CONSTRUCTION AND PERFORMANCE ANALYSIS OF SUN TRACKING SOLAR INVERTER

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

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DECLARATION

This is to certify that the thesis, "**Design and Implementation of Sun Tracking Solar System**," presented here is the result of work done by the undersigned student in order to complete the requirements for a B.Sc. in Electrical and Electronic Engineering under the guidance of Naimur Rahman , Lecturer of Electrical and Electronics Engineering at Daffodil International University.

The student undersigned completed this and has not submitted it to another institution for the award of a degree or diploma.

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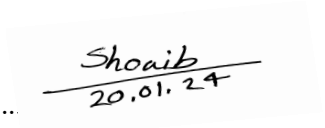

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APPROVAL

The Project titled " **Sun Tracking Solar Inverter** " submitted by **MD. Shoaib (ID: 192-33-5245)** and **Pretom Bain (ID 192-33-5192)** has been accepted satisfactory in partial fulfillment of the requirement for the degree of **Bachelor of Science in Electrical and Electronic Engineering in April,2023.**

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Dedicated to

We committed this task both our parents and our teacher. They are the main mainstay of my life and the greatest strength that God has given Us. Both of our father generally said that our home was fragmented without the commitment of our mother. We can never say thanks to her enough for making us what we're today. They have forever been so committed and strong in all phases of my life.

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LIST OF ABBREVIATIONS

LDR	Alternative Dispute Resolution
IDE	An Integrated Development Environment
DC	Direct Current
AC	Alternating Current
UV Light	Ultraviolet
RCCIIT	RCC Institute of Information Technology
PV panel	photovoltaic panels
HSAT	Home Sleep Apnea Test
VSAT	very small aperture terminal
PLX-DAQ	Parallax Data Acquisition tool
ACS-712	hall effect current sensor
CSP	communications service providers
GPS	Global Positioning System
CPV	Cost-per-view
PVC	polyvinyl chloride
FTDI USB	Future Technology Devices International Limited
IDE	Integrated development environment
CDS	Certificate of deposit
USAID	United States Agency for International Development
IDCOL'S	Infrastructure Development Company Limited (Bangladesh)

LIST OF SYMBOLS

Symbol	Types of Symbols
°	degree
v	volt
ω	Ohms

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Abstract

In this project, we made progress on an open-loop-based solar panel that tracks the sun. The main goal of the project is to capture the maximum amount of light from the sun and convert it to electricity so that it can be used and moved with ease. By positioning the solar panel such that it faces away from the sun's beams, this interaction should be achievable so that even the strongest daylight may be converted into electricity. Because of this system's incredibly high efficiency. This tracker's main feature is its independence from the sun's energy. It adjusts itself as suggested by that by taking the sun's coordinate directly in accordance with its position. Additionally, it provides improved dependability and efficiency. The advantages of

In order to extract the optimal power from solar radiation, the investigation article describes the planning of a cost-effective sun position global positioning framework. The AVR atmega8L microcontroller, an advanced device, forms the basis of the present system. A dedicated board is envisioned to track the location of the sun. The board consists of two photodiodes that are arranged in a standard manner. The location of the sun is determined by gradually contrasting the output of two photodiodes. The program is developed in Code Vision AVR's IDE and then ported to the intended target device. The Sun's rays are predicted to move from east to west as the globe rotates, with the resulting sensor modifications. Two sensors collect basic signals, which are then digitalized and evaluated. The direction of the pivot is determined by the correlation's outcome.

One of the key factors influencing a nation's financial prosperity is accession to power. Bangladesh is now suffering from a serious electricity problem. The majority of those who need access to power—about 65% of people—live in towns. Due to the developed power's inability to collect the interest, a massive shedding of up to 1500 MW was experienced. The invention of "Solar Home Systems" in the present can be a fantastic endeavor to address this issue by providing energy to the nation from a free-streaming, endless source, like sunshine. The Sun focused Home Frameworks business has dramatically grown over the last 20 years. Additionally, its current uses are growing gradually. Therefore, it is time to assess what are the

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CHAPTER 1
INTRODUCTION

1.1 Basic Concept

Progress is the vein through which current human advancement runs. Bit by bit energy is best used to fulfill the longings and wants of innumerable people. Each side of our life is encased by different layers of limit and there is energy in this reaction. Being a key part.

Therefore, the source of energy should be limitless or eternal. to move this massive population along. Normally, man is transformational. Nature's finest work may occasionally be competing for our attention while we consider the possibilities. In this dangerous environment, benefits and solace are available from every angle. Simple Matrix Different assessments reveal the greatest options for accelerating the reversal of energy shortages in a civilization as complex as our own. We want to make an effort to achieve just that.[14]

The Main Objective of Energy Conservation Given the current circumstances, it is apparent that traditional energy sources like coal, petroleum gas, oil, and so on will be all but extinct. Long-term self-satisfaction via continuing to engage in human strife The level of interest in these assets for each energy request has peaked. The usual method of obtaining energy, the consumption of petroleum goods like coal, oil, and flammable gas, is polluting the entire atmosphere.[15]

The present strategy is constructed with components including LDR modules, DC engines, photovoltaic displays, and so on. They won't function in a way that causes contamination or a change, unlike how other regular energies act. The sun itself functions as an energy source. There is no more notable energy than understanding. Sun-based energy is associated with abundant availability and free use.which, obviously, made the video a mind-blowing phenomenon.

All things considered, 1881 saw the invention of the first solar-powered chargers. The functional limit of sunlight-powered chargers has been noticeably better than before since Russell Ohl invented the potential of a sun-oriented cell in 1941. regardless of the fact that it is. Similar to Mother Energy Tracking, the concept of the incomprehensible is now not conceivable.

The project wants to limit every last bit of energy as an added measure. from being overlooked. LDR module used to connect the DC engine to the framework. Sun-oriented energy will be aided by measuring the strength of the sun's beams as they are fastened to the upper edge of the sunlight-based charger. Keep as much of the board's energy in reserve as is anticipated to change in response to the sun's growth.[5]

This arrangement shows up in the search for such objectivity. The sun produces the most energy of any planet in this solar system since heat is the source of all creation. establishing a regular habit and transferring it from one experience to the next.

In light of this, the task intends to increase the use of purported "programmed sun oriented global positioning frameworks." Sun energy and the conversion of that energy into another thing. In order to make this framework useful, attempts are made to avoid this task. Simple subject, easy to reach, and ultimately produces the most amazing art. This framework is a time-honored creation that is meant to be outstanding of its kind in terms of inventive advancement when time's pace is at its finest for the progression of time. In essence, this can show that the mission, which is an increase in solar energy, is a dependable source of energy and a never-ending oddity. Only 10 to 20 percent of the sun-based cells are really used. [28]

This framework is a valuable resource since it is contaminant-free and safe for the ecology. This structure will genuinely desire to form if the sea of pollution is engulfing every aspect of existence. A wave of faith amid this uncontrollable development. This demonstrates the framework's durability. It may be one if people tended to compare its capabilities to those of other mind-bending systems.

1.2 Purpose of the Study

To ensure of this project that the sun's rays are rising and falling, this project's goal is to do just that. The most solar energy is produced by solar panels. Energy-wise, solar energy is transmitted with the least amount of energy possible between the hours of (1200 and 1400), with the peak coming at noon when the sun is practically directly overhead the solar panel.[2]

Goes Performance of the tracker is further improved by the panel. It demands a strategy. Make the appropriate, low-power adjustments to address the economic 8 problem. Using a microcontroller, a solar tracking system may be created. Track the sun's relative velocity by allocating time and resources. Sleep at night to protect the sky and the daytime electrical grid. The motor control issue that exists is fixed using an algorithm.[8]

Despite the fact that solar trackers are growing in popularity, not everyone is aware of all of their benefits and possible drawbacks. Solar panel tracking systems are a more advanced solar panel installation technique. Static mounts, which keep panels in a fixed position, may not perform as well when the sun is shining at a less-than-ideal angle. To compensate for this and boost production, solar trackers automatically move to "follow" the path of the sun across the sky.[9]

Although there are a few things to consider before installing one at a particular project, it's an excellent system for energy output.

1.3 Statement of the Problem

Applications for solar tracker devices to increase consumption are numerous. sunlight seclusion Putting in place a strong system is the issue here. Production of solar energy will rise by 30–40%. It uses a microcontroller. Create a control circuit that will be used to steer a motor. Excellent solar panel.[1]

- As a result of the more sophisticated technology and moving components required for their functioning, solar trackers cost a little bit more than their stationary counterparts. Depending on the project's size and location, this typically represents an increase of $0.08 to $0.10 per W.
- Despite reliability improvements, solar trackers still require more maintenance than a conventional fixed rack; however, the quality of the solar tracker can influence how much and how frequently this maintenance is necessary.
- Compared to fixed racking, trackers are a more sophisticated arrangement. Accordingly, more site preparation is often required, such as additional grading and trenching for wiring.
- Single-axis tracker projects also need to pay extra attention to the stability and bankability of the firm. These systems are more complicated when it comes to project financing, and because of this, financiers consider them as carrying a larger risk.
- Solar trackers are a more practical option in warmer areas because they are often made for regions with little to no snowfall. Tracking systems have a harder time adapting to harsher environmental conditions than fixed racking does.
- Comparing fixed tracking systems to single-axis tracking systems, more field adjustment is possible. In general, fixed systems may tolerate slopes of up to 20% in the east-west direction, but tracking systems often offer less slope accommodation, typically about 10% in the north-south direction.

1.4 Thesis Outline /Organization

Chapter 1: Introduction Solar since the dawn of time, solar energy has been necessary to support life. The ability of man to use this vital resource and replace conventional energy sources with it is improving.

The cleanest energy sources that are now obtainable. It even makes no noise pollution-related contributions. Actually, we didn't need solar panels since fossil fuels were and are still a reliable source of solar energy.[1]

In reality, fossil fuels are just the sun's energy that has been captured in 200-million-year-old plants and is being extracted today by dangerous, expensive, and ecologically damaging methods. whereas solar energy is produced straight from the sun.

Chapter 2: A literature review offers detailed information, a summary, and a critical evaluation of these works in relation to the research subject under investigation. To give a general summary of this source that we have looked at while studying, literature reviews are given.
Since the amount of solar energy captured by a system directly influences the output power produced by the system, high-concentration solar thermal and photovoltaic systems must track the sun's position with extraordinary precision. Many methods have been proposed to simplify this procedure during the past 20 years. Because of this, the first section of this paper provides a general review of the sun tracking system field. The discussion of some of the most notable recommendations for closed-loop and open-loop sun tracking systems follows.[2]

Chapter 3: Methodology delves more into the method architecture while finalizing the methodology's explanation and providing illustrated examples.

While the solar tracking system records the sun's movement using a three-point motion for azimuthal tracking with a clockwise open-loop control system that runs from 6:00 to 18:00 each day, a linear actuator is utilized to measure the declination throughout the course of the year.[1]

Chapter 4: Instruments In this chapter, we discussed the materials and hardware we utilized for this project as well as how they functioned.
The Sun tracking solar panel is composed of two LDRs, a solar panel, a servo motor, and an ATmega328 Micro controller. There are two light-dependent resistors arranged in a row on the solar panel's borders. Light-dependent resistors provide less resistance when exposed to light.[12]

Chapter 5:The book's conclusion agitates its limits and new research possibilities. Thanks to advancements in sun tracking algorithms, solar thermal and photovoltaic systems have been created for a variety of applications in recent years. The quantity of solar energy collected by solar systems that track the sun's movement during the day is far larger than that of their typical fixed-position equivalents, and as a result, they produce much more electricity. In this article, the primary sun tracking algorithms developed during the previous 20 years have been examined.[18]

It has been shown that these sun tracking algorithms may be broadly characterized as either closed-loop or open-loop kinds depending on their mode of control. The control and computational underpinnings of each approach have been investigated, and their efficacy and relative advantages and disadvantages have been meticulously studied. Overall, the review's conclusions are in favor of using sun tracking devices for a number of high-performance solar-based applications.[5]

CHAPTER 2
LITERATURE REVIEW

2.1 Literature Review

Solar energy from sunlight-based jars is used in sustainable power sources. To switch to solar-based radiation, use solar-powered chargers or solar-oriented cells. The photoelectric effect is what most solar cells rely on. Because photons are slain, it is the cycle by which some materials, like metal, make electrons.

