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Research Article

Energy Efficient & Smart Power Management Solution Using IOT

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ABSTRACT
The proposed system, an energy efficient and smart power management system.The internet of the things (IOT) is used in the system to monitor the supply received at the loads. This system ensures that maximum power demand is met using the solar energy and if the solar energy is not sufficient, the power demand is satisfied using the AC power grid. The system generates maximum power from solar energy from the PV panels using algorithms even when the solar radiance is low. There is a power saver (battery)that stores the excess power when the power rating of the load is already met.The system is equipped with dual axis sun tracking mechanism for increased power generation from the solar panel. There is also an IOT based controller, being used to monitor the system parameters.

KEYWORDS: Solar Energy, Internet of Things (IoT), Sun Tracking, MPPT Algorithm, Arduino, Node MCU, AC Grid.

INTRODUCTION

Electricity is one of the most essential thing in our day to day life . As electricity is aenergy source it can be transformed from one form to another. Many people transform wind energy, geothermal energy, Biomass energy into useful forms of electrical energy . Here we are using solar energy as the source for our energy transformation.

The Proposed system is basically a parallel processing system where we have an alternate power supply AC grid .There is a switch connected to alter between the photovoltaic panel and Ac grid if the system experiences any shortage of power supply . An alternate power balancing system through IOT to automatically cut off the supply to the loads that are not currently in use is implemented to save the power

The MPPT algorithm ensures that the maximum extracted solar energy is supplied to the loads. The MPPT curve is analyzed through the matlab software. Untill the Maximum power point is encountered there will be a gradual hike in the supply power and when the maximum power point is achieved thereafter the power supply will be a constant

The source energy is extracted from the sun directly and is transformed from solar energy to electrical energy and further supplied to the loads. In order to monitor the supply voltage at both the source end and receiver end we are introducing the microcontrollers to display the accurate values of the power received.

PROPOSED SYSTEM

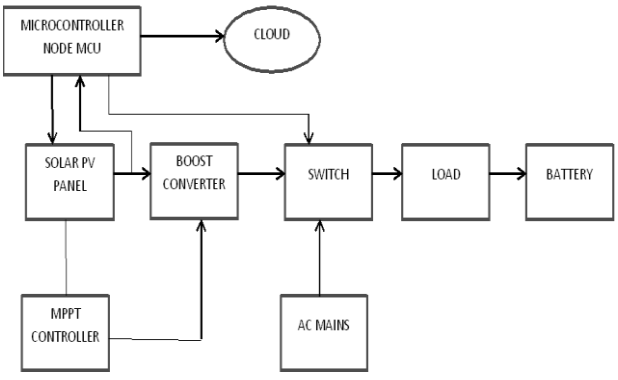

Figure 1- Block diagram of the energy efficient & smart power management system

The block diagram above depicts the proposed system for energy efficient and smart power management solution using Iot. The system consists of the following components

1. Solar PV panel with sun tracking
2. MPPT Algorithm
3. DC-DC Boost converter
4. Grid
5. Loads
6. Internet of Things (IoT)
7. Battery

The block diagram depicts the overview of the proposed system. In this system, the dual axis panel is the energy extracter and is connected to the DC-DC converter. There is also a node MCU microcontroller for the application of IoT based monitoring of the system. The switch alters the supply and the battery connected at the end retains the excess power, So that we can use this power for further needs.

SOLAR PV PANEL WITH SUN TRACKING

Solar panel is basically a device to extract solar energy. In the proposed system we are using a photovoltaic dual axis solar panel that can rotate around 360 degrees.

The panel is controlled and coded using the microcontroller to rotate clockwise, anticlockwise , rotate up and rotate down towards the sun's direction to consume as much as solar energy as possible

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Figure 2 - Solar PV Panel

Most photovoltaic modules have crystalline silicon cell coating to overcome the rust formation and also to slide off the dust particles. Most PV's are rigid but semi-flexible.

Solar panels have many practical applications for use in agriculture as a power source for irrigation. In medical industries to refrigerate the supplies

PV cells are made of semiconductor materials, such as silicon. For the solar cells, a thin semiconductor wafer is specially treated to form an electric field, positive on one side and negative on the other. When the light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor material. If electrical conductors are attached to positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of an electric current - that is, electricity. This electricity can be used to power a load. A PV cell can either be a circular or square in construction.

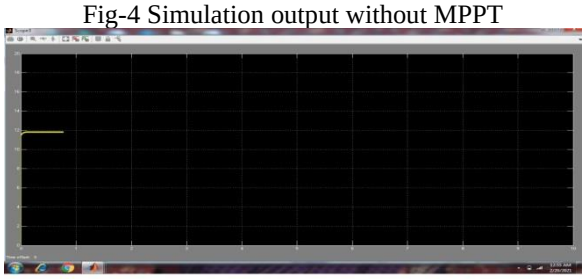
MPPT ALGORITHM

MPPT is an algorithm used to maximize the productivity and output from a PV panel using a microcontroller. The PV module is the main part of the system. MPPT is a method by which maximum output can be obtained by detecting the current, voltage and temperature using sensors. The DC-DC converter is responsible for improving the output voltage of the solar panel to match the value as required by the load.

Fig-3 Simulation output with MPPT

From the simulated output withmppt we can infer that there is a hike in power and after the maximum power point is experienced the supply will be a constant

Fig-4 Simulation output without MPPT



From this simulated output we can infer that there is no hike in the power received from the panel and at the receiver end there is no constant supply

Of power.

