PERFORMANCE ANALYSIS OF SOLAR ENERGY PRODUCTION USING MATLAB HETEROGENEOUS DUAL CORE MCU IN THE SMART GRID

Mr. D. Santhosh Kumar[1], Ms.A.Preethi[2], M.Prabha[3], B.Sahana[4], K.Sowthama[5]

[1] Assistant Professor, Electrical and Electronics Engineering,Vivekanandha College of Engineering for Women, Tiruchengode, Namakkal, India.

[2,3,4,5] Electrical and Electronics Engineering ,UG scholar, Vivekanandha College of Engineering for Women, Tiruchengode , Namakkal, India.

[1] santhoshkumar86@gmail.com ,[2]agpspreethi@gmail.com, prabhamurugan@gmail.com[3],mdusahana@gmail.com[4],kadharsowth.555@mail.com[5].

ABSTRACT

Renewable energy, also know as 'green energy', is electricity that's powered by natural sources such as the wind, water and sun. Renewable energy offers a carbon-free alternative to traditional fossil fuels. A smart grid is an electrical grid that uses information and communication technology. This paper discuss about the design of a smart grid enabled renewable energy node using a dual core micro controller. Presents the study of integrating renewable energy in smart grid system. Which attempts to investigate the role of smart grid in the renewable energy.The control of extract renewable energy is done on the dual core using MATLAB. This paper concludes that renewable energies can be used efficiently and in a smart way by using the smart grids. The Smart Grid will be able to make better use of these energy resources. The design of a smart grid enabled renewable energy node using a dual core micro controller. Integrate challenges for control and communication and the solution .

KEYWORDS : **Dual Core Mc, PV Panel, Grid Tied Inverter.**

I.INTRODUCTION

The grid operators new tools to reduce power demand quickly when wind or solar power dips, and it will have more energy storage capabilities to absorb excess wind and solar power when it isn't needed, then to release that energy when the wind and solar power dips. The ability of the smart grid to lower the cost of integrating renewable generation at the transmission , distribution , and residential levels. The opportunities of renewable smart grid systems indicates potential of research characteristics in the future. The smart grid is a concept and vision that captures a range of advanced information, sensing, communications, control, and energy technologies. These result in an electrical power system that can intelligently integrate the actions of all connected users from power generators to electricity consumers to both produce and consume electricity – to efficiently deliver sustainable, economic, and secure electricity supplies.

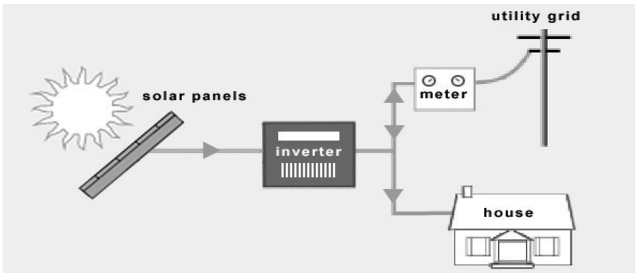

Fig 1.Grid Tied Solar System

Energy from renewable sources such as solar and wind are gaining interest as the world's power demand increase.As the Solar energy nodes vary in power rating from 100W-200W micro inverter, 2-3KW multi string inverter and mega watt central inverters.A solar inverter or PV inverter, is a type of electrical converter which converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, off-grid electrical network.

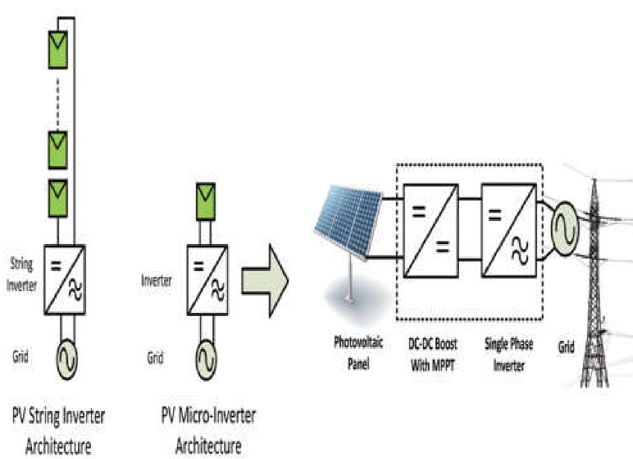

Fig 2.Grid Tied Inverter

Fig2.Shows Grid-tie inverters designed to quickly disconnect from the grid if the utility grid goes down. This is an NEC requirement that ensures that in the event of a blackout, the grid tie inverter will shut down to prevent the energy it transfers from harming any line workers who are sent to fix the power grid.

