THERMOELECTRIC CONCENTRATOR

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PROJECT - II

Report on

THERMOELECTRIC CONCENTRATOR

Submitted in fulfillment of the requirements

of the degree of

Bachelor of Engineering
(Electronics and Telecommunication Engineering)

by

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"THERMOELECTRIC CONCENTRATOR "

is a bonafide work done by

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Declaration

We wish to state that work embodied in this dissertation entitled "**ThermoElectric Concentrator**" has been carried out under the guidance of "Mrs.Debajani Mahanta" at Department of Electronics and Telecommunication Engineering, Ramrao Adik Institute of Technology during 2019-2020.

We declare that the work being presented forms my own contribution and has not been submitted for any other Degree or Diploma of any University/Institute. Wherever references have been made to previous works of others, it has been clearly indicated. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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A renewable resource is a resource that can be naturally replaced and used several times. Renewable energy never ends, for example: solar energy provides heat from the sun and never runs out. Collecting and using renewable resources generally does not cause pollution and benefits for global warming. The use of renewables and energy is increasing worldwide, and some countries, such as Bhutan and the United States, such as California, are beginning to rely fully on renewables. Sunlight based vitality is the brilliant light and warmth from the sun that is utilized by various ever-developing advancements, for example, sun based warming, photovoltaics, sun based warm vitality, liquid salt force, and counterfeit photosynthesis

In today's fast-paced world, electricity generation and consumption play an important role without affecting the nature of the environment. To achieve the environment-friendly electrical power generation a lot of research was done and succeeded with technologies such as photovoltaic, concentrated solar power, wind energy, tidal energy...etc. This work is aimed at a new way of converting solar energy into electrical energy using ss erieThermocouples and a parabolic reflector. Series of Thermocouples contain a number of hot and cold Junctions. Thermocouple hot junctions were arranged at the focal point of parabolic reflector whereas cold junctions insulated with some thermal insulation to reduce heat transfer. Parabolic reflector concentrates solar radiation at Thermocouple hot junctions; this rises intensity of radiation due to this temperature of hot junction increases. Cold junctions are maintained at low temperature by using an external cooling medium. The temperature difference between hot and cold junction causes in the series thermocouples e.m.f. This causes e.m.f to be stored in batteries. The heat generated can also be stored.

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Chapter 1

INTRODUCTION

1.1 Solar Energy

A few researchers have brought up the concernment of interchange inexhaustible wellsprings of energy for the fight to come against 'Energy Crisis'. Among the unlimited wellsprings of vitality, sun based vitality offers a useful response for the vitality issue which is obscuring the longing for mankind. Energy is consider as a way to improve the personal satisfaction and increment the efficiency and work, in this way ulter the territorial, national and global approaches and projects. The energy needs of our nation are increasing at a quick rate, and indigenous energy assets are restricted and may not be adequate over the long haul to help financial improvement. Improve the energy productivity and limiting the energy force of the economy ought to clearly comprise the premise of a convenient energy methodology. The energy inconvenience powers people, association and governments to all the more likely use new and inexhaustible wellsprings of energy, which alone can meet the energy issue. A few plans have been acknowledged to meet the circumstance, for example, energy protection, use and use of sustainable power source innovations.

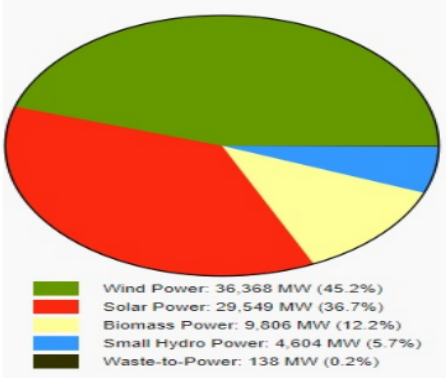


Figure 1.1: The Potential for Renewable Energy Sources

The important recommendation for the creating nations like India is to tackle non-traditional sustainable power sources on an astounding scale. Sustainable power sources are gaining significance against the regular energy sources in light of the fact that customary energy sources are embedded with a few imperatives like amount and nature of save,

the board of transportation and ecological contamination. Among the sustainable power sources, for example, wind energy, sunlight based energy, biomass and tidal energy, sun powered energy acquires distinction in light of the fact that different sources include high innovative improvement. "Sun based energy is the energy of things to come, not only an alternative"

The sun is the most enormous energy hotspot for the earth.Wind, petroleum derivative, hydro and biomass energy have their starting points in daylight. Sun oriented energy falls on the outside of the earth at a pace of 120petawatts, (1 petawatt = 1015 watt). This implies all the sun oriented energy got from the sun in every days can all around satisfied the entire world's interest for over 20 years. We can figure the potential for each sustainable power source dependent on the present innovation Future advances in innovation will lead the best approach to higher potential for every energy source. Notwithstanding, the overall interest for energy is anticipate continue ascending at 5 percent every year. Sun powered energy is the main decision that can fulfill such a gigantic and consistently rising interest.

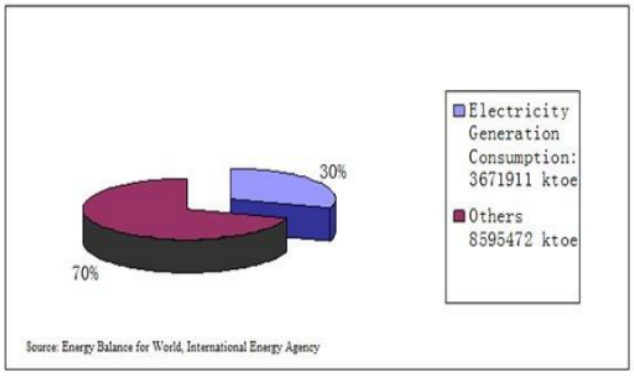


Figure 1.2: Electrical Energy Consumption Percentage of Total Energy

There are a few applications for sun based energy, for test: power age, photochemical, sun oriented impetus, sun based desalination, and room temperature control. The assortment of sun oriented energy and its exchange to power energy will have wide application and profound effect on our general public, so it has pulled in the consideration of the scientists.

1.1.1 Needs

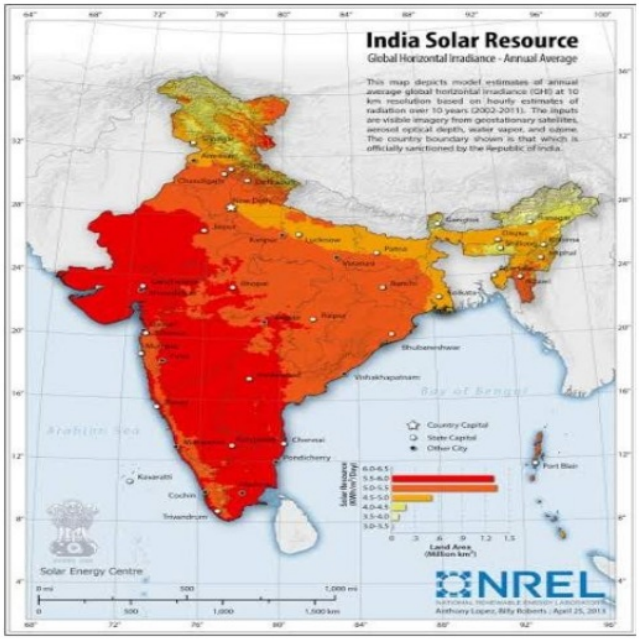


Figure 1.3: Indian Solar Resources

Energy has become the most elevated look at word with respect to government's perspective. As the number of inhabitants on the planet continuing rising, the non sustainable assets diminish step by step (e.g non-renewable energy sources). Researcher's gauge 50% ascent in overall energy utilization in 2030 and 70% to 100% in 2050. The bio and fossil can't beat this energy emergency in future. Every year, the sun sends over a billion terawatt long periods of energy to the Earth, which is equivalent to multiple times the world's power needs along these lines, the world is moving towards the sun based energy. Sustainable power source assets are getting numerous significant due to constantly diminish in customary energy source. Sun energy which is ordinarily called as sun oriented energy is the biggest assets of sustainable power source. Everywhere throughout the world, particularly in our nation more often than not in a year sun gives a decent introduction. The utilization of sun for lighting during day time and warming in winter season is definitely not another idea. This was accomplished for quite a long time. Be that as it may, because of rising energy issues world is moving toward using sustainable power source assets.

