CONSTRUCTION OF AUTOMATIC SOLAR TRACKING SYSTEM

BY

MD.MONOWAR HOSSAIN

ID: 101-33-134

AND

MD. ANWAR HOSSAIN

ID: 101-33-195

This Report presented in partial Fulfillment of the requirements for the Degree of Bachelor of science in Electrical and Electronics Engineering.

Supervised By

Mr.Md. Abdus Satter

Assistant Professor

Department Of EEE

Daffodil International university.

DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

FEBRUARY 2014

APPROVAL

This project titled “ **Construction Of Automatic Solar Tracking System”** submitted by Md. Monowar Hossain and Md.Anwar Hossain to the Department of Electrical and Electronics Engineering, Daffodil International University , has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc in Electrical and electronics Engineering and approved as to its style and contents .The presentation has been held on.

BOARD OF EXAMINERS

____

Professor Dr. M. Shamsul Alam
Professor and Dean
Department of EEE
Faculty of science & Information Technology
Daffodil International university

____

Dr.Md. Fayzur Rahman
Professor and Head
Department of EEE
Daffodil International University

____

Mr.Md.Abdus Satter
Assistant Professor
Department of EEE
Daffodil International University

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr.Md.Abdus Satter, Assistant Professor,** Department of EEE, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree.

Supervised by:

____

Mr.Md.Abdus Satter
Assistant Professor
Department of EEE
Daffodil International University

Submitted by:

____

Md. Monowar hossain
Id. 101-33-134
Department of EEE
Daffodil International University

____

Md Anwar hossain
Id: 101-33-195
Department of EEE
Daffodil International University

DEDICATED

To our beloved parent

ACKNOWLEDGEMENT

At first we are greatly praise to almighty Allah for successful completion of our undergraduate project.

We want to thanks our Project Supervisor Assistant Professor Mr.Md.Abdus Satter for his encouragement and for giving us permission to involve with this biomedical related project. We have done our project according to his direction. We are also grateful to our respected teachers.

We thank all staffs of our departmental lab for their help during working period.

We are extremely grateful to our parents, family member and friends for their support, constant love and sacrifice.

Finally, we beg pardon for our unintentional errors and omission if any.

CONTENTS

ABSTRACT
1. INTRODUCTION 1
1.1 Introduction to the project 2
1.2. Project Objective 3
1.3. Problem statement 3
1.4. Methodology 5
2. SYSTEM DEVELOPMENT 6
2.1 System Development 7
3. DESIGN AND WORKING PRINCIPLE 10
3.1.Equipments 11
3.2. Description of each Equipments 12
3.2.1 LM339 12
3.2.1.1 Features 12
3.2.1.2 Connection Diagrams 13
3.2.1.3 Description 14
3.2.1.4 Applications 14
3.2.1.5 Advantages 14
3.2.2 L293D 15
3.2.2.1 L293D Description 15
3.2.2.2 L293D Pin Diagram 16
3.2.2.3 Working of L293D 16
3.2.2.4 L293D Logic table 17
3.2.3 Variable resistance (VR) 17
3.2.3.1 Variable resistance Description 17
3.2.3.2 Variable resistance Diagram 17
3.2.3.3Working of Variable Resistor 17
3.2.4 Diode (1N4148) 18
3.2.4.1 Features 18
3.2.4.2 Diode (1N4148) Diagram: 18
3.2.4.3 Diode (1N4148) Description 19
3.2.4.4 Diode (1N4148) Applications 19
3.2.4.5 Marking 19

3.2.5 Geared Motor 20
3.2.5.1 Geared Motor Description 20
3.2.5.2 Geared Motor Diagram 20
3.2.5.3 Working of Geared Motor 21
3.2.6 Resistance 22
3.2.6.1 Resistance Description 22
3.2.6.2 Resistor Color Code 24
3.2.7 Printed Circuit Board 25
3.2.7.1 Printed Circuit Board Description 25
3.2.7.2 Design of Printed Circuit Board 25
3.2.7.3 Connection of Printed Circuit Board 27
3.3. Circuit diagram 28
3.4. Proposed assembly for the solar tracking system 29
3.5. Proposed assembly for the Automatic Solar Tracker Circuit diagram: 30
3.6. Operating principle 31
3.7. Flow chart 32
4. PERFORMANCE ANALISIS 33
4.1. Calculated Output 34
4.2. General output 35
4.3. Designed instruments output 36
4.4. Comparison of two output 37
4.5. Result 39
4.6. Future Scope 40
5. COST 41
5.1 Cost sheet 42
6 .CONCLUSION 43
6.1 Future work. 44
6.2 Conclusion 44

REFERENCES 45

APPENDIX

List of figures

Figure 01:(Top View) LM339 Quad comparator
Figure 02: L293D
Figure 03: Resistance Diagram
Figure 04: Simplified outline (SOD27; DO-35) and symbol
Figure 05: Geared motor
Figure 06: Resistance
Figure 07: Printed Circuit Board
Figure 08: Automatic Solar Tracker Circuit diagram
Figure 09: Proposed assembly for the Automatic Solar Tracker
Figure 10: Proposed assembly for the Automatic Solar Tracker Circuit diagram
Figure 11: Flow chart
Figure 12: Comparison of two output graph.

ABSTRACT

Solar energy is one of the popular renewable energy nowadays. It is consider as total free and clean energy source since the sun is estimated still able to exist for more 5×10^9 years. In addition, some natural resources like fossil fuels is consider as short-term resources because it is estimated will finished in next 30 years. Based on this situation, renewable energy like solar energy is essential to human being after the natural resources is finish. The fact is, conventional solar panel power system is stationary, means the solar panel will not always facing to the direction of sun, this make the light intensity falling on the solar panel is not in maximum level so the solar panel will not always work in its maximum performance.

This paper demonstrates a novel method which will automatically track the sun's position and accordingly change the direction of the solar panel to get the maximum output from the solar cell with the help with LM339, sensor and DC motor. This method enable the solar panel work in maximum performance because the light intensity falling on the panel will be in maximum intensity level in all long day. A solar tracker is designed and experimentally tested. The information and design detail are shown in the report.

INTRODUCTION

CHAPTER 1

CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

1.1 Introduction to the project
1.2. Project Objective
1.3. Problem statement
1.4. Methodology

1.1 Introduction to the project:

Generally, solar panels are stationary and do not follow the movement of the sun[1] .Here is a solar tracker system That tracks the sun's movement across the sky and tries to maintain the solar panel perpendicular to the sun's ray, Ensuring that the maximum amount of sunlight is incident on the panel throughout the day till evening [2].

Photovoltaic's is the field of technology and research related to the application of solar cells as solar energy [3]. Solar cells have many applications. Individual cells are used for powering small devices such as electronic calculators. Photovoltaic arrays generate a form of renewable electricity, particularly useful in situations where electrical power from the grid is unavailable such as in remote area power systems, Earth-orbiting satellites and space probes, remote radiotelephones and water pumping applications. Photovoltaic electricity is also increasingly deployed in grid-tied electrical systems.

Solar Energy has been the power supply of choice for Industrial applications, where power is required at remote locations. Most systems in individual uses require a few kilowatts of power. The examples are powering repeater stations or microwave, TV and radio, telemetry and radio telephones. Solar energy is also frequently used on transportation signaling e.g. light houses and increasingly in road traffic warning signals. Solar's great benefit here is that it is highly reliable and requires little maintenance [4] .

