RESIDENTIAL EV CHARGING STATION USING IOT

Project Interim Report

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by

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Abstract

The use of Electric Vehicle is increasing day by day hence the demand for supply is also increasing during peak time.As a result a heavy load is imposed on the utility grid system during peak hours.Here the need for alternate sources of energy also arises.The are always attempts done to flatten the load curve and reduce the demand during the peak hours,since the sudden increase in the load during peak hours have very bad effects on the equipment and the connected load

The battery inside a standstill electric vehicle can be used to power up the the residential building during this time.In this project, solar power along with power supply from grid is used to meet the required additional demand that may be produced.The EV battery is used to provide AC supply to the residential building using inverter circuit during peak time.The whole system is interlinked via IOT and it is also used to monitor the system and provide necessary switching whenever required.By making use of the Electric Vehicle battery,at the time of peak hours we will be able to reduce the demand that is generated on the utility grid as well we are able to provide a stand alone supply to the houses.By the introduction of this technique we will be able to provide almost an uninterrupted power supply

Contents

Chapter 1

Introduction

The increased population and increased use of electrical and electronic appliances creates an increase in the load demand in utility grid.This is one of the main issues that need to be dealt with.Moreover with the acceptance of Electrical vehicle this demand is further increasing.In order to solve this additional demand ,in this project we are making use of Electrical vehicle batteries.The peak load usually occurs during 5-9pm.During this period most of the electrical vehicles are at standstill.By making use of this situation we are using the battery of electric vehicles as an alternate source of power for the houses.

1.1 Objective

- In order to cope up with the increased demand for power supply during peak time
- To introduce an alternate and effective source of energy,to solve energy crisis
- To utilize the electric vehicle battery more efficiently

1.2 Literature Survey

Electric vehicle (EV) pulls in worldwide consideration of late and is anticipated that would get more noteworthy selection of transportation division into most nations because of its significant leverage of zero tailpipe emanations. EV was first presented in the nineteenth century yet soon supplanted by inner burning motor vehicles. The reasons were the development of suppressor and electric starter, which diminished the commotion of internal combustion engine vehicles and evacuated the need of hand wrenches to begin the internal combustion engine vehicles [1].The increased number of EVs could overload the existing power system especially at the distribution system which can cause voltage problems and frequency problems. Considering the increasing number of EVs, it appears important to build up an appropriate charging station to give their required electrical demand request. One solution is to charge EVs at home for Renewable Energy Sources (RES).Among all available sources PV system is the best solution. According to the report provided by the National Household Travel Survey (NHTS), vehicles are parked 5 hours of a day at a work place[2]. Electric vehicle charging with residential provides overloading of distribution transformer. As the upgrading of transformer is difficult one. Several literature to show the impact of EVs charging on the distribution transformer [3], [4].Hence to build an electric vehicle charging station at residential is to be effective. So some researchers motivate that, charging of EVs at night time. Night charging challenge is the use of the TOU (time-of use) pricing. Several papers presented residential distribution network..The charging station was fully automated by IoT technology.

Chapter 2

Block Diagram

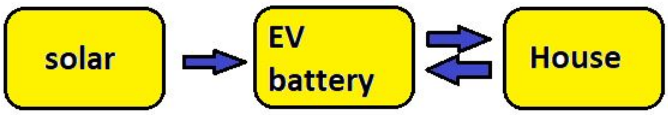

Figure 2.1: block diagram of overall system

The diagram shows the basic working of the charging station.The solar energy is used to charge the battery.The stored charge in the battery is used for the normal functioning of Electric vehicle and it is also used as an ups system for home.Micro-controller is used for the switching of connection between the grid during the time of peak hours and also for the switching of the electric vehicle battery charging.

The solar cell charging used to charge the electric vehicle battery whenever the solar power is available and vehicle is plug in to the system.The specification of solar panel and the output of the solar panel are selected in accordance to the battery of electric vehicle.In this project,We mainly aims at using an electric scooter as the electric vehicle.

EV battery specifications are used to select the charging current,output voltage and other parameters of the circuit.The battery can be charged by two methods- by making use of solar and by making use of utility.When making use of utility it is ensured that no charging is done during peak hours.

