SOLAR POWERED AIR COOLER FOR TRAFFIC POLICE BOOTH

Submitted to

Visvesvaraya Technological University, Belagavi

A project work in partial fulfillment

For the requirement for the award of the degree of

Bachelor of Engineering

In

Mechanical Engineering

Under the Guidance of

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2022- 2023

DEPARTMENT OF MECHANICAL ENGINEERING

MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

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MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE
Behind K.R Mills, SrirangapatnaTaluk, Mandya-571477
2022-2023

Certificate

This is to certify that project work entitled **"SOLAR POWERED AIR COOLER FOR TRAFFIC POLICE BOOTH"** carried out by Dheekshith S N (4MH19ME010), M Sharath Babu (4MH19ME019), Nishanth M (4MH19ME025), Pruthviraj T R(4MH19ME031) are the bonafied students of **MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE**, and this report is partial fulfillment for the award of the degree of **Bachelor of Engineering** in **MECHANICAL ENGINEERING** of **VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAVI** during the year **2022-2023**.

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NISHANTH M

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DECLARATION

We, **DHEEKSHITH S N (4MH19ME010), M SHARATH BABU (4MH19ME019), NISHANTH M (4MH19ME025) and PRUTHVIRAJ T R (4MH19ME031),** students of 8th semester BE in Mechanical Engineering, Maharaja Institute of Technology Mysore, hereby declare that the project work entitled **"SOLAR POWERED AIR COOLER FOR TRAFFIC POLICE BOOTH"** submitted to the Visvesvaraya Technological University during the academic year 2022-2023, is a record of an original work done by us under the guidance of **Prof. CHETHANA G D**, Assistant Professor, Department of Mechanical Engineering, MIT Mysore. This project work is submitted in partial fulfillment for the requirement for the award of the degree of Bachelor of Engineering in Mechanical Engineering. The results embodied in this project have not been submitted to any other institute or University for the award of any degree.

Date:

Place: Mysore

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ABSTRACT

The project work outlines the design and development of a Solar powered air cooler for traffic police booth. The project aimed to create a energy-efficient air cooler for traffic police booth, that could keep the booth cool in high temperatures.

The design process involved extensive research on air coolers along with the components used maintain optimum temperature inside the traffic police booth, experimentation with various designs to determine the most efficient and effective approach. Once the design was finalized, the development phase began, with the construction of frame and the integration of the various electronic components.

Solar powered air cooler was developed using a cooling system integrated with solar power, and temperature sensors, these sensors to detect the temperature. Additionally, a battery is installed to store electric energy in a humid day.

Overall, the project was successful in achieving its goals of designing and developing a Solar powered air cooler for traffic booth. With further refinement and testing, system has a potential decrease a very high temperature more efficiently.

Keywords:

Solar power, Energy-efficient

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CHAPTER 01:

INTRODUCTION

Energy is the primary and most universal measure of all kinds of work by human beings and nature. The rate of energy consumption is increasing. Supply is depleting resulting in inflation and energy shortage. This is called the energy crisis. Due to which the world today is facing various problems such as lack of energy resources and other atmospheric problems on a major scale which we have never faced earlier. The living comfort can be only achieved at the cost of very vast energy sources. Global warming, the depletion of ozone and escalating cost of fossil fuels are also some important issues for the resources.

The only solution to the problem related to the energy sources can be solved by using the natural sources of energy. As a kind of renewable energy source the world is moving towards the availability and more use of solar energy than any other power sources. The solar energy systems can be classified in two categories; (a) those are thermal systems which convert solar energy into thermal energy. (b) photovoltaic systems which convert solar energy to electrical energy.

