Design And Analysis of Integrated Solar Charging Station With Fuel Station

Chinmay Shetye[1], Aniket Rawool[2], Arpit Surve[3], Soham Shetye[4], Prof. Sumit S. Malusare[5]
[1, 2, 3, 4] Dept of Mechanical Engineering
[5]Associate Professor, Dept of Mechanical Engineering
[1, 2, 3, 4, 5] Academy of Management and Technology, Ratnagiri

Abstract- *The plenty of solar radiation reaches towards earth the use of this energy as power source in electric vehicle can help in reducing the pollution made by gasoline vehicle. The below study present a model for charging electric cars with help of IoT applications. Our model help to determine various data related power station like voltage of solar, main battery voltage, solar current etc. Most rural area facing problem of lack of electric grid so such technique suitable for rural areas*

Keywords- IoT, Solar panel, Electric vehicle, Blynk, solar charging station, green ev, green charger, Node mcuesp8266

I. INTRODUCTION

Indian government plans to build thousands of EVs charging station infrastructure on national highways to match up with the increasing number of EVs in our country. But the main problem arises to build a EVs charging stations on national highways at rural areas is lack of electricity power supply. So, off grid Solar Power Charging Station is an optimal solution in rural areas. The system we had designed gives the real time information of solar, battery, vehicle battery and also shows this information in graphical format.

In this study IoT is used along with voltage, relay module to monitor the real time status of different components. The information consists of voltage of solar panel, voltage of storage battery, voltage of charging vehicle battery. With the help of sensor based program on Arduino software we try to generate the output parameter in graphical form on the Blynk app

II. PROBLEM STATEMENT

- Electric vehicles are becoming increasingly popular in many countries of the world.
- EVs are proving more energy efficient and environmental friendly than ICVs.
- So integrating solar power station with existing fuel pumps is helping the fastest changing infrastructure.
- As EV usage grows, more public spaces are installing EV charging stations.
- There is lack of electric supply in remote areas so solar power can be optimum solution

III. PROJECT OBJECTIVE

- Design an on-grid solar power station for EV charging.
- Analyse various combinations of solar panel connections for maximum efficiency.
- Remotely monitoring the real time solar power station data such as power and charging status.
- Calculating distance between the power station and EV so it can help traffic management on solar power station.
- Using Blynk app on android to monitor the output results

IV. LITRATURE REVIEW

The several researchers carried out study in various types of solar powered charging station wherein the attempt has been made to design power efficient and affordable station. The study is extended to analyze influencing parameters like incident sun light, temperature, quantity of irradiation, direction of sun, dust on the solar panel, location of solar panel etc. Before starting any theoretical or experimental work it is preferable to review the research paper and reports available to public access. In view of the importance of literature study, the theoretical and experimental studies performed earlier by various researchers are presented in the current chapter.

1. Kondracki, Ryan; Collins, Courtney; Habbab, Khalid: - They were conducted research on building solar powered charging station which will provide power to charge devices using power generated from solar energy
2. Ilhami Colak; Ramazan Bayindir; Eklas Hossain; Sabri Sayilgan: -They proposes design of a model for a PV based electrical vehicle that forecasts total power output under particular conditions of Ankara city. First PV cell parameters are determined and then PV array formed including cells designed in order to calculate cumulative effect. Using actual irradiation

and temperature values They try to catch an approximation of output power for the future needs.

3. Jessica Robinson; Gary Brase; Wendy Griswold; Chad Jackson; Larry Erickson: - They Works on business model for solar powered charging stations to develop infrastructure for electric vehicles. They also done various surveys and various types of electric vehicle and their power rating
4. Aygegul Tagçjollu; Onur Tagkjn; Ali Vardar: - Within the scope of this study, time dependent power performances and power values of mono-crystalline and polycrystalline solar panels under different loads were intended by determining total and direct radiation and temperature values for Bursa, Turkey. The optimal tilt angle of solar panels used within this scope was adjusted to be 27∘, and they were positioned to face south. Similar analyses were made to choose optimal tilt angle for the solar panel in order to collect the maximum solar radiation in Madinah Saudi Arabia. It was found that the loss in the amount of collected energy when using the yearly average fixed angle is around 8%compared with the monthly optimum tilt angle
5. Stephen Lee; Srinivasan Iyenga; David Irwin; Prashant Shenoy: - They work on various type of analysis like Utilization and Fairness analysis, Battery level analysis, Impact of solar power intermittency in charge allocation, Feasibility analysis of solar-powered charging station.

