Robotic 360 Degree Solar Panel Tracking System

A Project submitted in partial fulfillment of the requirements for the Award of Degree of
Bachelor of Science in Electrical and Electronic Engineering

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Certification

This is to certify that this project and thesis entitled "**Robotic 360 Degree Solar Panel Tracking System**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 31 October 2019.

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The project and thesis entitled **"Robotic 360 Degree Solar Panel Tracking System,"** submitted by **Akramul Hoque & Md. Atikur Rahman**, ID No: 161-33-3179 & 162-33-304, Session: Summer 2016 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** on 31 October 2019.

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Dedicated to

Our Parents

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List of Abbreviations

CD	Chromatic Dispersion
EMI	Immune to Electromagnetic Interference
FBG	Fiber Bragg Gratings
FWHM	Full Width at Half Maximum
GVD	Group Velocity Dispersion
LED	Light Emitting Diodes
MD	Material Dispersion
NLSE	Nonlinear Schrödinger Equation
PMD	Polarization Mode Dispersion
PUA	Piecewise Uniform Approach
RMS	Root Mean Square
SSMF	Standard Single Mode Fiber
TFBG	Tilted Fiber Bragg Gratings
UV	Ultraviolet
WD	Wave-guide Dispersion
WDM	Wavelength Division Multiplexed

List of Symbols

λ	Wavelength
λ_B	Bragg wavelength
n_{eff}	Effective index
z	Position along the grating
n	Mode index
f	Fundamental Frequency
ω	Angular frequency
M	Modulation Index
T	Fundamental Time Period

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ABSTRACT

Sunlight based vitality is one of the most encouraging sustainable power sources that as of late has turned out to be more extensive in nowadays innovation. This article displays the idea of power through Ohm's law and the power condition, and how it applies to sun-powered photovoltaic (PV) boards.

Chapter 1

Introduction

1. 1. Introduction:

In spite of the fact that in this time power is one of the most significant pieces of our life, around 1.6 billion individuals as yet living without power. It's just for the significant expense of intensity framework fabricating and keeps up. This tremendous amount of vitality emergency can be meeting up by a sustainable power source over the creating scene. As individuals are abundantly worried about the non-renewable energy source fatigue and the ecological issues brought about by the customary power age, sustainable power sources and among them photovoltaic boards and wind-generators are currently generally utilized. So Solar Energy is a decent decision for electric power age. The sun based vitality is legitimately changed over into electrical vitality by sun powered photovoltaic module. Photovoltaic sources are utilized today in numerous applications, for example, battery charging, water siphoning, home power supply, satellite power frameworks and so forth. They have the upside of being upkeep and contamination-free however their establishment cost is high and in many applications; they require a power conditioner (dc/dc or dc/air conditioning converter) for load interface. Since PV modules still have moderately low transformation proficiency, the general framework cost can be decreased utilizing high effectiveness control conditioners which, also, are intended to remove the most extreme conceivable power from the PV module. In PV control frameworks greatest power point trackers (MPPTs) have a significant job. It's limiting the yield intensity of a PV framework and furthermore the bolt effectiveness just as its expense is lower than the other power framework. A significant quality of sunlight based boards is that the accessible greatest power is given uniquely in a solitary working point given by a restricted voltage and current known, called Maximum Power Point (MPP). Another issue is that the situation of this point isn't fixed yet it moves as indicated by the irradiance, the temperature, and the burden. On account of the moderately costly cost of this sort of vitality, we should separate the limit of watts of sun oriented boards. In this undertaking, we build up a Microcontroller based devoted MPPT controller for sun-powered PV module dependent on the gradual conductance technique.

1.2. Historical Background:

1839 – The electrical phenomenon Effect: Edmond physicist, in 1839, discovered that once 2 electrodes were placed in Associate in Nursing solution (electricity-conducting solution), a voltage developed once light-weight got hold of the solution. The essential principles of alternative energy had been uncovered. 1876 – Electricity from Light: A King's faculty prof, William Grills Adams, and his student, Richard Evans Day, found in 1876 that chemical element created electricity once exposed to light-weight. They connected Pt electrodes to chemical element and ascertained a current within the electrodes once the chemical element was exposed to light-weight. 1883 – The primary operating star Cell: yank artificer Charles Frits developed the primary electric cell, applying chemical element to a skinny layer of gold. This technique was solely ready to come through I Chronicles potency, creating it impractical for general use. 1904 – Einstein's Paper on light-weight & Electrons: within the snappily titled "On a Heuristic Viewpoint regarding the assembly and Transformation of sunshine," Einstein kicked off for the primary time the link between light-weight and electrons. Though disputed at the time, it had been bit by bit accepted by the scientific community and junction rectifier to his winning of the laurels in 1921. Later in 1916, parliamentarian Millikan would through an experiment prove Einstein's theory of the photoelectrical result. 1954 – A significant Breakthrough: 3 researchers at Bell Labs — Daryl Chapin, Calvin Fuller, and Gerald Pearson — discover chemical element star cells. The late Fifties – Increasing Efficiency: Throughout the late 50s, Hoffman physical science developed progressively economical star cells. It started at first at Associate in Nursing 8 May 1945 economical cell in 1957, before eventually increasing to a 14%-efficient, commercially on the market cell in 1960.

1.2.1. Earlier Research:

Early charge controllers were solely ready to scale back the quantity 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 oversized to confirm that the minimum voltage at high temperatures would be a minimum of as high because the battery to be charged and voltage headroom enough to force current into the battery. At any temperature less than the utmost, the surplus voltage from the PV panels would be discarded by the charge controllers. As a result of PV panels are the foremost pricey part of the system, the necessity for additional (or larger) PV panels negatively wedged the cost-effectiveness of such PV power systems. Individuals those days couldn't use a microcontroller for the management of the overall 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. Resent research:

More up to date and increasingly proficient charger controllers have risen that give a superior match between the PV boards and their heap. They will probably utilize all the power from the PV panel(s) paying little mind to the voltage and current at any measure of insolation or at any temperature. The more current charge controllers utilize a DC to DC converter area that is adjusted to powerfully charge the battery (or to straightforwardly control a heap) at the careful voltage and current that is most suitable for that battery (or burden). In spite of the fact that the more up to date charge controllers give improved framework efficiencies comparative with the more seasoned models, they over and over again experience the ill effects of a few inadequacies. All the more especially, the charge controllers are delayed to adjust to changing states of the PV panel(s) throughout some random day, incorporating low light conditions toward the beginning of the day, night and during overcast spread and furthermore temperature changes in some cases related with the adjustments in insolation.

The edges of mists make especially issues since they cause a quick change in lighting which might be trailed by a moderately fast change in temperature. Since they don't rapidly adjust to evolving conditions, the charge controllers have restricted effectiveness, which results in the requirement for extra (or bigger) PV boards to be utilized for a given power yield and significant expenses. Presently a-days all advanced MPPT controllers are controlled microcontroller. They consequently change the yield, move the board for daylight and furthermore shut down for microseconds if vital.

MPPT charge controllers are presently financially fabricated by a few organizations, for example, outback power, Xantres XW-SCC, Blue Sky Energy, Apollo sun based, Midnight sun powered, Morning star and a couple of others.

1.2.3. State of art technology:

PV innovation, PV boards produce current utilizing sun oriented vitality. It relies upon the measure of sun-powered radiation hitting the cells of the board.

Hypothetically, the most extreme measure of intensity from the sun the earth's surface is about 1KW per square meter at the equator on a crisp morning. The batteries store the power and supply the power in the evening for delivering current. Contingent upon the idea of PV board, it has an essential current versus voltage bend which changes with the difference in temperature and the measure of daylight on the point which the sun of daylight on the sun strikes the board, higher temperature, lower voltage and increment measure of daylight, increments the yield currently.

By utilizing the MPPT calculation, it expands the productivity of the PV board and protects the most extreme utilization of the intensity of daylight. In some cases there might be distinction voltage and current between PV board and the batteries, to keep up this bungle, there utilize a microcontroller. A charge controller functions as a DC-DC convertor.

1.3 Future Scope of this study:

Nearly everybody thinks that generating electricity via solar energy is sweet for the atmosphere. Renewable energy and star specifically stay rather polemic within the speechmaking regarding energy policy. The demand for alternative energy is running high. What motivated the United States of America is that the unclear vary of statements you've got out there relating to the value effectiveness of electricity supported star PV. Given the variety of opinions, that’s why we tend to wished to try and do our own analysis.

In a broad new assessment of the standing and prospects of star electrical phenomenon technology, Massachusetts Institute of Technology researchers says that it's “one of the few renewable, low-carbon resources with each the measurability and therefore the technological maturity to fulfill ever-growing international demand for electricity.” The use of star electrical phenomenon has been growing at an outstanding rate: Worldwide put in capability has seen sustained growth averaging forty-three pp. each year since 2000. To judge the prospects for sustaining such growth, the Massachusetts Institute of Technology researchers examine doable constraints on materials availableness and propose a system for evaluating the numerous competitive approaches to improved solar-cell performance.

1.3.1. Future scope:

In the future, solar power is vital to supply. So, exploitation MPPT star charge controller will generate a large quantity of current with success. During this means, the price of the assembly can even be reduced. In a word, it will develop a high power output MPPT system with a coffee value. This complete system schematic includes the feature of maintenance free use, no demand of fuel or lubricating substance, chrome steel hardware, inbuilt over-load, over-charge, low voltage protection, temperature paid charging and low battery disconnect facility. Moreover, it ensures the most continuous power at full load and at the same time pollution free and quiet maintenance. Moreover it's the power to charge the battery in low voltage thus it'll get decent backup just in case of a power outage.

1.3.2. Recommendation:

PV innovation, PV boards produce current utilizing sun powered vitality. It relies upon the measure of sun-powered radiation hitting the cells of the board.

Hypothetically, the most extreme measure of intensity from the sun the earth's surface is about 1KW per square meter at the equator on a sunny morning. The batteries store the power and supply the power in the evening for creating the current. Contingent upon the idea of PV board, it has an essential current versus voltage bend which changes with the difference in temperature and the measure of daylight on the edge which the sun of daylight on the sun strikes the board, higher temperature, lower voltage and increment measure of daylight, increments the yield currently.

By utilizing the MPPT calculation, it builds the proficiency of the PV board and guarantees the greatest utilization of the intensity of daylight. Now and then there might be distinction voltage and current between PV board and the batteries, to keep up this confound, there utilize a microcontroller. A charge controller fills in as a DC-DC convertor.

1.4. Limitations of this study:

1. Computing with other analog system, it is costly.
2. Programming of microcontroller is complex.
3. It depends on temperature and radiation of sun.

1.5. Advantage over traditional methods:

At first it is pollution free and reduces the waste of other using of MPPT algorithm increase the system's efficiency. The LCD Display helps the users to inform about the condition of charge. For microcontroller it's easy to use and ensures reliability the system.

1.6.1. Primary objectives:

AS the price of ancient current supply is increasing day by day, folks will take the advantage of renewable energy. With a lot of and a lot of moveable devices commencing all the time the requirement to use renewable energy is ever increasing. The event of this thesis is extremely vital as a result of today there's a current want within the marketplace for an alternate Energy device which will charge differing kinds of batteries expeditiously. The developed charging method isn't in no time however will guarantee Associate in Nursing economical loading and with none further price for the ultimate user. The overall system is used each commercially and unit generation. So, folks will cowl the crisis of electrical energy, by their own-self. The overall system, make sure the most potency with a coffee price comparison alternative sources and generation system.

1.6.2. Secondary objectives:

Processes involved are:

To manufacture two servo engines control obstruction with proposed circuit and build a model sun based cell development framework with a mechanical get together to move the board from east to west just as the sun track greatest edge. At last to plan an electronic circuit to detect the power of light and to control servo engines drive for the board development.