Some compounds, like selenium, are particularly susceptible to this effect and can be used anytime they are used in solar-powered cells. In order to generate some electrical potential, use photographs. A sunlight-powered charger composed of materials like silicon is exposed to the sun's radiation in the form of UV light, a kind of electromagnetic radiation. It is converted into electrical energy after being ingested by the image. Direct contact between solar-powered chargers and solar-oriented cells results in the greatest assimilation. The sun, with the intention of keeping its light rays on the assimilation's outer layer.[23]

Checking out the solar-powered charger won't be able to improve this retention and change. Additionally, solar-powered cells are typically installed on roofs that are inclined. Its competency is essential to offer workable solar-based electricity using a single facility. As a result of advancements, several strategies for using energy derived from the sun have been developed. Observe how the sun changes throughout the day.

W. Because there aren't as many resources available, modern society is forced to take its time. meet the requirements of the final choice. The demise of conventional energies as a result of human methods is a reminder of the problems with controllable turn of events as civilization advances. We developed a confident method of handling ourselves as a result of the lack of energy and its source. People are offered optional goods like solar electricity and boats. It is believed that the sun is the primary source of energy.[24]

Innovation has advanced through expanding. techniques for maximizing this energy. Whether it be gasoline, power, or nuclear power. and then some creation. Frameworks for photovoltaic or combined solar power (CSP) systems are being developed. converting solar energy that the

planet uses into power. This captured solar energy is used by the solar-powered GPS beacon through a network of photovoltaic columns that are supported by a fixed photovoltaic/sun-oriented cell. Sun-based cells, often known as photovoltaic cells, are used to convert light energy into electrical power.[16]

Photovoltaic cells operate according to a similar principle called photovoltaic impact. photoelectric effect The fact that electrons are not always transferred in photovoltaics is what matters. A voltage distinction is made by the substance that surrounds the surface. Solar-powered cells are false. silicon with precious stone. It is the component of solar cells that is used the most frequently. Solar cells use silicon in a very cost-effective and productive way.

Gem line silicon comes in two varieties. Create solar-facing cells. In addition to silicone, other materials like as cadmium telluride (CdTe), copper indium gallium (D) selenide (CIGS), and others can be used to create sun-oriented cells. Silicon is the best material used in sunlight-based global positioning systems because it is less expensive than other materials when combined with sun-oriented cells [2]. Effectiveness is about 15-20%, whereas cell material's proficiency at high temperatures drops to 10-15%. Starting with Introduction 4 AEIE, another structure that is less costly than the prior one but contains a band hole comparable to monocrystalline silicon is RCCIIT polycrystalline silicone.[5]

Although it has a similar band hole energy, it performs slower than this material, which is why it is used in low-cost goods. Unstructured silicon cells may function at extremely high temperatures, although they often have a lower presentation compared to other silicon architectures. technologies that use amorphous thin-film silicon (a-Si, TF-Si), CIGS, and CdTe. Slender film photovoltaic modules are the name given to the development of solar-powered cells. These thin-film solar cells are only marginally practical when compared to solar cells made on precious stone-line silicon.[5]

This material is used in low-cost goods despite the fact that it has a similar band hole energy but performs less well. Unstructured silicon cells are capable of operating at extremely high temperatures, although they often display worse performance compared to other silicon architectures. CdTe, CIGS, and amorphous thin-film silicon (a-Si, TF-Si)-using technologies. Slender film photovoltaic modules are the creation of solar-powered cells. In comparison to precious stone line silicon sunlight-based cells, these thin film solar cells are only marginally practical.

2.2 Types of Solar Trackers and Solar Tracking Techniques

Solar energy is prevalent in nature and renewable energy sources all around the world. The primary problem with the solar field is that photovoltaic (PV) devices only efficiently capture a tiny amount of solar energy.

The PV systems will work very effectively if the panel is kept perpendicular to the sun's beams. The PV panel is therefore always at its perfect position perpendicular to the sun's beams thanks to a solar tracker device. The goal of this article is to evaluate several solar tracking systems and determine the best orientation for PV panels.

The many solar tracking system technologies, including the chronological tracker system, active solar tracker, and passive solar tracker, have been covered. Additionally, the movement radii of single-axis and dual-axis solar tracking systems have been addressed.

The performance and design of the tracking technique are also included in this paper, along with an overview of the benefits and downsides of the existing solar tracking system. The drawbacks of solar tracking devices are also underlined in order to improve future action. Through these study studies, it was determined that the active solar tracker with the dual axis rotation was the most beneficial solar tracking system.[3]

The following categories can be used to categorize contemporary approaches to tracking

solar energy.

2.2.1 Single Axis-Solar Tracking System

This method is typically used for sun-based trackers intended for use in rainforests. a single hub whose center is to move in accordance with the sun's point of rising (point of tendency). By estimating a group of two LDRs in inverse headings to the sun, orientated by the development of the engine sun to drive the board, a single straight actuator is used to measure the force of sunlight-based radiation. Was it possible for a voltage to decrease across them, as opposed to a drive circuit. The two LDR voltages are equal, and the board's development is stopped. The sunlight-based charger is then often positioned such that it faces the sun's rays.[4]

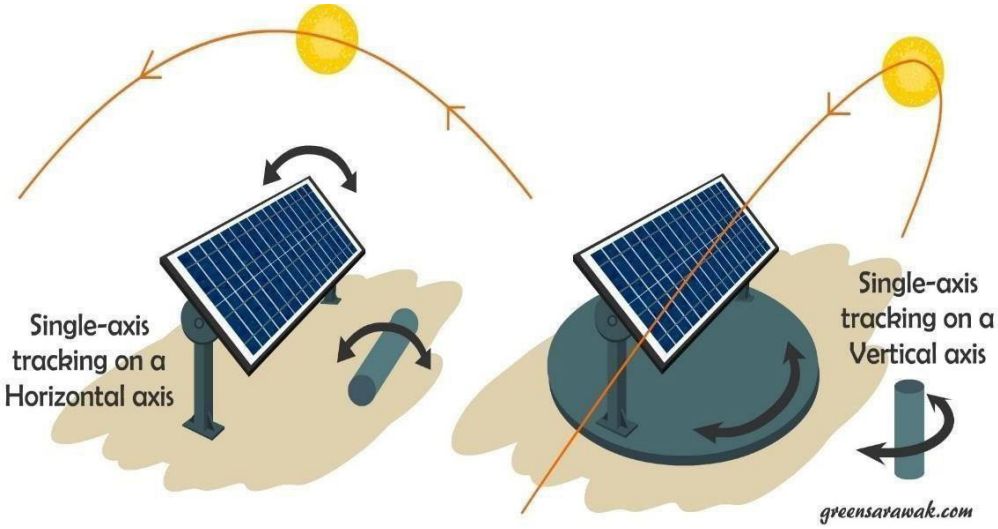

Figure 2.1: Single axis solar tracking system.

Advantages of Single-Axis Solar Tracker:

- Single-axis trackers usually move from the east to the west and follow the Sun's direction.
- Single axis trackers are cheap, very simple in set up and run at low cost.
- They are more reliable than dual-axis trackers.
- Single axis has higher lifespan than dual-axis trackers.
- Single-axis trackers suit companies that want a low-cost option.

- Single axis trackers also fit for areas with less sun.
- Single axis tracker has a better efficiency related to a solar panel in fixed form. The effectiveness of single axis solar tracker over fixed solar tracking mount panel is 32.17%.

The different types of single axis trackers are explained below:

Horizontal Single-Axis Solar Tracker (HSAT)

In many PV applications, the HSAT is regarded as the most economically beneficial tracker configuration since it spins constantly from east to west on a fixed axis that is parallel to the ground. The HSAT structure is preferred over other tracking geometries because it utilizes less material during construction, is constructed on several supports along the rotating axis, and has a horizontal design.

Horizontal Tilted Single-Axis Solar Tracker (HTSAT)

The HTSAT tracker is installed at a specified tilt, just as the HSAT. When compared to horizontal one-axis trackers, they are more expensive and complex. They are considered to be inflexible and call for a concrete foundation, which drives up the cost.

Vertical Single-Axis Solar Tracker (VSAT)

These gadgets can be installed in a north-south or east-west orientation to monitor the sun's broader "up-and-down" movement in the sky. In hilly or high-altitude settings, as well as in areas at higher latitudes, they are more commonly seen.[3]

Vertical-Tilted Single-Axis Solar Tracker (VTSAT)

They differ from HTSATs in that the tilt aligns to a horizontal position and rotates on a vertical axis. These trackers are more effective in producing energy than horizontal trackers. However, their tilt is more susceptible to wind stresses than horizontal units. In order to build a strong foundation, they also have a high structural requirement and need for more steel and concrete.

2.2.2 Dual Access Solar Tracking System

10 ° N and 10 ° S of the equator are the main target areas for this method. In order to constantly track the evolution of the sun, this technique makes use of both the point of tendency and the point of tendency of the sun-based tracker.

To transport solar energy, two actuators are used instead of a number of engines. The same goes for four LDRs, which are located on the opposite sides of two solar-powered chargers. When the voltage drops across each of the four LDRs is equal, the board is exposed to the strongest solar illumination, which causes the development to cease. This ensures that the solar charger is positioned precisely so that it faces the sun.

The two subcategories of the dual-axis tracking system are altitude-azimuth tracking and polar-axis tracking, respectively. Tracking along the polar axis is also known as spinning-elevation tracking.[4]

The collector or concentrator of the polar-axis tracking device has an axis that is parallel to the earth's axis of rotation and points toward the celestial north pole. The other axis is the declination axis, which runs parallel to the polar axis. When the device is in use, the mirror or collector revolves around the pole axis in the opposite direction and at a speed equal to the earth's rotational speed.[6]

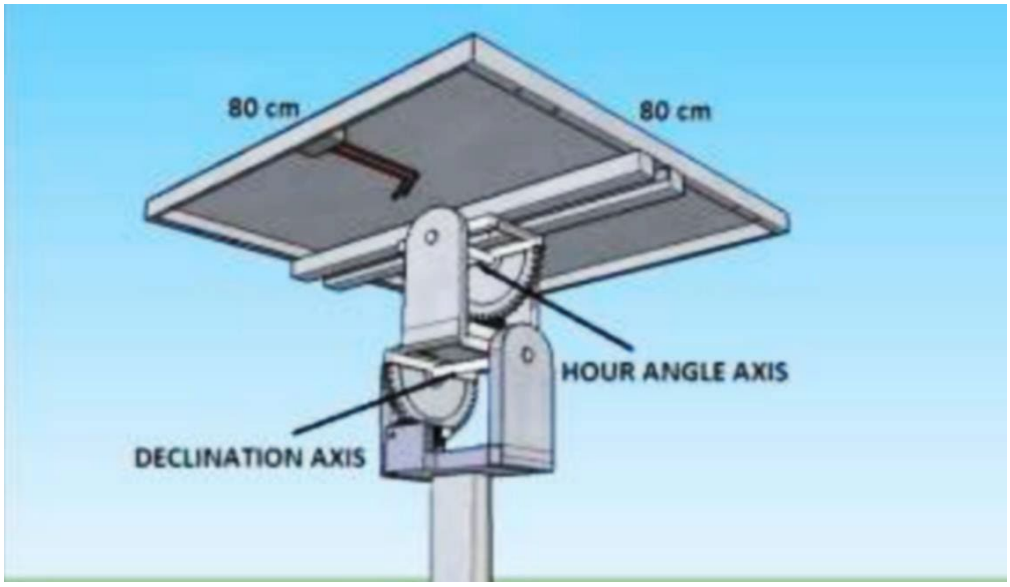

Figure 2.2: Dual axis solar tracking system.