1.2 The Laws of Thermodynamics

The laws of thermodynamics decide the essential physical amounts (temperature, vitality, and entropy) that describe thermodynamic frameworks

1.2.1 The First Law of Thermodynamics

The main law of thermodynamics, in any case called the law of insurance of essentialness, communicates this imperativeness can nor be made nor squashed; imperativeness can be moved or balanced beginning with one structure then onto the following. For example, obviously turning on the light imperativeness; nevertheless, electrical essentialness is changed over.

The way to convey the first law of thermodynamics is that any changes are internal the energy (E) of the system is reflected by the sum of heat (q) passing through its boundaries and work (W) done on the system environment:

$$E = q+w$$

The law expresses that there are two kinds of procedures: warmth and work that can prompt it change in the inward vitality of the framework. Because it is possible to measure both heat and work and it is clarified that it is the same as saying that any changes to the energy of the system should results in a corresponding change in the energy outside the system. In other words, energy cannot be created and destroyed. If heat enters the system or so the environment is working on this, the internal energy is increasing and the sign of q and w is positive. Conversely, heat flows from the system or is performed by the system (in the vicinity) will be due to internal energy and therefore q and w will be negative.

1.2.2 The Second Law of Thermodynamics

The second law of thermodynamics says that the entropy of any separated framework is consistently increments.Detached frameworks unexpectedly develop to warm balance - a state of most extreme framework entropy. Basically, the entropy of the universe (the last detached framework) just increments and never diminishes.
A straight forward method to think about the second law of thermodynamics is that the room, if not cleaned what's more, set up, with time they constantly become increasingly filthy and muddled how cautiously you have to keep it clean. At the point when a room is withdrawn, its entropy diminishes, yet endeavors to clean it have prompted an expansion in entropy outside the room that surpasses entropy is lost.

1.2.3 The Third Law of Thermodynamics

The third law of thermodynamics states that the entropy of a system approaches a constant value when the temperature approaches absolute zero. Entropy of the system in Absolute zero is usually zero, and in all cases only the number of different states of the earth is determined. In particular, the entropy of pure crystalline substance (perfect order) at absolute zero temperature is equal to zero. This statement is true, if perfect Crystal has only one state with minimal energy.

1.3 History

Legend has it that Archimedes utilized "xpending glass" to center the light in sunshine assault the Roman armada and repulse them from Syracuse. In 1973, a Greek analyst, Dr. Ioannis Sacas, inquisitive with regards to whether Archimedes could truly crush the Roman armada in 212 B.C., masterminded almost 60 Greek mariners, each holding a prolonged mirror slanted to the beams of the sun, and guiding them to the resinous 49 frameworks. m (160 feet) from here. In almost no time the vessel burst into blazes; Be that as it might, students of history keep on scrutinizing Archimedes' history.

In 1866, Auguste Mouchout used a figurative trough to produc steam for the chief sun based steam engine. The chief patent for a sun arranged gatherer was gotten by the Italian Alessandro Battaglia in Genoa, Italy, in 1886. Throughout the following years,invntors, for instance, John Ericsson and Frank Shuman made centering daylight based controlled dvices for water framework, refrigration, d locomtion. In 1913 Shuman completed a 55 HP illustrative sun based warm vitality tation in Maadi, Egypt for water system. The basic sun based force structure utilizing a mirror dish was worked by Dr. R.H. Goddard, who was by then extraordinary for his appraisal on fluid stimulated rockets and made an article in 1929 in which he stated that all the past deterrents had been tended to.

Teacher Giovanni France (1911–1980) fabricated and made the essential concentrated sun oriented venture, which in 1968 started tasks in Sant'Ilario, near Genoa, Italy. The present force plant with the sun was made at this plant. arrange ecipient in the center field of the daylight authority. The plant had the option to supply 1 MW with superheated steam at 100 bar and 500 C. In 1981, a 10 MW sun powered pinnacle was made in Southern California on one of the sunlight based boards each 1995, which executed an alternate arrangement with a blend of fluid salt. (60 % sodium nitrate, 40 % potassium nitrate). collector working fluid and as capacity. Liquid salt methodology has shown a convincing effect, and Solar Two worked effectively until it was decommissioned in 1999. The Innovative Neighborhood Solar Energy (SEGS) indicator launched in 1984 has been progressively useful. The 354 MW SEGS was the largest powerplant on the planet until 2014.

No solar-focused orientations have been developed since 1990, when the SEGS was completed until 2006, when a compact Fresnel reflector was produced at the Liddell power plant in Australia. Not many plants operated with this structure, despite the fact that in 2009 a 5 MW MW Kimberlin solar thermal plant was opened.

In 2007, 75 MW of Nevada Solar One was assembled, a trough structure and the primary huge installation since SEGS. Somewhere between 2009 and 2013, Spain operated more than 40 illustrative frameworks organized in 50 MW units.

Due to Solar Two, a business powerhouse called Solar Tres Power Tower operated in Spain in 2011 and was later renamed the Gemasolar Thermal Plant. The Gemasolar results have prepared for additional plants of this type. The Ivanpah solar power plant was designed simultaneously but without warmth using petroleum gas to preheat water.

Most solar-powered units use an explanatory trough structure rather than a Fresnel power tower or frame. There were also various explanatory frames for the feeders, such as the Harmonized Coordinated Sunlight (ISCC) cycle, which integrates troughs and conventional non-renewable energy sources.

CSP was initially considered to be a contender for photovoltaics, and Ivanpah worked without vitality, though Solar Two included a few hours of warm stock. By 2015, the cost of photovoltaic plants had decreased, and electricity with electricity sold 1-3 of the third

particleboard contract. In any case, gradually, the CSP was offered 3 to 12 hours of warm imperativeness, making the CSP the shipment sort of vitality running in the sun. All things considered, it's progressively seen as a rival with combustible gas and photovoltaic batteries for adaptable, shootable batteries.

Chapter 2

LITERATURE SURVEY

A brief review of use of Renewable Sources towards energy generation.

A. Borah, S.M. Khayer and L.N. Sethi., an indirect parabolic concentrator (CPC) was installed for the indirect drying of the product by the indirect drying method. Six numbers of semi-cylindrical parabolic concentrators were interpolated on the receiving plate to directly convert solar energy into thermal energy, capturing the maximum incident rays into the metal tubes that were located on the focal lines of the parabola. Experiments were conducted to study the comparative characteristics of a solar flat collector and a parabolic hub of the same size. An average temperature increase of 9.50 C was observed during this period. The manual solar track was facilitated on two axes to a vertical of 4.68o and a horizontal of 11.54o. An average temperature rise of 11.2 C can be achieved for the environment. Capture time of solar radiation at a constant temperature level increased by 1.5 hours compared to a fixed PDA.

Charles Kutcher, Frank Berkholder, Kathleen Staines have written about the general effectiveness of an illustrative trough gatherer as a component of both the division of direct typical radiation consumed by the recipient (optical proficiency) and the warmth lost by nature when the collector is at working temperature. Complete effectiveness can be dictated by testing the complex in true working conditions, or by estimating the two segments independently. He portrays how the estimation of optical effectiveness outside joins with the research center estimations of the warmth loss of the recipient to acquire a general productivity bend. It additionally presents another method for building effectiveness that is increasingly dependable in the working temperature scope of the recipient.