1.7. Introduction to the Project:

This is a Maximum Power Point tracking base solar charge controller which will be controlled by a microcontroller. The microcontroller wills co-ordinate the total system. This work presented a prototype board based on a small microcontroller that controls the battery charging process. The control algorithm executes the P&O maximum power point tracking function allowing, according to solar irradiance, the transfer of maximum energy generated by the photovoltaic panel to the battery. This P&O algorithm increases the efficiency power transference in comparison to systems that have not an MPPT (direct connection), reducing the size and the cost of the PV panel. In this paper, we have focused on how to increase the efficiency of a solar charge controller with a reduced cost of the overall system. [7-12]

Chapter 2

Literature Review

2.1. Introduction:

The sunlight based board is made of a small mix of sun oriented cell and the sun based cell is the gadgets that are intended to change over light to electrical vitality. The sun based board is, for the most part, produced using semiconductor materials, for example, silicon (Si), cadmium sulfide (CdS) and gallium arsenide (GaAs) can be utilized to make sun powered cells. The fundamental motivation behind utilizing sunlight based boards is getting the most extreme vitality by changing over light vitality to electric vitality. Utilizing sun based trackers is the most ideal route for getting the greatest vitality since it's keeping the boards lined up with the sun's position and it's likewise a viable answer for getting vitality with a sun oriented boards.

2.1.1. Block Diagram of This Proposed Project:

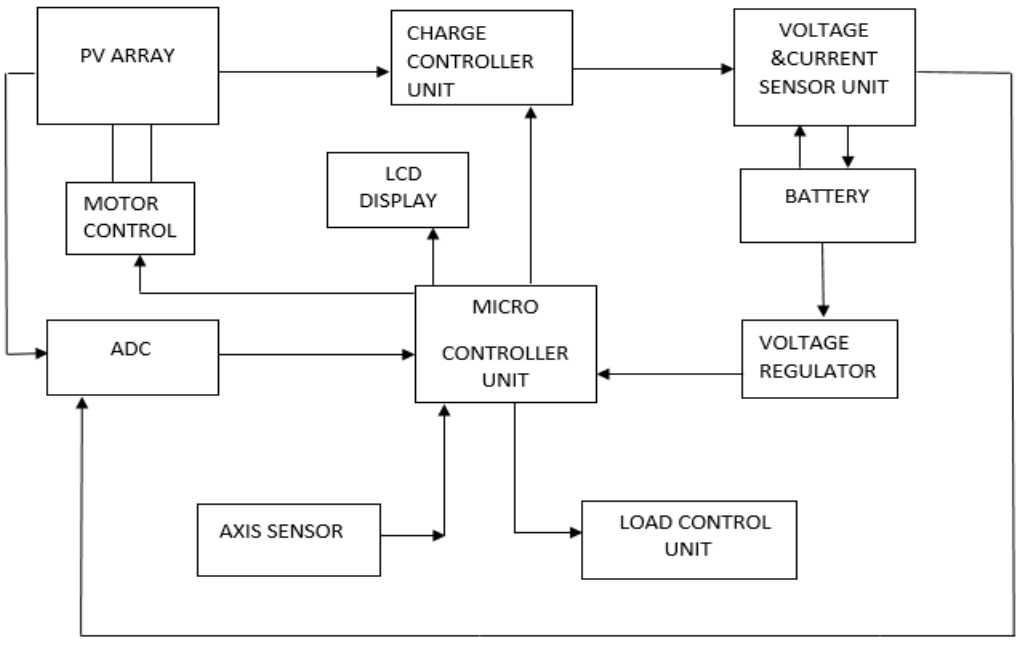

Fig2.1. Block Diagram of the proposed system.

2.1.2. The Model of the Project:

The Proposed model of Dual Axis Solar Tracker Robot.

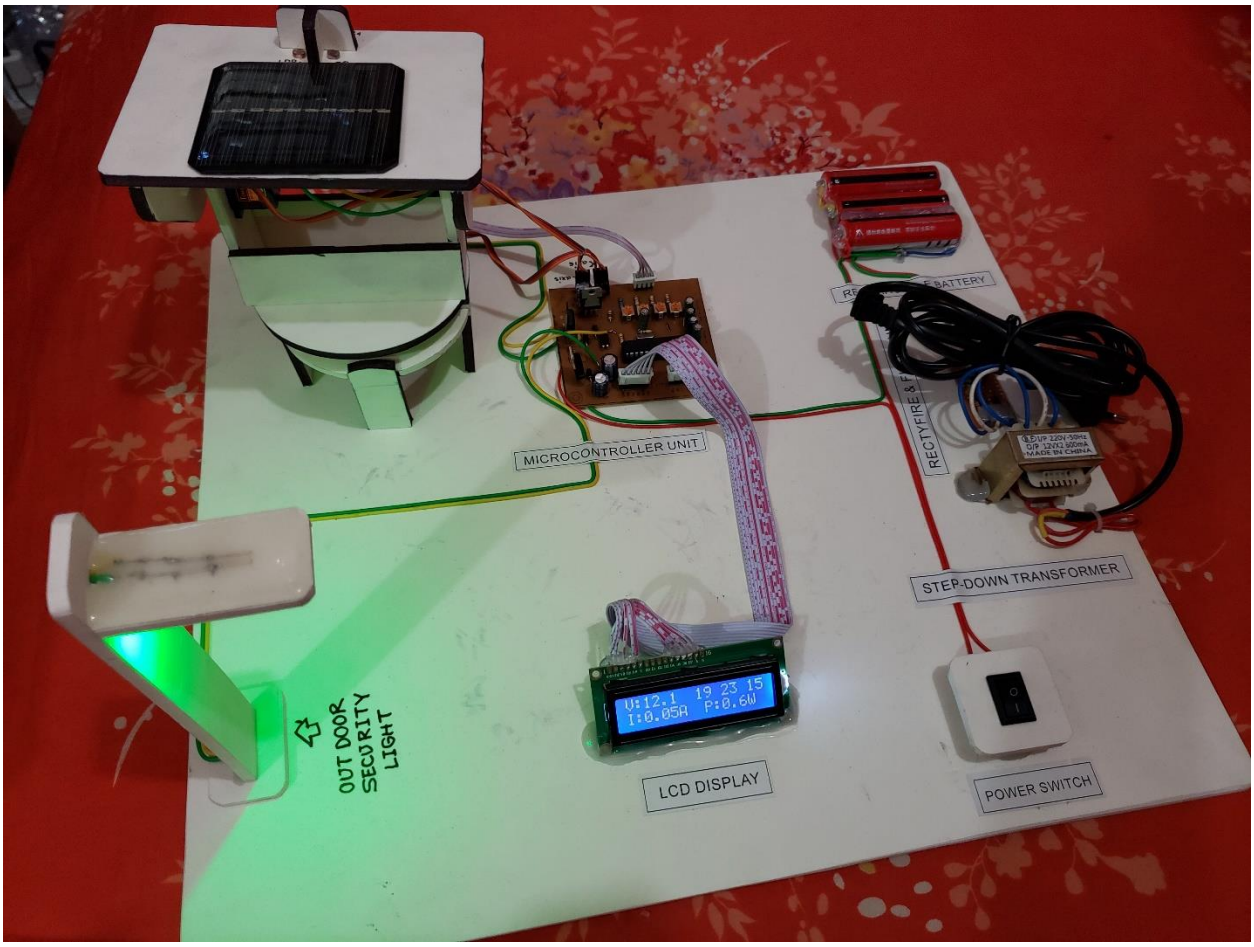

Fig2.2 Dual axis solar tracker Robot

2.2. 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."

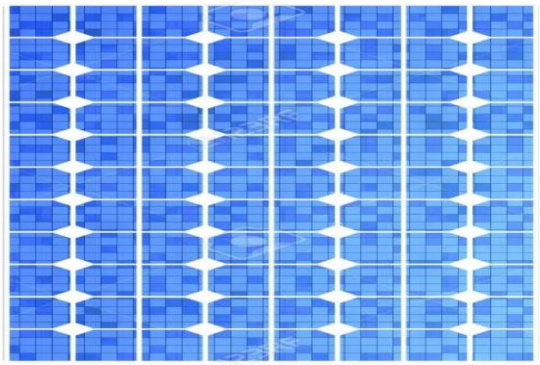

Fig 2.3 Solar panel Module

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 alternating current (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.

2.3. 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..

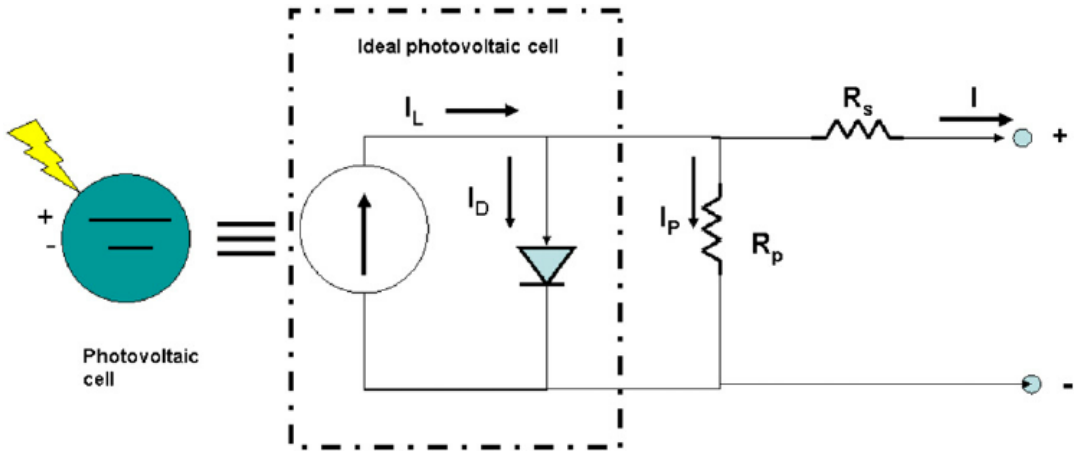

Fig 2.4 Circuit diagram of a PV cell

2.3.1. IV curve for a PV cell:

A general I-V characteristic of the cell for a given close irradiation 'G' and stuck cell temperature 'T' is shown in Fig three. For a precise resistive load, the load characteristic is a straight line with slope. Power delivered to the load depends on the worth of the resistance solely. In some cases if the R load is incredibly small; the PV cell operates within the M-N region of the IV curve, the PV cell act as a relentless current supply that is sort of comparable to a brief circuit current. However, if the R load is giant, the PV cell operates within the P-S region of the IV curve, the PV cell act as a relentless voltage supply nearly comparable to the electrical circuit voltage. A PV cell is characterized by the subsequent elementary parameters w.r.t Fig 2.3

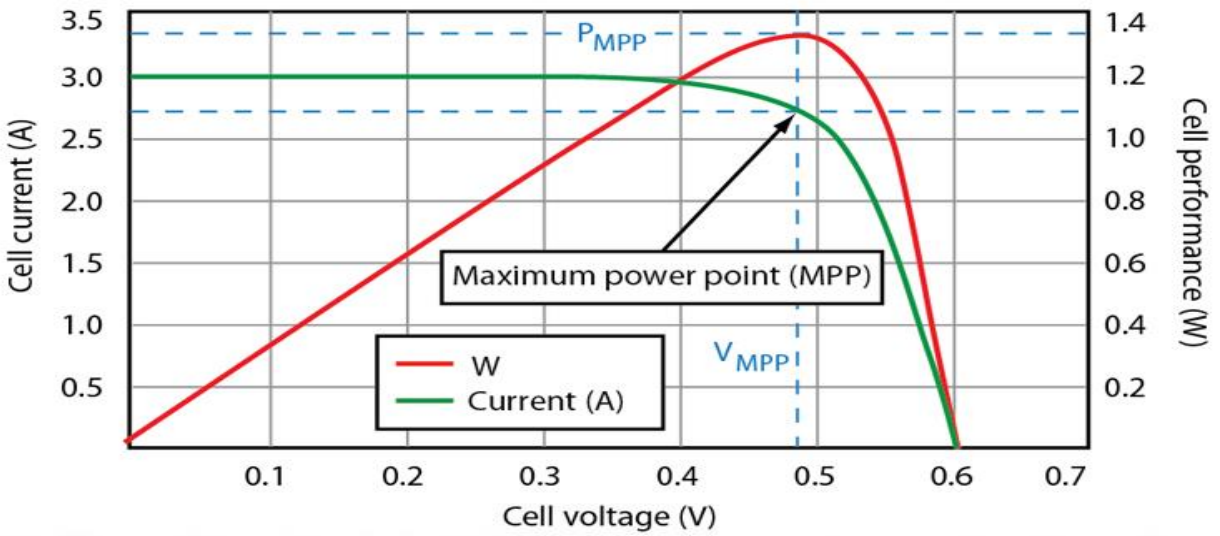

Fig 2.5 I/ V Characteristics of PV cell

- Short circuit current: Isc =Iph (Greatest worth of this generated by a PV cell, that is created by the tangency condition: V=0.
- Open circuit voltage is a drop across the diode D once the generated current I=0.It presumes the voltage of the PV cell within the night and it's expressed by (2).
- Maximum purpose/point/wall socket wall plug electric outlet electrical outlet/outlet/electric receptacle} is that the in operation point in Fig a pair of.3, wherever the facility dissipated within the resistive load is most. most potency is that the quantitative relation of the most power and also the incident alternative energy (photons). η=Pmax/Pin=Vmax Imax/AG .Where is the close irradiation and A is that the PV cell space.
- Fill issue (FF) is that the quantitative relation of {the most/the utmost the most} power that may be delivered to the load and also the theoretical maximum power that is that the product of Isc and Voc. FF=Pmax/Voc Isc=Vmax Imax/Voc Isc. FF may be a live of real I-V characteristic that worth a lot of be on top of zero.7 for a decent PV cell.