2.2.3 Active Solar Tracking

The sun will be checked often and continuously during this process. Position throughout the day, stopping or taking a break when it becomes dark, as directed by its plan. Light-touch sensors, such as photograph resistors (LDRs), whose voltage yield is fed into the microcontroller, should be able to accomplish this. They then start actuators (engines) to move the solar-powered chargers into their new location.

One of the shortcomings of solar panels as a renewable energy source is the lack of power output when the solar panel is not facing the sun directly. To increase the output power of solar panels, an active solar tracker based on the sun horizon coordinate system has been developed. The solar horizon coordinate system, which is used to establish the location of the sun at all times, enables the precise positioning of the solar panel with regard to the sun.[2]

An Arduino Uno is used to control this device, together with two servo motors to drive the panel, a PLX-DAQ program to monitor data, an ACS-712 to measure current, and a DC voltage sensor to measure output voltage. According to sensor characterisation, the sensor ACS-712 measures current in mA orde and has a maximum relative error of 4.25%.

The voltage sensor, on the other hand, has a maximum relative error of 4.34% and can detect output voltage up to 15 Volt. When compared to other active solar panels, this device's output power rises by 83,89%. Measurements were made in Bekasi and Tangerang, two different cities, to ascertain the impact of altitude and azimuth data. According to the findings, the two cities' output powers differ by 77.7%.[25]

2.2.4 Passive Solar Tracking

This method uses trackers to determine the location of the sun using a. The stress on the tracker is unevenly distributed across the two finishes. This is a result of imbalance. A low limit compressed gas liquid experiences a gas strain as a result of solar heat. Heading one way or the other, at which point the construction is moved. The self-driving car, also known as an autonomous vehicle (AV), a driverless car, or a mechanical car (robot car), is the vehicle where the vehicles A ground is included in automation.vehicle that can travel safely and without nearly any human knowledge may sense its present situation.[9]

This innovation's potential impact has already been felt by many firms, and it may manifest itself in several ways. Self-driving cars use a variety of sensors, like as thermographic cameras, radar, pioneers, sonar, GPS, odometers, and twin estimate units, to identify their surroundings. Progressed The control frameworks analyse tactile input to identify optimal route alignments, obstacles, relevant signs, and the number of attached cars.[26]

Although several concepts to develop fully autonomous commercial cars are in various stages of development, there isn't a self-driving car available to everyday users. The degree of SAE can be thought of as basically level 0, according to the framework developed by SAE International (SAE J3016, which is periodically reviewed), independence in cars is typically organized into six levels. No robotization, Level 1 hand on/shared control, Level 2, hands off, Level 3, eyes closed, Level 4, mind off, and Level 5 steering wheel discretion.[6]

Level 3 or above cars continue to make up a small portion of the market as of December 2021. In 2020, Waymo became the first specialized cooperative to provide driverless taxi services to the general public in several areas of Phoenix, Arizona. In any event, the cars genuinely have remote human supervisors even if there isn't a driver inside.

Honda became the first manufacturer to formally approve a Level 3 car in March 2021, while Toyota tested a prospective Level 4 assistance near the Tokyo 2020 Olympic Village. In California, Nuro has been given permission to launch an autonomous commercial conveyance operation in 2021.[18]

Mercedes-Benz became the second Level 3 manufacturer to comply with legal requirements in December 2021. Two freely open mechanical technology preliminary competitions were launched in China in 2020 by the Chinese company AutoX [19] in the Pangshan District of Shenzhen and by Baidu in the Shogang Park in Beijing, which will host the 2022 Winter Olympics. have left.

2.3 Solar panel Imports in Bangladesh – Overview

- Solar panel import shipments in Bangladesh are 1K, imported by 263 Buyers.
- Top 3 Product Categories of Solar panel Imports in Bangladesh are

1. HSN Code 85414020 : HS : photocells: light emitting diodes (electro-luminescent)
2. HSN Code 85414090 : HS : photocells: other

3. HSN Code 701603 : 701603

- Bangladesh imports most of its Solar panel from China, India and Hong Kong
- The top 1 import markets for Solar panel are Bangladesh. Bangladesh is the largest importer of Solar panel and accounts for 1,030 shipments.

These figures are up to date as of August 26, 2022, and are based on Volza's Bangladesh Import Data of Solar Panels, which was collected from 70 nations export import ships with names of clients, suppliers, and key decision makers, as well as their contact information, including phone numbers, emails, and LinkedIn profiles.

Latest 10 shipment information of Bangladesh Solar panel import

HS Code	Product Description	Origin	Destination	Qty.
90328900	CHARGE CONTROLLER FOR SOLAR PANEL	China	Bangladesh	245
90328900	CHARGE CONTROLLER FOR SOLAR PANEL	China	Bangladesh	5
90328900	CHARGE CONTROLLER FOR SOLAR PANEL	China	Bangladesh	5
90328900	CHARGE CONTROLLER FOR SOLAR PANEL	China	Bangladesh	245
90328900	CHANRGE CONTROLLER FOR SOLAR PANEL	China	Bangladesh	80
85414300	SOLAR PANELS , 40W , 50W , 65W , 85W , 100W , 130W	China	Bangladesh	NA
85414300	SOLAR PANELS	China	Bangladesh	NA
85414300	SOLAR PANELS	China	Bangladesh	NA
85414300	SOLAR PANEL (MONOCRYTALLINE GRADE A)	China	Bangladesh	NA

2.4 Estimation of Solar Radiation on Horizontal and TiltedSurface over Bangladesh

Energy consumption per person is used to measure a country's social and economic development. In affluent countries, 7.35 KW are required per person to maintain comfort and quality of life. The average for Europe is 5.02 KW per person, whereas the average for developing countries is 1.30 KW and the average for Bangladesh is only 0.228 KW. 2.37 KW is the typical global energy use per person. As a result, the countries with a lack of energy are in a terrible condition. There will be around 12 billion people on the earth by the year 2100. If present trends in technological development and innovation continue, the demand for energy will climb five times during the following ten years.

In light of this, it is evident that the present finite supplies of conventional energy, including wood, coal, natural gas, and oil, will not be sufficient to meet the world's growing energy needs. In addition to their high rate of consumption, conventional energy supplies' unequal distribution and use are a significant factor in the present energy crisis. The majority of people who live in developing or underdeveloped countries, which comprise around one-third of the world's population, utilize only a very tiny share of the energy in the globe.[16]

The present energy crisis has prompted a search for alternative energy sources to address the radically changing global energy situation. Due to the world's increasing industrialization and growth in energy consumption, conventional fuel will soon run out on the planet. This issue calls for an immediate and serious reaction that not only concentrates on the management of present resources but also on the short- and long-term development of future energy supplies, especially by the residents of developing and underprivileged nations. This is crucial because the effective use and exploitation of these countries' energy resources is essential to their social and economic development.[8]

In the years to come, the globe may rely on solar energy as one of the most potent, secure, and almost limitless sources of energy.

Solar energy, put simply, is the energy that the sun emits and gathers somewhere else, often on the earth. Between 20- and 26-degrees north is where Bangladesh is located.

latitude and 88- and 92-degrees east longitude, and it enjoys enough of sunshine for at leasteight months out of the year.

There are 147,570 square kilometers of land there. This terrain receives 5 KW/m2 of solar energy annually on average, while there may be more bright sunny days in different locations. 7200 MWh of electricity are generated yearly at a total efficiency of 12% even if just 1% of this area is employed to harvest solar radiation. Here, there is too much electricity.[23]

Clouds, aerosols, and water vapor concentrations have the strongest impacts on air transmissivity, with astronomical, geographic, and climatic variables having a less but still significant impact. Between 15 and 35 degrees north, which is regarded as the "most favorable band" including the locations with the finest circumstances for solar energy applications, is where Bangladesh is situated. In this way, Bangladesh has access to a lot of solar radiation.

August 2022 — Sunset, Sunrise , length , angle and much more are given below :

2022	Sun				Solar Noon		Civil Twilight		Nautical Twilight		Astronomical Twilight	
Aug	Sunrise	Sunset	Length	Difference	Time	Mil KM	Began	End	Began	End	Began	End
1	5:27 am ↑ (70°) ENE	6:41 pm ↑ (290°) WNW	13:13:31	-1:0	12:04 pm (84.3°)	151.846	5:03 AM	7:05 PM	4:35 AM	7:34 PM	4:05 AM	8:04 PM
2	5:28 am ↑ (70°) ENE	6:40 pm ↑ (290°) WNW	13:12:30		12:04 pm (84.0°)	151.827	5:04 AM	7:05 PM	4:35 AM	7:33 PM	4:06 AM	8:03 PM
3	5:28 am ↑ (70°) ENE	6:40 pm ↑ (290°) WNW	13:11:29		12:04 pm (83.8°)	151.806	5:04 AM	7:04 PM	4:36 AM	7:33 PM	4:06 AM	8:02 PM
4	5:29 am ↑ (71°) ENE	6:39 pm ↑ (289°) WNW	13:10:27		12:04 pm (83.5°)	151.785	5:05 AM	7:03 PM	4:36 AM	7:32 PM	4:07 AM	8:01 PM
5	5:29 am ↑ (71°) ENE	6:39 pm ↑ (289°) WNW	13:09:23		12:04 pm (83.2°)	151.763	5:05 AM	7:03 PM	4:37 AM	7:31 PM	4:07 AM	8:00 PM
6	5:30 am ↑ (71°) ENE	6:38 pm ↑ (289°) WNW	13:08:19		12:04 pm (83.0°)	151.741	5:06 AM	7:02 PM	4:37 AM	7:30 PM	4:08 AM	8:00 PM
7	5:30 am ↑ (72°) ENE	6:37 pm ↑ (288°) WNW	13:07:14		12:04 pm (82.7°)	151.718	5:06 AM	7:01 PM	4:38 AM	7:30 PM	4:09 AM	7:59 PM
8	5:31 am ↑ (72°) ENE	6:37 pm ↑ (288°) WNW	13:06:08		12:04 pm (82.4°)	151.695	5:07 AM	7:00 PM	4:38 AM	7:29 PM	4:09 AM	7:58 PM
9	5:31 am ↑ (72°) ENE	6:36 pm ↑ (288°) WNW	13:05:01		12:03 pm (82.1°)	151.671	5:07 AM	7:00 PM	4:39 AM	7:28 PM	4:10 AM	7:57 PM

2.5 History

Trackers are used for level board photovoltaic structures to reduce the point of rate between approaching daylight and photovoltaic boards, also known as cosine error. The amount of energy provided by a certain measure of introduced power age limit is expanded by decreasing this point. It was estimated in 2008–2009 that trackers may be used in around 85% of commercial buildings with more exceeding one megawatt from 2009–2012 for conventional solar applications.[13]

Frameworks have been presented in a growing amount of utility size projects, where access trackers have been worked on for value, reliability, and execution. According to data from Wood Mackenzie/GTM Research, exports of sun-based trackers reached a record 14.5 gigawatts in 2017. This reflects a 32% year-over-year growth, with rapid or equivalent growth anticipated in large-scale sun-oriented enterprises.

Trackers are used to power optical components in concentrating solar power (CSP) and radiating photovoltaics (CPV) frameworks, respectively. The optics in solar-powered applications that are centered on the sun recognize the immediate portion of daylight and should be set up properly to retain energy. Because they are most effective at collecting solar energy when the optical pivot event is associated with solar radiation, global positioning systems are present in all concentrator applications.[2]

CHAPTER 3
MATERIALS AND METHODS [OR PROJECT/SYSTEM DESIGN] [OR DESIGN PROCEDURE]

3.1 Introduction

Created through the founding of the "Sun Tracking Solar Inverter System" business. Different minimal necessities, such as solar-powered chargers that provide 12 volts as a consequence, an Arduino Nano serving as the MCU, a servo motor, and two LDR sensor modules.

The project is being built on a PVC board foundation that was placed in the earth. The servo engine empty bar is nailed aside, and the tube-shaped bar is connected to the empty as a cross with iron bars on the two sides.