R. Forristal., There proposed a report describing the design, validation and use of a heat transfer model implemented in engineering Solution equation (EES). The model determines the performance of the linear receiver of the parabolic passage of the solar collector, also called the element of the heat collector (VCE). All heat transfer equations and thermodynamic, optical properties and parameters used in the model are discussed. The assumptions and limitations of modeling are also discussed, as well as recommendations for improving the model. The model was implemented in EES in four different versions. To test the model and evaluate the field test data, two versions were developed to carry out the design and study of the HCE parameters, as well as two versions. The codes used one- and two-dimensional energy balances as needed. Each version of the codes is discussed briefly, which includes a discussion of the relevant EES chart windows, parameter tables and lookup tables. Detailed instructions for EES software are not included; however, links are provided. Model and design and parameter studies are tested to

demonstrate the model's versatility. The model was validated by comparing the field tests of EES codes and the experimental results of HCE. Parameters design and study includes numerous diagrams showing HCE performance trends based on various attachments and parameters. On the basis of the design and study of the parameters, suggestions for the improvement of SLE and trough and further studies are presented. The HCE software model compares well with the experimental results and has provided many HCE design ideas from parameter design and study.

Hank Price et al. The parabolic troughs of solar technology have been suggested to be the most proven and affordable technology with the lowest cost, primarily thanks tonine huge business scale sun oriented force plants working in the California Mojave Desert. These stations, created by Luz International Limited and called the Solar Power Generation Systems (SEGS), go in size from 14 to 80 MW and speak to 354 MW of introduced producing limit. In excess of 2,000,000 m2 of allegorical removal innovation has been in activity for a long time, and since 2001,these plants have collected 127 years of working experience. Luz's authority innovation has exhibited its capacity to work in a business power plant condition like no other sun oriented innovation on the planet. Albeit no new offices have been worked since 1990, noteworthy endeavors in plant gathering and configuration have been put forth conceivable by the attempts of SEGS plant administrators, the illustrative trough industry and sun based research labs. This article looks at the present condition of explanatory sun oriented vitality innovation and depicts the RD endeavors in progress to improve the innovation. The article likewise shows how the econo[17]y of future explanatory feed is required to improve.

R. McConnell, M. Symko-Davies, and H. Hayden. They communicated their conclusion about sun powered vitality and its qualities. Sun powered vitality is rich, more unsurprising and less sure than wind. Regardless of the advantages of sunlight based vitality and our best expectations, wind ranches stay a typi[17]l and sun powered homesteads are as yet phenomenal. It appears to be unavoidable that the scales will tilt, yet the normal time scales are excessively long (in any event for the creator). As we get a move on. The substance above is a creator's point of view on an answer that joins a bl[17]d of innovation, business the board, capital, cooperation and impact. Dave Holland - Managing Director of Solar Systems and Director of Renewable Energy Australia - an industry bunch speaking to m[29]ore than 90 % of sustainable power source in Australia.

Sateris A. Kologirov. This article gives a review of the various kinds of sun based warm authorities and embellishments. From the outset, an examination of the environmental issues related with the use of standard essentialness sources was presented, just as the advantages offered by a sustainable power source framework. The verifiable prologue to sun based vitality is joined by a portrayal of the different kinds of authorities, including level plates, illustrative associations, emptied pipes, explanatory troughs, Fresnel focal points, allegorical plates and heliostatic field gatherers. At that point there is an optical, warm and thermodynamic investigation of the authorities and a depiction of the strategies used to assess their qualities. Common augmentations to different sorts of gatherers are introduced to show the peruser the level of their reasonableness. This incorporates sun oriented water warming, which incorporates a thermosyphon, coordinated capacity gatherer, immediate and aberrant frameworks and air frameworks, space warming and cooling, including room warming and high temp water administration, air and water frameworks and warmth siphons, cooling, modern procedure heat comprising of air and water frameworks and steam generator frameworks, desalination, warm force frameworks comprising of an illustrative trough, an electric pinnacle and stomach related

frameworks istem, sunlight based stoves and science applications. Clearly, sun based force frameworks can be utilized for a wide scope of uses and have noteworthy advantages, so they ought to be utilized at whatever point conceivable.

Ted Collins all., Solar water heating with a parabolic trough is a well-proven renewable energy technology with significant potential for federal use. In the United States, parabolic water heaters are the most cost-effective in the Southwest, where direct solar radiation is high. Prison establishments, hospitals, barracks and other facilities that consistently use large volumes of hot water are particularly good candidates, as are rooms with central centers for centralized heating. Like any renewable energy or energy efficiency technology that requires significant upfront capital investment, the main condition that will make the parabolic deflection system economically viable is the replacement of expensive conventional water heating. In combination with absorption cooling systems, parabolic collector kits can also be used for air conditioning. Industrial Solar Technology (IST) from Holland, Colorado, is the only modern manufacturer of solar water heating systems. IST contracts a Perpetual Delivery / Perpetual Quantity (IDIQ) with the US Division of Energy's (DOE) Federal Energy Management Program (FEMP) to fund and introduce illustrative sun based water warming dependent on an Energy Efficiency Agreement (ESPC). For any federal entity that requires it and for which it is viable. For the ESPC project, the facility does not pay for design, capital equipment and installation. Instead, it pays only for guaranteed energy savings. Preparing and implementing delivery orders and orders against IDIQ is much easier than the standard purchasing process. This is the Federal Technology Notice (FTA) under the New Technology Demonstration Program - one of a number of guides to renewable energy and new energy-efficient technologies. It is designed to provide federal officials with the information they need to decide if they need to deal with parabolic solar or air conditioning for their facility and know how to do it. The software, available at the Federal Renewable Energy Program at the National Renewable Energy Laboratory (NREL), FEMP allows you to pre-analyze whether a parabolic collector will be effective in any situation based on minimal data. This FTA describes the technology of parabolic collectors, solar water heating systems and absorption cooling. It outlines the types of situations in which parabolic solar water heating is likely to be cost effective, and outlines the ESPC process available to federal agencies for parabolic feeder projects. In addition, the sidebars give an indication that the system will be effective, tips for successful operation and the source for determining system data. Case studies for a 10-year county jail system and one that is just beginning construction in a federal prison include economic evaluation data.

2.1 Background Research

Solar energy technology is being introduced in the 18s. Mr. Auguste Musho is the first person to use a parabolic trough in 1866 to produce steam for a steam engine. The first patent for a solar collector was invented by Mr. Battaglia in Genoa, Italy in 1866. Later John Erickson developed numerous CSP units for irrigation, cooling and movement.

2.2 Early Commercial Adaption

Solar Energy utilization techniques are not present research but scientist's are working from many years to utilize solar energy.

1897:

Frank Schunam, an American engineer and pioneer of solar energy, developed a small solar engine that worked by displaying solar energy on boxes filled with liquid whose boiling point was less than water.

1912-1913:

Schumman built the first-largest solar thermal power plant in Madi Egypt. It uses parabolic feeders to power 45-52, which pumps over 22,000 liters of water per minute from the Nile River to adjacent cotton fields.

2.3 CSP With Thermal Energy Storage

In a storage plant, energy based on sunlight is used for the first time to heat liquid salt or developed oil, which gives off thermal / thermal energy at high temperatures in protected tanks. In the following, hot liquid salt (or oil) is used in the steam generator to generate steam for electricity generation using a steam turbine generator as needed.A DAC with thermal storage frames is also available using the Brighton cycle with air rather than steam to generate electricity and extra steam without stopping. Thus, the sun-focused energy available in sunlight is simply used to generate electricity without interruption upon request as a bunch of subsequent power plants or solar-based pickers. The thermal storage limit is shown in large periods of intensity with a character limitation. Generally unlike solar-powered PV or CSP without storage, age-old solar thermal power plants can be distributed and self-maintained as coal / gas power plants, but without pollution. DSPs with thermal energy storage facilities can also be used as cogeneration units for permanent shutdown of both electricity and procedures. As of December 2018, age-related costs for DSPs with thermal energy storage facilities have moved between 5c / kWh and 7c / kWh, based on high to mid-sun radiation produced in the area. Unlike photovoltaic plants based on sunlight, DSPs with thermal energy storage facilities can also be used in a non-stop mode of cash to create a simple procedure that displaces steam from pollution, dumping oil.The CSP plant can likewise be reliable with PV in the sun for better cooperative energy.

