DESIGN AND FABRICATION OF DUAL AXIS SOLAR PANEL TRACKING SYSTEM

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Declaration

It is declared hereby that this thesis paper or any part of it has not beensubmitted to anywhere else for the award of any degree.

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Certification

This is to certify that this project entitled "**DESIGN AND FEBRICATION OF DUEL AXIS SOLAR PANEL TRACKING SYSTEM**" is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Mechanical Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Mechanical Engineering.

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The report titled as on "**DESIGN AND FEBRICATION OF DUEL AXIS SOLAR TRACKING SYSTEM.**

Panel tracking system" has been prepared to fulfil the requirement of our practicum program. In the process of doing and preparing our practicum report, we would like to pay our gratitude to some persons for their enormous help and vast co-operation.

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We are, indeed, grateful toe all those from whom we got sincere cooperation and help for the preparation of this report.

Dedicated

to

Our Parents

CONTENTS

CHAPTER 5: RESULT AND DISCUSSIONS

List of Abbreviations

LDR	Light Dependent Resistor
LCD	Liquid Crystal Display
DC	Direct Current
TXD	Data Transfer
RXD	Data Receiver
AC	Alternating Current
DC	Direct Current
ADC	Analog to Digital Converter
IC	Integrated Circuit

ABSTRACT

This is a project of **DESIGN & FEBRICATION OF DUEL AXIS SOLAR PANEL TRACKING SYSTEM**. The project is about making two axis solar panel tracker that can be working robotic system. The Solar Tracker is a device which follows the movement of the sun .we used four LDR (Light Dependent Resistor). They are light sensitive devices .They are also called as photo conductors. The working principle of an LDR is photo conductivity, that is nothing but an optical phenomenon .When the light is absorbed by the material then the conductivity of the material reduces. We use two servo motor. Servos are controlled by sending an electrical pulse of variable width. A servo motor can usually only turn 90° in either direction for a total of 180° movement .we use to PIC16F877 microcontroller .The microcontroller is there for controlling automatically. We use 7805 regulator IC, 10uF capacitor (6pcs), 100uF capacitor 1pcs. We use LCD (Liquid Crystal Display) display. The layers is made of liquid crystals which have the ability to change the direction of their polarization when a voltage is appliedto them. This creates an area which looks dark. Different areas are controlled by voltages from whatever circuitry controls the device. We used solar panel, 1N4007 diode, 1N4007 diode.

Chapter 1
Introduction

1.Introduction:

Though in this era electricity is one of the most important part of our life, approximately 1.6 billion people still living without electricity. It's only for the high cost of power grid building and maintains. This vast quantity of energy crisis can be meeting up by renewable energy across the developing world. As people are much concerned with the fossil fuel exhaustion and the environmental problems caused by the conventional power generation, renewable energy sources and among them photovoltaic panels and wind- generators are
now widely used. So Solar Energy is a good choice for electric power generation. The solar energy is directly converted into electrical energy by solar photovoltaic module. Photovoltaic sources are used today in many applications such as battery charging, water pumping, home power supply, satellite power systems etc. They have the advantage of being maintenance and pollution-free but their installation cost is high and in most applications; they require a power conditioner (dc/dc or dc/ac converter) for load interface. Since PV modules still have relatively low conversion efficiency, the overall system cost can be reduced using high efficiency power conditioners which, in addition, are designed to extract the maximum possible power from the PV module. In PV power systems maximum power point trackers (MPPTs) has an important role. It's minimizing the output power of a PV system and also the arrow efficiency as well as its cost is lower than the other power system. An important characteristic of solar panels is that the available maximum power is provided only in a single operating point given by a localized voltage and current known, called Maximum Power Point (MPP). Another problem is that the position of this point is not fixed but it moves according to the irradiance, the temperature and load. Because of the relatively expensive cost of this kind of energy we must extract the maximum of watts of solar panels. In this project we develop a Microcontroller based dedicated MPPT controller for solar PV module
based on the in cemental conductance method.

1.2 Historical Background:

1839 – The Photovoltaic Effect**:** Edmond Becquerel, in 1839, discovered that when two electrodes were placed in an electrolyte (electricity-conducting solution), a voltage developed when light fell upon the electrolyte. The basic principles of solar power had been uncovered.

1876 – Electricity from Light**:** A King's College Professor, William Grylls Adams, and his student, Richard Evans Day, found in 1876 that selenium produced electricity when exposed to light. They attached platinum electrodes to selenium and observed a current in the electrodes when the selenium was exposed to light.

1883 – The First Working Solar Cell**:** American inventor Charles Fritts developed the first solar cell, applying selenium to a thin layer of gold. This method was only able to achieve 1% efficiency, making it impractical for general use.

1904 – Einstein's Paper on Light & Electrons**:** In the snappily titled "On a Heuristic Viewpoint Concerning the Production and Transformation of Light," Einstein set out for the first time the relationship between light and electrons. Although controversial at the time, it was gradually accepted by the scientific community and led to his winning of the Nobel Prize in 1921.

Later in 1916, Robert Millikan would experimentally prove Einstein's theory of the photoelectric effect.

1954 – A Major Breakthrough**:** Three researchers at Bell Labs — Daryl Chapin, Calvin Fuller, and Gerald Pearson — discover silicon solar cells.

