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DESIGN OF ENERGY EFFICIENT PORTABLE SOLAR POWER INVERTER

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Abstract— **There is an demand of electricity for our human need, lots of power generation are arise today but the Electricty generation using Sun is the pollution free to our environment. This project is mainly designed to control the solar panel to get constant output.Due to the environmental changes the temperature varies. For this reasons solar panel may not get sufficient sun rays to work. Due to the rapid variation of Sun the panel get Nonlinear characterize. Thus the output Current and voltage from the panel get reduced. To overcome this disadvantages I Proposed Portable solar panel using P and O direct duty ratio Constant to linearise solar panel output with the help of microcontroller.The project proposes to design and simulate low cost portable efficient solar power inverter using MATLAB SIMULINK AND ARDUINO 2560 expected output is 230v.The portable solar panel produce large amount of energy that can be used to charge ac applicances**
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Index Terms—— **Solar panel; Buck converter; lead acid battery; DC-AC inverter; load**

I.INTRODUCTION

Energy is an important input for the provision of basic human needs and services, such as cooking, water supply, lighting, health services, communication and education.A photovoltaic system converts sunlight into electricity. The term array is usually employed to describe a photovoltaic panel (with several cells connected in series and/or parallel) or a group of panels. The electricity available at the terminals of a photovoltaic array may directly feed small loads such as lighting systems and DC motors. Some applications require electronic converters to process the electricity from the photovoltaic device. These converters may be used to regulate the voltage and current at the load, to control the power flow in grid connected systems and mainly to track the maximum power point (MPP) of the device. This is low power project, is designed for standalone application which ensures increased efficiency, minimal cost and overall reduction in the system size expected to bring benefits to numerous application areas including health care, manufacturing, and transportation. Currently, the use of IoT in transportation is still in its early stage and most research on ITSs has not leveraged the IoT technology as a solution or an enabling infrastructure

Switch mode power converters are popular and sometimes necessary for DC-DC power conversion. As the Sun delivers the DC power which is not constant . it is necessary to use switch mode power converters as interfacing circuit between the solar panel and the load

II MODELLING AND VALIDATION OF SOLAR CELL

A single cell is built employing a resistance Rs that's connected asynchronous with a parallel combination of a Current supply consisting of single diode with a shunt resistance structure RSH. cell uses physical phenomenon impact changing solar power directly into electrical energy. so electrical characteristic like current, voltage and resistance vary once lightweight is incident upon it. This leads to generation of electrical current while not being hooked up to any external voltage supply. to get power consumption, external load is hooked up.

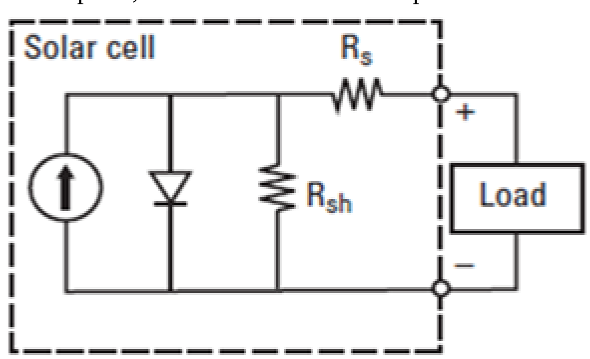


Fig: 1 Dc equivalent of a Solar Cell

From the equivalent circuit it's evident that this created by the photovoltaic cell is up to that created

by this supply IPNP, minus that that flows through the diode ID, minus that that flow through the shunt electrical device ISH as described: IL= Iph Np-ID-ISH
The current through these components is ruled by the voltage across them: VJ =V+IRS Diode Current is ruled by Shockley's equation given below: Id= Np IS [e (V/Ns) + (IRs/Ns)/N VTC -1] By Ohm's Law, the present through the shunt resistance is given as ISH= VJ /RSH ISH = (V+IRS)/RSH subbing these equations in equation to see load current IL= Iph Np - Np IS [e (V/Ns) + (IRs/Ns)/N VT C -1] - (IRS+V)/RSH

A. Photo Current Equation

Bright power from sun ends up in current flow through photovoltaic cell. Since thermal excitation of minority carriers contribute to current flow, reverse saturated current additionally affects photo Current Equ. The temperature depend on photocurrent is measured for reference cell and operative cell temperature.

