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Development of Battery Management System for PV Generation

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ABSTRACT: Photovoltaic is a renewable energy resource. Photovoltaic array converts sunlight into direct-current electricity. Energy generation is increased by tracking the solar panel. The solar tracker is based on a PIC16F877A microcontroller. This microcontroller based charge controller is designed to detect the sunlight through the LDR and then actuate the dc motor to position the solar panel where it can acquire highest sunlight. The main functions of a charge controller system are to control the voltage and current from solar panels. A power electronics circuit is used in charge controller to get more efficiency, availability and reliability. Simulation results for PV cell are obtained using the MATLAB.

KEYWORDS: Photovoltaic system, solar tracker, Battery management system, PIC microcontroller

I.INTRODUCTION

With the increased concerns on environment and cost of energy, more renewable energy sources are integrated into the power grid in the form of distributed generation (DG). The renewable energy source based DG systems are normally interfaced to the grid through power electronic converters and energy storage systems. A systematic organization of these DG systems, energy storage systems, and a cluster of loads forms a microgrid. The microgrid not only has the inherited advantages of single DG system but also offers more control flexibilities to fulfil system reliability and power quality requirement with proper management and control.

Photovoltaic source is becoming more and more used as a renewable source since it offers several advantages such as incurring no fuel, not being polluting and no emitting noise. PV modules have low conversion efficiency hence, controlling MPPT is essential in a Photovoltaic system. Many methods have been developed to determine the maximum power point. LDR is used to control the PV panel tracking system. The capability of the photovoltaic system to meet the power requirement depends on the atmospheric conditions. Due to the fluctuation nature of photovoltaic energy source, batteries are added in order to ensure continuous power-flow

Rather than using fossil fuel, energy storage such as battery can be used to provide fast frequency regulation, load following and ramping services when the DGs are integrated into the power grid. Developments in lithium-ion battery technology show many advantages compared to lead-acid batteries and nickel-metal hydride batteries, such as high power and energy density, high working cell voltage, low self-discharge rate and high charge-discharge efficiency. Battery management system and the control device which controls the Working mode and grid interfacing with energy storage system. The Battery management system controller monitors the parameters of each battery cell, such as cell voltage, temperature, charge and discharge current. A charge controller is used to sense the battery voltage and current when the voltage gets increased. A charge controller can also be used for to open the circuit when the battery is to be fully charged without any harm to the modules.

II. RELATED WORK

Batteries are used to store the energy for emergency and IN night hour FOR domestic and industrial applications. To charge the batteries from the solar panel rated amount of current for rated time duration is required. Patil A. R, Atar K. D, Potdar A. A, Mudholkar R. R present paper on used the Fuzzy Logic Algorithm in battery charging process to improves the efficiency of battery charging process and improved the battery life.[1] K. Hemanth presents energy management system with fuzzy control for a dc microgrid system. To increase the life cycle of the battery, fuzzy control manages the desired state of charge. [2] Sofia Lalouni, Djamila Rekioua has proposed energy management

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algorithm to satisfy the load power demand and to the safety and extend the life of the batteries. [4]. D Ravi Prasad, Dr. B.Rajesh Kamath, K.R Jagadisha, S.K Girish proposes the solar tracking system increased the power efficiency of solar panel. [3] Hao Qian used High-Efficiency Grid-Tie for Battery Energy Storage System to increased efficiency of energy storage system.B.Murali, D.Sivakumar, Dr.G.N.Kodhanda Ramaiah used a three sensor in a three direction to sense the direction of more intensity of light. It use a pic16f877a microcontroller as a brain to operate this system and a stepper motor to rotate the solar panel. [6] V.Srimaheswaran, R.Uthirasamy used SPWM technique is used to generate the PWM signal for boost inverter switches and Boost chopper output is fed to multilevel inverter to obtained the stepped wave.[7] Zaki Majeed AbduAllah, Omar Talal Mahmood, Ahmed M. T. Ibraheem AL-Naib presents the design and practical implementation of a buck-type power converter for Photovoltaic (PV) system for energy storage application based on constant voltage.[8] Romy Kansal used PIC Based Automatic Solar Radiation which instantly gives best alignment of solar panel with the sun, to get more output.[9] Mohd Shawal Bin Jadin proposes Photovoltaic Charge controller based on microcontroller (PIC 16F877A) which Minimizes difficulty in the electronic components to increased monitoring .[10]

III. SYSTEM DESCRIPTION

Photovoltaic System

Photovoltaic is the area of technology and research related to the use of solar cells in order to convert sun energy directly into electrical energy. Due to the increasing demand for clean energy sources, the production of solar cells and PV arrays has increased significantly in recent years. Solar cells generate dc current from light, where it is used to power devices to recharge a battery.

