RESEARCH ARTICLE OPEN ACCESS

Design and Development of Solar based Power Maximization using Solar Tracking System

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Abstract:

As the renewable sources are whether dependant like it has daily and seasonal patterns which results in difficulties of regulating the output power to cope with the load demand. Combining the renewable energy generation with energy storage bank & ac power from substation will enable the power generated from a renewable energy sources to be more reliable, affordable and used more efficiently.Emergency and standby power systems are designed to provide an alternate source of power if the normal source of power, most often the serving utility, if fails. As reliability of these types of systems is critical and good design practices are essential. RES's based solar systems are a potentially significant solution to rural ac electricity needs for continuity of electrical supply. In order to increase the efficiency of power we have design module of dual axis solar tracker.

Keywords — **Motors, Microcontroller , L293D, Relays, Solar Panel.**

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I. Introduction

There are many remote places in India, where grid supply has not reached yet and other places where the electricity is not available for 24 hours, keeping this as a view to design a system which can utilize availability of solar power with some controlling techniques using AVR Microcontroller, this project we can achieve continuity of supply for 24 hours.

Critical applications require a constant and reliable power supply to keep fundamental services running and prevent serious consequences due to interruption or absence of the electrical supply. This need is even stronger nowadays because of the increasing significance of key role, capacity and features of these systems. In order to ensure the high level of reliability requested, the system must include automatic changeover of desired connectivity. This proposed model can be installed where the availability of one renewable source i.e. solar & ac main supply both are existing. In such system, we can effectively utilize RES, it helps to reduce the load on power system and increase the life of transmission system. This system can be used for off-grid power generation in non-interconnected areas and also where ac supply is not available for 24 hours.

II. Literature Review

Literature review is very important before starting project and we need good literature review because it:

•Demonstrates & ensure that you know the field.

•Justifies the reason for your research.

•Allows you to establish your theoretical framework and methodological focus.

•Identifying knowledge gaps that demand further investigation.

•To compare previous findings.

F. Huang, D.Tien, James Or, in their paper mentioned the design and the implementation of a microcontoller based automatic sun tracker combined with a new solar energy conversion unit with a " current sweep " approach.

Jayanta Majee, Sumana Chowdhuri, Jitendranath Bera, Jayabrata Maity,Sanjib Kumar Mitra, in their paper mentioned that the power delivered to the load with MPPT is higher than to that the load without MPPT.hence we can say that efficiency of the system has been increased with the introduction of MPPT.

J.B. Board, A.R. Patel, in their paper mentioned the incremental conductance method is treated.This method consists in using the slope of the derivative of the current with respect to the voltage in order to reach the maximum power point. Boost converter with incremental conductance method able to transform unusable power into usable power ,which itself is significant capability improvement to the current technology as compare to previous technology.

Tzu-Chi Huang ,Yu-Huei Lee , Ming-Jhe Du , Chun-Yu Hsieh, in their paper mentioned a maximum power point tracking

controller using a [1] buck converter has been designed and developed for standalone photovoltaic array.

II. BLOCK DIAGRAM

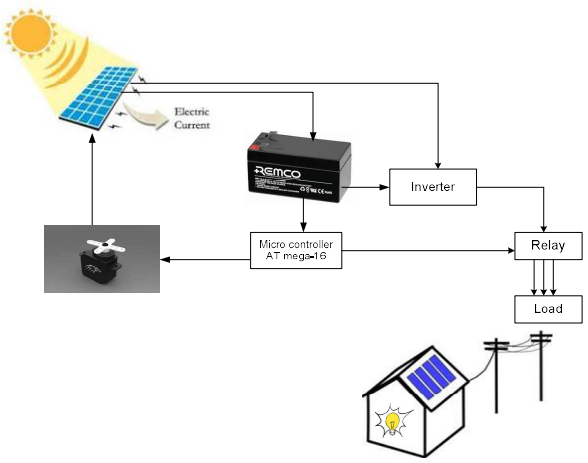


Fig: 1.1

In this system, solar tracking system is used to extract maximum amount of solar energy from solar panel. This system consists of two sources; Solar panel and Mains system. As per the above block diagram the input sources solar panel and Main system will get controlled by microcontroller for its switching and control system. LCD Screen is will display voltage level of battery. When the battery voltage will be less than 10V then it will be directly switch on the Mains otherwise if it is greater than 10V then it will be operated with the battery. Solar source can directly charge the battery. The system is designed in such a way that the generation of electricity always stored the power .The inverter power circuit which is interfaced with the battery and microcontroller send the digital signal to the AVR Microcontroller for displaying the update status. The current status of changeover of the system weather it is on Solar system Mode or System is in Main Mode will be displayed on LCD. As the sun moves from east to west direction the solar panel will be rotate in its axis about 180 degree. The Inverting system gives the output to the Driver circuit through which the load connected will be switch ON.

