Mini Project Report on

IOT BASED SINGLE AXIS SOLAR TRACKING SYSTEM USING ARDUINO

Submitted in partial fulfilment of the requirements of the degree of

Third year of Engineering in Information Technology.

Submitted by

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UNIVERSITY OF MUMBAI

2020

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CERTIFICATE

Date: _____

This is to certify that, the mini project work embodied in this report entitled, "**IOT based Single Axis Solar Tracking System Using Arduino**" submitted by "**Mitanshu Sankhe** bearing Roll No. 552" , "**Naisargi Shah** bearing Roll No. 556", "**Smit Shah** bearing Roll No. 557" for the award of **Third year in Bachelor Of Engineering (T.E.)** degree in the subject of **Information Technology**, is a work carried out by them under my guidance and supervision within the institute. The work described in this mini project report is carried out by the concerned students and has not been submitted for the award of any other degree of the University of Mumbai.

Further, it is certified that the students were regular during the academic year 2019-20 and have worked under the guidance of concerned faculty until the submission of this mini project work at **Rajiv Gandhi Institute of Technology, Mumbai**.

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CERTIFICATE OF APPROVAL

This mini project report entitled:

IOT based Single Axis Solar Tracking System Using Arduino

Submitted by:

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SMIT SHAH	**557**

In partial fulfilment of the requirements of the degree of **Third year in Bachelor of Engineering** in **Information Technology** is approved.

Internal Examiner

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SEAL OF INSTITUTE

External Examiner

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DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea / data / fact / source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

Solar power is the transformation of daylight into power, either straightforwardly utilizing photovoltaic (PV), or in a roundabout way controlling concentrated sun powered force (CSP). A feasible approach to maximize the efficiency of solar array systems is sun tracking. A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Thus, to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. This paper demonstrates a novel method which will automatically track the sun's position and accordingly change the direction of the solar panel to get the maximum output from the solar cell with the help of components like Arduino UNO, jumper wires, bread board, resistors, servo motor, solar panel, led. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum. It can be used for power generation at remote places where power lines are not accessible.

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INTRODUCTION

A worldwide temperature alteration is one of the real dangers for the survival of people and in addition endless species. Sunlight based force can be powerful in this respect which serves to abate/stop a dangerous atmospheric deviation. In this way, it can be an answer for the unnatural weather change emergency. The issue of the worldwide temperature alteration is mounting step by step. The use of the rechargeable battery is expanding in the last few years because of electronic gadgets, for example, mp3 player, advanced mobile phone and tablet, and so forth. So, the vitality asset is reducing and in addition humankind's presence is staying in risk. Fortunately, decades (or even hundreds of years) of exploration have prompted effective sun-oriented board frameworks that make power without delivering a worldwide temperature alteration contamination. A Solar tracker is an automated solar panel which actually follows the sun to get maximum power. The primary benefit of a tracking system is to collect solar energy for the longest period of the day, and with the most accurate alignment as the Sun’s position shifts with the seasons. A solar tracker device has a wide range of applications to improve harnessing of solar isolation. The problem posed thus is to implement a system that is capable of improving solar power production by 30-40%. A microcontroller is used to implement the control circuit which in turn positions a motor used to orient the solar panel optimally.

CHAPTER 2

AIM & OBJECTIVES

AIM: The aim of our project is to utilize the maximum solar energy from the sun and use that renewable energy for Mobile Charging and other purposes.

OBJECTIVE: This project helps the solar power generating equipment to get the maximum sunlight automatically and the solar panel tracks the sun from east to west automatically and gets bent where the maximum intensity of the light is there.

1. To create a single axis solar tracker.
2. To create a solar tracker for mobile charging.

CHAPTER 3

LITERATURE SURVEYED

Among the renewable energy sources, one of it is solar energy i.e. from the Sun that can be harnessed using solar panels or solar cells to convert solar energy into electrical current which can be used for different purposes.

