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AUTOMATIC SOLAR TRACKER

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Abstract: In today's world energy crisis is one of the important issue. Environmental energy resources is a prime culprit for environmental pollution and also very limited. In the world to avoid the dependency on conventional resources solar energy is rapidly gaining the focus. Solar energy, as an important means of expanding renewable energy, uses solar cells that convert solar energy into electrical energy. Different approaches are imposed to increase the efficiency of the solar cells by tracking the sun. This system will rotate according to the position of the sun. The operation of the experimental model of the device is based on a servo motor which is intelligently controlled by an Arduino UNO board that moves a mini PV panel according to the rotation of the sun. The energy obtained from the panel is calculated and passed to nodeMCU. NodeMCU sends a message to the user about the amount of energy is generated**.**

Index Terms **- Solar Energy, Solar Tracker, Power Generation, Electrical Energy.**

INTRODUCTION

In remote areas the sun is a cheap source of electricity because it uses solar cells to produce electricity. The output of solar cells depends on the intensity of sunlight to get the maximum efficiency. The solar panel remains according to the position of the sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of efficiency [3]. In order to get a constant output, an automated system is required which should be able to rotate the solar panel according to sun's position. Automatic solar tracker is made as a prototype to solve the problem that mentioned above. Automatic solar tracker is a prototype which rotates according to the position of the sun. The unique feature of this prototype is that, it takes position of the sun as a guiding source instead of earth's rotation. The solar power is used interchangeably with solar energy but refers more specifically to the conversion of sunlight into electricity by photovoltaic cells. It has become a popular investment for companies as well as for residential users. This demand has stimulated the research for increasing the overall output power of PV system causing people all over the globe to work hard on making the technology more efficient as well as cost effective. Solar panels are photovoltaic cells which gives voltage directly if you place them in sunlight.

EXISTING SYSTEM

The existing system is a fixed solar panel. These Solar panels convert the solar energy into electrical energy. There is a key component of the solar panel system. Most commonly available panels of today are either poly-crystalline or mono- crystalline solar panels [6]. The cells in solar panels collect the solar energy and turn it into direct current (DC) electricity. Most homes and businesses, however, use alternating current (AC). Inverters change the DC electricity from your panels into usable AC electricity. Racking and mounting systems are used to affix your solar panels either to your roof or to the ground. They also allow you to position your panels at an angle that is best for capturing the sun's rays.

Fig: Solar panels

PROPOSED SYSTEM

An automatic solar tracker helps by allowing the solar panel to automatically shift with sunlight. An automatic solar tracker senses the sun's position and moves accordingly. This means the solar panel moves from east to west with respect to sun. There are two major types of residential solar panel tracker: single axis and dual axis. The single axis solar tracker can move the angle of the tracker in one direction as the day progresses [1]. A dual axis tracker has two pivot directions [2]. Like a single axis solar tracker it moves east to west across the sky as the sun rises and sets every day, but it can also adjust itself in a North to South direction as the sun's position shifts throughout the year. These solar trackers increase solar panel's efficiency up to 25%-30% than the fixed panel [4]. Solar trackers generate more electricity in roughly the same amount of space needed for fixed tilt systems, making them ideal optimizing land usage.

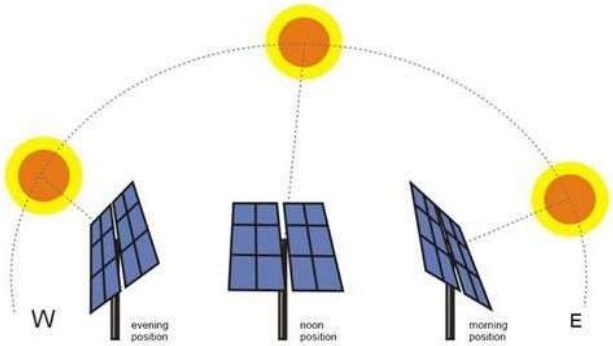
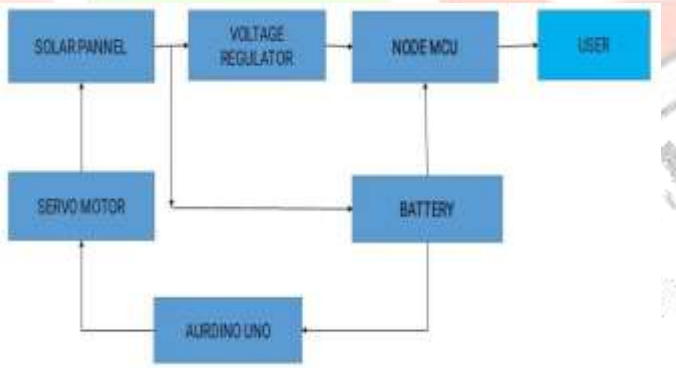


