IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 5, May 2022
Impact Factor: 6.252

Development of Solar Based E-Bicycle

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Abstract: *Electric vehicles (EVs) stand out enough to be noticed attributable to their utilization of clean energy. Huge advancement in lithium-particle battery has pushed the improvement of EVs. In any case, the test is that developing number of EVs prompts gigantic interest in electric power, which will irritate the power framework load. This prompts an investigation for option and clean wellsprings of energy to charge EVs. This venture executes solar based energy framework to raise a charging station for EV application. The charging station utilizes multi-port charging. The charging regulators are worked in light of the idea of force equilibrium, and constant current/constant voltage charging.*

Keywords: Solar PV Module, Charge Controller, Energy Storage Device, ELDC Hub Motor

I. INTRODUCTION

This project is about the usage of solar energy to power up the vehicle. In order to achieve the required voltage, the Photo Voltaic (PV) Module may be connected either in parallel or series, but it's costlier. In many developing nations like India petroleum is imported at very large scale and very excessive subsidy is furnished by using authorities to the people, which purpose losses of cost-effective growth. A proper energy management system is needed to control the energy uses, every single watt of stored energy have importance in electrical vehicle. The voltage is then boosted up using the boost power converter, ultimately running the BLDC motor which is used as the drive motor for our vehicle application. In the course work, the characteristic features of the components; solar panel, charge controller, battery, power converter and BLDC motor required for the vehicle application. The demand for energy is increasing due to the increase in population and the economic conditions of many countries. Recent research works reported that fossil fuels have limitations such as global warming, limited resources and economical issues. The energy crisis is expected in the near future and the utilization of renewable energy is to be explored to the maximum possible extent to overcome the problems that arise out from fossil fuels. Many researchers suggested the use of renewable energies considering many environmental aspects. Renewable energy such as solar energy can be an effective alternative in terms of its availability, cost-effectiveness and environmental friendliness. The team's research indicated a benefit to the campus for such a structure and also for improvement on other existing charging stations.

II. METHODOLOGY.

The primary block of this flowchart involves four PV Module which is fundamentally a multicrystalline PV module. Every module has the rating of 12V, 50W so according to our need we interface them and get the expected result for the application. The result coming from PV module is then given to Distribution board which will give the expected voltage level to satisfy our necessities. Then the following and most significant block of this flowchart who is answerable for assuming command over engine and energy stockpiling gadget. The different capacity of regulator is to screen battery voltage and gave expected contribution to the engine.

2.1 PV MODULE

It is 50W, 12V multicrystalline solar powered PV module, additionally it is made by associating photovoltaic (PV) cells. They are comprised of semiconductor material like translucent silicon.

Solar powered PV modules convert light energy from sun into electrical energy. Ordinarily, solar based PV module appraised at 50W to 350W. Sunlight based PV modules are utilized for supporting the power result of PV cells by associating them.

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Solar based PV modules are utilized to increment power result of PV cells by interfacing them.
At the point when PV cells (present in sun-oriented module) assimilate daylight, energy contained in light photons is moved to semiconductor material.
It is 50W, 12V multicrystalline sun-oriented PV module, additionally it is made by associating photovoltaic (PV) cells.
50-Watt 12-volt monocrystalline sun powered charger is the ideal introduction board for solar based fledglings, or for prepared clients needing a little sun-oriented arrangement.
It has a key element which is it is a solid and it has progressed exemplification material with diverse sheet covers to improved cell execution and offers a long assistance life.

