AUTOMATED SINGLE AXIS SUN TRACKING MOBILE CHARGING SYSTEM



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Declaration

This is to certify that the project titled "Automated Single Axis Sun Tracking Mobile Charging System" is the result of our study in partial fulfillment of the B.Sc. Engineering degree under the supervision of Rudaina Tasnuva, Lecturer, Department of Electrical and Electronic Engineering (EEE), Sonargaon University, Bangladesh. It is also hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree.

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ABSTRACT

The Automated Single Axis Sun Tracking Mobile Charging System is give you all kind of power information over built in LCD Display. Solar tracking uses complex instruments to determine the location of the Sun relative to the object being aligned. These instruments typically include computers, which can process complicated algorithms that enable the system to track the Sun, and sensors, which provide information to a computer about the Sun's location or, when attached to a solar panel with a simple circuit board, can track the Sun without the need for a computer. This system can produced 30-40 percentage more energy than previous solar system. Its generate 2.5x energy in same time and same space with same panel. This solar system is used Arduino Nano, Servo motor, LDR, Robotic arm, Display Module etc.

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LIST OF ABBREVIATIONS

A	Ampere
AC	Alternative Current
AFH	Adaptive Frequency Hopping
C	Capacitance
CDI	Capacitor Discharge Ignition
CMOS	Complementary Metal Oxide Semiconductor
CT	Current Transformer
DC	Direct Current
EDR	Enhance Data Rate
EEPROM	Electrically Erasable Programmable Read-Only Memory
EN	Enable
F	Farad
FTDI	Future Technology Devices International
GHz	Giga Harz
GND	Ground
GSM	Global System for Mobile Communication
IC	Integrated Circuit
I/O	Input Output
IRLED	Infrared Light Emitting Diode
IoT	Internet of Thinks
K	Kilo
KB	Kilo Byte
LCD	Liquid Cristal Display
LDR	Light Dependent Resistor
LED	Light emitting Diode
mA	Mile Ampere
MAC	Media Access Control

Mbps	Mega Byte per Second
MCU	Microcontroller Unit
MHz	Mega Harz
MPU	Microprocessor Unit
N/O	Normally Open
N/C	Normally Close
PCB	Printed Circuit Board
PT	Potential Transformer
PWM	Pulse Wide Modulation
R	Resistance
RAM	Random Access Memory
RSR	Reset
RX	Receiver
RXD	Received Serial Data
R/W	Read Write
S/I	International System
SPDT	Single Pull Double Throw
SPP	Serial Port Protocol
TTL	Transistor-Transistor Logic
TX	Transmitter
TXD	Transmitted Serial Data
USB	Universal Serial Bus
V	Voltage
VCC	Voltage Common Collector
Vin	Input Voltage

LIST OF SYMBOLS

Ω	ohm
uF	Microfarad
nF	Nano farad
Ωt	Time Phase
°C	Degree Celsius
Q	Charge

CHAPTER I

INTRODUCTION

1.1 Introduction

Solar tracker, a system that positions an object at an angle relative to the Sun. The most-common applications for solar trackers are positioning photovoltaic panels, so that they remain perpendicular to the Sun's rays and positioning space telescopes so that they can determine the Sun's direction. PV solar trackers adjust the direction that a solar panel is facing according to the position of the Sun in the sky. By keeping the panel perpendicular to the Sun, more sunlight strikes the solar panel, less light is reflected, and more energy is absorbed. That energy can be converted into power.

Solar tracking uses complex instruments to determine the location of the Sun relative to the object being aligned. These instruments typically include computers, which can process complicated algorithms that enable the system to track the Sun, and sensors, which provide information to a computer about the Sun's location or, when attached to a solar panel with a simple circuit board, can track the Sun without the need for a computer.

Studies have shown that the angle of light affects a solar panel's power output. A solar panel that is exactly perpendicular to the Sun produces more power than a solar panel that is not perpendicular. Small angles from perpendicular have a smaller effect on power output than larger angles. In addition, Sun angle changes north to south seasonally and east to west daily. As a result, although tracking east to west is important, north to south tracking has a less-significant impact.

Solar trackers provide significant advantages for renewable energy. With solar tracking, power output can be increased by about 30 to 40 percent. The increase in power output promises to open new markets for solar power. However, solar trackers have several important disadvantages. A static solar panel may have a warranty that spans decades and may require little to no maintenance.

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1.2 Background Study

After reading various literature papers, we got only single directional solar panel, then we decide to make a sun tracking solar system. After reading many papers relative to this concept, we found one paper that was very much helpful to us in leading the project. In this technical paper, describe how to stabilize a sun tracker or sun tracking solar system. This tracker is help to produced more solar energy than previous solar system. This tracking system is used a smart sensor called LDR. This LDR are track the sun and give positioning data to MPU. Microcontroller control solar panel using servo motor by perpendicular to sun. Previous solar system can give us only 30-40 percentage of solar energy. But our sun tracking solar system can give us 70-80 percentage of solar energy. We can use this system in various purpose like home industry, factory, etc.

1.3 Problem Statement

Generally, solar panels are stationary and do not follow the movement of the sun. Because of this disadvantage of solar panel, it can only work efficiently only if the presence of the sun is strong and we all know that the incident of sunlight changes of moves with the time of the day. Solar tracker system is used to track the suns movement across the sky and tries to maintain the solar panel perpendicular to the sun rays, ensuring that the maximum amount of sunlight is incident on the panel throughout the day.

1.4 Objectives

The main objective of the project is to position a solar panel according to the motion of the sun so that it can produce maximum power. And second objective is charge mobile phone from this sun tracker solar system. This project used solar panels, mechanism and servo motor in finding the position of the sun.

1.5 Purpose of the project

The purpose of this working is to build a device that when sun is high up in the sky, the tracking system must follow its position. An active control can help achieve this purpose by using time movement. The system need to be automatic thus making it simple and easy to use. The operator interference need to be negligible and must be restricted.

1.6 Significance of the project

Adding solar trackers to a solar panel array are very important and a very good idea. These solar trackers actually increase the time a panel may face the sun which helps them produce power more effectively. We have used the concept of using time to track the sun, and not the device which could sense the presence of the sun and move the panel in that particular direction.

1.7 Scopes

Solar tracking system has always proved to be an effective way to generate more energy because it helps the solar panel remain exactly in front of the solar rays. The concept behind these researches is that it is a fact that the sun keeps on moving across the sky, the whole day long therefore it's a good idea to track its location so that the solar panel can remain exactly in front of it absorbing more power. By applying this concept tracking system were designed which help increase the amount of energy a solar panel may accumulate. Solar panel is connecting with servo motor. Servo motor interface with servo motor controller.

1.8 Benefit of the project

Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays. This increase can be as much as 10 to 25% depending on the geographic location of the tracking system.

There are many different kinds of solar trackers, such as single-axis and dual-axis trackers, all of which can be the perfect fit for a unique jobsite. Installation size, local weather, degree of latitude and electrical requirements are all important considerations that can influence the type of solar tracker best suited for a specific solar installation.

Solar trackers generate more electricity in roughly the same amount of space needed for fixed-tilt systems, making them ideal for optimizing land usage.

In certain states, some utilities offer Time of Use (TOU) rate plans for solar power, which means the utility will purchase the power generated during the peak time of the day at a higher rate. In this case, it is beneficial to generate a greater amount of electricity during these peak times of the day. Using a tracking system helps maximize the energy gains during these peak time periods.

1.9 Project Outline

This project is organized as follows:

Chapter 1 Introduction.

In this chapter we discus about this project.

Chapter 2 Analysis of the system component.

In this chapter we discus about all component, which component we used in this project. like Arduino Nano, Servo motor, Servo controller, Li-Po controller, Boost converter, LCD display, etc.

Chapter 3 Hardware development.

In this chapter we discus about hardware developing. how we develop our project, how we make this project.

Chapter 4 Result and discussions.

In this chapter we discus about project output, we check our panel by using a touch light, we got a perfect result.

Chapter 5 Conclusions.

CHAPTER II

ANALYSIS OF THE SYSTEM COMPONENT

2.1 Introduction

The proposed system is a sun tracking solar system. The system ensures to absorbed more power from the sun rays. This system is produced 30-40 percentage more energy than before. This is fully automatic controlled with fault protection. The system will bear following functionalities:

A. It will use 70-80 percentage sun light to make PV voltage.
B. It will produce 30-40 percentage more energy classic solar system.
C. Its fully MPU controlled automatic system

2.2 Required Component

The Controller has the following main components.

i. Arduino Nano.
ii. Servo motor.
iii. Servo controller.
iv. Robotic Arm.
v. Solar panel.
vi. LDR.
vii. Voltage Regulator IC.
viii. Li-Ion Charge controller.
ix. Li-Ion Battery.
x. Boost Converter.
xi. LCD Display.
xii. Power Switch.
xiii. Diode.
xiv. Resistor.
xv. Capacitor.
xvi. Transistor.

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xvii. Vero-board.

xviii. Mobile Phone.

xix. Connecting wire.

xx. Arduino IDE.

2.3 Arduino Nano

The Arduino Nano is a MPU based developer board. It is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a dip-30 like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-b micro-USB cable, or through a 9V battery.

In 2019, Arduino released the Arduino Nano Every, a pin-equivalent evolution of the Nano. It features a more powerful ATmega4809 processor, and twice the RAM.