While the output of solar cells depends on the intensity of sunlight and the angle of incidence, it means to get maximum efficiency; the solar panels must remain in front of sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of their efficiency. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The Solar Tracking System is made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun where we get maximum output.

1.2 Project Objectives:

Project objectives are basically the mission, purpose or standard that can accomplish within the expected schedule. There are two main goals have to be achieved at the end of the project, which are:

(a) To design and construct a automatic solar tracking system where this system will align and orientate the position of solar panel according to light intensity falling on it to keep the surface of the solar panel always perpendicular to the sun position so that light falling on the solar panel will be in maximum level.

(b) To combine solar charger with the solar tracker system so that the solar charger can worked in maximum performance. Ultimately increase the total efficiency of a solar system.

1.3 Problem Statement:

The problem of the global warming is getting serious recently. Thus, the demand of the clean energy or renewable is keep increasing. The solar system is using sunlight as source, convert the solar radiation into electrical energy is one the popular renewable energy nowadays.

The main purpose of this project is to charge the small electronic devices by using solar charger system and maximize the efficient of solar panel by creating solar tracking system.

The demand and usage of the rechargeable battery is keep increase in last few years due to electronics devices, such as mp3 player, smart phone and tablet are getting popular. The user will need one to two hour to charge up their battery in home which power source is non-renewable energy. A solar charger can improve the condition because it is using totally free and clean energy in the charging process, brought many benefits to user and also environment.

Besides, the performance of the solar panel is basically depends on its efficient, its performance will not improve unless a higher efficient solar panel was invented. In addition, most of the solar panel is stationary; it will always face to only one direction while the position of the sun keeps change in day.

As a result, the intensity of sunlight falling on the solar panel will not always in highest level, this lead to negative effect of the performance of solar panel. A solar tracking system will improve the performance of solar panel.

By combining the solar charger and the solar tracking system, the solar charger can be worked in maximum performance.

1.4 Methodology:

Methodology is actually the general guideline to the execution of project. It includes some analysis of the rules or the principles that might include in the project and study of the potential methods that will be used in the project. It gives a plan to the one who is going to do the project where it will show planning activities.

First of all, discussion with the supervision has been made to discussion about the potential final year project title. Then, literature review was made. The proposal of the project is made to identify the project objective, project scope and problem statement of the project. Inside the proposal, the flow chart must be clearly statement because well planning of time is the key success of the project. After that, project proceeds to simulation, hardware and mechanical construction. Troubleshooting has been made to solve the potential problem of the prototype. Prototype can be finalized after all the problems has been solved.

CHAPTER 2

SYSTEM DEVELOPMENT

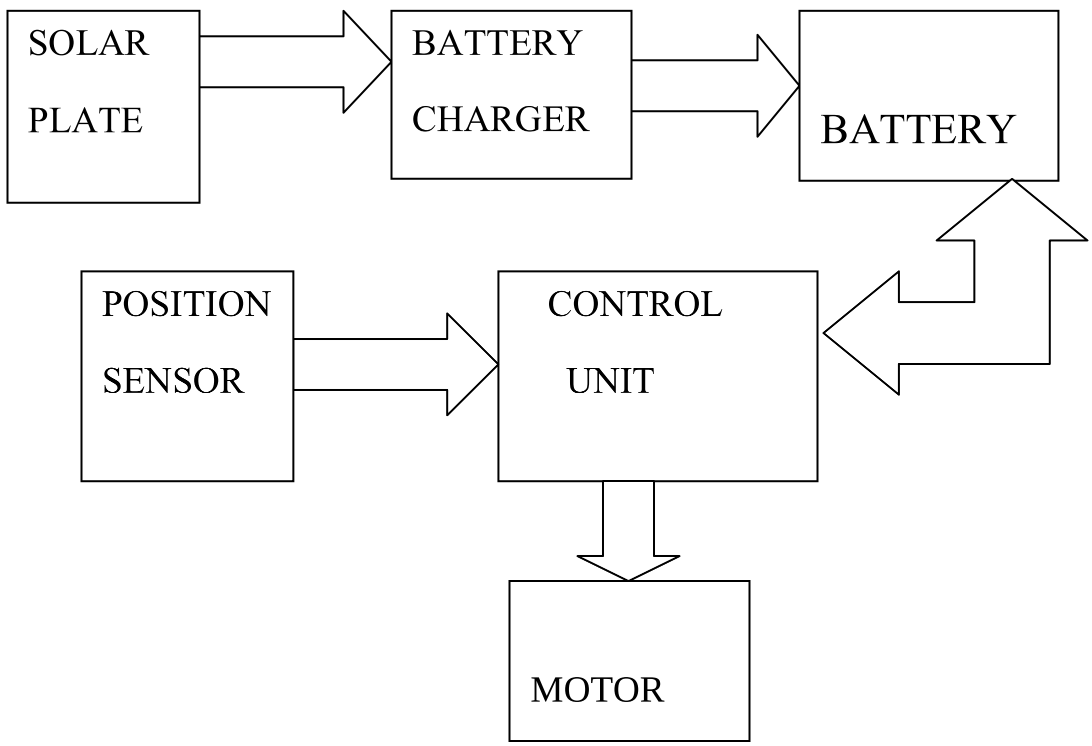
CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

2.1 System Development

2.1 SYSTEM DEVELOPMENT:

- East: Initiate the sensor
- During the day tracker function as the usual
- West: tracker function as usual
- At Evening and night tracker doesn’t react.



A solar cell, sometimes called a photovoltaic cell, is a device that converts light energy into electrical energy. A single solar cell creates a very small amount of energy (about .6 volts DC) so they are usually grouped together in an integrated electrical panel called a solar panel. Sunlight is a somewhat diffuse form of energy and only a portion of the light captured by a solar cell is converted into electricity.

Sunlight is made up of packets of energy called photons. When the photons strike the semi-conductor layer (usually silicon) of a solar cell a portion of the photons are absorbed by the material rather than bouncing off of it or going through the material. When a photon is absorbed the energy of that photon is transferred to an electron in an atom of the cell causing the electron to escape from its normal position. This creates, in essence, a hole in the atom.
This hole will attract another electron from a nearby atom now creating yet another whole, which in turn is again filled by an electron from another atom.

One of the problems with solar power is that the output of the solar panel is variable. These solar systems are designed to extract the maximum amount of power available from the solar panels and deposit it in the battery. These solar charge controllers also protect your panels from discharging through the batteries after the sun goes down.

Talking of the design of solar panel battery chargers, solar panel battery charger manufacturers use thin film second generation technology to create these devices. This is to take advantage of the flexible nature of this kind of solar cell technology. Solar battery chargers used on boats and on water can be found in waterproof prototypes. Solar panels used to capture and convert energy from the sun into electrons are offered in various volts gradations; a solar panel battery charger is available from 2 watt to 30 watt range.

Table 1: Voltage and Current Specification

Discrete Components	Ratings
Lead Acid Battery Voltage	12 VDC
Maximum Solar PV panel open circuit voltage	18 VDC
Continuous charge/load current	800mA
Maximum solar charge current (5 min)	850mA
Voltage across terminals (PV to Battery)	0.6 V
Voltage across terminals (Battery to Load)	0.3V

An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS).
An LDR has a zigzag cadmium sulphide track. It is a bilateral device, i.e., conducts in both directions in same fashion.

