CHAPTER-1 OVERVIEW
1.1 Introduction
A Solar tracker is a device for orienting a solar photovoltaic panel towards the sun. In solar tracking systems the surface of the module tracks the sun automatically throughout the day. Tracking system increases the efficiency of the system considerably there by reducing the cost per unit of output energy.  

1.2 Why To Use Solar Tracking System
From many centuries, sun has been the primary source of energy for the globe. Technically, solar energy can be defined as Electromagnetic energy transmitted from the sun (solar radiation). The amount of energy that reaches the earth is equal to one billionth of total solar energy generated. But is that small? No. The amount of energy which strikes the surface of the earth in one day exceeds daily consumption by 10,000 to 15,000 times. In other words, the amount of solar energy intercepted by the earth every minute is greater than the amount of energy the world uses in fossil fuels each year. Moreover, of all the renewable energy sources available, solar energy has the smallest environmental impacts. Electricity produced from photovoltaic cells does not result in air or water pollution, deplete natural resources, or endanger animal or human health. In spite of these benefits, man is not able to use this energy completely and economically. Two billion people in the world still have no access to electricity. For most of them, solar energy would be their cheapest electricity source, but they cannot afford it. This is because the price of electricity produced from solar cells is still significantly more expensive than it is from fossil fuels like coal and oil. This is because of cost involved in converting the solar energy into required form of electrical energy and low efficiency of solar system i.e., the output from the solar system is not completely sufficient for our needs. The problem here is that the sun’s position is not constant throughout the day. The output from the solar system depends on...
the intensity of sunlight and the angle at which radiation is being incident. Hence there is a need to track the sun in order to produce maximum output throughout the day. The solution to the problem is our project “SOLAR TRACKING SYSTEM”.  

1.3 Analysis of Solar Tracking System  
A Solar tracker is a device for orienting a solar photovoltaic panel towards the sun. In solar tracking systems the surface of the module tracks the sun automatically throughout the day. Tracking system increases the efficiency of the system considerably by reducing the cost per unit of output energy. Concentrators, especially in solar cell applications require a high degree of accuracy to ensure that the concentrated sunlight is directed precisely to the powered device, which is at the focal point of the reflector or lens. The output greatly depends on the angle of incidence, Zenith angle and azimuth angle. Some solar trackers may operate most effectively with seasonal position adjustment and most will need inspection and lubrication on an annual basis. FIG 1.1 Solar Panels

1.3.1 Types of tracking systems  
Solar trackers may be active or passive and may be single axis or dual axis. Single axis trackers usually use a polar mount for maximum solar efficiency. Single axis trackers will usually have a manual elevation (axis tilt) adjustment on a second axis which is adjusted on regular intervals throughout the year. Compared to a fixed mount, a single axis tracker increases annual output by approximately 30%, and a dual axis tracker an additional 6%. There are two types of dual axis trackers, polar and altitude-azimuth. Polar Trackers: Polar trackers have one axis aligned to be quasi-parallel to the axis of rotation of the earth. , polar trackers are used on high accuracy astronomical telescope mounts, which rotate on an axis exactly parallel to the earth's axis. Fig 1.2 Polar Trackers

Horizontal Axle: Several manufactures can deliver single axis horizontal axis trackers which may be oriented by either passive or active mechanisms, depending upon manufacturer. 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. These devices are less effective at higher latitudes. The principal advantage is the inherent robustness of the supporting structure and the simplicity of the mechanism. FIG 1.3 Horizontal Axle

Active Trackers: Active Trackers use motors and gears to direct the tracker as commanded by a controller responding to the solar direction. Fig: 1.4 Active trackers

Passive Trackers: Passive trackers use a low boiling point compressed gas fluid that is driven to one side or the other (by solar heat creating gas pressure) to cause the tracker to move in response to an imbalance. As this is a non-precision orientation it is unsuitable for certain types of concentrating photovoltaic collectors.