2.4 Maximum Power Point Tracking (MPPT):

Maximum wall socket chase (MPPT) is Associate in nursing electronic system that operates the electrical phenomenon (PV) modules that permits the modules to provide all the facility they're capable of. MPPT could be an absolutely electronic system that varies the electrical operational purpose of the modules in order that the modules are able to deliver most obtainable power.

Let, the values of this (I) and voltage (V) of the cell end in a most power output and a selected load resistance, R= V/I, as fixed by Ohm's Law. The facility P is given by P = V*I. From basic circuit theory, the facility delivered

From or to a tool is optimized wherever the by-product of the I-V curve is equal and

Opposite of the I/V magnitude relation. This is often called the most wall socket (MPP). The load with resistance R=V/I, that is adequate the reciprocal of this price and attracts

The maximum power from the device is typically known as the characteristic resistance of the cell. If the resistance is lower or above this price, the facility drawn are but the most obtainable, and so the cell won't be used as with efficiency because it may well be. Most wall socket trackers utilize differing types of feedback loop or logic to look for this time and so to permit the convertor circuit to extract the most power obtainable from a cell.

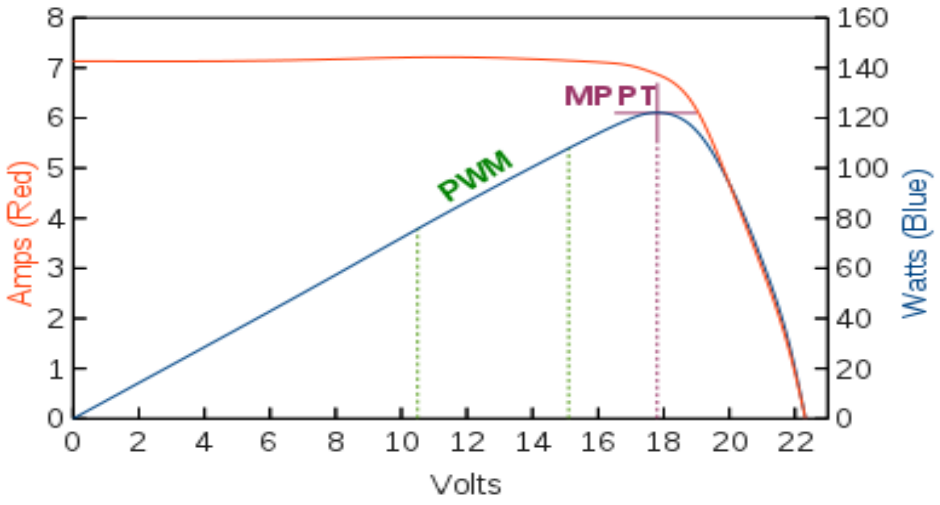

Fig 2.6 maximum power tracking

2.5. Solar Irradiation: Sunlight

Electromagnetic radiation means which the sun delivers energy to the earth.

Visible range (400-700 nm) up to several thousands of nm (IR).

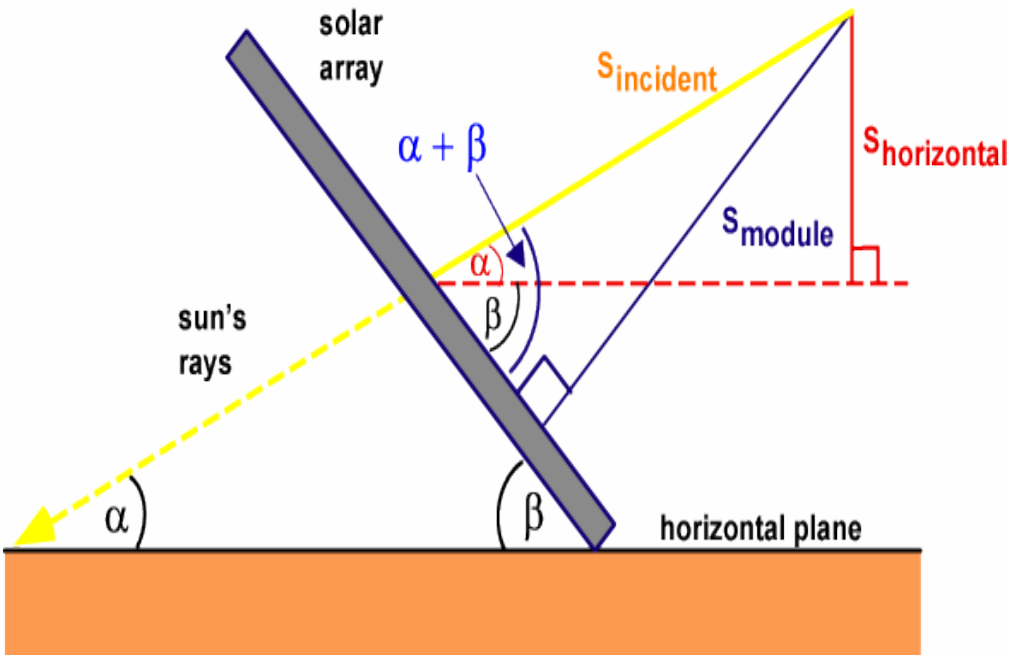

Fig 2.7 Solar Irradiation Sunlight

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 Majority of the sun's harmful radiation deflects by the earth atmosphere.

2.6. 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. Using tracker on solar panel makes this 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.

2.6.1 Single axis solar tracker:

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 2.958 w. Average practical efficiency of solar panel for single axis is 6.55%. Average power gain of single axis solar tracker up to 18.32%.

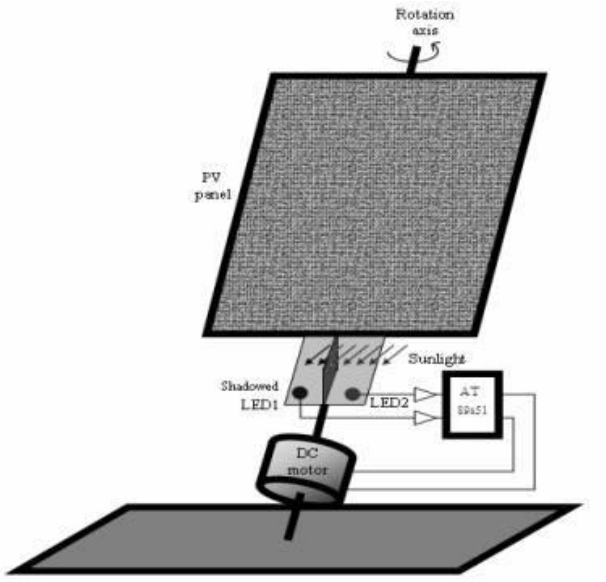

Fig 2.8 Single axis solar tracker

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.

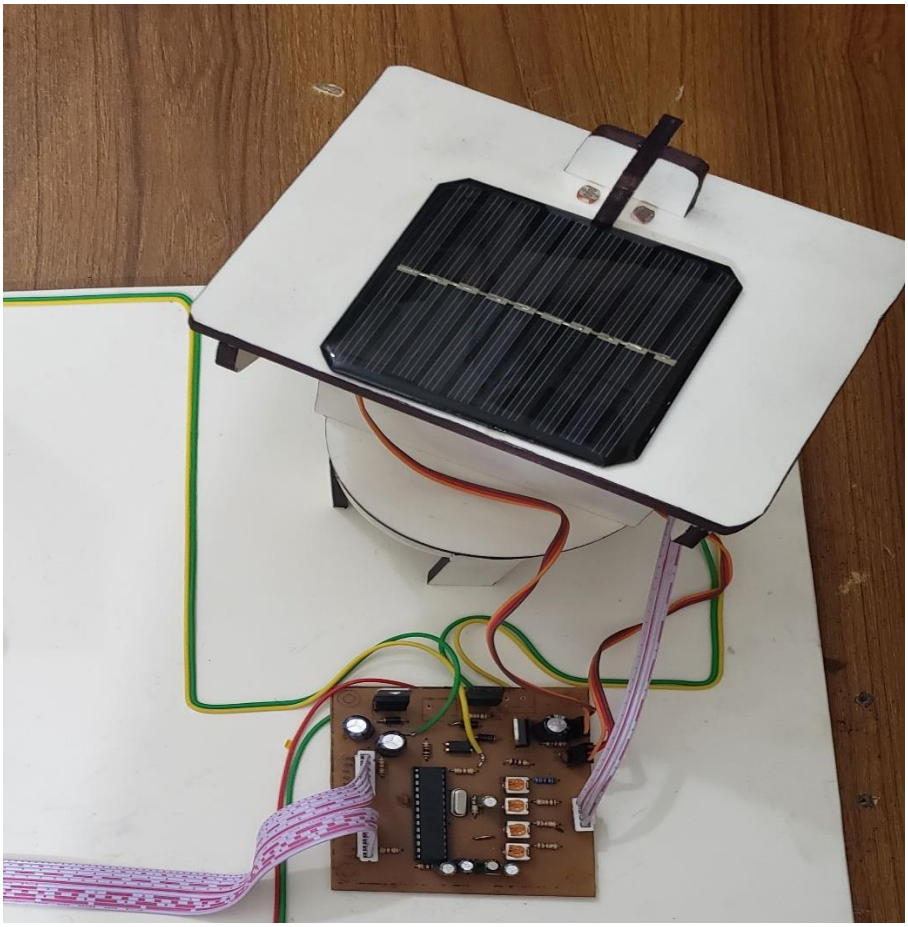

Fig 2.9 Dual axis solar tracking

2.7. Efficiency of Solar panel:

The efficiency is the parameter which is most commonly used to compare with one solar panel to anthers panel. Efficiency is defined as the ratio of energy output from the solar cell to input energy from the sun.

$$P_{max} = V_{OC} I_{SC} FF$$

$$\eta = \frac{V_{OC} I_{SC} FF}{P_{in}}$$

The input power for efficiency calculations is 1 kW/m^2 or 100 mW/cm^2. Thus the input power for a 100 × 100 mm^2 cell is 10 W and for a 156 × 156 mm^2 cell is 24.3 W.

2.8. Advantages & Disadvantages of solar energy:

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

2.8.1. 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 machines used for pumping oil or for power generation are noisy.
- Solar energy can be used in very remote areas where extension of the electricity power grid is costly.

2.8.2. Disadvantages:

- 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.

Chapter 3

Components, Design & Implementation

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 energy bands above the valence band.

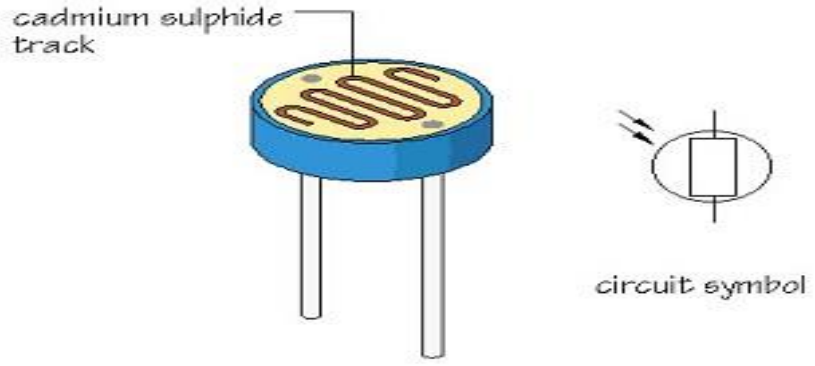

Fig 3.1 Light Dependent Resistor

3.1.1. 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. 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.