Types of Solar Tracking Systems:

1. **Single Axis Solar Tracking System:**

   This is method is usually used for solar trackers aimed to be used in the tropics where the focus is to track the angle of altitude (angle of tilt) of the sun along a single axis. A single linear actuator is used, such as a motor to drive the panel according to sun movements. A set of two LDRs on opposite sides of the solar panel may be used to measure the intensity of the solar irradiation by measuring the voltage drops across them which is then compared by a drive circuit until the two LDR voltages are equal and the motion of the panel is stopped. This way, the solar panel is always oriented, normally to sun irradiation.

   Example: Solar Panel

Fig 3.1

2. **Dual Axis Solar Tracking System:**

This method is mainly designed for localities outside the tropics or areas beyond 10°N and 10°S of Equator. In this technique, both angle of azimuth and angle of Tilt of the solar tracker are used to track the sun movements throughout the year. Consequently, a set of two actuators (component of a machine that is responsible for moving and controlling a mechanism), usually motors is used to move the solar panel accordingly by receiving voltage control signals from a set of four LDRs (two on opposite sides of solar panel) and when the voltage drops on all the four LDRs is equal then the panel is experiencing the maximum solar irradiation and therefore the motion stops. This ensures the solar panel is at right angles with sunlight at all times.

Example: Solar panel which can move in two different directions.

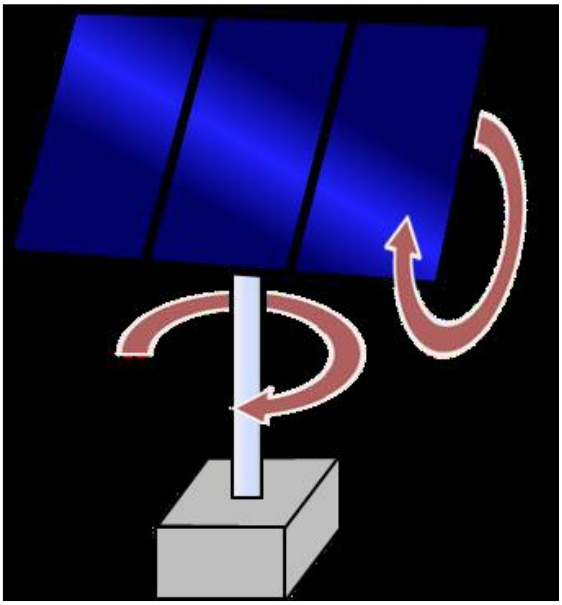

Fig 3.2

METHODS OF SOLAR TRACKING:

1. **Active Tracking:** The position of the sun is continuously determined by the sensors during the day. The sensor triggers the motion of motor or actuator in such a way so that the solar panel will always face the sun throughout the day. Active tracking is accurate with the help of sensors. But the main problem occurs when the sensors fail to discriminate between the measurements and give false trigger or miss original trigger during cloudy days.

2. **Passive Tracking:** Passive tracking method does not use sensors like active tracking. Instead of using sensors, a passive tracker moves in response to imbalance in pressure between two points at the ends of the tracker. This pressure imbalance is caused by heat from sun that creates gas pressure from compressed pressure moves the structure. This method does not have to rely on electrical sensors and requires negligible amount of power to operate. However, the mechanical design has to be very crucial to maintain accuracy.

3. **Chronological Tracking:** A chronological tracker is a timer-based tracking system. The structure is moved at a fixed rate throughout the day since the sun moves across the sky at a fixed rate of about 15 degrees per hour. This method is better suitable for single axis tracking without sensors. For dual axis tracking a modified version can be implemented. The position of sun throughout the day can be calculated and set by the program implemented on the controller module. The solar tracker rotates according to data sent from control units' memory of pre-stored data or calculated from given formula. This method of sun-tracking is accurate and reliable. However, data storage, calculation continuous data transmission is power consuming and unnecessary rotation when sun light is too low can never be avoided. All the three methods are applicable with single axis and dual axis tracking system. Which method is best suitable, is determined by the location of installation, purpose of generation and demand of solar power. Modern trackers combine both the sensor-controlled method and sensor less control method at the same time to increase efficiency.