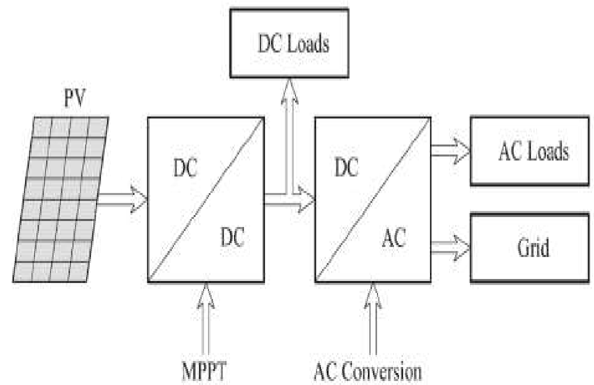

Fig 3.Design of PV grid

Many solar inverters are designed to be connected to a utility grid, and will not operate when they do not detect the presence of the grid. They contain special circuitry to precisely match the voltage, frequency and phase of the grid. It converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into alternating 240V current (AC). This AC electricity then can be fed into your home to operate your appliances. When the sun shines on your solar photovoltaic (PV) system, electrons within thesolar cells start to move around, which produces direct current (DC) energy. When your solar panels collect sunlight and turn it into energy, it gets sent to theinverter, which takes the DC energy and turns it into AC energy.

II.HARDWARE PLATFORM

- In the proposed system the control and monitoring process are done in dual core.

Advantage

- Dual-core chips also allow higher performance at lower energy.
- By converting single core to dual core the efficiency will be increased.

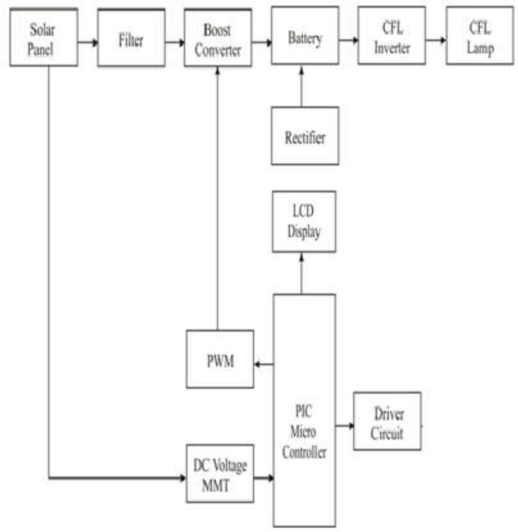

Fig 4.Block Diagram

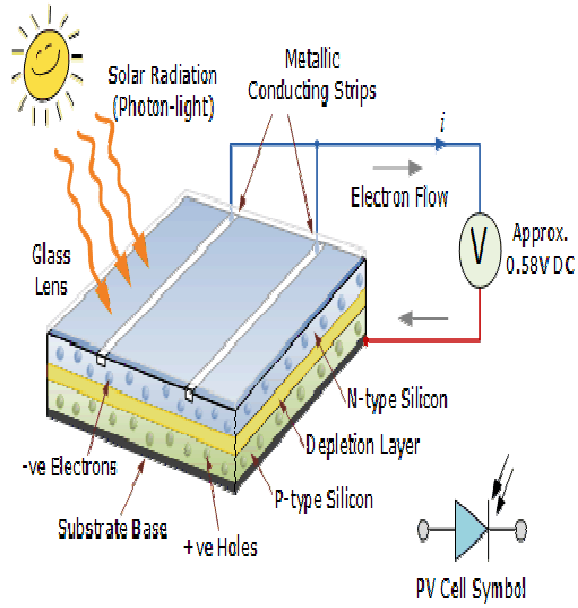

Fig 5.Design of Solar Panel

A.SOLAR PANEL

A Solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells. (Photovoltaic simply means they convert sunlight into electricity) The sun shines on the solar panels, generating "DC" (Direct Current) electricity. The electricity is fed into a solar inverter that converts into "AC" (Alternating Current) electricity. The AC electricity is used to power appliances in your home.

