ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

SOLAR POWERED BATTERY OPERATED ELECTRIC VEHICLE AS AN OPTION FOR FUEL VEHICLE

Pallavi M. Mankar *, Atul A. Ghute
* M.E.[EE] student, PRPCEM, Amravati, Maharashtra, India
Assistant Professor EE department, PRPCEM, Amravati, Maharashtra, India

ABSTRACT

India's road are becoming moreconngested each year with cars and buses. Research has shown that motorization is increasing even more rapidly than urbanization and increased traffic worsens India's pollution problem. With the factors of pollution and increased traffic, the best way is to developa more efficient design of vehiclethat will be powered by a nonpolluting energy source, which can be achieved with an electric drive since there are zero pollutants. A renewable source would makeit a better solution compared to the current alternativefuel powered vehicle. The electricity may be provided by renewable sources in addition to energy-storage system such as batteries.

KEYWORDS: Solar Vehicle, Photovoltaic, Renewable energy, BLDC motor.

INTRODUCTION

If Environmental concerns keep growing, and restrictive guidelines constrain the use of the pollutant sources, wind and solar Photovoltaic (PV) power can be considered as viable option for future transportation. Besides being emission-free, the energy coming from the sunrays is available at no cost[4].

As the awareness of environmental protection and energy saving continues to rise, only the electric vehicle can realize real zero oil consumption and zero pollution. The gasoline engine and the diesel engine (no matter how much their efficiency is improved) as well as hybrid vehicles all consume fossil fuel, so there is still some way to go in realizing real zero emissions. Therefore, the electric vehicle with zero emission will undoubtedly become the mainstream means of private transportation in the future. The governments of each country and their societies have outlined large scale plans to promote battery-powered electric vehicles and are vying for considerable opportunities to change the nature of private vehicles.

This paper discusses about the solar powered battery opereated EV as an option for fuel vehicle. In the cost analysis part it is shown that EV is better than fuel vehical. And simulation part gives the exact result regarding EV. Hence it is considered that simulation results are supportive to prototype. In order to achieve the required voltage, the Photo Voltaic (PV) Module may be connected either in parallel or series, but it's costlier.Thus to make it cost effective; power converters and batteries are been used.The electrical charge is consolidated from the PV panel and directed to the output terminals to produce low voltage. The charge controllers direct this power acquired from the solar panel to the batteries through buck converter, ultimately running the BLDC motor which is used as the drive motor for our vehicle application. In the course work, prototype EV and bajaj auto rikshaw are taken into consideration. And the nature of working of EV are studied in real time and also are modeled individually using MATLAB/SIMULINK..

COST ANALYSIS

Comparative cost analysis of EV and Fuel operated vehicle is done. For this purpose a bajaj three wheeler auto rikshaw is referred as a fuel vehicle and a Prototype available is referred as EV. Fig.1 shows the prototype drive used in this project as EV for comparision.

a) Fuel vehicle:Bajaj three wheeler
   Vehicle power:- 800W
   Passenger capacity:-4
   Average:- 24-35KM/lit

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

Hence from the available data and considering fuel cost as 75rs/lit, it charges of Rs 2.54/ KM

b) Electric Vehicle
BLDC motor:- 48V, 850 Watt
Passenger capacity:-4
Battery used: Lead acid battery, 12V/90AH

For one complete charge EV can cover 90 Km distance as per battery discharge standard[6], approximately 3 hours; in this case battery is discharged upto 70%. Fig. 1 shows prototype used.

Fig.1: Prototype BLDC drive in EV

Table 1 shows yearwise cost analysis

Table 1. Yearwise cost analysis

ITEM	Fuel Vehicle	Solar EV
Vehicle Cost	Rs 1,50,000/Yr	Rs 50,000/yr
Solar Cost	00/-	60,000/-(one time investment)
Running Cost 90Km/day	2.54Rs/km, Rs 83439/Yr	00/-
Maintainance Cost	Rs 10,000/Yr	Rs 1000/year
Total	Rs 2,43,439/Yr	Rs 1,11,000/ Yr

ACQUIRING POWER FROM THE SUN

The first part of this paper deals about how to acquire the power from the sun, and there on to recharge the battery.The second part deals with using the power from battery in running and controlling the motor.

The rating of the components required for this work is completely based on the motor which is to be used for the application.We are using the 850Watts (48V) BLDC motor for our application.According to the rating of the motor the other components are selected. In order to drive the BLDC motor through the batteries, we would require four batteries of rating 12V/42Ah connected in series**.** In this work, four Amaron 12V/90Ah batteries are connected in series. After selecting the batteries, the solar controller and the solar panels are to be selected. The complete flow of the work is represented in the schematic diagram in Fig 2

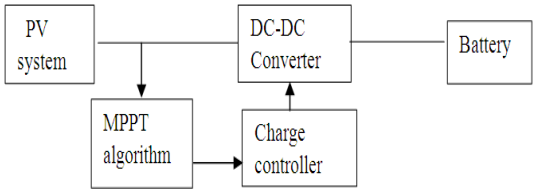


Fig. 2: Block diagram of system.