Late 1950s – Increasing Efficiency: Throughout the late 50s, Hoffman electronics developed increasingly efficient solar cells. It started out initially at an 8% efficient cell in 1957, before eventually increasing to a 14%-efficient, commercially available cell in 1960

1.2.1 Earlier Research:

Early charge controllers were only able to reduce the amount of voltage from the PV panels if too high for the batteries. Since the voltage from the PV panels would be lower at high temperatures, the PV panels had to be over sized to ensure that the minimum voltage at high temperatures would be at least as high as the battery to be charged plus voltage headroom enough to force current into the battery. At any temperature lower than the maximum, the excess voltage from the PV panels would have to be discarded by the charge controllers. Because PV panels are the most expensive component of the system, the need for extra (or larger) PV panels negatively impacted the cost-effectiveness of such PV power systems. People those days could not use microcontroller for the management of the total system.

This system was first commercially introduced in Australia. Stuart Watkinson and his friend Barry James Aston was first founded "Australian Energy research Laboratories (AERL)," in September 1985.

The US department of Energy's solar Energy research center in Colorado along with Florida State University's solar research center at Cape Canaveral was also involved in early trials of the product. [4-5]

1.2.2 Recent research:

Newer and more efficient charger controllers have emerged that provide a better match between the PV panels and their load. Their goal is to use all the power from the PV panel(s) regardless of the voltage and current at any amount of insolation or at any temperature. The newer charge controllers employ a DCto DC converter section that is adapted to dynamically charge the battery (or to directly power a load) at the exact voltage and current that is most appropriatefor that battery (or load). Although the newer charge controllers provide improved system efficiencies relative to the older models, they too often suffer from several shortcomings. More particularly, the charge controllers are slow to adapt to changing conditions of the PV panel(s) over the course of any given day, including low light conditions in the morning, evening and during cloud cover and also temperature changes sometimes associated with the changes in insolation. The edges of clouds create particularly issues because they cause a rapid change in lighting which may be followed by a relatively rapid change in temperature. Because they do not quickly adapt to changing conditions, the charge controllers have limited efficiency,

which results in the need for extra (or larger) PV panels to be used for a given power output and high costs. Now-a-days all digital MPPT controllers are controlled microcontroller. They automatically adjust the output, move the panel for sunlight and also shut down for microseconds if necessary.
MPPT charge controllers are now commercially manufactured by several companies, such as outback power, Xantres XW-SCC, Blue Sky Energy, Apollo solar, Midnight solar, Morning star and a few others...

1.3 Future Scope of this study:

Nearly everyone thinks that generating electricity via solar power is good for the environment. Renewable energy and solar in particular remain rather controversial in the public debate about energy policy. Demands of solar energy have been running high. What motivated us is the bewildering range of statements you have out there regarding the cost effectiveness of electricity based on solar PV. Given the range of opinions, that's why we wanted to do our own analysis.

In a broad new assessment of the status and prospects of solar photovoltaic technology, MIT researchers say that it is "one of the few renewable, low- carbon resources with both the scalability and the technological maturity to meet ever-growing global demand for electricity." Use of solar photovoltaic has been growing at a phenomenal rate: Worldwide installed capacity has seen sustained growth averaging 43 percent per year since 2000. To evaluate the prospects for sustaining such growth, the MIT researchers look at possible constraints on materials availability, and propose a system for evaluating the many competing approaches to improved solar-cell performance.

1.3.2 Recommendation:

Future studies into maximum power point tracking could include the use of a different DC/DC converter and also some different MPPT algorithm such as Current MPPT (CMPPT) for example, could be implemented. Another extension of this project could be to design the DC/DC converter in full. The converter design could be done to optimize the components and in turn increasing the power efficiency. By optimizing the DC/DC converter the MPPT algorithms would achieve improved efficiencies and power tracking capabilities. Finally a future work can also improve the developed software in order to efficiently use the capabilities of the microcontroller. A final prototype could then be design and implemented in order to have a final portable prototype for the solar charger. The whole system into a single integrated.

Chapter 2
LITERATURE REVIEWS

2.1 Introduction

Solar Panel is made of tiny combination of solar cell and solar cell is the devices that are designed to convert light to electrical energy. Solar panel is mainly made from semiconductor materials such as silicon (Si), cadmium sulphide (CdS) and gallium arsenide (GaAs) can be used to make solar cells. The main purpose of using solar panel is getting the maximum energy by converting light
energy to electric energy. Using solar tracker is the best way for getting the maximum energy because its keeping the panels aligned with the sun's position and it's also an effective solution for get energy with solar panel**.**