A 2,000 square foot home would be allowed a solar array of 4,000 watts. Depending on the type of panel that you choose, a system of this size would be anywhere from 12-18 solar panel.

Solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells. Photovoltaic simply means they convert sunlight into electricity.

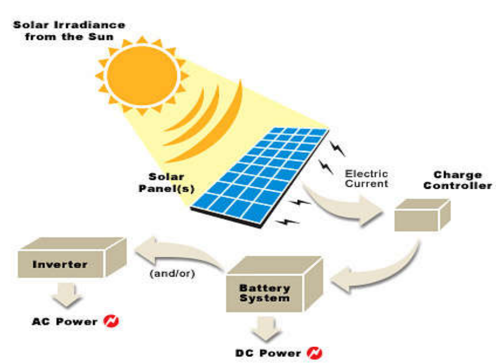

Fig 6. Solar Grid

The grid connect inverter converts the DC electricity produced by the solar panels into 240 V AC electricity, which can then be used by the property/household.Some electricity companies will meter the electricity fed into the grid by your system and provide a credit on your bill.

B.FILTER

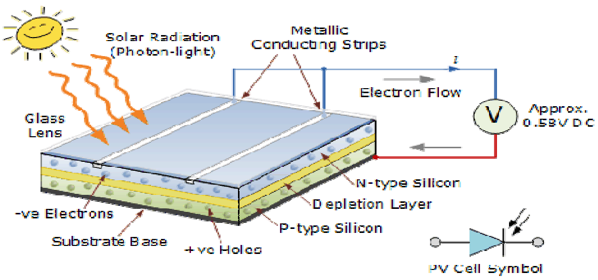

Fig 7.Design of filter in PV system

C.BOOST COVERTER

The solar panel is used to charge the battery. The solar panel also supplies the load during the day time when the light source is high. During the night time the solar panel and the boost converter are isolated from the solar panel and the battery solelysupplies the load.A 18V to 24V boost converter with a solar panel as its input and a variable resistor at the load side for taking measurements. The boost converter will be doing the Maximum Power Point Tracking (MPPT) for the panel.

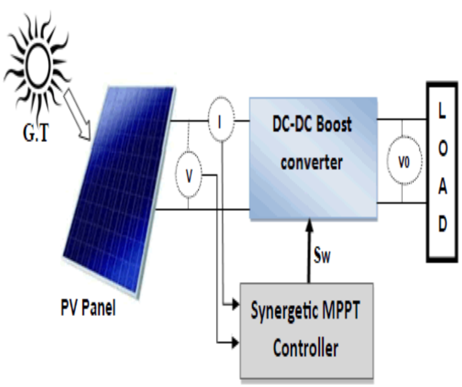

Figure 8: Block diagram of PV system with synergetic controller.

The solar panel has the following specifications: Pmax = 50 Watts, Vmp = 18.68 V, Imp = 2.77 A, Voc = 22.53 V, Isc = 2.97 A MPPT is only useful when the load can accept the maximum power. This usually happens with solar battery chargers and grid-tie inverters. But if the load does not need the maximum power that the panel can produce, then you don't want to run MPPT. In that case, you want to select the duty cycle that produces the correct output voltage, regardless of the maximum power point.

D.BATTERY

Batteries used in home energy storage typically are made with one of three chemical compositions: lead acid, lithium ion, and saltwater. In most cases, lithium ion batteries are the best option for a solar panel system, though other battery types can be more affordable.