Photocurrent Equ IPh= [ki (TOPT -TREF) +ISC] IRR (1)

IPh: Photocurrent perform of irradiation and junction temperature (5 A).

ki: Current proportion constant (2.2*10-3).

TOPT: operative Temperature of Cell (°C).

TREF: Reference operative Temperature of Cell (25 °C).

IRR:Irradiance

B.Thermal Voltage Equation

Vt = kBTOPT/q The thermal voltage equation is employed to describe average energy of electrons subtle in photovoltaic cell moving haphazardly at given temperature. Thermal volt is concerning 25.85 mV at 300K

Thermal Voltage Equ = kBTOPT/q (2)

kB: Boltzman constant (1.38 × 10-23 j/k).

TOPT: operative Temperature of Cell (°C).

q: negatron charge (1.602 × 10-19 C).

B. Diode Current Equation

Id= Np Is [e (V/Ns) + (IRs/Ns)/N VT C -1] (3)

The diode equ gives an expression for the current through a diode as a function of voltage.

Diode Current Equation ID= Np IS [e (V/Ns) + (IRs/Ns)/N VT C -1] (4)

Np: No. of cells in parallel. I_S: Reverse Saturation Current of Diode (2*10-4 A).

Eg: Energy Band Gap (1.12 eV).

V: Operating Voltage (V).

N_S: No. of cells in series.

V_T: Thermal Voltage (V). C= No. of cells in Module.

I_S: Reverse Saturation Current of Diode (2*10-4 A).

D. Reverse Current Equation

Dependence of reverse saturation current is taken into account relative to electric circuit voltage and operational temperature so as to observe potential modification in reverse saturation current equation.

Reverse Current equation RS=ISC/[e(q VOC/kiCTOPT)-1] (5)

ISC:Short Circuit Current

q: negatron charge (1.602 × 10-19 C).

VOC:Open Circuit Voltage

ki: Current proportion constant (2.2*10-3).

C:Constant

TOPT: operational Temperature of Cell (°c).

E. Reverse Saturation Current

The reverse saturation current conjointly called outflow current IS, is that the current that flows within the reverse direction once the diode is reverse biased. The reverse saturation current IS relies on temperature, diffusion constants, Energy Band gap, quality issue, Boltzmann constant as in equation. IS may be a live of the recombination in a very device. It will increase as T will increase and reduces as material

Reverse Saturation Current IS = [IRS (TOPT/TREF) 3*q2Eg/NkB *e (1/TOPT-1/TREF) (6)

IRS: Reverse Current Equation

TOPT: in operation Temperature of Cell (°C

TREF: Reference in operation Temperature of Cell (25 °C).

Eg: Energy Band Gap (1.12 eV).

kB: Boltzmann constant (1.38 × 10-23 J/K).

F. Shunt Current Equation

It can be shown that for a solar cell (low R_S and I_S, and high R_{SH} and I_{SH}) alters expression of equations. Losses occurring in solar cell are due to manufacturing defects in values of series and shunt resistance. Solar cell behaves neither as current source nor as a voltage source. Since losses caused by series resistance are given by $P_{LOSS}=IV=I^2R_S$, they increase quadratically with photocurrent. Similarly, current diverted through the shunt resistor increases causing the voltage-controlled portion of the IV curve to sag towards origin.

Shunt Current Equation $I_{SH} = (IR_S+V)/R_{SH}$ (7)

IRS: Reverse Current Equation

V: Operating Voltage (V).

Load Current equation
IL is described by difference of current across current source and diode

Load Current Equation IL = IPh Np- ID-ISH (8)

I_{Ph}: Photocurrent function of irradiation and junction temperature (5 A).

ID: Diode Current Equation

ISH:Shunt Current Equation

Output power equation
Output Power P=VI (9)
The above equation is used to design the solar panel in matlab simulink.

