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Load sharing of renewable energy source

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ABSTRACT

Solar energy is one of the greatest attractions among the renewable energy re-sources used for electrification. Harnessing solar energy needs photovoltaic (PV) system that converts light energy from sun into direct electricity. Photovoltaic systems can be installed at any place where sufficient energy potentials are avail-able. The major challenge in the PV systems is to study its performance as it is varying with respect to various parameters and system components functioning. Hence real time monitoring system is needed to assess its performance. This study briefs about the use of internet of things (IoT) in performance monitoring and real time control of PV systems. Focus is made on the IoT need and its architecture for PV systems with relevant discussions. Use of IoT enhances the understanding over the real time operating parameters. This helps in accessing the control over the PV systems installed at remote areas, effective and fast fault diagnosis, maintenance, recording generation and performance data for analysis.

Keyword: PVarray, Pic, Controller, Regulator, Inverter, Converter.

INTRODUCTION

Photovoltaic or Solar cells cell are semiconductor diodes that convert available sunlight into electrical power. Semiconductor is P-N junction photodiodes with very large light-sensitive area. Each photodiode is a solar cell. All these solar cells are connected in a module to form a solar panel. These solar panels are cascaded together to form arrays to generate high power electricity. To attain the maximum benefit from these solar panels, we need to position them in the direction that captures most of the energy. Therefore this direction depends upon various factors.

The solar panels are mounted at a fixed tilt, but because the sun keeps changing its position due to the rotation as well as the revolution of earth, these solar panels can capture more energy if their tilt is adjusted periodically. It is more beneficial to use wind/solar hybrid system than single wind or solar power generation since it suppresses rap-id change in the output power of the single source such as the wind turbine system. Grid interface of the hybrid system with battery storage improves system reliability. Power system frequency stability relies on the balance between the active power output of the generators and the active power consumed by the loads. Therefore, it is essential to reduce the renewable energy power fluctuation up to a certain range.

The Renewable energy sources are intermittent in nature hence it is therefore a challenging task to integrate renew-able energy resources into the power grid. Some of the challenges and issues associated with the grid integration of various renewable energy sources particularly solar photovoltaic and wind energy conversion systems are: (i) Maintaining power quality (Reduction in harmonics, and control of frequency and voltage fluctuations) (ii) Power fluctuation (Elimi-nation/Control of small time power fluctuations and long time or seasonal power fluctuations) (iii) Storage (iv) Protection issues (v) Optimal placement of renewable energy sources [1-4]

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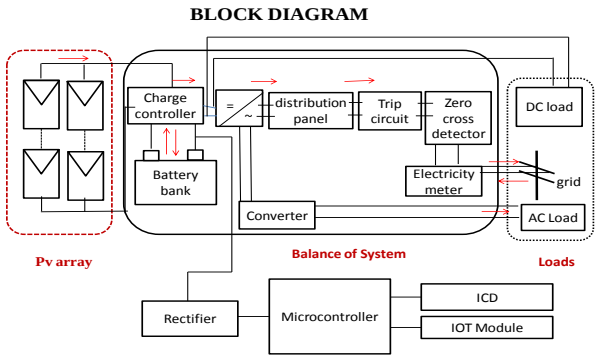
BLOCK DIAGRAM AND DESCRIPTION

Block diagram



Description

Battery

An electric battery is a device which can store an electrical charge as chemical energy and convert it to electrical energy while a rechargeable battery can also convert electrical energy to chemical energy and store it. The basic principal of a battery is that, during its charging cycle, electrons are stored in its cells into which the current flows and, during its discharging cycle, electrons are extracted from itscells and the current flows to the load. Details model and control technique are explained below. [5-8]

Power supply

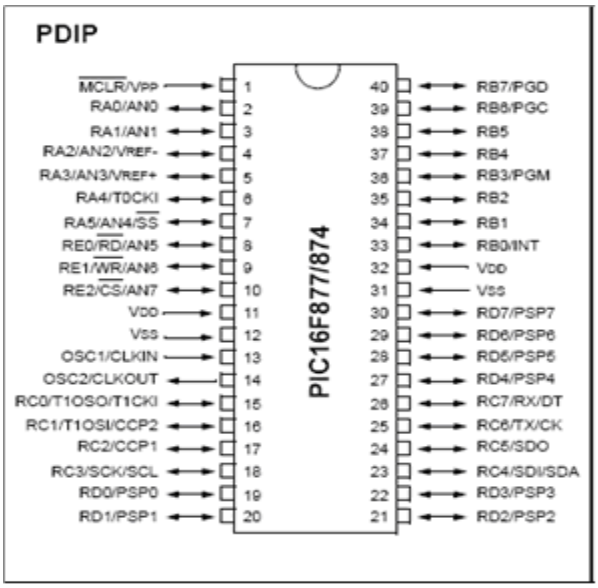
A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others