Technology Use:

For our project for tracking system and for automatic controlling of changeover of system we referred to use AVR Microcontroller.[7] AVR Studio provides a project management tool, source file editor, chip simulator and In-circuit emulator interface for the powerful AVR 8-bit RISC family of microcontrollers.

Similarly, Microcontrollers are important part of embedded systems. It helps to understand Structure & working of system. For designing good Embedded system complete understanding of microcontrollers required. It consists of integrated chip that typically contains integrated CPU, memory (RAM ROM), I/O ports on a single Chip. System on a single [2]Chip Designed to execute a specific task to control a single system.

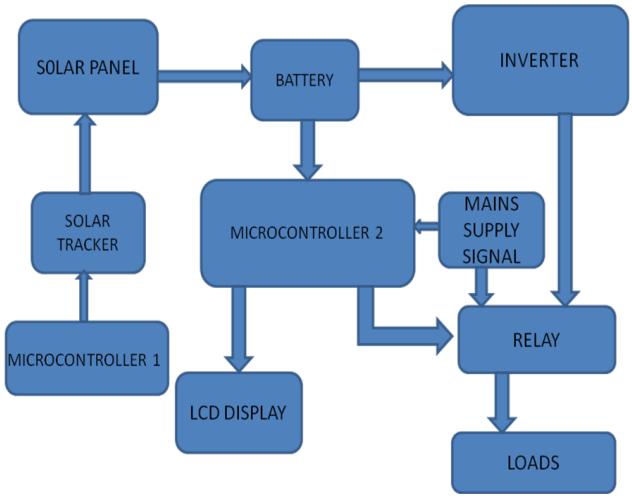


Fig: 1.2

Using above architecture, we can use any renewable source which gives dc output like wind energy system instead of solar energy system. [8]Depending on the load requirement we can upgrade the system.

Solar Tracking System for Maximum Power Generation:

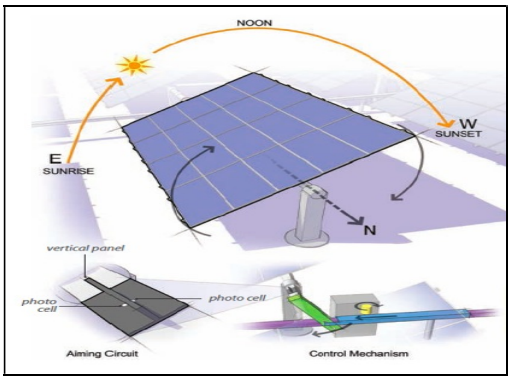


Fig: 1.3

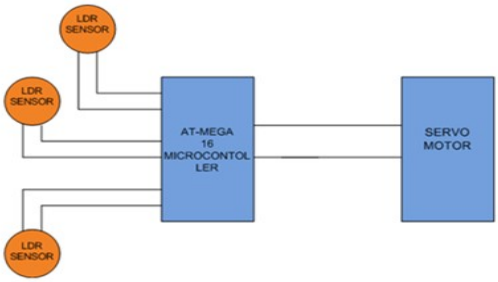
The axis of rotation for horizontal single axis tracker is horizontal with respect to the ground. Horizontal trackers typically have the face of the module oriented parallel to the

axis of rotation. As a module tracks, it sweeps a cylinder that is rotationally symmetric around the axis of rotation

In single axis horizontal trackers, a long horizontal tube is supported on bearings mounted upon pylons or frames. The axis of the tube is on a north-south line. Panels are mounted upon the tube, and the tube will rotate on its axis to track the apparent motion of the sun through the day. [9]4MW horizontal single axis tracker is installed in Vellakoil, Tamil Nadu, India.

III. Working

For the tracking we are using three LDR which sense the light intensity of sun and give the analog signal in the form of voltage to the microcontroller (AVR AT mega 16). As shown in flowchart.