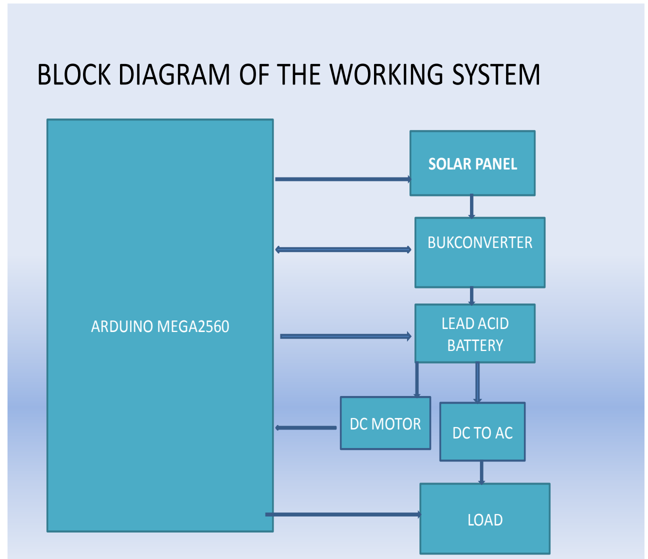


Fig : 2 Functional Block Diagram

Electricity generation using portable solar panel

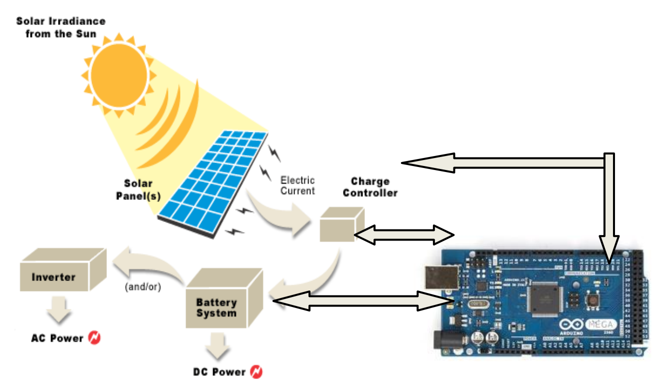


Fig : 3 Pictorial Representation

The following components are connected in matlab simulink

1. Solar panel
2. Buck-Boost converter
3. Arduino microcontroller
4. Lead acid battery
5. Inverter
6. Relay
7. Load

Portable solar panel

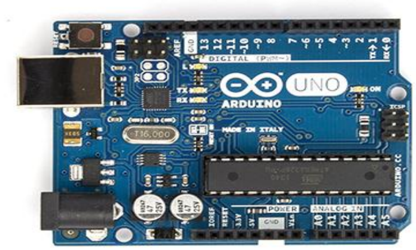
Portable solar panels are power-up electronic devices in areas wherever associate degree electricity or wall shops aren't accessible. once daylight enters the star cells, the energy from the sun charges electrons inflicting them to maneuve during a specific direction through a skinny layer of wiring. And these electrons move through the wiring, they supply power within the sort of electricity which will power electric battery or associate degree device.

Buck-Boost:A Buck-Boost device could be a sort of switched mode power provide that mixes the principles of the Buck device and also the Boost device in an exceedingly single circuit. Like different SMPS styles, it provides a regulated DC output voltage from either Associate degree AC or a DC input. The Buck device produces a DC output in an exceedingly vary from 0V to only but the input voltage. The boost device can turn out Associate in Nursing output voltage starting from an equivalent voltage because the input, to A level abundant beyond the input. There area unit several

applications but, like powered systems, wherever the input voltage will vary wide, beginning at full charge and step by step decreasing because the battery charge is employed up. At full charge, wherever the battery voltage is also beyond really required by the circuit being supercharged, a buck regulator would be ideal to stay the provision voltage steady. but because the charge diminishes the input voltage falls below the amount needed by the circuit, and either the battery should be discarded or re-charged; at now the perfect different would be the boost regulator

ARDUINO UNO 2560

The Arduino Uno may be a microcontroller board supported the ATmega328 (datasheet). it's fourteen digital input/output pins (of that half-dozen will be used as PWM outputs), half-dozen analog inputs, a sixteen megacycle ceramic resonator, a USB association, an influence jack, AN ICSP header, and a push. It contains everything required to support the microcontroller; merely connect it to a pc with a USB cable or power it with a AC-to-DC adapter or battery to urge started.The Uno differs from all preceding boards in this it doesn't use the FTDI USB-to-serial driver chip. Instead, it options the Atmega16U2 (Atmega8U2 up to version R2)