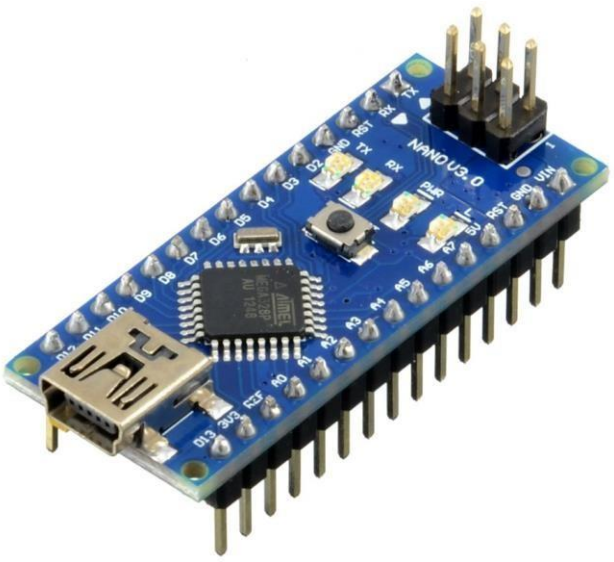


Fig: 2.1 Arduino Nano.

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI

drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

2.3.1 Specification of Arduino Nano

Table: 2.1 Specification of Arduino Nano

Arduino Nano	
Microcontroller	Microchip ATmega328p
Operating Voltage	5V
Input Voltage	6-20V
Digital I/O Pins (DIO)	14
Analog Input Pins (ADC)	8
DC Current per I/O	40mA
SPIs	1
I2Cs	1
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
USB	Mini type B
Reset Button	YES
Serial LED	2 pcs
Load LED	1 pcs (pin 13)
Length	45 mm
Width	18 mm
Weight	7 gm

2.3.2 Pin Function of Arduino Nano

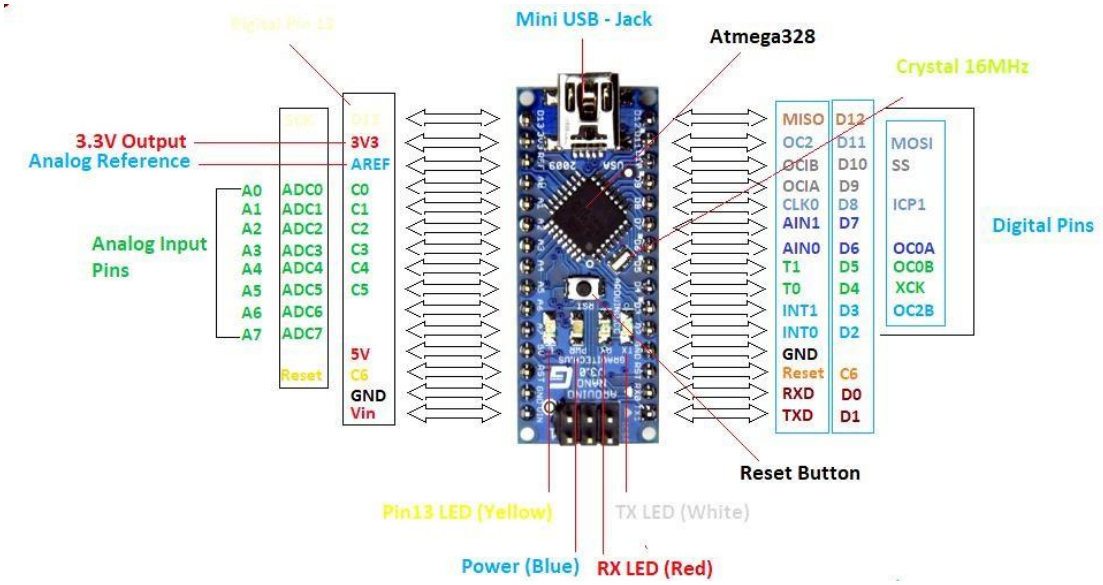


Fig: 2.2 Pin Function of Arduino Nano.

Table: 2.2 Pin function of Arduino Nano.

Level	Data Pin(D)	Notes
A0-A7		Analog to Digital Converter (ADC)
Reset		Reset Pin
D0-D13		Data Pin
RX	0	Serially Receiving Pin
TX	1	Serially Transmitting Pin
INT0	2	Interrupt Pin 1
INT1	3	Interrupt Pin 2
PWM	3, 5, 6,9,10,11	Pulse Wide Modulation Pin
SPI	10, 11, 12, 13	SS, MOS1, MOS0, SCK
GND		Ground
3V3		3.3V Output
LED	13	Inbuilt LED
RST		Reset
GND		Ground
Vin		Raw input Voltage
2IC	A4, A5	Serially data transmit

2.4 Servo motor

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servo motors.

Servo motors are not a specific class of motor, although the term servo motor is often used to refer to a motor suitable for use in a closed-loop control system.

Servo motors are used in applications such as robotics, CNC machinery, and automated manufacturing.



Fig: 2.3 Servo Motor.

2.4.1 Mechanism of servo motor.

A servo motor is a closed-loop servo mechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

The motor is paired with some type of position encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

The very simplest servo motors use position only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models.

More sophisticated servo motors use optical rotary encoders to measure the speed of the output shaft, and a variable speed drive to control the motor speed. Both of these enhancements, usually in combination with a PID control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting.

Servo motors are generally used as a high-performance alternative to the stepper motor. Stepper motors have some inherent ability to control position, as they have built-in output steps. This often allows them to be used as an open-loop position control, without any feedback encoder, as their drive signal specifies the number of steps of movement to rotate, but for this the controller needs to 'know' the position of the stepper motor on power up. Therefore, on first power up, the controller will have to activate the stepper motor and turn it to a known position, e.g. until it activates an end limit switch. This can be observed when switching on an inkjet printer; the controller will move the ink jet carrier to the extreme left and right to establish the end positions. A servomotor can immediately turn to whatever angle the controller instructs it to, regardless of the initial position at power up, if an absolute encoder is used.

The lack of feedback of a stepper motor limits its performance, as the stepper motor can only drive a load that is well within its capacity, otherwise missed steps under load may lead to positioning errors and the system may have to be restarted or recalibrated. The encoder and controller of a servomotor are an additional cost, but they optimize the performance of the overall system (for all of speed, power and accuracy) relative to the capacity of the basic motor. With larger systems, where a powerful motor represents an increasing proportion of the system cost, servomotors have the advantage.

There has been increasing popularity in closed loop stepper motors in recent years. They act like servomotors but have some differences in their software control to get smooth motion. The main benefit of a closed loop stepper motor is its relatively low cost. There is also no need to tune the PID controller on a closed loop stepper system.

2.5 Robotic Arm

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement.[1][2] The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. However, the term "robotic hand" as a synonym of the robotic arm is often proscribed.



Fig: 2.4 Robotic Arm.

2.5.1 Types of Robotic Arm.

A. **Cartesian robot / Gantry robot**: Used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It is a robot whose arm has three prismatic joints; whose axes are coincident with a Cartesian coordinator.

B. **collaborative robot / Cobot**: Cobot applications contrast with traditional industrial robot applications in which robots are isolated from human contact. Cobot has a large variety of applications such as: Commercial Application, Robotic Research, Dispensing, Material Handling, Assembly, Finishing, Quality Inspection. Cobot safety may rely on lightweight construction materials, rounded edges, and the inherent limitation of speed and force, or on sensors and software that ensures safe behavior.

C. **Cylindrical robot**: Used for assembly operations, handling at machine tools, spot welding, and handling at die casting machines. It is a robot whose axes form a cylindrical coordinate system.
D. **Spherical robot / Polar robot**: Used for handling machine tools, spot welding, die casting, fettling machines, gas welding and arc welding. It is a robot whose axes form a polar coordinate system.
E. **SCARA robot**: Used for pick and place work, application of sealant, assembly operations and handling machine tools. This robot features two parallel rotary joints to provide compliance in a plane.
F. **Articulated robot**: Used for assembly operations, die-casting, fettling machines, gas welding, arc welding and spray-painting. It is a robot whose arm has at least three rotary joints.
G. **Parallel robot**: One use is a mobile platform handling cockpit flight simulators. It is a robot whose arms have concurrent prismatic or rotary joints.
H. **Anthropomorphic robot**: It is shaped in a way that resembles a human hand, i.e. with independent fingers and thumbs.

2.6 Solar panel

A solar cell panel, solar electric panel, photo-voltaic (PV) module, PV panel or solar panel is an assembly of photovoltaic solar cells mounted in a usually rectangular frame, and a neatly organized collection of PV panels is called a photovoltaic system or solar array. Solar panels capture sunlight as a source of radiant energy, which is converted into electric energy in the form of direct current (DC) electricity. Arrays of a photovoltaic system can be used to generate solar electricity that supplies electrical equipment directly, or feeds power back into an alternate current (AC) grid via an inverter system.



Fig: 2.5 Solar panel.

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In 1839, the ability of some materials to create an electrical charge from light exposure was first observed by the French physicist Edmond Becquerel. Though these initial solar panels were too inefficient for even simple electric devices, they were used as an instrument to measure light.