Photovoltaic Model

Solar panel when exposed to the sun, a DC current is generated. The generated current varies linearly with the solar irradiance. The equivalent electrical circuit of an ideal solar panel can be treated as a current source parallel with a diode as shown in Fig.3. There some losses exist in the real operation of the solar panel, to pick up these losses series resistance and shunt resistance are added to the PV system.

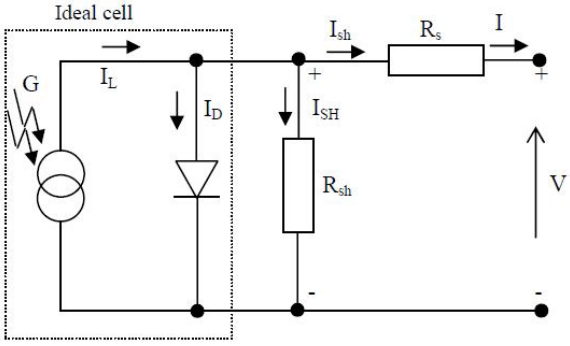


Fig.3: Equivalent circuit for PV system.

The electrical characteristic of solar cell used in the PN union is almost same as that of diode which is represented by the equation of Shockley[3].

PROGRAMMING AND SIMULATION OF THE MODEL

a) Charging of Battery

To draw maximum amount of power from the PV system, maximum power point tracking (MPPT) is necessary. Perturb and observe algorithm is very popular because of its ease of implementation and simplicity[2]. The module voltage is perturbed by a small increment, and the result change in power is observed. If the change in power positive, the voltage

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

is adjusted by the same increment, and the power is again observed. This continues until the change in power is negative, at which point the direction of the change in voltage is reversed. Fig.4 represents the simulink block of solar panel and P&O method.

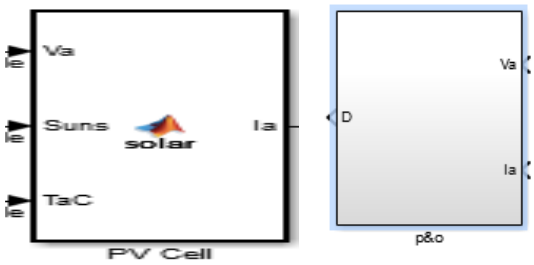


Fig.4: Solar Panel and P&O

Fig 5 shows the solar array system in simulink.

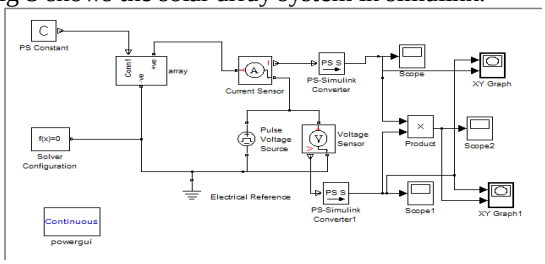


Fig.5: Solar Array simulink Model

DC-DC Buck Converter

A DC/DC converter consists of a number of storage elements and switches that are connected in a topology such that the periodic switching controls the dynamic transfer of power from the input to the output, in order to produce the desired DC conversion. To obtain stable voltage from Solar cell that is higher and lower than the output, buck-boost converters are especially used. The purpose of the DC/DC converter is to transform a DC voltage from one level to another. This is done by varying the duty cycle. The duty cycle is defined as the ratio of the "on" duration to the switching time period[8]. For step down voltage buck converter, step up voltage boost converter are used. DC-DC buck converter and subsystem is shown in fig.6

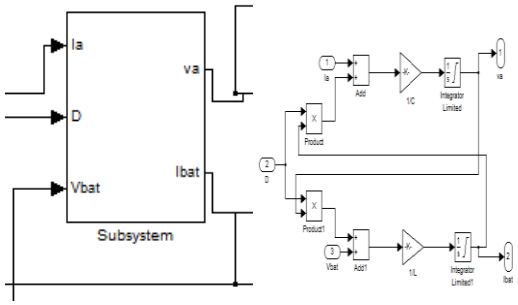


Fig.6: DC-DC Buck Converter and simulink

Battery:

The battery used in this EV system is lead acid battery of amron company. Four batteries are connected in series each of specification 12V/90AH to give voltage to BLDC motor as 48V. But in the battery charging system only one battery is connected to solar panel. And in the next section a subsystem of four batteries connected to BLDC drive is discussed.

b) Battery driven BLDC motor.