III. IMPLEMENTATION OF MPPT P AND O ALGORITHM

Renewable energy particularly star electrical phenomenon is seen as necessary alternate supply of energy for the long run, and has recently earned importance attributable to heap of analysis and development tired the realm of star cells and power converter technology to cut back the value and increase the system potency. star electrical phenomenon generation systems have 2 inherent major issues. the primary is low conversion potency (10 to 16 PF potency for commercially out there amorphous Si star cells) and second is presence of extremely nonlinear i-v characteristics. The matter gets worse attributable to dependence of characteristics of cell on temperature and isolation level . Further, attributable to pair between the operational purpose and most outlet (MPP) of the star cells, the ability out there from the star cells isn't invariably absolutely extracted . so as to extract the most quantity of energy, the PV system should be capable of pursuit the solar array distinctive most outlet that varies with irradiance and temperature. A MPPT may be a power electronic DC/DC convertor inserted between the PV module and cargo to attain optimum matching. By mistreatment Associate in Nursing intelligent formula, it ensures that the PV module invariably operates at its most outlet. many MPPT algorithms are projected in different literatures like Perturb & Observe (P&O), Incremental Conductance, Constant Voltage, Constant Current and fuzzy based algorithms. These techniques differ in many aspects like complexity, convergence speed, hardware implementation, sensors needed, cost, vary of effectiveness and want for parameterization. completely different device topologies like buck,boost, buck-boost and cuk converters area unit enforced for MPPT style

A. PERTURB AND OBSERVE ALGOTITHM

perturb and observe algorithm also known as hill climbing method.which is popular and mostcommonly used in practice because of its simplicity in algorithm and ease of implementation.The most basic form of the P and O algorithm is as follows .Generally PV module output curve as a function of voltage Pv(Curve) at the constant irradiance and the constant module temperature.assuming the Pv module is operating at a point which is away from the MPP.In this algorithm the operating voltage of the pv module is perturbed by small increment, and the resulting change of power, p is absorbed,if p is positive,then it is supposed that it has moved the operating point closer to the MPP.Thus,further voltage perturbations in the same direction should move the operating point towards the Mpp.If the p is negative,the operating point is move away from the Mpp.If the P is negative, the operating point has moved away from the Mpp and the direction of the Perturbation has reversed to move backwards towards the Mpp

SYSTEM DESCRIPTION

The objective of the paper is to present a novel cost effective and efficient microcontroller based MPPT system for solar photovoltaic system to ensure the maximum power point operation at all changing Environmental condition. The P&O MPPT algorithm is used to control the maximum transfer power from a PV panel. This algorithm is executed by using an embedded c program that is fed into an microcontroller. The Arduino uno Atmega 328 using the PV voltage and current data of the solar panel and to control the duty cycle by applying a pulse width modulation signal applied to a MOSFET switch in the DC/DC converter. I Design a Matlab simulink model by interfacing solar panel ,buk converter and Dc motor using blocks and observe the DC Motor speed using simulink graph.Hardware connections such as solar panel,buck converter ,battery and DC motor is connected and observe the speed, torque and armature current output of Dc motor and glowing of light according to the temperature variation and it can be displayed in the LCD.

SIMULATION OUTPUT

SOLAR PANEL SIMULINK BLOCK

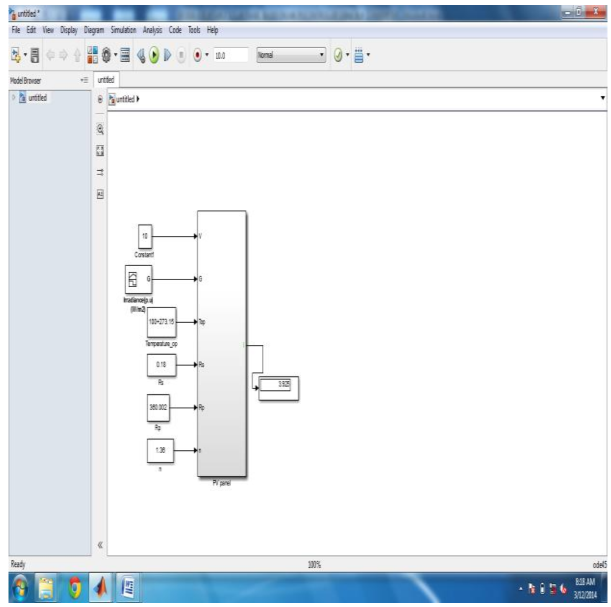


Fig: 4 Solar panel Simulink Block

SOLAR PANEL,BUCK CONVERTER AND DC MOTOR SIMULINK BLOCK

This block shows the connection of Solar panel,Buckboost Converter,Lead acid Battery, Inverter and DC Motor.By varying the temperature and irradiance the speed and torque and armature current vary which gives constant Current and voltage Output with respect to irradiance and temperature variation with of Sun.