2.4 Organization Around The World

Commercial implementation of the US nuclear power plant began in 1984 in the US with SEGS plants. The last SEGS plant was completed in 1990. From 1991 to 2005, no NPP was built anywhere in the world. Worldwide installed capacity for particleboard has increased almost tenfold between 2004 and 2013 and has increased by an average of 50 percent annually over the past five years. 51 In 2013, worldwide installed capacity increased by 36 % or nearly 0.9 GW (GW) to more than 3.4 GW. Spain and the United States remain world leaders, while the number of CSPs is increasing, but the rapid decline in PV solar costs, policy changes and the global financial crisis have halted most development in those countries. 2014 was the best year for the CSP, but it was followed by a rapid decline, with only one major station in the world completed in 2016. There is a noticeable trend towards developing countries and regions with high solar radiation with several major stations being built in 2017.

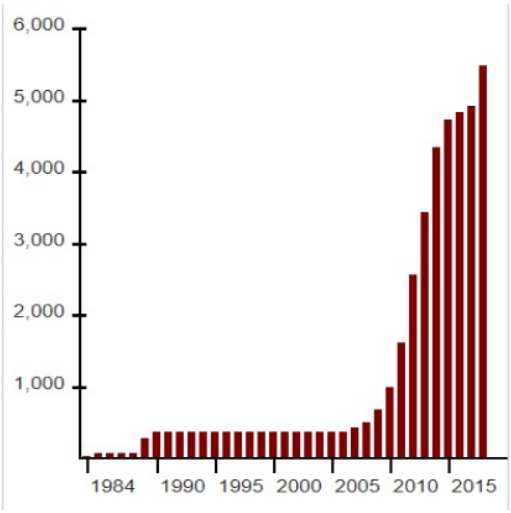


Figure 2.1: Worldwide CSP Capacity Since 1984 in MWp

country	Total	added
Spain	2,300	0
United states	1,738	0
South Africa	400	100
Morroco	380	200
India	225	0
China	210	200
United Arab Emirates	100	0
Saudi Arabia	50	50
Algeria	25	0
Egypt	20	0
Australia	12	0
Thailand	5	0

Table 2.1: National CSP Capacities in 2018 (MWp)

CSP is likewise progressively rivaling less expensive photovoltaic sunlight based vitality and with concentrated photovoltaic power (CPV), a quick paced innovation that, as CSP, is most appropriate for areas with high sun based protection. Also, another CPV/CSP sun oriented half breed framework was as of late proposed.

Chapter 3

PROPOSED METHOD

In this project we are construct a solar concentrator which serves as an energy utilizer for various applications. To design a parabolic trough to produce heat energy by capturing naturally available sunlight. The procedure yield is relying on light vitality from the sun. The sun powered vitality is get gathered as warmth vitality reflector. After this heat energy is get converted in the form of electric energy using thermocouple.

First we are constructing a Solar concentrator. There is various type of solar concentrator which we are going to see in upcoming chapters. We are construct Parabolic Concentrator to collect the radiation of solar. The parabolic concentrator concentrate the solar energy to it's focal length. The reflected vitality is as warmth, this warmth vitality is fall on the safeguard. The absorber get converted Heat energy into electric form using thermocouple. Concentrator is a mechanical gadget which focus the sunlight based radiation on its point of convergence. The sunlight based radiation reflected from the concentrator surface and fall on the safeguard. So for this the surface of the reflector must be shiny or its have the property of reflection. To make the reflector more efficient we are use the Fresnel glass which reflect the solar radiation. Use of Fresnel glass improve the efficiency of the concentrator. Fresnel glass helps to collect more heat energy from sun. A Thermocouple is a gadget used to change over warmth into electrical force. It quantifies the temperature contrast between two focuses. Thermocouples is a sensor used to quantify temperature. It comprise of two wire legs produced using various metals. The wires legs are welded together toward one side, making an intersection. This intersection is the place the temperature is estimated. Thermocouples are among the most generally utilized temperature sensors because of their wide accessibility and ease.

In this project we are using sun tracking system for concentrator. The concentrator continuously track the sun using tracking system. Tracking system consist of motor and sensor. Sensor sense the intensity of sun and give instruction to motor to move the solar concentrator in suns direction. Following framework is valuable to build the effectiveness of the sun oriented concentrator. It tracks the sun consistently by utilizing light sensors. Two sensors are there to detect the force of light.

Chapter 4

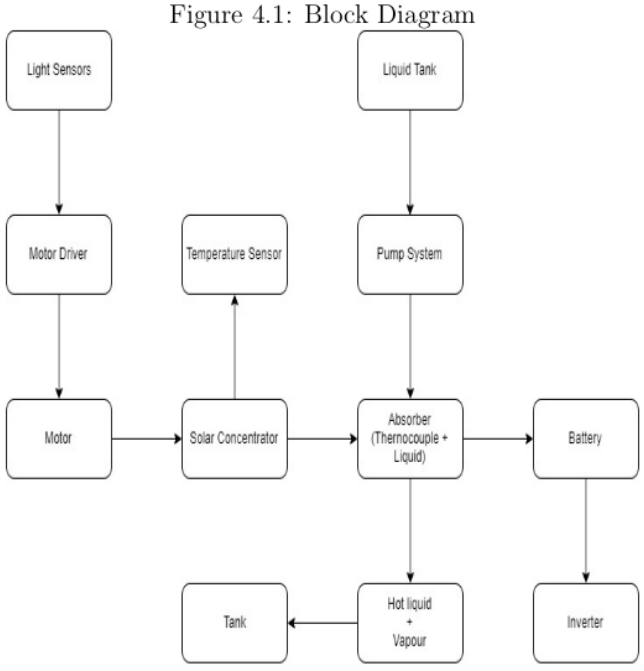
FRAMEWORK ARCHITECTURE

The Framework Architecture consists of the block diagram, various components used and the software used for programming the micro controller. This chapter will walk you through the entire project and explain the bits and pieces and have they are merged together to get the desired objective satisfied.

4.1 Block Diagram

The figure 4.1 gives an overview of the project along with its major components. The main block include the Solar Concentrator which concentrate sun radiation toward absorber. Absorber Absorb the warmth vitality and convert it into electric structure utilizing thermocouple. The vitality created by thermocouple is put away in the batteries. Sensors, Motor driver, Motor is a piece of Sun following framework.

Figure 4.1: Block Diagram



4.2 Sun Tracking System

In this topic we are going to discuss about Tracking system. Tracking System consist of Light Sensor, Motor Driver, Motor, Manual Handle. Here in this section we discuss each component.

4.2.1 Light Sensor

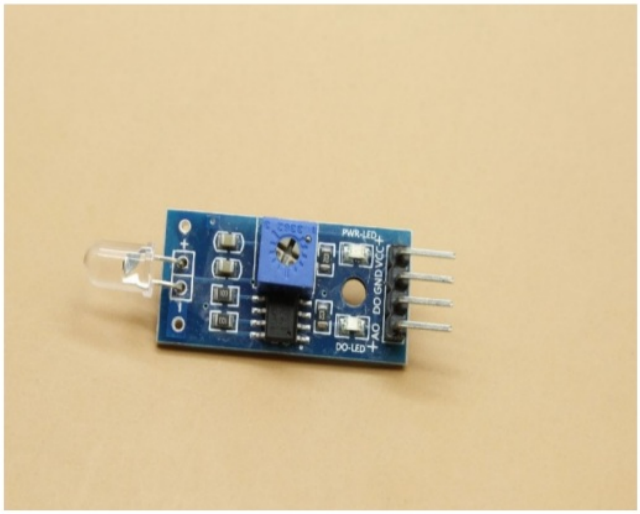


Figure 4.2: Light Sensor

Light sensor is the device which sense the intensity of the light. Here we use IR Light Sensor Model to sense the light intensity of sun. This intensity is given to the motor driver. The light sensor sense the light and gives output in the form of voltage. Its act as a register when there is no light. Here for solar tracking system we uses two or more IR sensor. Its detects the intensity of light.

Specifications

Working Voltage: 3.3V to 5V DC
Working Current: 15ma
Output Digital - 0V or 5V, Adjustable trigger level from preset
Output Analog - 0V to 5V dependent on light on sensor
LEDs showing output and power
PCB Size: 3.2cm x 1.4cm
LM393 based design

4.2.2 Motor Driver

Motor Driver is a device which drives the motor in clockwise or anti-clockwise direction. It takes input from the Light sensor module. The light sensor module provide he input, there is two light sensor is used. Light sensor detects the intensity of the sun, the intensity is converted in the form of voltage. The motor driver get two inputs from two light sensors. The motor sensor detects the difference between them and decide that whether motor move in clockwise direction or in anticlockwise direcction.