The solar-powered global positioning system's circuit is divided into three parts. The information stage consists of two LDR modules designed to create a voltage divider circuit, the driving circuit, which includes the DC engine, and a microcontroller modified by software called the Arduino ide that is put in the framework. It helps turn the solar-powered charger. driver of the engine.[10]

Three terminals are recognized, two for engine input/yield and one each for power. Two of the fourteen computerized input/yield pins on the Arduino board are connected to the info engine input terminal. The engine terminal is connected to the DC engine at the nanoscale and beyond. Two LDR sensor modules are connected to platforms that use straightforward Arduino information sources. The light-dependent resistors are then added to the length of the charger driven by sunlight's two sides.[11]

3.2 Block Diagram of the System

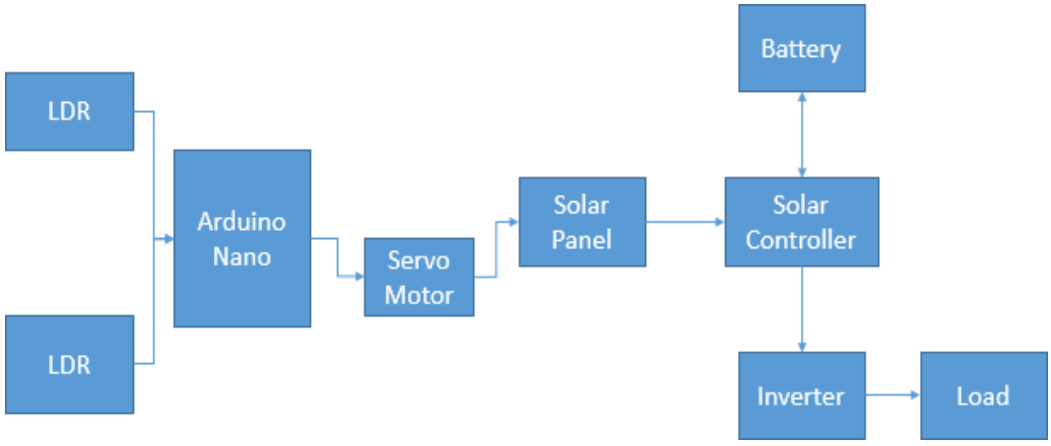

Figure 3.1: Block Diagram of the Project.

3.3 Solar Panel

A group of photovoltaic cells that are installed in a building for construction is known as a photovoltaic (PV) module, solar-powered electric board, photovoltaic cell board, or sunlight-based charger. Direct flow electricity is generated by solar chargers using daylight as their energy source. A PV board is a collection of PV modules, while a column is a configuration of PV boards. Electrical equipment gets solar energy from photovoltaic columns.[2]

Alexander-Edmund Becquerel recognized the potential for some accessories to generate electric charge from light opening in 1839. Even though these early solar-powered chargers were insufficient for simple electrical devices, they were nonetheless used as a tool for measuring light.

Discovered that this charge may be the result of selenium and light colliding. William Girls Adams and Richard Evans Day published "The Lighting Process on Selenium" in 1876 as a result of this revelation, in which they illustrated the basic steps used to replicate Smith's results.

Charles Fritz developed the first popular solar charger in 1881. Fritz described it as providing "constant, perpetual, and adequate power for openness to sun as well as for faint, diffused daylight."4) Nevertheless, they were solar-powered chargers. Genuinely constrained, especially in comparison to coal-fired power plants. Russell Ohl developed a sun-oriented cell design in 1939, and it is now used in several ultramodern solar-powered chargers. In 1941, he secured his strategy.

In 1954, this plan was first utilized by Bell Labs to make industrially possible siliconsun-based cells.

Mohammed M. Atala helped develop the technique for heated oxidation of silicon essence in 1957 at Bell Labs. Sun-derived energy (photons) is used by photovoltaic modules to generate electricity through the photovoltaic effect. The majority of extreme modules use wafer-mounted, clear line silicon cells or thin film cells. Either the higher subcaste or the opposing subcaste may be the major (freight carrying) member of the module. Cells need to be safeguarded against mechanical damage and moisture. Although most rigid modules are unbending, there are certain bones that are semi-adaptable that are supported by delicate film cells. In order to create the flow, cells are typically electrically connected to one another in series at the required voltage. The precise task of measuring module power (in watts) [26]

A PV intersection box serves as the device's main connecting point and is attached to the opposite of the solar charger. Most extreme photovoltaic modules include external connections that employ MC4 connectors to lubricate straightforward precipitation-safe connections with the rest of the framework.

Additionally, a USB power connection port can be used. In order to further support the board structure, sunlight-based chargers also employ embodiment methodologies that combine swirling variables, classes, glass forms, and sections. rows of PV module rows Only a little amount of electricity may be initiated by a single sun-based module. The wiring and PV system in the vast majority of extreme businesses are enhanced by various modules that boost voltage or current. The majority of photovoltaic systems have several solar modules, an inverter, a battery pack for energy storage, a charge controller, association wiring, circuit combers, wires, detachable switches, voltage measurements, and purposeful sun powered shadowing. There is a medium involved.[19]

There is a clear tendency to reduce power losses throughout projects, energy storage, impact transmission, and the switch from direct current to alternating current.

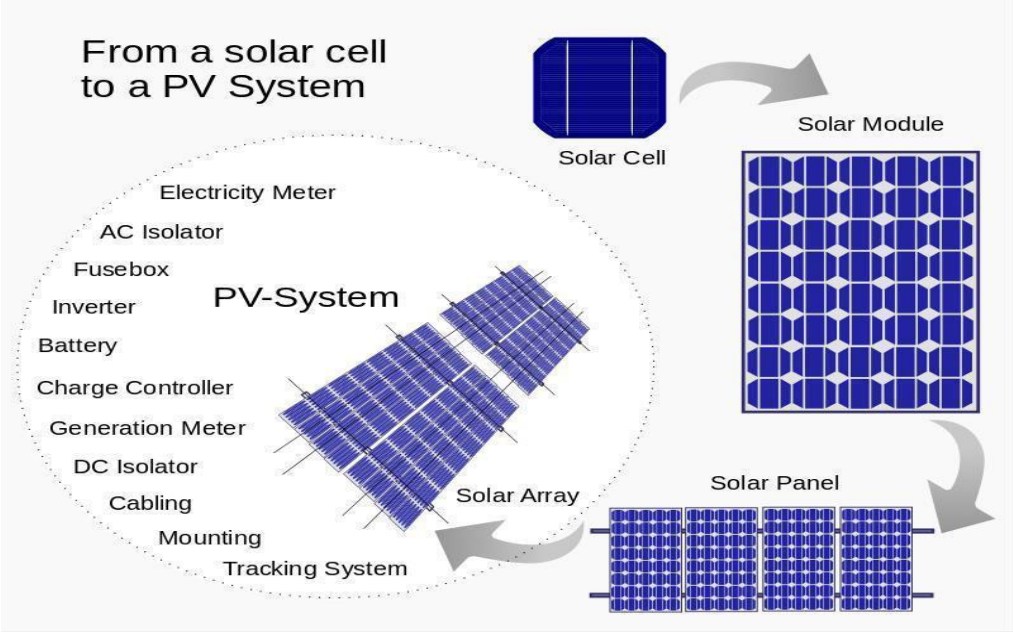

Figure 3.2: Solar Panel

3.4 LDR Sensor

An inactive component that reduces the barrier of a part to obtain light at a delicate surface is a photograph resistor, also known as a photocell, light-subordinate resistor, LDR, or photograph conductive cell. The opposition of the photo resistor decreases as the severity of the situation increases.

It exhibits photoconductivity as a result. Light-sensitive finder circuits, as well as light- and dim-actuated exchange circuits that function as opposition semiconductors, can be equipped with a photo resistor. A photoreceptor's resistance in darkness can be as low as a few megaohms (M), but in light, it can typically be as low as two or three hundred ohms. If the episode light on the camera resistor above a certain threshold, the photons absorbed by the semiconductor provide the trapped electrons with enough energy to jump into the transmission band.[28]

Because of this, opposition is reduced by the power that liberated electrons (and their punctured partners) direct. Between different devices, there might be substantial differences in the resistivity range and awareness of photo resistors. Furthermore, unique photoreceptors have a range of responses to photons within a given frequency spectrum.

The photoelectric device may be external or inside. An internal semiconductor, like silicon, is everything but an effective semiconductor since it contains its own charge transporter. The photone should have enough energy to excite electrons throughout the band hole in interior instruments since only the accessible electrons are in the valence band. Contaminations found in outside instruments, sometimes known as dupents, have a ground-level energy that is close to the transmission band.[29]

Low energy photons (long frequencies and low repetition), which are sufficient to move the device, can move it because the electron needs more space to bounce. Extra electrons would be available for transmission if some of its particles in the silicon test were replaced by phosphorus molecules (rottenness). An example of an outside semiconductor is shown here.

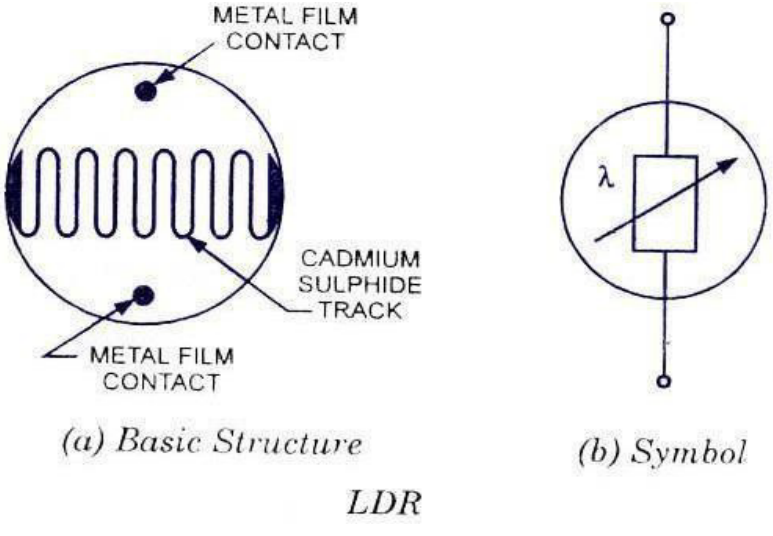

Figure 3.3: LDR System

3.5 Working Principle of Arduino Nano

The Arduino is a single-board microcontroller that enables the application to access an excessive number of duplicate items both within and outside of it. Open-source equipment board designed around a 32-bot Atmel ARM or equipment holding an 8-bit Atmel AVR microprocessor. The most recent models have a USB interface, 14 advanced I/O sticks, 6 basic information pins, and the ability to associate various association sheets.