Fig: Solar tracker

IMPLEMENTATION

In order to rotate the solar panel a servo motor is attached to it. Panel is inserted into the wheels of servo motor. Servo motor rotates the solar panel on the basis of input received from Arduino board. To initiate the system we have to turn on the switch, which is available on the top of the battery. Now the power passes to Arduino, nodeMCU and servo motor. After getting the power supply the Arduino starts running the program which is available in it. The Arduino board gives the input to the servo motor according to the instructions given by the user as a program. Now the solar panel rotates according to the position of sun which is mentioned in the program. The obtained solar energy is passed to nodeMCU through a voltage regulator. NodeMCU consists of Wi-Fi module[5]. User needs to connect to nodeMCU through a blynk app by giving user id and password to Wi-Fi module of nodeMCU. NodeMCU gives information to the user about the amount of energy generated through a blynk app. User gets the information like voltage, current and power in blynk app. The power value is calculated with voltage value which is received from panel. Power is supplied to the entire system by a 9V battery.



LED light is used as another component which helps in dark times. LDR sensor senses the environment and pass this information to relay. Relay acts as a switch which helps in turning on/off he light. This LED light will get turned on automatically in dark times. This additional component protects the solar panel from damages in dark surroundings.

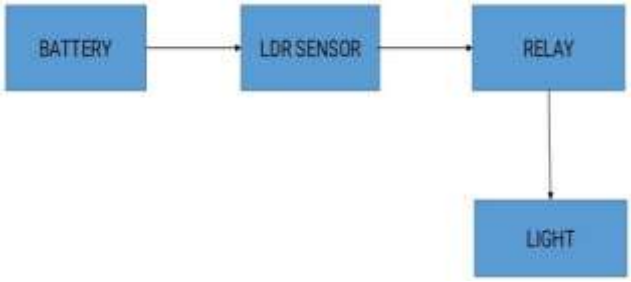


Fig: System Architecture

HARDWARE REQUIREMENTS:

ARDUINO BOARD:

Arduino is a single board microcontroller, intended to make the application of interactive objects or environments more accessible. Pre-programmed into the on-board microcontroller chip is a boot-loader that allows uploading programs into the microcontroller memory without needing a chip /device programmer. An Arduino board consists of an Atmel 8-bit microcontroller with complementary components[2].

Fig: Arduino UNO board

NODE MCU:

TheESP8266 itself is a self- contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi- Fi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs[4].

Fig: Node MCU

SERVO MOTORS:

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. It comes with a 3 horns (arms) and hardware[8].

Fig: Servo motor

SOLAR PANEL:

A solar panel is an assembly of solar cells that can convert light directly into electricity. By combining the capacity of several solar panels, part of a family's electricity needs can be covered. At the moment, depending on the type of panel, 5 to 19 % of the light energy can be converted into electricity. This is known as the "output" of the panel. As the technology is constantly being improved, the output should increase further. Using solar panels you can convert sunlight, which is free and inexhaustible, into electricity. This conversion is achieved

thanks to the so-called "semiconductor" material from which each solar cell is made. A solar panel generates direct current. To be able to use this current in the home or place the surplus on the grid, it has to be converted to alternating current of 230 V. This is done by the converter, which is integrated into the electrical circuit close to the solar panels [6].

Fig: Solar panel

VOLTAGE REGULATOR

A voltage regulator is designed to automatically maintain constant voltage level. A voltage regulator may be a simple feed forward design or may include negative feedback control. It may use an electromechanical mechanism or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements [7].