CHAPTER 3

DESIGN AND WORKING PRINCIPLE

CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

3.1. Equipments
3.2. Description of each Equipments
3.3. Circuit diagram
3.4. Proposed assembly for the solar tracking system
3.5. Proposed assembly for the Automatic Solar Tracker Circuit diagram:
3.6. Operating principle
3.7. Flow chart

3.1 Equipments:

Name	Model / Value	Quantity
Integrated circuit (IC)	LM339	1
Integrated circuit (IC)	L293D	1
Diode	1N4148	4
Light Dependent Resistors		4
Resistance	10K	4
Resistance	12K	2
Resistance	22K	2
Resistance	50K	2
Variable resistance	47K	2
Variable resistance	100 K	2
Motor	12V 10 RPM Geared Motor	2
Supply	+ 5V	
Supply	+12V	
Printed Circuit Board		1

3.2 **Description of each Equipments:**

3.2.1 LM339**:**

3.2.1.1 Features:

These comparators are designed for use in level detection, low−level sensing and memory applications in consumer, automotive, and industrial electronic applications.

- Single or Split Supply Operation.
- Low Input Bias Current: 25 nA (Typ)
- Low Input Offset Current: ± 5.0 nA (Typ)
- Low Input Offset Voltage.
- Input Common Mode Voltage Range to GND.
- Low Output Saturation Voltage: 130 mV (Typ) @ 4.0 mA
- TTL and CMOS Compatible
- ESD Clamps on the Inputs Increase Reliability without Affecting Device Operation.
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant.

3.2.1.2 Connection Diagrams:

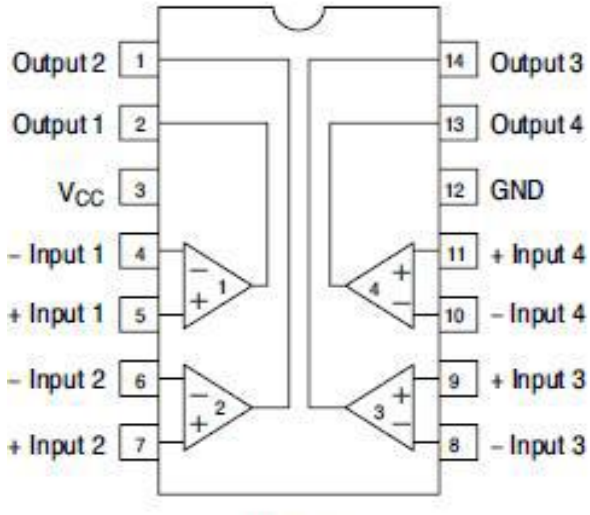
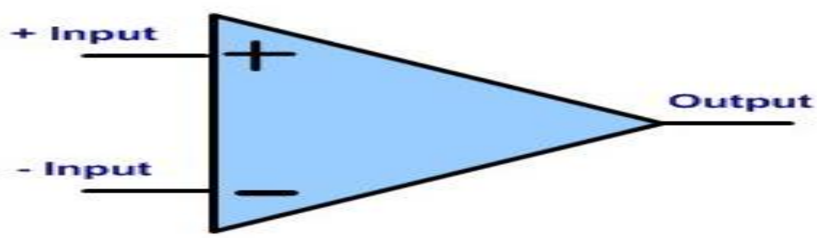


Figure 01:(Top View) LM339 Quad comparator



Comparator Symbol

LM339 Quad IC

National Semiconductor LM339 Quad comparator, 4 Independent comparator In 14 pins Dil package.

3.2.1.3 Description:

The LM139 series consists of four independent precision voltage comparators with an offset voltage specification as low as 2 mV max for all four comparators. These were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

The LM139 series was designed to directly interface with TTL and CMOS. When operated from both plus and minus power supplies, they will directly interface with MOS logic— where the low power drain of the LM339 is a distinct advantage over standard comparators.

3.2.1.4 Applications:

- Limit Comparators
- Simple Analog-to-Digital Converters
- Pulse, Square wave and Time Delay Generators
- Wide Range VCO; MOS Clock Timers
- Multivibrators and High Voltage Digital Logic Gates

3.2.1.5 Advantages:

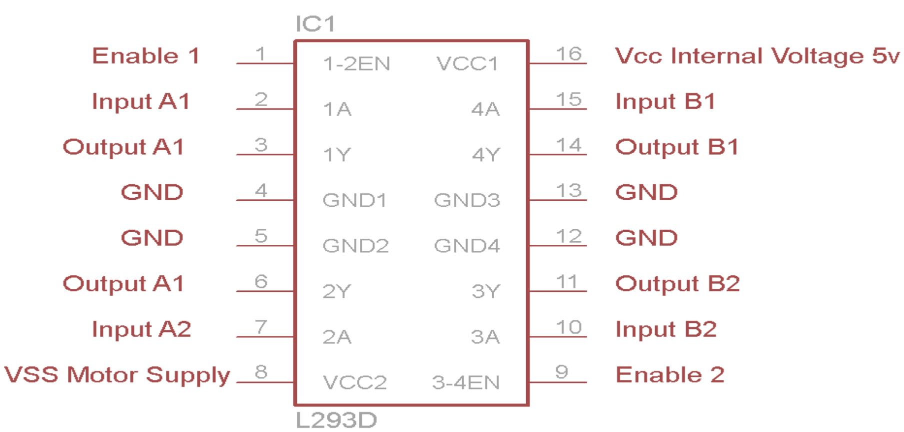
- High Precision Comparators
- Reduced V_{OS} Drift Over Temperature
- Eliminates Need for Dual Supplies
- Allows Sensing Near GND
- Compatible with all Forms of Logic
- Power Drain Suitable for Battery Operation

3.2.2 L293D:

3.2.2.1 L293D Description:

L293D is a typical motor driver or motor driver IC which allows DC motor to drive on either direction. L293D is a 16 pin IC which can control a set of two DC motor simultaneously in any direction .It means that we can control two DC motor with a single L293D IC.

3.2.2.2 L293D Pin Diagram:



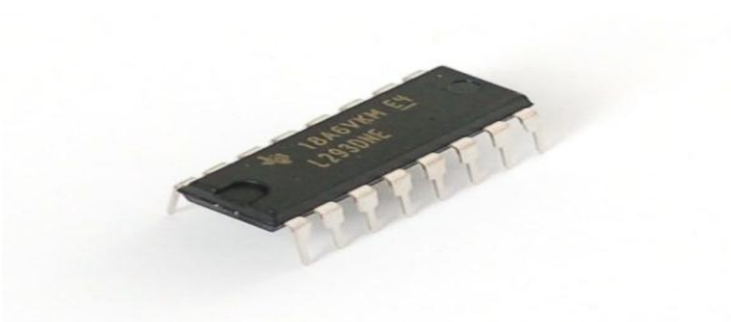


Figure 02: L293D

3.2.2.3 Working of L293D:

The there 4 input pins for this L293D, pin 2,7 on the left and pin 15,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

In simple we need to provide Logic 0 or 1 across the input pins for rotating the motor .

3.2.2.4 L293D Logic table:

Lets consider a motor connected on left side output pins (pin 3,6) . For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

- Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi- Impedance state]
- Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

In a very similar way the motor can also operated across input pin 15,10 for motor on the right hand side .

3.2.3 Variable resistance (VR):

3.2.3.1 Variable resistance Description:

A variable resistor is a device that is used to change the resistance according to our needs in an electronic circuit. It can be used as a three terminal as well as a two terminal device. Mostly they are used as a three terminal device. Variable resistors are mostly used for device calibration.