2.2 Block Diagram of This Proposed Project:

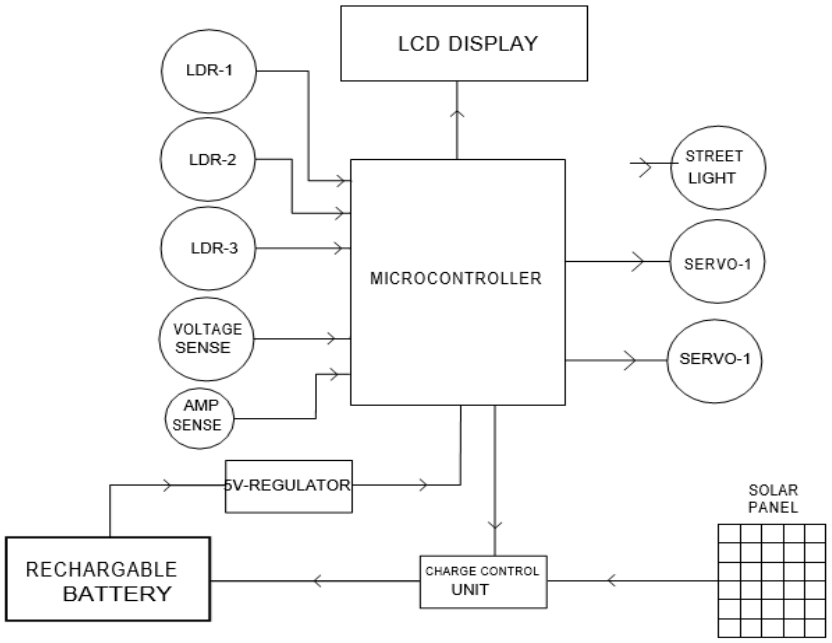


Figure. 2.1. Block Diagram of sun tracking system.

The Model of the Project:

The Proposed model of Dual Axis Solar Tracker Robot .

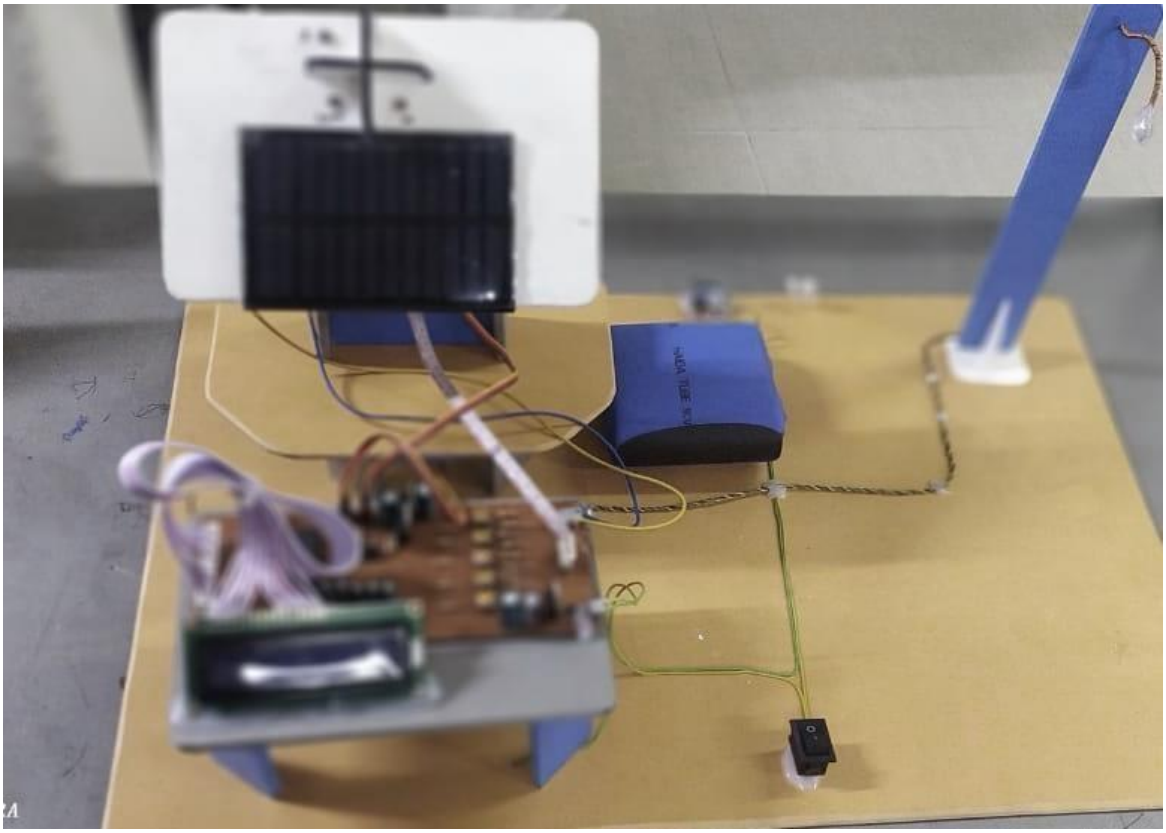


Figure. 2.2 Dual axis solar tracker Robot

Solar panel:

Solar panel is mainly designed as a panel which absorbed the sun's rays and convert light into electricity. Most of the time the most powerful source of light available is the Sun, called Sol by astronomers. It is called photovoltaic which means, basically, "light-electricity."

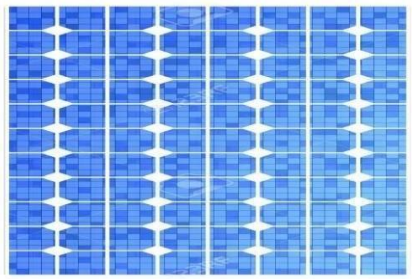


Figure. 2.3 Solar panel Module

A solar panel is a collection of solar cells. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. Solar power generating systems take advantage of this property to convert sunlight directly into electrical energy. Solar panels also called "solar modules produce direct current (DC), which goes through a power inverter to become alternatingcurrent (AC) — electricity that we can use in the home or office or other sectors.