CHAPTER 2 AIM AND SCOPE OF THE PROJECT
2.1 Aim And Scope of The Project
From many centuries, sun has been the primary source of energy for the globe. Technically, solar energy can be defined as Electromagnetic energy transmitted from the sun (solar radiation). The amount of energy that reaches the earth is equal to one billionth of total solar energy generated. But is that small? No. The amount of energy which strikes the surface of the earth in one day exceeds daily consumption by 10,000 to 15,000 times. In other words, the amount of solar energy intercepted by the earth every minute is greater than the amount of energy the world uses in fossil fuels each year. Moreover, all of the renewable energy sources available, solar energy has the smallest environmental impacts. Electricity produced from photovoltaic cells does not result in air or water pollution, deplete natural resources, or endanger animal or human health. In spite of these benefits, man is not able to use this energy completely and economically. Two billion people in the world still have no access to electricity. For most of them, solar energy would be their cheapest electricity source, but they cannot afford it. This is because the price of electricity
produced from solar cells is still significantly more expensive than it is from fossil fuels like coal and oil. This is because of cost involved in converting the solar energy into required form of electrical energy and low efficiency of solar system i.e., the output from the solar system is not completely sufficient for our needs. The problem here is that the sun’s position is not constant throughout the day. The output from the solar system depends on the intensity of sunlight and the angle at which radiation is being incident. Hence there is a need to track the sun in order to produce maximum output throughout the day. The solution to the problem is our project "SOLAR TRACKING SYSTEM".

2.2 Objective of the Project
The main aim of our project is to make the panel to rotate according to the sun’s direction from morning to evening automatically so that the panel grabs the solar energy to a maximum extent possible throughout the day. Intelligent Solar Tracking System for maximizing the energy is used to generate power from sunlight and can be used by storing the generated power. This method of power generation is simple and is taken from natural resource. This need only maximum sunlight to generate power. This project helps for power generation by setting the equipment to get maximum sunlight automatically. This system is tracking for maximum intensity of light. When there is a decrease in intensity of light, this system automatically changes its direction to get maximum intensity of light. Here we use two sensors in two directions to sense the direction of maximum intensity of light. The difference between the outputs of the sensors is given to the microcontroller unit, which is used for tracking and generating power from sunlight. It will process the input voltage from the comparison circuit and control the direction in which the motor has to be rotated so that it will receive maximum intensity of light from the sun. The power generated from this process is then stored in a lead acid battery and is made to charge an emergency light and is made to glow.

3.1 Block Diagram
The block diagram of Intelligent Solar Tracking System for Maximising the Energy is as shown below. The different components used to build the System are explained in different sections below. Fig 3.1 Block diagram of Intelligent Solar Tracking System for Maximising the Energy.

3.1.1 Interfacing Diagram
Fig 3.2 Interfacing diagram of Intelligent Solar Tracking System for Maximizing the Energy.

3.2 Micro Controller
AT89C52
An AT89C52 microcontroller is an integrated chip that is often part of an embedded system. It includes a CPU, RAM, ROM, timers and i/o ports like a standard computer, but because they are designed to execute only a single specific task to control a single system, they are much smaller and simplified so that they can include all functions required on a single chip. AT89C52 is a popular version of 8052. The Atmel AT89C52 is an 8052-based microcontroller with 32 I/O Lines, 2 Timers/Counters, 6 Interrupts/2 Priority Levels, UART, 4K Bytes Flash Memory, 128 Bytes On-chip RAM. The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile.
memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

3.3 Light Emitting Diode (LED)

A light-emitting diode, usually called an LED, is a semiconductor diode that emits incoherent narrow-spectrum light when electrically biased in the forward direction of the p-n junction, as in the common LED circuit. This effect is a form of electroluminescence. A LED is usually a small area light source, often with extra optics added to the chip that shapes its radiation pattern. LEDs are often used as small indicator lights on electronic devices and increasingly in higher power applications such as flashlights and area lighting. The color of the emitted light depends on the composition and condition of the semiconducting material used, and can be infrared, visible, or ultraviolet. LEDs can also be used as a regular household light source. Besides lighting, interesting applications include sterilization of water and disinfection of devices.