3.2.3.2 Variable resistance Diagram:

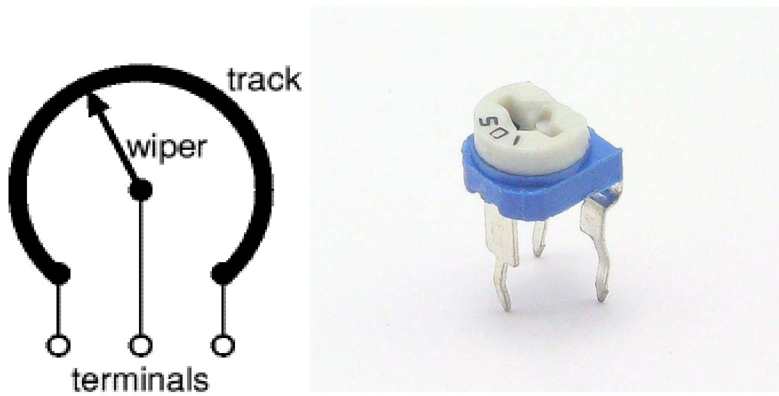


Figure 03: Resistance Diagram

3.2.3.3 Working of Variable Resistor:

As shown in the diagram below, a variable resistor consists of a track which provides the resistance path. Two terminals of the device are connected to both the ends of the track. The third terminal is connected to a wiper that decides the motion of the track. The motion of the wiper through the track helps in increasing and decreasing the resistance.

The track is usually made of a mixture of ceramic and metal or can be made of carbon as well. As a resistive material is needed, carbon film type variable resistors are mostly used.

3.2.4 Diode (1N4148) :

3.2.4.1 Features:

- Hermetically sealed leaded glass SOD27 (DO-35) package
- High switching speed: max. 4 ns
- General application
- Continuous reverse voltage: max. 100 V
- Repetitive peak reverse voltage: max. 100 V
- Repetitive peak forward current: max. 450 mA.

3.2.4.2 Diode (1N4148) Diagram:

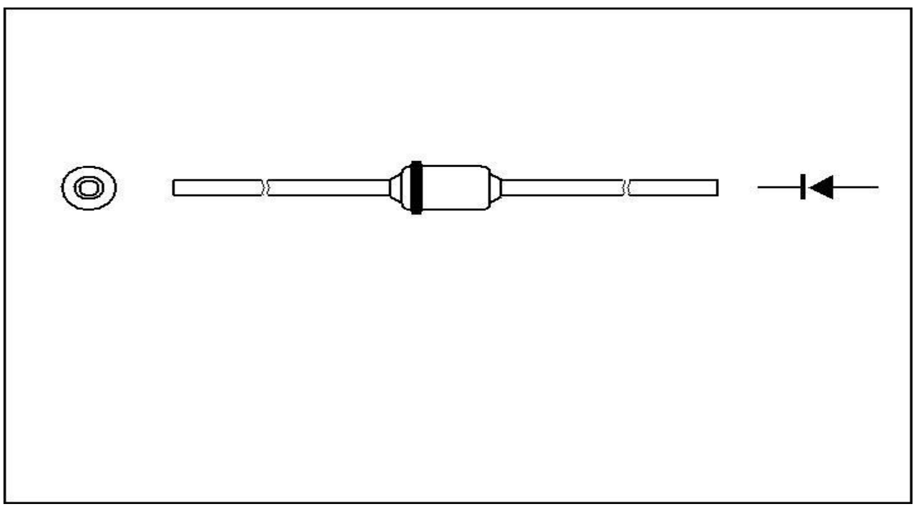


Figure 04: Simplified outline (SOD27; DO-35) and symbol.

3.2.4.3 Diode (1N4148) Description :

The 1N4148 and 1N4448 are high speed switching diodes fabricated in anar technology, and encapsulated in hermetically sealed leaded glass SOD27 (DO-35) packages.

3.2.4.4 Diode (1N4148) Applications :

- High-speed switching.

3.2.4.5 Marking

TYPE NUMBER	MARKING CODE
1N4148	1N4148PH or 4148PH

3.2.5 Geared Motor :

3.2.5.1 Geared Motor Description:

A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower, or low speed, motor output. Gear motors can be found in many different applications, and are probably used in many devices in your home.

Gear motors are commonly used in devices such as can openers, garage door openers, washing machine time control knobs and even electric alarm clocks. Common commercial applications of a gear motor include hospital beds, commercial jacks, cranes and many other applications [6].

3.2.5.2 Geared Motor Diagram :

Gear

Figure 05: Geared motor

3.2.5.3 Working of Geared Motor :

The DC motor works over a fair range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. For example, if the motor works in the range of 6-12V, it will have the least RPM at 6V and maximum at 12V [5].

In terms of voltage, we can put the equation as:

$RPM = K1 * V$, where,

$K1$= induced voltage constant

V=voltage applied

The working of the gears is very interesting to know. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it.

In any DC motor, RPM and torque are inversely proportional. Hence the gear having more torque will provide a lesser RPM and converse. In a geared DC motor, the concept of pulse width modulation is applied. The equations detailing the working and torque transfer of gears are shown below:

$$\tau_{in}\,\omega_{in} = \tau_{out}\,\omega_{out}$$, where

τ_{in} = input torque by the driver gear

ω_{in} =angular speed of the driver gear

τ_{out} = output torque of the driven gear

ω_{out} = angular speed of the driven gear

In a geared DC motor, the gear connecting the motor and the gear head is quite small, hence it transfers more speed to the larger teeth part of the gear head and makes it rotate. The larger part of the gear further turns the smaller duplex part. The small duplex part receives the torque but not the speed from its predecessor which it transfers to larger part of other gear and so on. The third gear's duplex part has more teeth than others and hence it transfers more torque to the gear that is connected to the shaft [5].

3.2.6 Resistance :

3.2.6.1 Resistance Description :

When electrons flow through a bulb or another conductor , the conductor does offers some obstruction to the current . This obstruction is called electrical resistance.

- ⇨ The longer the conductor higher the resistance.
- ⇨ The smaller its area the higher its resistance.

Every material has an electrical resistance and it is the reason that the conductor give out heat when the current passes through it.

