



# Design of Reconstructed Solar Array and Segmented Battery Management to Improve Converter Efficiency

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**ABSTRACT:** Solar panel is a power source having nonlinear resistance. As the intensity of light falling on the panel varies, its voltage as well as its internal resistance both varies. To extract maximum power from the panel, the load resistance should be equal to the internal resistance of the panel. Maximum power point tracker (MPPT) are used to operate a photovoltaic panel at its maximum power point in order to increase the system efficiency. Maximum Power Point Tracking algorithms (MPPT) are used to track Maximum Power, a DC-DC boost converter is used to obtain the impedance matching between the PV array and the load. The recent trends in the MPPT converters in PV systems which are researched extensively to improve the design, modified closed-loop converter technology based on SoCis presented here. This paper aims to provide detailed information on the modern-day solar Maximum Power Point Tracking (MPPT) controller and Battery Management System (BMS). Most MPPT controller examination researched in the pastis suitable only for fixed rated battery capacity which limits the converter capability and applications. The proposed paper here uses the distributed energy management control technique to dispatch multi-battery charging based on the State of Charge (SoC). The converter construction is modified here as per the prerequisite of the model. The system hardware is developed and tested using Atmega2560 low power RISC based high-performance microcontroller. The batteries SoC level and State of Health (SoH) is calculated using embedded sensors and communication platform is through the IoT platform and Global System Monitoring (GSM) technology.

## I.INTRODUCTION

The reconfiguration strategy is based on the fact that, on one hand, the maximum power point (MPP) voltage has a small variation within a wide range of the irradiance on a PV module, and, on the other hand, that the MPP current of a PV module can be considered nearly proportional to the irradiance value. The overall system performance was verified by the hardware prototype. The automatic reconfigurable pattern of the solar panel resulted in excellent MPP tracking ability under partial shading effect. The converter has ability to perform based on the rated battery connected as load. The converter designed for 12v, 24v and 48 v respectively. These voltage levels are automatic achieved by variable switching technique. Battery SoC and SoH are calculated for individual and entire series connected system. In addition that it provides accurate result in automatic charging and discharging and also it indicates the other problems like charging relay failure and discharging relay failure. Renewable energy plays a vital role in the energy sector. The renewable energy sector has witnessed phenomenal growth in recent times. Despite the recent pandemic and looming uncertainties, the development of renewable energy remains strong, and the industry saw an increase of 15% from January 2020 to October 2020 as opposed to for the same period. It is expected that the renewable energy sector is set to grow by about 4% globally reaching upto 200GW predominantly led and dominated by China and the United States. Among them, solar power PV sector is estimated to jump by 30% in many countries. IEA estimates that the sector is likely to witness a surge in Europe and India by 2021 and is expected to peak by 10-12% (IEA, 2020).Insights from the world data indicate the total solar energy generated accounted for 2000 giga watts indicating that the renewable energy investments across the global have gone up



substantially (RE, 2018) with an annual growth rate of over 20% in most developing countries. This phenomenal growth also reduced the weighted cost of electricity by 26%, while solar alone accounted for a (Venkatachary et al., 2020).

### II.LITERATURE REVIEW

Abdel Rahim and Wang et al(2020) propose an improved DC/DC model predictive control based MPPT (MPC-MPPT). Unlike the PV DC/DC converter where traditional MPC based converters employ two voltage and one current sensor, the proposed model employs two sensors with a view to reducing the costs. The improved model is also said to operate on both fixed and variable switching frequency. The test result of the suggested model is said to improve the gain by ten times the input voltage with an efficiency of 93%.

#### Relevance to current Research

Rezk et al(2019) propose an adaptive fuzzy logic-based system and demonstrate their model in a simulated C-Block PSIM software-based environment and verify the feasibility on a floating-point digital signal processing controller (TMS320F28335). They conclude that the proposed model exhibits greater consistency and accuracy on the output power of the PV system.

#### Relevance to current Research

Patnaik et al (2019) proposes a Constant Current and Constant Voltage (CC & CV) based power converters. Among the battery charging techniques, the most commonly used charging mechanisms employ open-loop approach. The need for closed-loop instantaneous cell charging techniques is essential to a faster charging on the batteries. Therefore, a closed-loop Constant Temperature Constant-Voltage Charging Technique(CT-CV) charging control was proposed by Patnaik et al., where the battery cell temperature is maintained by implying closed control temperature control mechanism. The results indicated faster charging time by over 20% rather than a conventional CC-CV charger (Patnaik et al., 2019).