The house is the most important section of this project.By making use of this system,we are able to provide an uninterrupted supply to the house.During Peak hours,if possible the house is disconnected from the utility grid automatically and connected after the peak hours or if the electric vehicle is not present in the equation.If multiple vehicles are present they all can be used as independent sources.

Controller mainly performs two functions

- Controls the charging of EV battery
- Connects and disconnects the house from utility grid

So all of these is done in an automated fashion.Controller detects whether it is peak time and also it ensures that the EV battery is capable of providing the supply for home.By making use of IoT we are able to control and schedule the charging of EV batery from utilty.

Chapter 3

Methodology

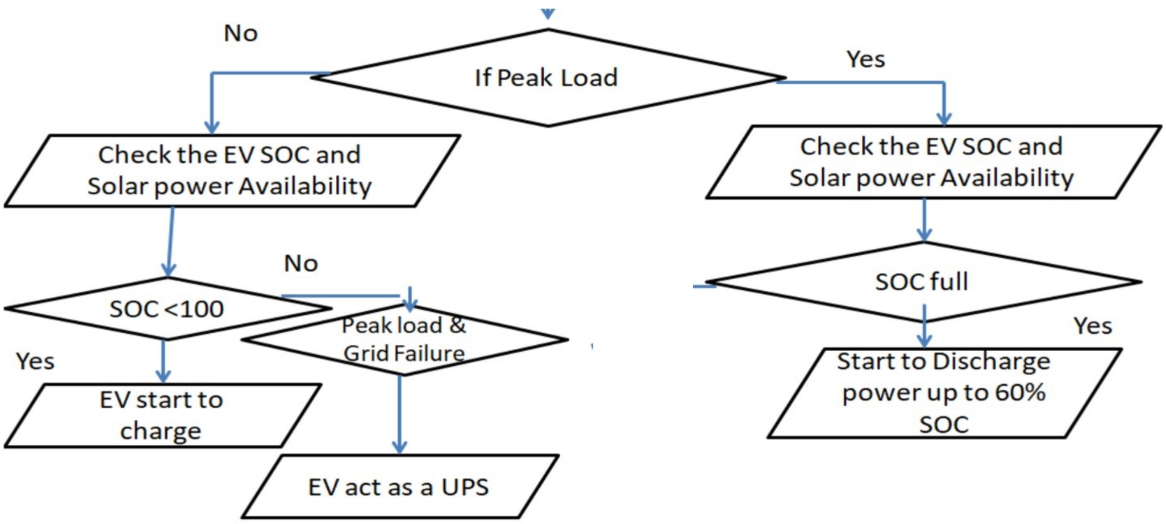

Figure 3.1: Algorithm of the working of charging station

The above figure explains the working of the charging station.Basically what happens is that,the controller will detect whether it is peak time or not.If it is peak time the EV battery State of charge is noted.If the battery vehicle soc is full,then batter will discharge up to sixty percentage of its soc.In the case of grid failure also the EV battery will act as UPS.

If it is not during peak load,then EV battery is charged either by making use of solar or from the grid based on the availability of solar.These operations are controlled by making use of IoT and the micro-controller.So in short this is the basic working of the whole system.

The peak load time is usually set as 5-9pm,as it is during this period peak load is experienced in India.So making use of this data,the controller automatically cut off the main supply.Before disconnecting from the utility grid,the battery percentage is ensured above sixty percent.The controller also check the availability of supply from the mains supply and act in the similar fashion.

3.1 Component selection

The solar panels are selected in accordance with the battery specifications and the vehicle being charged.Also the boost and buck circuits are designed accordingly.The main components of this circuit are

- solar panel
- mppt
- buck converter
- boost converter
- voltage multiplier
- inverter

Chapter 4

Simulations

All of the simulations in this project is done using MATLAB software.The simulation of solar batter charging and simulaion of battery powered inverter circuit is mainly explained in this section.The output of voltage quadruple is also included:

4.1 Solar batter charging

4.1.1 Methodology

For the extraction of optimum power from SPV array, maximum power point tracking (MPPT) techniques are used.Among existing MPPT techniques, PO and INC are the two widely used techniques for SWP. The PO exhibits a straight forward control approach involving perturbation of the SPV array voltage towards the maximum power point (MPP). However, this method suffers from the drawback of steady state oscillations due to perturbations.In this simulation P O algorithm is chosen