Figure 06: Resistance

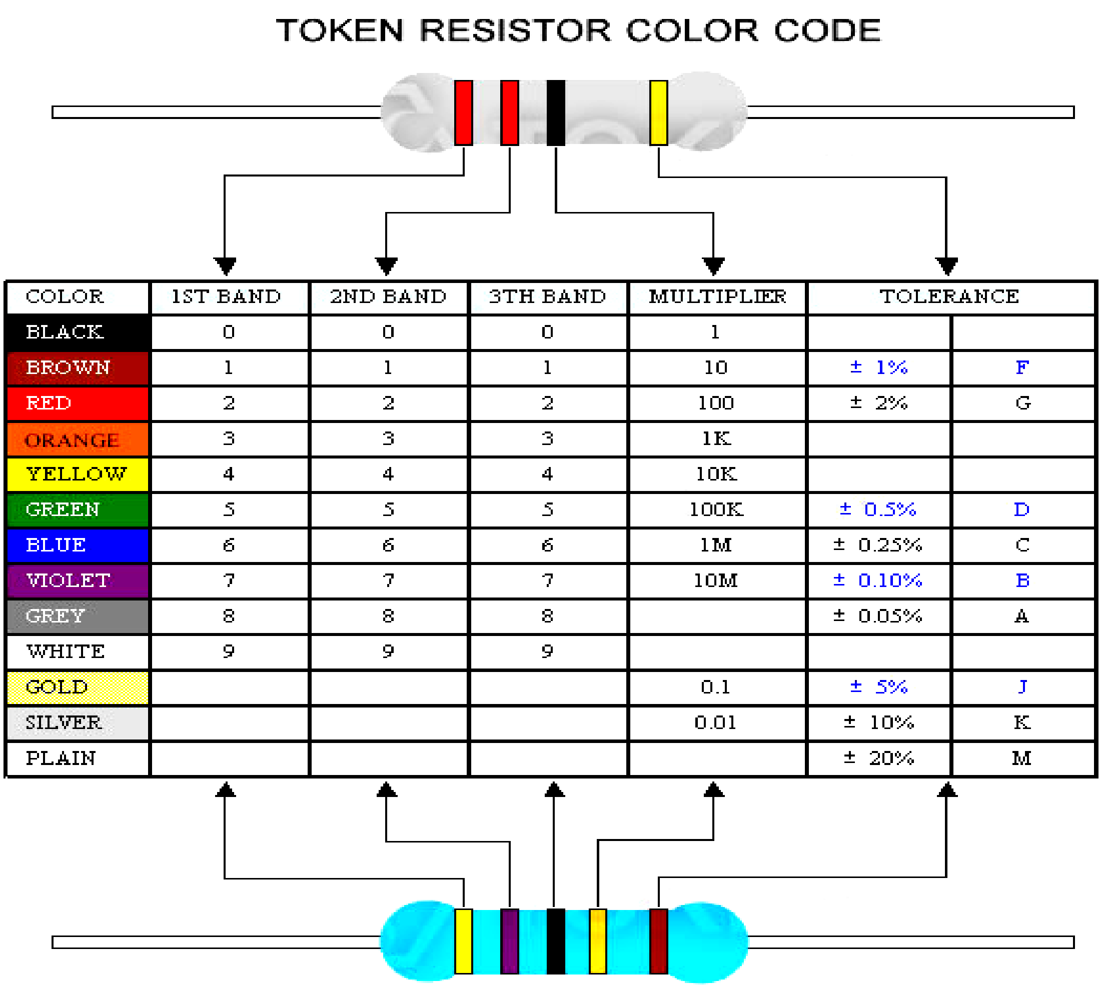
Resistance is the opposition that a substance offers to the flow of electric current. It is represented by the uppercase letter R. The standard unit of resistance is the ohm, sometimes written out as a word, and sometimes symbolized by the uppercase Greek letter omega. When an electric current of one ampere passes through a component across which a potential difference (voltage) of one volt exists, then the resistance of that component is one ohm.

In general, when the applied voltage is held constant, the current in a direct-current (DC) electrical circuit is inversely proportional to the resistance. If the resistance is doubled, the current is cut in half; if the resistance is halved, the current is doubled. This rule also holds true for most low-frequency alternating-current (AC) systems, such as household utility circuits. In some AC circuits, especially at high frequencies, the situation is more complex, because some components in these systems can store and release energy, as well as dissipating or converting it.

The electrical resistance per unit length, area, or volume of a substance is known as resistivity. Resistivity figures are often specified for copper and aluminum wire, in ohms per kilometer.

Opposition to AC, but not to DC, is a property known as reactance. In an AC circuit, the resistance and reactance combine vector ally to yield impedance.

3.2.6.2 Resistor Color Code:



COLOR	1ST BAND	2ND BAND	3TH BAND	MULTIPLIER	TOLERANCE	
BLACK	0	0	0	1		
BROWN	1	1	1	10	± 1%	F
RED	2	2	2	100	± 2%	G
ORANGE	3	3	3	1K		
YELLOW	4	4	4	10K		
GREEN	5	5	5	100K	± 0.5%	D
BLUE	6	6	6	1M	± 0.25%	C
VIOLET	7	7	7	10M	± 0.10%	B
GREY	8	8	8		± 0.05%	A
WHITE	9	9	9			
GOLD				0.1	± 5%	J
SILVER				0.01	± 10%	K
PLAIN					± 20%	M

3.2.7 Printed Circuit Board:

3.2.7.1 Printed Circuit Board Description:

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCB's can be single sided (one copper layer), double sided (two copper layers) or multi-layer. Conductor on different layers are connected with plated-through holes called vias. Advanced PCB's may contain components - capacitors, resistors or active devices - embedded in the substrate.

When the board has only copper connections and no embedded components it is more correctly called a printed wiring board (PWB) or etched wiring board. Although more accurate, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is called a printed circuit assembly (PCA), printed circuit board assembly or *PCB* assembly (PCBA). The IPC preferred term for assembled boards is circuit card assembly (CCA), for assembled backplanes it is backplane assemblies. The term PCB is used informally both for bare and assembled boards.

.

3.2.7.2 Design of Printed Circuit Board:

Printed circuit board artwork generation was initially a fully manual process done on clear mylar sheets at a scale of usually 2 or 4 times the desired size. The schematic diagram was first converted into a layout of components pin pads, then traces were routed to provide the required interconnections. Pre-printed non-reproducing mylar grids assisted in layout, and rub-on dry transfers of common arrangements of circuit elements (pads, contact fingers, integrated circuit profiles, and so on) helped standardize the layout.

Traces between devices were made with self-adhesive tape. The finished layout "artwork" was then photographically reproduced on the resist layers of the blank coated copper-clad boards.

Modern practice is less labor intensive since computers can automatically perform many of the layout steps. The general progression for a commercial printed circuit board design would include.

- Schematic capture through an electronic design automation tool.
- Card dimensions and template are decided based on required circuitry and case of the PCB. Determine the fixed components and heat sinks if required.
- Deciding stack layers of the PCB. 1 to 12 layers or more depending on design complexity. Ground plane and power plane are decided. Signal planes where signals are routed are in top layer as well as internal layers.[3]
- Line impedance determination using dielectric layer thickness, routing copper thickness and trace-width. Trace separation also taken into account in case of differential signals.
- Placement of the components. Thermal considerations and geometry are taken into account. Vias and lands are marked.
- Routing the signal traces. For optimal EMI performance high frequency signals are routed in internal layers between power or ground planes as power planes behave as ground for AC.
- Gerber file generation for manufacturing.

3.2.7.3 Connection of Printed Circuit Board:

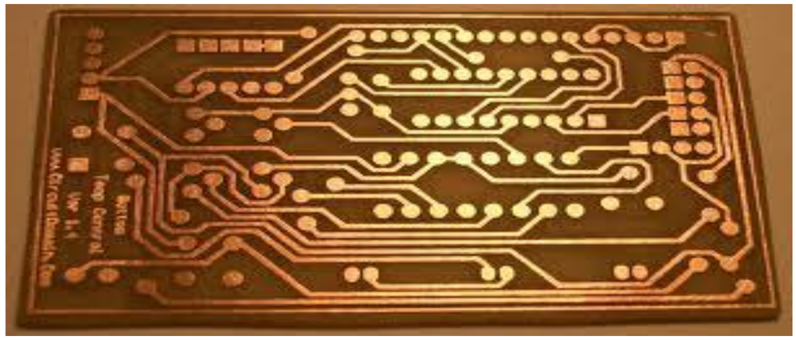


Figure 07: Printed Circuit Board

When your application calls for the highest reliability and frequent wire terminations, the screw-cage clamp should be your choice. As the clamp is tightened, the nickel-plated cage rises, pressing the wire firmly against the busbar, ensuring solid connections every time. Standard color is green.