Photovoltaic Arrangements

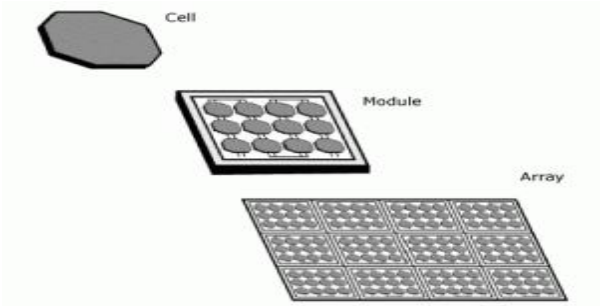

Fig: 1 Photovoltaic system

Fig.1 shows basic arrangements of Photovoltaic system such as cell, module, and array .The basic ingredients of PV cells are semiconductor materials, such as silicon. For solar cells, a thin semiconductor wafer creates an electric field, on one side positive and negative on the other. A PV cell can either be circular or square in construction. Because of the low voltage generation in a PV cell (around 0.5V), several PV cells are connected in series (for high voltage) and in parallel (for high current) to form a PV module for desired output. A photovoltaic array is an interconnection of modules which is made up of many PV cells in series/parallel. The energy produced by single module is not enough to meet the requirements of commercial applications, so modules are connected to form array to supply load. In an array the connection of the modules is same in a module.

Solar Tracking System

A solar tracker is an electro-mechanical system used for a solar photovoltaic panel in the direction of the sun Light. it is also dependent on the angle of incidence of the sunlight providing power to the solar cell's surface, The solar cell applications require a high accuracy in order to concentrated sunlight precisely to the powered device. Solar trackers may be single axis or dual axis which use motors for responding to the solar direction

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Modelling of PV Panel

The photovoltaic system can generate direct current electricity without environmental impact when is exposed to sunlight. The basic building block of PV arrays is the solar cell, which is basically a p-n junction that directly converts light energy into electricity. The output characteristic of PV module depends on the cell temperature, solar irradiation, and output voltage of the module. The Fig.2 shows the equivalent circuit of a PV array with a load.

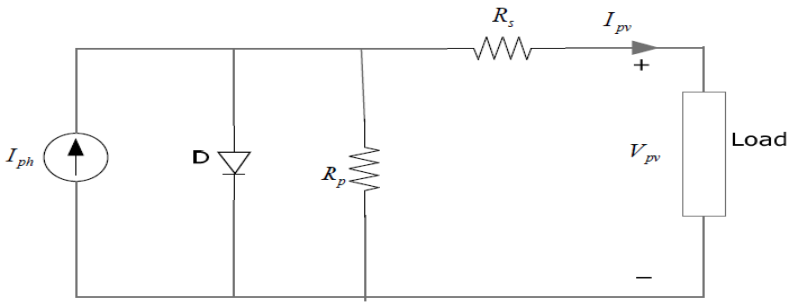

Fig: 2 Equivalent Circuit of PV panel

Usually the equivalent circuit of a general PV model consists of a photocurrent, a diode, a parallel resistor which expresses a leakage current, and a series resistor which describes an internal resistance to the current flow.

IV. HARDWARE ARCHITECTURE

Fig.3 shows Block Diagram of Hardware Architecture of proposed system. The Hardware Architecture consists of PV Panel, Battery Charge Controller, Rechargeable battery, voltage/ current sensor, a microcontroller, liquid crystal display. The power generated by PV is given to charge controller.