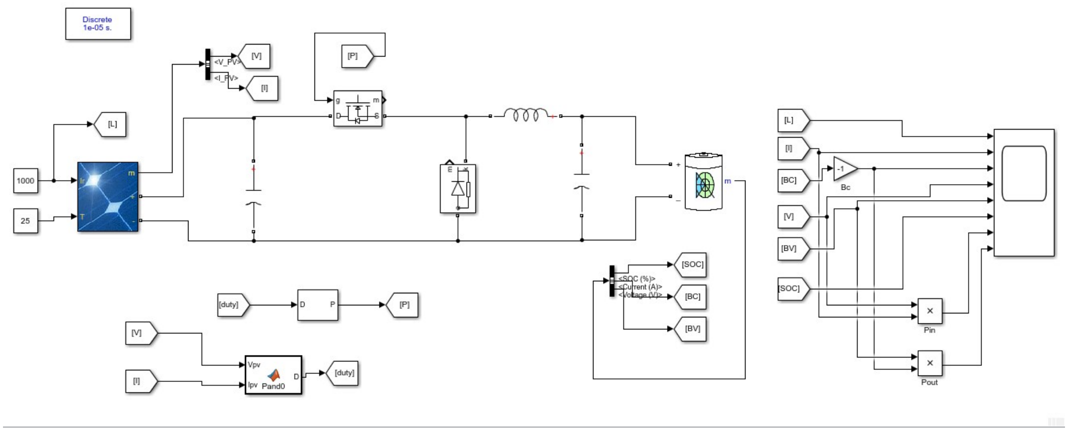

Figure 4.1: solar charging circuit

4.1.2 Circuit

In this circuit,A electric scooter battery of capacity 24V is selected for simulation purposes.Five solar panels each of 100W capacity is selected.And each solar panels employs PO algorithm to obtain the maximum power from the solar panels.By using this circuit an output voltage of 27V is generated.The duty ratio produced by the MPPT is given to the gating pulse of MOSFET. The buck circuit is selected according to the equations given in below figures.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{\Delta I_L \times f_S \times V_{IN}}$$

Figure 4.2: Inductor equation

$$C_{OUT(min)} = \frac{\Delta I_L}{8 \times f_S \times \Delta V_{OUT}}$$

Figure 4.3: capacitor equation

Accordingly:

- Current ripple =0.807 A and Voltage ripple = 0.24 V
- inductor,L = 0.561 mH
- capacitor,C = 15.16 microF

4.1.3 Output

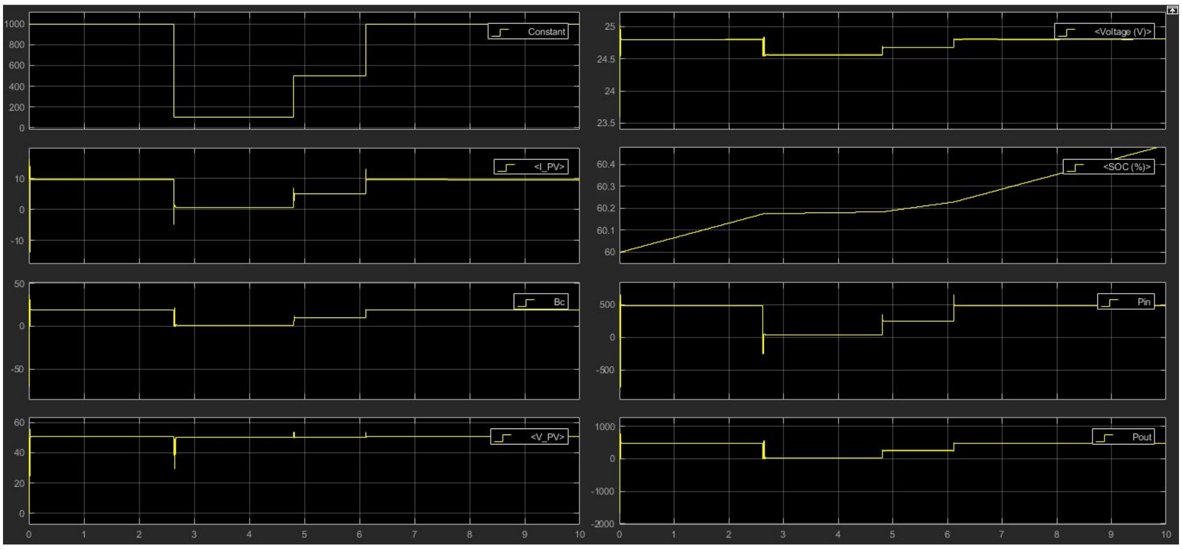

Figure 4.4: output for different irradiation

The output graphs for different level of irradiance are shown in the graph.

