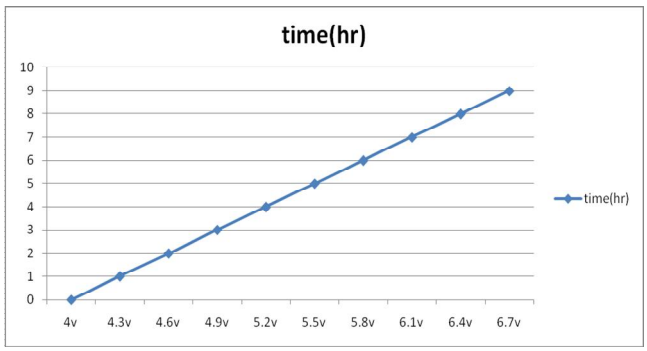
Battery discharge in Volts

After that, two EVs used to observed discharging time of battery. By the combination of two EVs the voltage is same but the current level is increased due to parallel connection of EVs. The voltage level is same 5V but current level is increased i.e 10A. Therefore, the energy level of batteries are more so it requires more time to discharge. It required 129 minutes to discharge upto 4V. After the voltage fall below 4V the relay is trip again. The graph shown in below. Here also times shown in minutes.



Battery discharge in Volts

After that, we also observed charging time of battery. We have 1.8 W solar PV panel on each electric vehicle. The battery is already charged upto 4V when we tested. At morning we charged the battery and the time required to charge the battery is 9 hrs. Means 0.3 V charged in 1 hr. The full charged battery required 6.7 V. The battery charging time graph is shown below:



Battery charging in Volts

VI. SCOPE OF V2G

As general car which used by customer, it's creates pollution, also costly for maintainance. So EVs are most beneficial for avoid these problems. By using the battery of EVs we can support the grid. The remaining energy from battery transfer to grid.

In USA, the generating power capacity is less than power required for EV. The EVs in USA parked 23 hours a day. So the parking cost is also more. Instead of paying parking cost they connect the EVs to grid .The extra energy from battery of EVs is transfer to Grid.

The PV panel is connected to battery of EVs to charge. Drive and deliver power to the grid during demand periods. Driver controls how much energy is available to the grid and also used microcontroller to handled to process. It is not possible for single vehicle to support the grid. But if large no. of vehicles parked then there should be capacity to transfer the energy to grid.

VII. FUTURE VISION OF V2G

In future, electric vehicles come with grid power connections and solar PV panel connected to battery of EVs. Most of peak load needs energy from vehicle generation. Vehicles provide proper services to the grid. There has been an increasing interest among some famous companies towards Some of them are- Ford, DaimlerChrysler, Honda, EPRI, AC Propulsion.

VIII. CONCLUSION

In these paper, the electric vehicle's advantages we seen. The running cost is less but the installing cost is more which is difficult to buy for normal consumer. The cost of solar panel and battery is more which are main components of system.

In these above system, we used 6V, 5A battery and 1.8W solar panel in electric vehicle. In our demo model, we studied charging and discharging time of battery. If we used only one vehicle to transfer energy to load, then the discharging time of battery is less. But if we used more vehicles in parking slot, then the discharging time of battery should be increased. The components which we are used in system are very low ratings.

But in future, if we used real car for research then there should be obviously we get good result to transfer the energy from vehicle to grid.

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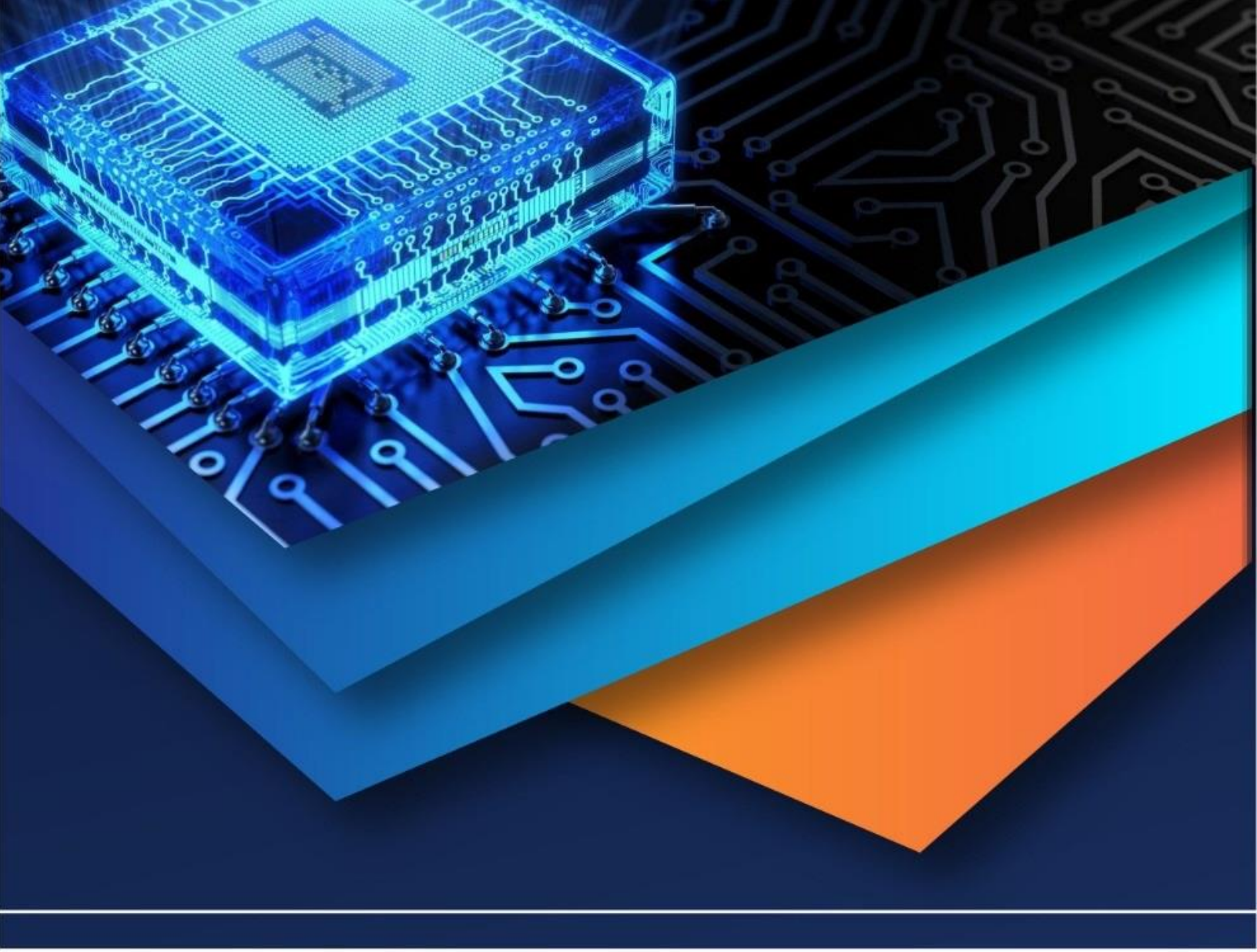

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