The observation by Becquerel was not replicated again until 1873, when the English electrical engineer Willoughby Smith discovered that the charge could be caused by light hitting selenium. After this discovery, William Grylls Adams and Richard Evans Day published "The action of light on selenium" in 1876, describing the experiment they used to replicate Smith's results.

In 1881, the American inventor Charles Fritts created the first commercial solar panel, which was reported by Fritts as "continuous, constant and of considerable force not only by exposure to sunlight but also to dim, diffused daylight. However, these solar panels were very inefficient, especially compared to coal-fired power plants.

In 1939, Russell Ohl created the solar cell design that is used in many modern solar panels. He patented his design in 1941. In 1954, this design was first used by Bell Labs to create the first commercially viable silicon solar cell.

Solar panel installers saw significant growth between 2008 and 2013. Due to that growth many installers had projects that were not "ideal" solar roof tops to work with and had to find solutions to shaded roofs and orientation difficulties. This challenge was initially addressed by the re-popularization of micro-inverters and later the invention of power optimizers.

Solar panel manufacturers partnered with micro-inverter companies to create AC modules and power optimizer companies partnered with module manufacturers to create smart modules. In 2013 many solar panel manufacturers announced and began shipping their smart module solutions.

2.7 LDR

LDR (Light Dependent Resistor) as the name states is a special type of resistor that works on the photoconductivity principle means that resistance changes according to the intensity of light. Its resistance decreases with an increase in the intensity of light. It is often used as a solar sun tracker, light sensor, light meter, Automatic street lights,

and in areas where we need to have light sensitivity. It is also called a Light Sensor. LDR are usually available in 5mm, 8mm, 12mm and 25mm dimensions.

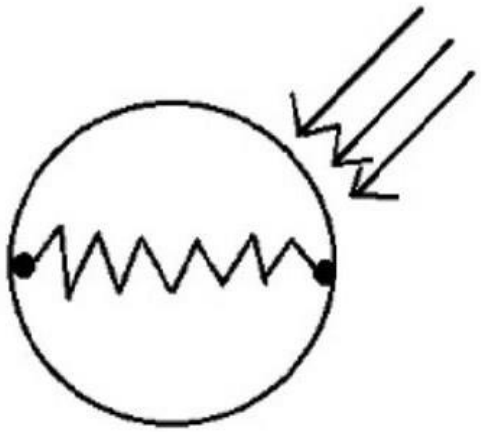


Fig: 2.6 Symbol of LDR

The LDRs made with photosensitive semiconductor materials like Cadmium Sulphides (CdS), lead sulfide, lead selenide, indium antimonide or cadmium selenide and they are placed in Zig-Zag shape as you can see in the pic below, and two metal contacts are placed on both ends of the Zig-Zag shape these metal contacts helps in creating a connection with the LDRs.

Now, a transparent coating is applied on the top so that the zig-zag-shaped photosensitive material gets protected and as the coating is transparent the LDR will be able to capture light from the outer environment for its working.

2.7.1 Working Principle of LDR

It works on the principle of photoconductivity whenever the light falls on its photoconductive material, it absorbs its energy and the electrons of that photoconductive material that is in the valence band get excited and go to the conduction band and thus increasing the conductivity as per the increased in light intensity.

Also, the energy in incident light should be greater than the bandgap gap energy so that the electrons from the valence band got excited and go to the conduction band.

The LDR has the highest resistance in dark around 1012 Ohm and this resistance decreases with the increase in Light.



Fig: 2.7 Light Dependent Resistor

2.7.2 Types of LDR

Intrinsic photo-resistor: This type of photo-resistor is made with pure semiconductors without any doping. This kind of photo-resistor uses pure semiconductors like silicon and germanium. when the incident light having an adequate amount of energy falls on this then electrons gain that energy and got excited and a few of them go to the conduction band.

Extrinsic Photo-resistor: This type of photo-resistor uses the doped semiconductor; this means some impurities are mixed with the semiconductor such as phosphorus to make this photo-resistor.
Extrinsic light-dependent resistors are generally designed for longer wavelengths of light, with a tendency towards infrared (IR).

2.8 Voltage Regulator IC

Voltage sources in a circuit may have vacillations bringing about not giving settled voltage yields. A voltage controller IC keeps up the yield voltage at a consistent esteem. 7805 IC, an individual from 78xx arrangement of settled straight voltage controllers used to keep up such changes, is a mainstream voltage controller IC. The xx in 78xx demonstrates the yield voltage it gives. 7805 IC furnishes +5 volts controlled power supply with arrangements to include a warmth sink.

2.8.1 Specification of LM7805

i. Input voltage range 7V to 35V.

ii. Output Current 1 A.

iii. Output voltage range V_{Max} = 5.2V, V_{Min} = 4.8V.

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2.8.2 Pin Function of LM7805

Table: 2.3 Pin Function of 7805 IC.

Pin NO	Pin Name
1	Input pin
2	Ground pin
3	Output pin

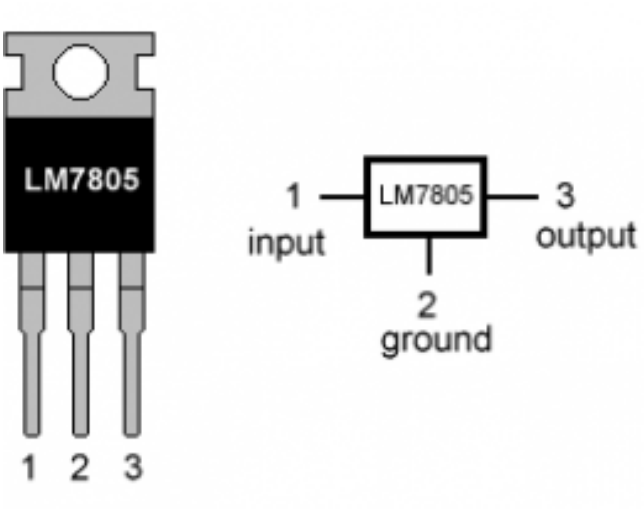


Fig: 2.8 Voltage Regulator IC.

2.9 Li-Ion Charge Controller

A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries to protect against electrical overload, overcharging, and may protect against overvoltage. This prevents conditions that reduce battery performance or lifespan and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger.

The TC4056A is a complete single-cell Li-Ion battery with a constant current and constant voltage linear charger. Heat sink on the bottom. The ESOP8/DIP8 package and fewer external components make the TC4056A ideal for portable applications. TC4056A can be used for USB The source and adapter power supplies work.



Fig: 2.9 Li-Ion Charge controller.

2.9.1 Protection Features of TP4056

This module uses the TP4056 or TC4056 Li-Ion charge controller IC and a separate protection IC. There are other types of modules on the market that use the TP4056 or TC4056 but lack any protection circuits or ICs to provide the necessary protection needed with lithium batteries. This module uses both the TP4056 or TC4056 and the DW01A Li-Ion battery protection IC, which together in combination provide the following protection features:

- Manage the constant current to constant voltage charging of a connected lithium battery
- Over-discharge protection - keeps your battery from being discharged below 2.4V, a healthy minimum voltage level for your battery.

  If a connected battery has been discharged below 2.4V the module will cut output power from the battery until the battery voltage has been re-charged above 3.0V (the over-discharge release voltage), which at that time the module will again allow discharge of power from the battery to a connected load. Although the module cuts output power from the battery during an over-discharge situation, it still allows charging of the battery to occur through the parasitic diode of the discharge control MOSFET (FS8205A Dual MOSFET).

- Overcharge protection - the module will safely charge your battery to 4.2V
- Overcurrent and short-circuit protection - the module will cut the output from the battery if the discharge rate exceeds 3A or if a short-circuit condition occurs

- Soft-start protection limits inrush current
- Trickle charge (battery reconditioning) - if the voltage level of the connected battery is less than 2.9V, the module will use a trickle charge current of 130mA until the battery voltage reaches 2.9V, at which point the charge current will be linearly increased to the configured charge current.

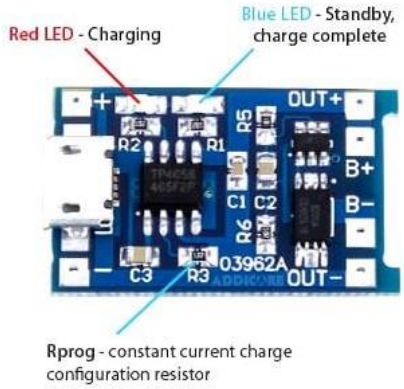


Fig: 2.10 TP4056 Indicator's.

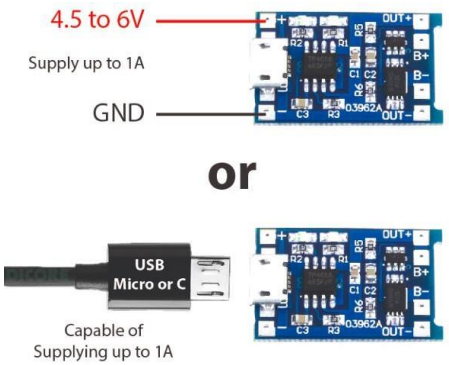


Fig: 2.11 Li-Ion Charge Controller Power IN.

It can be powered, for charging, from a USB cable (USB Micro or USB C) or the (+) and (-) connections, see Power Supply Options Diagram below. The power source needs to be able to provide at least 1A for the charger to correctly charge a connected battery. Most modern phone/USB chargers can provide 1A or more; refer to the label on your phone charger to verify. If you use a USB cable, make sure that it is made to carry at least 1A.