3.1.2 The Design and implementation of using Four LDRs:

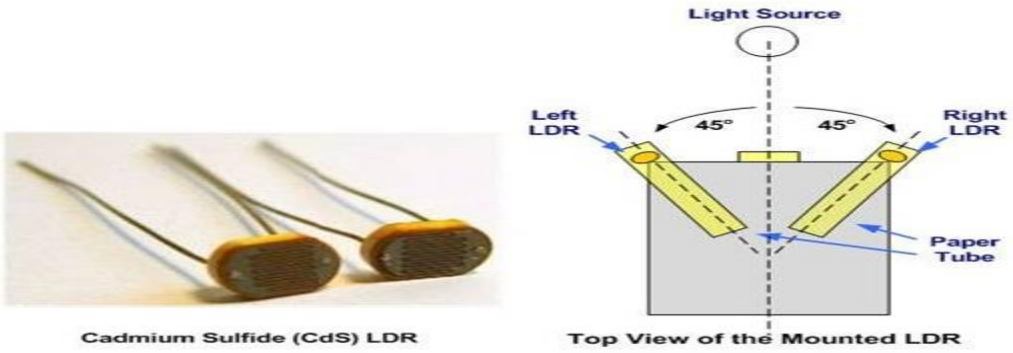

Fig 3.2 quadrant wise LDR positioning

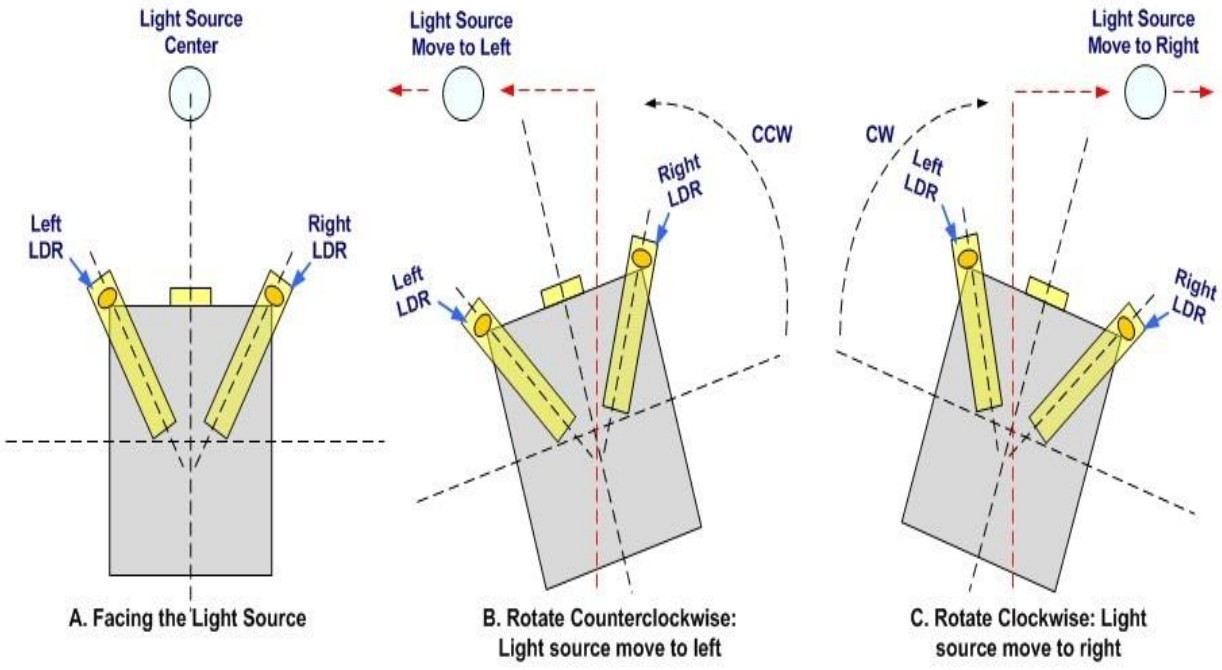

Fig 3.3 the Sensing Element and Signal Processing

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.

3.1.3 The minimum light detectable Equation:

It's a circuit used to detect the condition when there is no sunlight to turn off the tracking system

It uses a summing op. amp. Circuit its output is given by:

$$V_{AIN0} + V_{AIN1} - 5\left(\frac{RV2}{RV2 + R6}\right) = 1.23\,V$$

Where 1.23V is the internal band gap reference used by the analog comparator in the UC.

By calculating the value of V (AIN0) and V (AIN1) at sunset and adjusting RV2 the output of the comparator can be used to turn on or turn off the solar tracking system.

3.2. LCD (2 Line 16 Carriers):

Fig 3.4 LCD

A sixteenx2 {Lcd/liquid crystal show/LCD/digital display/ alphanumeric display} suggests that it will display 16 characters per line and there are a unit two such lines. During this digital display every character is displayed in 5x7 pel matrix. This digital display has 2 registers, namely, Command and information. A register that commanded storage the command directions to the given digital display like initializing it, clearing its screen, setting the indicator position, dominant show etc. the information register stores the information to be displayed on the digital display.

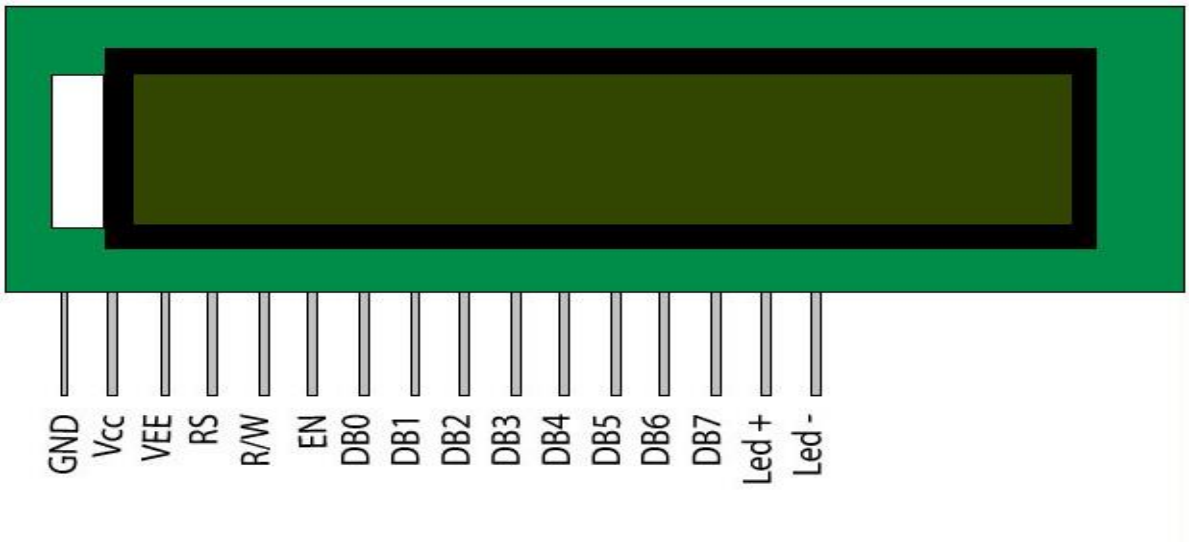

Fig 3.5 LCD (2*16) Pin

3.2.2. Pin Features:

- 5*8 Dots with cursor
- 16 Characters *2 line display
- 4-bit or 8-bit MPU interfaces
- Display mode & Backlight Variations
- ROHS Compliant

3.2.3. Pin Description:

16 pin LCD description given bellow:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

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.

FIg3.6 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.

3.3.1. Components of servo motor SG-90:

Fig 3.7 Physical Construction of Servo SG-90

In our work we used SERVO MOTOR SG90 and it's easy to use because it is small in size which makes our work comfortable. In briefly below we discussed on SG90.

SERVO MOTOR SG-90:

It is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees and it works just like the standard kinds

3.3.2. Servo Mechanism:

A servo system principally consists of 3 basic parts - a controlled device, associate degree output detector, a feedback system. This can be associate degree automatic control system. Here rather than dominant a tool by applying variable signaling, the device is controlled by a feedback signal generated by comparison sign and reference signaling. once reference signaling or command signal is applied to the system, it's compared with output reference signal of the system created by output detector, and a 3rd signal created by feedback system. This third signal acts as signaling of

controlled device. This signaling to the device presents as long as there's a logical distinction between reference signaling and sign of the system. When the device achieves its desired output, there'll be now not logical distinction between reference signaling and reference sign of the system. Then, third signal created by comparison theses higher than aforesaid signals won't stay enough to control the device additional and to provide additional output of the system till succeeding reference signaling or command signal is applied to the system.

3.3.3. Working Principle of Servo Motor:

A servo motor is essentially a DC motor (in some special cases it's AC motor) beside another special purpose elements that build a DC motor a servo. In an exceedingly servo unit, you'll notice a tiny low DC motor, a potentiometer, gear arrangement associated an intelligent electronic equipment. The intelligent electronic equipment beside the potentiometer makes the servo to rotate in keeping with our desires.

As we know, a tiny low DC motor can rotate with high speed however the force generated by its rotation won't be enough to maneuver even a light-weight load. This is often wherever the gear system within a servo mechanism comes into image. The mechanism can take high input speed of the motor (fast) and at the output; we'll get an output speed that is slower than original input speed however a lot of sensible and wide applicable.

Currently associate electrical signal is given to a different input terminal of the error detector electronic equipment. Currently distinction between these 2 signals, one comes from potentiometer and another comes from external supply, are going to be amplified within the error detector electronic equipment and feeds the DC motor. This amplified error signal acts because the input power of the dc motor and therefore the motor starts rotating in desired direction. Because the motor shaft progresses the potentiometer knob conjointly rotates because it is including motor shaft with facilitate of substances arrangement. Because the position of the potentiometer knob changes there'll be associate electrical signal created at the potentiometer

port. Because the spatial relation of the potentiometer knob progresses the output or feedback signal will increase. Once desired spatial relation of motor shaft the potentiometer knob is reaches at such position the electrical signal generated within the potentiometer becomes same as of external electrical signal given to electronic equipment. At this condition, there'll be no output from the electronic equipment to the motor input as there's no distinction between external applied signal and therefore the signal generated at potentiometer. Because the input to the motor is naught at that position, the motor stops rotating. This is often however an easy abstract servo motor works.

3.3.4. Servo Motor Control:

Let us take into account Associate in nursing example of servomotor that we've got given a proof to rotate by Associate in nursing angle of 45° then stop and look forward to additional instruction.

The shaft of the DC motor is not to mention another shaft referred to as output shaft, with facilitate of substances assembly. This gear assembly is employed to step down the high rate of the motor's shaft to low rate at output shaft of the servo system.

The voltage adjusting knob of a potentiometer is therefore organized with the output shaft by means that of another gear assembly, that in rotation of the shaft, the knob conjointly rotates Associate in Nursing creates a varied electrical potential in step with the principle of potentiometer. This signal i.e. electrical potential is augmented with angular movement of potentiometer knob in conjunction with the system shaft from 0° to 45°. This electrical potential or voltage is taken to the error detector feedback electronic equipment in conjunction with the input reference commends i.e. signaling voltage.

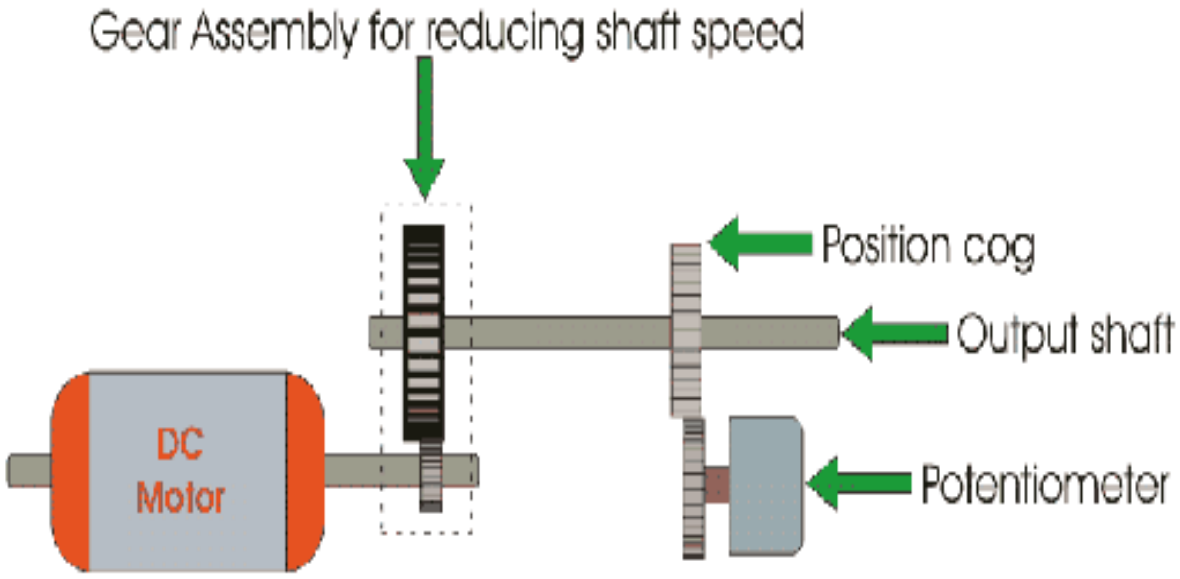

Fig 3.8 Servo Gear assembly

As the angle of rotation of the shaft increases from 0° to 45° the voltage from potentiometer increases. At 45° this voltage reaches to a value which is equal to the given input command voltage to the system. As at this position of the shaft, there is no difference between the signal voltage coming from the potentiometer and reference input voltage (command signal) to the system, the output voltage of the amplifier becomes zero.