Availability of supply			Operated on load
Ac main	**Charge battery**	**Discharge battery**	
YES	YES	NO	BATTERY
YES	NO	YES	AC MAIN
NO	YES	NO	BATTERY
NO	NO	YES(REMAINING)	BATTERY

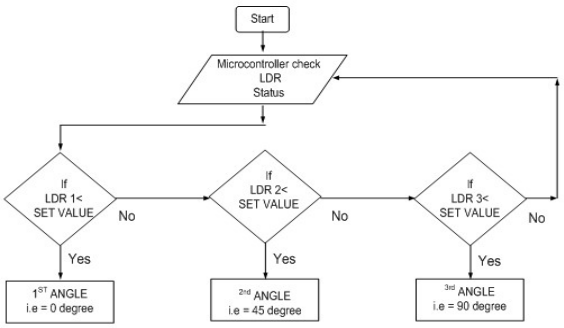


Fig: 1.4. Solar Tracking Flow Chart

Fig: 1.5 Solar Block

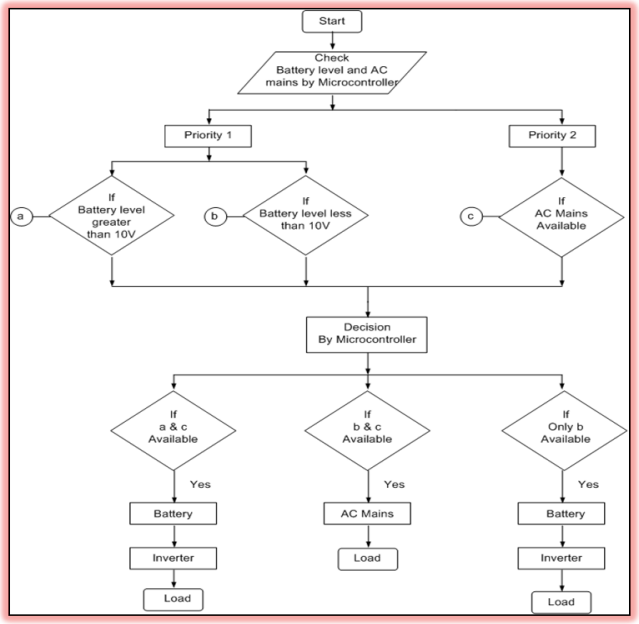


Fig. 1.5 Flow Chart of Controlling Part

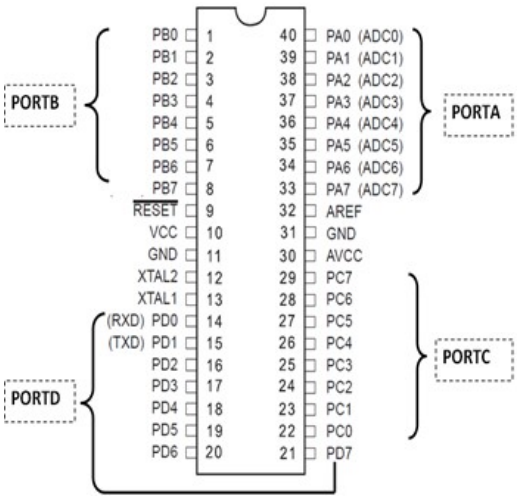
III. COMPONENTS USED

a) Servo Motor

A DC motor has a two wire connection. All drive power is supplied over these two wires—think of a light bulb. When you turn on a DC motor, it just starts spinning round and round. Most DC motors are pretty fast, about 5000 RPM (revolutions per minute) With the [3]DC motor, its speed (or more accurately, its power level) is controlled using a technique named pulse width modulation, or simply PWM. This is idea of controlling the motor's power level by strobing the power on and off. The key concept here is duty cycle—the percentage of "on time" versus"off time." If the power is on only 1/2 of the time, the motor runs with 1/2 the power of its full-on operation.

b) ATMega16 Microcontroller

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced [5]RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.



Pin Descriptions

VCC Digital supply voltage.

GND Ground.

Port A (PA7..PA0): Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they

will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B (PB7..PB0): Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port C (PC7..PC0): Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. Port C also serves the functions of the JTAG interface and other special features of the

Port D (PD7..PD0) Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

RESET Reset Input. A low level on this pin for longer than the minimum pulse length will generate

a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

XTAL1 Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2 Output from the inverting Oscillator amplifier.

AVCC AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

AREF AREF is the analog reference pin for the A/D Converter.

IV. CONCLUSION

As per market survey and awareness of green energies, its utilization has great response. This energy utilization varies region wise and availability wise.

[6]In Maharashtra, government started encouraging for utilization of green power with various schemes, incentives and subsidies. There initiatives have led to attract foreign investors to invest in these attractive schemes.

[10]So, as solar energy plays very important role in changing energy scenario, this work will definitely helpful for effective and affordable utilization of solar energy.

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