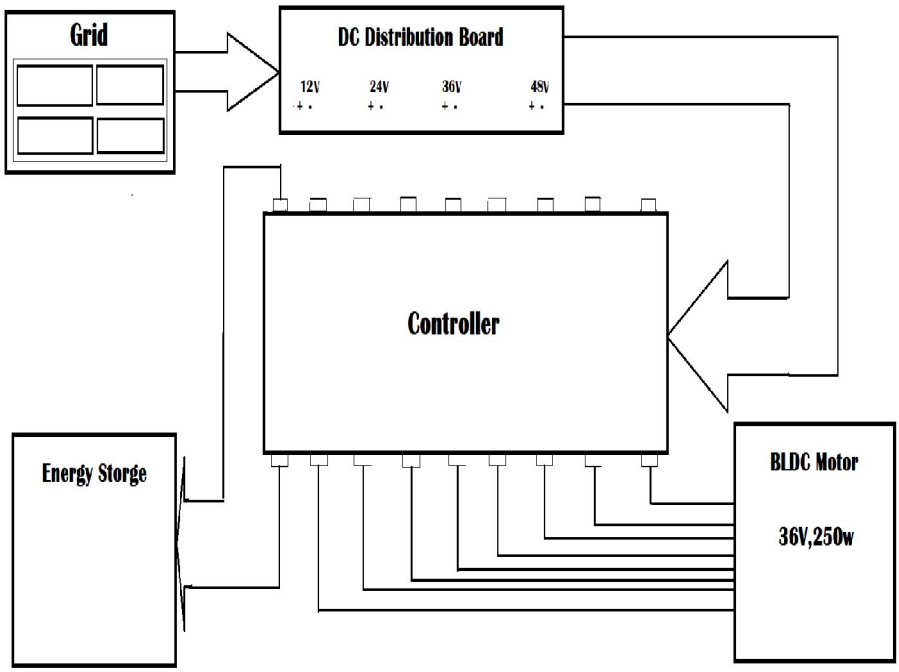

Figure 1: Block Diagram

2.2 CHARGE CONTROLLER

A charge regulator or charge controller is fundamentally a voltage and current controller to help batteries from cheating. It directs the voltage and current from the solar based chargers going to the battery.
Kinds of Charge Controller:

1. Linear Charge Controller
2. Pulse width Modulation (PWM)
3. Maximum Power Point Tracking (MPPT)

2.3 MAXIMUM POWER POINT TRACKING

To work on the effectiveness of a solar based charger, utilization of MPPT, which is a power electronic gadget, comes into picture. By utilizing MPPT, the framework will begin working at Maximum Power Point (MPP) and produces its greatest power yield by identifying the most extreme radiation from the sun that falls on the PV module. The MPPT solar based charge regulator behaves like a DC transformer, which changes power from a higher voltage to a lower voltage level. On the off chance that the result voltage is lower than the info voltage, the result current will be higher than its feedback current so item P=V*I stay consistent. This condition infers that variance in power additionally mean changing of voltage and current qualities.
There are numerous strategies utilized for most extreme power point following a couple are recorded underneath:

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- Perturb and Observe strategy
- Increment Conductance strategy
- Parasitic Capacitance strategy
- Constant Voltage strategy
- Constant Current strategy

2.4 ENERGY STORAGE DEVICE

36V 10AH LiFePO4 Battery for Electric vehicles collected by 12pcs cells in series. Energy has seriously contending innovation, excellent cell innovation, and strength. This innovation improves the portability, plan adaptability, and execution of the EV.

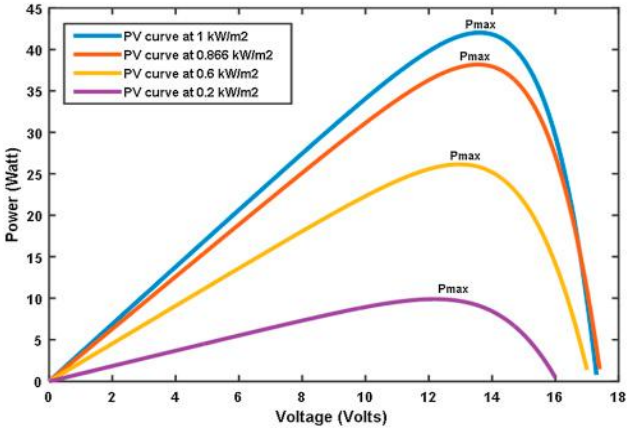

Fig.2. P-V Characteristics of solar PV panel

Fig.3. LiFePo4 Battery

Purposes behind choosing LiFePo4 energy capacity gadget:

Contrasted and other lithium family batteries packs which LiFePO4 battery gets have high proficiency energy change together to 95% and gangs the more life cycle up to multiple times than the other lithium family batteries packs life cycle about from 400 to multiple times. LiFePO4 battery packs is additionally entirely appropriate with power supply for electric engines and for power the board like power bike, unadulterated power bike and half and half vehicles applications, etc., and later on will turn into the standard of electric vehicles.

