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DESIGN AND IMPLEMENTATION OF PARABOLIC SOLAR COOKER WITH TRACKING SYSTEM

by

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INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG

DECEMBER 2020

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A project

Submitted as partial fulfilment of the requirement for the degree of

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

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INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG

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CERTIFICATE OF APPROVAL

The thesis/project entitled as **“Design & Implementation of Parabolic Solar Cooker with tracking system”** submitted by **Muntasir Rahman,** bearing Matric ID. **ET153020** and **Abir Bin Rahmat Ullah**, bearing Matric ID. **ET153042** of session **Spring 2020**, to the Department of Electrical and Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on 09 December,2020.

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this thesis/project has been submitted elsewhere for the award of any degree or diploma.

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Muntasir Rahman

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Abir Bin Rahmat Ullah

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Authors

ABSTRACT

Solar energy is extremely large, in exhaustible source of energy. the utilization of renewable energy is receiving growing interest worldwide. Cooking is that the measure necessity for people everywhere the planet. the ability from the sun is 1.8×1011 MW on the planet is thousand-fold greater than all other commercial sources of energy available on the planet. Everybody demands clean and safe energy devices with cost effective. Its use doesn't effect on the pollutants to the environment and greenhouse gases. Also, in solar cooker device if black material coating is completed for receiver it improves the efficiency of system and it also increases the temperature of cooker for cooking. Black coating improves the absorbance of the receiver surface. Black coatings for solar applications are particularly presented and discussed. during this project , designing and fabrication of a Concentrated Parabolic reflector targeting the Experimental analysis of effect of cooker base coating material on the performance of solar cooker.

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LIST OF ABBREVIATIONS

QFD	Quality Function Development
HCE	Heat Collection Element
CUO	Copper oxide
CSP	Concentrated Solar Power
CDR	Climate Data Record
GPS	Global Positioning system
DSC	Dye-sensitized Solar Cell
CPV	Concentrator Photovoltaic

CHAPTER 1

INTRODUCTION

1.1 Introduction

This Project was assigned with making a solar cooker. The cooker will better meet the wants of members of developing communities in Bangladesh by offering power current state-of-the-art products while being inexpensive, feasible, friendly to use, and serviceable on quickly. It should outdo the previous built of other solar cooker and can be competitive with other solar cookers on the market. For the purpose of this project, we've concentrated our efforts on the planning and building construction of the coating frame, tracking system, and concentrating disc of a solar cooking system. Future projects may investigate integration into living structures, cooktop design, and insulation of cookware. within the future, this project will facilitate the event of a solar cooking system which will improve the standard of life in developing communities worldwide.

1.2 Background:

Since classical antiquity, the concept has been around, pointing to ancient Greece, and in his book, On Burning Mirrors, Rome Damocles, a mathematician in medieval times, wrote that parabolic reflectors focus a parallel beam to a point. Ancient greece is said to have designed a big mirror, or parabolic reflector, and used it to catch fire by opposing ships in the Battle of the Siege of Syracuse. We would have enough to satisfy our energy needs by 2030 if we only turn 1% of this solar radiation into energy (Source: National Action Plan, Climate Change). Solar energy is in two forms: heat and light. Heat for heating water, cooking, drying, purification of water, generation of electricity. Light is turned into energy that can be used in illumination, pumping, communication, and power supply. 90% of household electricity is accounted for by Cooking Energy. 1,5 million people die per year from biomass fuels because of smoke. [1] Unsustainable demand for biomass fuels exceeds sustainable supply, resulting in significant deforestation and land degradation.

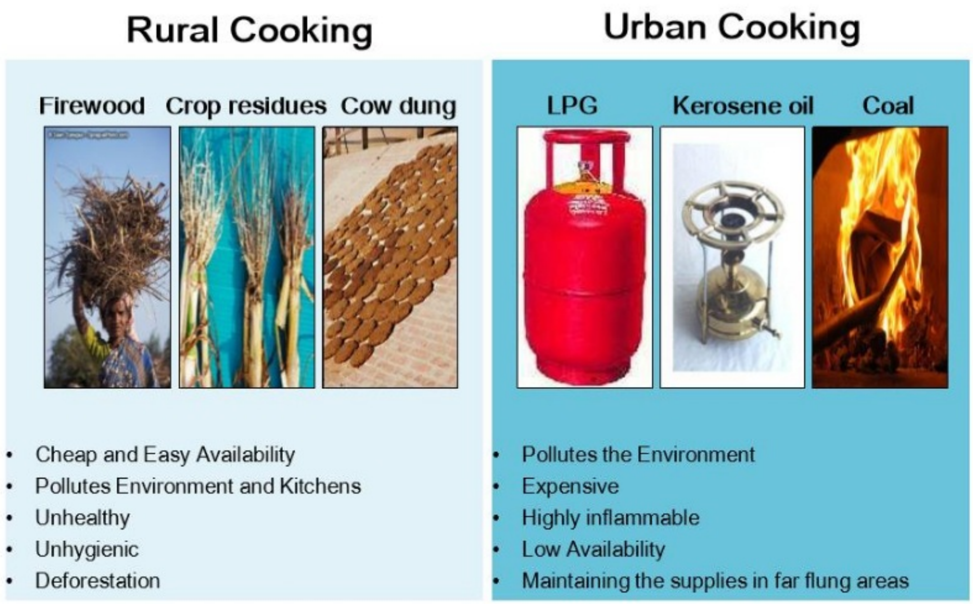

Fig: 1.1: Comparison between Rural and Urban Cooking

1.3 User-Friendliness

It has to be more user-friendly than open fire for a solar cooker to be efficient. This ensures that user inputs, such as repositioning the cooker or making tuning changes, are reduced in number and magnitude. This implies, by implication, that the cooker should be independent—no one should have to keep it when in service.

For low-income communities, a solar cooker is a substantial investment, so it needs to be built to last. Therefore, it was our intention to design a weather-resistant solar cooker that needs easy, minimal cost.

1.4 Project objectives

- For the purpose of cooking, we aimed to maximize the sunlight concentration at a single stationary 'point'.
- Maximize user-friendliness.
- Low operating cost and sustainability
- Sustainable manufacture and materials
- Ultimately, we used a standardized QFD diagram to ensure that there are engineering specifications that can be measured to assess that a product meets consumer requirements.

1.5 Project Outline:

- In Chapter one, we introduced the project and included the objective of our project.
- Literature review, Background, types of solar cooker have been discussed in Chapter two.
- We discussed about our project design, material selection procedure and guidelines in chapter three.
- Project Circuit diagram, flow chart, block diagram and working procedure of the project has been added in chapter four.
- Data analysis is done in chapter five.
- Conclusion and future scope of work has shown in chapter six.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction:

The full report contains the complete project process, including background analysis, need recognition, design specifications, design creation, proposed design, design implementation, proposed design modifications, and design verification. We were tasked with designing and manufacturing a "dual mirror" solar cooker to validate a concept for a new type of off-axis parabolic solar cooker developed by off-axis parabolic solar cookers to use a deformable concentrator to modify the solar location for seasonal change. Replacing the deformable concentrator with a rigid dish and using a monitoring heliostat to compensate for seasonal variation, redirect the sun, and provide a steady light source on the dish was the main innovation of the dual mirror design. The aim of this move is to simplify construction and reduce costs, as deformable plates must retain accurate geometry during deformation and are therefore difficult to produce. This implies that conventional off-axis parabolic solar cookers are mostly beyond the financial control of intended users: in developing countries, economically deprived communities. Initially, the scope of the project included the construction of both the concentrator and the heliostat, but was redefined at the beginning of the fall quarter to include the tracking heliostat only, as proof of concept could be achieved using a concentrate previously constructed. The heliostat was completed and the fall quarter was checked. [2]

2.2 INFORMATION ABOUT SOLAR COOKERS:

A solar cooker is a system that makes use of the sun's power to cook food and sterilize water. In order to work, solar cookers only need clear skies and healthy sunlight. Most of the solar cookers that are available today, however, are low tech models. High-tech models, such as solar-operated versions, are rather costly.

2.3 Uses of a Solar Cooker:

In developed countries, where safe drinking is scarce, or in disaster areas. For purifying water, a solar cooker is used. Sanitized pans, dishes, kitchen utensils and containers, sterilization of health equipment and life-saving devices, and pasteurized milk may also be used. A solar cooker is suitable for soups and stews, but brownies, pizza and other fast breads can be baked as well. In a solar cooker, food preparation will differ, so prepare your dishes early in the day. Dark metal cookie pans and bowls, graniteware and cast-iron pots are best used for solar cooking. Test other recipes out. Most importantly, without worrying about fire, you can let your children help cook simple solar cooker recipes.

2.4 Why Parabolic Reflectors

- Geometric parabolic form properties.
- The theory is that if the angle of incidence equals the angle of reflection to the inner surface of the collector, any incoming ray (light, sound, or radio) that is parallel to the dish will be reflected to a central point or focus
- Orient the rays outward in a beam just as they reach the reflector.
- A spherical aberration does not impact parabolic reflections.
- Beams of any kind of width can be made to embrace
- The first type of solar cooker ever developed was possibly parabolic reflectors.

2.5 About Mirror Solar Cooking

Solar cooking is the easiest, fastest, most convenient way to cook food without consuming fuel or heating up the kitchen by solar radiation. A solar cooker is a system that heats, cooks, or pasteurizes drinks and other food items using the energy of direct sunlight. Many solar cookers are relatively affordable, low-tech devices currently in use, although some are as powerful or as costly as conventional stoves,[2] and hundreds of people can cook modern, large-scale solar cookers. Many non-profit organizations promote their use worldwide because they use no fuel and cost nothing to run, in order to help reduce fuel costs (especially where monetary reciprocity is low) and air pollution, and to slow down the deforestation and desertification caused by the collection of firewood for cooking.

Fig: 2.1: Mirror Type Solar Cooker [3]

2.6 Optimize Concentration at a Stationary Point

A main consider concentration efficiency is that the geometry of the concentrator dish. We implemented a parabolic reflector, which relies on precise geometry to accurately redirect light to its point of interest. Box and panel type concentrators, in contrast, use planar surfaces angled in such some way on reflect light onto a focal area. Our objective was to style the optimal concentrator dish geometry to focus nearly all of the incident radiation. this is often important to the top user, because it affects how quickly the user can cook. Adaptability to the instantaneous position of the sun is additionally important to optimal concentration. because the sun travels across the sky, the incident radiation changes direction, and also the solar concentrator must account for this. for a few concentrator designs requiring lower precision it'd be sufficient for the user to reorient the cooker by hand, as needed. For cookers requiring greater precision, like parabolic reflectors, a more precise positioning system is required. The sun's relative position also changes counting on the season and latitude, which a cooker's frame geometry must be able to account for. this is often important to the user because it's difficult to regulate the cooker and cook simultaneously.

2.7 Types of Solar Cooker:

Different kinds of solar mirror cookers (more than 300 solar cooker models have been developed so far) use very different cooking methods, but most adopt the same basic principles.