In the tubular screw and box clamp design, tightening the screw presses the conductor directly against the bottom of the clamp. These systems are ideal for cost sensitive, lighter duty applications or applications with infrequent wire terminations. Wire protectors are standard. Standard color is black for tubular screw and green for box clamp.

3.3 Circuit diagram:

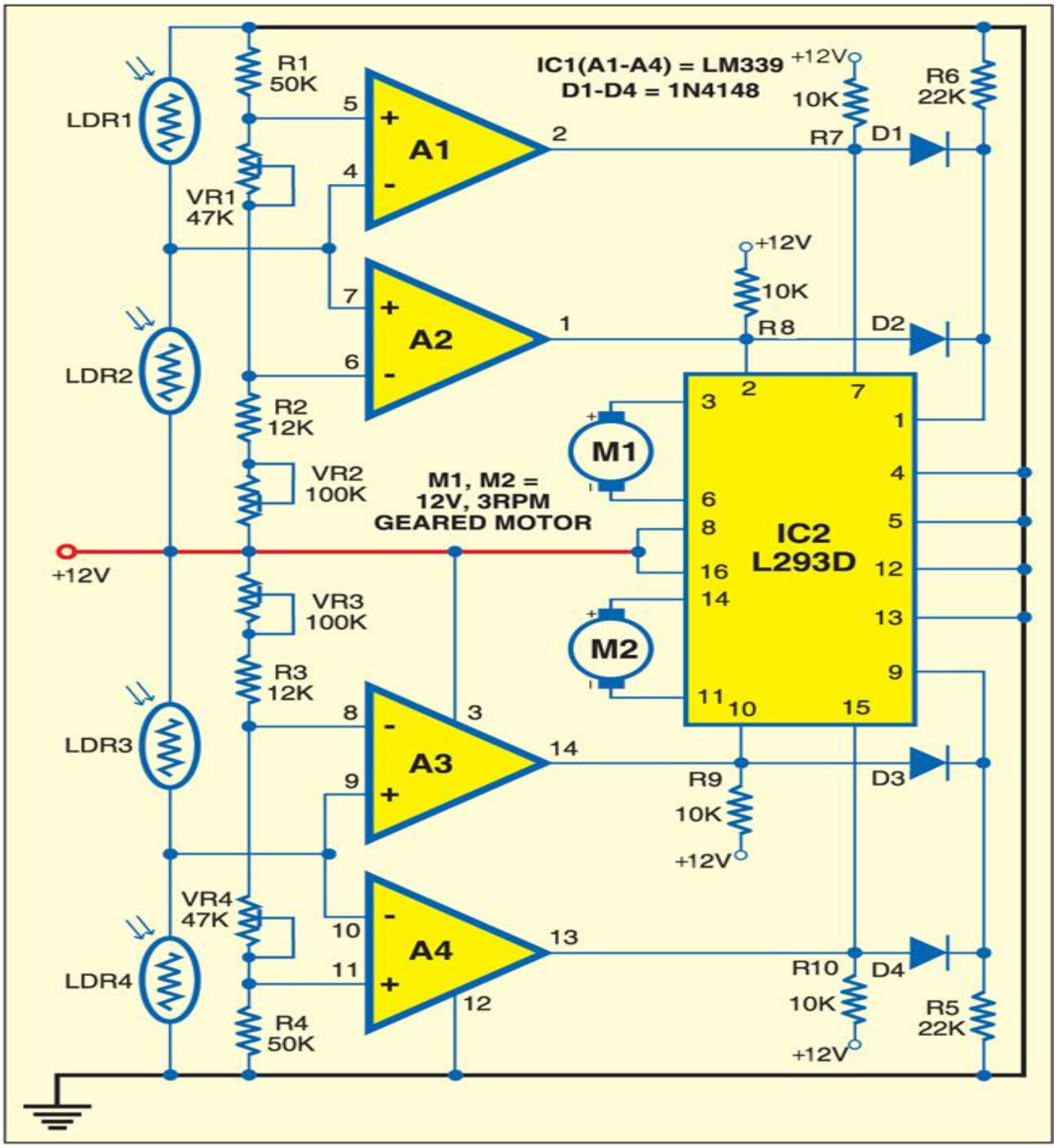


Figure 08: Automatic Solar Tracker Circuit diagram.