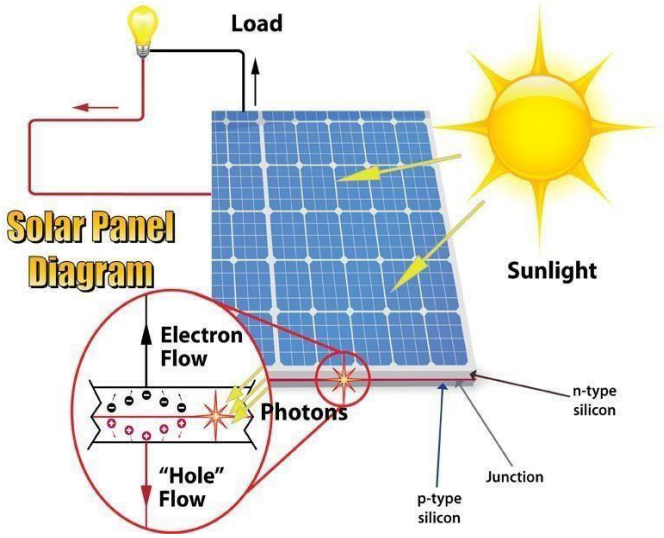


Fig 1.1: Solar panel diagram

The performance of human being is greatly affected by his surroundings. This is also true in the case of the policeman, who stands under the traffic police booth. The temperature under the roof of the booth is found to be higher than the comfort level of an individual, especially, when the sun is hot at the peak. Reducing the inside temperature range for traffic police booth could increase the effectiveness of the person and improve his work. So to overcome the issue faced

by the traffic policeman, solar powered air coolers can be installed to the booths where the temperature inside can be reduced and policeman can work with a temperature lesser than that of outside temperature and also many other problems such as energy utilization ,global warming and non-availability of electricity in remote areas to operate the coolers.

The solar power air cooler is a device that has been designed to provide cooling solution during hot climates. The device consists of an air cooler arrangement, solar panel, inverter and a battery. The solar panel collects the sun's energy and converts it into electricity, the converted electricity is stored in the battery and then used to power the air cooler

Fig 1.2: Traffic police booth

CHAPTER 02:

LITERATURE REVIEW

1. **Vijay Kumar Kalwa, R Prakash, 2012, "Design & development of solar power air cooler".** This research paper gives the information about the problems faced by the excess usage of the non-renewable resources. Room occupants also add the heat to the room since the normal body temperature is much higher than the room temperature. Hence the solution to the problem can be solved by the requirement of the sources which are abundantly available in nature that's Solar Energy. They provided information, Calculations, Analysis on Solar Energy conversion. Components Used are: • Solar Panel • Battery • Charge Controller • Inverter • Blower • Ceramics Slabs the Converted Energy is used to run the Centrifugal Fan. Blower is surrounded by cooling pads through which continuous water supply is provided. When Blower is switched ON it sucks atmospheric air into cabin through cooling pads, so that the cooling effect is introduced into the room. They selected Solar panel of 40W & Battery of 40Ah.

2. **Maneesh Bhardwaj (2012), "Solar Air Cooling",** They stated the major disadvantages of the solar cooler that is; High cost of manufacturing, low conversion efficiencies & need for continual streams of photons to produce power. The peak output from solar panel can be obtained during Noon hours.

3. **Anh-Khoi Trinh et al., Solar Thermal Energy Conversion to electrical Power, Applied Thermal Energy 70 (2014), pp-675-686**. This paper reviews the conversion of solar power to electrical that presently depends totally on the electrical phenomenon impact within which gauge boson photovoltaic cells drives an electromotive force within the material The newest advancement in state-of-art of electricity system management by combining solar evacuated tube technology is bestowed. The target heat supply is radiation and therefore the target conductor is thermal convection into the close air hoping on wind power-assisted forced convection. These sources of energy square reproduced in an exceedingly laboratory-controlled surrounding so as to keep

up a thermal dipole across a electricity module. The equipment is then tested in an exceeding natural surrounding. The novelty of the current work lies in a net thermoelectric power gain for ambient environment applications and an experimental validation of theoretical electrical characteristics relative to a variable electrical load.