2.7.1 Box and Panel Design

There is a clear glass or plastic top in a box cooker and it may have additional reflectors to direct sunlight into the box. To allow dark pots containing food to be put inside, the top can typically be removed. To bounce extra light into the interior of the oven chamber, one or more reflectors of shiny metal or foil-lined material may be placed. The cooking containers and the bottom of the interior of the cooker should be dark or black. To minimize radioactive heat loss, the inside walls should be reflective and the light should bounce towards the pots and the dark bottom that is in contact with the pots. The box should have sides that are insulated. The box should have sides that are insulated. The solar box cooker's thermal insulation must be able to withstand temperatures of up to 150 °C (300 °F) without melting or out-gassing. The walls of the cooker can be insulated using crumpled newspaper, wool, rags, dried grass, sheets of cardboard, etc. With either flat-black spray paint (one that is non-toxic when warmed), black tempera paint, or soot from a fire, metal pots and/or bottom trays may be darkened. Usually, the solar box cooker reaches a temperature of 150 ° (300 °F). This is not as hot as a regular oven, but still hot enough for a slightly longer period of time to cook food.

Fig. 2.2: Hot pot panel solar cooker [4]

2.7.2 Oven Type Cooker:

Cheap solar cookers that use reflective panels to direct sunlight to a cooking pot that is enclosed in a clear plastic bag are a solar oven made of cardboard, newspapers, and reflective tape panel solar cookers. In high schools and universities, such as the "Solar Oven Throw-down" at the University of Arizona, Solar Oven science experiments are routinely carried out as projects.[7] These projects show that both high temperatures can be reached and high temperatures can be predicted using mathematical models.

Fig. 2.3: Oven Type Cooker [5]

2.7.3 Paraboloidal reflectors

A solar cooker parabolic with segmented construction. Paraboloids are compound curves, which are more difficult than single curves to create with simple equipment. While solar paraboloid cookers can cook as well as or better than a traditional stove, it is hard to create them by hand. These reflectors are commonly generated using several tiny segments, all single curves that together approximate compound curves. Although it is difficult to make paraboloids from flat sheets of solid material, they can be created quite easily by rotating open-topped containers containing liquids. The top surface of a liquid that is rotated around a vertical axis at constant speed naturally takes the shape of a paraboloid. Centrifugal force causes material to shift outward from the rotation axis until the surface forms an appropriate deep depression so that the force is balanced by the gravity levelling effect. Depression is a precise paraboloid, it turns out. (See Liquid mirror telescope.) If the material solidifies as it rotates, after the rotation ends, the paraboloidal form is retained and can be used to create a reflector. This rotation method is often used for astronomical telescopes to make paraboloidal mirrors, and has also been used for solar cookers. Tools for building such paraboloids are referred to as rotating furnaces. Paraboloidal reflectors produce high temperatures and cook easily, but for safe operation, they require regular adaptation and supervision. Several hundred thousand, mostly in China, exist. They are particularly useful for household and large-scale institutional cooking in particular.

Fig. 2.4: Paraboloidal reflectors[6]

2.7.4 Scheffler Solar Cooker

A Scheffler cooker (named after its inventor, Wolfgang Scheffler) uses a preferably large paraboloidal reflector that uses a mechanical mechanism to rotate around an axis that is parallel to the earth, rotating at 15 degrees per hour to compensate for the rotation of the earth. The axis moves through the center of mass of the reflector, making it possible to quickly transform the reflector. The cooking vessel is positioned at the middle of the rotation axis, so the mirror concentrates sunlight all day on it. To compensate for the seasonal change in the declination of the light, the mirror has to be periodically rotated around a perpendicular axis. The cooking vessel does not move along this perpendicular axis. Therefore, if the reflector was a rigid paraboloid, as the reflector tilts, its attention would not remain stationary in the cooking vessel. To keep the emphasis stationary, the form of the reflector has to vary. It stays paraboloidal, but as it tilts, its focal length and other parameters change. Consequently, the Scheffler reflector is flexible, and can be bent to change its shape. It is also made up of a large number of small plane parts joined together by flexible plastic, such as glass mirrors. A device that can be used to tilt it and also bend it correctly requires a structure that supports the reflector. The mirror is never precisely paraboloidal, but for cooking purposes, it is still close enough.

The revolving reflector is often placed outdoors and the reflected sunlight passes into an indoor kitchen through an opening in a wall, sometimes a large communal one, where the cooking is done.

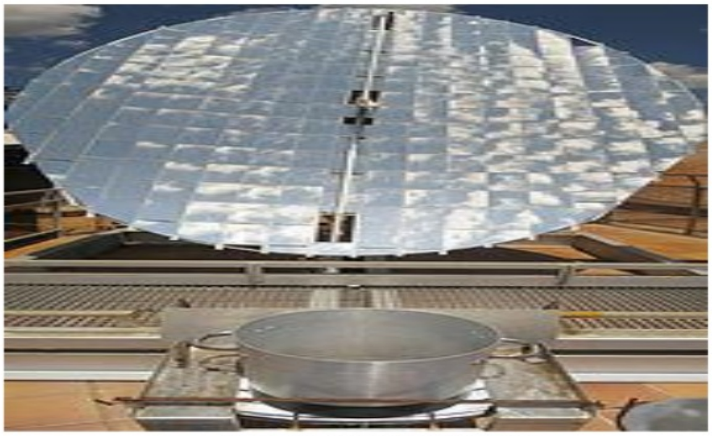

Fig. 2.5: Scheffler cooker [7]

2.7.5 Parabolic Solar Cooker

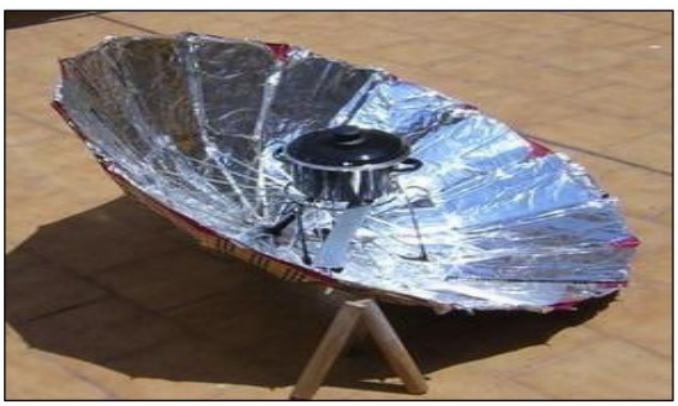

Fig. 2.6: Parabolic Solar Cooker [8]

- In order to focus the incident solar radiation on the vessel, it uses a parabolic dish.
- The aperture diameter of a standard dish solar cooker is 1.4 m and the focal length is 0.28 m. Anodized aluminium sheet, which has a reflectivity of over 80 percent, is the reflecting material used for the manufacture of this cooker.

- Up to 10 liquefied petroleum gas (LPG) cylinders per year can be saved by the dish solar cooker after complete use in small establishments.
- For large-scale institutional cooking, they are particularly useful.
- Parabolic cookers hit elevated temperatures and easily cook
- Too costly, too difficult to build, too fragile.
- So much use of Glare. Maintenance-high
- Needs periodic modification and oversight for safe operation

2.7.6 Box Type Solar Cooker

Fig. 2.7: Box Type Solar Cooker [9]

- The incident solar radiation on the vessels is diverted by a mirror reflector and a glass lid.
- An outer case, a double glass lid, a mirror reflector, insulation, and cooking pots are a typical box-type solar cooker.
- Up to 3 - 4 liquefied petroleum gas (LPG) cylinders per year can be saved by the solar dish cooker after maximum use in small establishments.
- Domestic cooking, slow cooking, but preserving food with nutrients.
- Cheap and quick to create and to maintain,
- More time for cooking compared to the parabolic form.
- Too hard. Transfers and operations are very cumbersome.
- Vulnerable to conditions in the climate

2.7.7 Focus-balanced parabolic reflector

A parabolic solar cooker with segmented construction. Paraboloids are compound curves, which are harder to create with simple equipment than single curves. Although paraboloidal solar cookers can cook further as or better than a traditional stove, they're difficult to construct by hand. Frequently, these reflectors are made using many small segments that are all single curves which together approximate compound curves. Although paraboloids are difficult to create from flat sheets of solid material, they'll be made quite just by rotating open-topped containers which hold liquids. the highest surface of a liquid which is being rotated at constant speed around a vertical axis naturally takes the shape of a paraboloid. force causes material to maneuver outward from the axis of rotation until a deep enough depression is made within the surface for the force to be balanced by the levelling effect of gravity. It seems that time period is a precise paraboloid. (See Liquid mirror telescope.) If the fabric solidifies while it's rotating, the paraboloidal shape is maintained after the rotation stops, and might be wont to make a reflector.Devices for constructing such paraboloids are referred to as rotating furnaces. Paraboloidal reflectors generate high temperatures and cook quickly, but require frequent adjustment and supervision for safe operate.

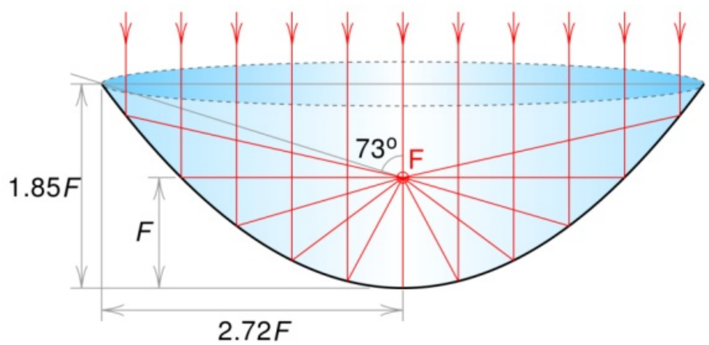

Fig. 2.8: Focus-balanced parabolic reflector [10]

2.8 World's largest 38500-meal Solar Kitchen

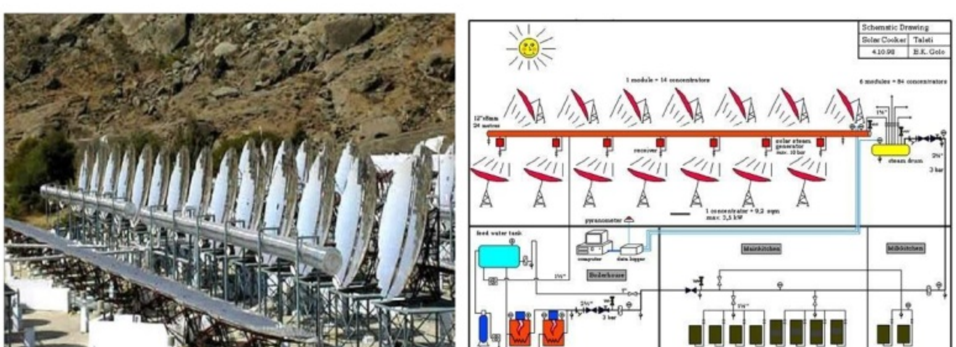

Fig. 2.9: World's largest 38500-meal Solar Kitchen [11], [12]

2.9 Hybrid Cooker Operation

- Development of the stroller wheel for fast handling and transport.
- Flexi-Handle to tilt the Full Solar Radiation cooker.
- Black Stacked Lightweight Style Case.
- Flexi - a cheap and light-weight glass style.
- Two heating elements (solar/electric) to assist the hybrid mode.
- During solar cooking, the first heating element (half capacity) will work on the battery to reduce the cooking time.
- The second heating element (full capacity) will work to make it Weather-Proof on direct supply during bad weather.