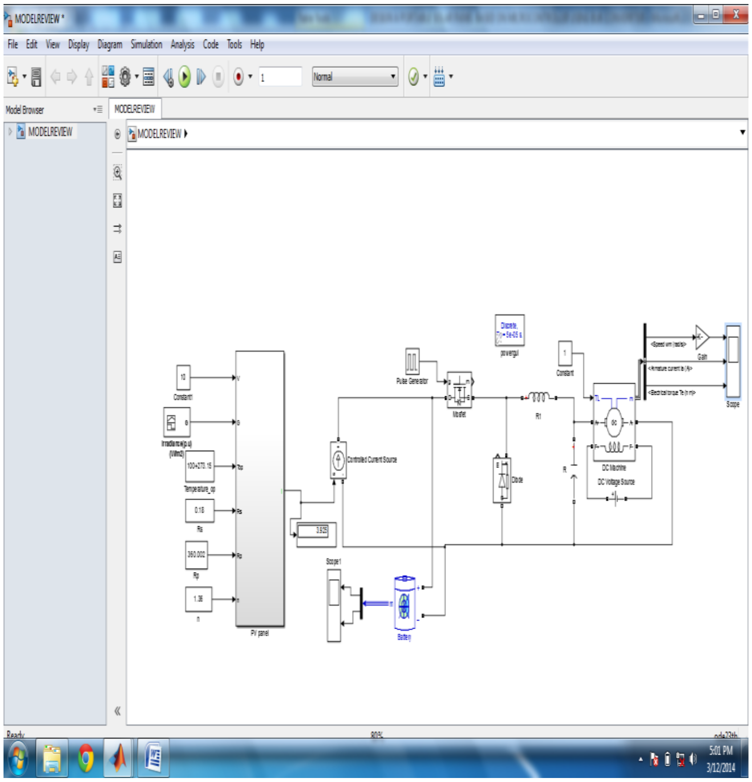


Fig: 4 Solar panel, Buck boost converter and DC motor connected simulink block

SPEED,ARMATURE CURRENT AND TORQUE OUTPUT

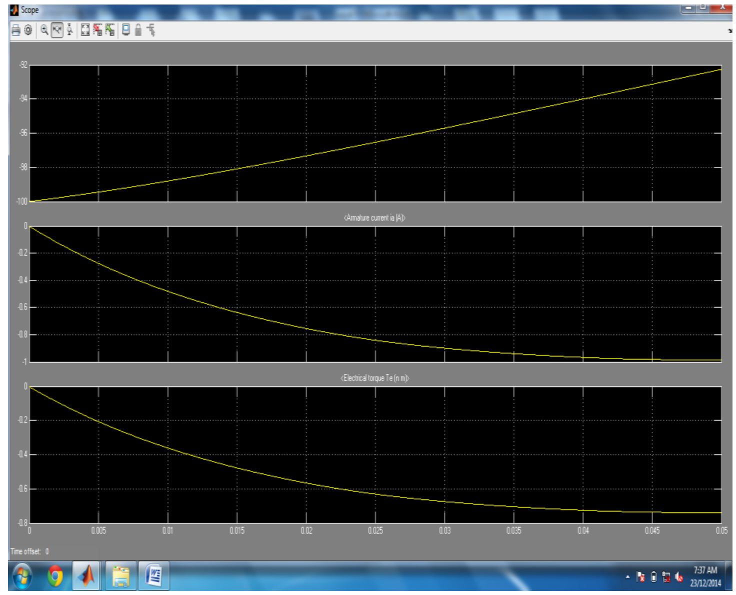


Fig : 4 Simulation Output

FUTURE WORK

Hardware connections will be made by connecting Solar panel ,Buck boost converter and lead acid battery and inverter are connected. And Arduino Uno 2560 is programmed using embedded C and to control the duty ratio of the buck boost converter to get the Constant Output from the panel to load by using perturb and observe method.

Abbreviation

Ac - Alternating Current, BC - Battery Charging, DC - Direct current, Kva - Kilo Watt Ampere, Kwh -Kilo mino Watt hour, Kwh/m2 - Kilo Watt Hour Per Square Metre, PV - Photovoltaic, RE - Renewable Resources, STC -Standard Test Conditions (reference testing voltage of cell temperature).

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