- The irradiance,PV current,battery current and PV voltages are given in left side of graph
- Battery voltage,Battery SOC,input power and Output power are given on the right side of graph

The graph shows that the input power matches the output power and also gives the information about the working of MPPT and the voltage and current at which the battery is charging.

4.2 Battery Inverter

4.2.1 Methodology

In this circuit the battery voltage is being stepped up to 110v andis given to a inverter circuit.The inverter circuit receives its timing pulses from a sine pwm generator.In the sine pwm generator a triangular wave is used as sampling signal along with a sine wave,whic is used as reference signal it has a frequency of 50hz.The out put is given to the gating pulse of MOSFET.The output is then filtered making use of LC filter to obtain a sine output.

4.2.2 Circuit

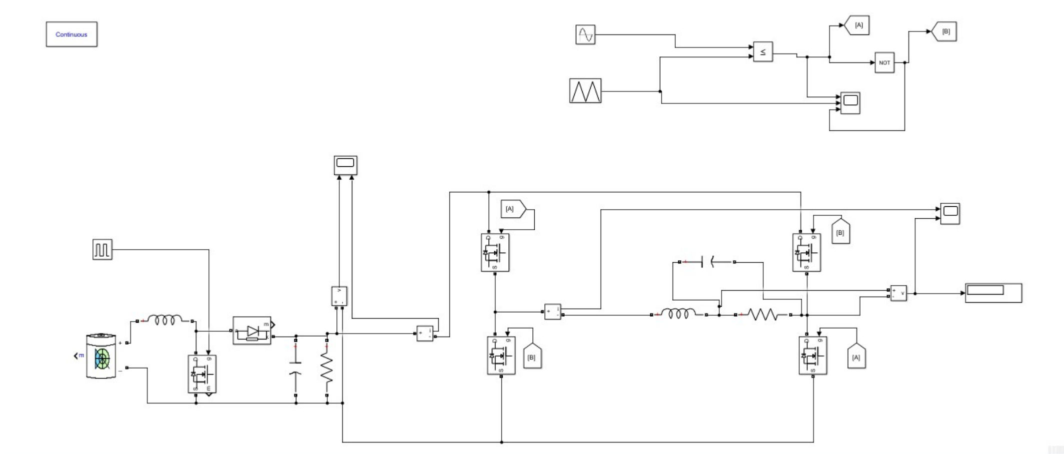

Figure 4.5: battery inverter circuit

The battery selected is 24V as discussed earlier.The output of this inverter is further given to voltage multiplier circuit to ontain the required output.The output thus produced have an rms value of almost 150v.

The boost circuit is selected according to equations: Accordingly:

$$L = \frac{V_{IN} \times (V_{OUT} - V_{IN})}{\Delta I_L \times f_S \times V_{OUT}}$$

Figure 4.6: battery inverter circuit

$$C_{OUT(min)} = \frac{I_{OUT(max)} \times D}{f_S \times \Delta V_{OUT}}$$

Figure 4.7: battery inverter circuit

- Dutyratio = 0.76
- capacitor = 60.8 microF
- inductor L = 7.3 mH
- switching frequency = 25KHz