V. COMPONENT SELECTION

i. Solar Panel

Our team have use total 6 number of solar panel which has rated output as 40 watts each. The solar panels cover about 75% of total cost. Total out we get is about 240 watt. The solar panel are connected in parallel.

ii. Charge controller

The charge controller is used to control solar charge as the current and voltages generated by solar panel are not constant and fluctuate throughout the day. Charge controller has rated current output as 20A.the charge controller control the rate of the current and voltage to prevent battery from overcharging.

iii. Microcontroller (Node MCU)

Node MCU is special microcontroller board which is compatible with Arduino platform. It is based on ESP-8266 Wi-Fi development module. Similar like other microcontroller board, node MCU also offers several GPIO pins I.e. General purpose input output pins to interface various sensors, actuators

iv. IC CD4067BE

The CD4067BE; 74HCT4067 is a single-pole 16-throw analog switch (SP16T) suitable for use in analog or digital 16:1 multiplexer/de-multiplexer applications. The switch features four digital select inputs (S0, S1, S2 and S3), sixteen independent inputs/outputs (Yn), a common input/output (1) and a digital enable input (Vss). When Vss is HIGH, the switches are turned off. Inputs include clamp diodes.

v. Relay & Voltage sensor

Relay module is used for switching the supply from the main battery to on/off. It is controlled by the ESP8266 and the power for the relay module is supplied from a 5v battery. The voltage sensors are used for checking the voltage at the node points in the circuit. They can operate the voltage between 0-25 volts. We have used 3 of them in our system

vi. Battery

The battery used by us is based on lithium ion technology and suited best for the charge controller. It holds capacity of 32 Ah and can charge around 25 small dry cadmium cells used by us in project

vii. Cadmium cell

These are small dry cells used in our project to represent the vehicles coming on the charging station. Each set of cells holds capacity of 1Ah.

viii. Mobile platform monitoring

The mobile platform used by us to monitor the project and also to manage traffic is BLYNK App. This is free app which helps to develop the platform to create the iot monitoring app. Also allows to launch the app on the play store in minimal cost

VI. SOLAR PANELS CONNECTION AND OUTPUT

- Solar panel specification

Type of product	polycrystalline solar panel
Rated power range	30-40 W
Current	2.20
voltage	18.20

We have tried various combination of solar panel connection by theoretically as bellows.

1. All panels are connected in series.
   Output voltage-109.2Volts
   Output current-2.20Amp
2. All the panels are connected parallel
   Output voltage-18.20Volts
   Output current-13.2Amp
3. (2-2-2) panels are connected in series and connected in parallel to each other.
   Output voltage-36.40Volts
   Output current-6.60Amp
4. (3-3) panels are connected in series and then parallel to each other.
   Output voltage-54.6Volts
   Output current-4.40Amp
5. (3-3) panel are connected in parallel and then in series.
   Output voltage-36.40Volts
   Output current-6.60Amp

From above calculation we have selected the 2 combination i.e. all panel are connected in parallel which gives output that is required by our system