CHAPTER 3

HARDWARE DESCRIPTION AND DESIGN PROCEDURE

3.1 Introduction

In this chapter we are going to describe about the hardware's that has been used in this project with their specification and related figure.

3.2 Motor Driver Module

The L298N is a monolithic integrated circuit in the Multi-watt and PowerSO20 15-lead sets. It is a dual full-bridge driver de-signed for high voltage, high current to accept regular TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. To allow or disable the system independently of the input signals, two enabled inputs are given. The emitters of each bridge's lower transistors are linked together so that the corresponding external terminal can be used to bind the external sensing resistor. In order for the logic to operate at a lower voltage, an additional supply input is given.

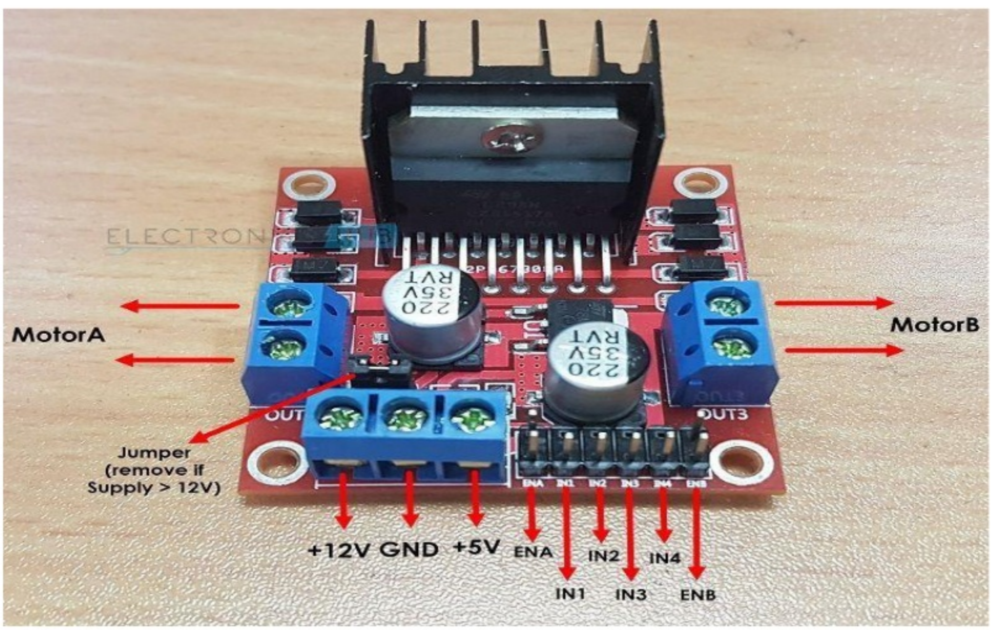

Fig .3.1: Motor Driver Module [18]

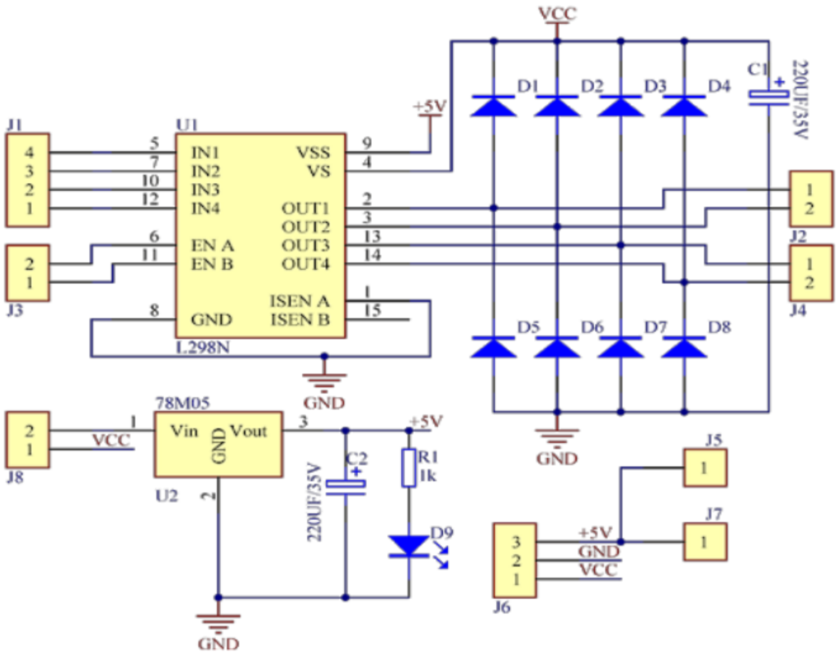

Fig. 3.2: Schematic diagram for motor driver module [19]

3.2.1 Features:

- High operating voltage, up to 40 volts;
- The instantaneous peak current can be up to 3A with a broad output current; 25W rated power;
- High voltage, broad current, full bridge driver, two built-in H-bridge, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads.
- Using the regular control logic level signal.
- Capable of driving a two-phase stepper or four-phase stepper motor and DC motors in two stages.
- Adopt a high-capacity filter capacitor and a freewheeling diode that prevents the reverse current of an inductive load from damaging devices in the circuit, increasing reliability.
- To receive 5v from the power supply, the module can use the built-in 78M05 stabilivolt tube. But to protect the chip from damage to the 78M05, an external 5v logic supply should be used when the drive voltage is greater than 12v.
- Drive voltage: 5-35V; logic voltage: 5V; scale of the PCB: 4.2 x 4.2 cm;

3.2.2 Application

It is possible to add the module to: - Drive DC engines. As a dual H-bridge drive is used by the module, it can drive two motors at the same time. Stepping Drive Motors. It can also synchronously drive two stepping motors.

3.3 DC Motor

Fig. 3.3: Dc Motor [20]

A DC motor is one of a class of rotary electrical machines that converts mechanical energy into direct current electrical energy. The forces generated by magnetic fields depend on the most common forms. Almost all types of DC motors have some internal function, either electromechanical or electronic, in order to change the current path of part of the motor periodically. As they could be powered from existing direct-current lighting power distribution systems, DC motors were the first type of motor commonly used. The speed of a DC motor can be regulated over a wide range, either using a variable supply voltage or by adjusting the current intensity of its field windings. In instruments, toys, and appliances, small DC motors are used. The universal motor is a lightweight brushed motor used for portable power tools and appliances, but can work on direct current. Currently, larger DC motors are used in electric vehicle propulsion, elevator and hoist propulsion, and in steel rolling mill drives. In many applications, the advent of power electronics has made replacement of DC motors with AC motors possible.

3.4 Photo Resistor

A photoresistor (acronymic LDR for Light Decreasing Resistance, or light-dependent resistor, or photo-conductive cell) is a lively component that decreases resistance with relevancy receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity. A photoresistor is applied in light-sensitive detector circuits and light-activated and dark-activated switching circuits acting as a resistance semiconductor. within the dark, a photoresistor can have a resistance as high as several megaohms (MΩ), while within the light, a photoresistor can have a resistance as low as some hundred ohms. If incident light on a photoresistor exceeds a specific frequency, photons absorbed by the semiconductor give bound electrons enough energy to leap into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photoresistor can substantially differ among dissimilar devices. Moreover, unique photoresistors may react substantially differently to photons within certain wavelength bands. A photoelectric device is either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and isn't an efficient semiconductor, for instance, silicon. In intrinsic devices, the sole available electrons are within the valence band, and hence the photon must have enough energy to excite the electron across the whole bandgap. Extrinsic devices have impurities, also called dopants, added whose state energy is closer to the conduction band; since the electrons don't have as far to leap, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has a number of its atoms replaced by phosphorus atoms (impurities), there'll be extra electrons available for conduction.

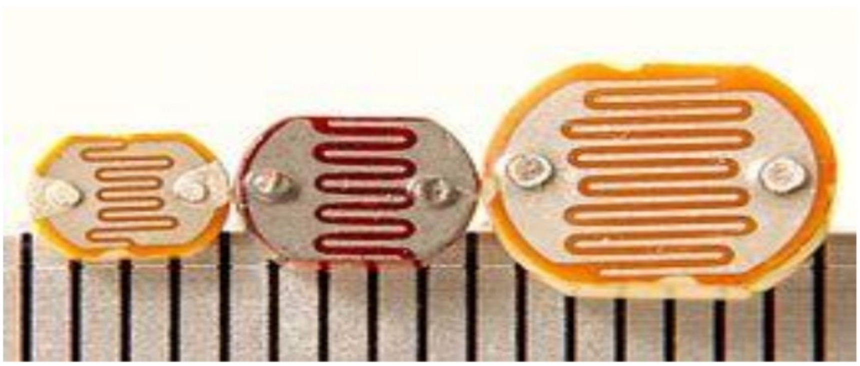

Fig. 3.4: Three photo-resistors with scale in mm [21]

3.4.1 Application

The internal components of a photoelectric control for a typical American streetlight. The photo resistor is facing rightwards, and controls whether current flows through the heater which opens the most power contacts. At night, the heater cools, closing the facility contacts, energizing the road light.

Photoresistors are available in many varieties. Inexpensive mineral cells will be found in many consumer items like camera light meters, clock radios, alarm devices (as the detector for a lightweight beam), nightlights, outdoor clocks, solar street lamps and solar road studs etc. Photoresistors are often placed in streetlights to regulate when the sunshine is on. Ambient light falling on the photoresistor causes the streetlight to show off. Thus energy is saved by ensuring the sunshine is simply on during hours of darkness.

They are also employed in some dynamic compressors along with atiny low incandescent or neon tube, or diode to manage gain reduction. a typical usage of this application may be found in many guitar amplifiers that incorporate an onboard tremolo effect, because the oscillating light patterns control the extent of signal running through the amp circuit.

The use of CdS and CdSe[3] photoresistors is severely restricted in Europe thanks to the RoHS ban on cadmium.

Lead sulfide (PbS) and indium antimonide (InSb) LDRs (light-dependent resistors) are used for the mid-infrared spectral region. Ge:Cu photoconductors are among the most effective far-infrared detectors available, and are used for infrared astronomy and infrared spectroscopy.

3.5 Pinion & Bearing

A pinion is a circular gear commonly used in many applications, including drivetrain and rack and pinion systems, the smaller of two meshed gears.

3.5.1 Applications

3.5.1.1 Drivetrain

Drivetrains usually feature a gear known as the pinion, which can differ in different systems, including the typically smaller gear in a gear drive train (although the pinion was very large in the first commercially popular steam locomotive, the Salamanca).[22] In many cases, the pinion is also the drive gear for a reduction in speed, as electric motors work. However, in watches, where gear trains begin with a high-torque, low-speed spring and end in a fast-and-weak escapement, the reverse is valid. The smaller gear that drives to a crown gear in a differential drive at a 90-degree angle. A tiny front pin on a chain-driven motorcycle. In radio-controlled cars with an engine (e.g., nitro), the clutch bell gear when coupled with a centrifugal clutch.[23] A bearing is a feature of the system that limits relative motion to only the desired motion and decreases friction between moving parts. For example, the bearing design may allow for free linear movement of the moving part or for free rotation around a fixed axis; or it can prevent movement by regulating the usual force vectors that bear on the moving parts of the bearing. By minimising friction, most bearings promote the desired motion. The bearings are broadly categorized according to the form of operation, the motions permitted, or the load (force) directions applied to the components. Inside mechanical systems, rotary bearings carry rotating components such as shafts or axles, and move axial and radial loads from the load source to the supporting structure. A shaft revolving in a hole consists of the simplest type of bearing, the plain bearing. In order to minimize friction, lubrication is used. Rolling components such as rollers or balls with a circular cross-section are placed between the races or journals of the bearing assembly in the ball bearing and roller bearing to decrease sliding friction. There is a broad range of bearing designs to allow the application's demands to be properly met for maximum efficiency, reliability, durability and performance. The term "bearing" is derived from the verb "to bear". A bearing is an aspect of the machine that enables one part to carry another (i.e., to support). The simplest bearings are bearing surfaces with varying degrees of control over the shape, size, roughness and position of the surface, cut or shaped into a component. Other bearings are separate devices placed on a section of a system or machine. Very precise devices are the most advanced bearings for the most challenging applications; their production involves some of the highest standards of current technology.