4. **Chris Dixon et al., Progress of Thermoelectrical Power Generation Systems: Prospect for tiny to medium scale power generation, Renewable and property Energy Reviews 33 (2014), pp-371-381**. The paper represents the method of thermoelectrical power generation system and their potential to be incorporated in little to medium scale power generation systems with encouraging prospects of grid affiliation. This paper shows the urgency and need of searching another supply of energy to change the present inclination of civilization towards fossil fuels. Following this the potential of thermoelectrical technology to be used with another sources is indisputable. New advanced materials and innovative techniques to utilize renewable energy for power generation victimization thermoelectrical generators square measure delineated within the main body of this paper a short literature survey is conferred within the analysis paper concerning grid affiliation for thermoelectrical generators.

5. **S.A.Abdalla, Kamal N. (2016), "A radiant air-conditioning system using solar driven liquid desiccant evaporative water cooler".** They described that the solar driven liquid "desiccant" evaporative cooling system & method used for investigating its performance is providing cold water for radiant air-conditioning system in Khartoum. For more than decades, Air-conditioning is considered as the reliable & efficient source due the popularity gained by the Vapour Compression Machines. But the air-conditioners produces harmful effects on the ozone layer due to presence of Halogenated Hydrocarbons. In liquid Desiccant Evaporative Cooling process, air is used, dehumidified by desiccant solution to cool water by direct evaporative cooling.
   It's considered to be modified version of the direct evaporative cooling that can cater for different climatic conditions. They concluded that the system is environmentally friendly as it requires low high-grade input & improves indoor air quality substantially in energy efficient manner radiant air conditioning .

6. **Fabio Maria Montagnino, Solar cooling technologies: Design, application and performance of existing projects, Solar Energy (2017).** This paper introduces the idea of star cooling as a serious issue within the valorisation of the solar supply before of the challenge depicted by the worldwide growing demand of cold. The foremost relevant solar cooling technologies are in brief mentioned furthermore as their doable combination and implementation in several contexts. Some real-world installations are planned as representative of doable plant style in a very sort of climate and building integration conditions. Through these cases, trends of innovation are known each for tiny and settlement scale applications, supporting the angle of a lot economical exploitation of the solar cooling potential.

2.1 CONCLUSION OF LITERATURE SURVEY

Numerous studies have been published in the area of solar air cooling however none of them have predominantly targeted air coolers for traffic police with evaporative cooling method.

CHAPTER 03:

PROBLEM DEFINITION

In contrast to office jobs where workers may easily sit and perform their duties, traffic police's profession demands a person to stand for extended periods of time. Despite the fact that not all of the challenges experienced by police officers while on the job have proper solutions, the solar air cooler provides them with much-needed reprieve from the sweltering heat.

CHAPTER 04:

OBJECTIVES

- To design an effective air cooler police booth.
- To fabricate an affordable air cooler police booth powered by solar energy.

CHAPTER 05:

METHODOLOGY

Solar Conversion Solar energy conversion is done by using battery, inverter and charge controller. As sun light falls on solar panel, which converts into electrical energy by photoelectric effect. This electrical energy stored in battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. The stored energy directly can be used for DC loads or else need to be converted AC (alternate current) by the help of inverter. Below shown figure explains solar energy conversion.

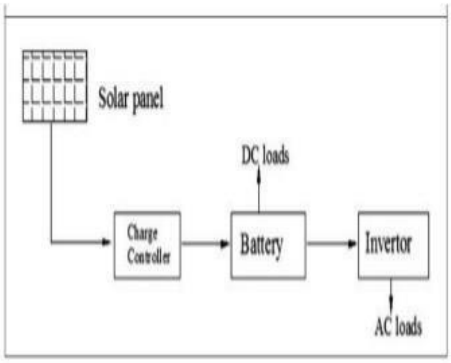


Fig 5.1: solar energy conversion.

Cool Air Generation by Centrifugal Fan The converted energy is used to run the centrifugal fan. This fan covered with cooling pads, through which water is passed at a specific rate. As the fan sucks the hot air through cooling pads, heat transfer occurs between air and water thus generated cool air enters into the room.