Includes two indicator LEDs. Red LED indicates charging. Blue LED indicates charge complete.

The charge current can be configured externally with the Rprog resistor. The datasheet for the TP4056 includes a table and equation for what resistor values to use for configuring different charge currents.

The module uses a very small amount of current (in the micro amps) whenever it is connected to a battery. It is fine to leave it connected to a battery for long periods, but if you plan to not charge the battery within four months then we recommend disconnecting the module from the battery.

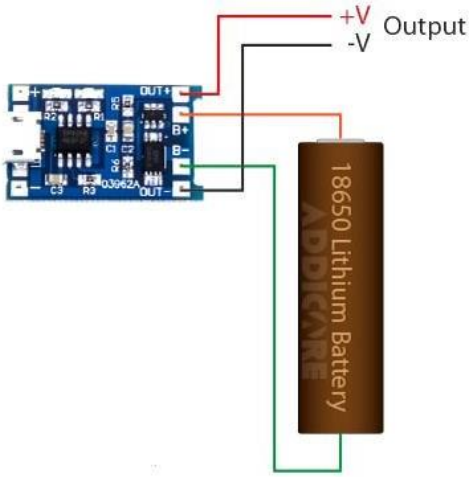


Fig: 2.12 TP4056 Battery Connection.

You can connect two lithium battery cells in parallel to form an equivalent single cell battery with a total capacity of twice that of the individual single cells, but we do not recommend connecting more than two cells at a time to this module. Refer to the Two Parallel Cell Connection diagram below. Care must be taken when setting up this type of configuration; refer to Precautionary Note 1 concerning precautions to connecting parallel cells.

2.10 Li-Ion battery

An 18650 battery is a rechargeable lithium-ion battery. They tend to have a nominal voltage of 3.6V and range in capacity from 1800mAh to 3600mAh. In all honesty.

Popular in flashlights and portable electronic devices such as laptops, lithium-ion batteries are used extensively for a variety of reasons - they have a higher capacity, give higher output and do not leak over longer periods of time. They also have built-in safety features.

Lithium is the lowest density metal which also has the greatest electrochemical potential and energy to weight ratio. This means that lithium has excellent energy storage capacity. These high energy density and low weight density properties make it the ideal material to act as a power source for when high power and low weight is needed.

Batteries containing lithium were first experimented with in 1912 and then first sold in the 1970's. They were used in industries looking for powerful, long lasting batteries which were also lighter in weight. Other types of battery including nickel-cadmium and lead acid are slowly being replaced with li-ion cells. Not to be confused with lithium-

metal batteries which are non-rechargeable, lithium-ion batteries can be recharged many times over.



Fig: 2.13 Li-Ion Battery.

18650 batteries are a popular choice in EDC and tactical flashlights because of their size which allow the flashlight to have a good balance of runtime, output and portability.

For all li-ion batteries, their approximate physical dimensions, in mm determine the name of them. The first two digits indicate the approximate diameter and the following two indicate the approximate length. These two sets of numbers are then followed by a zero. So for an 18650 battery, the first two digits are 18, meaning every 18650 battery has about 18mm diameter, the next two digits are 65, meaning they have around 65mm length.

There are actually a number of different chemical compositions for li-ion 18650 batteries which are listed below. It is worth finding out the composition of the 18650 battery because each of the various ones are slightly more suited for different tasks.

These different types of li-ion chemical compositions are listed in order from the least volatile to the most volatile. Volatility is measure of how prone to overheating and exploding the battery is:

- **LiFePO4**: Lithium iron phosphate abbreviated to IFR or LFP or Li-phosphate.
- **LiMn2O4**: Lithium manganese oxide abbreviated to IMR or LMO or Li-manganese
- **LiNiMnCoO2**: Lithium manganese nickel abbreviated to INR or NMC
- **LiNiCoO2**: Lithium nickel cobalt oxide abbreviated to NCO
- **LiCoO2**: Lithium cobalt oxide abbreviated to ICR or LCO Li-cobalt.

2.11 Boost Converter

A boost converter is a DC to DC power converter that steps up voltage from its input to its output. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors are normally added to such a converter's output and input.

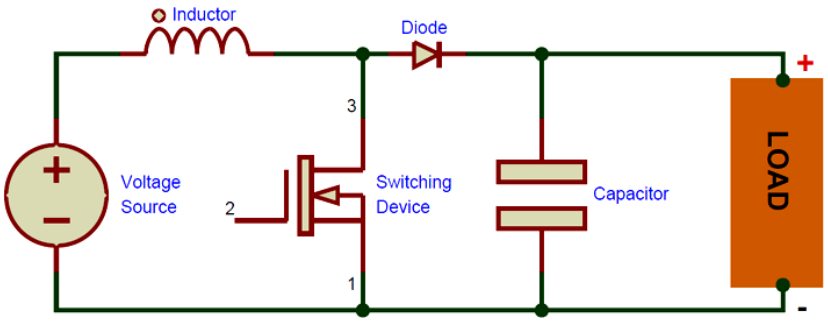


Fig: 2.14 Boost Converter.

For high efficiency, the switched-mode power supply (SMPS) switch must turn on and off quickly and have low losses. The advent of a commercial semiconductor switch in the 1950s represented a major milestone that made SMPSs such as the boost converter possible. The major DC to DC converters were developed in the early 1960s when semiconductor switches had become available. The aerospace industry's need for small, lightweight, and efficient power converters led to the converter's rapid development.

Switched systems such as SMPS are a challenge to design since their models depend on whether a switch is opened or closed. R. D. Middlebrook from Caltech in 1977 published the models for DC to DC converters used today. Middlebrook averaged the circuit configurations for each switch state in a technique called state-space averaging. This simplification reduced two systems into one. The new model led to insightful design equations which helped the growth of SMPS.

XL6009 module is a non-isolated step-up boost voltage converter featuring adjustable output voltage, high efficiency. It converts input voltage of 5-32V DC to an output voltage of 4-38V DC.

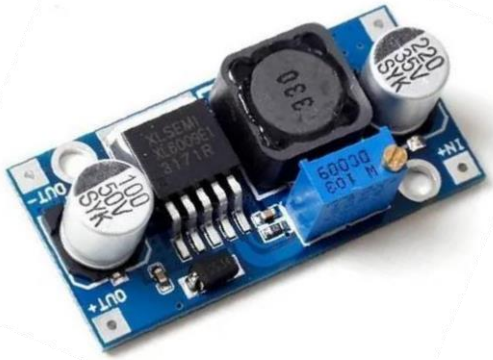


Fig: 2.15 XL6009 Booster.

2.11.1 Features of Boost Converter

1. Wide input voltage 3V ~ 32V, optimum operating voltage range is 5 ~ 32V;
2. Wide Output voltage 5V ~ 35V;
3. Built-4A efficient MOSFET switches enable efficiency up to 94%; (LM2577 current is 3A)
4. High switching frequency 400KHz, can use a small-capacity filter capacitors that can achieve very good results, the ripple smaller and smaller. (LM2577 frequency only 50KHz)

2.11.2 Booster Test Results

Formula of XL6009 Boost converter: Vin * Iin * Efficiency = Vout * Iout

1. Input 3V Output 12V 0.4A 4.8W
2. Input 5V Output 12V 0.8A 9.6W
3. Input 7.4V Output 12V 1.5A 18W
4. Input 12V Output 15V 2A 30W
5. Input 12V Output 16V 2A 32W
6. Input 12V Output 18V 1.6A 28.8W
7. Input 12V Output 19V 1.5A 28.5W
8. Input 12V Output 24V 1 A 24W

2.11.3 Technical Parameters of XL6009

1. Module Properties: Non-isolated boost.
2. Rectification: Non-Synchronous Rectification.
3. Input Voltage Range: 3V ~ 32V.

4. Output Voltage: 5V ~ 35V.
5. Input Current: 4A.
6. Conversion efficiency: <94%.
7. Switching frequency: 400KHz.
8. Output Ripple: 50Mv.
9. Load Regulation: ± 0.5%.
10. Voltage Regulation: ± 0.5%.
11. Operating Temperature: -40 ~ +85 Degree Celsius.
12. Dimensions: 43mm * 21mm * 14mm (L * W * H).

When using these modules remember that the output current will be a lot less than the input current, (remember - W = VA). For example, if you have a 10V output at 1A from a 5V input, the input current will be around 3.6A. The real-life maximum amount of power you can get out of these things is around 10W.

2.12 Display Module

A liquid-crystal display is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. Here, in this able we're going to use a monochromatic 20x4 alphanumeric LCD. 20x4 means that 20 characters can be displayed in each of the 4 rows of the 20x4 LCD, thus a total of 80 characters can be displayed at any instance of time.

This 20x4 Character LCD Display is built-in with RW1063 controller IC which are 6800, 4 line SPI or I2C interface options. The WH2004G 20x4 LCD Display have the same AA size and pin assignment as existing WH2004A and WH2004B character LCD modules but with smaller outline and VA size.