In the next phase of the work, the power which is stored in the batteries is used in driving the BLDC motor.In this phase the detail study of motor is done and simulated.The specification of the BLDC motor is given in Table 2.From the specification it's well understood that the required voltage to run the motor is 48V, while the rated voltage of a single battery is 12V.Thus to achieve the rated voltage of the motor; we are in need of four batteries which when connected in series can satisfy the requirement.

Table 2. Specification of BLDC motor

Power	850W
Rated Votage	48V
Running current	17A
Speed	1500rpm

The Brushless DC (BLDC) motor is used as the drive motor for the vehicle. It's a permanent magnet square wave motor. BLDC motor uses feedback directly of the rotor angular position so that the input armature current can be switched among the motor phases in exact synchronization with the rotor motion.The specification of the BLDC motor is given in Table 1.The reason for opting for the BLDC motor is because of its efficiency, noiseless operation, dynamic response and high torque to weight ratio. BLDC motor in simulink is shown in fig.7.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

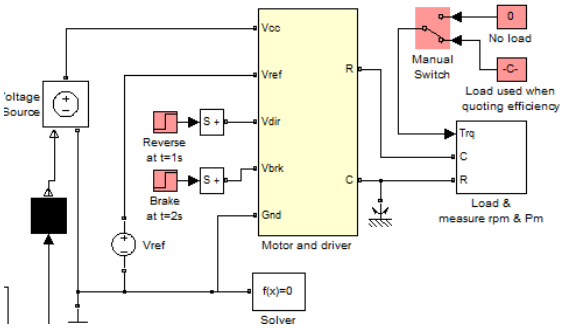


Fig.7: BLDC motor

SIMULATION RESULTS AND DISCUSSION

a) Charging System

The complet simulation model for battery charging system with the help of PV panel is shown in fig. 8. And results of this simulation like PV graph, voltage and SOC of battery are gathered in fig. 9.

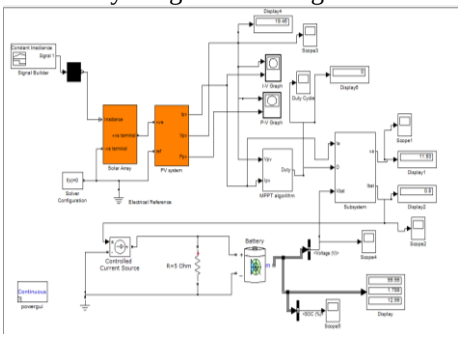


Fig.8: Battery Charging System

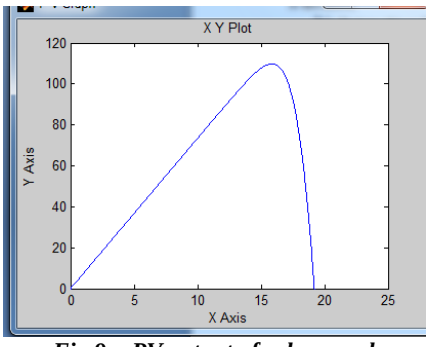


Fig.9a: PV output of solar panel

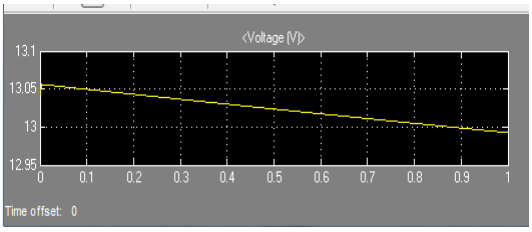


Fig.9b:Voltage of charged battery

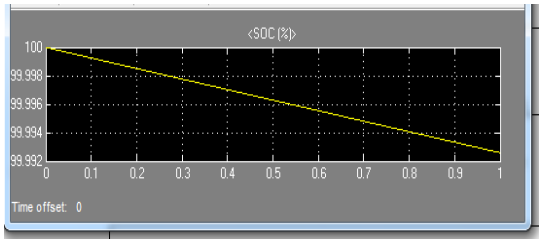


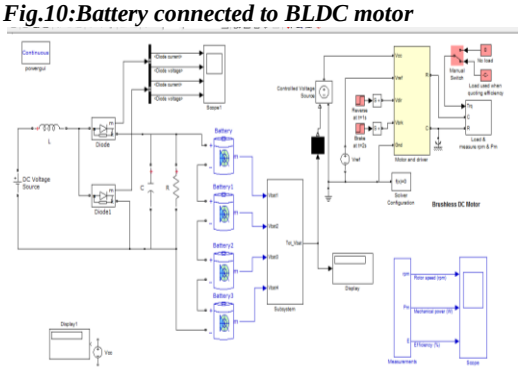
Fig.9c:SOC of charged battery

Above result shows that maximum generated power by solar panel is 115W. And after complete charging of battery its SOC is shown with its voltage.