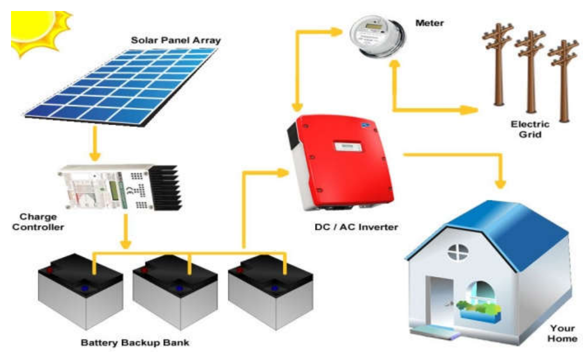

Fig 9.Design of Battery Bank

E.PIC MICROCONTROLLER

PIC microcontrollers are a family of specialized microcontroller chips produced by Microchip Technology in Chandler, Arizona. The acronym PIC stands for "peripheral interface controller," although that term is rarely used nowadays.A typical microcontroller includes a processor, memory, and peripherals.

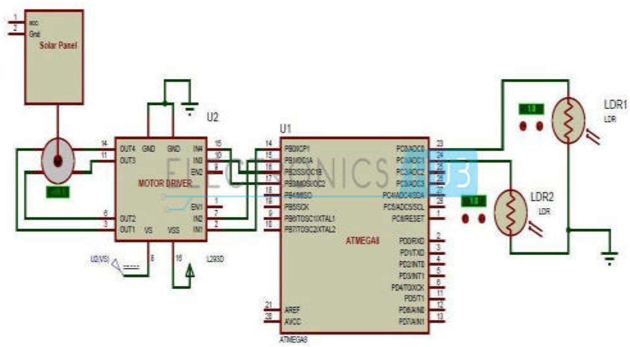

Fig 10.Design of PIC MC dual core

The PIC microcontroller transmit and receive the data with respect to clock pulses, the PIC microcontroller operates with 4MHz crystal frequency. Two capacitors are connected to the crystal oscillator with range of 20pf to 40pf which is used to stabilize the clock signals. At some times, the PIC microcontroller goes to block state or missing time calculation,at that time we need to reset the microcontroller. If a microcontroller is reset for 3sec time delay, 10k resistor and 10uf capacitor are connected to the respective pins.The 5v DC supply is given to the 11 pin of the microcontroller which drives the circuit. The crystal is connected to the 13 and 14 pins of the microcontroller. The reset circuit is interfaced at 1 pins of the microcontroller. The Yellow LEDs is connected to the PORTB of the microcontroller.

F.PULSE WIDTH MODULATION (PWM)

Pulse-WidthModulation (PWM) comes into play when the battery bank is full. During charging, the controller allows as much current as the PV panel/array can generate in order to reach the target voltage for the charge stage the controller is in.Pulse Width Modulation (PWM) is the most effective means to achieve constant voltage battery charging by switching the solarsystem controller's power devices.

G.RECTIFIER

The use of bypass diodes allows a series (called a string) of connected cells or panels to continue supplying power at a reduced voltage rather than no power at all. Bypass diodes are connected in reverse bias between a solar cells (or panel) positive and negative output terminals and has no effect on its output.

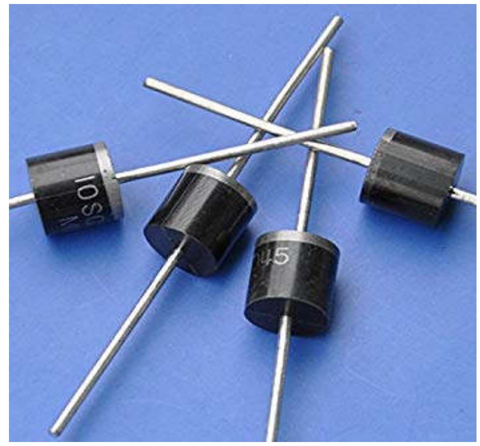

Fig 13.Rectifier

H.CFL INVERTER

Solar 3 CFL SOLAR Inverter with ABS body, 5 Switches & 3 Output Sockets including *5* pin Mobile Charge. In-Built 'Solar Charge Control' for battery safety.