III. RESULTS AND DISCUSSION

Design Calculation:

Diameter of the bicycle wheel D = 0.66m, Radius r = 0.33mSpeed required N = 30km/h, Bicycle weight Wb= 20kg
Weight of the rider (Approximately) Wr = 60 kg, Total weight Wt = 80 kg

Power calculation:

Normal reaction on each tyreWn = Wt/2 = 40 kg
Force F = Wn * g = 40* 9.81 = 392.4 N

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Considering static friction:
Static friction coefficient u = 0.03
Fs = u * F = 0.03 * 392.4 = 11.77N
Torque Ts = Fs * r = 11.77 * 0.33 = 3.88 Nm

Considering dynamic friction:
Static friction coefficient u = 0.004
F_d = u * F = 0.004 *392.4 = 1.567 N
Torque T_d= F_d* r = 1.567 * 0.33 = 0.517 Nm

Angular Speed:
w = velocity/radius = 30,000/ (0.33*3600) = 25.25 rad/sec

Power Requirements:
1. on plane Ground
For static condition
Ps = Ts*w = 3.88 * 25.25 = 97.97 W
For dynamic condition
P_d = T_d * w = 13.05 W
Overall power requirement = 97.97 * 2 = 195.94 W.

2. On inclined surface
Let angle of inclination a = 2
a] considering static friction
F = u * m*g * cos (a) + m*g sin (a) = 49.28 N
Therefore,
Power required = F*V = 447.33 W
Extra power required = 447.33 – 195.94 = 251 W

b] Considering dynamic friction
F = u * m*g * cos (a) + m*g sin (a)= 27.34 N
Power P = F*V = 262 W
By considering the above calculations we require 250W hub motor.

Charging adapter selection:
Charging current should be 10% of the Ah rating of the battery.
Therefore,
Charging current of adapter = battery Ah * (10/100) = 1 A
Due to some losses, we may take 1- 3 Amperes for battery charging purpose instead of 1 Amp. We select 36V 2.2A charging adapter.

Calculation of charging time of battery:
Charging time of battery by adapter = Battery Ah / charging current.
Charging time for 10Ah battery = 10 Ah/ 2.2 A = 4.5 Hrs.
It is for ideal cases…
Practically, it has been 40%lossescomes in case of battery charging.
Then 10*(40/100) =4Ah.
Therefore, 10+4 = 14Ah (10Ah + losses)
Now, charging time of battery = 14 Ah /2.2A = 6.3 Hrs.

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Determination of solar powered charger:

We utilize two panels of 50 W, 12V each having aspect 350mm* 550 mm associated in series to give 24V result.

Charging time of battery when charged by sunlight powered chargers:

Charging time of battery by connector = Battery Ah/charging momentum.

Charging time= 10 Ah/2.5 A= 4 Hrs.

The estimation gives the necessary rating of the gadgets that are to be utilized in the undertaking. These appraised parts are gathered in an appropriate way to foster our task. The results of every one of these are broke down and talked about.

Maximum Power (Pmax)	50W
Maximum Power Voltage	19.95v
Maximum Power Current	2.51A
Short Circuit Current	2.63A
Open Circuit Voltage	22.26v