The main components used in the power supply unit are Transformer, Rectifier, Filter and Regulator. The 230V AC supply is converted into 9V AC supply through the transformer. The output of the transformer has the same frequency as in the input AC power. This AC power is converted into DC power through diodes. Here the bridge diode is used to convert AC supply to the DC power supply. This converted DC power supply has the ripple content and for normal operation of the circuit, the ripple content of the DC power supply should be as low as possible. Because the ripple content of the power supply will reduce the life of the circuit. So to reduce the ripple content of the DC power supply, the large value of capacitance filter is used.

Pic controller

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller" now it is "PIC" only.

PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability



Photovoltic cell

Conversion of light energy in electrical energy is based on a phenomenon called photovoltaic effect. When semiconductor materials are exposed to light, the some of the photons of light ray are absorbed by the semiconductor crystal which causes a significant number of free electrons in the crystal. This is the basic reason for producing electricity due to photovoltaic effect. **Photovoltaic cell** is the basic unit of the system where the photovoltaic effect is utilised to produce electricity from light energy. Silicon is the most widely used semiconductor material for constructing the photovoltaic cell. The silicon atom has four valence electrons. In a solid crystal, each silicon atom shares each of its four valence electrons with another nearest silicon atom hence creating covalent bonds between them. In this way, silicon crystal gets a tetrahedral lattice structure.

Instrument transformer

If we want to measure extremely high values of current and voltage than there are two ways of measuring it. One is to use high capacity instruments which would be obviously costly. Another way is to use the transformation property of current and voltage.

Current and voltage can be stepped down by using a transformer whose turn's ratio is known and then measuring the stepped down current and voltage by a normal ammeter or voltmeter. The original magnitude can be determined by multiplying the stepped down magnitude with the turn's ratio.

There are two types of instrument transformer:

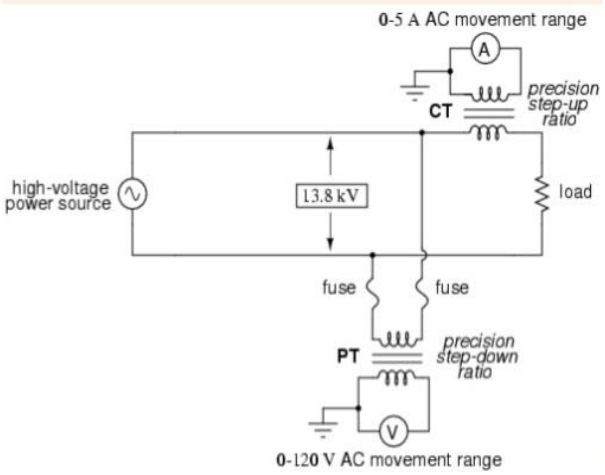
1. Current transformer
2. Potential transformer

CT and PT

Current transformer: Current transformer are put in series with the line in which the current is to be measured. They are used to step down the current to such a level so that it can easily be measured by using an ammeter. Generally they are expressed as primary: secondary current ratio for e.g.: A 100:5 amp CT will have primary current of 100 Amp's and secondary current of 5 Amp's.

Potential transformer: Potential transformers are also known as **voltage transformers** and they are basically step down transformers with extremely accurate turn's ratio. Potential transformers step down the voltage of high magnitude to a lower voltage which can be measured with standard measuring instrument. These transformers have large number of primary turns and smaller number of secondary turns.

A potential transformer is typically expressed in primary to secondary voltage ratio. For example, a 600:120 PT would mean the voltage across secondary is 120 volts

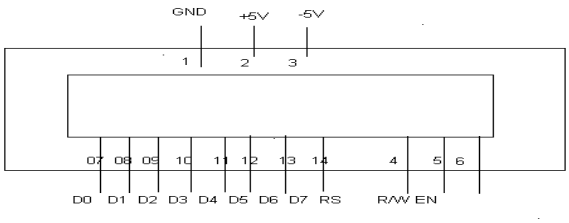


IOT

The 'Thing' in IoT can be any device with any kind of built-in-sensors with the ability to collect and transfer data over a network without manual intervention. The embedded technology in the object helps them to interact with internal states and the external environment, which in turn helps in decisions making

IoT applications are flourishing across all industries & market. The IoT has a multitude of expansion over various industries. It spans over all groups of users, from those who are trying to reduce & conserve energy in their home to large organizations who want to improve their business operations. IoT has not only proved itself useful in optimizing critical applications in many organisations, but also have boosted the concept of advanced automation which we have imagined a decade before. Let's understand the capabilities of IoT across different industries and look how they are revolutionizing them. IoT uses multiple technologies and protocols to communicate with devices based on the requirements. The major technologies & protocols are Bluetooth, wireless, NFC, RFID, radio protocols and WiFi-Direct.