DC-DC CONVERTER

The DC-DC boost converter is used to step up the voltage . The converter used here is a boost converter i.e. to increase the value of voltage from lower voltage to the higher or require output.

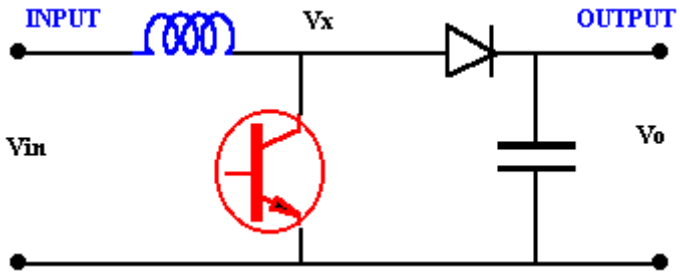


Figure 3 - DC-DC Boost converter

The boost converter in figure-3 increasethe input voltage. The supply from the
PV panel reaches the DC-DC converter to get boosted to a maximum voltage so as to avoid the fading or lack of supply at the output

MICROCONTROLLER (IOT)

The IoT is used in the proposed model to enable monitoring of the load and the system remotely. IoT is an active technology cuurently being used for communication between two devices using the sensors and actuators. The

system uses a node MCU microcontroller which is connected with sensors for current, voltage monitoring and the data is uploaded to the cloud and is accessible via mobile application.

BATTERY

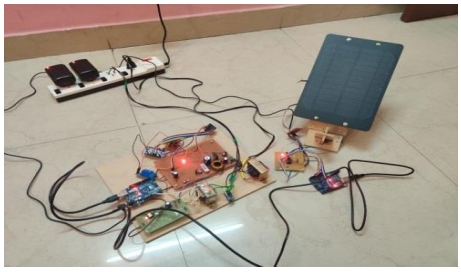
A battery is connected at the end of the model. The purpose of installing a battery is that when the load is switched off or not in use, the power generated can be stored in the battery and can be used for other purposes.

IMPLEMENTATION

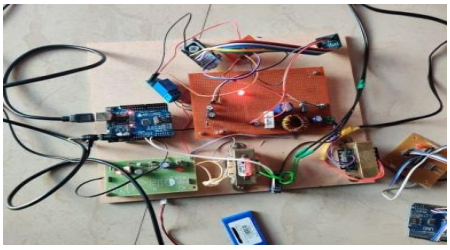
The solar Photovoltaic panel is connected to the DC-DC converter. The panel has a sun tracking mechanism which is controlled by a microcontroller. The input from the solar panel is given to the boost converter, which has the MPPT algorithm programmed. The input of the solar panel is thus boosted by the converter using MPPT to the desired value of the load. There is a switch to which the booster circuit is connected, and the AC power grid is also connected, this is used for switching the system to the AC power when the solar power output is low.

The second part of the circuit details the IOT implementation of the proposed model. The connection between the microcontroller and the circuit is established through MQTT(Message Queuing Telemetry Transport) to transfer the desired data between the device and the application. A node MCU microcontroller board and an android application is used to control the device for remote communication and monitoring between the devices. The node MCU controller and the android application is connected to the same network. Once connection is established successfully, we can start monitoring the system remotely. The various parameters of the system can be monitored.

RESULT AND OUTPUT



Setup



output

In the output relay circuit as a result of the Input power supply from pv panel the led glows. The solar energy is now converted to electrical energy.
The setup part consists of a boost converter to increase the consumed power from the panel so as to ensure that there is hindrance to match the power rating of the loads.
From the microcontroller connected to the photovoltaic panel we monitor the
Movement of panel towards the sun

In the output part

we have a switch to oscillate between the ac grid and the input supply fromthe panel if any shortage of supply occurs in order to ensure constant supply of power. We

confirm thesupply has reached the load by theglow from the led.
The simulated readings from the mppt and the hardware readings are the same when verified.
The excess power is stored in the battery if the power rating of the load is already met. We monitor the loads through Iot with the help of node mcu microcontroller and verify it with the simulation readings .
We can use the power stored in the battery for further use if the climatic condition is not met. So the energy is conserved and utilized on accordance
With our needs.

EFFICIENCY CALCULATION

Power readings at the input			power readings at the output		
Voltage (v)	Current (A)	Power(watts)	Voltage(v)	Current(A)	Power(watts)
0	0	0	0	0	0
1.5	1.5	2.25	1	1	1
2	2	4	1.5	1.5	2.25
3	3	9	2.94	2.94	8.64
3	3	9	2.94	2.94	8.64
3	3	9	2.94	2.94	8.64

The default resistance value at the boost converter is (1 ohms)
Power at input side (PI)
v=3v, I=3A
p = vi
PI=3*3=9 W
Power at output side (P0)
V=2.94v, I=2.94A
p = vi
P0=2.94*2.94 = 8.64W

Efficiency =ɳ=100*P0/PI
=100*8.64/9
ɳ=96%
So the 96% consumed solar energy is converted into electricity

CONCLUSION
So in the proposed system, we have implemented the MPPT algorithm using a microcontroller to maximize the solar power derived from the panel for powering the system. Then it is connected to a boost circuit for deriving the required power demanded by the load. The AC grid power is connected to the system in the switch in parallel, to switch to it if the output from the solar power is lower. IOT monitoring of the system established through node MCU microcontroller has also been implemented in the system.

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