Figure 4.3: Motor Driver

Working Mechanism

Input1	Input2	Result
0	0	Stop
0	1	Anti-Clockwise
1	0	Clockwise
1	1	Stop

Table 4.1: Working Mechanism

4.2.3 Motor

In Motor segment we are talk about engines. We are utilizing Servo engine to pivot the concentrator.A servomotor is a rotational actuator or straight actuator that thinks about accurate control of exact or direct position, speed and speeding up. It contains a proper motor coupled to a sensor for position analysis. It also requires a by and large present day controller, consistently a gave module arranged unequivocally for use with servomotors.

Servo motor chips away at PWM (Pulse width adjustment) guideline, implies its point of pivot is constrained by the term of applied heartbeat to its Control PIN. Essentially servo motor is comprised of DC motor which is constrained by a variable resistor

Figure 4.4: Servo Motor

(potentiometer) and a few apparatuses. Fast power of DC engine is changed over into torque by Gears. We realize that WORK= FORCE X DISTANCE, in DC motor Force is less and separation (speed) is high and in Servo, power is High and separation is less. Potentiometer is associated with the yield shaft of the Servo, to ascertain the point and stop the DC motor on required angle.

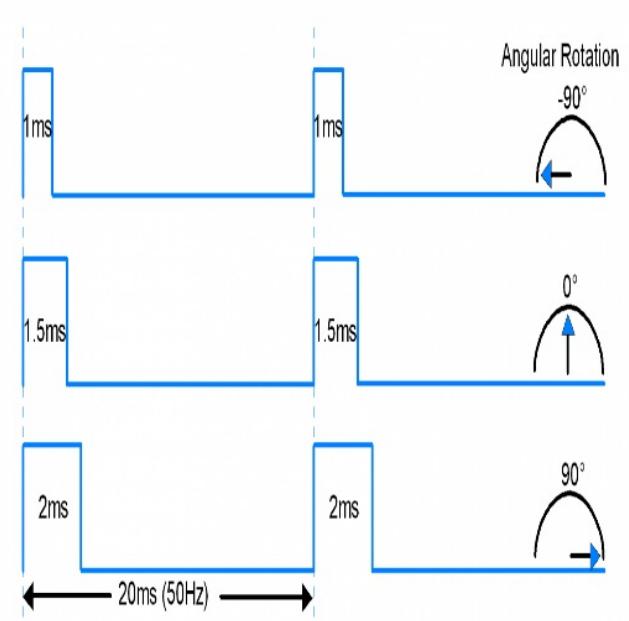


Figure 4.5: Servo Motor Angular Rotation

4.3 Concentrator

Concentrator:

Concentrator are arranged to follow the sun with the goal that the shaft radiation will be coordinated on to the retaining surface. Authority that coordinates radiation on to the collector.

Collector:

The aperture of the concentrator is the opening through which the sun based radiation enters the concentrator.

Current Concentrator Technology

Concentrated sun oriented vitality is utilized to create power (at times alluded to as sun oriented thermoelectricity, for the most part produced through steam). Concentrated sun oriented innovation frameworks use mirrors or focal points with following frameworks to concentrate enormous regions of daylight over a little territory. Thought light is then utilized as warmth or as a warmth hotspot for a traditional force plant (sun oriented thermoelectricity). Sunlight based concentrators utilized in concentrated sun powered vitality frameworks can frequently additionally be utilized to warmth or cool a mechanical procedure, for example, sun oriented forced air systems.

Concentration technologies exist in four optical types, namely: parabolic trough, cookware, Fresnel linear reflector and solar tower. Parabolic troughs and Fresnel concentrated linear reflectors are classified as linear types of focus collectors. The dish and the solar tower as the type of focus point. Linear collection tricks reach medium concentrations (50 suns and more), and point collections reach high concentration factors (more than 500 suns). Although simple, these solar concentrators are far from their maximum theoretical concentration. For example, the concentration of parabolic origin gives about 13 of the theoretical maximum for the design angle of reception, that is, for the same general tolerances for the system. The approximation to the theoretical maximum can be achieved by using more sophisticated hubs based on optics without imaging.

Various kinds of center points produce diverse pinnacle temperatures and correspondingly unique thermodynamic efficiencies, which is because of contrasts by they way they track the sun and concentrate light. New developments in concentrated sun based innovation are driving the path for frameworks to turn out to be increasingly prudent.

4.4 Types of Concentrator

4.4.1 Parabolic Trough

An Parabolic chute is a kind of sun oriented warm authority that is straightforwardly in one measurement and bended as a parabola in the other two, fixed with a metal mirror. The daylight entering the mirror corresponding to the plane of its evenness is engaged along the central line where the articles planned for warming are found. For instance, in a sun based board, nourishment is put in the center line of the feeder, which is readied when the trough is coordinated with the goal that the sun is in its plane of balance.

Figure 4.6: Parabolic Reflector

For other purposes, the tube containing the fluid runs along its focal length along the trough. Sunlight concentrates on the tube, and the liquid is heated to high temperature by the energy of sunlight. The hot fluid can be directed to a heat engine that uses thermal energy to control the machines or to generate electricity. This solar energy collector is the most common and well-known type of parabolic trough.

When heat transfer fluid is used to heat steam to drive a conventional turbine generator, thermal efficiency ranges between 60-80 %. Total collector-to-grid efficiency, ie (electrical output power) / (total prescriptive solar power) is about 15 %, similar to PV (photovoltaic cells) but less than the Stirling dish concentrators. Large-scale solar thermal power plants need a way to accumulate energy, such as a thermocline reservoir that uses a mixture of silicon from sand and quartzite to displace much of the volume in the reservoir. It is then filled with a coolant, usually molten nitrate.

Efficiency

The trough is commonly arranged along the north-south center and goes to follow the sun as it moves over the sky every day. On the other hand, the feeder can be adjusted east-west; this decreases the general proficiency of the complex because of the daylight entering the corner, however requires the trough to be agreed with the developing seasons, maintaining a strategic distance from the need to follow motors. This following strategy moves toward the hypothetical effectiveness of the spring and harvest time equinoxes with less exact light centering at different seasons. The day by day development of the sun through the sky likewise presents the best mistakes at dawn and dusk and the littlest at south. As a result of these wellsprings of mistake, regularly tuned illustrative consumers are commonly structured with a result of less focus.

Concentrators of parabolic troughs have a simple geometry, but their concentration is approximately 1/3 of the theoretical maximum at the same angle of reception, that is, for the same general system tolerances for all types of errors, including those mentioned above. The theoretical maximum is best achieved by using more sophisticated primary-secondary concentrator hubs that can be used to almost double the concentration of conventional

parabolic bowls and used to refine practical designs such as stationary receivers.

The coolant (usually thermal oil) passes through a tube to absorb concentrated sunlight. This raises the liquid temperature to about 400 C. The coolant is then used to heat the steam in a standard generator. The process is economical and, when the pipe is heated, the thermal efficiency varies between 60-80 %. Total collector-to-grid efficiency, ie (electrical output) / (total prescriptive solar power) is about 15 %, similar to PV (photovoltaic cells) but less than Stirling cookware hubs.

4.4.2 Solar Power Tower

A solar tower, also known as a "central tower", a power plant or a "heliostat," or a power plant, is a type of solar oven that uses the tower to produce focused sunlight. It uses an array of flat moving mirrors (called heliostats) to focus the sun's rays on the collector tower (target). Concentrated solar thermal energy is considered as one rational solution for renewable, non-polluting energy.

Figure 4.7: Solar Power Tower

Early structures utilized these engaged beams to warm water, and utilized the subsequent steam to control a turbine. More up to date structures utilizing fluid sodium have been illustrated, and frameworks utilizing liquid salts (40% potassium nitrate, 60% sodium nitrate) as the working liquids are currently in activity. These working liquids have high warmth limit, which can be utilized to store the vitality before utilizing it to bubble water to drive turbines. These plans likewise permit capacity to be produced when the sun isn't sparkling.