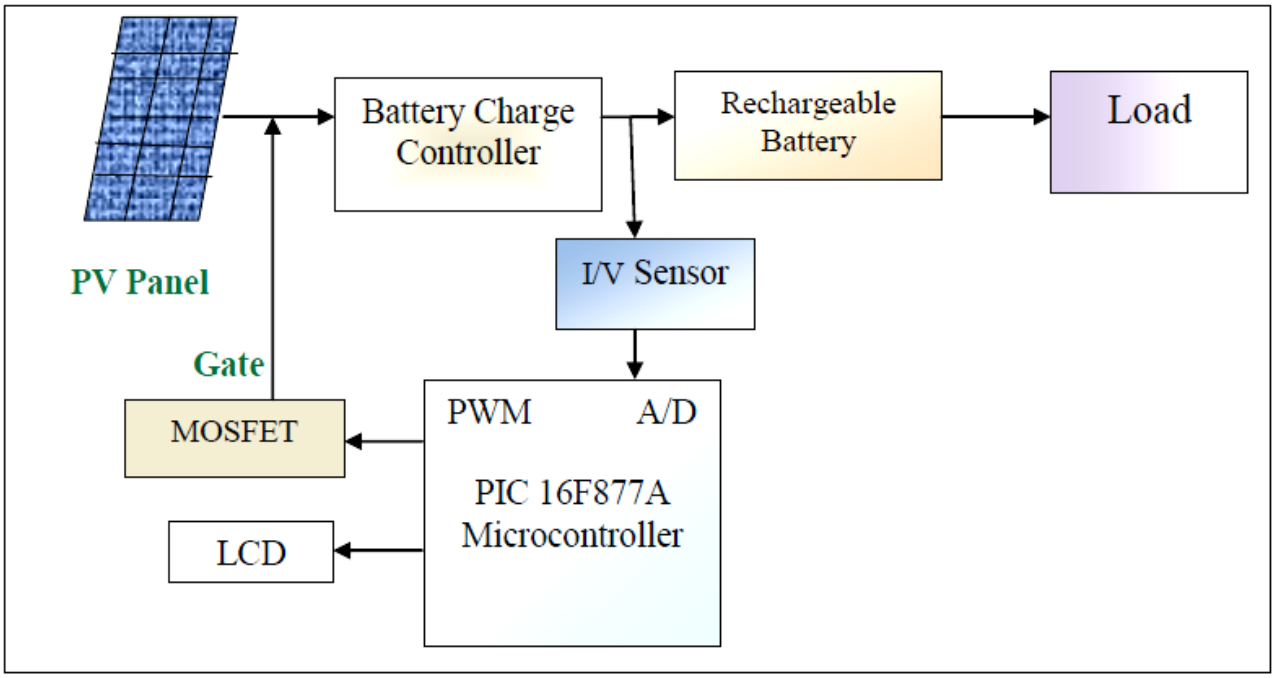

Fig: 3 Block Diagram of Hardware Architecture

The battery charge Controller is used to regulate charging voltage from PV module to recharge battery. Driver circuit is important in charge controller for amplification and transfer the PWM signal from microcontroller to MOSFET. A

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microcontroller based charge controller is designed to detect the sunlight through the LDR and then actuate the motor to rotate the solar panel where it can receive more sunlight PV battery charging system The LCD display the present current and voltage of the battery. The rechargeable battery is used to stored electrical energy in chemical form to operate dc load when required and also it requires less maintenances, has longer life and gives good performance compared to normal battery

V. SIMULATION RESULT

Simulation study was carried out to analyze the dynamic performance of the proposed photovoltaic. the proposed method of PV generations is verified by simulation. The simulation block for proposed method is shown in Fig.4