When sunlight hits the semiconductor, an electron springs up and is attracted to the n-type semiconductor. This causes more negative electrons in the n-type semiconductor and more positive electrons in the p-type, thus generating a flow of electricity in a process known as the photovoltaic effect.• The majority of solar modules use wafer-based crystalline_silicon cells or thin-film cells based on cadmium telluride or silicon.

2.4 Photovoltaic cell model:

A simplest equivalent circuit of a solar cell is a current source in parallel with a diode. The output of the current source is directly proportional to the solar energy (photons) that hits on the solar cell. During darkness, the solar cell is not an active device; it works as a diode, i.e. A p-n junction. It produces neither a current nor a voltage. The diode determines the IV characteristics of the cell.

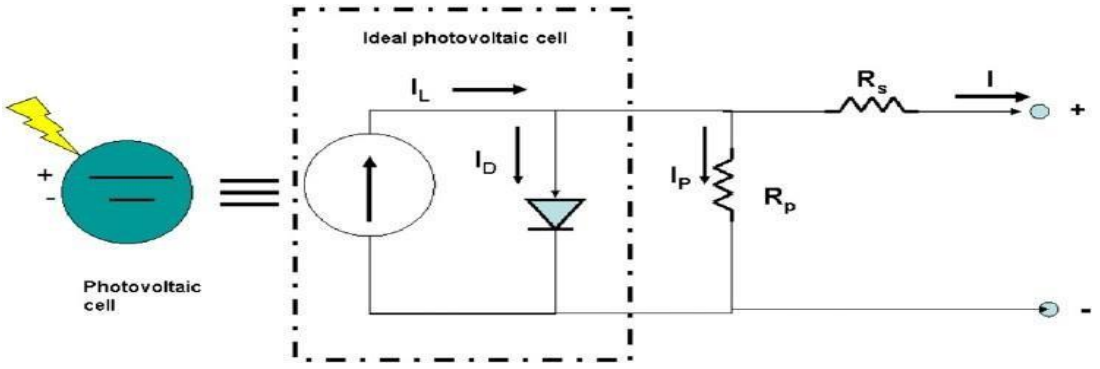


Figure. 2.4 Circuit diagram of a PV Cell

Reference: MPPT controllers for PV array panel connected to Grid Abid Hafedh (University of Sfax)

2.4.2 Solar Irradiation: Sunlight

Electromagnetic radiation means which the sun delivers energy to the earth. The radiation flows evenly distributed from a surface which is close to spherical. The sunlight covers a broad range of wavelengths from roughly 250 nm (UV) over the Visible range (400-700 nm) up to several thousands of nm (IR).

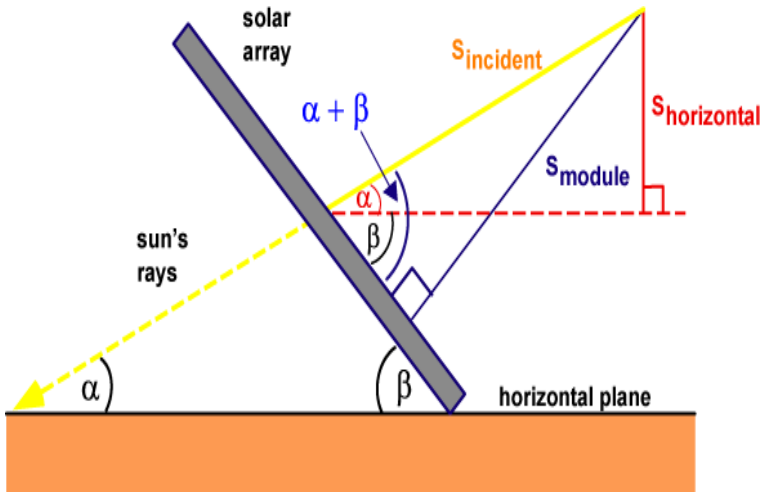


Figure. 2.7 Solar Irradiation Sunlight

Reference: Solar Radiation Year and Some Climatology Aspects of East Coast of West Malaysiya Abdul Majeed Muzathik (South Eastern University of Srilanka)

There is solar fusion that results from the temperature and pressure at the core of the sun. Protons converted into helium atoms at 600 million tons per second. Fusion gives rise to lots of energy in form of gamma rays that are absorbed by particles in the sun and re-emitted. This spectrum contains visible light and near- visible radiation, such as x-rays, ultraviolet radiation, infrared radiation, and radio waves. The visible light and heat of the sun makes life possible, and is called daylight or sunshine. Majority of the sun's harmful radiation deflects by the earth atmosphere.

2.5 Types of Solar Trackers & System:

Solar Trackers are almost worldly used in case of Solar Thermal Technology because it generates high amounts of energy from sunlight .It's a way to install the pv panel that the sunlight reach them at perpendicularly or reduce the incidence angle as much as possible.

system smart and the tracker track the sun rays and it's rotate the panel according with rays. There are two types of tracker system and they are single axis solar tracker and dual axis solar tracker.

2.6 Single axis solar tracker:

Single axis trackers will track the sun from east to west on a single pivot point. With advanced tracking algorithms, it is possible to align them in any cardinal direction. Single axis solar tracker device, on the basis of LDR sensor values, orients the solar panel in accordance with the position of the sun. Average output power of single axis solar tracker is 2.958w. Average practical efficiency of solar panel for single axis is 6.55%. Average power gain of single axis solar tracker up to 18.32%.