3.5.2 Bearings

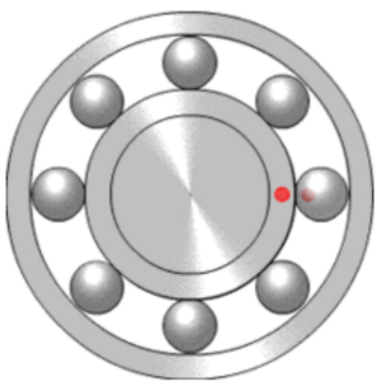

Fig. 3.5: Animation of ball bearing (Ideal figure without a cage). The inner ring rotates and the outer ring is stationary.

3.5.2.1 Types

At least 6 common types of bearings are available, each operating on different principles: Plain bearing, consisting of a shaft in a cavity that rotates. Many particular types are available: bushing, journal bearing, sleeve bearing, rifle bearing, composite bearing; Rolling-element bearing, where sliding friction is prevented by rolling elements mounted between the turning and stationary races. Two key forms exist:

- Ball bearing, of which spherical balls are the rolling elements;
- Roller bearing, of which the cylindrical, taper and spherical rollers are rolling components;
- Jewel bearing, a single bearing in which an ultra-hard glass jewel material such as sapphire is made of one of the bearing surfaces to minimize friction and wear;
- Fluid bearing, a non-contact bearing in which a gas or liquid (i.e. air bearing) supports the load;
- Magnetic bearing, in which a magnetic field supports the load;
- Flexure bearing, in which a load part that bends supports the motion.

3.5.2.2 Motions

Common motions permitted by bearings are:

- Radial rotation e.g., shaft rotation;
- linear motion e.g., drawer;
- spherical rotation e.g., ball and socket joint;
- Hinge motion e.g., door, elbow, and knee.

3.5.2.3 Friction

For reliability, to decrease wear and to encourage extended use at high speeds and to avoid overheating and premature bearing failure, reducing friction in bearings is often necessary. Essentially, because of its form, its substance, or by adding and containing a fluid between surfaces or separating the surfaces with an electromagnetic field, a bearing can minimize friction. Usually, by shape, benefit is obtained by using spheres or rollers, or by forming flexure bearings. The design of the bearing material used takes advantage of material by material. (Using plastics with low surface friction would be an example.) Using fluid, the low viscosity of a fluid layer, such as a lubricant or a pressurized medium, is used by fluid to prevent the two solid parts from touching or by reducing the usual force between them.

Electromagnetic fields, such as magnetic fields, are exploited by fields to prevent solid pieces from touching. To prevent solid parts from touching, air pressure exploits air pressure. Combinations of these within the same bearing may also be used. An example of this is where the cage is made of plastic, separating the rollers/balls by their form and finish, reducing friction.

3.6 Liquid Crystal Display (LCD)

The electronic display module is an LCD (Liquid Crystal Display) panel. The most simple module is a 16x2 LCD display and is very widely used in various devices and circuits. Seven segments and other multi-segment LEDs are favored over these modules. A 16x2 LCD means 16 characters per line can be displayed and there are 2 such lines. Each character is shown in a matrix of 5x7 pixels on this LCD. There are two registers for this LCD, namely Command and Data. The command register stores instructions provided to the LCD with the command. A command is an instruction given to the LCD to perform a predefined operation, such as initializing it, clearing the screen, setting the location of the cursor, display control, etc. The data register stores the information on the LCD to be displayed. The ASCII value of the character to be shown on the LCD is the data[24].Pin configuration of LCD is shown in

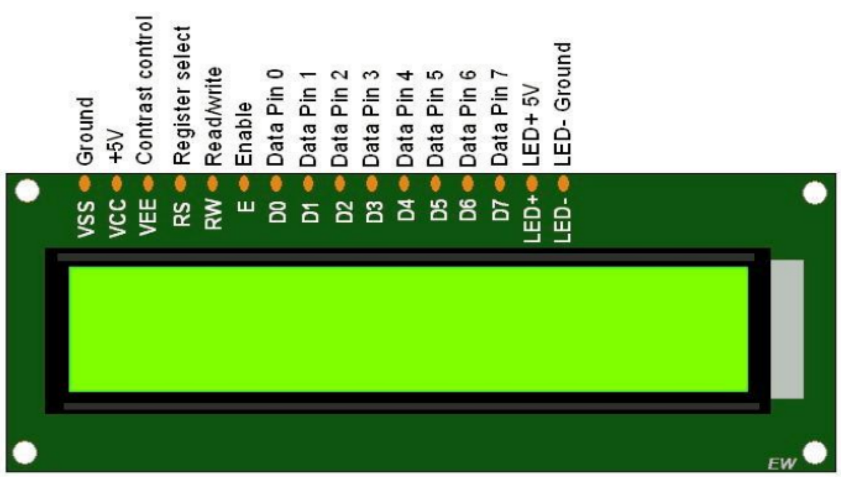

Fig. 3.6: LCD 16×2 pin configuration [24].

3.7 Arduino Nano

A lightweight, full, and breadboard-friendly board based on the ATmega3288 is the Arduino Nano (Arduino Nano 3.x). It has the same features as the Arduino Duemilanove, more or less, but in a separate box. It just lacks a DC power port, and operates instead of a normalonewith a Mini-B USB cable [25]

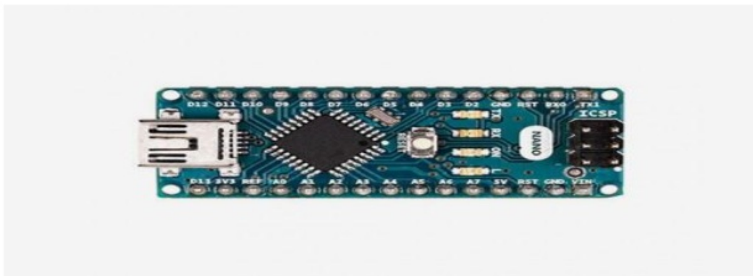

Fig. 3.7: Arduino Nano[26]

3.8 Temperature Sesnsor (LM35)

LM35 is a temperature measurement device that has a temperature-proportional analog output voltage. In Centigrade, it provides output voltage (Celsius). Any external calibration circuitry is not required. LM35's sensitivity is 10 mV/degree Celsius. Output voltage also increases with rising temperature. 250 mV means 25 ° C. It is a 3-terminal sensor used to calculate ambient temperatures from -55 ° C to 150 ° C. LM35 has a temperature output that is more reliable than the output of the thermistor .[27]

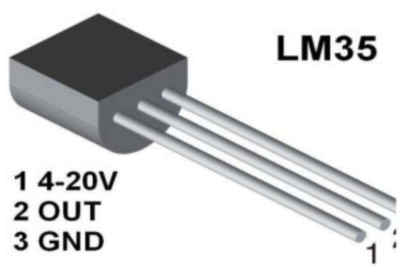

Fig. 3.8: LM35 Temperature Sensor[28]

3.9 Proposed Design

By offering a full overview of the geometry, components, manufacturing methods, and testing plans, this section examines the chosen definition. At the time of the CDR, the design outlined in this section had been suggested. Changes were made at the end of the spring quarter and the entire fall quarter following the CDR and have been recorded since the Crucial Design Report in Section 5.2 Design Changes.

3.9.1 Design Details

Our design is divided into two parts: the heliostat (also known as the reflector or primary reflector in this report) and the concentrator. The heliostat redirects sunlight in such a way that maximum irradiation is obtained by the concentrator. We give the specifics of these two primary sections of the design in this section.

3.9.1.1 Reflector

The reflector consists of a plane mirror, as seen in Figure 3.9, with three main geometric concerns: latitude, regular tracking, and seasonal tracking. The plane mirror's rotation is guided by a small motor to follow the sun's regular motion. A relatively small analog circuit controls this small motor and is powered by a 12V battery. Two photo-resistors, standard resistors, an op-amp comparator, a DC relay, a breadboard, and a rechargeable battery make up the circuit. The two photo-resistors are used to detect the direction of the sun: the circuit rotates the mirror to directly face the sun when one of the photo-resistors does not receive sunlight. With a time delay, this results in discrete motions of the mirror. This is beneficial over a directly related motor that continuously turns the mirror, as the battery is drained rapidly by continuous motion. [13] The mirror will be rotated by our engine through a string drive. In a cost-effective process, this offers a broad moment arm. The rotational axis is secured by a pin joint on one side, and a concentric half-pipe on the other side. With an end cap, the bottom end of the rotary pipe is fixed with a small bowl drilled in the middle, mating with a bolt milled to a point, which provides a low-cost, low-friction bearing. The rotating pipe is cupped by a half-pipe at the high end, protecting the vertical load, while the axial load resists a bolt protruding out of the top.

Fig. 3.9: A 3D rendering of the primary reflector

To compensate for latitude differences, the rotational axis must be precisely bent relative to level land. This is achieved correctly by making the angle of the axis of rotation equal to the local latitude with respect to the horizontal, thereby creating an axis parallel to the Earth's. Light can then be reflected onto a concentrator on the equator-side of the reflector by angling the reflector towards the equator (due South, for our Northern Hemisphere location). The reflector must direct the light so that it is parallel to the rotational axis (and the Earth's axis) in order to ensure that the incoming light provides continuous irradiation at an unchanging angle. Therefore, as seen in Figure 3.10, the rotational axis must be in line with the paraboloid axis. This is achieved by supporting the pin joint and the concentric pipe by supporting

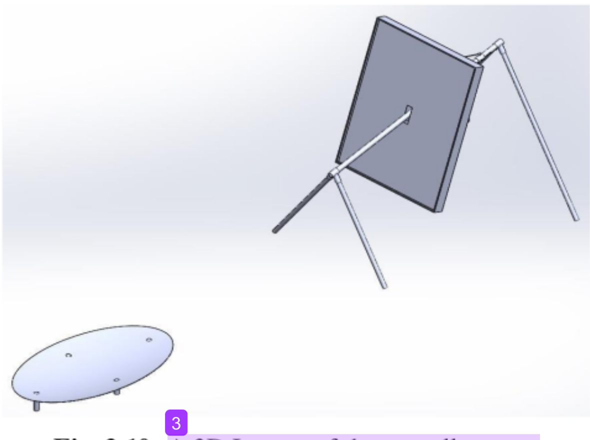

Fig. 3.10: A 3D Layout of the overall system

Angled steel plates are clamped to steel pipes that act as the frame's legs. Additionally, to compensate for the seasonal shift of the Sun's path through the atmosphere, the heliostat must adapt. The angle of our reflector with respect to the rotational axis must vary between 33° and 57° to account for this transition. For any latitude, this is valid since the seasonal variation is directly related to the inclination angle of the rotational axis of the Earth. Initially, we thought to do this by connecting the back of the reflector frame to a tiny pipe through a rigid rod, concentric to the rotary pipe, which could be fixed in place by a pin fitting into a hole in the tiny pipe and a series of holes in the rotary pipe. We opted for two rigid rods to increase the rigidity of the frame, and we opted for a pair of fixed screws instead of a quick-release pin to increase the resolution of the seasonal change. This is useful, since the shift in the mirror angle is not discretized over the year, but changes constantly instead. [14]