3.3.1 Physical function of LED

Like a normal diode, the LED consists of a chip of semiconducting material impregnated, or doped, with impurities to create a p-n junction. As in other diodes, current flows easily from the p-side, or anode, to the n-side, or cathode, but not in the reverse direction. Charge-carriers—electrons and holes—flow into the junction from electrodes with different voltages. When an electron meets a hole, it falls into a lower energy level, and releases energy in the form of a photon. The wavelength of the light emitted, and therefore its color, depends on the band gap energy of the materials forming the p-n junction. In silicon or germanium diodes, the electrons and holes recombine by a non-radiative transition which produces no optical emission, because these are indirect band gap materials. The materials used for the LED have a direct band gap with energies corresponding to near-infrared, visible or near-ultraviolet light. LED development began with infrared and red devices made with gallium arsenide. Advances in materials science have made possible the production of devices with ever-shorter wavelengths, producing light in a variety of colors. LEDs are usually built on an n-type substrate, with an electrode attached to the p-type layer deposited on its surface. P-type substrates, while less common, occur as well. Many commercial LEDs, especially GaN/InGaN, also use sapphire substrate. Substrates that are transparent to the emitted wavelength, and backed by a reflective layer, increase the LED efficiency. There refractive index of the package material should match the index of the semiconductor, otherwise the produced light gets partially reflected back into the semiconductor, where it may be absorbed and turned into additional heat, thus lowering the efficiency. This type of reflection also occurs at the surface of the package if the LED is coupled to a medium with a different refractive index such as a glass fiber or air. The refractive index of most LED semiconductors is quite high, so in almost all cases the LED is coupled into a much lower-index medium. The large index difference makes the reflection quite substantial (per the Fresnel coefficients), and this is usually one of the dominant causes of LED inefficiency. Often more than half of the emitted light is reflected back at the LED-package and package-air interfaces. The reflection is most commonly reduced by using a dome-shaped (half-sphere) package with the diode in the center so that the outgoing light rays strike the surface perpendicularly, at which angle the reflection is minimized. An anti-reflection coating may be added as well. The package may be cheap plastic, which may become colored, but this is only for cosmetic reasons or to improve the contrast ratio; the color of the packaging
does not substantially affect the color of the light emitted. Other strategies for reducing the impact of the interface reflections include designing the LED to reabsorb and emit the reflected light (called photon recycling) and manipulating the microscopic structure of the surface to reduce the reflectance, either by introducing random roughness or by creating programmed moth eye surface patterns. Conventional LEDs are made from a variety of inorganic semiconductor materials, producing the following colors: Fig 3.3

- Aluminium gallium arsenide (AlGaAs) — red and infrared
- Aluminium gallium phosphide (AlGaP) — green
- Aluminium gallium indium phosphide (AlGaInP) — high-brightness orange-red, orange, yellow, and green
- Gallium arsenide phosphide (GaAsP) — red, orange-red, orange, and yellow
- Gallium phosphide (GaP) — red, yellow, and green
- Gallium nitride (GaN) — green, pure green (or emerald green), and blue
- Silicon carbide (SiC) as substrate — blue
- Silicon (Si) as substrate — blue (under development)
- Sapphire (Al2O3) as substrate — blue
- Zinc selenide (ZnSe) — blue
- Diamond (C) — ultraviolet
- Aluminium nitride (AlN), aluminium gallium nitride (AlGaN), aluminium gallium indium nitride (AlGaInN) — near to far ultraviolet (down to 210 nm)

With this wide variety of colors, arrays of multicolor LEDs can be designed to produce unconventional color patterns. 3.3.2

Efficiency and operational parameters
Most typical LEDs are designed to operate with no more than 30–60 mill watts of electrical power. Around 1999, Philips Lumileds introduced power LEDs capable of continuous use at one watt. These LEDs used much larger semiconductor die sizes to handle the large power inputs. Also, the semiconductor dies were mounted onto metal slugs to allow for heat removal from the LED die. One of the key advantages of LED-based lighting is its high efficiency, as measured by its light output per unit power input. White LEDs quickly matched and overtook the efficiency of standard incandescent lighting systems. In 2002, Lumileds made five-watt LEDs available with luminous efficacy of 18–22 lumens per watt (lm/W). For comparison, a conventional 60–100 watt incandescent light bulb produces around 15 lm/W, and standard fluorescent lights produce up to 100 lm/W. (The luminous efficacy article discusses these comparisons in more detail.) In September 2003, a new type of blue LED was demonstrated by the company Cree, Inc. to provide 24 mW at 20 mA. This produced a commercially packaged white light giving 13 9.

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