specifications:

- Battery-12V 7Ah
- Backup-2 hours on full load
- Input-90~270VAC
- Load capacity-45VA max
- Solar Panel-10W 12V

HETEROGENIOUS DUAL CORE MCU

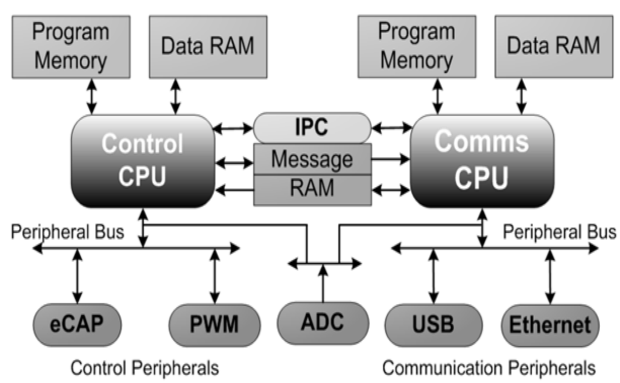

Fig 14.Block diagram of Dual core MCU

In many applications Dual core MCU can offer an integrated single chip solution, where one core handles the communication and other core handles the control tasks. However, using the same core for control and communication, leads to compromise on performance of one or the other because control and communication have different processor requirements.Texas Instruments TMS320F28M35x series controller are heterogeneous dual core MCU's which have two different CPU cores on a single chip. One of the CPU core is the Texas Instruments C28x which is optimized for control tasks and the other CPU is an ARM Cortex M3. The control peripherals such as pulse width modulators, time capture modules etc are mapped to the C28x. The communication peripherals such as Ethernet and USB are mapped to the M3 core. A single analog to digital converter is shared by both the processors. Having ADC access by both cores with different ISA's adds features of redundancy in the system, for safety critical checks.

MATLAB SIMULATION

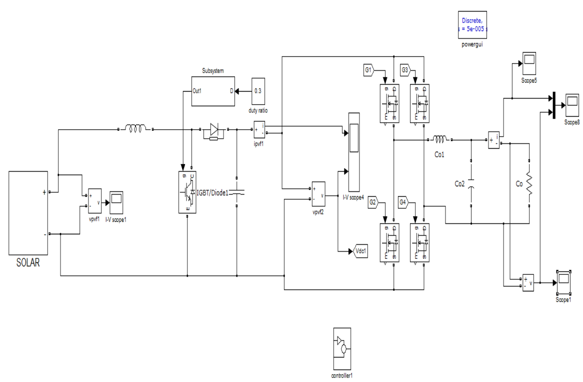

Fig 15.MATLAB Simulation controlof grid tied PV system

The fig 15 shows that the simulink diagram of the proposed system this work, an 11 kV grid integrated PV system is simulated. At 1000 W/m^2 solar irradiance the PVarray delivers a maximum power of 70 kW. At 1000 W/m^2 solar irradiance,the PV array generates voltage of about 321 V. The V_{oc}, I_{sc}, V_{mp} and I_{mp} of one module of PV array is 64.2 V , 5.96 A ,54.7 V and 5.58 A respectively.

MATLAB SIMULATION RESULT

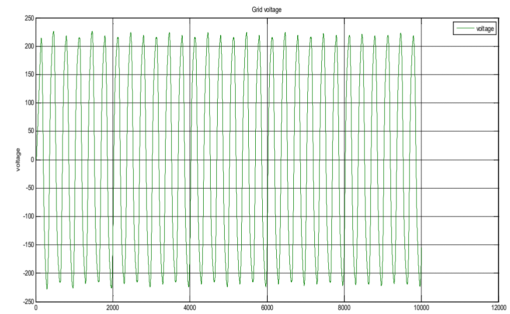

Fig 17.Simulation Graph For PV Panel Voltage Measurement

Fig 17 and fig 18. shows that Simulation studies are performed on grid connected inverter implemented with all proposed PWM techniques in MATLAB/Simulink. The results obtained from the simulations are taken with some specific values of the parameters taken. A reference radiation (G) of 1000 W/m2 and module temperature (Tc) of 25o C were used in the simulation.