3.9.1.2 Concentrator

At the time the CDR was written, the design of the concentrator was not finalized to the same degree as the heliostat. At Cal Poly, a variety of different production methods have previously been explored, none of which we were comfortable with deciding on before recognizing first-hand the complexities of creating a paraboloid surface. We chose to create a small-scale prototype to enhance our understanding and better inform our design decisions. The construction technique we selected for the prototype involved constructing a mould for the surface of the paraboloid, then laying up a lattice of wood lath in this mould and gluing it together. Finally, the finished lattice was affixed with reflective Mylar strips. In a shallow hole in the earth at the Student Experimental Farm, the mould was formed by rotating a parabolic pattern around its axis, sweeping out a parabolic profile. As it is similar to the first concepts of a paraboloid, essentially rotating a parabolic path in space, we decided to make the mould this way. By marking and connecting points on a piece of thin plywood, the parabolic profile was developed, the positions of which were computed and mapped in Cartesian coordinates. The points were linked and this profile was cut out then. The cut-out was then connected to an axle and assisted so that, when rotated, it would sweep out a shallow hole in the ground. First, the hole was drilled so that across the range of its sweep, there remained about 1cm between the solid earth and the wood pattern. In the shallow hole, a thin layer of a cement-like mixture of water, sand, and clay was then applied. It could be seen where the blend wanted to be lower or higher by sweeping back and forth with the pattern. The pattern was swept back and forth and the mixture redistributed until its whole range was just in contact with the pattern. The mould was allowed to recover afterwards. After sweeping out a uniform base, it reveals the parabolic pattern and mould.

Fig. 3.11: Parabolic profile sweep setup with finished mould surface. When revolved about the axis, the pattern lightly contacts the light brown concrete-like mixture evenly.

When healed, thin wooden laths were put in two orthogonal layers in the mould. To help with adhering to the reflective material later, the top layer was chosen to run concentric to the parabolic axis. At each point where the slats crossed, a dab of glue was applied, then the assembly was forced into place by burying it in soil. A sheet of thick plastic had separated the wood and the pressing soil. They allowed the glue to heal for two days. They removed the pressing dirt and plastic. The bricks were required because the wood's elasticity caused the frame to slightly detach from the mould.

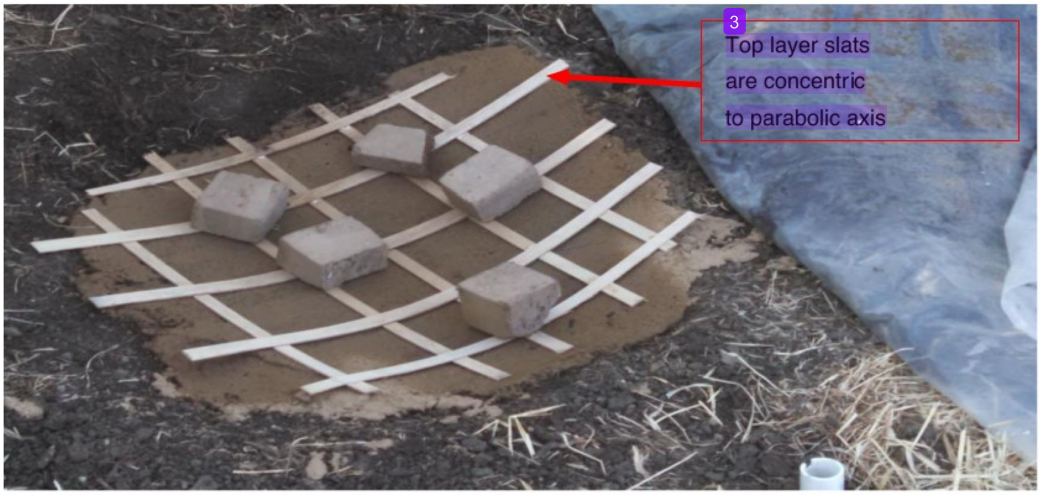

Fig. 3.12: Wooden lath frame, weighted down by bricks after

The wooden frame was removed until healed. Mylar sheets were cut to cover the gap between the top layer slats, and then added, followed by tape, using a single staple in the middle. The finished prototype is shown in figure 3.13.

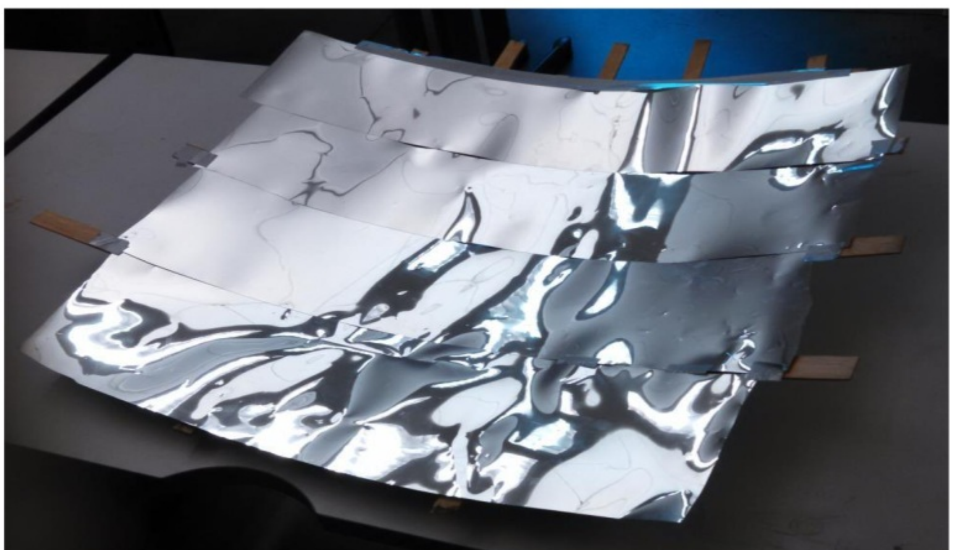

Fig. 3.13: Completed prototype with Mylar strips adhered to wooden frame.

We learned that the wood lath frame was too springy when designing the concentrator this way; once the frame was removed from the mold, it sprung back slightly into its original planar form. We also heard about the criticality in the reflective surface of imperfections. It

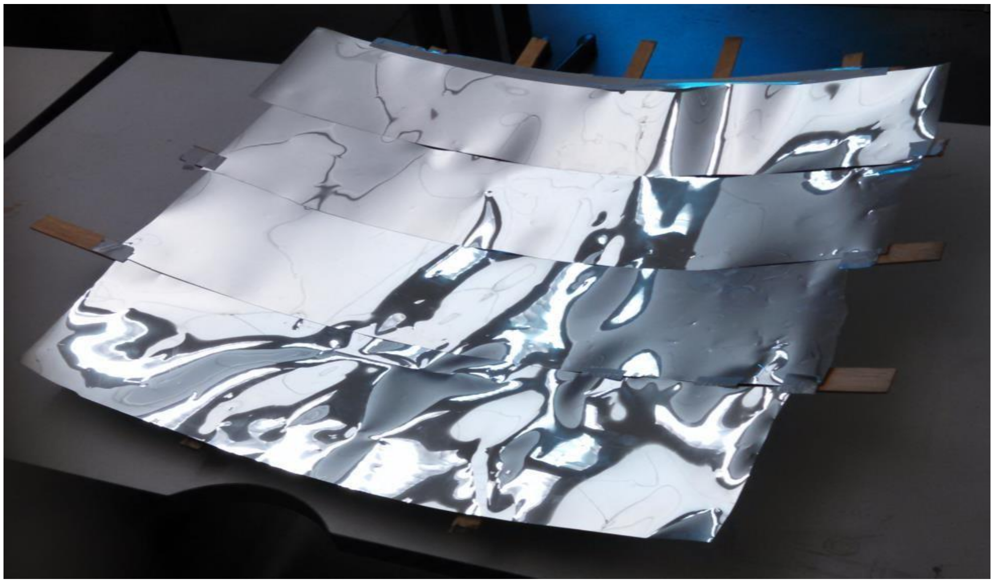

Fig. 3.13: Completed prototype with Mylar strips adhered to a wooden frame.[28]

3.10 Guidelines for setup

The parabolic cooker system consists of the main reflector, a secondary reflector, and a Mechanism for monitoring in **Fig. 3.14**. A converging beam of sunlight aligned with an axis creates the primary reflector. The rotation is parallel to the earth's axis and moves through the centers of the two reflectors. The monitoring device rotates the main reflector around its rotation axis, holding the reflected beam aligned with the primary reflector. Rotation axis, as the sun moves. The beam from the primary reflector reflects the fixed secondary reflector. When the cooking method concentrates, it is then focused on a cooking pot or frying board, so it is The primary reflector must always be held in a natural position relative to the sun's rays. The sun is always shining. Therefore, shifting to preserve the primary reflector orientation usual to the sun rays, the sun tracking mechanism Necessary is. Two tracking axes are required for this form of cooking device [29].

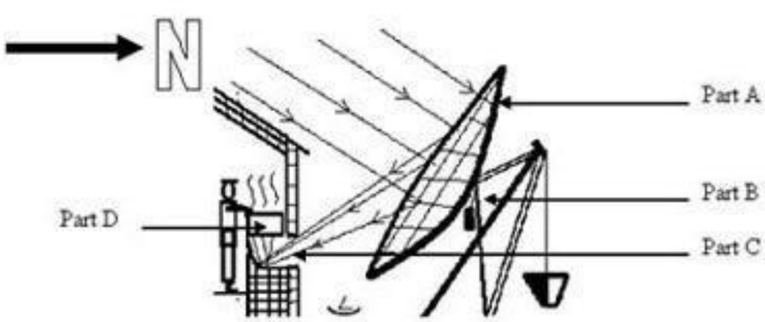

Fig. 3.14: Structure Parabolic Concetrating Cooker[29]

3.11 Material Selection and Production

To better satisfy our design demands, we selected materials. For the frame, strength, reliability, ease of manufacture, and cost were the key considerations. There was an additional factor of reflectivity for the mirrors. Besides, we considered the availability and manufacturing of each commodity in developing countries. Though we developed the product to be calibrated and used in San Luis Obispo, where we had access to comprehensive manufacturing technology, we kept the design simple and capable of producing irrespective of place.

3.11.1 Analysis Results

We have examined important interface features as a tool in our design process to learn more about the system and to add trust to our decisions. The correlations between Concentrator size and cooking strength, Reflector deflection and concentration, Heliostat construction and out-of-plane deflection, Reflector construction and torque requirements, and weight and deflection of the Reflector are especially noteworthy. The findings from these investigations are summarized in this section. For full estimates, refer to Appendix D: Comprehensive Review.