Fig: Voltage regulators

RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits are amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. A type or relay that can handle the high power required to directly control an electric motor or other loads is called a contractor [9].

Fig: Relay

LDR SENSOR

A photo resistor or light-dependent resistor (LDR) or of a photo resistor decreases with increasing incident light intensity, in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. Photo resistors come in many types. Inexpensive cadmium sulphide cells can be found in many consumer items such as camera light meters, street lights, clock radios, alarm devices, night lights, outdoor clocks, solar street lamps and solar road studs, etc. They are also used in some dynamic compressors together with a small incandescent lamp or light-emitting diode to control gain reduction [7].

Fig: LDR Sensor

BATTERY

The nine-volt battery is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top [8].

Fig: Battery

SWITCH

A switch may refer to one of many different things. For example, it may refer to part of the physical circuit components that control the flow of signals. It can be a button or lever to turn a device on or off[8].

Fig: Switch

LED LIGHT

In the simplest terms, a light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material. Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps)[8].

Fig: LED Light

Software Requirements:

Arduino software:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .in. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information[7].

Fig: Arduino software IDE

Bylnk App:

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. After downloading the app, create an account and log in. Click the "Create New Project" in the app to create a new Blynk app. Give it any name. Blynk works with hundreds of hardware models and connection types. Select the Hardware type. After this, select connection type. In this project we have select WiFi connectivity[9].

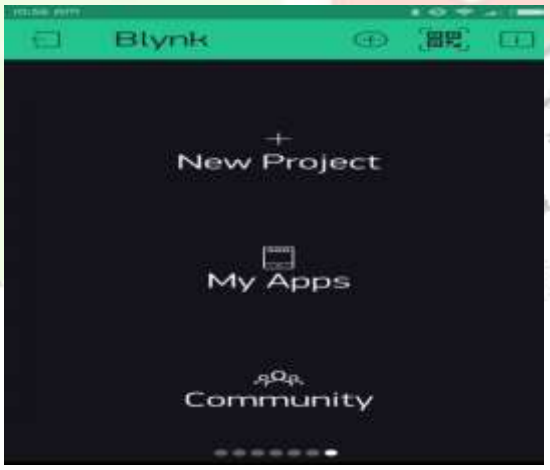


Fig: Blynk app

RESULTS:

To initiate the system we have to turn on the switch, which is available on the top of the battery. Now the power passes to Arduino, nodeMCU and servo motor. After getting the power supply the Arduino starts running the program which is available in it. Servo motor rotates its wheels according to the input getting from Arduino board. Here the panel is inserted into the wheels of servo motor. Now we can observe that the panel is rotating according to the position of sun which is mentioned in the program that is available in Arduino board.

Fig: Solar panel is rotating according to the position of the sun

NodeMCU gives information about amount of energy generated to the user. NodeMCU consists of Wi-Fi module through which it connects to the user. User needs to connect to nodeMCU through a blynk app by giving user id and password to Wi-Fi module of nodeMCU. User gets the information like voltage, current and power in blynk app. The power value is calculated with voltage value which is received from panel.