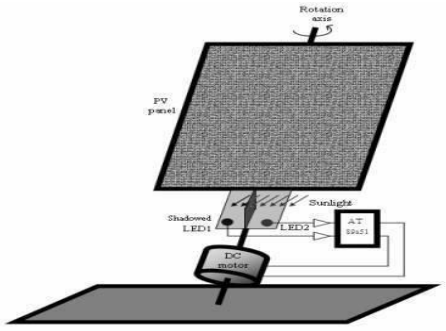


Figure. 2.8 Single axis solar tracker

2.6.2 Dual axis solar tracker:

Dual axis tracking system uses the solar panel to track the sun from east to west and north to south. Dual axis solar tracker has two axis of freedom that act as axes of rotation. These axis are fixed with respect to the ground axis consider as a primary axis. But this one is also costly and complicated then single axis solar tracker. Dual axis solar tracker will be reliable and accurate and it is maximize the output to static and single axis tracking system. This system uses four LDR's, two motors and a controller. The four LDR placed on at four different

directions. The controller detects the signal from the LDR’s and commands themotor to rotate the panel in respective direction.

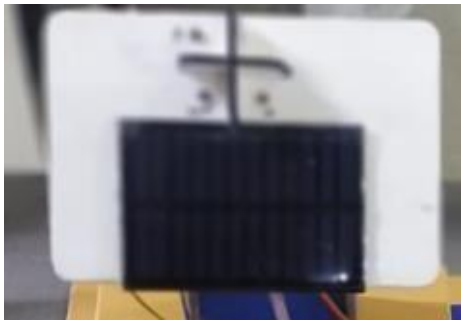


Figure. 2.9 Dual axis solar tracking

2.7 Advantages & Disadvantages of solar energy:

There are several benefits that solar energy has and which make it favorable formany uses.

2.8 Advantages:

- Solar energy is a clean and renewable energy source.
- It is pollution free.
- Solar cells are free of any noise. On the other hand, various machinesused for pumping oil or for power generation are noisy.
- Solar energy can be used in very remote areas where extension of theelectricity power grid is costly.
- Once a solar panel is installed, the energy is produced at reduced costs.
- Can be installed virtually anywhere, in a field to on a building.
- Safer than traditional electric current.

2.8.2 Disadvantages:

- Solar power stations do not match the power output of conventional power stations of similar size. Furthermore, they may be expensive to build.
- Generation of electricity from solar is dependent on the country's exposure to sunlight. This means some countries are slightly disadvantaged.

- Solar panels can be costly to install resulting in a time lag of many years for savings on energy bills to match initial investments.

- Needs lots of space as efficiency is not 100% yet
- Cloudy days do not produce as much energy.
- Lower solar production in the winter months.

- Solar powered cars do not have the same speeds and power as typical gaspower cars.
- No solar power at night so there is a need for a large battery bank.

2.8.3 Applications of Solar Energy:

- Solar thermal of Power Generation
- Heating and Cooling of Buildings
- Solar water and Air Heating
- Salt Production by evaporation of Seawater
- Solar Distillation
- Solar Drying of Agricultural Products
- Solar Cookers
- Solar Furnaces
- Electricity Generation through photovoltaic Cells

Chapter 3
Methodology

3.1 LDR (Light Dependent Resistor):

LDR (Light Dependent Resistor) is called as light detecting sensor to build solar track which has included phototransistors, photodiodes and LDR. It is a made up of semiconductor materials which has high resistance. LDR is the most common in electronics and it is spread used in many types of electronics. LDR can use for street lamp, outside lights, a number of indoor home appliances, and so on. It is utilize the light sensor circuit for automatic switch OFF the loads based on daylight's intensity by helping of a light sensor. In daylight the rays of sun falls on the photovoltaic panel and photo resistor and when the light falls on the resistor, then the resistance changes. This resistor's has different functions and resistance. Using LDR in a circuit or in a electronics project it is make circuit effective and the collection of LDR parts of the circuit are easily available and accuracy of this circuit is more than accuracy of other circuits. It is so much helpful for saving energy. There are two types of photoresist or based on material used and they are Intrinsic Photo Resistors and Extrinsic Photo Resistors. Intrinsic Photo Resistors are made up of pure semiconductor devices like silicon or germanium. When the light falls on the Intrinsic Photo Resistors, the electrons get excited from the valence band to the conduction band and number of charge carriers increases on a resistor. Extrinsic Photo Resistors are doped with impurities and this impurity creates a new energybands above the valence band.

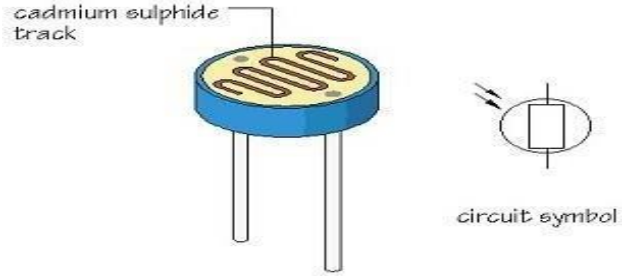


Figure. 3.1 Light Dependent Resistor

3.1.2 Working Principle of LDR:

Photo Conductivity is the main principle of the light depended resistor. Photo conductivity is an optical method, which the material's conductivity is increased when light is absorbed by the materials. When the light (photon) falls on the materials, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This causes the free electrons or holes to conduct electricity and thus dropping the resistance (< 1 Kilo ohm). This is the working principle of light dependent resistor. The equation to show the relation between resistance and illumination can be written as:

R = A.E^a

Where E – Illumination (lux)R – Resistance (Ohms)A, a – constants

The value of 'a' depends on the CdS used and on the manufacturing process. Values usually range between 0.7 and 0.9.