The ATmega328 microcontroller is used in the Arduino Nano board. It contains 6 PWM yields, 14 computerized input/yield sticks, a 16 MHz artistic resonator, an ICSP header, a USB connector, 6 basic data sources, a power jack, and a reset button. This includes the necessary assistance for the microcontroller. These are first primarily connected to a PC by a USB cable, an AC-DC connection, or a battery. The FTDI USB-chronic driver chip is not used by the Arduino Uno Board, making it different from any other boards.[19]

The Atmega16U2 adapted as a USB to serial converter displays it. There are several types of Arduino sheets, including a suitable variety for outsiders. The Arduino Nano R3 and Arduino Nano V3 are the most powerful models. Demand for a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB flash memory, 14 advanced I/Os, and six simple I/Os has suddenly increased. These devices also don't appear to be running 32KB Windows. Arduino projects can run alone or be linked to the end result when the PC starts. The load up features a USB association for power and transmission and is timed by a 16 MHz ceramic resonator. You can often add a little SD card capacity for larger tasks.[5]

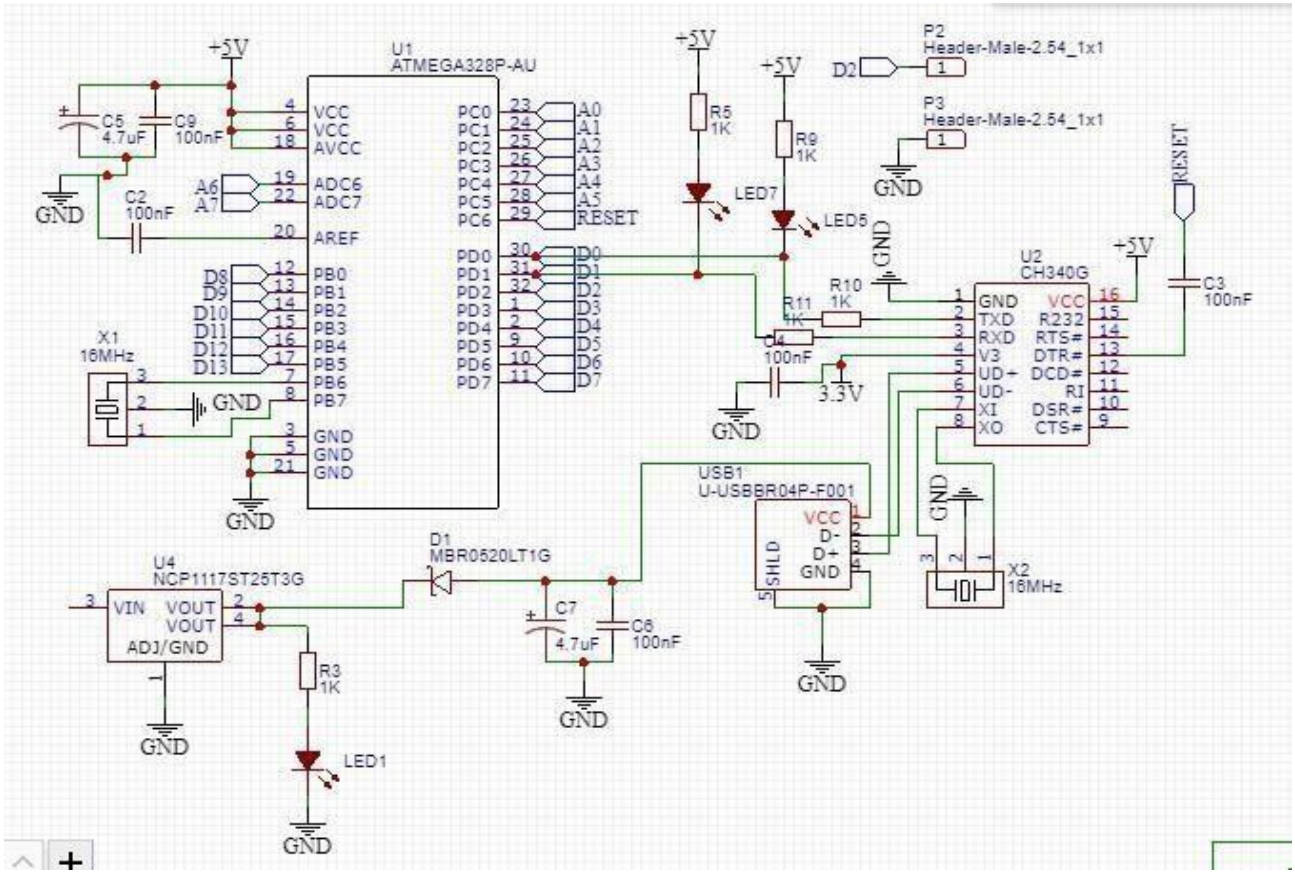

Figure 3.4: Circuit Diagram of Arduino Nano

3.5.1 Programming Software for Arduino Nano

The software standard is set using the Arduino IDE. The main website for Arduino hosts the IDE. It's free software. Therefore, anyone may create anything based on their preferences.

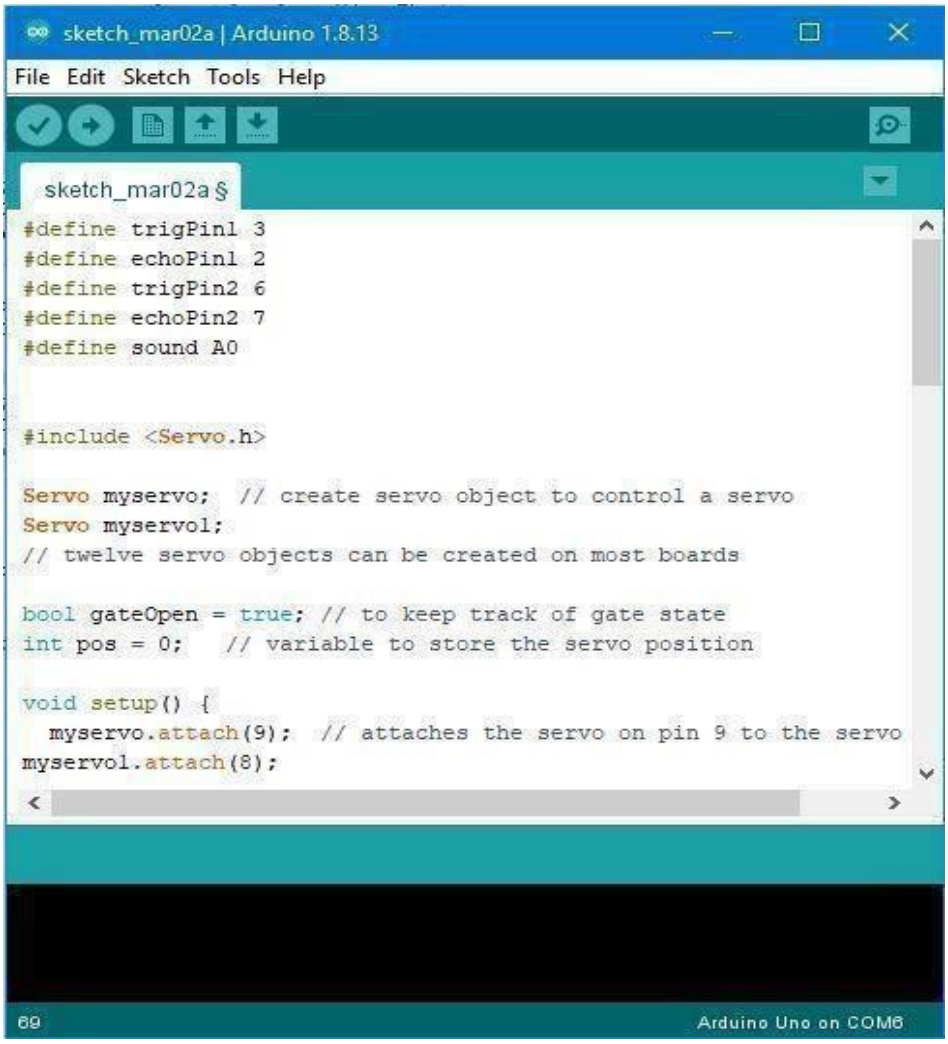

Figure 3.5: Arduino IDE Interface

3.6 Working Procedure

First, we use Arduino IDE and programming language C to create an Arduino Nano for our system. In front of our solar panel, we then attach two LDR. These LDRs are attached to the Arduino's pins A0 and A1. The D2 pin of an Arduino is connected to a servo motor. The solar panel is attached to the servo to power it. A 12 volt battery is also linked to the controller's battery port, and the load port is connected to a 12 volt to 220 volt converter. The supply is connected from the solar panel to the solar controller's panel port. We obtained the desired 220 volt AC output from the inverter's output.[21]

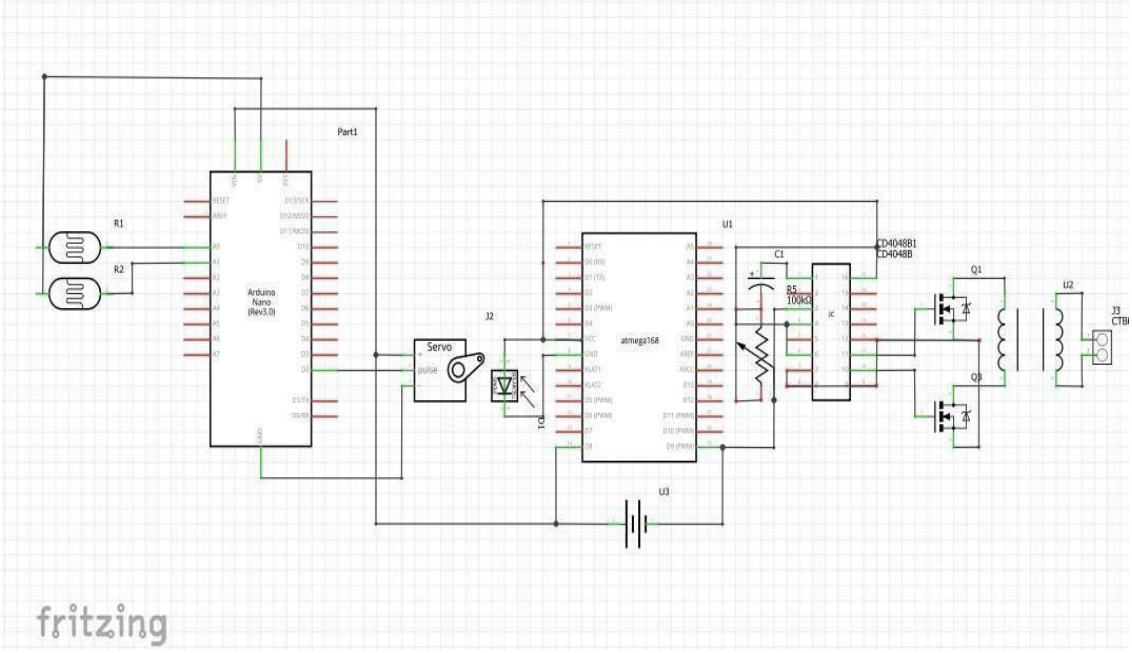

Figure 3.6: Circuit Diagram of the Project.

3.7 Instruments

We constructed the system using widely available electronic components. This system's primary processor is an Arduino. Our input devices are the GPS module, IR proximity sensor, LDR sensor, Gyroscope sensor, and LDR sensor. The output device we use is a GSM module and a display.

Two LDRs, a solar panel, a servo motor, and an ATmega328 microcontroller make upthe Sun tracking solar panel.

There are two light-dependent resistors arranged in a row on the solar panel's borders. Light-dependent resistors produce low resistance when exposed to light. The servo motor that is connected to the panel causes it to rotate in the direction of the Sun. The panel is positioned to allow comparison of the light coming from two LDRs, and it is then turned in the direction of the LDR that has the greater intensity and lower resistance. A servo motor aids in the panel's rotation.[5]

When the light intensity on the right LDR is higher than the left LDR, the panel gently slides to the right, and when the left LDR is brighter than the right, it slowly goes to the left. The brightness of both panels is equal at noon, when the Sun is over the horizon. In such cases, the panel doesn't rotate and stays in place.

3.8 Hardware Description

Servo motor, LDR sensor, battery, inverter, solar panel, solar controller, and Arduino Nano are among the pieces of hardware utilized in this project. Below is a description of each piece of equipment.

3.8.1 Arduino Nano

The open-source Arduino Nano microcontroller board, developed by Arduino, is typically used. It is based on the Microchip ATmega328P microprocessor. The Arduino Nano has already been covered on pages 15 and 16.