Power towers (also known as 'central tower' power plants or 'heliostat' power plants) capture and focus the sun's thermal energy with thousands of tracking mirrors (called heliostats) in roughly a two square mile field. A tower resides in the center of the heliostat

field. The heliostats focus concentrated sunlight on a receiver which sits on top of the tower. Within the receiver the concentrated sunlight heats molten salt to over 1,000 F (538 C). The heated molten salt then flows into a thermal storage tank where it is stored, maintaining 98% thermal efficiency, and eventually pumped to a steam generator. The steam drives a standard turbine to generate electricity. This process, also known as the "Rankine cycle" is similar to a standard coal-fired power plant, except it is fueled by clean and free solar energy.

The advantage of this design above the parabolic trough design is the higher temperature. Thermal energy at higher temperatures can be converted to electricity more efficiently and can be more cheaply stored for later use. Furthermore, there is less need to flatten the ground area. In principle a power tower can be built on the side of a hill. Mirrors can be flat and plumbing is concentrated in the tower. The disadvantage is that each mirror must have its own dual-axis control, while in the parabolic trough design single axis tracking can be shared for a large array of mirrors.

A cost/performance comparison between power tower and parabolic trough concentrators was made by the NREL which estimated that by 2020 electricity could be produced from power towers for 5.47 /kWh and for 6.21 /kWh from parabolic troughs. The capacity factor for power towers was estimated to be 72.9% and 56.2% for parabolic troughs. There is some hope that the development of cheap, durable, mass producible heliostat power plant components could bring this cost down.

The first commercial tower power plant was PS10 in Spain with a capacity of 11 MW, completed in 2007. Since then a number of plants have been proposed, several have been built in a number of countries (Spain, Germany, U.S., Turkey, China, India) but several proposed plants were cancelled as photovoltaic solar prices plummeted. A solar power tower went online in South Africa in 2016. Ivanpah Solar Power Facility in California generates 392 MW of electricity from three towers, making it the largest solar power tower plant when it came online in late 2013.

4.4.3 Dish Collector

A dish Stirling or dish engine system consists of a stand-alone parabolic reflector that concentrates light onto a receiver positioned at the reflector's focal point. The reflector tracks the Sun along two axes. The working fluid in the receiver is heated to 250–700 C (482–1,292 F) and then used by a Stirling engine to generate power. Parabolic-dish systems provide high solar-to-electric efficiency (between 31% and 32%), and their modular nature provides scalability. The Stirling Energy Systems (SES), United Sun Systems (USS) and Science Applications International Corporation (SAIC) dishes at UNLV, and Australian National University's Big Dish in Canberra, Australia are representative of this technology. A world record for solar to electric efficiency was set at 31.25% by SES dishes at the National Solar Thermal Test Facility (NSTTF) in New Mexico on 31 January 2008, a cold, bright day. According to its developer, Ripasso Energy, a Swedish firm, in 2015 its Dish Sterling system being tested in the Kalahari Desert in South Africa showed 34% efficiency. The SES installation in Maricopa, Phoenix was the largest Stirling Dish power installation in the world until it was sold to United Sun Systems. Subsequently, larger parts of the installation have been moved to China as part of the huge energy demand.

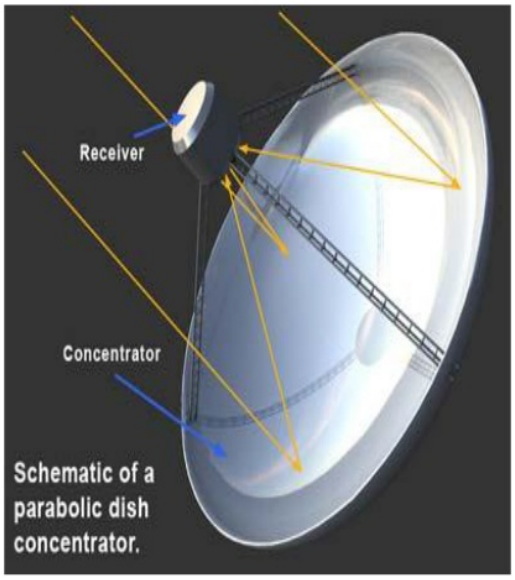


Figure 4.8: Dish Collector

4.5 Absorber

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Figure 4.9: Absorber

Absorber is a device which absorb the concentrated heat. Absorber Absorb the

heat and converted it to another form of energy. Here we are using Thermocouple as a absorber. With Thermocouple we also using liquid to pass through absorber. Absorber absorb the heat energy in two forms i.e. Electric Heat storage using liquid. Absorber consist of lots of thermocouple connected in series.

Basically Absorber is a hollow metallic tube. The hollow tube is useful to pass liquid through it. The liquid is get heated or get vaporise.

4.6 Pumping System

Pumping System include the motors and tanks. Tanks which stores the liquid. There is Tanks, One is to store the cool liquid another is for hot liquid. Pump system Pump the liquid through absorber.

Figure 4.10: Pumping Motor

Pumping system uses motors to pump liquid. This system is very useful and controller by the controller or manually. It sense the temperature of hot liquid and decide the

flow of liquid.Solar water pumps are an effective alternative to conventional gas, diesel or electric pumps. The pumps are powered by solar energy effectively, and are often used for irrigation and drinking water. Solar water pumping systems use solar energy to pump water. The systems offer very high reliability, minimum maintenance and a long service life. The biggest advantage of solar pumps is that there are no running costs except for maintenance.

4.7 Gear

Figure 4.11: Gear

A gear or cogwheel is a rotating machine part having cut teeth or, in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on

the two meshing gears all have the same shape.Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation. The gears in a transmission are analogous to the wheels in a crossed, belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.

4.8 Pillow Block Bearing

Figure 4.12: Pillow Block Bearing

The pillow block bearing consists of a mounting bracket (cushion block) that holds the bearing and is used in low rotation and light load.

In this configuration, the cushion unit is screwed to the foundation, securing it, and the shaft and the inner ring of the bearing can rotate freely. Usually made of gray cast iron, the pillow blocks are of two types, split or non-split. With the help of pillow blocks, the housing or cover element can be separated from the base. The undivided pillow is made of a solid piece. According to the cushion bearing and the plumbing block bearing are used synonymously, but two different devices. Both are designed for surface mounting through mounting holes at the base of the unit. They are characterized in that the plumbing block bearings contain an internal bearing and are also designed for higher loads and more aggressive conditions.

4.9 Bright Bar

Bright bars are steel bars that are geometrically fit as a fiddle and have a resistance which is tight dimensional. Its surface completion is smooth and glossy, which gives off an impression of being splendid. Splendid steel bars have a few uses and applications. Splendid bars are accessible in adjusts, pads, hexagonal and squares.

These bars are made in numerous evaluations and diverse assembling forms are utilized relying upon the type of use and plans. Splendid bars are fabricated in extreme quality, which is the reason they are well known with our customers. We produce Industrial evaluation splendid bars in Carbon steel, Mild steel, Case nitriding and solidifying, Micro alloyed, combination steel, reviewed steel, free cuts which are without carbon or tweaked brilliant bars as indicated by customer's prerequisite.

Figure 4.13: Bright Bar

Our metallurgical plant is furnished with best in class creation advances that experience present day steel creation forms. The high quality of the production process, combined with advanced equipment, has secured us the reputation of the highest quality manufacturers and exporters in the country. A steel bar is normally a carbon steel amalgam that has improved the surface condition by applying, stripping or pounding. hot-moved completion provided by the steel factory. Focal points are improved machining, lower costs during part producing, upgraded physical and mechanical properties, and improved resiliences and clear measurements.

4.10 Hollow Pipe

Circular hollow sections, also known as round steel pipes, are a common type of steel section used in different formats for different industries in South Africa.

These steel sections are rolled from a steel sheet or slit gap. A tight strip of steel coil passes through the molding and sizing section in a conventional cold steel plant. The mill consists of a series of passes through which a sheet is gradually formed, each passage bending the steel sheet more and changing the radii on each passage. This is done until the two ends of the steel are compressed and then welded with string.