4.2.3 Output

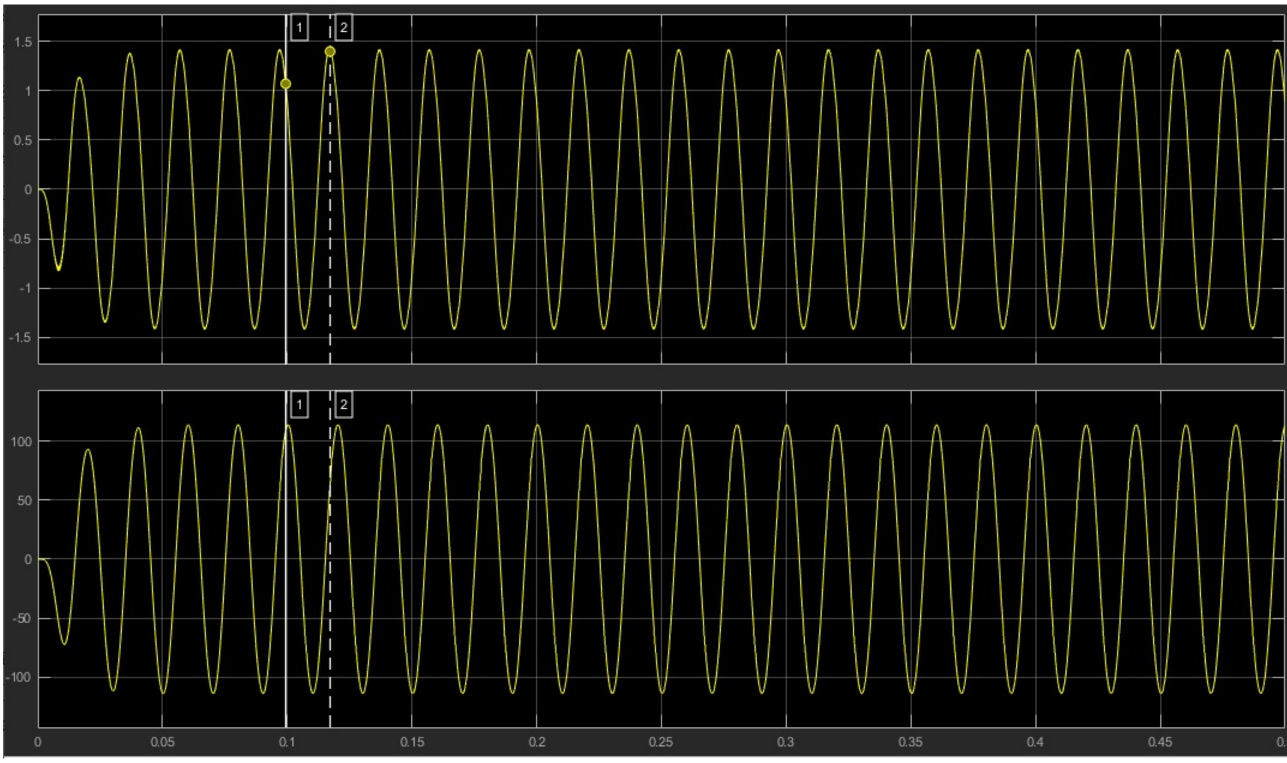

Figure 4.8: battery inverter output

The output generated now has only an rms output of upto 75V.This is given to the voltage tripler circuit for further processing.

4.3 Result

From this proposed work we did simulation model of entire system . We are assuming the tariff of power is maximum during peak load time (Time of Use tariff) during this condition our plug in electric vehicle was support the grid for avoiding Maximum loading . During base load only our Plug in Vehicle will charge . During night time if any maximum demand occurs or grid power failure condition our Vehicle battery will act as an Uninterrupted power back up . The Time of Use tariff data will take from webpage .

4.4 Cost Estimation

This section involves the rough cost calculation for overall project.

ESTIMATE	
COMPONENT NAME	AMOUNT
Solar Panel(100W*5)	Rs.12000
Mppt	Rs.1000
Inverter	Rs.4000
Battery(24V Li-ion)	Rs.5000
Arduino, Circuit components	Rs.1000
Relays	Rs.400
TOTAL	**23,400**

Figure 4.9: Approximate cost for the project

Conclusion

As a result of the simulation our group was able to develop an charging station which is working almost to the designed values.The output and the switching between the charging from the residential and solar charging are the things that need to be taken look into. Meeting with the increasing demand of energy has always been one of the main problem faced by the energy sector.By making use of these type of charging station we will be able to solve the problem to a very much extent.And since it act as a ups during power failure it is also very helpful,in case of remote areas.Where charged vehicle can be used as a power supply for homes.EV can be also charged at Workstations where they remain idle during the day,and there by charging EV from the grid can be very much eliminated.

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