Features

Microcontroller	: ATmega328P
Operating Voltage	: 5V
Input Voltage (recommended)	: 7-12V
Input Voltage (limit)	: 6-20V
Digital I/O Pins	: 14 (of which 6 provide PWM output)
PWM Digital I/O	: Pins 6
Analog Input Pins	6
DC Current per I/O Pin	: 20 mA
DC Current for 3.3V Pin	: 50 mA
Flash Memory	: 32 KB (ATmega328P)
SRAM	: 2 KB (ATmega328P)
EEPROM	: 1 KB (ATmega328P)
Clock Speed	16
Length	: 68.6 mm

Areas of Application

1. Traffic Light Countdown Timer

2. Parking Lot Counter

3. Weighing Machines

4. Medical Instruments

5. Emergency Light for Railway

6. Window Aircon controller

7. Washing Machine

8. Microwave Oven

9. Security Systems

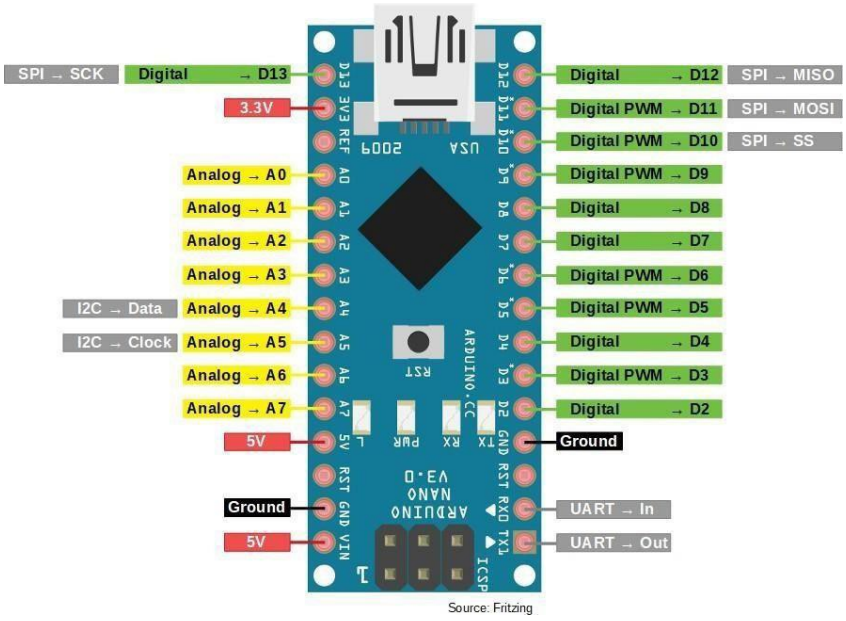

Figure 4.1: Pin Description of Arduino Nano

3.8.2 Inverter

A power electronic device or circuit that converts direct current (DC) to alternating current (AC) is known as a power inverter or inverter. The specific equipment determines how frequently the AC power is given. Inverters function instead of "converters," which are actually very large electromechanical devices that change alternating current to direct current. And the overall power handling depends on the design of the particular device or circuit.[18]

Current is not delivered by the inverter. DC power is installed. Power inverters can combine mechanical or entirely electronic effects (such as reversing devices) with an electrical circuit. The majority of power applications involving high current and high voltage use power inverters. Oscillators are circuits that provide a similar function for electronic signals and often have incredibly low flows and voltages.[24]

Rectifiers are circuits that perform the opposite task of converting substituting current to coordinated current. Converter Information: Systems Converter Shorthand: Converter Power: 360 Watts

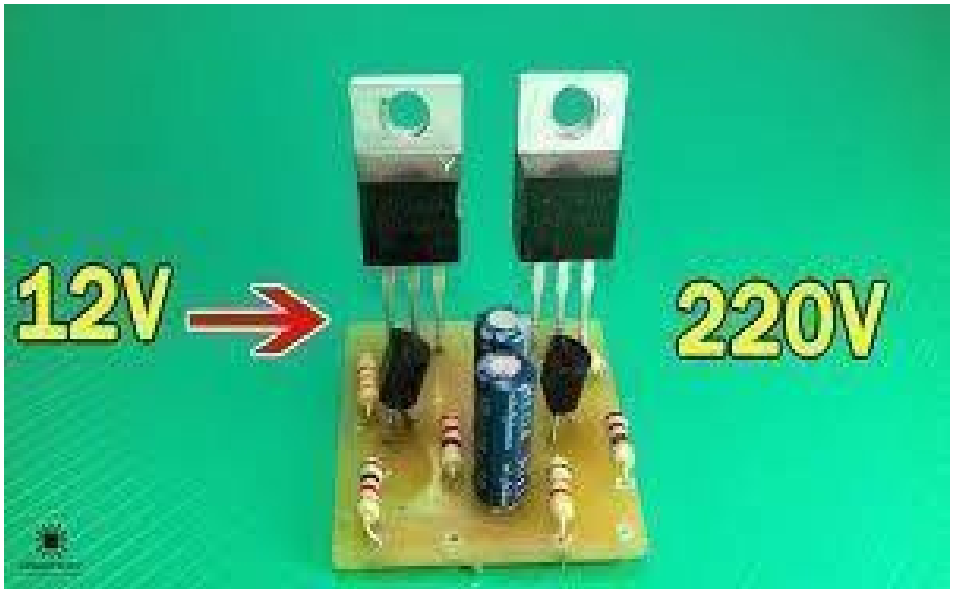

Figure 4.2: Inverter Circuit

3.8.3 Solar Panel

The source of solar energy is the sun. Sun-powered energy boards (also known as "PV boards") are used to convert daylight into electricity, which is made up of energy particles called "photons" that carry electrical loads. able can be used for driving.

Sunlight-based chargers may be used for a wide range of applications, such as remote power systems for hotels, broadcast communications equipment, remote sensing, and, obviously, power generation through domestic and commercial sun-oriented power systems. On this page, we'll talk about the variety of solar-powered chargers' experiences, innovations, and benefits.[5]

We'll examine how solar-powered chargers' function, how they're built, how they generate electricity, and where you can get them. A Synopsis of Solar Panel History The photovoltaic effect was discovered by Edmund Beckrell. Over a century has passed since solar energy technology was improved.

In the good old days, solar energy was mostly used to generate steam, which was then used to power equipment. However, it wasn't until Edmund Becquerel discovered the "photovoltaic impact" that allowed for the conversion of sunlight into electrical energy.

When Bakeryl was discovered, Charles Fritz was inspired to create the first real solar-powered cell, which was constructed by overlaying selenium with a thin coating of gold. Additionally, this humble beginning will result in the creation of the device known as the Solar Panel. The first silicone sunlight-based cell was granted a license by Russell Ohl, an American inventor working for Bell Laboratories, in 1941.[5]

Ohl's invention inspired the company to produce the first solar-powered charger in 1954. Satellites in orbit have used solar-powered chargers on a regular basis. The primary solar-powered charger of many people's lives was probably put in their brand-new adding machine in the 1970s.

The regulation of a variety of uses is now accomplished by means of sunlight-based chargers and full solar charger systems. Solar-powered cells are still used in number crunchers, therefore solar-powered chargers are definitely a thing. They are also used to provide sun-oriented capacity to entire residences and commercial buildings, such as Google's California headquarters.[2]

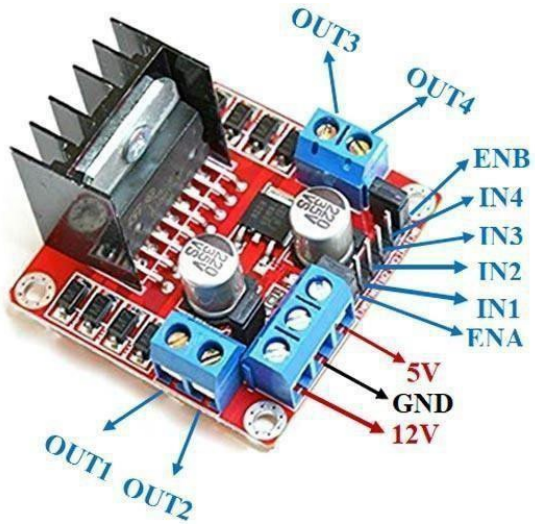

Figure 4.3: Solar Panel

3.8.4 Servo Motor

The control circuit, servo engine, shaft, potentiometer, driving pinion wheels, speaker, and either an encoder or solver are some of the components that pertain to servo engines in a free-flowing circular framework. A servo engine is a tone-made electric device that spins machine passage with exceptional sufficiency and extreme finesse.

In contrast to a typical engine, this one allows the issue shaft to be moved at a precise angle, speed, and location. The servo engine makes use of a regular engine and connects it to the locator for positioning feedback. The controller is the primary component of the servo engine that is specifically designed and used for this purpose.[1]

The servo engine is a free-circulation medium that fuses positional input to regulate rotational or direct speed and position. The amount of mix that addresses the shaft's final order position is determined by an electrical sign, either basic or sophisticated, which controls the engine's speed. an encoder kind that functions as a speed and position input finder. The engine package, which is often equipped with a material structure, has the circuit elevated right inside of it.[21]

Figure 4.4: Servo Motor

3.8.5 Solar Controller

A charger controller or charge regulator is chiefly a voltage and additionally current regulator that keeps batteries from cheating. It controls the voltage and current coming from the sun powered chargers going into the battery. Utmost"12 volt" boards charge around 16 to 20 volts, so assuming there's no guideline, batteries will be harmed by cheat. Most extreme batteries bear about 14 to14.5 volts to be totally charged. Do I generally require a charge controller? Not consistently, yet all the same overall. Though inconsistently, ultimately, they are all the same.

Most of the time, no charge controller is needed to destroy charge boards, similar to 1-to-5-watt boards, or to preserve them. A strict rule is that you don't need it if the board generates 2 watts of power or less for each 50 amp-long stretch of battery. For reference, a typical compact golf car's battery has a capacity of roughly 210 amp-hours. Therefore, you need a board with roughly 4.2 watts to retain one of these series dyads (12 volts) for preservation or storage purposes alone. Well-known 5 watt boards are near enough and won't need a controller.But if you stick with AGM deep cycle, you may use a lesser board of 2 to 2 watts, comparable to the Concorde Sun Xtender.[3]

Why are boards for 12-volt systems 17 volts? Furthermore, the objectionable query "Why weren't the boards raised for only 12 volts?"The rationale is that if you follow these instructions, the boards may be able to provide electricity while cool, in fantastic condition, and in direct sunlight. In the worst environments, you can't rely on this product. The boards must provide some extra voltage so that when the sun is low in the sky, there is heavy fog, a pall of cloud cover, or it is really hot outside, you can actually get some work done by the board.[12]

The board must be kept out at a minimum under such absurd situations because a fully charged "12-volt" battery is around 12.7 volts very still (typically 13.6 to 14.4 cheated). * In contrast to spokes, solar-powered chargers function effectively in colder climates. A 100 watt board would be equivalent to an 83 watt board at 110 degrees at room temperature. specific information about MPPT charge controllers. When the battery is needed, the charge controller regulates the board's 16 to 20 volt output. Depending on the battery's charging condition, battery type, and other factors, this voltage will change from around 10.5 to 14.6.[29]

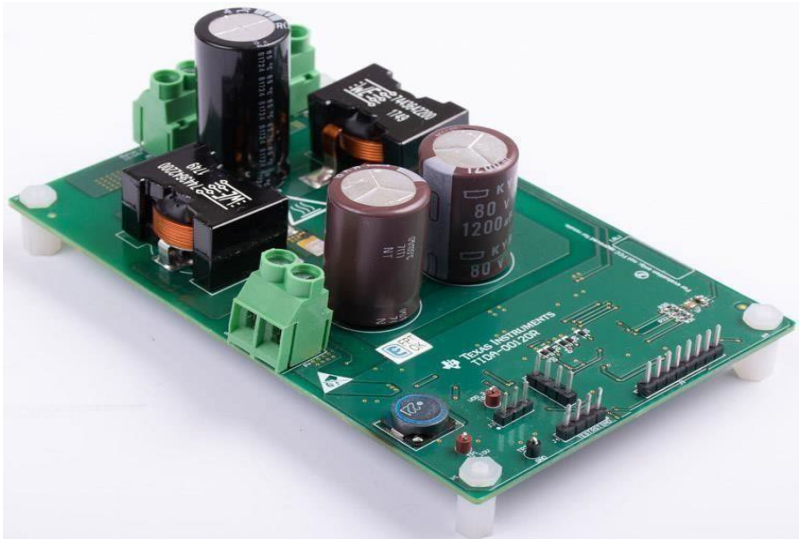

Fig. 4.5: Solar Controller

3.8.6 Connecting wires

A path for electricity to flow from one end of the circuit to the other is needed for the connecting wire. Copper or aluminum make up the majority of connecting wires. Copper has a low price and is very conductive. Silver, which has a high conductivity but is highly expensive to use, can be used in place of copper. Wire connectors from male to female, female to female, and male to male have all been used in this project.