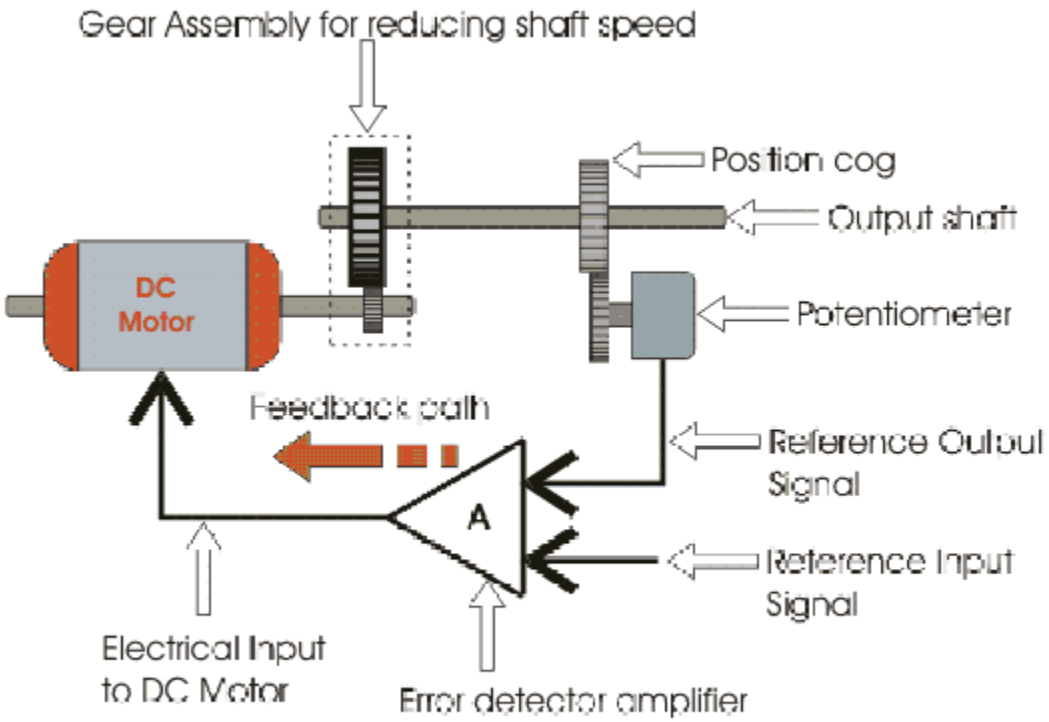

Fig 3.9 inside look of Servo motor

As per the picture given above the output electrical voltage signal of the amplifier, acts as input voltage of the DC motor. Hence the motor will stop rotating after the shaft rotates by 45°. The motor will be at this rest position until another command is given to the system for further movement of the shaft in desired direction. From this example we can understand the most basic **servo motor theory** and how **servo motor control** is achieved.

3.3.5. Servo PWM(Pulse Width Modulation) controlled:

Servos are sent through sending electrical pulses of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, maximum pulse and a repetition rate. Servos can usually turn only 90 degrees in either direction for a total of 180 degrees

movement. The neutral position of the motor is defined as that where the servo has the same amount of potential rotation in both the clockwise and counter-clockwise direction.

The PWM sent to the motor determines the position of the shaft, and based on the duration of the pulse sent through the control wire the rotor will turn to the position that is desired .The servo motor expects to see a pulse after every 20 milliseconds and the length of the pulse will determine how far the motor will turn. For instance, a 1.5ms pulse makes the motor to turn in the 90 degrees position. For applications where there is requirement of high torque, servos are preferable. They will also maintain the torque at high speeds, up to 90% of the rated torque is available from servos at high speeds. Their efficiencies are between 80 to 90%. A servo is able to supply approximately twice their rated torque for short periods of time, offering enough capacity to draw from when needed.

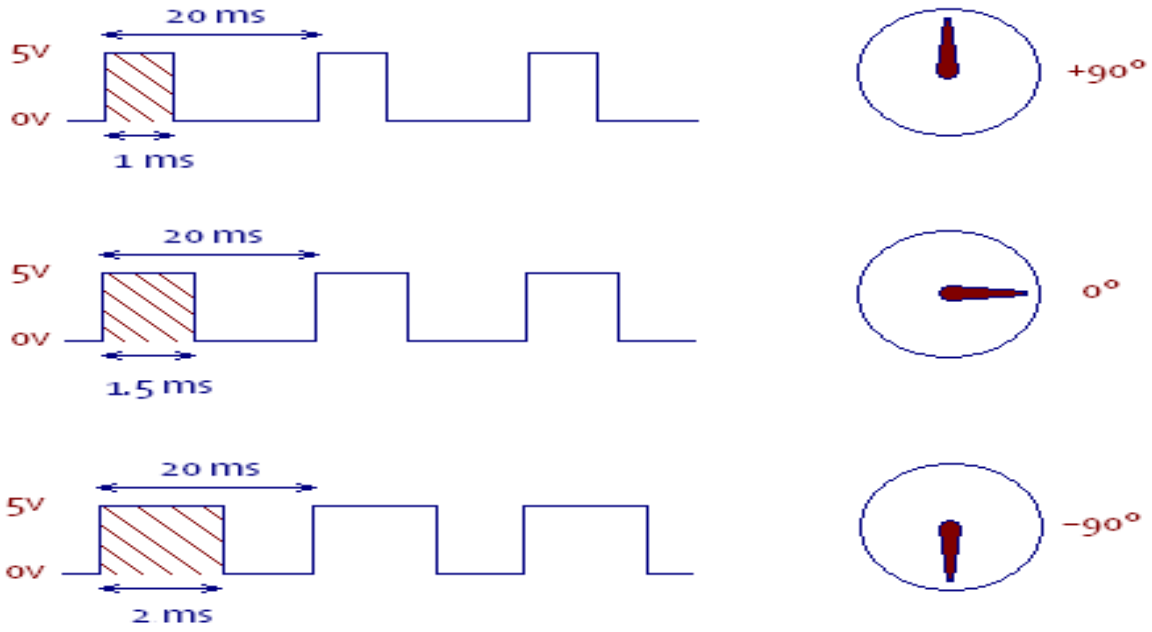

Figure 3.10 variable pulse width control servo position

In addition, they are quiet, are available in AC and DC, and do not suffer from vibrations.

3.3.6. Advantages & Disadvantages of using Servo motor:

There are some advantages and disadvantages of using servo motor. In below we 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 motor can be damaged for overloading.
- Servo motor has poor motor cooling. Servo motor design more mechanically complex.
- Servo motor maintenance requirements will also increase.

3.4. 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. Here we use PIC16F877A microcontrollers.

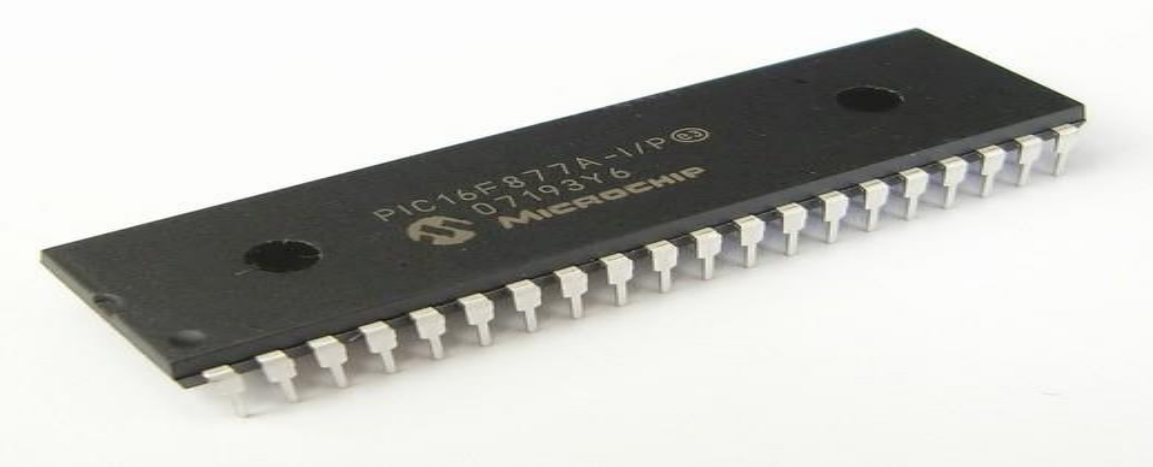

Fig3.11 PIC16F877A Microcontroller

3.4.1 Basic Block Diagram of Microcontroller:

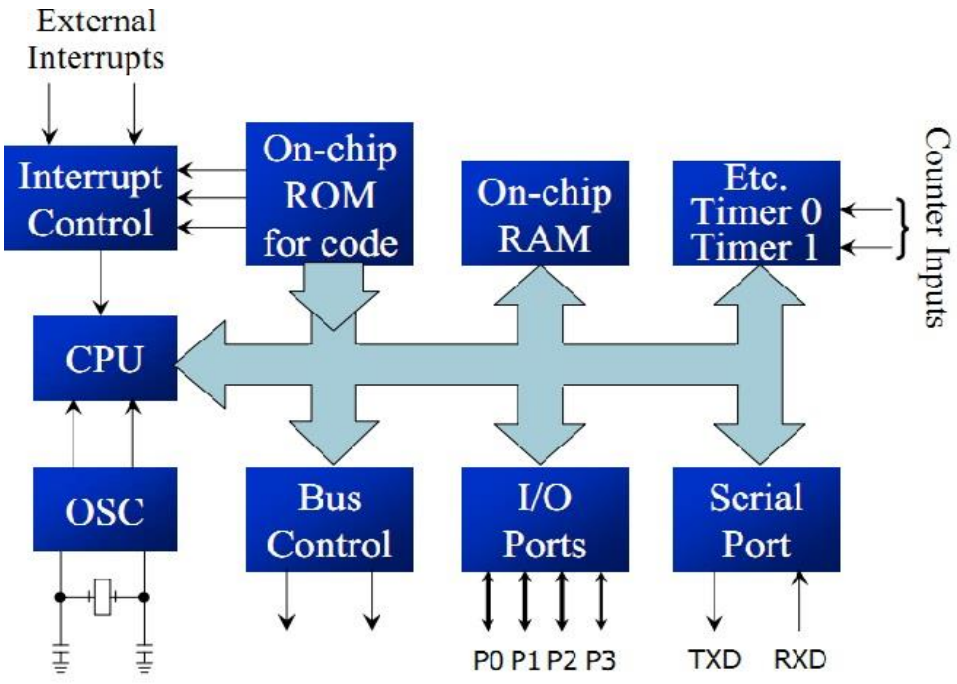

Fig 3.12 Basic Block Diagram of Microcontroller

3.4.2. PIC16F877 Pin Diagram:

The 16F877A is one of the most popular and advanced microcontrollers from Microchip and it are easy to implement in a circuit. The 40 pins make it easier to use the peripherals as the functions are spread out over the pins. This controller is widely used for experimental cause its application range is wide, high quality, ease of availability and low cost.