Proposed Model

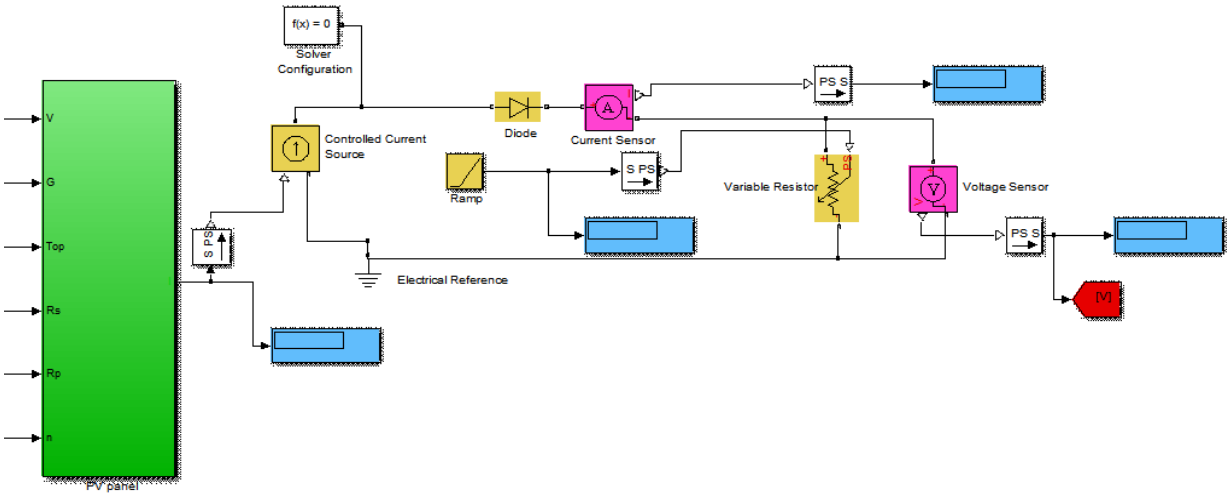

Fig: 4 Simulation Model of PV Cell

Simulation Output

The current-voltage characteristic of a solar cell is non-linear, which makes it difficult to determine the maximum power point. MATLAB is used to simulate the characteristic of a solar array. Fig.5 and Fig.6 shows the simulated P-V and I-V characteristic of the solar array under a fixed temperature (T=25℃) and a fixed irradiance of 1000 W/ respectively.

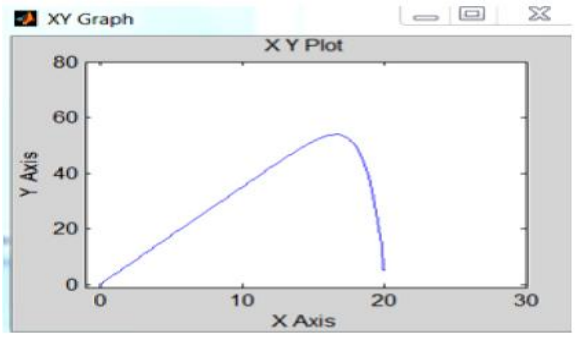

Fig: 5 PV curve for a PV cell

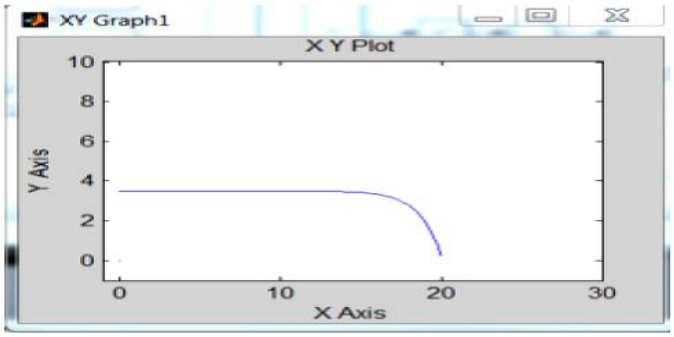

Fig.6 IV curve for a PV cell

VI. CONCLUSION

Solar power is pollution free during use. The generation of electricity using photovolatic technology has seen a significant growth. Solar tracking system with single-axis can increase energy output by approximately 20% .The control circuit for the solar tracker was based on a PIC16F877A microcontroller. This PIC was the brain of the entire

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tracking system, and it was programmed to detect the sunlight through the sensors .the solar panel voltage due to the change of irradiation and temperature will produce a constant output voltage. Output of PV panel is store in battery. A complete model of proposed PV generation system show satisfactory results of voltage and current characteristic with respect to time for a solar system.

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