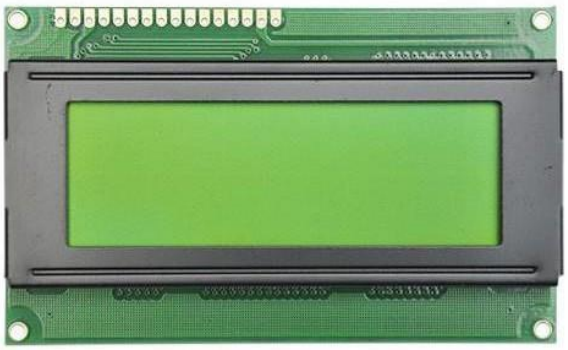


Fig: 2.16 16x2 LCD Display.

2.12.1 Specification of LCD Display

Table: 2.4 Specification of LCD Display.

Pin No	Symbol	Description
1	V_{SS}	Ground
2	V_{DD}	Power Supply
3	V_0	Contrast Adjustment
4	RS	Data / Instruction select signal
5	R/W	Read / Write Signal
6	E	Enable Signal
7-14	D0-D7	Data Bus line
15	A	Back kit LED Anode pin
16	K	Back kit LED Cathode pin

2.13 Power Switch

In electrical designing, a switch is an electrical segment that can "make" or "break" an electrical circuit, interfering with the flow or redirecting it starting with one conduit then onto the next. The system of a switch expels or reestablishes the directing way in a circuit when it is worked. A switch will have at least one arrangements of contacts, which may work at the same time, successively, or on the other hand. Switches in powerful circuits must work quickly to counteract ruinous arcing, and may incorporate unique highlights to aid quickly intruding on a substantial current. [15]



Fig: 2.17 Power Switch.

2.14 Power Connector

Barrel connectors are ordinarily found on minimal effort purchaser hardware which can be connected to divider control by means of massive AC divider connectors. Divider connectors are generally accessible, in an assortment of intensity evaluations and voltages, making barrel connectors a typical means for interfacing capacity to little tasks. The female barrel connector can be obtained in a few assortments: PCB mounted

link mount, or board mount. A portion of these connectors will have an extra contact that enables the application to identify whether a power supply is connected to the barrel jack or not, in this manner enabling the gadget to sidestep batteries and spare battery life when running on outside power. [16]

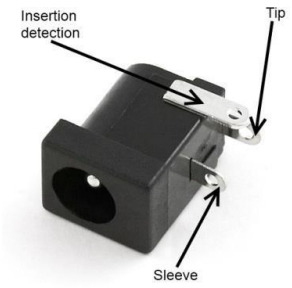


Fig: 2.18 Power Connector Port.

2.15 Diode

Diode, an electrical component that allows the flow of current in only one direction. In circuit diagrams, a diode is represented by a triangle with a line across one vertex. The most common type of diode uses a *p*-*n* junction. In this type of diode, one material 'N' in which electrons are charge carriers abuts a second material 'P' in which holes (places depleted of electrons that act as positively charged particles) act as charge carriers. At their interface, a depletion region is formed across which electrons diffuse to fill holes in the *P*-side. This stops the further flow of electrons. When this junction is forward biased (that is, a positive voltage is applied to the *P*-side), electrons can easily move across the junction to fill the holes, and a current flows through the diode. When the junction is reverse biased (that is, a negative voltage is applied to the *P*-side), the depletion region widens and electrons cannot easily move across. The current remains very small until a certain voltage (the breakdown voltage) is reached and the current suddenly increases.

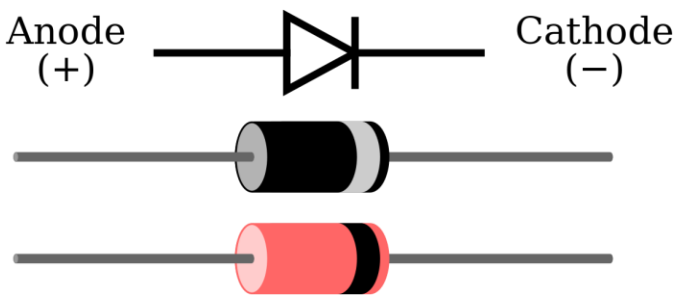


Fig: 2.19 Diode.

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2.16 Resistor

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, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

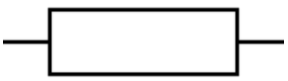


Fig: 2.20 Fixed Resistor Symbol.



Fig: 2.21 Fixed Resistor Symbol (ANSI).

2.16.1 Type of Resistor

i. Fixed Resistor.
ii. Variable Resistor.
    a. Potentiometer.
    b. Rheoter.
    c. Trimpot.
iii. Resistance depend on a physical quantity.
    a. Thermistor.
    b. Photo Resistor.
    c. Varistor.
    d. Magneto Resistor.

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e. Strain Gauges Resistor.

iv. Material base.

a. Carbon composition.

b. Carbon film.

c. Metal film.

d. Metal oxide film.

e. Wire-wound. f. Foil.

2.16.2 Resistor's Color Code

The obstruction esteem and resistance are shown with a few hued groups around the segment body. This stamping method of electronic segments was at that point created in the 1920's. Printing innovation was as yet not far created, what made printed numerical codes excessively troublesome on little segments. These days, the shading code is as yet utilized for most hub resistors up to one watt. In the figure a precedent is appeared with four shading groups. In this precedent the two first groups decide the noteworthy digits of the obstruction esteem, the third band is the duplicating factor and the fourth band gives the resistance. Each shading speaks to an alternate number and can be gazed upward in a resistor shading code table.

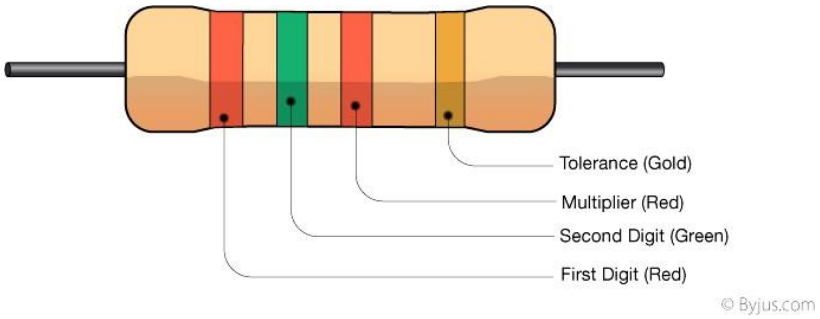


Fig: 2.22 Resistor Color Code.

Table: 2.5 Resistor color code table.

Color	Value	Multiplier	Tolerance
Black	0	1 Ohm	
Brown	1	10 Ohm	1%
Red	2	100 Ohm	2%
Orange	3	1 K Ohm	
Yellow	4	10 K Ohm	

Green	5	100 K Ohm	0.5%
Blue	6	1 M Ohm	0.25%
Violet	7		0.1%
Grey	8		
White	9		
Gold			5%
Silver			10%
No Color			20%

2.17 Capacitor

A capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as a condenser. This name and its cognates are still widely used in many languages, but rarely in English, one notable exception being condenser microphones, also called capacitor microphones.

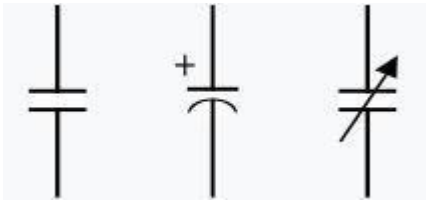


Fig: 2.23 Symbol of Capacitor.

The physical form and construction of practical capacitors vary widely and many types of capacitor are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The non-conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, air, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy, although real-life capacitors do dissipate a small amount. When

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an electric potential, a voltage, is applied across the terminals of a capacitor, for example when a capacitor is connected across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate.



Fig: 2.24 Different Type of Capacitors.

No current actually flows through the dielectric. However, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. If a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

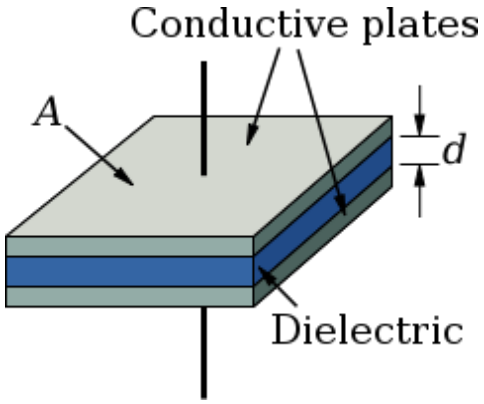


Fig: 2.25 Internal Architecture of Capacitor.

Capacitance is defined as the ratio of the electric charge on each conductor to the potential difference between them. The unit of capacitance in the International System of Units (SI) is the farad (F), defined as one coulomb per volt (1 C/V). Capacitance values of typical capacitors for use in general electronics range from about 1 pico-farad (pF) (10^{-12} F) to about 1 mille-farad (mF) (10^{-3} F).

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$$C = \frac{Q}{V}$$

An ideal capacitor is characterized by a constant capacitance C, in farads in the SI system of units, defined as the ratio of the positive or negative charge Q on each conductor to the voltage V between them.