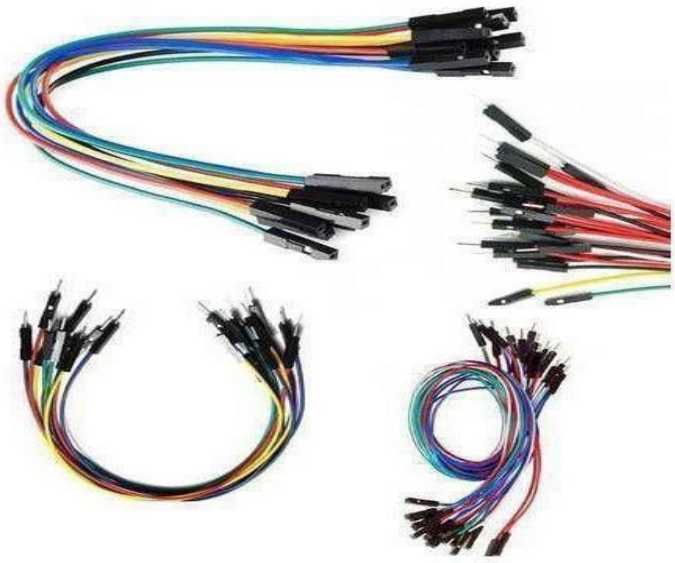

Fig 4.6: Connecting wires

3.8.7 Battery

A battery is a source of electrical energy made up of one or more electrochemical cells connected to the outside world. The battery has a positive terminal cathode and a negative terminal anode when it is managed. A source of electrons flowing through an external electrical circuit to a positive terminal is known as an adversely named terminal.[30]

The redox reaction converts high-energy reagents into low-energy materials whenever the battery is connected to an external electrical load, and the difference in free energy is transferred as electrical energy to the external circuit. All things considered, even if its use has expanded to include single cell devices, the term "battery" still specifically refers to a device made up of many cells. Batteries that are necessary (disposable) or "expendable" are used just once before being discarded since the terminal material changes permanently upon release.[19]

Basic batteries, which are used in many flashlights and practical electrical devices, are a classic example. The applied electric flow can be used to release and re-energize auxiliary (battery-powered) batteries several times.

By using switch current, the cathode's original design may be restored. Models include lithium-particle batteries used in practical devices like workstations and mobile phones as well as lead-corrosive batteries used in automobiles. Batteries come in a variety of sizes and forms, including small cells used in mobile phones, large lead-corrosive or lithium-ion batteries, and the largest battery banks. Small cells are also used in powerful portable amplifiers and timepieces.[10]

Room estimations that enable phone trades and PC server farms in times of need. Comparing batteries to conventional fillers like petroleum, batteries have a far lower explicit (energy per unit mass). In relation to automobiles, this is partially due to electric engines' superior ability to convert energy into mechanical work as compared to gas-powered motors. Battery Information the generic Lead acid battery, 108 Wh Voltage nominal: 12 Volt 108Wh, nominal capacity.[29]

Fig 4.7: Battery

3.8.8 LDR Module

Other names for the light-dependent resistor (LDR) are print resistor and cadmium sulfide (CdS) cell. It is also known as print skipper. A print cell primarily lowers the bar for photoconductivity. The open component mostly consists of a resistor, whose opposition value decreases as light intensity increases.

This optoelectronic device is heavily used in circuits for light and extremely powerful exchanging as well as bright light indication systems. Some of its duties include out-of-entryway watches, intelligent bank reprimands, street lights, watch radios, light beam recommendations, and camera light measurements.[20]

Fig 4.8: LDR

3.9 Project Physical View

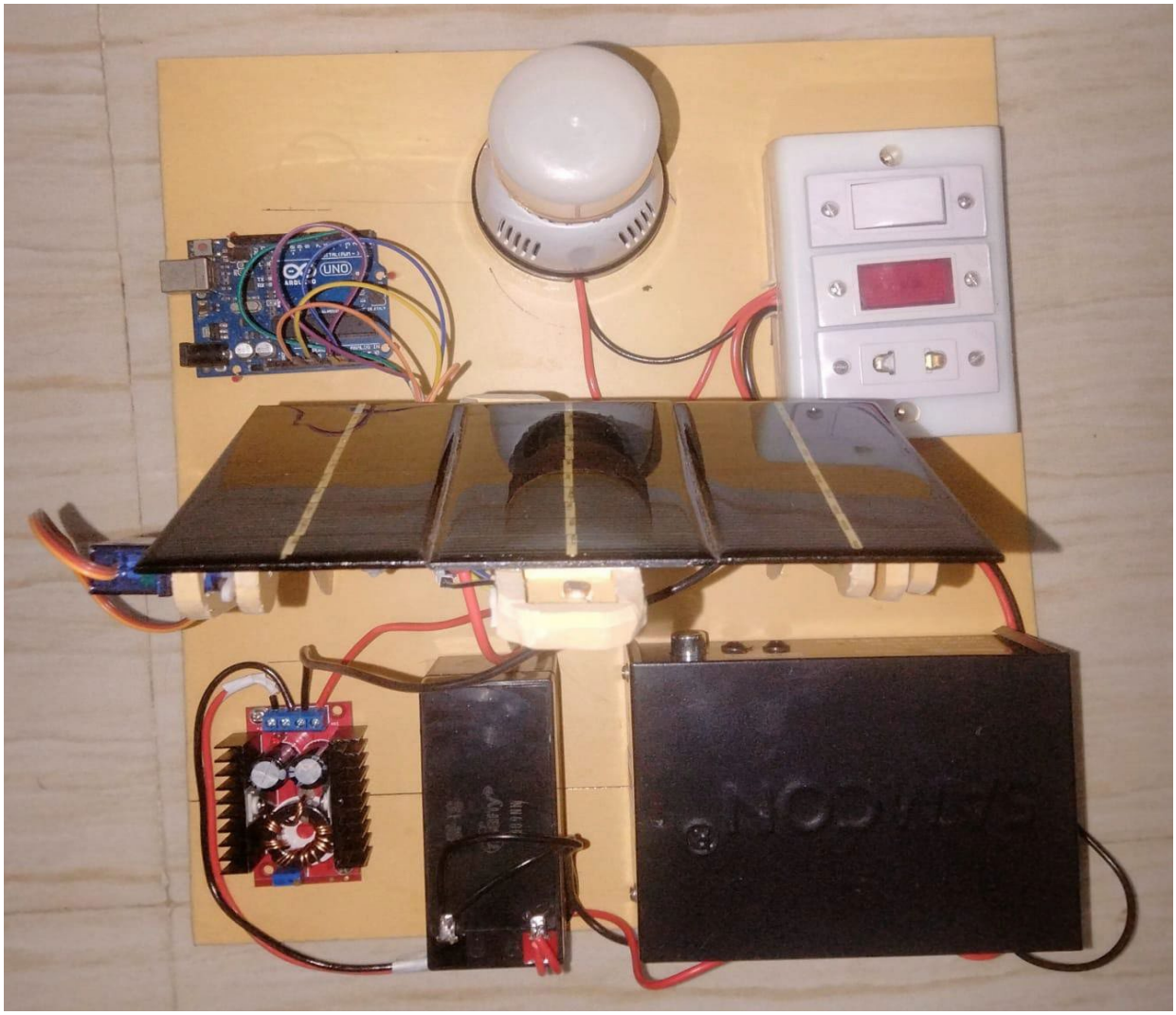

Fig 4.9: Project Outlook

3.10 Video Link

https://drive.google.com/file/d/1RCqTmYDPzdSV2FvqEuWDNAYKg7EwHmmU/view?usp=drivesdk

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Introduction

Imaginative design for solar-powered chargers. The creation of several solar-powered warm-land PV systems has demonstrated that there are two types of sun trackers: single hub and double hub, actis or aloof trackers. The result confirms this at elevation. is founded. More effective sun powered trackers have a double pivot. According to test results, the potential for producing solar-powered chargers has increased by at least 5%.[2]

This rate is calculated after subtracting all of the energy used. Framework and endeavor for global positioning. Towns without electricity can make use of this tactic. It might be quite expensive to connect them to the public framework. So it's possible that it is. a form of decentralized racing that is used. It evolves. Trust. Mistake removal time is cut down since it isn't. connected to an intricate matrix

4.2 Discussions

Solar energy is that which comes from the sun. Whether you know it or not, the sun already illuminates our world and supplies the energy needed to maintain both the environment and human growth. All of human needs, plus a few more, may be met by the sunlight that enters the earth's atmosphere.In contrast to fossil fuels, the sun has more than enough energy to supply the entire world's energy demands, and it won't run out anytime soon. The sole constraint on solar energy as a renewable resource is our capacity to efficiently and economically convert it to electricity.[25]

We employ a solar panel, a ldr, an Arduino Nano, an inverter, a servo motor, a solar controller, a battery, and other components in our project. Here, we harness solar energy (light from the sun) and turn it into electrical energy. The PV cells on a solar panel capture the energy from the sun's rays as it shines on the panel. In reaction to an internal electrical field within the cell, this energy generates electrical charges that move, which results in the flow of electricity.

In Bangladesh, a sizable section of the population still doesn't have access to grid power and lives in rural, isolated, and mountainous locations. Due to its reduced cost and simpler installation process, solar household systems have gained a lot of appeal in order to meet these people's electrical needs. Due to Bangladesh's rising industrialization, automation, and urbanization, the country has an increasing need for energy. Furthermore, roughly 30% of its entire population, who reside in rural regions, still lacks access to grid energy. Making power from renewable energy sources, particularly solar energy, can help to reduce this energy constraint.[30]

Installing a 1 MW solar-powered power plant typically requires 3.5 to 4 acres of land. For a tiny but densely populated nation like Bangladesh, this high land usage really appears to be a major concern. Therefore, the Bangladeshi government promotes the installation of solar power producing facilities on building rooftops and in open areas.

Mini grid is defined as 10 MW. Because it may supply power generated by solar panels to home owners who installed them and distribute the remaining electricity to other customers in areas with limited access to electricity, solar micro grids are becoming more and more popular in developing nations. IDCOL has thus far put in place 26 solar micro grids with a total installed capacity of 5 MW. In Bangladesh's rural areas, these small grid initiatives have successfully brought energy to 16,000 people. The solar micro grid initiatives of IDCOL are receiving financial backing from organizations including the World Bank, JICA, USAID, and ADB.[24]

This project may be used to meet the electrical needs of our houses, offices, etc. We may use this on the rooftop of our home. We have the option to use the open area or solar panels in our workplace, such as Daffodil International University. In our country, there is a lot of load shedding. We can simply remedy the problem by adopting renewable energy sources, such solar electricity.

There were several solar projects at DIU, including solar cars. The 'Solar Car' was created by the "Yes You Can" team of 22 students from Daffodil International University's Department of Computer Science and Engineering. The 'Yes You Can' Team, a group of young and gifted kids, developed the concept for the "Solar Car" (7' long X 4' broad) as part of the world's transition to green technology. This is a fully functional, two-seat solar automobile that is propelled by environmentally friendly technologies.

CHAPTER 5
PROJECT MANAGEMENT

5.1 Task, Schedule and Milestones

Because it is environmentally friendly, emits little carbon dioxide, and has nearly no manufacturing costs, the use of renewable energy has recently attracted a lot of attention. They have an infinite supply; thus they may be used again. Bangladesh is extremely lucky to have a vast array of renewable energy sources, which might be crucial in meeting the nation's current and future energy needs. Bangladesh has access to a variety of renewable energy sources, including solar, wind, biomass, hydropower, geothermal, and biogas. By 2030, the Bangladeshi government hopes to generate 4190 MW of power from these renewable resources.

Milestones are used to monitor all of your project's significant touchpoints. Some of these could be outlined in your contract as conditions for completion, while others can just be critical junctures in the project that you want to keep an eye on. Everyone should be informed on the milestone list which milestones are necessary and which are not.