Round steel sections can be rolled from different materials. Most often it is hot and cold rolled steel pipes. Hot-rolled profiles are used mainly for structural purposes, while cold-rolled steel tubes have a better bending ability and give a more aesthetic appearance after powder application. Steel sections can also be operated with fins and inside scarves.

Figure 4.14: Hollow Pipe

The fin-adjustable pipe means that the inner welded portion of the ball has been adjusted to an absolute minimum, while the hinge has been removed from the scarf steel pipe. This allows the tube to be suitable for bending the mandrel.

Drawn steel profiles and well-drawn steel pipes play a big role in the steel industry. Steel sections can be obtained from a standard pipe of an available size into a smaller steel section. With the help of high-precision tubes, the inner diameter of the steel tube can be adjusted with a mandrel, and the outer diameter is lowered through the die.

4.11 Glass

Flexible distortion of meager glass gives an elective method for shaping a bended glass reflector, which can dispense with a portion of the impediments of thicker glass. This article depicts the idea where silver-dainty glass is fixed on a steel substrate to frame an overlay that displays more than 93 percent. Subsequent bending of a flat reflector laminate to a concentrated profile produces compression stresses throughout the glass when the laminate is properly designed. These compressive stresses increase the resistance to fracture, and lamination provides protection for silver. The design of the laminate is laid out for glass thickness of 0.25 and 0.51 mm and discusses the manufacturing procedures. Thermal / wet bikes, hail effects, bond strength measurements and reflectivity are demonstrated to demonstrate the capabilities of this reflector laminate concept.

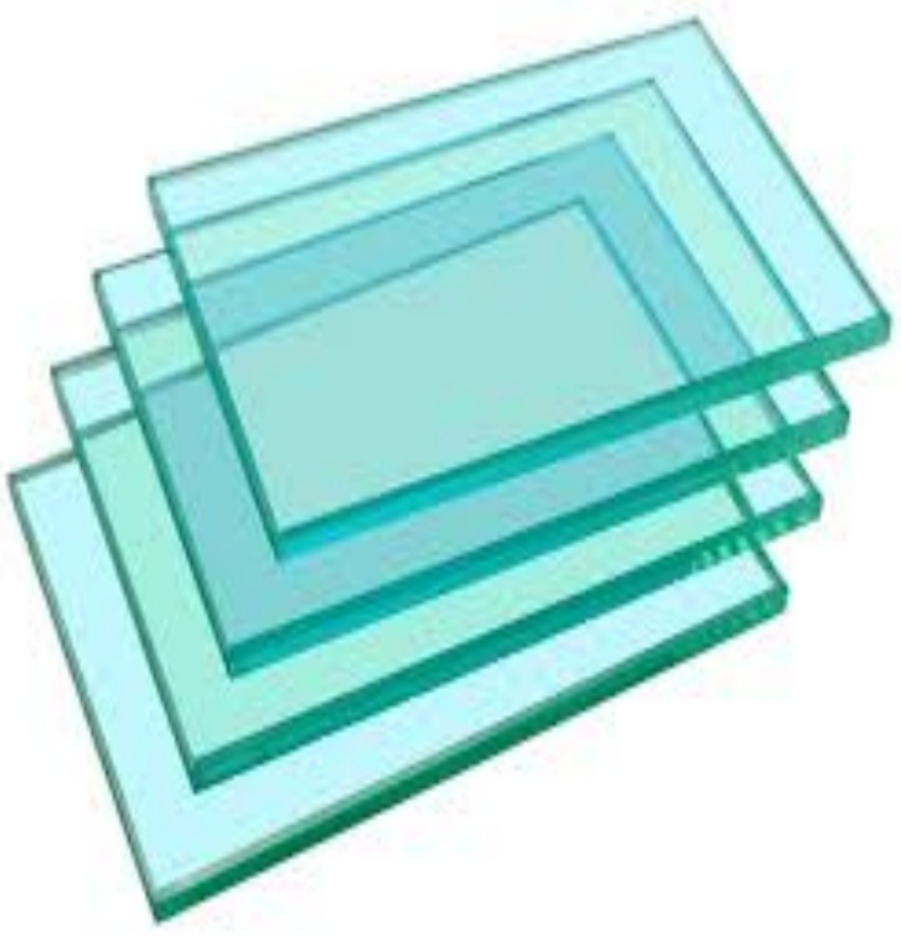

Figure 4.15: Glass

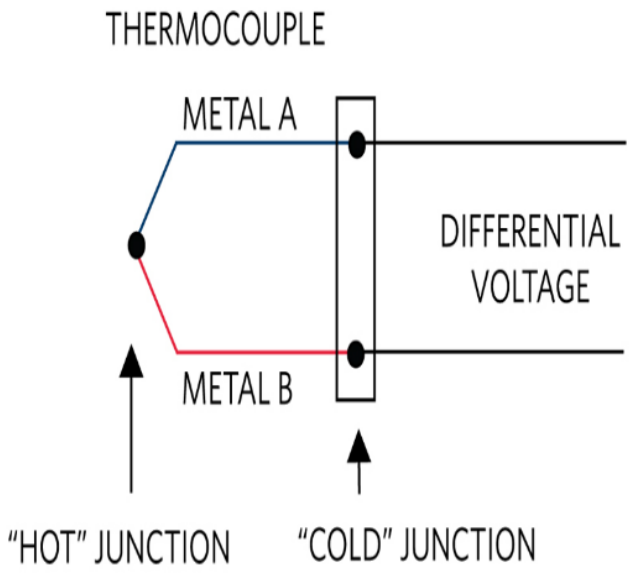

Figure 4.16: Thermocouple

4.12 Thermocouple

A thermocouple is a sensor used to measure temperature. Thermocouples consist of two wire legs made of different metals. The legs of the wires are welded from one end to the other, creating a joint. At this point of connection, the temperature is measured. When the transition experiences a change in temperature, a voltage is created. The voltage can then be interpreted using thermocouple reference tables to calculate the temperature.

There are many types of thermocouples, each with its own unique characteristics in terms of temperature range, durability, vibration, chemical resistance and compatibility. J, K, T and E thermocouples are the most common types of thermocouples. Types R, S and B are noble metal thermocouples used in high temperatures (see Temperature Pairs in Thermocouples). more) Thermocouples are used in many industrial, scientific and domain fields. They can be found in almost all industrial markets: power generation, oil / gas, pharmaceutical, biotech, cement, paper and cellulose, etc. Thermocouples are also used in household appliances like ovens, stoves and toasters.

Thermocouples are usually chosen because of their low cost, high temperature limitations, wide temperature range and durability.

4.13 Arduino

Figure 4.17: Arduino

Arduino is an open source electronic stage dependent on easy to use equipment and programming. Arduino sheets can understand inputs - light on a sensor, finger on a catch or a message on Twitter - and transform it into a yield - including the engine, including the LED, by posting something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do this, you use the Arduino programming language (based on posting) and Arduino software (IDE) based on Processing. For years, Arduin has been the brain of thousands of projects, from everyday life to sophisticated scientific tools. A worldwide community of producers - students, fans, artists, programmers and professionals - gathered around this open source platform, their contributions complemented by the incredible amount of knowledge available that can be useful to both beginners and experts.

Arduino was born at the Ivrea Interaction Design Institute as a simple prototyping tool for students with no electronics and programming qualifications. As it reached the more extensive network, the Arduino board started to change to adjust to new needs and difficulties, recognizing its contribution from basic 8-piece sheets to items for IoT applications, wearables, 3D printing and inherent conditions. All Arduino sheets are completely open source, permitting clients to fabricate them themselves and in the long run tailor them to their private needs. The product is additionally open source and developing gratitude to commitments from clients around the globe.

4.14 INVERTER

A power inverter, or inverter, is a power electronic device or circuitry that changes direct current (DC) to alternating current (AC).

The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source.

A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process.

Power inverters are primarily used in electrical power applications where high currents and voltages are present; circuits that perform the same function for electronic signals, which usually have very low currents and voltages, are called oscillators. Circuits that perform the opposite function, converting AC to DC, are called rectifiers.