b) BLDC motor fed by battery

Complete simulation model for a BLDC motor connected to battery is shown in fig. 10

Fig.10:Battery connected to BLDC motor



Simulation results are shown in fig.11. Fig 11a shows that if the battery is discharged with 17A then it takes complete 5 hours to discharge and corresponding speed and power of BLDC motor is shown in Fig.11b.

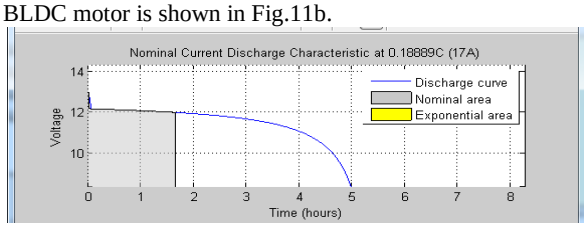


Fig.11a: Discharge characteristics of battery

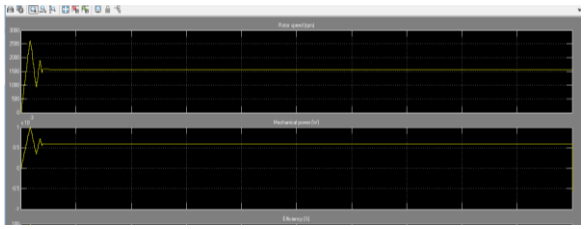


Fig.11b:Output of BLDC motor

CONCLUSION

This paper gives a clear idea that electric vehicle powered with the help of solar energy is more cost

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

effective than fuel vehicle. Simulation result shows that if batteries connected to load (BLDC) then it will take 5 hrs for complete discharge. Hence this result are supportive to prototype results.

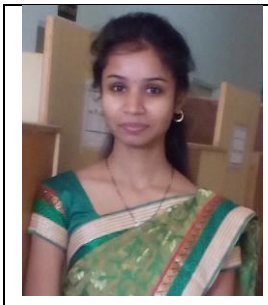
ACKNOWLEDGEMENTS

I take this opportunity of thanking my dissertation guide Prof. Atul A. Ghute, Assistant Professor Department of Electrical Engineering, PRPCEM, Amravati for his indispensable guidance, generous help, perpetual encouragement, constant attention offered throughout in preparation of this dissertation. This would not have been successful without enlightened ideas timely suggestion and been interest of him. I am grateful for the support and guidance provided by him, as and when required without who this project would have remained as a dream

REFERENCES

1. MiGa06] – Min Chen and Gabriel A. Rincón-Mora, "Accurate Electrical Battery Model Capable of Predicting Runtime and IV Performance", IEEE Transactions on Energy Conversion, June 2006; Vol. 21, No.2.
2. M. Azab, "A New Maximum Power Point Tracking for Photovoltaic Systems", in WASET.ORG, 2008; vol. 34, 571-574.
3. Priety and Vijay Kumar Garg, "To Perform Matlab Simulation of Battery Charging Using Solar Power With Maximum Power Point Tracking (MPPT)", International Journal of Electronic and Electrical Engineering. ISSN 0974-2174, Volume 7, Number 5 (2014), pp. 511-516.
4. Pradeep K Katti, Dr. Mohan K Khedkar; "Integrated Operation of Decentralised Resources for Rural Area Power Supply Applications"; 2005 IEEE/PES Transmission and Distribution Conference & Exhibition: Asia and Pacific Dalian, China.
5. Immanuel Alphonse, Dr. S. HosiminThilagar, F. Bright Singh; "Design of Solar Powered BLDC Motor Driven Electric Vehicle";International journal of renewable energy research Immanuel Alphonse et al.,Vol.2, No.3, 2012
6. Datasheet of Amron lead acid battery; 12V, 90AH.
7. Manual of Bajaj Three wheeler Fuel Vehicle.
8. Mahesh Gowda N M1, Yadu Kiran2, Dr. S.S Parthasarthy, "Modelling of Buck DC-DC Converter Using Simulink", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 7, July 2014.

AUTHOR BIBLOGRAPHY

	**Pallavi M. Mankar** M.E. [EE] student, PRPCEM, Amravati, Maharashtra
	**Prof. Atul A. Ghute** Assistant Professor, PRPCEM, Amravati. M.Tech [EE], GCOE, Amravati, Maharashtra