A capacitance of one farad (F) means that one coulomb of charge on each conductor causes a voltage of one volt across the device. Because the conductors are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than when the conductors are separated, yielding a larger capacitance. In practical devices, charge build-up sometimes affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes.

$$C = \frac{\mathrm{d}Q}{\mathrm{d}V}$$

2.18 Transistor

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

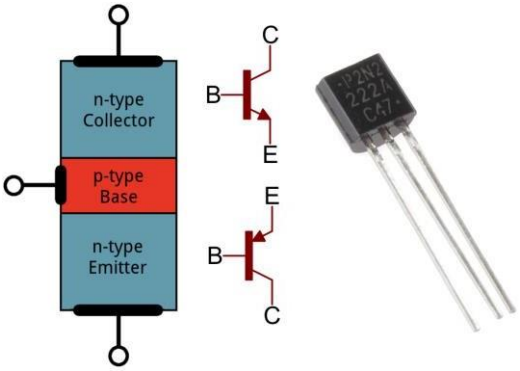


Fig: 2.26 Symbol & Internal Layer of Transistor.

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Austro-Hungarian physicist Julius Edgar Lilienfeld proposed the concept of a field-effect transistor in 1926, but it was not possible to actually construct a working device at that time.[1] The first working device to be built was a point-contact transistor invented in 1947 by American physicists John Bardeen and Walter Brattain while working under William Shockley at Bell Labs. They shared the 1956 Nobel Prize in Physics for their achievement.[2] The most widely used transistor is the MOSFET (metal–oxide–semiconductor field-effect transistor), also known as the MOS transistor, which was invented by Egyptian engineer Mohamed Atalla with Korean engineer Dawon Kahng at Bell Labs in 1959.[3][4][5] The MOSFET was the first truly compact transistor that could be miniaturized and mass-produced for a wide range of uses.

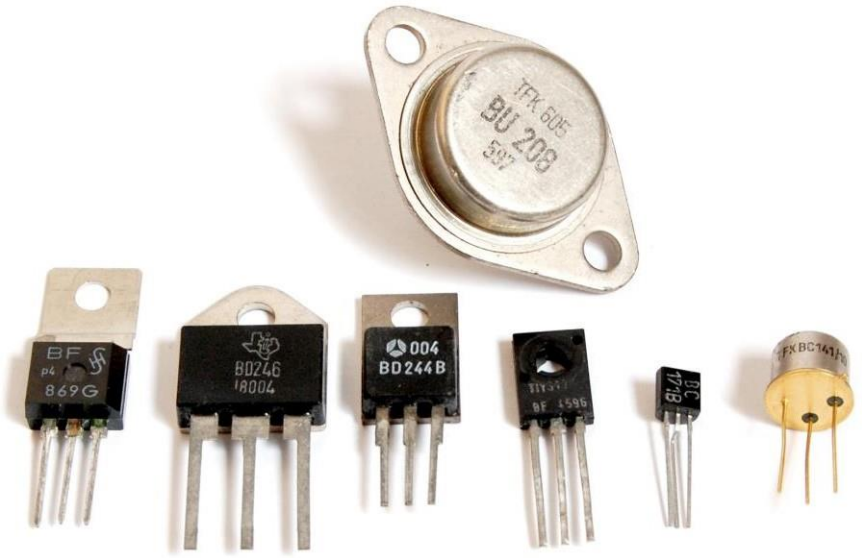


Fig: 2.27 Different Type of Transistor.

Transistors revolutionized the field of electronics, and paved the way for smaller and cheaper radios, calculators, and computers, among other things. The first transistor and the MOSFET are on the list of IEEE milestones in electronics. The MOSFET is the fundamental building block of modern electronic devices, and is ubiquitous in modern electronic systems. An estimated total of 13 sextillion MOSFETs have been manufactured between 1960 and 2018 (at least 99.9% of all transistors), making the MOSFET the most widely manufactured device in history.[11]

Most transistors are made from very pure silicon, and some from germanium, but certain other semiconductor materials can also be used. A transistor may have only one kind of charge carrier, in a field-effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube,

transistors are generally smaller, and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages. Many types of transistors are made to standardized specifications by multiple manufacturers.

2.19 Vero Board

Strip board is the generic name for a widely used type of electronics prototyping board characterized by a 0.1 inch (2.54 mm) regular (rectangular) grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. It is commonly also known by the name of the original product Vero board, which is a trademark, in the UK, of British company Vero Technologies Ltd and Canadian company Pixel Print Ltd. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. With care, it is possible to break between holes to allow for components that have two pin rows only one position apart such as twin row headers for IDCs.

Strip board is not designed for surface-mount components, though it is possible to mount many such components on the track side, particularly if tracks are cut/shaped with a knife or small cutting disc in a rotary tool.

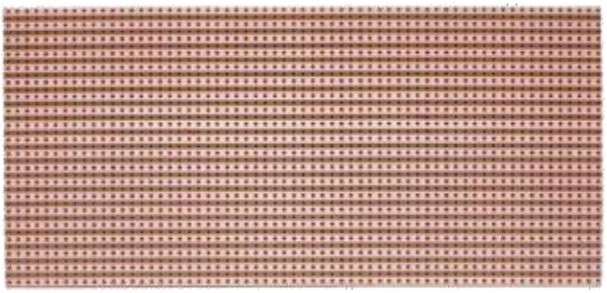


Fig: 2.28 Vero Board.

2.20 Connecting Wire

A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire gauges come in various standard sizes, as expressed in terms of a gauge number. The term *wire* is also used more loosely to refer to a bundle of such strands, as in 'multi stranded wire', which is more correctly termed a wire rope in mechanics, or a cable in electricity.

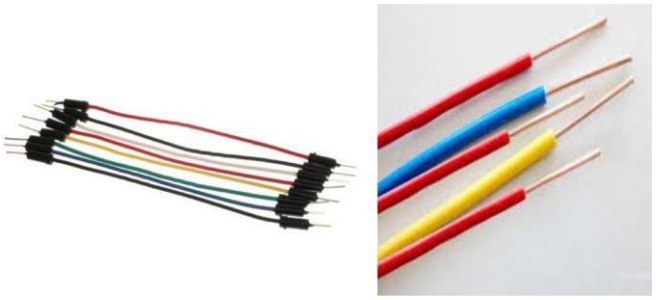


Fig: 2.29 Connecting Wire.

2.21 Mobile Phone

A mobile phone is a wireless handheld device that allows users to make and receive calls. While the earliest generation of mobile phones could only make and receive calls, today's mobile phones do a lot more, accommodating web browsers, games, cameras, video players and navigational systems. Also, while mobile phones used to be mainly known as "cell phones" or cellular phones, today's mobile phones are more commonly called "smartphones" because of all of the extra voice and data services that they offer.



Fig: 2.30 Mobile phone.

2.22 Arduino IDE

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 are called sketches**.** These sketches are written in the text editor and are saved with the file extension .ino. 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, including complete error messages and other

information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

2.22.1 How to use Arduino IDE

- *New*
  Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
- *Open*
  Allows to load a sketch file browsing through the computer drives and folders.
- *Open Recent*
  Provides a short list of the most recent sketches, ready to be opened.
- *Sketchbook*
  Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.
- *Examples*
  Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.
- *Close*
  Closes the instance of the Arduino Software from which it is clicked.
- *Save*
  Saves the sketch with the current name. If the file hasn't been named before, a name will be provided in a "Save as.." window.
- *Save as...*
  Allows to save the current sketch with a different name.
- *Page Setup*
  It shows the Page Setup window for printing.
- *Print*
  Sends the current sketch to the printer according to the settings defined in Page Setup.
- *Preferences*
  Opens the Preferences window where some settings of the IDE may be customized, as the language of the IDE interface.
- *Quit*
  Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.

2.23 Proteus

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape based auto-routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017.

2.24 Summary

The components used are studied individually. Their purpose in the system is explained along with their ratings, pinouts and connections.

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CHAPTER III

HARDWARE DEVELOPMENT

3.1 Introduction

This chapter will be explaining about the construction of Automated Single Axis sun Tracking Mobile Charging system.

We explain how to design an Automated Single Axis sun Tracking Mobile Charging system, how can we detect sun position and how to control angle of solar panel by using servo motor.

In this chapter we be will discuss about block diagram and circuit diagram of sun tracing system.

3.2 Block Diagram:

Automated Single Axis sun Tracking Mobile Charging system's block diagram are shown in blew:

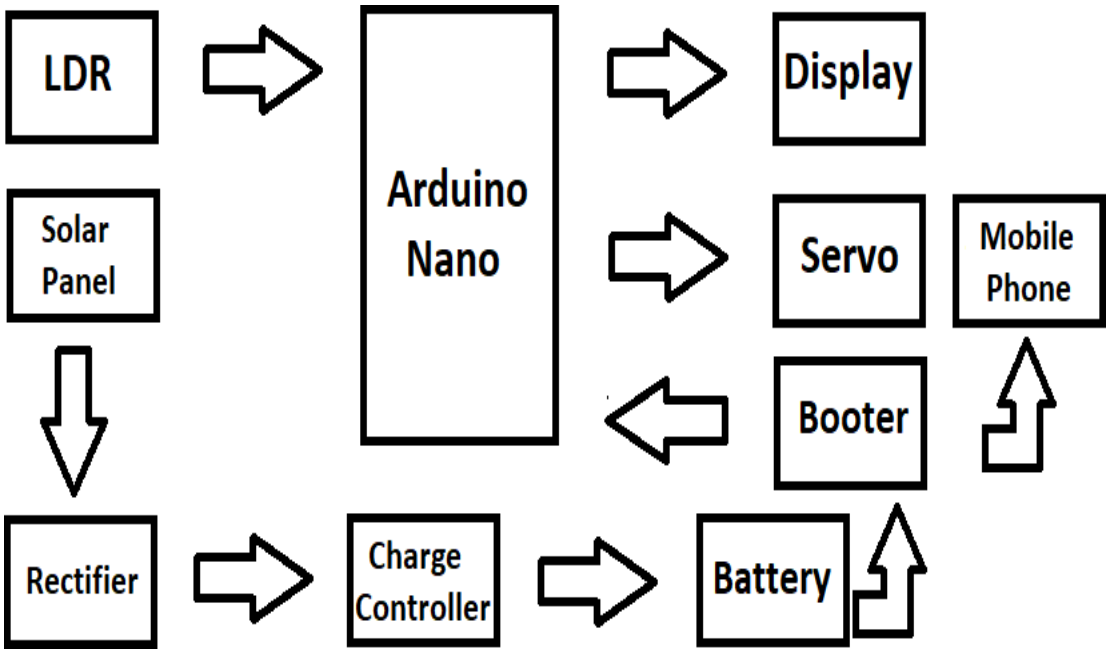


Fig: 3.1 Block Diagram of Sun Tracker.