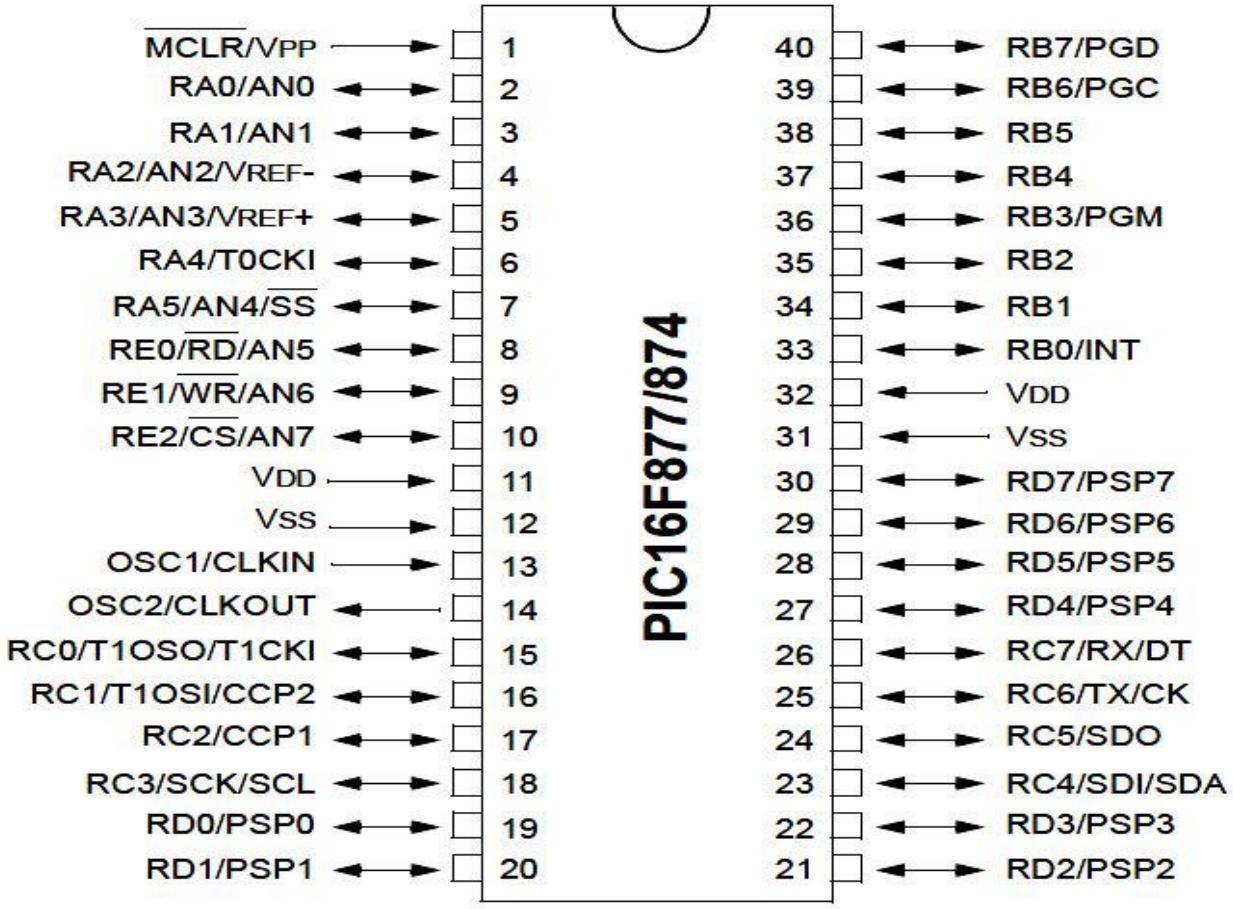

Fig: 3.13 PIC16F877 Microcontrollers

3.4.2. Block Diagram of PIC16F877A:

The Block Diagram of PIC16F877 has given bellow:

Device	Program FLASH	Data Memory	Data EEPROM
PIC16F874	4K	192 Bytes	128 Bytes
PIC16F877	8K	368 Bytes	256 Bytes

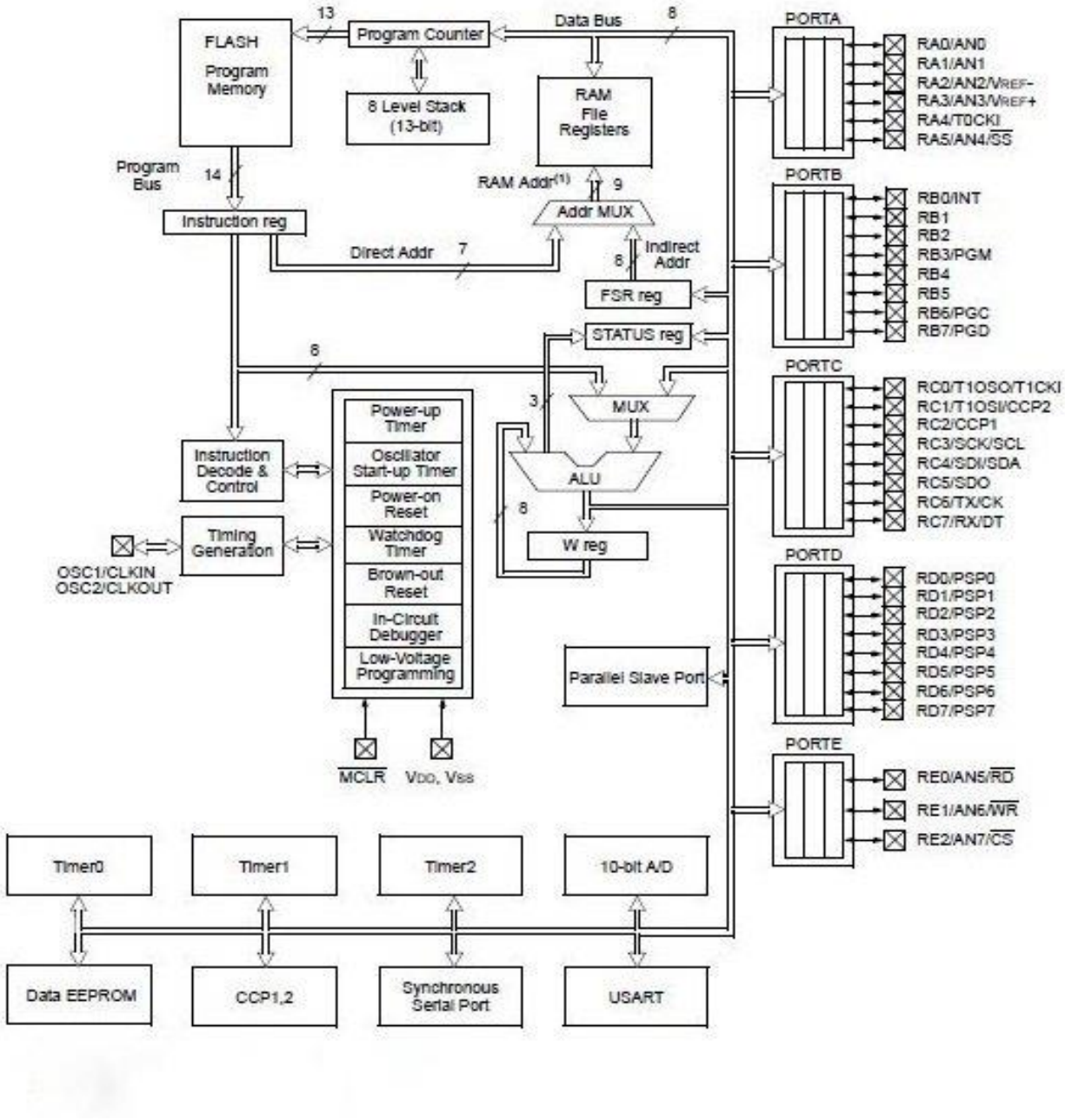

Fig 3.14 Block Diagram of PIC16F877A

3.4.3. Pin and their functions:

Pin Number	Description Function
❖ 1	Description perform
❖ 2	MCLR/VPP - Master Clear Input
❖ 3	RA0/AN0 - Port A
❖ 4	RA1/AN1 - Port A
❖ 5	RA2/AN2/VREF-/CVREF - Port A
❖ 6	RA3/AN3/VREF+ - Port A
❖ 7	RA4/T0CKI/C1OUT - Port A
❖ 8	RA5/AN4/SS/C2OUT - Port A
❖ 9	RE0/RD/AN5 - Port E
❖ 10	RE1/WR/AN6 - Port E
❖ 11	RE2/CS/AN7 - Port E
❖ 12	V_{dd} - Positive Power offer
❖ 13	V_{ss} - Ground
❖ 14	OSC1/CLKI - generator Input
❖ 15	OSC2/CLKO - generator Output
❖ 16	RC0/T1OSO/T1CKI - Port C
❖ 17	RC1/T1OSI/CCP2 - Port C
❖ 18	RC2/CCP1 - Port C
❖ 19	RC3/SCK/SCL - Port C
❖ 20	RD0/PSP0 - Port D
❖ 21	RD1/PSP1 - Port D

❖ 22	RD2/PSP2 - Port D
❖ 23	RD3/PSP3 - Port D
❖ 24	RC4/SDI/SDA - Port C
❖ 25	RC5/SDO - Port C
❖ 26	RC6/TX/CK - Port C
❖ 27	RC7/RX/DT - Port C
❖ 28	RD4/PSP4 - Port D
❖ 29	RD5/PSP5 - Port D
❖ 30	RD6/PSP6 - Port D
❖ 31	RD7/PSP7 - Port D
❖ 32	V_{ss} - Ground
❖ 33	V_{dd} - Positive Power offer
❖ 34	RB0/INT - Port B
❖ 35	RB1 - Port B
❖ 36	RB2 - Port B
❖ 37	RB3/PGM - Port B
❖ 38	RB4 - Port B
❖ 39	RB5 - Port B
❖ 40	RB6/PGC - Port B

3.4.4. The Features of PIC16F877:

There are various features that make the PIC16F877 a good choice for the project:

High-Performance RISC mainframe

- only thirty five single word directions to find out
- all directions square measure single cycle (1µs) aside from program branches
- operating speed: DC - 20MHz clock input
- 8 Kbytes Flash Program Memory
- 368 computer memory unit RAM knowledge Memory
- 256 computer memory unit EEPROM knowledge Memory

3.4.5. PIC16F877 Development Board:

The colossally well-known PIC16F877 improvement board for the PIC16F877 empowers simple advancement and testing of different arrangements. PIC16F877 is as of now included together with power supply segments and precious stones.

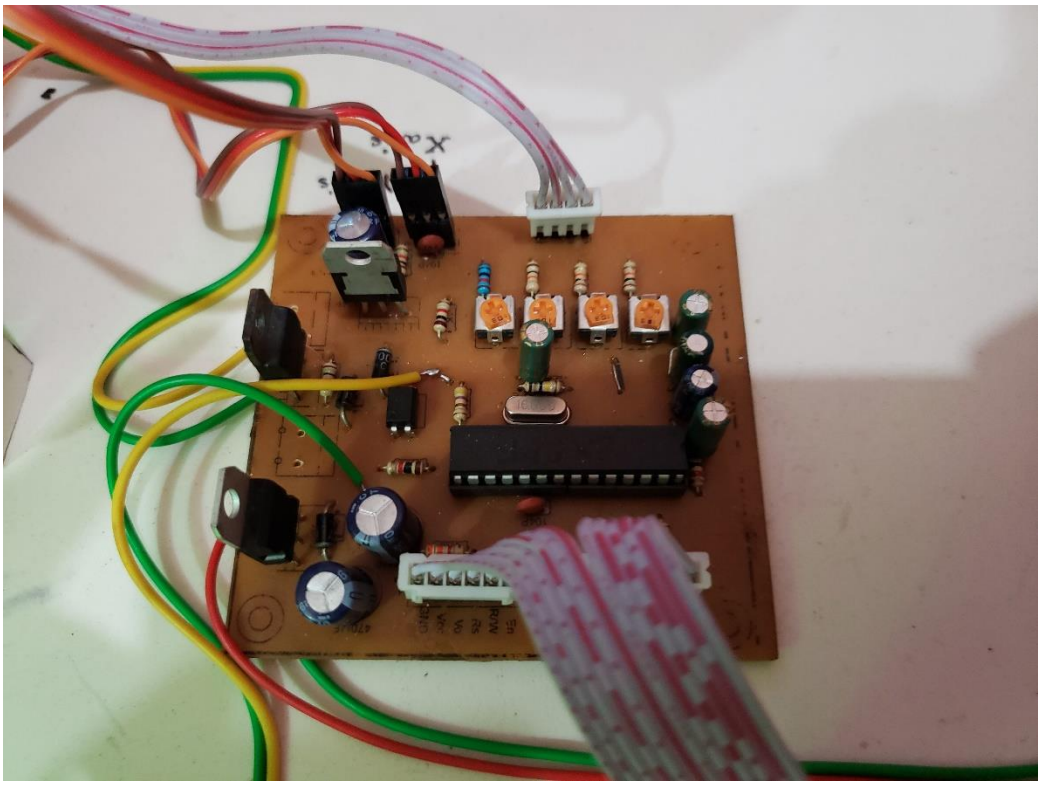

Fig3.15 Pic16F877 development board

3.5. Voltage regulator:

A transformer generates a hard and fast output voltage of changes to its input voltage or load conditions. The transformer should be stable with its condition. Here we have a tendency to use IC 7805 transformer. IC 7805 could be a 5V transformer that restricts the voltage output to 5V and attracts 5V regulated power offer. The voltage supply in a very circuit could have fluctuations and wouldn't provide the mounted voltage output. The transformer IC maintains the output voltage at a relentless worth.