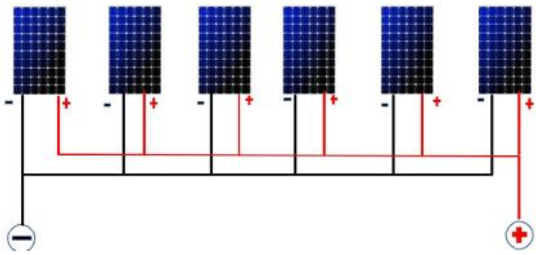

Fig 1-parallel connection of solar panel

VII. SYSTEM DIAGRAM

1) SYSTEM MODEL

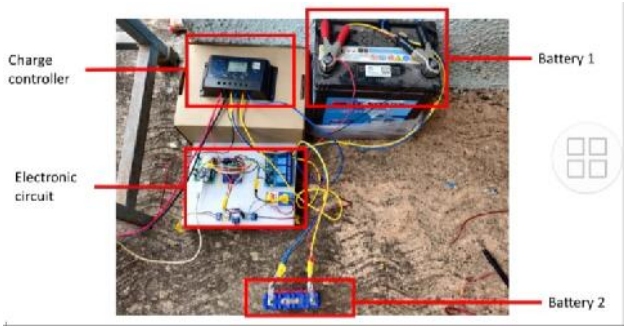

Fig 2-exact model of our project

The above photograph shows exact model of our project. The charge controller have 1input, 1 ip/op, and 1 output port which are connected to solar panel ,main battery and the charger circuit respectively. On every nodes of solar panel, battery, load output the sensors are connected to get exact voltage. The battery two representing the vehicle on the charging status

2) ELECTRONIC CIRCUIT

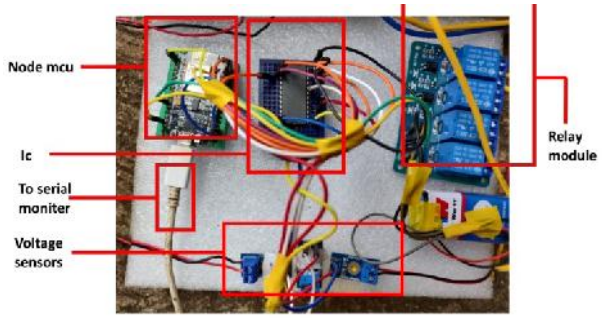

Fig 3 – electronic circuit

Here in the electronic circuit of the project the ic is used to take the voltage reading from the various nodes of the circuit and pass to the single analog input of the esp8266. Microcontroller {ESP8266} is connected to the serial monitor screen of laptop. The relay is supplied high voltage from charge controller to charge the vehicle and controlled by the microcontroller the power supply to the relay is provided with 5 v battery

3) FLOW CHART

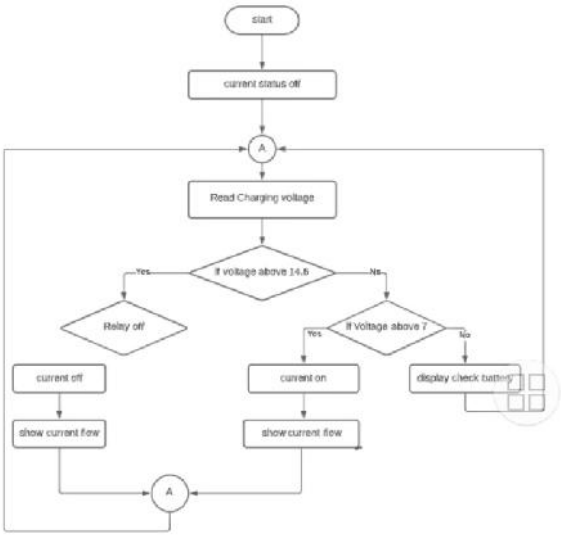

Fig4 -Automated power cutoff charger flow chart

VIII. RESULT

1) SENSOR DATA COLLECTED AT SERIAL MONITOR

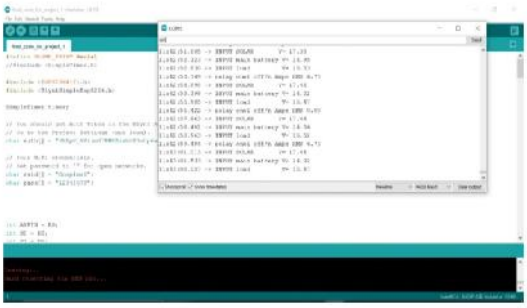

Fig5-sensor data collected at serial monitor

This is the data obtained on the serial monitor screen delivered by the microcontroller .We get this data in real time