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3.3 Circuit Diagram

Automated Single Axis sun Tracking Mobile Charging system's circuit diagram are shown in blew:

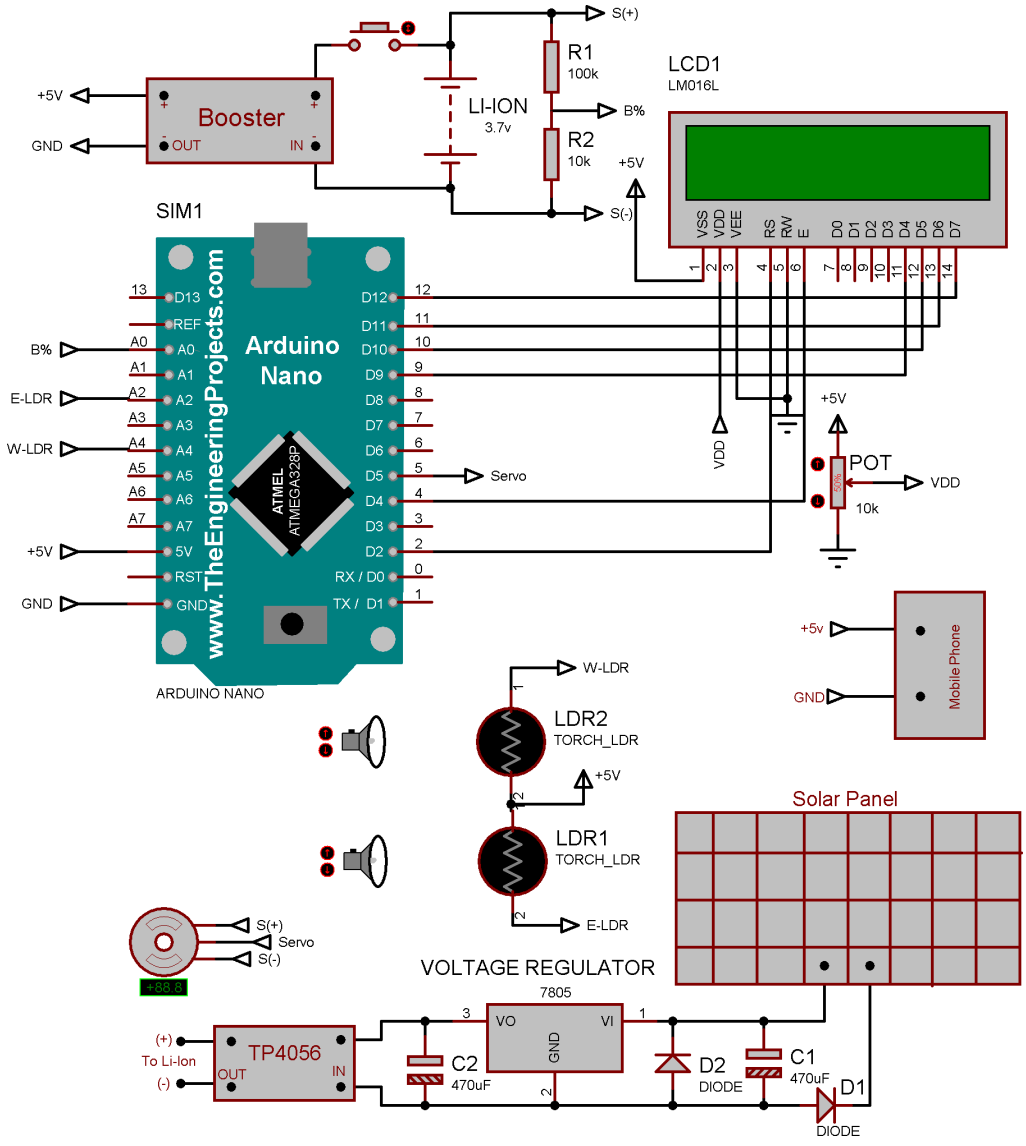


Fig: 3.2 Circuit Diagram of Single Axis Solar Tracker.

3.4 Construction of Circuit

At first we need to collect all equipment for Automated Single Axis sun Tracking Mobile Charging system, which is listed in chapter 2.2. Then we need to connect as shown in figure 3.2.

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We use LDR as a sun positioning sensor. LDR is a light depending resistor by this cause its resistance dependent by light. We setup LDR in solar panel on top side, we use two LDR for sensing sun position. Number one is for east side and number two is for west side, each LDR have to leg's pins, it is does not have any polarities. We connect two LDR in series system, and center pin connect to +5V VDC. Than we have two pin for two LDR. We connect this two pins to Microcontroller. East LDR is connected to Arduino Nano's analog pin (A2). And West LDR is connected to Arduino Nano's analog pin (A4). We also connect two 10k ohm resistor with this LDR sensor for neutralizes sensing voltage.

On other hand we charge our Li-Ion battery by using this solar panel. We use 12v DC solar panel for our sun tracking project. Solar panel does not have pure DC voltage, and does not have any reverse voltage protection system. By this cause, at first we rectify this solar output voltage. We use 1N4007 Diode for rectifying this system. We need 5V DC for charging this battery. In this case we use 7805 voltage regulator IC for converting this 12V DC to 5V DC. We also use two filter capacitor for filtering this DC voltage. We attached this capacitor on regulators both side. And we add an indicator LED for indication solar voltage.

Now we connect a TP4056 Li-Ion charge controller for charging our Li-Ion battery. In battery section we use a voltage divider for measure battery voltage. We use a 10k ohm resistor with a 100k ohm resistor for making voltage divider. We connect 10k ohm resistor with ground and we connect 5V DC with 100k ohm resistor. And w connects this dividing point to Arduino's analog pin A0.

We use a 3.7v li-ion battery but our Arduino Nano's operation voltage is 5V. In this case we use a DC to DC voltage booster XL6009 for boosting 3.7v to 5.0v DC. We connect this booster between battery and Arduino Nano.

Now we attached a 16x2 LCD display for showing battery voltage and battery charge. Our LCD have total 16 pins, but we use only 12 pins for displaying. We connect LCD's VSS pin to +5V DC and VEE pin to GND. We connect a potentiometer to LCD's VDD pin for controlling contrast ratio. Than we connect Reset pin to Arduino's digital pin 2 and we connect Enable pin to Arduino's digital pin 4. Now we connect data pin D4-D7 to arduino's digital pin 9, 10, 11, 12. Display's other two pin is for background LED's. we connect this led to 5v dc and ground pin's.

Finally, we connect our servo motor with Arduino. Servo motor have three pins', number one is VCC, we connect this pin to 3.7V DC. Number two is data pin, we connect this pin to arduino's PWM pin 5. And number three is ground pin, we connect this pin to circuit's ground.

3.5 Working Principle

After assembling the system, what remains is to observe its operation and efficiency. This Automated Single Axis sun Tracking Mobile Charging system is fully Arduino based system. This sun tracker is ensuring to generate a green energy with 30-40 percentage of more energy with more effectively and more efficiently. All this process we are showing to the LC display we also try to justify how a system as simple as ours can compete with those available commercial.

3.5.1 Flowchart

Automated Single Axis sun Tracking Mobile Charging system's flowchart are shown in blew:

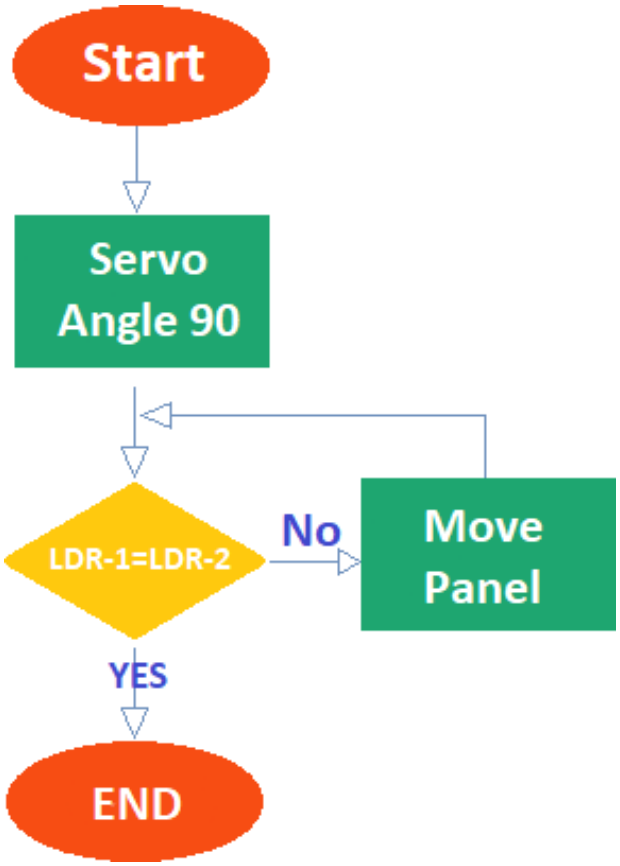


Fig: 3.3 Flowchart of Single axis solar tracker.