3.1.3 The Design and implementation of using Four LDRS:

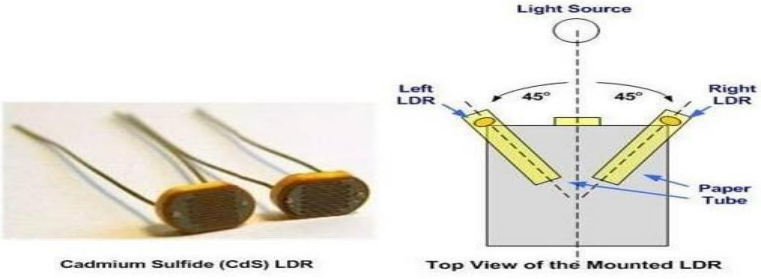


Figure. 3.1.3 quadrant wise LDR positioning

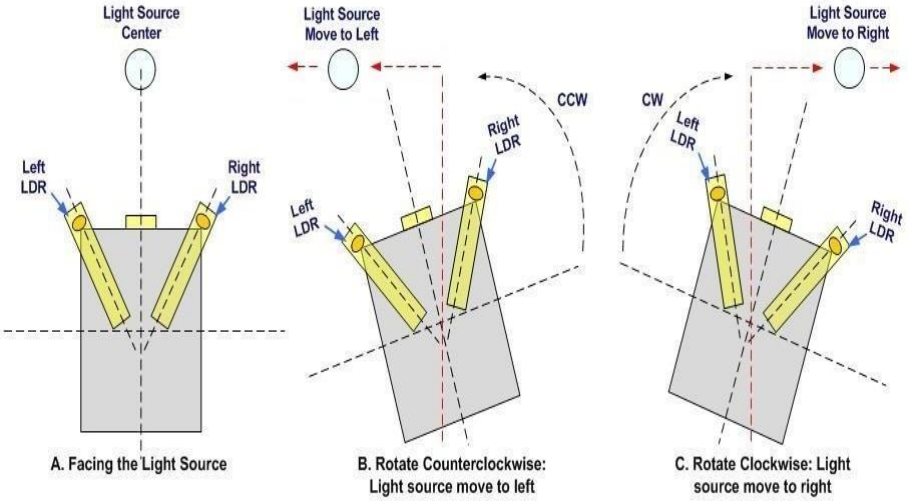


Figure. 3.3 the Sensing Element and Signal Processing

Reference: Sensors and Signal Processing Sraft version (unedited and before final revision) of Chapter 5 the book "Mechatronics: Fundamentals and Applications" Diogo Montalvao (Bournemouth University)

There are several method was proposed and used to track the position of sun light. We used four LDRs to track our module properly. A Light Dependent Resistor separated by a small plate to act as a shield to sunlight, as shown in the next figures. The two LDRs are connected to a bridge and the output of the bridge is connected to a comparator (the analog comparator of the microcontroller is used).

When LDR1 has higher light intensity than LDR2 then the resistance of LDR1 is smaller than that of LDR2 then voltage at AIN0 is higher than that of AIN1 and the output of comparator is high.

When LDR2 has higher light intensity than LDR1 then the resistance of LDR1 is larger than that of LDR2 then voltage at AIN0 is smaller than that of AIN1 and the output of comparator is low. Then the output of the comparator is used in the UC program to control the stepper motor RV1 variable resistor is used to balance the bridge when the two LDRs having the same light intensities (due to the mismatch between the two LDRs).

Similarly, we used the process for LdR3 and LDR4 using Dark and Bright Fringes.

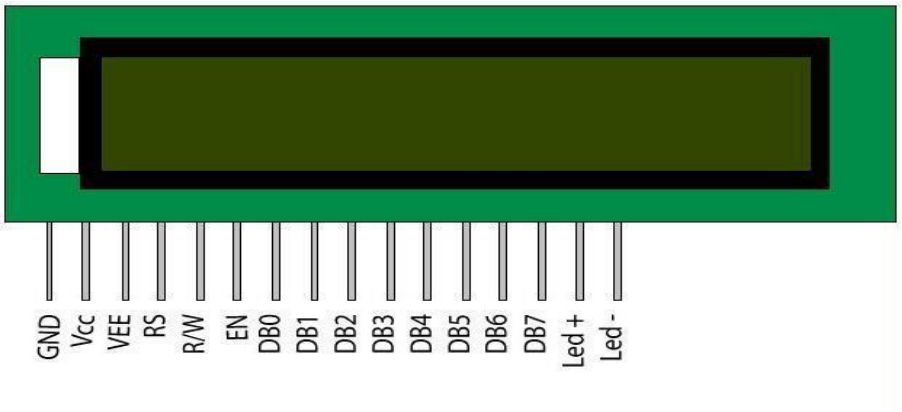
3.2 LCD (2 Line 16 Carriers):

LCD (Liquid Crystal Display) screen is an electronic display module. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

Figure. 3.4 LCD

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. A register which commanded storage the command instructions to the given LCD like initializing it, clearing

its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.