#### Relevance to current Research

Tan et al (2020) study State of Health (SoH) estimation strategy dependent on the Equivalent Internal Resistance (EIR). The results indicate that the relation between EIR and battery deterioration can be predicted with greater accuracy and ensure efficiency and monitoring of the batteries.

#### Relevance to current Research

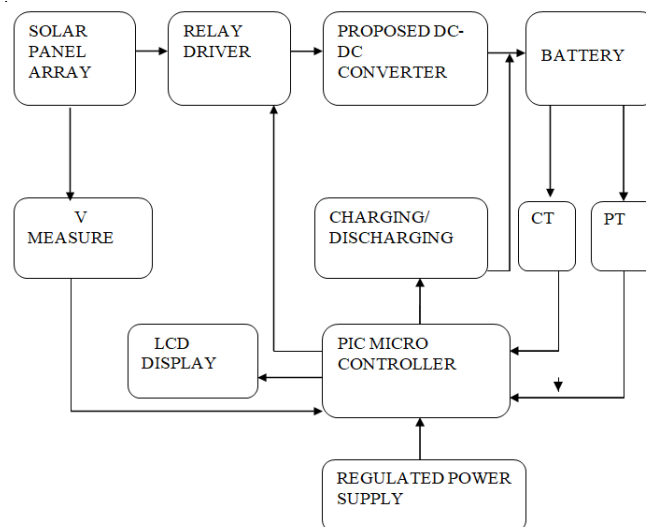
Sony et al (2019) study Convolutional Neural Network and Long Short Term Memory(CNN-LSTM) networks and train the network using data collected from discharge profiles. The trained results indicate that the network records the data the relationship of the SoC and variables and exhibit smooth and accurate results. The experimental result of CNN and LSTM network record the real value of SoC even under nonlinear conditions and the Root Mean Square Error (RMSE) as low as 2%. To overcome some of the problems in SoC like in cubature kalman algorithms, Zhang et al. present a modified algorithm using Adaptive Weighting Cubature Particle Filter.

### III.METHODOLOGY OF PROPOSED SURVEY

The experimental setup states the rating of 48V lithium-ion battery charging scheme with the ampere rating of 2.5 Ah. The initial stage of the model is the renewable charging scheme. The input charging section consists of the solar panels that have the structure of reconfigurable that is adapted with respect to the power generated by the panels. The feedback from the panels is fed to the microcontroller that has the sensing unit Analog to Digital Converter (ADC) it is calibrated and based on the reference threshold value. If the panel power not sufficient to the input of the converter, it is adjusted with

series and parallel connection to balance the power. It is a circuit, typically a DC-DC converter used to extract the maximum and efficient power from the Solar array. The process is called Maximum Power Point Tracking as it tracks the max power value that can be extracted from the panels any time during its operation, which is available for efficient conversion. To overcome some of the problems in SoC like in algorithm using Adaptive Weighting Cubature Particle Filter.

The power produced by PV panels depend on various parameters including external sunlight(Irradiance value) and internal load side characteristics(Current,voltage,frequency, resistance...typically the load).So in order to get the most out of the PV array MPPT tracks the best output(Max Point on an IV curve)which the array can output at a given time and holds that point and produces an arbitrary load characteristic against the PV array so that maximum output is pulled into the circuit, which can be filtered, regulated and converted to desired load characteristics to feed the load.(Here the power is not boosted, but the voltage and currents are manipulated for desired output).



**Figure.1 Block Diagram of Proposed System**

The second part of the model is the charge controller that is the converter side. The driver circuit for the converter is designed with the SG3525 PWM generation IC. It has the technique of closed-loop PWM generation, that is the controller adapts to the battery current voltage. This adoptive charging technique eliminates the normal charging scheme. The duty cycle of the converter adjusted depends on the battery current voltage levels. This is shown in fig 3.4 The third part of the model is the SOH and SOC. In this part, battery maintenance and protection form the core. The battery parameters like voltage, current and temperature measurement are controlled using sensors. In this paper, the SOC is calibrated by the ESI reference. The voltage divider rule measures the battery voltage. The battery voltage is limited between the 5V for the protection of microcontroller PIC microcontroller chip.

As the input in battery varies, the PIC microcontroller chip will recalibrate. The system, in turn, regulating the charging and discharging with the help of the relay driver circuits. This model uses the PIC microcontroller native source code as developed by the Arduino IDE software platform.

#### IV.RESULT

The overall system performance was verified by the hardware prototype. The automatic reconfigurable pattern of the solar panel resulted in excellent MPP tracking ability under partial shading effect. This proved Instead of tracking single solar

panel tracking multi panel tracking always have the higher efficiency. The hardware result tested by dual panel. In future need to develop multi panel configuration pattern. But it having some complexity that good be avoid by machine learning approach. The converter has ability to perform based on the rated battery connected as load. The converter designed for 12v, 24v and 48 v respectively. These voltage levels are automatic achieved by variable switching technique. Battery SoC and SoH are calculated for individual and entire series connected system. In addition that it provides accurate result in automatic charging and discharging and also it indicates the other problems like charging relay failure and discharging relay failure.