CHAPTER 4

PROPOSED SYSTEM

In this project include design and construction of an Arduino based solar tracker. This solar tracker system uses the Arduino board, a servomotor, 2 LDR and 2 resistors to rotate the solar panel towards the sun or a source of light. In this project LDR was selected since it has no polarity, and easy to interface with circuit, cheap, reliable and is described by high spectral sensitivity, so that difference in high intensity is represented immediately by change in its resistance value.

In constructing the solar tracking system, LDRs are used to determine solar light intensity. The 2 LDRs are connected to pin A0 and A1 on the board. One servo motor is used for rotation part. Usually the servo has a yellow wire that is used to control the cycle and it must be associated on pin 9 on the board. When light falls on the LDR, its resistance differs and a potential divider circuit is used to obtain corresponding voltage value from the resistance of LDR. The voltage signal is sent to the microcontroller. Constructed on the voltage signal, a corresponding PWM signal is send to the servo motor which origins it to rotate and finally attains a position where intensity of light falls on the solar panel is maximum.

In this project the angles are designed by finding which LDR is in shadow. For example, if high source is right with respect to right LDR will receive maximum light and left LDR will be in shadow. The major components of this system are as follows, Light dependent resistor, Arduino board, Servo motor, 10 k resistor.

CHAPTER 5

IMPLEMENTATION

CIRCUIT DIAGRAM:

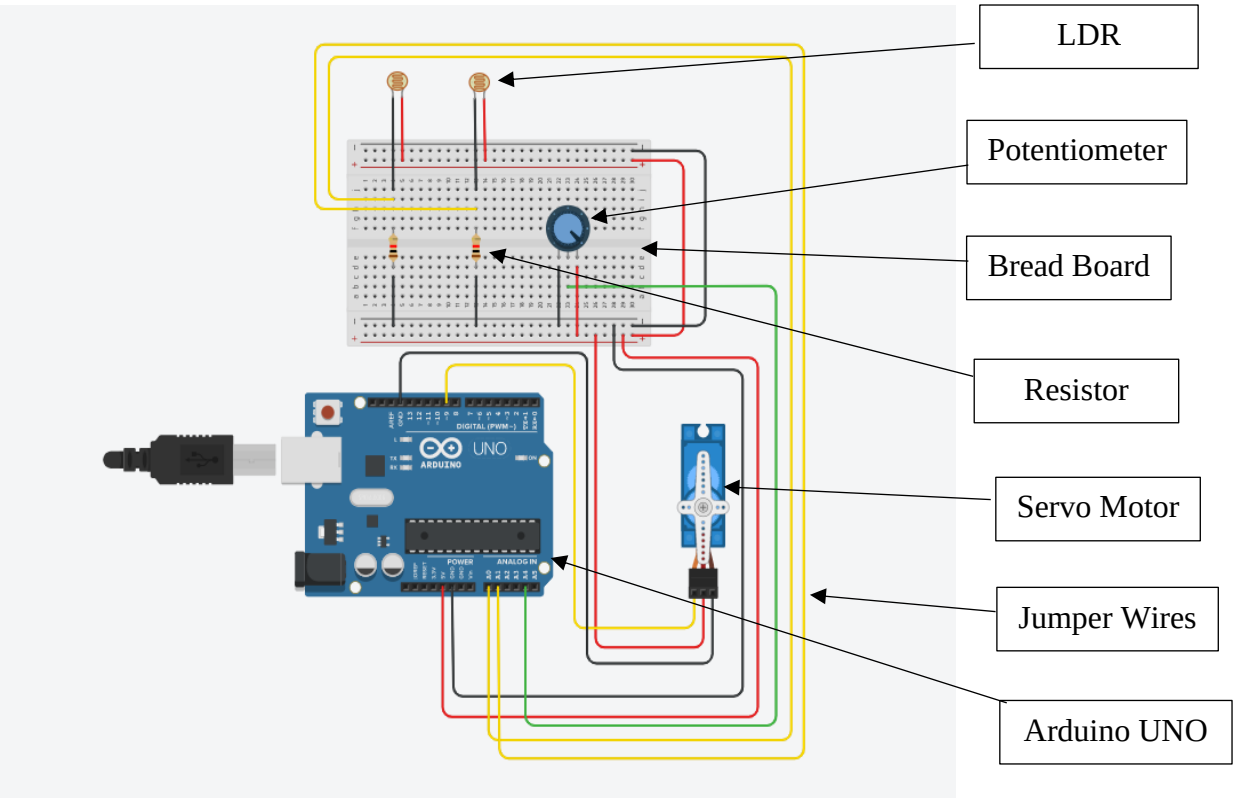

Fig 5.1

```
#include <Servo.h>
Servo myservo1;
int pos = 10;
void setup()
{
        myservo1.attach(9);
}
void loop()
{
```

```
    myservo1.write(pos);
}
```

Upload to your Arduino, and see where the servo moves to. Keep changing the 'pos' values between 0 and 180 in the sketch and re uploading the sketch, until you find the positions where the servo arm points straight up and down. Those are your max and min values. If the value somehow overlaps from 180-back to 0, take the servo arm off and reposition it so that it can be aligned correctly.

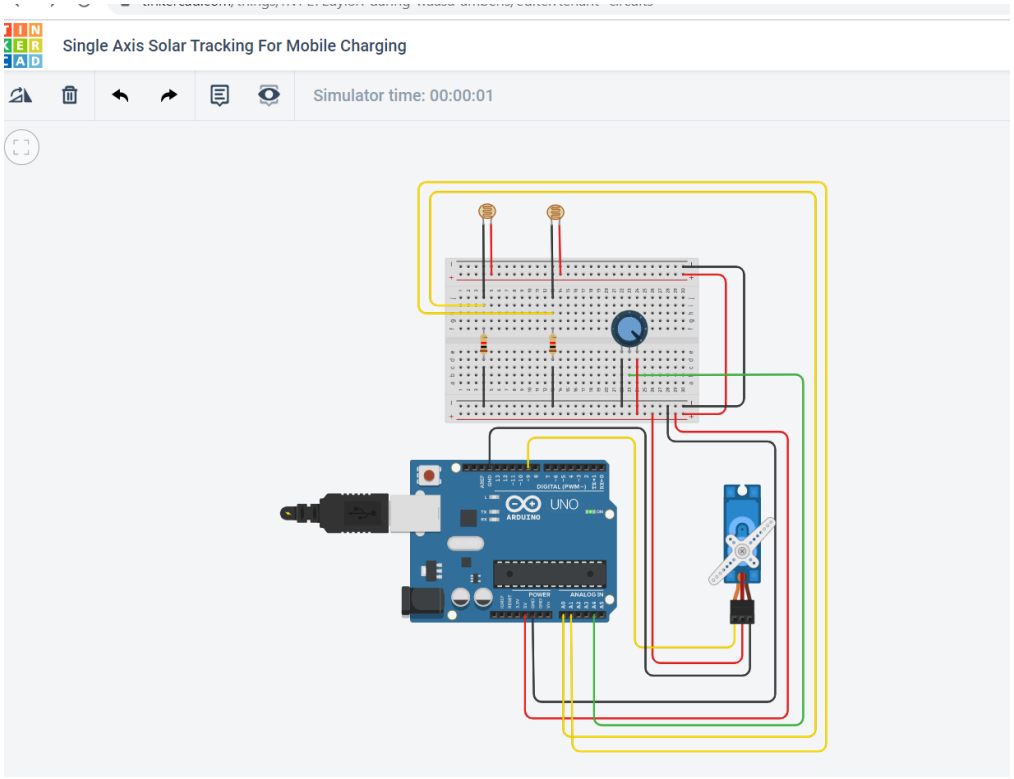

Fig 5.2

Open the Serial Monitor, and shine light onto the LDR's. Try and shine it evenly on to both, and check what the difference value being printed to the serial monitor is. If its anything greater than about 25, or less than -25, you need to add an error calibration. Add the relevant error value into the code, and then add or subtract that value from the relevant LDR. If the difference values are close, it should be fine to leave as is.