3.3 Servo Motor:

Servo motor is a self-contained electric devices and simple electrical motor, which is controlled with the help of servomechanism. It is a motor which has a output shaft and can be moved to a specific angular position by sending it a coded signal. The servo motor will maintain the position of the shaft .When we changed the coded signal, the angular position of the shaft will changed. Servo motors are used for various applications. They are normally small in size and have good energy efficiency. The cost of this motor also less than others motors and also simple to used. Servos are found in many places from toys to home electronics to cars and airplanes. Servos also appear behind the scenes in devices we use every day.

Servo motor also used in robotic projects for every moving of their joint. The servo circuitry is built inside the motor unit and comes with a position able shaft that is fitted with a gear

FIgure. 3.6 Standard Servo Motor SG-90

The motor is controlled with an electric signal that determines the amount of shaft movement. In a market there are found two types of servo motor, one are made up of metal gear and another are made up of plastic gear. The metallic one is much heavier than other gear one. The size of metallic gear servo motor is also bigger than plastic gear servo motor.

3.4 Advantages & Disadvantages of using Servo motor:

There are some advantages and disadvantages of using servo motor. In belowwe discussed about advantages and disadvantages of servo motor.

Advantages:

- Servo motors are the better option for high speed and high torque.
- Servo motors are available at much faster speed.
- Servo motors are accurate positioning.
- Servo motors also maintain torque at high speed, up to 90%.
- Servo has efficiency of about 80-90%.
- Servo motors are small is size.
- Servo motor has a resonance and vibration free operation.

Disadvantages:

- Servo motors are expensive to buy.
- Servo motors have requires setup to stabilize feedback loop. Servo motorcan be damaged for overloading.
- Servo motor has poor motor cooling. Servo motor design moremechanically complex.
- Servo motor maintenance requirements will also increase.

Data:

Day	Battery	Solar Voltage
20/01/2023	81.92%	5v
21/01/2023	79.88%	4v
22/01/2023	80.56%	5v
23/01/2023	75.67%	3v

Microcontroller:

A microcontroller is a single chip micro-computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Basically microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. A microcontroller is available in different word lengths like microprocessors (4bit,8bit,16bit,32bit,64bit and 128 bit microcontrollers are available today). Here we use PIC16F877A microcontrollers.

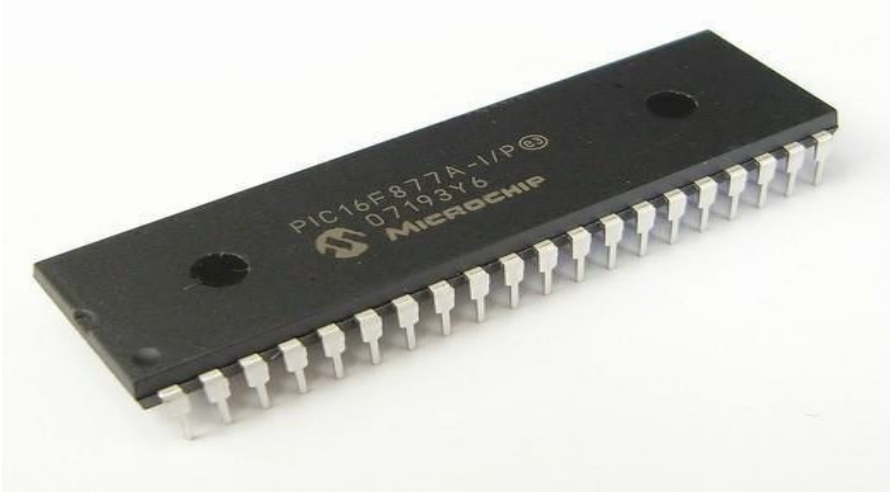


Figure. 3.11 PIC16F877A Microcontroller

A microcontroller contains one or more of the following components:

- Central processing unit (CPU)
- Random Access Memory (RAM)
- Read Only Memory (ROM)
- Input/output ports
- Timers and Counters
- Interrupt controls
- Analog to digital converters
- Digital analog converters
- Serial interfacing ports