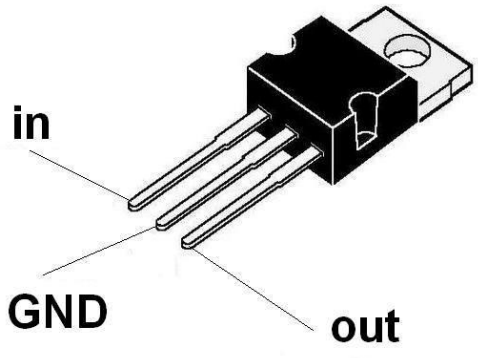

Fig 3.16 Voltage Regulator

IC 7805 could be a 5V transformer that restricts the voltage output to 5V and attracts 5V regulated power provide. It comes with a provision to feature sink. The most worth for input to the transformer is 35V. It will offer a hard and fast steady voltage flow of 5V for higher voltage input until the edge limit of 35V. If the voltage is on the subject of seven.5V then it doesn't manufacture any heat and therefore no want for warmth sink. If the voltage input is a lot of, then excess electricity is liberated as heat from 7805. It regulates a gradual output of 5V if the input voltage is in the rage of seven.2V to 35V. Therefore to avoid power loss attempt to maintain the input to seven.2V. In some electronic equipment voltage fluctuation is fatal (for e.g. Microcontroller), for such state of affairs to confirm constant voltage IC 7805 transformer is employed. IC 7805 could be a series of 78XX voltage regulators. The name the last 2 digits 05 denotes the quantity of voltage that it regulates. Therefore a 7805 would regulate 5v and 7806 would regulate 6V then on. The schematic given below shows the way to use a 7805 IC, their square measure three pins in IC 7805, pin one takes the input voltage, GND of each input and out square measure given to pin two, pin three produces the output voltage.

3.5.1. Pin Description:

Pin no.	Function	Name
1	I/P volt (7Volt-18Volt)	Input
2	GND (0V)	Ground
3	Regulated output; 5V (4.9V-5.1V)	Output

3.6. Capacitor:

A capacitor is an important element of our project. we are able to use the capacitance in several applications. victimization capacitance an awfully} microcontroller should be owing to the microcontroller could be a digital device with quick shift edges that uses an oversized quantity of current for a very short amount of your time at every transition. The capacitors offer the massive quantity of current required so the ability offer does not sag throughout that point making noise. The most operate of a capacitance is storing charge. A charged capacitance might be used as a voltage supply. It's forever best to use a spread of capacitors on the ability offer pins of the microcontroller {to provide to offer to produce} a coffee electrical resistance band supply. In our work we tend to used variable worth of capacitors and that they are ten µF (6 Pcs) & 100µF (1Pc). Capacitors are used for many functions like the temporal arrangement, smoothing power offer, coupling, filtering, calibration for the radio system, storing energy etc.

Fig 3.17 100µF & 10µF Capacitors

3.7. 606-Transformer:

6-0-6 it’s an honest quality electrical device, power provides for all types of project & circuit boards. It’s step down 230V AC to 6V with a most of 200mA current. We tend to used this electrical device to induce AC current and that born-again to DC current with a facilitate of device.

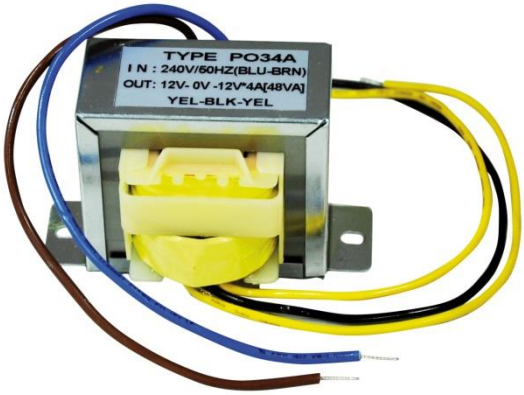

Fig 3.18 606-Transformer

3.8. The Designing Tools:

We use CCS C as Microcontroller programing compiler and Proteus Design Suite as a powerful electronic design application. A Short description given bellow:

3.8.1. CCS C Compiler:

CCS represents Custom Computer Services, a Microchip PIC Microcontroller Tool Solutions organization. CCS C are the best compilers for learners as they incorporates a great deal of inherent libraries which empower us to program a PIC Microcontroller without the profound information of its inside engineering. I think CCS C is the best High Level Language Compiler

for PIC Microcontroller as it is nearly equipment free.

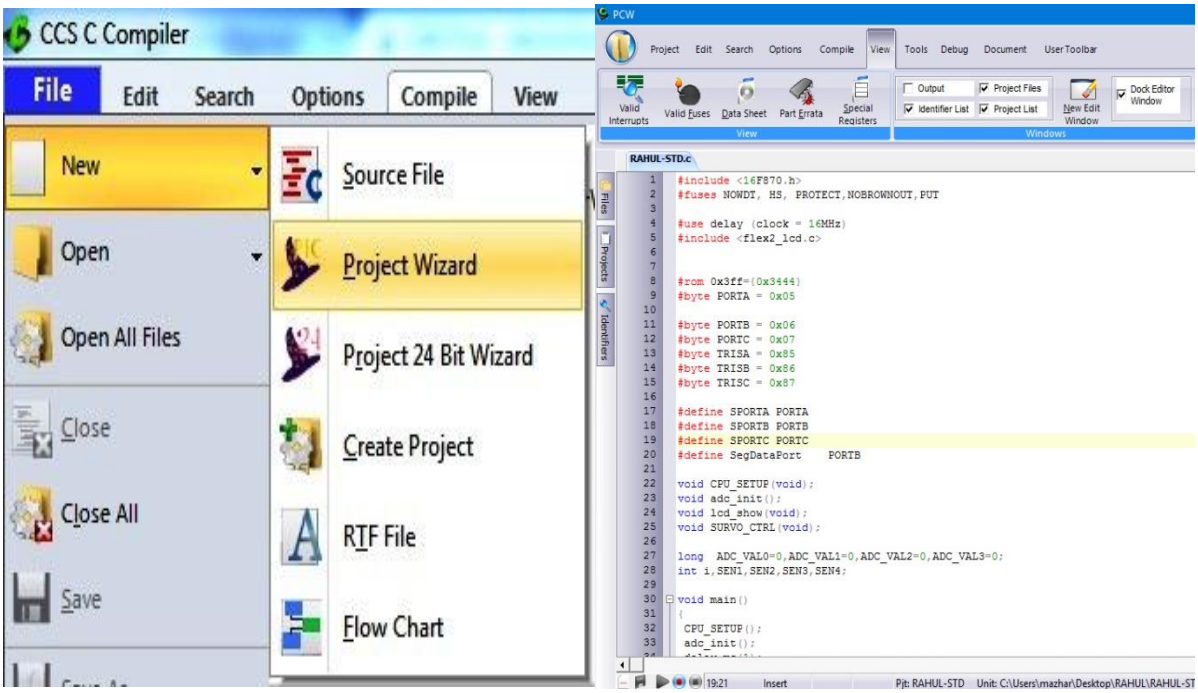

Fig3.19 CCS C Compiler

Key Compiler Features:

- Easily migrate between all Microchip PIC MCUs devices.
- Minimize development time with: peripheral drivers and standard C constructs.
- C++ style input/output streams with full data formatting to any device or for strings.
- Use CCS libraries and object code royalty free
- The integral one-bit type permits the compiler to generate very efficient Bit-oriented code
- Easily define, set-up and manage interrupts.

3.8.2. Proteus Design Suite:

Proteus may be a code package for software, simulation and style of electronic circuits. It consists of 2 main components, the ISIS, the circuit style atmosphere that even the machine VSM includes, and therefore the ARES, the PCB –Designer. Proteus Virtual System Modeling (VSM) has mixed mode SPICE circuit simulation, animated elements and silicon chip models to ease co-simulation of complete microcontroller primarily based styles.

It offers a spread of style options including:

- Schematic capture
- Mixed-mode (analogue and digital circuit) electronic circuit simulation
- Microprocessor / microcontroller simulation
- PCB style with manual and AutoRoute choices
- Graph-based simulation

3.9. Soldering wire:

Patch is fundamentally metal wire with a "low" dissolving point, where low for our motivations means low enough to be softened with a binding iron. For hardware, it is generally a blend of tin and lead. At the point when the fastening wire chilled an electrical association will lead. This is getting a decent mechanical association between the wires. The fibers of each wire ought to be turned together, act progressively like a solitary substance. Initial step is to set up the wires at that point tinning the wears, beside join the wires and patch graft together.

Fig 3.20 Soldering two wires

3.10. Crystal:

Crystal generators square measure electronic oscillator circuits that use inverse electricity. With this impact, once field is applied across bound materials they'll turn out mechanical deformation. Thus a crystal uses mechanical resonance of a moving crystal of electricity material in order that there's creation of an electrical signal with precise frequency. They need high stability, square measure low value and quality issue that makes them superior over such resonators as LC circuits, ceramic resonators and turning forks.

The crystal action may be diagrammatic by a similar electrical circuit. The best values of the capacitors rely on whether or not a quartz or ceramic resonator is getting used. It'll additionally rely on application-specific necessities on start-up time and frequency tolerance. Crystal oscillators aren't engineered into ICs as a result of they can't be simply fictitious with IC processes and also the size is physically larger than IC circuits. The inner oscillators of microcontrollers square measure RC oscillators. The explanation why crystal oscillator's square measure used is as a result of the standard issue is on the order of one hundred thousand whereas that of RC oscillators is on the order of one hundred. Therefore, the oscillator has lower section noise and lower variation in output frequency.

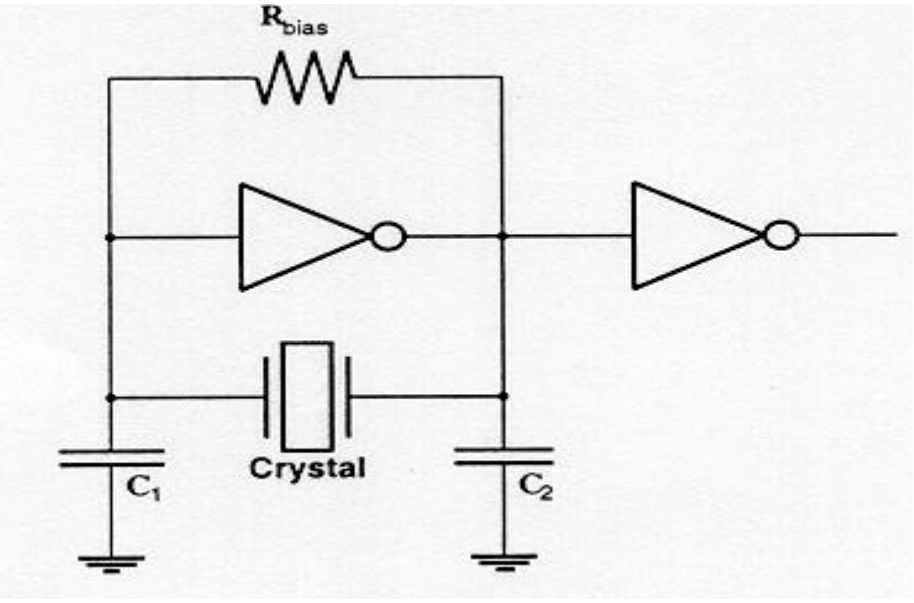

Fig3.21. Crystal

CHAPTER 4

ANALYSIS AND SIMULATION

4.1 Introduction

Sun tracking solar panel tracker is a device which follows the movement of the sun. Using solar trackers increases the amount of solar energy which is received by the solar energy collector and improves the energy output of the heat/electricity which is generated. This chapter contains the whole description of the project.