You are ready to give it a test! The easiest is to go into a dark room and with a torch/lamp. swing the light from one LDR slowly to the other and watch the panel move. You can also cover up one LDR and the panel should swing away from that one.

If you want to actually make use of the panels output, you can wire up a 2.5V- 5 V DC-DC boost converter directly to the leads coming off the panels. It's an entirely separate circuit from the Arduino/breadboard. Note than a standard phone charges at 5V, and your panels may be putting out 5 V but a low current, so if your battery is full or the sunlight low, you won't have enough output to charge. The easiest way around this is to simply add more panels!

By adjusting the intensity of LDR or photo register the Servo motor changes its direction and rotates accordingly.

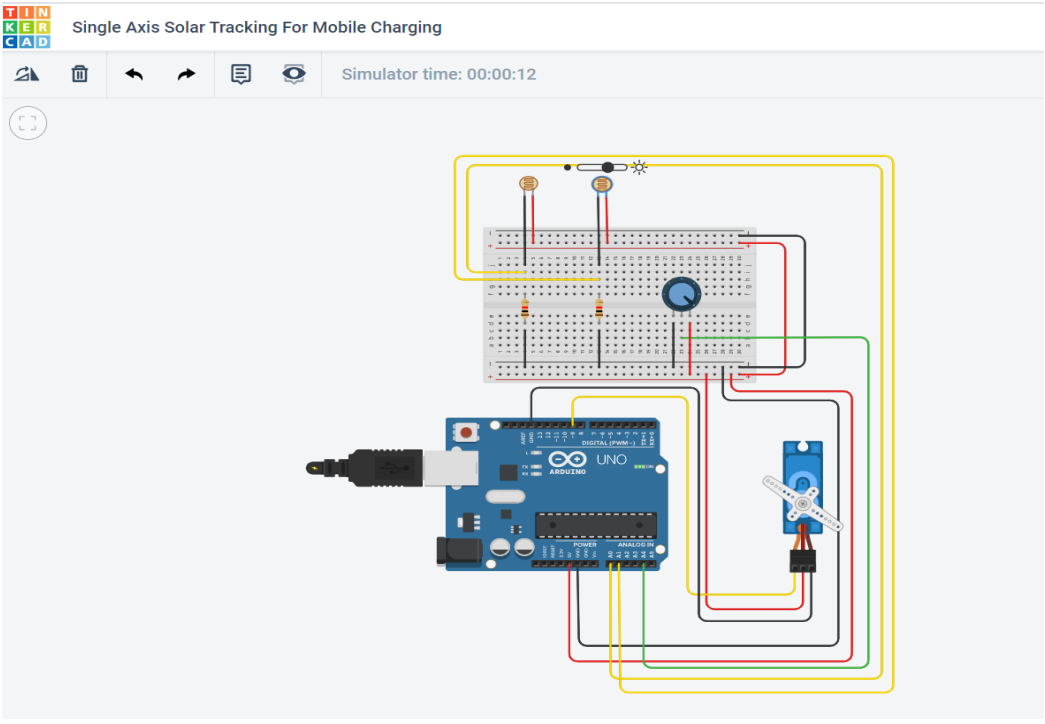

Fig 5.3

You can also attach a serial monitor to debug and check if both LDRs behave differently in a noticeable way when there is same amount of light shining on them. If yes, then you can correct the errors.