Figure 4.18: Solar Inverter

Input

A typical power inverter device or circuit requires a relatively stable DC power source capable of supplying enough current for the intended power demands of the system. The input voltage depends on the design and purpose of the inverter. Examples include:
12 V DC, for smaller consumer and commercial inverters that typically run from a rechargeable 12 V lead acid battery or automotive electrical outlet.
24, 36 and 48 V DC, which are common standards for home energy systems.
200 to 400 V DC, when power is from photovoltaic solar panels.
300 to 450 V DC, when power is from electric vehicle battery packs in vehicle-to-grid systems.
Hundreds of thousands of volts, where the inverter is part of a high-voltage direct current power transmission system.

4.14.1 Solar Batteries

Solar cells are C10 deep cycle batteries designed to be connected to solar charge controllers and inverters to provide backup power at night. It is designed to charge solar cells a day from sunlight. The main component of the battery is the lead inside it. Higher scores provide better battery performance and quality. Lead acid batteries are not leak-proof and maintenance-free, so you need to refill water every 3-6 months.

How to Choose Solar Battery

1) Battery capacity, measured in Ah (ampere-hour)

2) Battery warranty

3) Cost depends on battery and warranty.

There are two types of battery:

a) Flat battery
b) Tubular battery
There is no big difference in these battery technologies except for the guarantees and the lifetime. Battery height determines the type of technology, tubular means high battery, and flat plate means short-battery.

Figure 4.19: Solar Battery

Chapter 5

CALCULATION

5.1 S.S Sheet

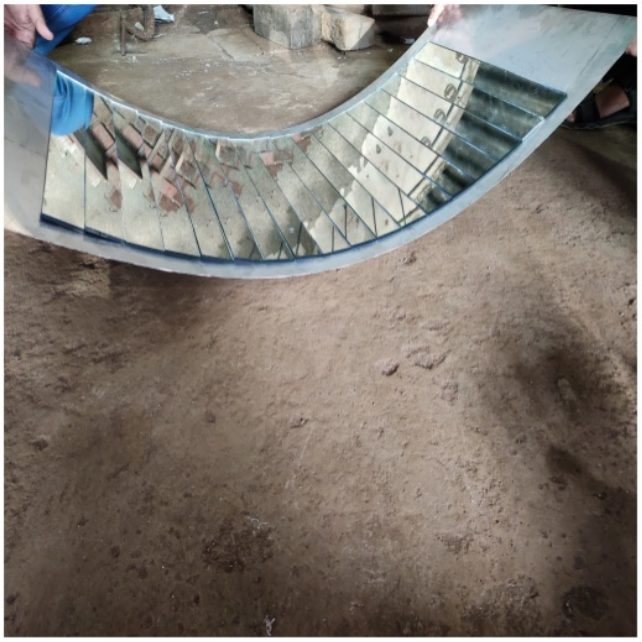

Figure 5.1: Parabolic Concentrator

Thickness = 1mm

Height = 33cm

Aperature = 90cm

$$H = A^2/16F \tag{5.1}$$

$$F = A^2/16H \tag{5.2}$$

A = Aperature Of Reflectior

H = Height Of Reflector

F = Focal Length Of Reflector

5.2 Glass

Height of Glass = 6ft

Width of Glass = 1.2ft

used piece :- 1.5inch * 1.2ft

Chapter 6

ADVANTAGES AND DISADVANTAGES

6.1 Advantages

1. This helps reduce costs by replacing an expensive large receiver with a less expensive reflective or refractive zone.
2.Because of the fixation in the littler territory, the zone of warmth misfortune diminishes.
3. In addition, the warm mass is a lot littler than that of a level gatherer, and in this manner momentary introduction is little.
4. Delivery temperature is high, there is a thermodynamic coincidence between the temperature of the problem.
5.It expands the force by focusing the vitality accessible on a huge surface, on a littler surface (safeguard).

6.2 Disadvantages

1. Non uniform flux on absorbers.
2. Maintenance is high.
3. Wide variation in shape.
4. The higher the collector concentration, the higher the precision of the optics and the greater the cost of the unit.

Chapter 7

APPLICATION

1. Cooking
2. Water heating
3. Process heat
4. Water treatment
5. Power generation
6. Cooling and air conditioning.
7. Steam generation (for power plants).
8. Seawater desalination.
9. Production of hot water for domestic and industrial use.
10. Production of hydrogen gas.

Chapter 8

FUTURE SCOPE

A study done by Greenpeace ICooking 2. Water heating 3. Process heat 4. Water treatment 5. Power generationnternational, The European Solar Energy Association and the International Energy Agency's SolarPACES group have investigated the potential and eventual fate of concentrated sun powered. The investigation found that concentrated sun oriented vitality could represent up to 25 % of the world's vitality needs by 2050. The expansion in speculation is from 2 billion worldwide to 92.5 billion over that period. Spain is a pioneer in concentrated sun based vitality innovation and in excess of 50 government-endorsed ventures. Also, it sends out its innovation, further expanding the portion of innovation in vitality around the world. Since this innovation works best in spots of high insolation (sun based radiation), specialists anticipate the most noteworthy development in spots, for example, Africa, Mexico and the southwestern United States. This shows nitrate-based warmth stockpiling frameworks (calcium, potassium, sodium, ...) make DSP plants progressively gainful. The investigation took a gander at three distinct results of this innovation: the absence of an expansion in CSP innovation, proceeded with speculation as it was in Spain and the US, lastly, the genuine capability of CSP with no boundaries to development.

Year	Annual Investment	Cumulative Capacity
2015	21 billion	4,750 MW
2050	174 billion	1,500,000 MW

Table 8.1: CSP Investment and Capacity

Finally, the study recognized how technology for CSP is improving and how it will dramatically reduce prices by 2050. It is forecast to fall from the current range from 0.23–0.15 / kWh to 0.14–0.10 / kWh.

European Union considers the development of a 400 billion euro $(774 billion) solar network based in$
$free network linking Europe, the Middle East and North Africa". The plan was largely supported by Ger$

Other organizations have predicted that by 2015, the CSP will cost $0.06(kWh) due to increased f$

In 2009, scientists at the National Renewable Energy Laboratory (NREL) and SkyFuel jointly developed large curved metal sheets that can be 30 % less expensive than the best modern collectors of concentrated solar energy, replacing glass-based models with silver polymer sheets. which has the same characteristics as heavy glass mirrors but at a much lower cost and weight. It's also much easier to deploy and install. The glossy film uses several layers of polymers, the inner layer of pure silver.

Telescope designer Roger Endell (Arizona State University) paid attention to CPV and is a partner in a company called Rehnu. The angel uses a spherical concentration lens with large telescope technologies, but much cheaper materials and mechanisms to create efficient systems.

Experience with CSP technology in 2014-2015 in Solana, Arizona and Ivanpah, Nevada, indicates a large production shortfall in electricity generation between 25 % and 40 % in the first years of operation. Manufacturers blame clouds and thunderstorms, but critics seem to believe there are technological problems. These problems are forcing utilities to pay high prices for wholesale electricity and jeopardize the long-term viability of technology. As the cost of photovoltaic electricity continues to decline rapidly, many believe that CSP has a limited future in scale generation.

By 2022, China plans to have a total load capacity of 5.3 GW after PCBs. By 2018, China's 15 hour LCOE DSP has fallen to 0.1 US $/kWh. China has come to have confidence in CSP tech$

The CSP has uses other than electricity. Researchers are exploring solar thermal reactors to produce solar fuel, so that in the future, solar will be a completely portable form of energy. These researchers use the CSP solar heat as a catalyst for thermochemistry to break down H2O molecules to create hydrogen (H2) from solar energy without carbon emissions. Due to the splitting of both H2O and CO2, other commonly used hydrocarbons - such as the jet fuel used to fly commercial aircraft - can also be generated with solar energy rather than fossil fuels.

Chapter 9

WORK DONE TILL DATE

Figure 9.1: Parabolic Concentrator

Figure 9.2: Dish Concentrator

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