3.11.1.1 Concentrator Size and Cooking Power

The calculation of the cooking power we use is the density of the area, kW/m2, which captures the combination of two characteristics: the total power supplied and the area to which it is distributed. The total power supplied is proportional to the irradiation area of the concentrator and the geometric precision of the concentrator is related to the distribution area. We considered the reflective efficiencies and construction inaccuracies as power losses to calculate the size of the concentrator needed for our cooking power requirement, then back-solved for the required irradiation area, knowing the average insolation for our place. We have found that we would need a region of irradiation of approximately 1.13 m2 [15].

3.11.1.2 Reflector Deflection and Efficiency

The heliostat reflector is completely planar for a perfect structure, so if incident rays are parallel, then all reflected rays are parallel. The geometric theory of the paraboloid concentrator we are employing is that rays are mirrored to the focal point parallel to the axis of the paraboloid and incident to the concave face of a paraboloid. When incident rays are not parallel, they are not seen to converge at the focus of the parabola; instead, they may not concentrate at all or concentrate at any other point. Our system needed to understand how deflection of the primary reflector can influence concentration in the focus. With a reflector of circular curvature and an ideal concentrator, we moulded the device. From the ideal

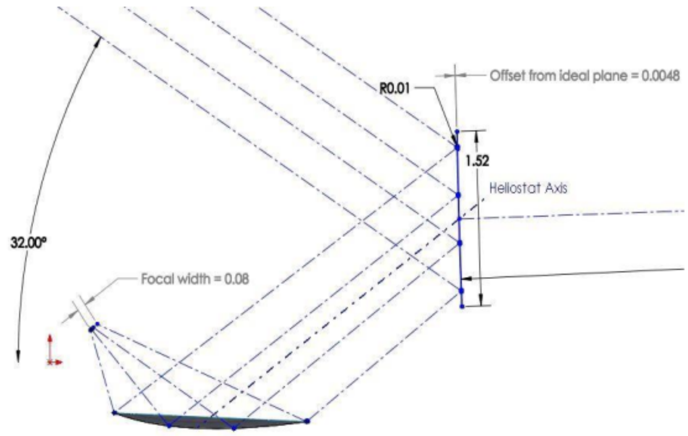

Fig. 3.15: Solid works ray tracing sketch, assuming ideal concentrator and circular reflector. Dimensions in meters.

3.11.2 Heliostat Construction and Out-Of-Plane Deflection

With an understanding of how forgiving the reflector deformation mechanism is, we had to check that our reflector's structure does not allow for unnecessary deformation. When bending under its own weight, we moulded the reflector surface as a beam, treating the components as homogeneous materials. We believed that the plywood was bonded perfectly to the beams behind it. The study took advantage of the symmetry in the structure and viewed the reflector only as a 2D model. This meant that weight densities were broken down into a single aircraft and taken into account in units of weight per length. To yield a conservative analysis, worst-case material properties and reflector orientation were used. A peripheral deflection of about 3 mm was suggested by the results of the beam theory study, which is permissible based on the results of our ray tracing. A deflection of 4.8 mm produces a focal width of 8 cm, as seen in Figure 3.15, which is small enough to achieve our desired concentration.

3.11.2.1 Reflector Construction and Torque Requirements

We needed to know how much torque would be necessary to turn the regular tracking axle in order to design the tracking motor and drive train system. Due to friction in the bearings, we considered torques and the torque needed to accelerate the reflector at 0.5 rpm/s. We have found that a torque of 2.26 N-m (20.0 in-lbf) is needed to shift the reflector as desired.

3.11.2.2 Reflector Weight and Deflection

We tested the deflection it would undergo due to its weight and the weight of the reflector to make sure that the component used for the regular tracking axis was robust enough. In bending, the axle was moulded as a simple beam supported by a distributed load and a point load. The model presumed that the beam was horizontal, thereby providing a conservative estimate. The reflector weight was taken from the reflector assembly's Solid Works model, which accounts for the volumes and densities of components. We discovered that the beam can deflect by less than 1 mm (.04 in). This is an appropriate deflection as it will not impede the reflector's function.

3.12 User Parameters

In order to ensure the product is easy to use, the user parameters were chosen. We assume that anyone who uses our product would not want to spend more than 10 minutes on a regular basis tuning or handling it in any way. Any adult should be able to do so when the consumer wants to adjust the output of the unit, so the 30 N (6.7 lb.) maximum input power. The difficulty of running the product is also important to user friendliness. Since the ease of operation is influenced by the number of potential user inputs, we restricted them to 5.

3.13 Material Selection and Production

To better suit our design criteria, we selected materials. For the frame, strength, reliability, ease of manufacture, and cost were the key considerations. There was the additional factor of reflectivity for the mirrors. In addition, we considered the availability and manufacturing of each commodity in developing countries. Although we developed the product to be calibrated and used in San Luis Obispo, where we had access to comprehensive manufacturing technologies, we kept the design simple and capable of manufacturing regardless of place.[16],[17]

CHAPTER 4

METHODOLOGY

4

4.1 Introduction

This chapter discuss the system design of this project which includes Block diagram, Circuit diagram, flow chart and working procedure.

4.2 Project Block diagram

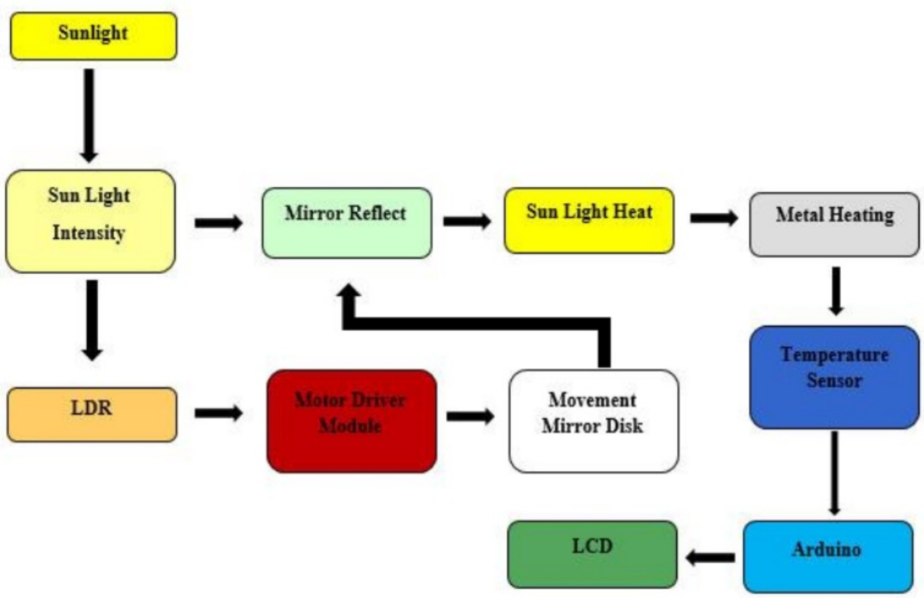

Fig. 4.1: Project Block diagram

Block diagram of this project is shown in **Fig 4.1**. Here the sunlight falls into the reflector and the LDR. Due to the falling of sunlight in the LDR.it passes a signal to motor driver module then the motor driver module move the motor disk. Here we uses LM35 temperature sensor in the stand. Which measure the boiling temperature and gives this value to Arduino nano then from Arduino nano it shown the value on a LCD display.

4.3 System Flowchart

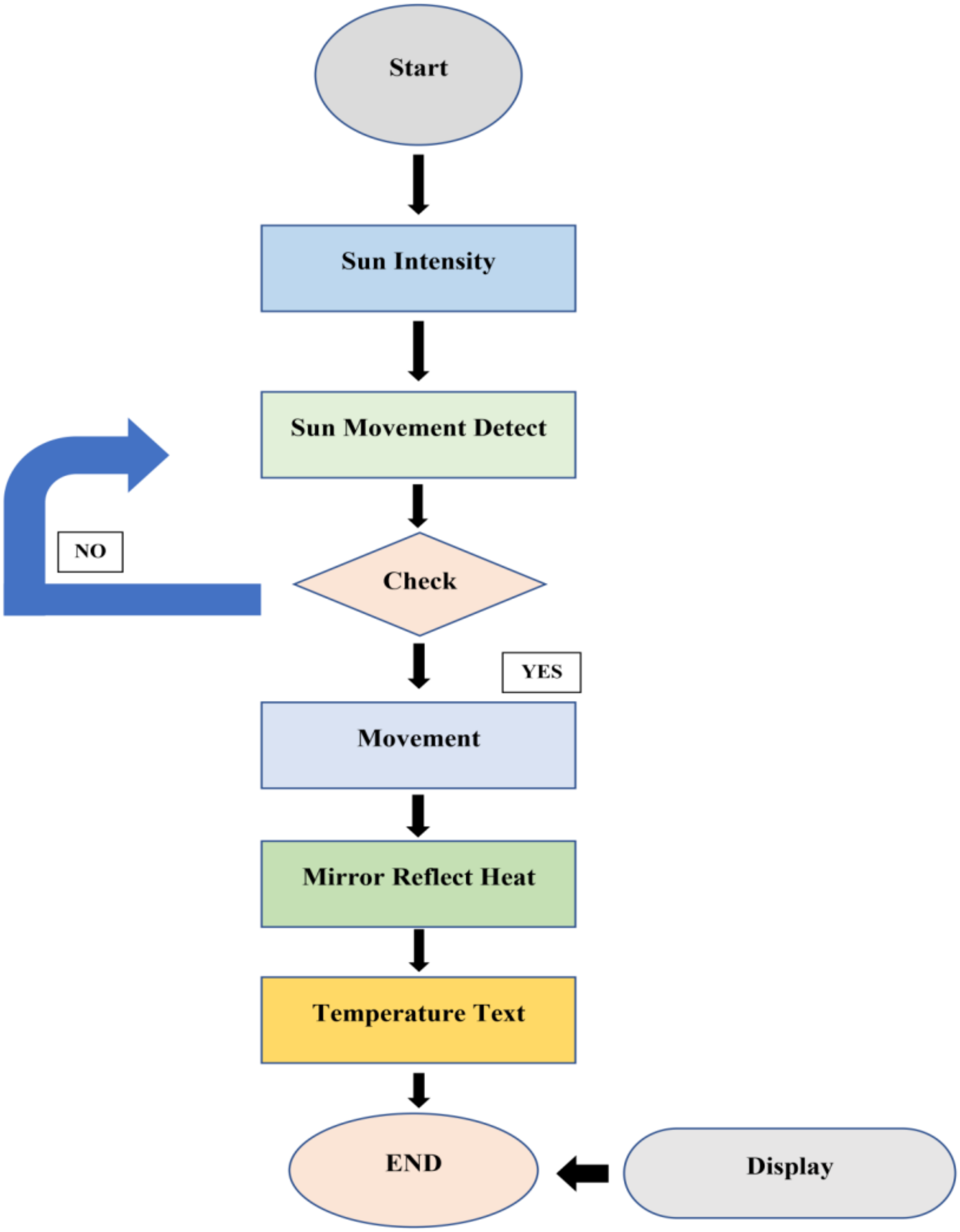

Fig. 4.2: System Flow chart

The flow chart in Fig. 4.3 describe the overview of the system. According to the sun intensity and the sun movement the body move. The LDR check that whether it has enough light to move the system. If it found that it moves towards that sun direction the body can move both anti clockwise or clockwise direction. Then the mirror reflection falls onto the desire object that we out on the stand. By checking the temperature, it shows the temperature value onto display.