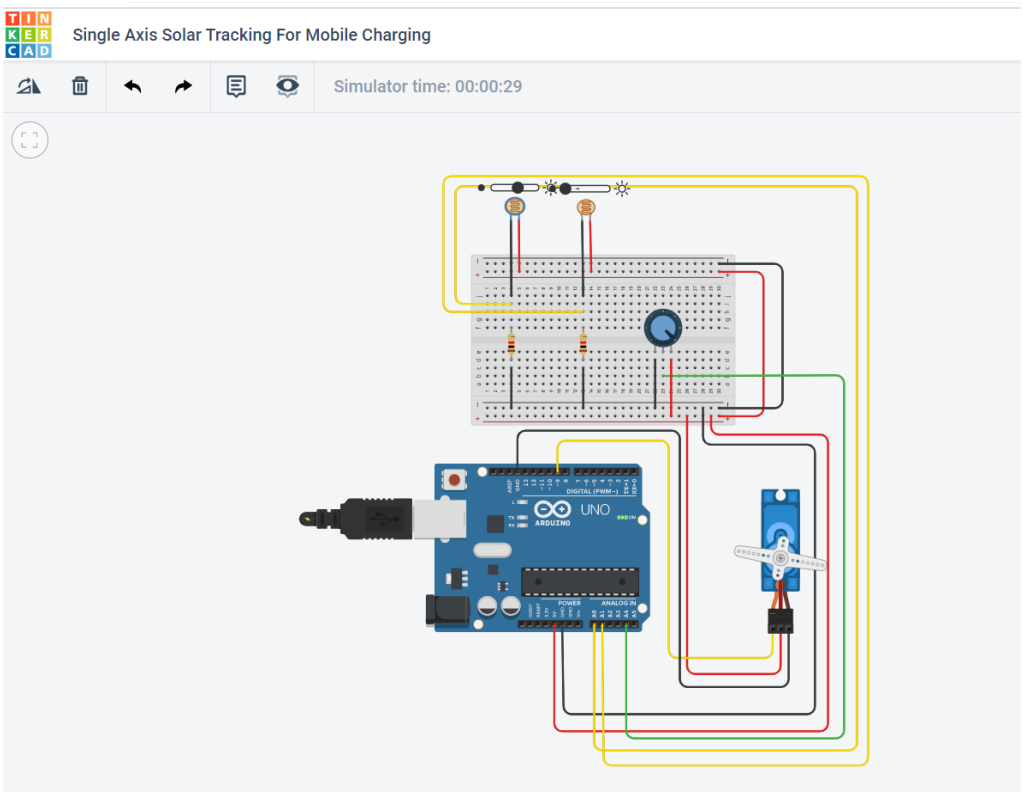

Fig 5.4

CHAPTER 6

HARDWARE AND SOFTWARE DETAILS

SOFTWARE

ARDUINO IDE:

- Here IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go. Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