2) FUNCATIONAL STATUS OF POWER ON MOBILE SCREEN

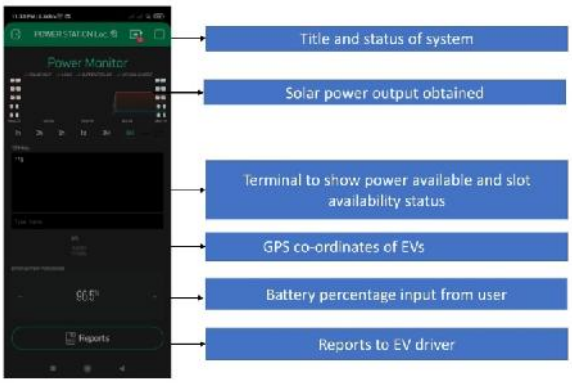

Fig 6- mobile screen

3) ACTUAL GRAPH

Fig7- graph shows the entire monitoring of the system where the graph lines are colour coded to get better

Looking at the above graph, we can conclude that automatic cut-off charging is achieved. From the above graph we can say, current flowing through circuit is high when the battery is charging and low at other points

IX. CONCLUSION

[1] We get desired output on Blynk as we expected which is reliable and accurate (if compared with the data obtained manually by using multi-meter).
[2] Solar & battery voltage Monitoring was successful and real time graph is displayed on mobile screen.
[3] When Battery gets fully charged the charging is cut-off automatically.
[4] We get GPS co-ordinates of EV so that we can manage traffic and provide slot availability to them.

X. FUTURE SCOPE

[1] Increasing number Evs can provide ample of business opportunities.
[2] This can help youth of remote areas to get employment.
[3] The system can be integrated with the new technologies of future to obtain the higher efficiency.
[4] Gov. can create organization to make this project work under them and can achieve there goals green energy.

REFERANCES

[1] Balo, Figen, and Lütfü Şağbanşua. "The selection of the best solar panel for the photovoltaic system design by using AHP." *Energy Procedia* 100.100 (2016): 50-53.
[2] Karraker, D. W., Gokhale, K. P., & Jussila, M. T. (2011). *U.S. Patent Application No. 13/151,766*.
[3] Kazem, Hussein A., et al. "Effect of shadows on the performance of solar photovoltaic." *Mediterranean Green Buildings & Renewable Energy*. Springer, Cham, 2017. 379-385.

[4] Khan, Wajahat, Furkan Ahmad, and Mohammad Saad Alam. "Fast EV charging station integration with grid ensuring optimal and quality power exchange." Engineering Science and Technology, an International Journal 22.1 (2019): 143-152.
[5] Lee, Stephen, et al. "Shared solar-powered EV charging stations: Feasibility and benefits." 2016 Seventh International Green and Sustainable Computing Conference (IGSC). IEEE, 2016.
[6] Mehrjerdi, Hasan, and Reza Hemmati. "Electric vehicle charging station with multilevel charging infrastructure and hybrid solar-battery-diesel generation incorporating comfort of drivers." *Journal of Energy Storage* 26 (2019): 100924.
[7] Robinson, Jessica, et al. "Business models for solar powered charging stations to develop infrastructure for electric svehicles." *Sustainability* 6.10 (2014): 7358-7387
[8] SEZER, MEVLÜDE, and MERT ARPACIOĞLU. "Unicharge: An Application for Smart Charging of Electric Vehicles."
[9] www.saurenergy.com
[10] www.buildwithrise.com
[11] www.Energyworld.com
[12] Solar powered EV charging station developed by Indian Institute of Science, Bengaluru
[13] EV Charging Definitions, Modes, Levels, Communication Protocols and Applied Standards on www.researchgate.com
[14] Solar Panel Supplier Selection for the Photovoltaic System Design by Using Fuzzy Multi-Criteria Decision Making (MCDM) Approaches article published on Energies.
[15] Charging electric cars from solar energy by Blekinge Institute of Technology.