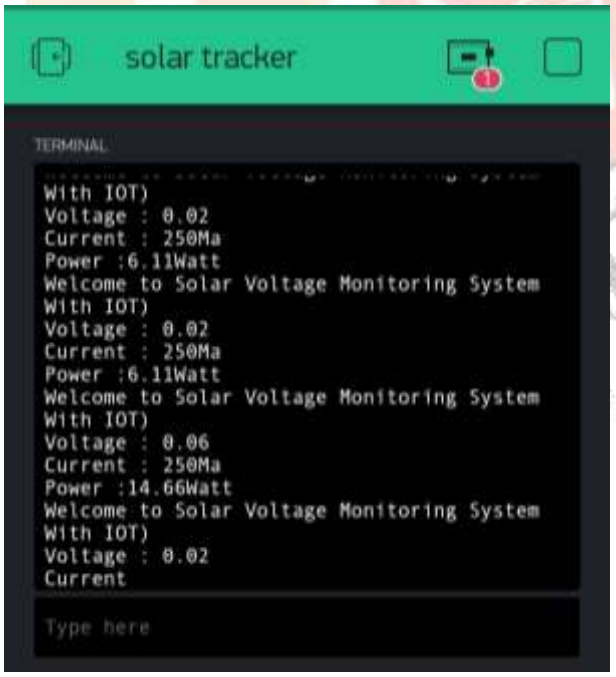


Fig: Output messages sent to the user

An additional component like led is attached to the system in order to save the system from physical damage in dark surroundings. The LDR sensor senses the surroundings and gives the input to relay which act as a switch. In the following picture surroundings are not dark. Now the LDR sensor passes 0 signal to relay. After receiving 0 from the sensor, the relay does not turn on the LED light.

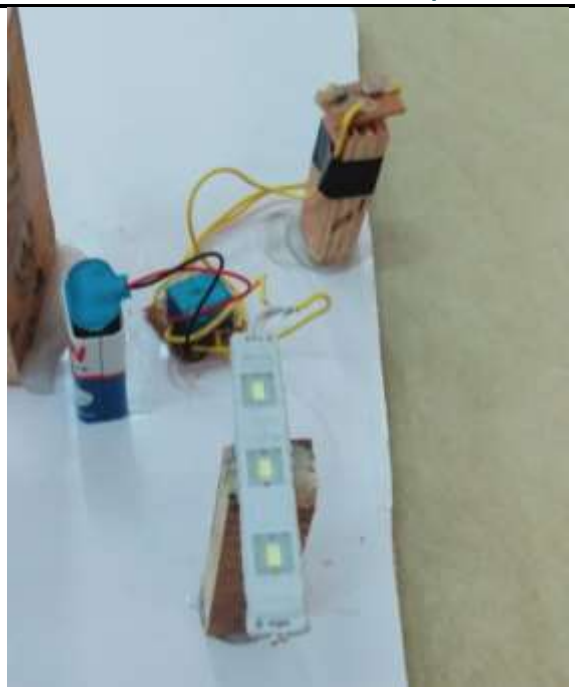


Fig: LED turned off when the surroundings are not dark

In the following picture dark environment is created around the LDR sensor by closing it with a hand. Now LDR sensor passes 1 signal to the relay. After receiving 1 signal from the sensor, the relay turn on the LED light. This LDR sensor and relay get power supply from a 9v battery.

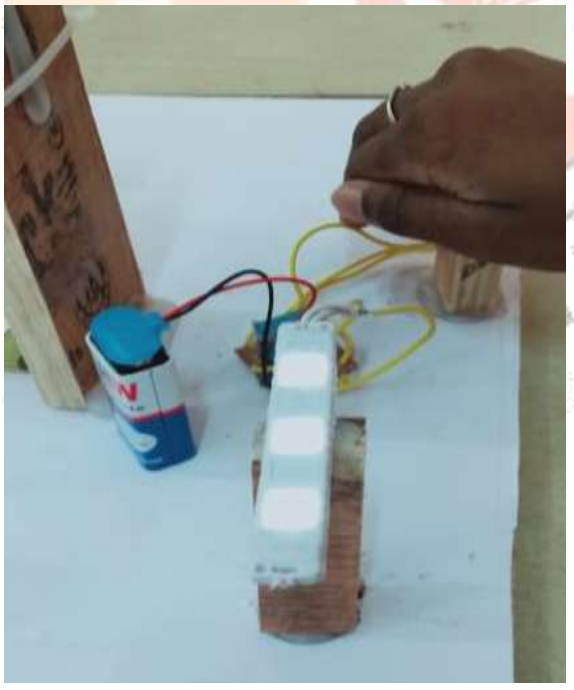


Fig: LED turned on when the surroundings are dark

CONCLUSION

An Arduino Uno board based automatic solar tracker has been implemented using servo motor. Form experimental results it can be proved that automatic solar trackers are more helpful than fixed panels. Different set of readings are obtained based on the sun light.

- According to the sun angle, the panel rotate 15degree per hour.
- Based on sunlight it gives maximum power and it gives message to the user through nodeMCU how much energy is consumed.

From the above conclusions, a final conclusion could be according to sun rotation it will give maximum output than the fixed panels

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