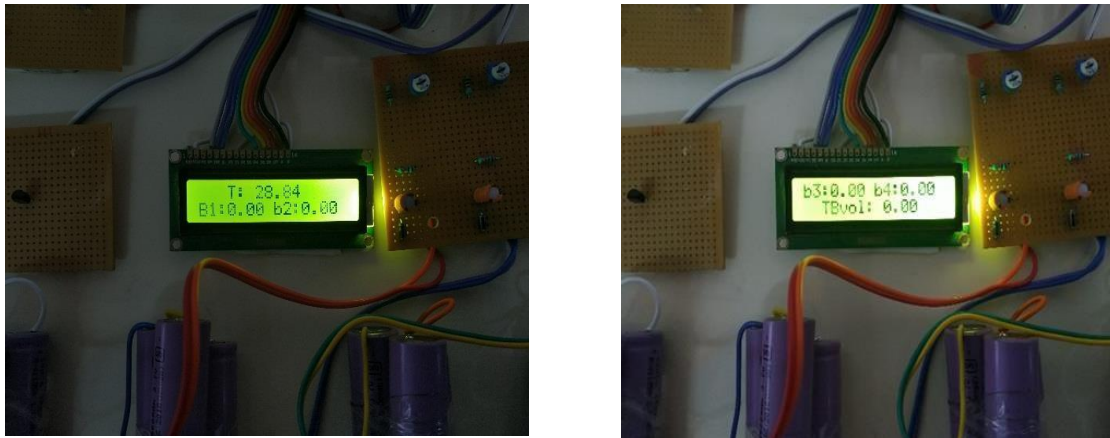


Figure 2. Battery State is in OFF Condition.

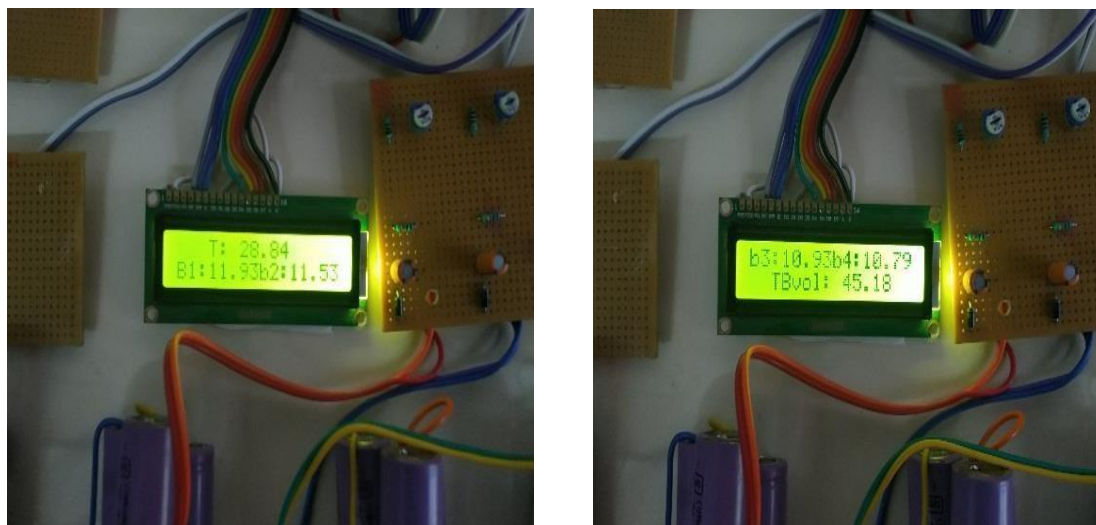


Figure 3. Battery State is in ON Condition

#### IV.CONCLUSION AND FUTURE WORK

Thus the “Design of Reconstructed Solar Array and Segmented Battery Management Strategy to Improve Converter Efficiency” has been designed successfully. It has been developed by integrated features of all the hardware components used.. The designed system discussed above, shows prominent advantages and can be implied in day to day life usage at small scale as well as large scale purposes.

With the growing emphasis on environment friendly technologies in the energy conservation sector, it is more important to save the power for our future generation. Avoiding the wastage of power is much more important then, now an the



power may be inadequate. .. The designed system discussed above, shows prominent advantages and can be implied in day to day life usage at small scale as well as large scale purposes.

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