LCD



Pin descriptions

Vcc, Vss and Vee

While Vcc and Vss provide +5V and ground respectively, Vee is used for controlling LCD contrast.

RS Register Select

There are two very important registers inside the LCD. The RS pin is used for their selection as follows.If RS=0, the instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home, etc.If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W, read/write

R/W input allows the user to write information to the LCD or read information from it.

- R/W = 1 for reading.
- R/W= 0 for writing.

EN, enable

The LCD to latch information presented to its data pins uses the enable pin. When data is supplied to data pins, a high–to-low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450 ns wide.

D0 – D7

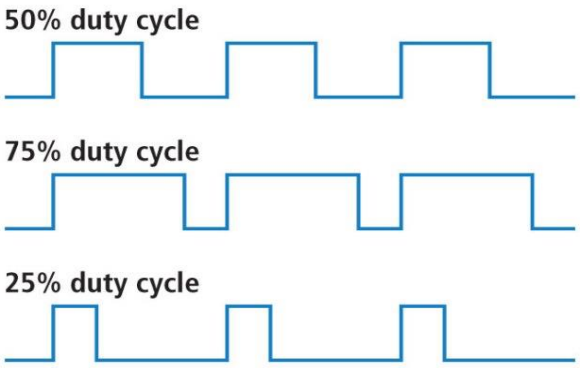
The 8–bit data pins, DO – D7, are used to send information to the LCD or read the contents of the LCD's internal registers.To display letters and numbers, we send ASCII codes for the letters A–Z, a-z numbers 0-9 to these pins while making RS=1.There are also instruction command codes that can be sent to the LCD to clear the display or force the cursor to home position or blink the instruction command codes

Pluse- with modulation

Pulse Width Modulation (PWM) is a fancy term for describing a type of digital signal. Pulse width modulation is used in a variety of applications including sophisticated control circuitry. A common way we use them here at SparkFun is to control dimming of RGB LEDs or to control the direction of a servo motor

Pulse-width modulated motor drives are becoming the dominant method of variable speed motor control, and are being used not only in industry, but in applications as diverse as electric vehicles and domestic air conditioners. PWM drives produce complex waveforms, both on the motor output and in the electrical supply to the drive. This article first looks at the electrical characteristics of PWM motor drives and then details the electrical measurements used for proper analysis.

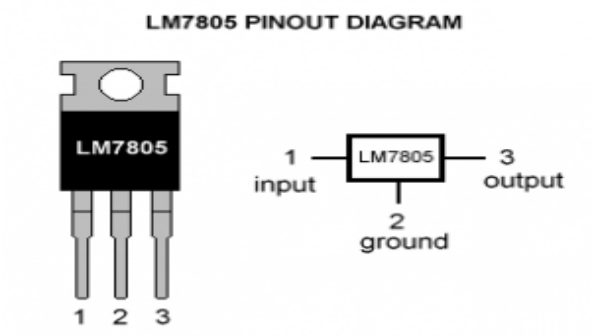
Speed control of an AC motor requires a three phase supply that can vary both voltage and frequency. Such a supply creates a variable speed rotating field in the stator that allows the rotor to spin at the required speed with low slip. This AC motor drive, or PWM, can efficiently provide full torque from zero speed to full speed, can over speed if necessary, and can, by changing phase rotation, easily provide bi-directional operation of the motor.



Duty cycle

Regulator 7805

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power.



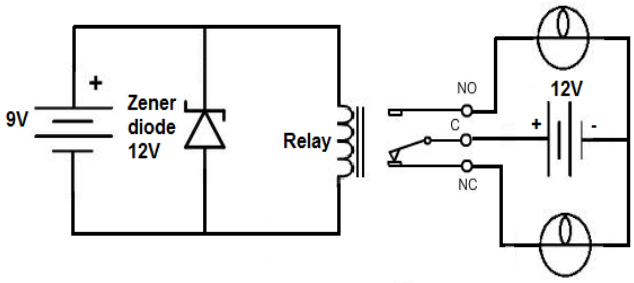
Relay driver

All relays come with a voltage rating. This is called on a relay's datasheet its rated coil voltage. This is the voltage needed in order for the relay to be able to operate and be able to open or close its switch in a circuit. In order for a relay to function, it must receive this voltage at its coil terminals. Thus, if a relay has a rated voltage of 9VDC, it must receive 9 volts of DC voltage to operate. So the most important thing a DC relay needs is its rated DC voltage. If you don't know this, look up what relay you have and look up its datasheet and check for this specification.