1. Step 1: Site Survey
2. Step 2: Leveling of site
3. Step 3: Site after leveling
4. Step 4: Marking of mounting structure
5. Step 5: Drilling Holes for Foundations
6. Step 6: Solar Foundations
7. Step 7: Adjusted frame of solar panel
8. Step 8: Fitting of Module & Alignment
9. Step 9: DC Cable laying and conduit dressing
10. Step 10: Control Room
11. Step 11: Measure of tilt angle
12. Step 12: Transmission line for solar plant
13. Step 12: Transmission line
14. Our Services

5.2 Resources and Cost Management

Commercial solar system maintenance costs are minuscule in comparison to the many benefits of lighting, ventilation, equipment power supply, etc. derived by installing them. That said, the costs of solar PV maintenance and operations are dependent on:

1. Location: controlled access, remote or for restricted hours of operations
2. Type of solar panel system: ground mounted, roof-top, fixed vs. tracking, etc.
3. PV components: number of combiners and solar modules, type and number of inverters, number of transformers, etc.[13]
4. Cover provided by the warranties in place*:* environmental conditions like salt air, humidity, heat, pollen, sandy location, population of birds, industrial emissions, heavy insolation, presence of construction sites in proximate locations, etc.

Given the scenario of heavy usage and high electricity bills, in-house solar power plants in the form of captive models and/or off-site solar farms are becoming the first choice for industries. These solar energy producing units are useful during times of peak loading of grids, which result in power outages. Additionally, they eliminate the high tariff rates applicable at peak hours.

5.3 Lesson Learned

Even if a jury of my peers would not find me guilty, I still feel terrible after all these years.

I passed on a good thought from one solar installation to another in May 2006. On the south and west sides of my La Mesa roof, five business representatives had offered wild arrangements with panels.

Another option was put out by Clean Power Resources, a now-defunct Poway-based business. Why not keep the system straightforward? Install the panels on slanting aluminum racks and span your terrace in the backyard.

For a 5,100-watt system, the firm representative offered $44,000. I asked the other bidders through email, claiming that a neighbor had given me the idea: How much would you charge for the similar setup? $41,000, DSH Solar Electric retorted. I contributed Clean Power Resources.[34]

CHAPTER 6

IMPACT ASSESSMENT OF THE PROJECT

6.1 ECONOMICAL, SOCIETAL AND GLOBAL IMPACT

Home and business owners are liberated from having to rely only on their local utility system when they use solar power to produce electricity. People in some areas are frequently kept in the dark on a regular basis since their utility cannot meet their demands due to stress.

Solar energy is a renewable resource that plays a significant part in lowering greenhouse gas emissions and preventing climate change, which is essential for safeguarding people, animals, and ecosystems. Additionally, the usage of solar energy can minimize water use and enhance air quality.

6.2 Environmental and Ethical Issues

Depending on the technology, which falls into one of two broad categories: photovoltaic (PV) solar cells or concentrating solar thermal plants (CSP), the potential environmental effects of solar power land use and habitat loss, water use, and the use of hazardous materials in manufacturing can vary significantly.

6.3 Utilization of Existing Standards or Codes

For your house or place of business, solar panels are a terrific method to produce clean, renewable energy. However, you must adhere to the laws and regulations that guarantee their performance and safety before you install them. You will discover the essential criteria and safest techniques for solar panel installation in this post.

You might need to adhere to various norms and rules for solar panel installation depending on where you reside. For instance, some states and localities have particular regulations for electrical wiring, fire safety, roof-mounted equipment, permits, and inspections. Before beginning any project, you should verify with your local government and utility company. The National Electrical Code (NEC), the International Building Code (IBC), and the International Fire Code (IFC) are only a few of the national regulations that apply to solar panels. These codes establish the requirements for solar panel system design, installation, and upkeep.

6.4 Other Concerns

Some PV cell technologies employ heavy metals, and after their useful lives are up, these cells and PV panels may need to be handled differently. Some solar thermal systems employ potentially dangerous fluids to transmit heat; if these materials leak, the environment might be harmed.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The sun is the source of solar energy. Whether you are aware of it or not, the sun already provides light and energy to keep the environment and human development healthy. The sunlight that reaches the earth's atmosphere may provide for all of human requirements as well as a few additional ones.The sun contains more than enough energy to meet the entire world's energy needs, and it won't run out any time soon, unlike fossil fuels. Solar energy's only limitation as a renewable resource is our ability to effectively and affordably turn it into power.

In our project, we use a battery, an Arduino Nano, an inverter, a servo motor, a solar controller, a solar panel, and other parts.[26]

In Bangladesh, a sizeable portion of the populace still lives in remote, hilly areas without access to grid power. For these people's electricity demands, solar home systems have become quite popular due to their lower cost and easier installation procedure. Bangladesh's requirement for energy is expanding as a result of the nation's growing industrialisation, automation, and urbanization. Additionally, 30% of the country's population, who live in rural areas, still lacks access to grid electricity. This energy limitation can be eased by producing electricity using renewable energy sources, notably solar energy.[20]

Typically, 3.5 to 4 acres of land are needed for the installation of a 1 MW solar power plant. For a small but populous country like Bangladesh. It looks that land use is a serious topic. As a result, the Bangladeshi government encourages the development of solar power generation equipment in open spaces and on the rooftops of buildings.

A 10-MW mini grid is considered one. Solar micro grids are gaining popularity in developing countries as a result of their ability to both deliver power generated by solar panels to house owners who installed them and disperse the remaining electricity to other customers in areas with limited access to electricity. 26 solar micro grids with a combined installed capacity of 5 MW have been erected by IDCOL thus far. These tiny grid projects in Bangladesh's rural areas have been effective in providing energy to 16,000 people. Organizations like as are providing financial support for IDCOL's solar micro grid programs.[25]

We may utilize this project to fulfill the electricity requirements for our homes, workplaces, etc. We could utilize this on our house's rooftop. We have the choice of using solar panels or an outdoor space at work, like Daffodil International University. There is a lot of load shedding in our nation. Adopting sustainable energy sources, such solar electricity, will easily solve the issue. At DIU, there were several solar-related initiatives, including solar automobiles. The "Yes You

Can" team of 22 students from the Department of Computer Science and Engineering at Daffodil International University developed the "Solar Car." The idea for the "Solar Car" (7' long X 2' wide) was created by the youthful and talented "Yes You Can" Team a component of the global shift to green technologies. This is a two-seat solar vehicle that is completely operational and powered by green technologies.

7.2 New Skills and Experiences Learned

1. Even though solar energy can be used to the fullest extent possible, this could cause issues during the rainy season.
2. Despite the fact that solar energy may be stored in batteries, these devices are bulky, take up more room, and need to be replaced periodically.
3. They are expensive.

7.3 Future Recommendations

1. We will add IoT in future.
2. We will add AI for better accuracy.
3. Use more accurate LDR sensor for better accuracy.

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APPENDIX A

TURNITIN REPORT

Turnitin Originality Report

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APPENDIX B

COMPLEX ENGINEERING PROBLEM SOLVING AND ENGINEERING ACTIVITIES

Complex Engineering Problems (P) Solving		
	Attributes	Statement from students
P1	Range of resources	Solar radiation is a broad word for the electromagnetic radiation that the sun emits. It is also sometimes referred to as the solar resource or just sunshine. A multitude of devices may be used to collect solar radiation and transform it into usable forms of energy, such as heat and electricity.
P2	Level of interaction	The LDR traking the light and roted the solar panal .Then it abjorbe the energy and processing the energy inverter (220)v.
P3	Innovation	Renewable Energy and Power Standards
P4	Consequences of society and environment	As a renewable source of power, solar energy has an important role in reducing greenhouse gas emissions and mitigating climate change, which is critical to protecting humans, wildlife, and ecosystems. Solar energy can also improve air quality and reduce water use from energy production.
P5	Familiarity	Solar panel purchases are mostly motivated by monthly energy savings, according to 48% of homeowners.
P6	Extent of stakeholder involvement and conflicting requirements	The stakeholders' queries and worries regarding solar energy are likely to fall into a few distinct categories, despite the fact that they will all have diverse points of view. The following discussion includes a few of the typical problems that might arise throughout the stakeholder engagement process.
P7	Interdependence	Project developers, installation businesses, component producers, and other trade workers including roofers, HVAC installers, and electricians are some of the stakeholders in the solar sector. These firms may be headquartered locally or aim to grow their operations in the neighborhood.

Complex Engineering Problems (P) Solving		
	Attributes	Statement from students
A1	Depth of knowledge required	Observe portfolios from a single dashboard. Improve the performance of your portfolio. Manage solar assets while increasing electricity generation and streamlining O&M processes (CMMS). Strong & Secure. monitoring many energies. trustworthy and safe monitor. (CMMS) Reduce downtime Boost efficiency. rapid and easy monitoring. any collection of data. Bring in more returns. flexible surveillance.
A2	Range of conflicting requirements	Always have a battery or power supply with twice as much capacity as you need for the day. For instance, if you use 30 to 50 amps per day, your battery or power supply has to be at least 70-to- 100-amp hours. The battery will need to be twice as large because the solar panel(s) will be what powers it.
A3	Depth of analysis required	The majority of common commercial panels have physical dimensions of around 77 by 39 inches and a thickness of roughly 1.5 inches. The majority of home solar panels have dimensions that are standardized at 60 cells, 65 by 39 inches in area, and 1.5 inches in thickness.
A4	Familiarity of issues	They won't produce electricity at night when you need it for light and they can be inefficient during storms and gloomy days. Your solar energy system needs batteries if you plan to fully depend on solar energy to power your home.
A5	Extent of applicable codes	A light-dependent resistor is used as a light sensor to detect sunlight, the Arduino microcontroller serves as the system's primary controller, and the servo motor rotates the solar panel so that it faces the sun. The solar tracking system prototype was constructed and put to the test.

APPENDIX C
PROGRAM CODE

```
#include <Servo.h>

Servo myservo;

 #define ldr1 A0 // set ldr 1 Analog input pin of East ldr as an integer

 #define ldr2 A1 // set ldr 2 Analog input pin of West ldr as an integer

int pos = 90; // initial position of the Horizontal movement controlling servo motor

int tolerance = 20; // allowable tolerance setting - so solar servo motor isn't constantly in motion

void setup(){
 myservo.attach(6);
pinMode(ldr1, INPUT);
pinMode(ldr2, INPUT);
myservo.write(pos);
       delay(1000);
Serial.begin(9600);
}

void loop(){

int val1 = analogRead(ldr1); // read the value of ldr 1
int val2 = analogRead(ldr2); // read the value of ldr 2

 Serial.print("LDR1 = ");
 Serial.print(val1);

 Serial.print("LDR2 = ");
 Serial.println(val2);

 Serial.print("servo = ");
 Serial.println(pos);

if((abs(val1 - val2) <= tolerance) || (abs(val2 - val1) <= tolerance)) {

//no servo motor horizontal movement will take place if the ldr value is within the allowable tolerance

}
else {

if(val1 > val2) // if ldr1 senses more light than ldr2

{
```

```
 pos = pos+1; Serial.println("Increase");// decrement the 90 degree poistion of the horizontal servo motor - this will move the panel position Eastward

 }


 if(val1 < val2) // if ldr2 senses more light than ldr1

{
 pos = pos-1;Serial.println("Decrease"); // increment the 90 degree position of the horizontal motor - this will move the panel position Westward
 }
}

if(pos > 143) {pos = 143;} // reset the horizontal postion of the motor to 180 if it tries to move past this point

if(pos < 38) {pos = 38;} // reset the horizontal position of the motor to 0 if it tries to move past this point

myservo.write(pos); // write the starting position to the horizontal motor delay(50);

}
```

APPENDIX D

DATASHEET OF COMPONENTS

Name:	Number:	Rating:
LDR	2	
Solar Panel	3 (5v) Series Connection	15v
Solar Controller	1 (DC-DC)	12v
Inverter Circuit	1 (DC-AC)	12v to 220v
Battery	1	12v
Wires		Male-Female, Female-Female, Male-Male
Arduino Nano	1	Input 5v
Servo Motor	1	Mini
Switch Board	1	
Light	1	AC 7w
Resistance	2	