4.2 Building the Project

The project is about making sun tracking 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 used 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 applied to 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. Model remote control car. The microcontroller is there for programming language C++. The main objectives of this project is to investigate a newly.

4.3 Block diagram of this project

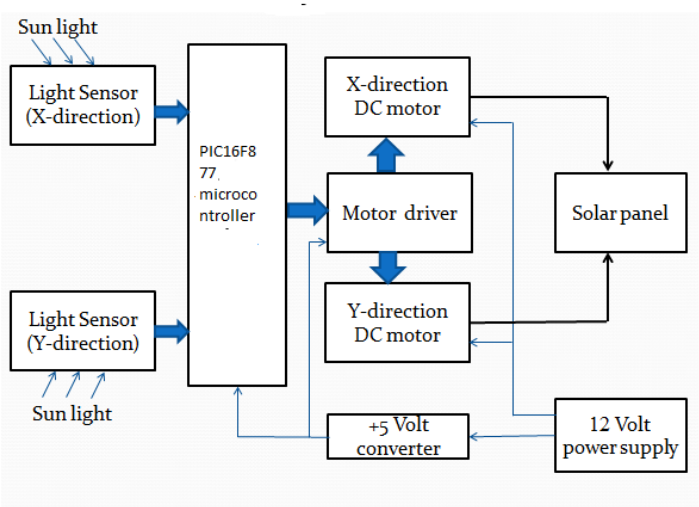

Fig. 3.1 Block diagram of this project.

4.4 Tracking principle

There are many different methods have been proposed and used for tracking the position of the sun. Among all, the simplest method uses an LDR (Light Dependent Resistor) to detect light intensity changes on the surface of the resistor. The proper and efficient use of LDR also reduces the overall cost of the system. The resistivity of LDR decreases significantly with the increase in illumination. The general resistivity vs. illumination plot of an LDR can be observed in following

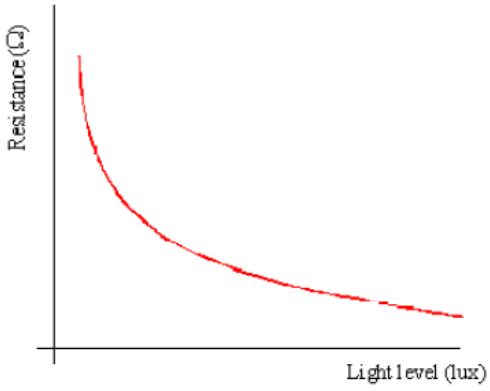

Fig.3.2 the Variation of the Resistance in Function of the Light Level.

4.5 Working principle

The setup of the hardware for the greater application of this project includes the placement of LDRs on the surface of a large curvature. The mechanism should be done such that any two immediate LDRs must remain active at the same time. And the dc motor will follow the bit pattern due to which the solar panel connected on the shaft of the dc motor will always face the sun perpendicularly. The combination of LDR plays the significant role in the movement of solar panel. Actually these combinations of signals are fed to the microcontroller and this directs the motor connected to driver. The required bit pattern for motor is shown in Table1.

LDR 1	LDR 2	LDR 3	LDR 4
1	1	0	0
0	1	1	0
0	0	1	1
1	0	0	1

Table no.1: Desired Bit Patten

When the stepper motor gets the last bit sequence of the table, the stepper motor will move to its initial position again follow these steps again, as the sun traverse from the beginning in next day. The dc power from battery is given as an input to the Inverter, which converts it into an alternating power so that it can be used with ease by home appliances and for Industrial purpose also.

4.6 Circuit Diagram &Description:

An automated dual axis solar tracking system by using Arduino is proposed. Here microcontroller ATmega328 controls the solar panel's movement which rotates and follows the motion of the sun anywhere in sky. There are three limit switches used in the circuit. Among which two are attached to the solar panel to mark its maximum angular positions in the east and west. The limit switch's status is read by microcontroller and the maximum angular position in either direction is indicated. When this position has been reached the panel should not be driven any further. And third limit switch is used to mark its angular position horizontally (i.e.360º). As the plane of the panel is always kept perpendicular to the direction of the sun, maximum amount of thermal energy can be obtained from the solar panel.

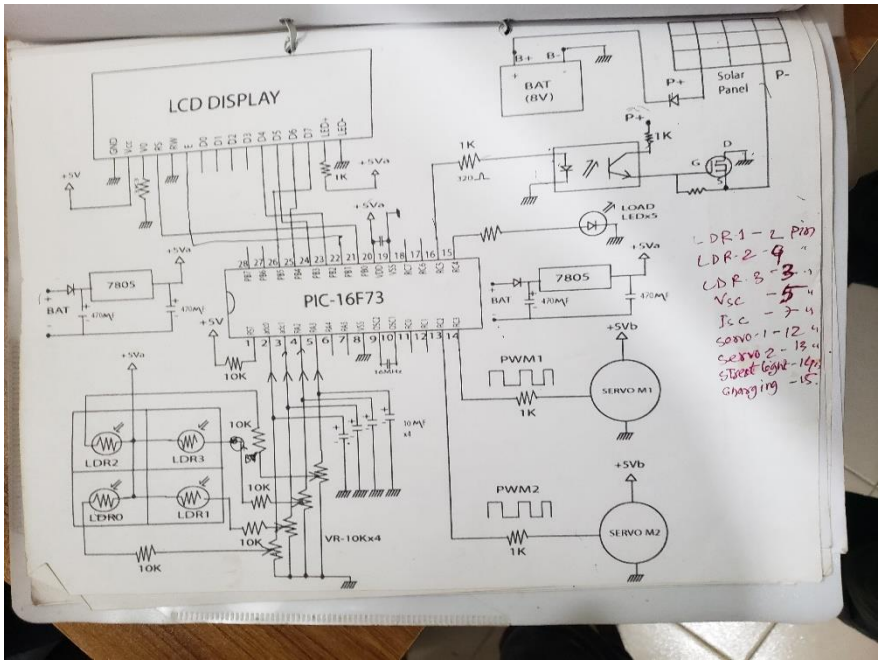

Fig. 3.4 Circuit Diagram of this Project

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. This is specially designed for the ease of artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino receives an input signal from different sensors to sense the Environment, and is able to affect its surroundings by controlling motors, lights, and other type of actuators. The microcontroller mounted on the board can be program in this chapter has discussed about principle of digital automatic ac voltage regulator. It has included block diagram, circuit diagram and physical appearance of this project. It has also explained operating system of the project and showed physical input/output screen result. Med using the Arduino programming language (based on Wiring) and the Arduino development environment.

4.7 Summary

In this chapter has discussed about principle of two axis solar panel. It has included block diagram, circuit diagram and physical appearance of this project. It has also explained operating system of the project.

Chapter 5

Discussions

5.1. Discussion:

In this work, a MPPT charge controller is bestowed. A microcontroller is employed to manage the most electric outlet trailing algorithmic program that is employed in PV systems to maximize the electrical phenomenon array o/p power.

An optimized and effective technique has been planned considering the mentioned drawbacks. The planned system was simulated and made, and also the practicality of the steered management thought was evidenced. The planned system was simulated and made, and also the practicality of the steered management thought was evidenced. From the results uninheritable throughout the simulations and hardware experiments, it had been confirmed that, with a well-designed system together with a correct device associate degreed choosing an economical and evidenced algorithmic program, the implementation of MPPT is straightforward and might be simply made to realize an appropriate potency level of the PV modules. The results additionally indicate that the planned system is capable of trailing the PV array most power and therefore improves the potency of the PV system and reduces low power loss and system price. This methodology protects the MPPT effects from environmental variations and leads United States of America to correct direction to the hunter that makes it freelance of environmental changes (particularly irradiation and temperature). the strategy has been changed supported the progressive electrical phenomenon and also the simulated result offers high potency throughout stable conditions likewise as quick dynamic conditions and thus it maintains the advantage of the present strategies.

The work dead during this project deals with analyzing and modeling of electrical device less PV systems associated with the escape current development which will degrade electrical device performance and cause human. In addition escape current is associate degree unwanted loss particularly once it involves distributed generation system. one in every of the main tasks of this analysis was to research and verify the electrical device less topologies and management ways that will minimize the escape current of PV electrical converter topologies so it will befits the quality needs, safety of human interaction and mitigation of unwanted losses. [13-14]

5.2. 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 would improve the system’s efficiency and improve reliability.

5.2.1. 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.

5.2.2. 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. [15]

Chapter 6

Conclusions and Applications

6.1. Conclusion:

The fast increase in energy demand cannot be resolved simply till there's another thanks to meet the demand. The small grid will undertake to resolve this kind of scenario in future. Solar, wind and biomass energy is that the main supply of energy used for optimizing the system and thus to form it economical. Therefore the user can diminish compulsive on the convenient fuel energy. The keep energy additionally plays a major role to avoid the imbalance of the facility system. To confirm the electrical phenomenon generator in operation its most outlet, MPPT controllers are usually used. These controllers are meant for MPP pursuit and to so minimize the error between the in operation power and therefore the reference most power that is variable in keeping with the load and of the weather. The MPPT based mostly charge controllers are best appropriate for wind and star systems as they track the utmost power just in case of power fluctuations at the input aspect because of status variation. Thus it's suggested to use the MPPT based mostly charge controllers. Use of microcontroller based mostly systems provides vast machine capability and reduction within the hardware. The MPPT charge controller operates with high potency (90% or perhaps higher) as compared to existing charge controllers. [10]

6.2. Applications

- Dual axis sun tracker can be used for large & medium scale power generations.
- It can also be used for power generation at remote places.
- It may be used as domestic backup power systems.
- It can be used in solar street lighting system.
- It may be used in water treatment technologies and solar heating.

Programming Code

```
#include <16F73.h>

#use delay (clock = 16000000)        // HEADER FILES
```

```
INT V,A,W;
//////////////////////////////////////////////////
void main()
{
 lcd_gotoxy(1,1);
 printf("  WELCOME TO    ");
 lcd_gotoxy(1,2);
 printf("     DIU        ");
 delay_ms(3000);

 printf(lcd_putc, " SUBMITTED BY:  ");
 lcd_gotoxy(1,2);
 printf(lcd_putc, "                ");
 delay_ms(3000);

 lcd_gotoxy(1,1);
 printf(lcd_putc, "AKRAMUL HOQUE   ");
 lcd_gotoxy(1,2);
 printf(lcd_putc, "                ");
 delay_ms(3000);

 lcd_gotoxy(1,1);
 printf(lcd_putc, "MD.ATIKUR RAHMAN ");
 lcd_gotoxy(1,2);
 printf(lcd_putc, "                ");
 delay_ms(3000);
```

```
while(1)
{
  lcd_gotoxy(1,1);
  printf(lcd_putc, "B:BV LDR1 LDR2 LDR3 ");
  lcd_gotoxy(1,2);
  printf(lcd_putc, "I:A       P:W       ");

  SURVO_CTRL();

 //////////////////////////
  set_adc_channel( 0 );
  LDR1 = read_adc();

  set_adc_channel( 1 );
  LDR2 = read_adc();

  set_adc_channel( 2 );
  LDR3 = read_adc();

  set_adc_channel( 3 );
  V = read_adc()
  set_adc_channel( 4 );
  A = read_adc();
  W=(V*I);
 //////////////////////////
}
```

```
} // end main()
////////////////////////////////////////////////////////////////////////
void SURVO_CTRL(void)
{
  ////////////////////////  SURVO-1 CONTROL   ////////////////////////
       if( LDR0 > LDR1 )
        s1ds++;
       if( LDR0 < LDR1 )
        s1ds--
  ////////////////////////   SUUURVO-2 CONTROL   ///////////////////////
       if( LDR0 > LDR2 )
        s2ds++;
       if( LDR0 < LDR2 )
        s2ds--
  ////////////////////////   LOAD CONTROL      ////////////////////////
}
```

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