HARDWARE

1. ARDUINO UNO:

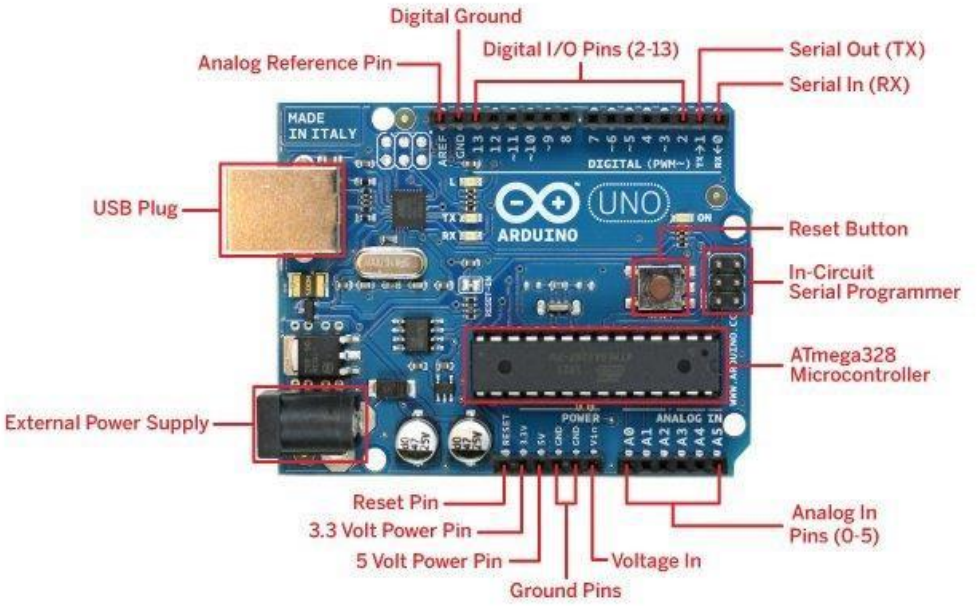

Fig 6.1

- The Arduino Uno board is the most popular board and mostly referred for the beginners as they are super easy to begin with, it does not require any specific Arduino UNO software instead of that all you need is to select the Arduino UNO in the device option before uploading your program.
- There are plenty of Arduino UNO boards look different from the one as shown. But they all have plenty of the same components given below. Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller.
- It also supports serial communication using Tx and Rx pins. You should also have a look at this UNO for beginners. There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega.

2. JUMPER WIRES:

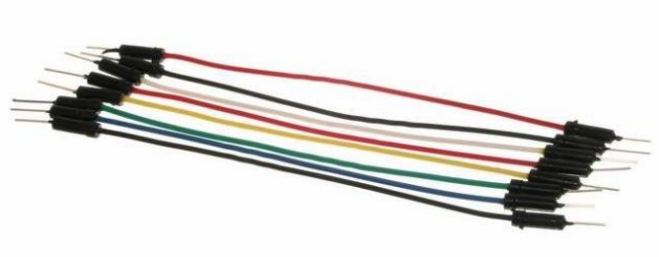

Fig 6.2

- A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.
- Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.
- Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

3. BREADBOARD:

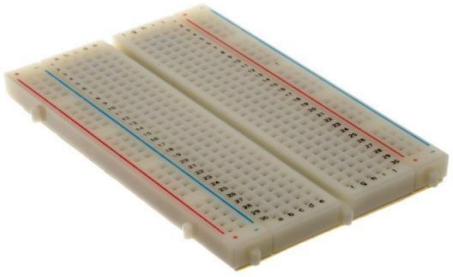

Fig 6.3

- A breadboard is a construction base for prototyping of electronics. Originally the word referred to a literal bread board, a polished piece of wood used for slicing bread.
- Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solderless breadboards are also popular with students and in technological education. Older breadboard types did not have this property.
- A stripboard (Veroboard) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central.

4. RESISTOR:

Fig 6.4

- A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element.
- In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, terminate transmission lines and much more.

5. SERVO MOTOR:

Fig 6.5

- Micro Servo Motor SG90 is a tiny and lightweight server motor 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

- WIRE DESCRIPTION:

  RED = Positive

  BROWN = Negative

  ORANGE = Signal

6. MINI SOLAR PANEL:

Fig 6.6

- A solar panel comprises photovoltaic cells which are made of silicon or other semiconductor materials. A normal solar panel seen on rooftops is typically 65 x 39 inches in size and used for residential applications. Similarly, a solar panel seen on solar farms or commercial solar power plants is generally 77 x 39 inches in size.
- As opposed to these conventional solar panels, there are smaller types of solar panels which qualify as mini solar panels. These panels can come in sizes that range from 0.6 x 2.55 inches to 8.85 x 5.12 inches.

7. LDR:

Fig 6.7

- A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulphide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity.
- The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits.
- Some of its applications include camera light meters, street lights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.

CHAPTER 7

CONCLUSION

In future, when conventional energy may not be sufficient for us, there will be an entail of manipulating non-conventional energy source. By using this straightforward outline, it is feasible for a single person to build the gadget themselves. Solar tracker has played a vital role in increasing the efficiency of solar panels in recent years, thus proving to be a better technological achievement. The tracking system described here is designed such that it can trap the solar energy in all possible directions. Specifically, it demonstrates a working software solution for maximizing energy output by positioning a solar panel at the point of maximum light intensity. This project presents a method of searching for and tracking the sun and resetting itself for a new day. Single-axis trackers are nearly 32.17% efficient compared to a fixed solar tracker mount panel. These trackers follow the Sun from East to West, providing consistent power output all day long. The trackers generate 15-16% higher annual power as compared to a static station of the same installed capacity.

CHAPTER 8

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