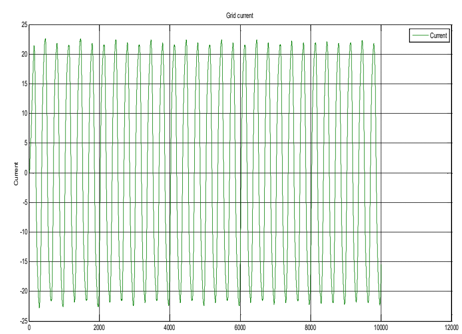

Fig 18.Simulation Graph For PVPanel Current Measurement

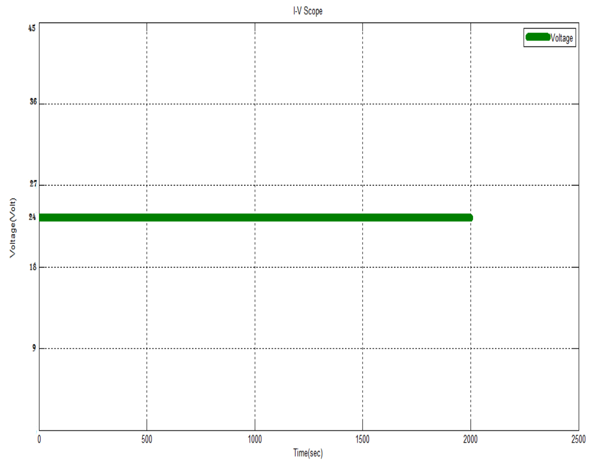

Fig 16.Simulation Result Graph

Fig 16. explains about depicts that grid connected PV line current injected to voltage and current measurement is result with 12V PV scope. this results show that the PV/Battery dynamic model works properly and the system has reasonable reactions to the environmental and technical Changes.

CONTROLLER	HYSTERESIS CONTROLLER	PROPOSED METHOD
Data memory	128 bytes	368 bytes
Input voltage	12 v	24v
Grid voltage	105 v	230v
Grid current	11amps	23 amps
Grid connection	Either in light or heavy load condition	Both in light load and heavy load condition

Table 1.Comparison of existing controller with proposed controller

III.CONCLUSION

- Hence in our paper the system integrates challenges for a PV inverter for smart grid, the unique control and communication challenges are described, with a solution using a heterogeneous dual core MCU.
- The design of the hardware platform for the PV inverter is discussed and results of the grid connection under varying light conditions and heavy loads are highlighted.

IV.REFERENCES

1. Zhang Housheng, Zhao Yanlei, “Research on a Novel digital Photovoltaic Array Simulator.” Intelligent Computation Technology and Automation (ICICTA) 2010 International Conference on vol2 no.,pp.1077-1080,11-12 May 2017.
2. Remus Teodorescu, Marco Lisrre, Pedro Rodriguez, “Grid Converters for Photovoltaic and Wind Power Systems,”John Wiley and Sons,2016.
3. Remus Teodorescu, marco liserre, petro Rodriguez, Grid converters for photovoltaic , john wiley and sons, 2016.
4. Texas Instruments TMS320F28M35x Datasheet and Techincal Reference Manual
5. Zhang Housheng; Zhao Yanlei; , "Research on a Novel DigitalPhotovoltaic Array Simulator," Intelligent Computation Technology and Automation (ICICTA), 2010 International Conference on , vol.2,no., pp.1077-1080, 11-12 May 2014.
6. Britton, Lunscher, and Tanju,“A 9KW High-Performance Solar Array Simulator”, Proceedings of the European Space Power Conference, August 2012 (ESA WPP-054, August (2012) Soeren Baekhoej Kjaer ,Design and Control of an Inverter for Photovoltaic Applications, Department of Energy Technology , Aalborg University, 2009
7. Francisco D. Freijedo et al, “Robust Phase Locked Loops Optimizd for DSP implementation in power quality applications,” IECON 2011.