Components Needed

- DC Relay
- Zener Diode
- DC Voltage SourceAgain, the DC relay must receive its rated voltage value in order to operate.
- The DC power source can be either batteries, wall wart power, or a DC power supply- any DC power source.

The zener diode is placed reverse biased in parallel to the relay



DC Relay Driver Circuit Schematic

Software requirements

- PIC CCS Complier
- EMBEDDED C
- PIC KIT 2 V2.61

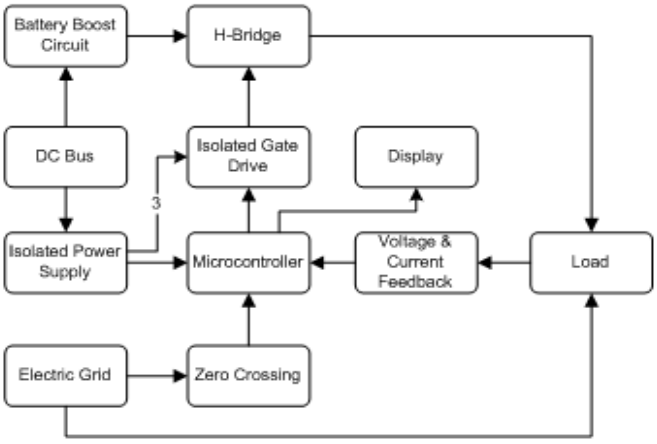
Working

PV arrays are used to generate the electricity .Charge controller is connected with battery bank and machine learning algorithm is used in charge controller for constant output. Here, bimodal inverter is used to convert DC supply into AC supply. By using this inverter output power losses are reduced.Next interleaved converter is used to convert fixed AC to variable AC .Our government provide 100 unit free power per a month, so we can utilize that power . After that the solar power is used.Aftercompleting 100 unit the trip circuit automatically give the notification using microcontroller.

Then it will utilize the solar power, until the solar power is supplied to EB line .A zero cross detector gather the wave form from grid supply for synchronization.A electricity meter is used to measure the power usage and transmit power .The generated power is used for AC and DC load A microcontroller is separately used to control the charge controller .Main aim of this project is used increase the efficiency and also clear the drawbacks while connected to the AC load.

Grid interfacing system

The system should be capable of converting DC input of 24V to AC output of 230V at 50Hz.The DC power is fed to a DC-DC boost converter with voltage gain. This simply boosts 24V DC to about 350V DC. The output of this converter is then fed to the inverter stage which converts it to 230V AC. The system implementation can be easily understood.



Grid interfacing system

Grid connected system

The utility interactive inverters not only conditions the power output of the PV arrays but ensures that the Renewable energy system output is fully synchronized with the utility power as shown in Fig. 4 [2]. These systems can be battery less or with battery backup. Systems with battery storage provide addi-tional power supply reliability.

The grid connection system is gathering momentum be-cause of various rebate and incentive schemes. This system allows the consumer to feed its own load utilizing the availa-ble solar energy and the surplus energy can be injected into the grid under the energy by back scheme to reduce the pay-back period. Grid-connected systems can become a part of the utility system. F.Load sharing

The load sharing principle [3], [13] is used to control the power output of the inverter. The power is varied depending upon the input and load so that the output is made stable. The pow-er output is controlled by changing the phase angle and mod-ulation index of the inverter.

If the power output of the inverter is less than the demand, then the phase angle is adjusted to make the output of the in-verter stable thus limiting the output power. The remaining demanded power is fed to the load by the grid. The power delivered by the inverter p is given by:

$$p = \frac{VinvVt}{Xi} \sin \delta$$

Where V_{inv} is the output voltage of the inverter, V_t is the grid voltage and δ is the angle between the grid voltage and inverter voltage.

Advantages

- Renewable energy source
- Reduces electricity bills
- Low maintenance cost
- Technology development

Applications

- Single axis sun tracker can be used for large and medium scale power generation
- It can also be used for power generation at remote places
- It may be used as domestic backup power system
- It can be used in solar street lighting system
- It may be used in water treatment technologies and solar heating
- It can be commercialized.

CONCLUSION

The objective was to utilize renewable energy sources as much as possible and at the same time minimizing electricity con-sumption from the utility company. The inverter was devel-oped using a ferrite core transformer which had the advantage of very low losses, small size and less weight. The designed was developed on the basis of load sharing principle. The an-gle δ, the angle between inverter output voltage and grid volt-age is varied to control the real power output of the inverter.

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