3.4 Proposed assembly for the solar tracking system:

Figure 09: Proposed assembly for the Automatic Solar Tracker

3.5 Proposed assembly for the Automatic Solar Tracker Circuit diagram:

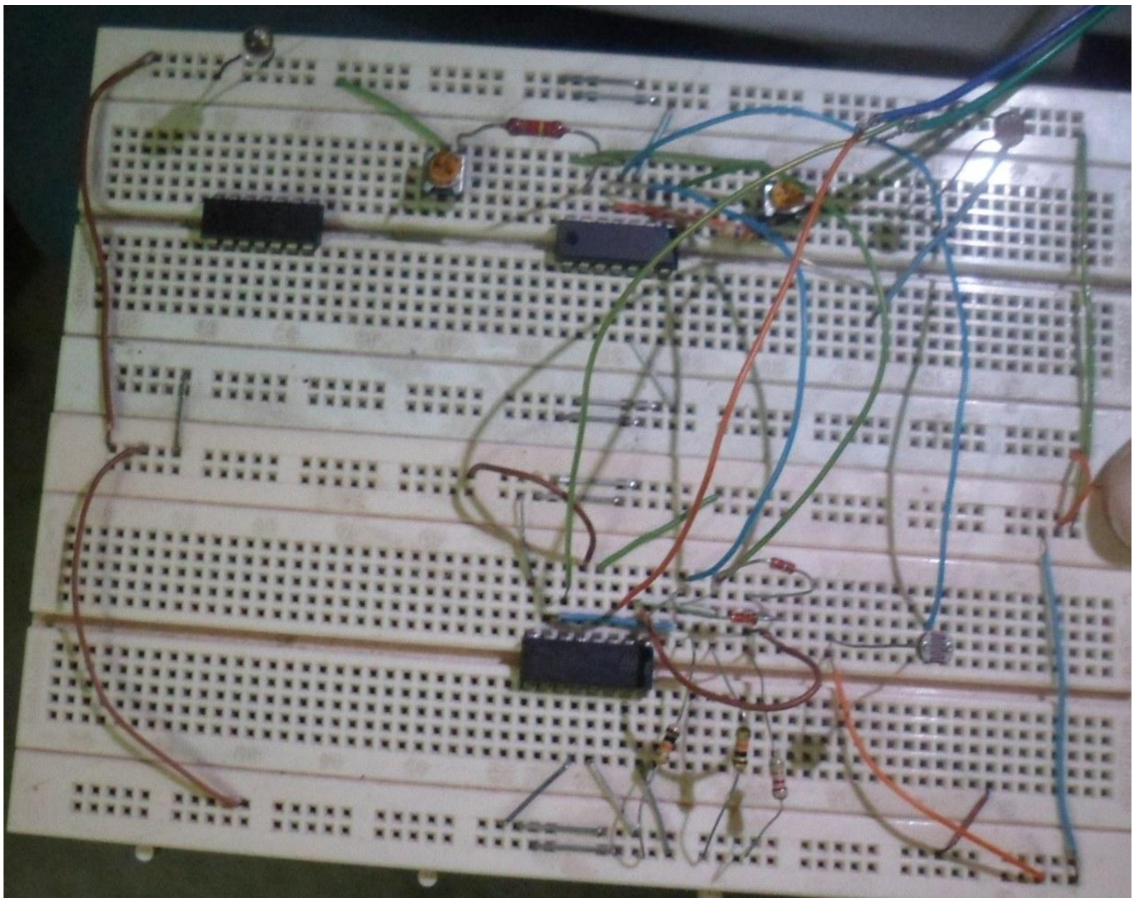


Figure 10: Proposed assembly for the Automatic Solar Tracker Circuit diagram

3.6 Operating principle:

Shows the circuit of the solar tracking system. The solar tracker comprises comparator IC LM339, H-bridge motor driver IC L293D (IC2) and a few discrete components. Light-dependent resistors LDR1 through LDR4 are used as sensors to detect the panel's position relative to the sun. These provide the signal to motor driver IC2 to move the solar panel in the sun's direction. LDR1 and LDR2 are fixed at the edges of the solar panel along the X axis, and connected to comparators A1 and A2, respectively. Presets VR1 and VR2 are set to get low comparator output at pins 2 and 1 of comparators A1 and A2, respectively, so as to stop motor M1 when the sun's rays are perpendicular to the solar panel.

When LDR2 receives more light than LDR1, it offers lower resistance than LDR1, providing a high input to comparators A1 and A2 at pins 4 and 7, respectively. As a result, output pin 1 of comparator A2 goes high to rotate motor M1 in one directionsay,anti-clockwise) an turn the solar panel.

When LDR1 receives more light than LDR2, it offers lower resistance than LDR2, giving a low input to comparators A1 and A2 at pins 4 and 7, respectively. As the voltage at pin 5 of comparator A1 is now higher than the voltage at its pin 4, its output pin 2 goes high. As a result, motor M1 rotates in the opposite direction (say, clock-wise) and the solar panel turns. Similarly, LDR3 and LDR4 track the sun along Y axis.

3.7 Flow chart :

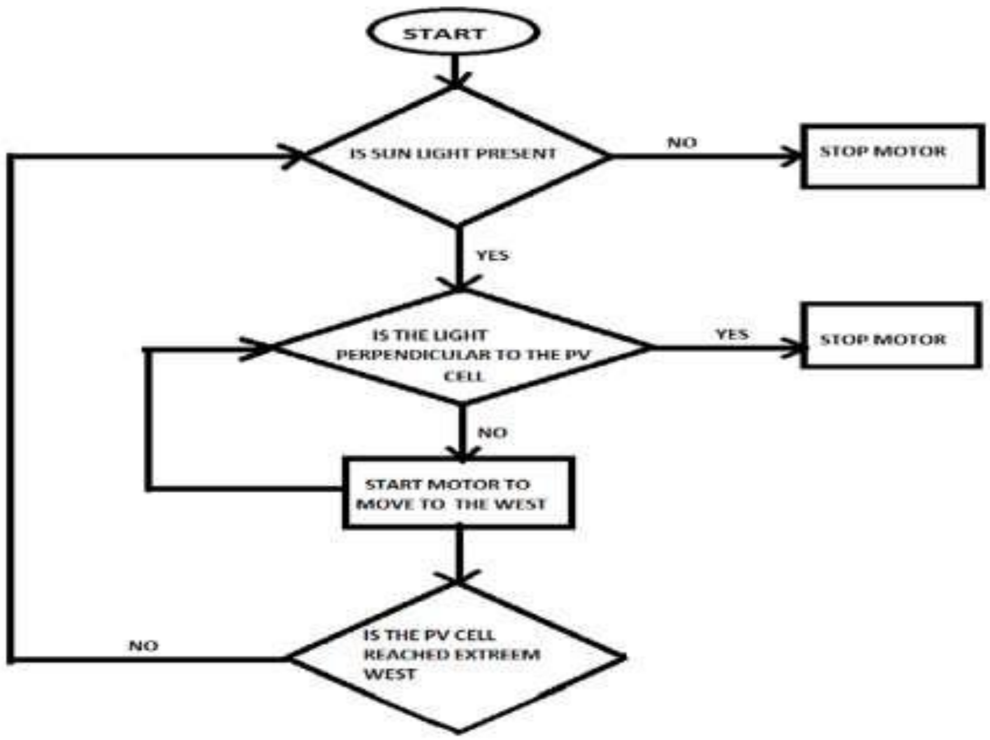


Figure 11: Flow chart

CHAPTER 4

PERFORMANCE ANALISIS

CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

4.1. Calculating Output
4.2. General output
4.3. Designed instruments output
4.4. Comparison of two output
4.5. Result
4.6. Future Scope

4.1 Calculated output:

Here we have use dc geared motor of 10 R.P.M, 12 Vdc, to rotate the solar panel from east to west and reverse direction.

The circuit takes 24mA at 12 Vdc. So, the required Power= 24mA*12V = 288mW/sec.

For 6 sec, The required power=288*6=1728mW=1.8W.

In a day the panel (or we can say motor) moves east to west and back to east.

For 10 rotations the motor takes 1 min/ 60 sec.

Therefore, for 1 rotation (360 degree) the motor takes (60/10) =6 sec.

To rotate from east to west (180 degree) the motor takes 3 sec.

So, for 10 degree displacement it takes (3000ms*10degree)/180degree= 167msec.

In general, the moves from east to west i.e. 180degree in 12 hours (6am to 6pm) or 720mins.

For 10degree displacement, the sun takes 720/180= 40 mins.

So, in 2 hrs the sun travels 30degree. To cover this 30degree displacement the panel takes (167*3) msec= 501msec.

4.2 General output :

Time of day	Open circuit voltage(V)	Closed circuit voltage(V)	Current at fixed angle 0 degree(Amperes)
8.00 A.M	19.07	15	0.59
9.00 A.M	19.08	15	0.71
10.00A.M	18.74	15	0.65
11.00 A.M	18.66	15	0.64
12.00 noon	18.80	15	0.69
1:00 P.M	18.78	15	0.60
2:00 P.M	18.74	15	0.64
3:00 P.M	18.54	15	0.63
4:00 P.M	19.12	15	0.59
5:00 P.M	18.97	15	0.44
Total			6.18

4.3 Designed instruments output :

Time of day	Open circuit voltage(V)	Closed circuit voltage(V)	Maximum current at variable angle (Amperes
8.00 A.M	19.07	15	0.75
8.00 A.M	19.08	15	0.73
10.00 A.M	18.74	15	0.71
11.00 A.M	18.66	15	0.70
12.00 noon	18.80	15	0.67
1:00 P.M	18.78	15	0.65
2:00 P.M	18.74	15	0.64
3:00 P.M	18.54	15	0.63
4:00 P.M	19.12	15	0.60
5:00 P.M	18.97	15	0.58
Total			6.66

4.4 Comparison of two output :

Time of day	Open circuit voltage(V)	Closed circuit voltage(V)	Current at fixed angle 0 degree (Amperes)	Variable Angle (degrees) for Maximum current	Maximum current at variable angle (Amperes)
8.00 A.M	19.07	15	0.59	-30	0.75
9.00 A.M	19.08	15	0.71	-15	0.73
10.00 A.M	18.74	15	0.65	-15	0.71
11.00 A.M	18.66	15	0.64	0	0.70
12.00 noon	18.80	15	0.69	0	0.67
1:00 P.M	18.78	15	0.60	0	0.65
2:00 P.M	18.74	15	0.64	0	0.64
3:00 P.M	18.54	15	0.63	0	0.63
4:00 P.M	19.12	15	0.59	+15	0.60
5:00 P.M	18.97	15	0.44	+30	0.58
Total			6.18		6.66