4.4 Circuit Diagram

In this project two LDR sensor is used and they are divided into left LDR U1 and right side LDR U2.According to the intensity of sunlight each LDR sensor switching the relay circuit which allows the supply pass through it and drive the DC motor.220V supply is converted into 12V by a transformer and to drive the dc motor 12V AC is rectified and turned into 12V dc supply now given to the motor driver module to drive the dc motor. When left side LDR U1 sense greater light intensity than the right side LDR U2.DC motor driver module passes the signal to dc motor to rotate in the reverse direction and the parabolic solar disk rotate anti clockwise

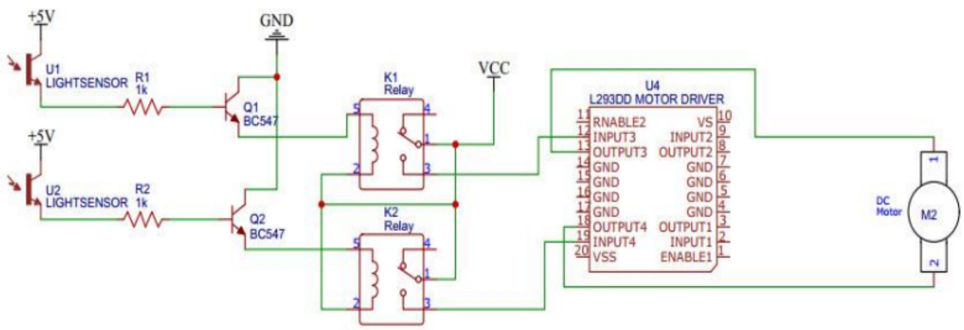

Fig. 4.3: Circuit Diagram of Parabolic Solar Mirror Movement

Arduino Nano Pin A4 connect with the LM35 pin 2. Arduino Nano pin D7, D6, D5, D4, D3, D2 connect with the LCD display pin 7,6,5,4, RS and E.

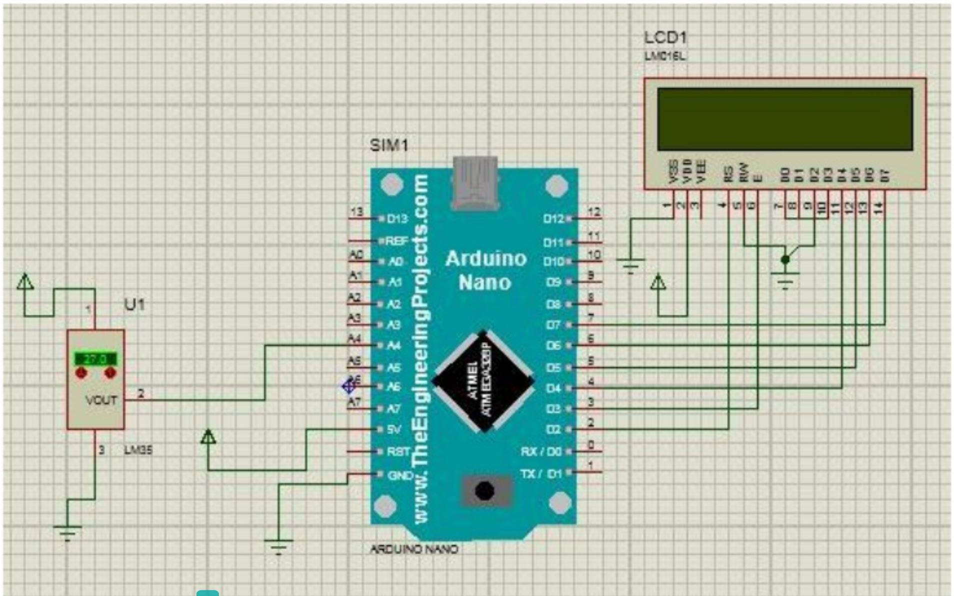

Fig. 4.4: Circuit Diagram of Temperature Checking

4.5 Working procedure

1. **Structure of Parabolic Disc:** A high-specular reflectivity mirrored surface is used to focus light from the sun into a small cooking area. Sunlight might be focused, depending on the surface material.We use glass mirror as a coating.The thickness of our glass mirror we used is 3mm.It is the most heating material for making solar cooker with heat can reach upto 350° C on a suuny day.
2. **Concentrating sunlight:** Really, temperatures are not the main necessary thing if we use perfect or choose perfect material for solar cooker. Usually, solar cooking items are designed to hit temperatures on a sunny day of 65 °C (150 °F) (baking temperatures) to 400 °C (750 °F) (grilling/searing temperatures). [10]

3. **Converting light energy to heat energy:** Solar cookers focus sunlight, such as a cooking pan, on a receiver. Light is converted to heat by the interaction between the light energy and the receiver material and this is called conduction. By using materials that conduct and retain heat, this conversion is maximized. To maximize absorption, pots and pans used on solar cookers should have a matte black color.

4. **Trapping heat energy**: By isolating the air inside the cooker from the air outside the cooker, it is necessary to reduce convection. It increases light absorption from the top of the pan by simply using a glass lid on your pot and provides a greenhouse effect that enhances heat retention and minimizes loss of convection. We can also use aluminum foil paper as a lid of the pot. It can contain the temperature of inside the pot.
5. **Temperature & Humadity Result** :We used LM35 for measuring temperature.we can also use DHT11 for measuring both temperature and humadity. We put LM35 on the focus point to the stand middle. By using arduino nano we can see the result in LCD.

CHAPTER 5

RESULT ANALYSIS

5.1 Introduction

In this chapter, we will discuss about the result of every steps of the system and analyze the system output as our desire. Also, describe cost analysis and the advantage and disadvantage of the system.

5.2 Project Picture:

Fig. 5.1: Mirror Section

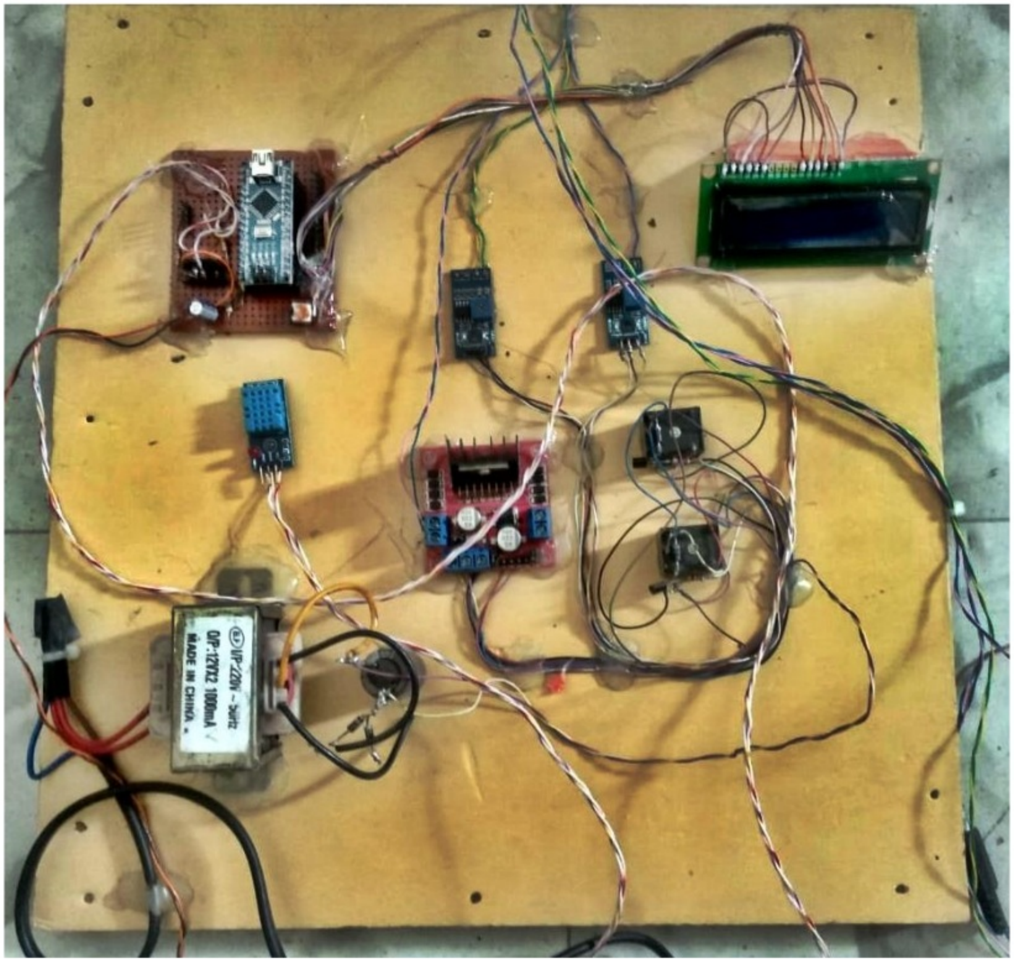

Fig. 5.2: Controlling Section

5.3 Collected Data

We formulated a set of engineering specifications from the goals discussed above to assess how well a design meets each one. The next page of Table 5.1 summarizes these criteria. The expected risk is indicated as high (H), medium (M) or low for each of them (L). The conformity or procedure used to check that the specification is met is indicated by a combination of analysis (A), test (T), inspection (I) or similarity with existing designs (S).

Table 5.1 Solar cooker formal engineering requirements

Spec. #	Parameter Description	Requirement or Target	Tolerance	Risk	Compliance
1	Daily setup time	10 minutes	Max.	L	T, S
2	Maximum user input force	30 N	Max.	L	T, S
3	Number of user controls	5 controls	Max.	L	I
4	Purchase price	$200	Max.	M	I, S
5	Static heat spot, relative to cooker	True	± 5 cm	L	T
6	Product life	5 years	Min.	M	I
7	Functional latitude range	34.6°	± 1°	L	T
8	Wind speed while operable	10 m/s	Min.	L	T
9	Wind speed before failure	30 m/s	Min.	M	A
10	Risk of minor injury, severe injury	1%, 0.1%	Max.	L	I
11	Power to cooking surface	40 kW/m^2	± 10 kW/m^2	L	A, T
12	Works with ordinary cookware	True	None	L	I
13	Annual maintenance	10 hours	Max.	L	A
14	Daily maintenance	5 minutes	Max.	L	T
15	Materials source able within range of target location[1]	200 km range	Max.	M	T

5.4 Cost Analysis

Table 5.2 shows the overall cost of the project. In this project, we used Arduino NANO in temperature checking part. We used the disk base and mirror. We cut the mirror in small pieces. We used DC motor and Motor driver module. We used an LCD display which shows the value of temperature and LM35 sensor to measure this sensor.