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3.5.2 Step by step operation

The flowchart shown in the figure 3.3 explain the workflow of system.

1. When we turn on the power switch, servo motor will move to 90-degree angle.
2. In this step LDR will be start sensing. And LDR will continuously transfer data to Arduino.
3. Now Arduino will be compare LDR's data and give feedback to servo motor.
4. If east LDR's voltage is greater than west LDR voltage, then servo will decrease angle from current degree.
5. Else if west LDR's voltage is greater than east LDR's voltage, then servo will increase angle from current degree.
6. Else servo will stop moving.
7. Finally we connect our cell phone to boost converter for charging.

3.6 Summary

A circuit diagram (electrical diagram, elementary diagram, electronic schematic) is a graphical representation of an electrical circuit. A pictorial circuit diagram uses simple images of components, while a schematic diagram shows the components and interconnections of the circuit using standardized symbolic representations. The presentation of the interconnections between circuit components in the schematic diagram does not necessarily correspond to the physical arrangements in the finished device.

CHAPTER IV

RESULT AND DISCUSSION

4.1 Introduction

Most solar system has fixed directional system, but we make a perfect solar system, this solar system can move east to west by tracking the sun. This system can measure all kind of data like; solar voltage, solar power, battery voltage and battery charge. Our system also has data storing facility. This facility did not have previous solar system. We make a better solar system because previous solar system can only use 30% - 40% of sun power, but our solar system can use 70% - 80% of sun power. By this because we got 2.5x more power per day.

This chapter will present all the results, calculations, and relevant discussions.

4.2 Result

The experimental model was made according to the circuit diagram, and the results were as expected. When we turn on the power switch, our system is start working. We use a torch light as a sun. we move torch light slowly as soon as possible. We notice, solar panel is moving by tracking touch light. We are checking from low angle like sun rising and higher angle like sunset moment. We got a perfect result then we expect. Then we check display data. Now display is showing battery charging condition. Now it's showing 96% of battery charge. At the end we connect our cell phone to our boost converter for charging. Wow! Is showing charger is connected. That's sound is good.

4.3 Advantage of Sun Tracking Solar System

1. It's use 70-80 percentage of sun power.
2. This system can have produced 2.5x more power.
3. This system can generate more energy in same area or space.
4. Maintaining cost is very low.
5. Fully automatic system, No need to man power.

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6. It’s does not effect by dust.
7. It’s does not effect by weather.
8. It can power up any USB device. Like cell phone, cctv camera, etc.

4.4 Disadvantage of Sun Tracking Solar System

1. Initial cos high.
2. Installation process is difficult.
3. Programing can also take longer time to accomplish than circuit analysis.
4. Error in the programming is possible.

4.5 Cost Estimation of the Project

Table: 4.1 Price list and component quantity.

Serial No	Particulars	Quantity	Cost in BDT
01	Arduino Nano	1	1600
02	Servo Motor	1	1450
03	Servo Controller	1	350
04	Display Module (16x2)	1	480
05	Voltage Regulator IC (LM-7805)	1	20
06	Solar panel	1	300
07	LDR	2	40
08	Li-Ion Battery	1	180
09	Battery case	1	70
10	Booster (XL6009)	1	150
11	Capacitor (470uF)	2	50
12	Capacitor (104pF)	3	15
13	Pot 10k ohm	1	10
14	Resistor 10k ohm	4	8
16	Diode (1N4007)	2	4
17	Li-Ion Charge Controller (TP4056)	1	120
18	Vero Board	1	20
19	Switch	1	10
20	Rail (I & L)	2	50
21	Connecting Wire (Male to female)	6	30
22	Other Wire	1	10
23	Soldering lead	4	80
24	Glue Strike	2	50
		Total =	**5097**

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4.6 Application of Sun Tracking Solar System

1. Home purpose.
2. Office.
3. Industry.
4. Factory.
5. School, Collage, University.
6. All kind of farm.
7. Irrigation.
8. Power up any kind of USB device.

4.7 Summary

The conventional solar system is use fixed direction, but our solar system is trackable by sun, for this reason we can get 30-40 % more energy in same time and same area.

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CHAPTER V

CONCLUTION

5.1 Conclusions

1. It can be first priority for getting electric energy.
2. Less power consuming and more energy generator.
3. This system can use as a power plant in future.

The goal of the sun tracking solar system is produce more energy then previous solar system. Its produce green energy and its does not pollute our planet. It can be first choice to make energy for our electricity backup. Its safer then all electricity generator. It's does not consume any fuel like other power generator.

5.2 Future Scopes of Modification

In this paper we have discussed about developing a "Automated Single Axis sun Tracking Mobile Charging system: A Next Generation Smart power generator" by incorporating many features like live monitor, storing data, sun track mood, that are lacked in the conventional solar system. Especially this system is designed for generate more green energy in same time and same area.

We practically check this solar system, and we get perfect result from solar, we can easily observe this system by checking display data. Finally, we satisfied to our solar system.

1. It can be implement with dual axis mood.
2. We can add GSM system with it.
3. We can add AC system with this solar.

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APPENDIX

Controller Code:

```
//Automated Single Axis sun Tracking Mobile Charging system


#include <LiquidCrystal.h>

#include <Servo.h>


#define max_angle 160

#define min_angle 20

#define servo_center 90

#define t1 5


LiquidCrystal lcd (2, 4, 9, 10, 11, 12); //R E D4 D5 D6 D7

Servo servo_1;


int servo_pos = 90; // minimun angle 10 degree

int east_ldr = A2;    // pin for sensor 1

int west_ldr = A4;    // pin for sensor 2

int battery_pin = A0;  //pin for battery voltage


int east_val = 0;

int west_val = 0;

int east_val_avg = 0;
```


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```
int west_val_avg = 0;


int battery_val = 0;
int battery_val_avg = 0;
float battery_volt = 0;
float battery_ch = 0;
int battery_ch_per = 0;

int i = 0;
int j = 0;
int k = 0;

void setup()
{
   lcd.begin(16, 2);
   servo_1.attach(5);    //servo motor pin

   pinMode(east_ldr, INPUT);
   pinMode(west_ldr, INPUT);
   pinMode(battery_pin, INPUT);

   lcd.clear();
   lcd.setCursor(2,0);
   lcd.print("Single Axis");
   lcd.setCursor(1,1);
   lcd.print("Solar Tracker");
```


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```
  delay(2000);  //for 2 sec
}

void loop()
{
  servo_1.write(servo_pos);

 // ******************East Sensor Calculation******************
  for(i=0; i<10; i++)
    {
      east_val_avg = (east_val_avg + analogRead(east_ldr));
      delay(t1);
    }
  east_val = (east_val_avg/10)/10;
  east_val_avg = 0;

 // ********************West Sensor Calculation********************
  for(j=0; j<10; j++)
    {
      west_val_avg = (west_val_avg + analogRead(west_ldr));
      delay(t1);
    }
  west_val = (west_val_avg/10)/10;
  west_val_avg = 0;

 // **********************Battery Calculation**********************
```


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```
for(k=0; k<=10; k++)
{
  battery_val_avg = (battery_val_avg + analogRead(battery_pin));
  delay(t1);
}
battery_val = (battery_val_avg / 10);
battery_val_avg = 0;
battery_volt = (((battery_val * 5.0) / 1024.00) * 10);
battery_ch = ((100/4.2)*battery_volt);
battery_ch_per = battery_ch;

if(battery_ch_per >= 100)
  {
    battery_ch_per = 99;
  }
if(battery_ch_per < 0)
  {
    battery_ch_per = 0;
  }

// ************************Panel Position**************************
  if (east_val > west_val)
    {
      servo_pos--;
      if (servo_pos <= min_angle)
```


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```
    {
      servo_pos = min_angle;
    }
  }

if (west_val > east_val)
  {
   servo_pos++;
   if(servo_pos >= max_angle)
    {
     servo_pos = max_angle;
    }
  }

if ((east_val <= 10) && (west_val <= 10))
  {
   if(servo_pos <90)
    {
     servo_pos++;
     delay(50);
    }
   if(servo_pos > 90)
    {
     servo_pos--;
     delay(50);
```


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```
        }
      }

//*************************Display Section*********************
  lcd.clear();


  lcd.setCursor(0,0);
  lcd.print("Panel Angle: ");
  lcd.setCursor(13,0);
  lcd.print(servo_pos);


  lcd.setCursor(0,1);
  lcd.print("Battery CH: ");
  lcd.setCursor(12,1);
  lcd.print(battery_ch_per);
  lcd.print(" %");


  delay(200);
}
```


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