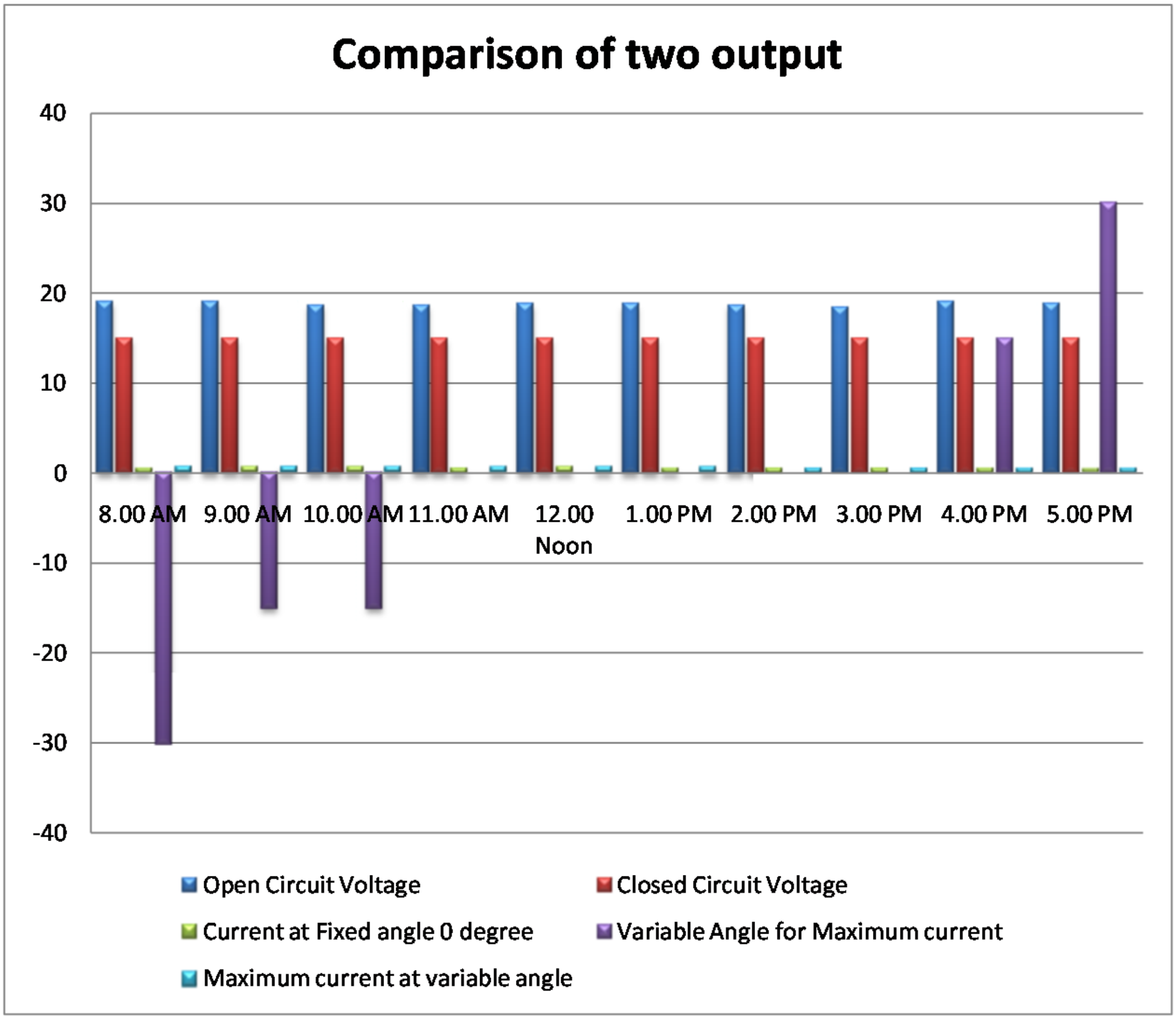


Figure 12: Comparison of two output graph.

$$\text{Efficiency} = \frac{(6.66 - 6.18) \times 100}{6.18} = 7.767\%$$

4.5 Result:

Each and every project is never complete as new things are learned further modifications can be done. Thus we have tried to make an automated solar tracking system which will increase the efficiency of the solar panel system available. Although there is higher initial cost involved we have tried to make the system cost effective .This is just the beginning, we can add different enhancements to make the system more efficient so that it will work round the year. The solar panels using this system compared with the system prevalent at present has many advantages.

In the present system, solar panels used are stationary which gives less output and hence decrease the efficiency. But by making use of tracker solar panels we can increase efficiency of solar system.

- The operator interference is minimal since the system is automated this increases efficiency of the stationary solar system.

- Each project will get better than previous one as practice can make us perfect.

4.6 Future Scope :

There are always remains an infinite scope of improvement to a system design. It's only the time and financial constraints that impose a limit on the development. Following are the few enhancements that may add further value to the system.

- During rains, rainfall sensors can be used to keep the system working

CHAPTER 5

COST ANALYSIS

CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

5.1 Cost sheet

5.1 Cost sheet : Cost for X axis .

Name	Model / Value	Quantity	Purchase Price Tk
Integrated Circuit (IC)	LM339	1	20
Integrated circuit (IC)	L293D	1	120
Diode	1N4148	2	10
Light Dependent Resistors		2	20
Resistance	10K	2	2
Resistance	12K	1	1
Resistance	22K	1	1
Resistance	50K	1	1
Variable resistance		2	20
Solar Panel stand		1	350
Motor	12V 10 RPM Geared Motor	1	400
Printed Circuit Board		1	240
Others			50
Total			1235

CONCLUSION

CHAPTER 6

CHAPTER CONTENTS

This chapter explains the overview of this project which includes the information of the list below:

6.1 Future work.

6.2 Conclusion.

6.1 Future work:

There are always remains an infinite scope of improvement to a system design. It's only the time and financial constraints that impose a limit on the development. Following are the few enhancements that may add further value to the system.

- During rains, rainfall sensors can be used to keep the system working.

6.2 Conclusion:

A solar tracker is designed employing the new principle of using small solar cells to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker can be successful in maintaining a solar array at a sufficiently perpendicular angle to the sun.

Solar tracking is by far the easiest method to increase overall efficiency of a solar power system for use by domestic or commercial users. By utilizing this simple design, it is possible for an individual to construct the device themselves.

REFERENCES

[1]. Toby Peterson, Justin Rice, Jeff Valane, "Solar Tracker", ECE 476, spring 2005. [2]. A.K. Saxena and V. Dutta, "A versatile microprocessor- based controller for solar tracking", IEEE Proc., 1990, pp. 1105 - 1109.

[3]. N. Barsoun, "Implementation of a Prototype for a Traditional Solar Tracking System", The Third UKSim European Symposium on Computer Modeling and Simulation, pp. 23-30, 2009.

[4]. C. Jaen, J. Pou, G. Capella, A. Arias, and M. Lamich, M, "On the use of sun trackers to improve maximum power point tracking controllers applied to photovoltaic systems", The IEEE conference on Compatibility and Power Electronics, pp. 67-72, 2009.

[5] engineersgarage

[6] http://www.doityourself.com/stry/how-a-gear-motor-works#b

[7] Solar Energy, Renewable Energy and the Environment by Robert foster ,Alma cota.