3.4.1 Basic Block Diagram of Microcontroller:

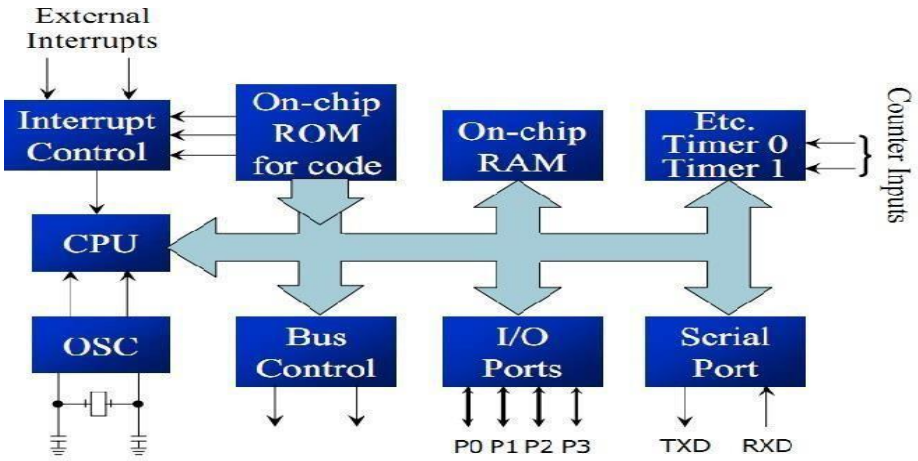


Figure. 3.12 Basic Block Diagram of Microcontroller

3.5 Capacitor:

Capacitor is an essential component of our project. We can use the capacitor in different many applications. Using capacitor in a microcontroller its must because of the microcontroller is a digital device with fast switching edges which uses a large amount of current for a very short period of time at each transition. The capacitors supply the large amount of current needed so that the power supply doesn't sag during that time creating noise. The main function of a capacitor is storing electric charge. A charged capacitor could be used as a voltage source. It is always best to use a variety of capacitors on the power supply pins of the microcontroller to provide a low impedance wideband supply. In our work we used variable value of capacitors and they are 10 µF (6 Pcs) & 100µF (1Pc). Capacitors are used for several purposes like timing,smoothing power supply, coupling, filtering, tuning for radio system, storing energy etc.

Figure. 3.17 100µF & 10µF Capacitors

3.6 606-Transformer:

6-0-6 it’s a good quality transformer, power supplies for all kinds of project & circuit boards. It is step down 230V AC to 6V with a maximum of 200mA current. We used this transformer to get AC current and which converted to DC current with a help of converter.

Figure. 3.18 606-Transformer

Chapter- 4
Data Calculation

A panel of 150w maximum power capacity at position. Find Per day energy generated?

Solution: Peak sun hour = $\frac{\text{Global Irradiance per day}}{\text{Stc. Irradiance}}$

$= \frac{215\ wh/m^2/day}{1000w/m^2}$

$= 0.215$ h/r

[Global irradiance of Dhaka Bangladesh average range 2/5 /day]

In 1 hr. of sunlight =150wh0.215 hr. = 0.215 x 150

= 32.25 wh/day **(Ans)**

Chapter 5
Discussions and Conclusions

5.1 Discussion:

In this work, a MPPT charge controller is presented. A microcontroller is usedto control the maximum power point tracking algorithm, which is used in PV systems to maximize the photovoltaic array o/p power.
An optimized and effective technique has been proposed considering the discussed drawbacks. The proposed system was simulated and constructed, and the functionality of the suggested control concept was proven. The proposed system was simulated and constructed, and the functionality of the suggested control concept was proven. From the results acquired during the simulations and hardware experiments, it was confirmed that, with a well-designed system including a proper converter and selecting an efficient and proven algorithm, the implementation of MPPT is simple and can be easily constructed to achieve an acceptable efficiency level of the PV modules. The results also indicate that the proposed control system is capable of tracking the PV array maximum power and thus improves the efficiency of the PV system and reduces low power loss and system cost. This method protects the MPPT effects from environmental variations and leads us to proper direction to the tracker which makes it independent of environmental changes (particularly irradiation and temperature). The method has been modified based on the incremental conductance and the simulated result offers high efficiency during stable conditions as well as fast changing conditions and hence it maintains the advantage of the existing methods.

The work executed in this project deals with analyzing and modeling of transformer less PV systems related to the leakage current phenomenon that can degrade solar panel performance and pose human. Additionally leakage currentis an unwanted loss especially when it comes to distributed generation system. One of the major tasks of this research was to investigate and verify the transformer less topologies and control strategies that would minimize the leakage current of PV inverter topologies so that it can comply with the standard requirements, safety of human interaction and mitigation of unwanted losses.

5.1.2 Suggestion for Future work :

The main objective of this project is to achieve the highest performance a solar charge controller using MPPT system. This system successfully uses MPPT algorithm to reach our goal. Reaching a stable, true MPP at steady state instead of oscillating around this point

5.2 Development of microcontroller:

Development of different Microcontroller based dedicated MPPT controller for solar PV module based on the different algorithm such as observe & perturbation, computational method etc. This can be a low cost embedded controller. Or to incorporate the power supply into the system that draws energy from the solar panel or an energy storage element that is in turn charged by the solar panel. This extension would allow the system to be deployed to remote locations. Converting the whole system into a single Integrated Circuit.

5.2.3 Development of MPPT system & PV panels:

The PV panels that are being used for tests of the diagnostic methods in this thesis can be considered as a small-scale representation of a photovoltaic array. A full-scale residential PV system should be also considered for field testing. New kind of topologies or control strategies can be introduced which can handle the elimination or minimization of the DC part in the injected AC current. Besides this only real power output for AC is analyzed here. Development of a high Power Output MPPT system.

5.3 Conclusion:

The rapid increase in energy demand cannot be resolved easily until there is an alternative way to meet the demand. The micro grid can undertake to solve this sort of situation in future. Solar, wind and biomass energy is the main source of energy used for optimizing the overall system and hence to make it efficient. So the user will become less compulsive on the convenient fossil fuel energy. The stored energy also plays a significant role to avoid the imbalance of the power system. To ensure the photovoltaic generator operating its maximum power point, MPPT controllers are often used. These controllers are intended for MPP tracking and to thus minimize the error between the operating power and the reference maximum power which is variable according to the load and of the weather conditions. The MPPT based charge controllers are best suitable for wind and solar systems as they track the maximum power in case of power fluctuations at the input side due to environmental condition variation. Hence itis recommended to use the MPPT based charge controllers. Use of microcontroller based systems provides huge computational capability and reduction in the hardware.

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