IV. EXPERIMENTAL SETUP

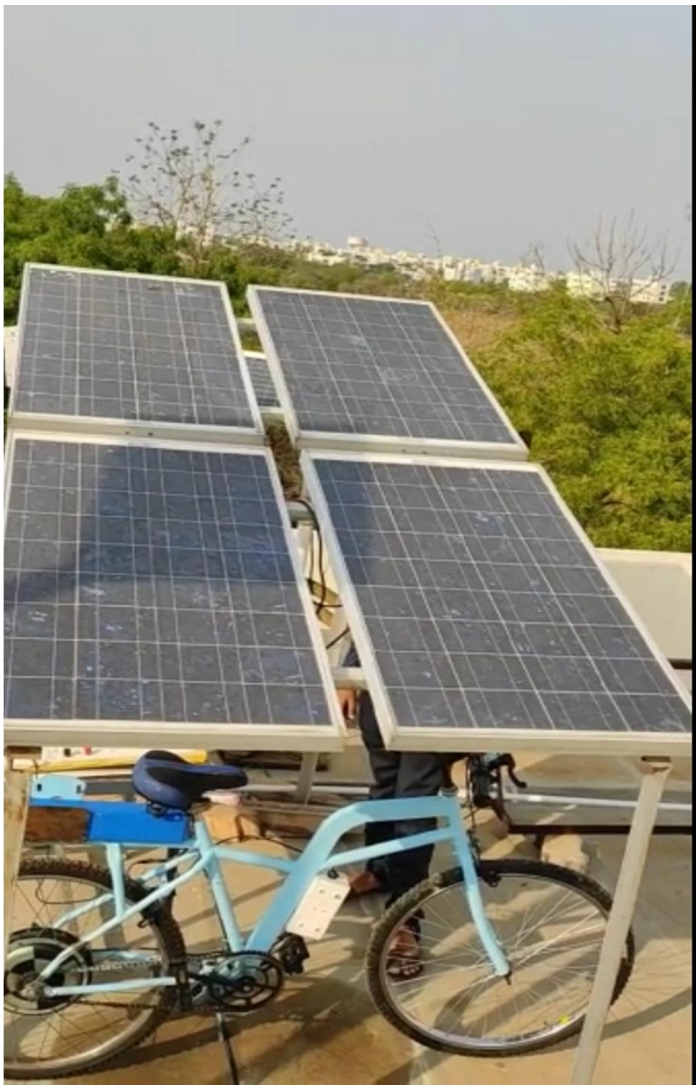

Fig.4. Final Module

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In this project, we are developing the renewable energy powered E-Bicycle in which the source of energy is sun from which the radiations are captured by the Solar PV Module installed in our charging station and then it will convert the solar energy into electricity which will be given for charging of our E-Bicycle.

The main components of this model comprises Solar PV Module, Charging Adapter, LiFePo4 Energy Storage Device, Charge Controller, BLDC hub motor and ratings of this components are selected according to the application. The main component of this E-Bicycle is the charge controller that performs the whole controlling action from taking supply from the source and then charges the energy storage device in the healthy condition. There is a switch connected near the pedal of the bicycle that turn ON the E-Bicycle and the battery is then connected to the motor through controller which supplies the right amount of current to be delivered during the different condition of operation.

In this setup we implemented an idea that make use of solar energy with the help of two solar panels having rating of 50 kW and 12v each connected in series to fulfill the requirement of our load, so as per the BLDC hub motor rating 250W 36v, the rating of battery is selected LiFePo4 10Ah 36v, charge controller having the same rating as motor and battery which is 36v.

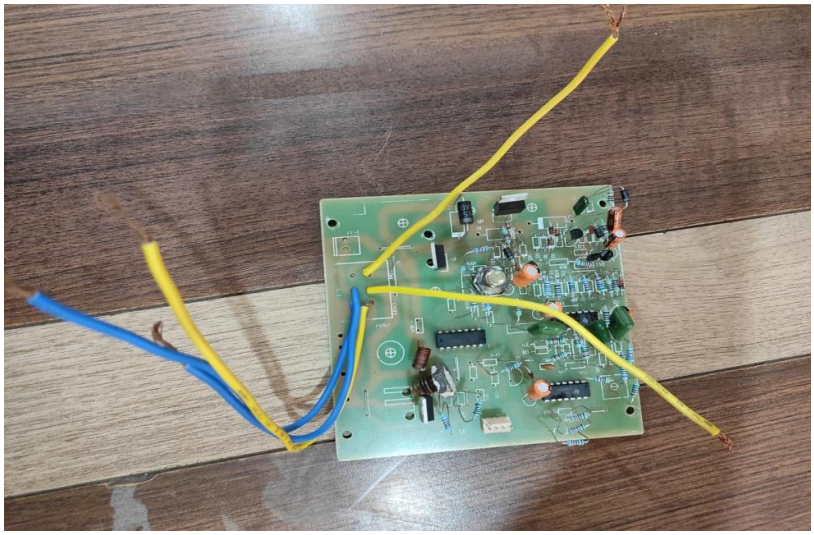

Fig.5. PWM based MPPT charge controller

V. CONCLUSION

After every one of the examinations and portrayal, we can say that on the off chance that the thought recommended by us is executed, the ordinary petroleum worked bike can be supplanted by our sun powered based E-bike and furthermore number of charging station will increment and uncommonly the sun oriented based EVST. Then, at that point, there will be decline in energy interest from the Grid. At last, the fossil fuel byproduct will diminish and contamination will be less the energy hole among request and supply of power will be decreased and everyday utilization of power will be given everybody. As India is a non-industrial nation so it will help in developing the economy additionally, as number of charging station will expand, the interest for EV will likewise increment and additional assembling units will open. It will make a greater number of open positions and fortify the economy.

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