Table 5.2: Cost analysis of the project

Component	Cost (TK)
Mirror	800
Disk Base	1200
Disk	600
Jar Stand	450
Nut Bolt	200
DC Motor	500
LDR	30
Pinion	140
Bearing	220
Motor Driver Module	350
Arduino Nano	350
LCD Display	500
LM 35	50
Others	460
Total Cost	**5900**

5.5 Advantages

- High-performance solar parabolic cookers and cookers with vacuum tubes can reach temperatures above 550 °F (290 °C).
- Conventional cookers in solar boxes reach temperatures of up to 165 °C (325 °F). They can sterilize water or prepare most foods, including bread, vegetables and meat, that can be made in a traditional oven or stove for hours.[13]
- Solar cookers don't need gasoline.
- Reducing environmental harm caused by the use of gasoline. Since 2.5 billion people cook on open fires using biomass fuels, by reducing deforestation, solar cookers could have large economic and environmental benefits.
- They do not add inside heat when solar cookers are used outside, potentially saving fuel costs for cooling as well.
- Cooking without the use of fossil-based fuels or grid power from conventional sources decreases your carbon footprint.

5.6 Disadvantages

- In gloomy weather and near the poles where the sun is low in the sky or under the horizon, solar cookers are less useful.
- To fry popular foods, such as fried eggs or flatbreads like chapattis and tortillas, cooks can need to learn special cooking techniques. Some thick foods, such as large roasts, loaves of bread, or soup pots, may not be possible to cook safely or entirely, particularly in small panel cookers; the cook may need to divide these into smaller portions before cooking.

Table 5.3: Result Analysis

SL No	Water Litter	Day Time	Heating Time	Water Condition
01	01	11:30 AM	5 Minute	Boiling
02	02	11:50 AM	9 Minute	Boiling
03	03	12: 30 PM	13 Minute	Boiling
04	05	12:00 PM	22 Minute	Boiling
05	10	11: 30 Am	35 Minute	Boiling

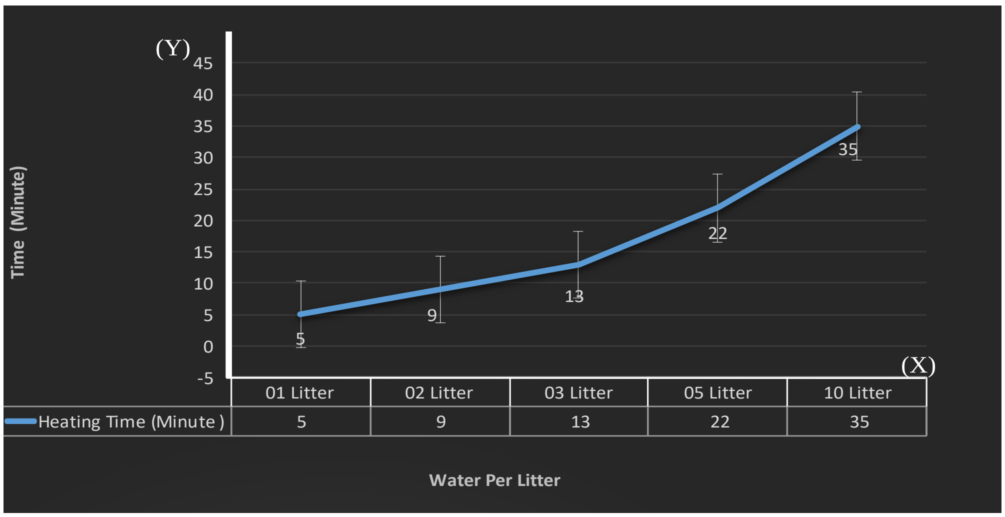

Fig: 5.3: Heating Time VS Water

Fig. 5.3 shows the graph result of our experiment that we did on October 28th when the temperature of that day was 35° C.By using temperature sensor LM35 we measure the highest temperature on the focus point was 107° C. In Fig 5.3 x-axis is the measurement of water and the y-axis is the amount of time that had been taken to steam the water in the pot.

CHAPTER 6
CONCLUSION

6.1 Introduction

In this chapter we will discuss about conclusion of the overall project. Also, we discuss about our project limitation, application and future improvement cab be done in this project.

6.2 Conclusion

It is noted that in the industrial and commercial sectors, the system generating steam for solar water heating would be very useful, this system will help reduce the load of fossil fuel energy used for steam generation and will also help black coating to achieve boiling temperature as well as boost the performance of surface temperature increases of the system receiver. The solar cooker is often capable of cooking food on the basis of solar radiation levels and within the expected length of time. The bottom section of the cooking vessel is directly exposed to solar radiation and the atmosphere is in contact with the remaining parts of the cooking vessel. With minimal cooking strength, the coated capacity cooker pressure cooker is faster than the food. This is because of the conductivity in the cooker of the coating material given. More efficiency is given by using coated surface cookers.

6.3 Application

- Cooking
- Sterilization of Medical apparatus
- Water Purification
- Roasting coffee and peanut for commercial purposes.
- Wax melting

6.4 Limitations

In cloudy weather, solar cookers are less useful.

Some solar cookers take longer to cook food than a traditional stove, particularly solar ovens. Cooks can need to learn special cooking techniques to fry common foods, oven, etc.

6.5 Future Improvement

Via more research suggested below, such potential works can be applied later:

We can attach a pair of wheels below of our mechanical structure so we can move the whole structure easily anywhere we want to move. We can attach an oven thermometer to see the temperature of the product we are heating.

REFERENCES

[1] Background,Michael West, Ph.D. June. Solar Energy Basics and More. (1993). Access date-03.12.2020

[2] About Mirror Solar Cooking, John a. Duffie & William a. Beckman. Solar Engineering of Thermal. Access date-03.12.2020

[3] https://5.imimg.com/data5/LW/XX/MY-6373175/solar-cooker-500x500.png. Access date-03.12.2020

[4]Box and Panel Design, https://upload.wikimedia.org/wikipedia/en/5/52/HotPot_solar_cooker_with_panel_reflector_%285_liter_capacity%2C_front_view%29.png Access date-03.12.2020

[5]Oven-Type-solar-cooker. https://upload.wikimedia.org/wikipedia/commons/thumb/b/b8/Solar_funnel_cooker_with_hot_dogs.jpg/300px-Solar_funnel_cooker_with_hot_dogs.jpg. Access date-03.12.2020

[6]Paraboloidalreflectors,https://encryptedtbn0.gstatic.com/images?q=tbn:ANd9GcTBo59KswPFFZWIbSaWpCh1oeu4u-sza79ZVQ&usqp=CAU. Access date-03.12.2020

[7]Scheffler-Solar-Cookeer, https://upload.wikimedia.org/wikipedia/commons/thumb/8/8f/Parabole_de_cuisson_solaire_Scheffler_coccion_solar_cooking.jpg/880pxParabole_de_cuisson_solaire_Scheffler_coccion_solar_cooking.jpg. Access date-03.12.2020

[8]Parabolic-Solar-Cooker ,https://lh3.googleusercontent.com/proxy/A8LfJofCSz_bxYy8fiIhJ7Vue0jMTfT252G4THrlzgxHaKE-EApKy8inLzlwUSsF-Rki5FeezpJ-mJF3ZbdUzszpuPiJJb4q2m. Access date-03.12.2020

[9]BoxTypeSolarCooker.https://i.pinimg.com/736x/b3/f0/35/b3f035cdfe86d9e4efeeb1f6ba0e902a--solar-cooker-place-a.jpg. Access date-05.12.2020

[10]Focus-balancedparabolic-reflector, https://upload.wikimedia.org/wikipedia/commons/thumb/2/2a/Focusbalanced_parabolic_reflector.svg/300px-Focus-balanced_parabolic_reflector.svg.png. Access date-05.12.2020

[11] World's largest 38500-meal Solar Kitchen,https://i1.wp.com/www.inhabitat.com/wpcontent/uploads/solarkitchenimage.jpg. Access date-05.12.2020

[12] World's largest 38500-meal Solar Kitchen ,https://i1.wp.com/www.inhabitat.com/wp-content/uploads/solarkitchen5.jpg. Access date-05.12.2020

[13] Reflector,Bradshaw, R.W., C.E. Tyner, 1988, Chemical and Engineering. Factors Affecting Solar Central Receiver Applications of Ternary Molten Salts, Sandia National Laboratories Report, SAND88-8686. Access date-05.12.2020

[14] Reflector ,Herrmann, UIF, et al.2002, "Overview on Thermal Storage Systems, "Flabeg Solar International Gmblt", Workshop on Thermal Storage for Trough Power Systems. Access date-05.12.2020

[15] Concentrator Size and Cooking Power,V.K.Krishnan and T.Balusamy, "studies on concentrating type solar cooker" Access date-08.12.2020

[16] Material Selection and Production, P.A.Jeeva , S.Narayanan "Black coating for solar energy storing system" Access date-08.12.2020

[17] Material Selection and Production, J. Takadoum "black coating materials. Access date-08.12.2020

[18]MotorDriverModule,https://i.pinimg.com/originals/ae/a5/00/aea500ba31f99047ac2ef4dfd375453d.jpg.Access date-08.12.2020

[19]Schematic-diagramfor-motordriver-module, https://lh3.googleusercontent.com/proxy/jVqqvoElX74HI1Bquz9Cloa .T97pc3IcQ8tDEu9JNIx7sqi_l1w40mEHjxaWEvXoqZ97uRhSVv5OqZyTqh970aQy-AKy2ak .Access date-08.12.2020

[20]DC-MOTOR, https://images-na.ssl imagesamazon.com/images/I/61H%2B0kIGnZL._SL1200_.jpg. Access date-08.12.2020

[21]PhotoResistor,https://upload.wikimedia.org/wikipedia/commons/thumb/9/9a/Photoresistors_-_three_sizes_-_mm_scale.jpg/1200px-Photoresistors_-_three_sizes_-_mm_scale.jpg] Access date-08.12.2020

[22] Drivetrain, Michael West, Ph.D. June. Solar Energy Basics and More. (1993). Access date-10.12.2020

[23] Drivetrain, John a. Duffie & William a. Beckman. Solar Engineering of Thermal. Access date-10.12.2020

[24] Liquid Crystal Display (LCD), Description and pin diagram of LCD display. https://www.google.com/search?q=lcd+display+16x2&tbm=isch&hl=en&chips=q:lcd+display+16x2,g_1:pin+d iagram:JH3RDpc-4O8%3D&bih=560&biw=360&client=ms-android-samsung&prmd=ivmn&hl=en&ved=2ahUKEwiJmuOQyZPmAhVRhY8KHfKRCYsQ4lYoAXoECAEQFw. Access date-10.12.2020

[25]Arduino-Nano,https://www.arduino.cc/en/pmwiki.php?n=Main/ArduinoBoardNano. Access date-10.12.2020

[26] Arduino Nano , https://store.arduino.cc/usa/arduino-nano. Access date-10.12.2020

[27]TemperatureSesnsor(LM35),https://www.electronicwings.com/components/lm35-temperature-sensor Access date-10.12.2020

[28]Temperature Sesnsor,https://www.instructables.com/LM35-Temperature-Sensor/ . Access date-10.12.2020

APPENDIX

For Temperature Measurement

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

int , temp;
void setup()
{
  lcd.begin(16, 2);
 }
void loop()
 {
    temp = analogRead(A7);
  temp = temp * 0.4887;
    delay(500);
  lcdprint(0, 0, (String)temp + (char)223 + "C  );
  delay(500);
}
  lcd.setCursor(x, y);
  lcd.print(txt);
}
  return r;
}
```

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