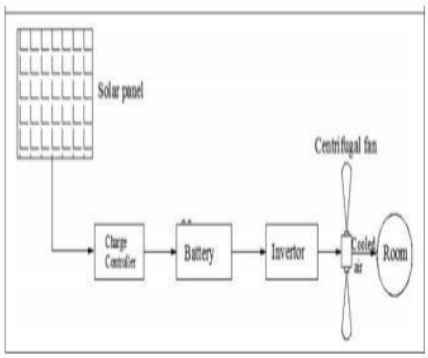
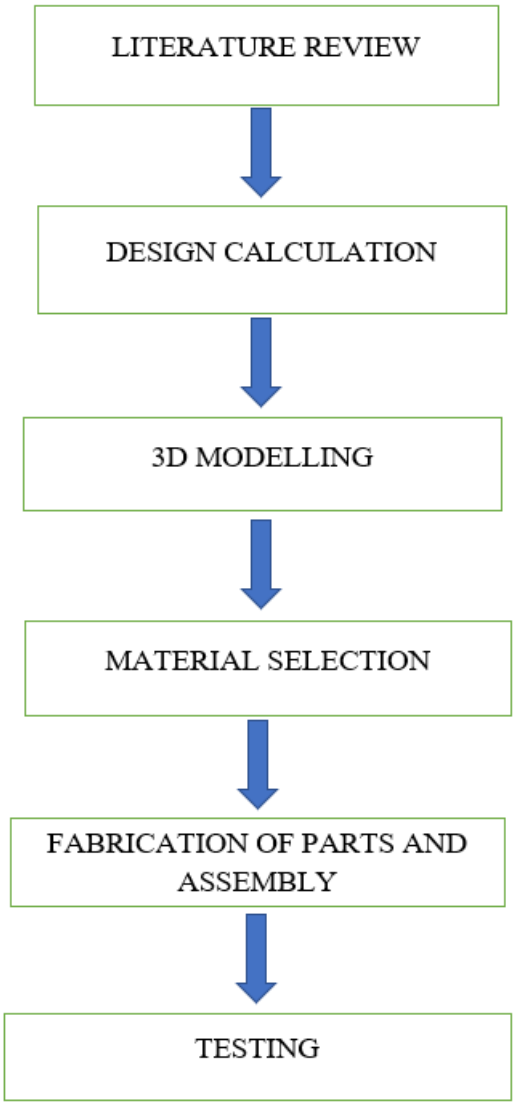


Fig 5.2: Cool air generation

5.1 PROJECT PROCESS



CHAPTER 06:

DESIGN CALCULATION

1. **Design of Motor for Fan**:

Suppose, weight of fan blade = 100 gm = 0.100 kg

Force required = 0.1 x 9.81=0.981N _1 N

Torque required =Force x Perpendicular distance

Here, Perpendicular distance = Radius of Fan = 300 mm = 0.300 m

T = (1 x 0.300) N-m T = 0.3 N-m

Power = 2_nT / 60

Consider, Motor of 1000 rpm

P = 2 x 3.14 x 1100 x 0.3/60

P = 34.54 W

Hence, we will use the motor of 35 watts.

2. Capacity of solar panel and battery required

Soto run 35W blower on for 1 hour will take

35×1 = 35 Wh from the battery (battery capacity is measured in Amp hours)

For 10Ah, 12v battery the watt hours is given by

P = V×I

Appendix - 3 36 V = 12v and I = 40Ah

P = 40×12 = 480 Wh

So, the 35W centrifugal impeller type fan runs for

120/35 = 13.71 ≈ 14h

This means the battery could supply 35W blower for 14 hours.

3. water pump:

Water pump of 35W is requires

Hence the total solar power required is 100W

Battery required is 100Ah

CHAPTER 07:

DESIGN

7.1: 3DIMENTIONAL MODEL

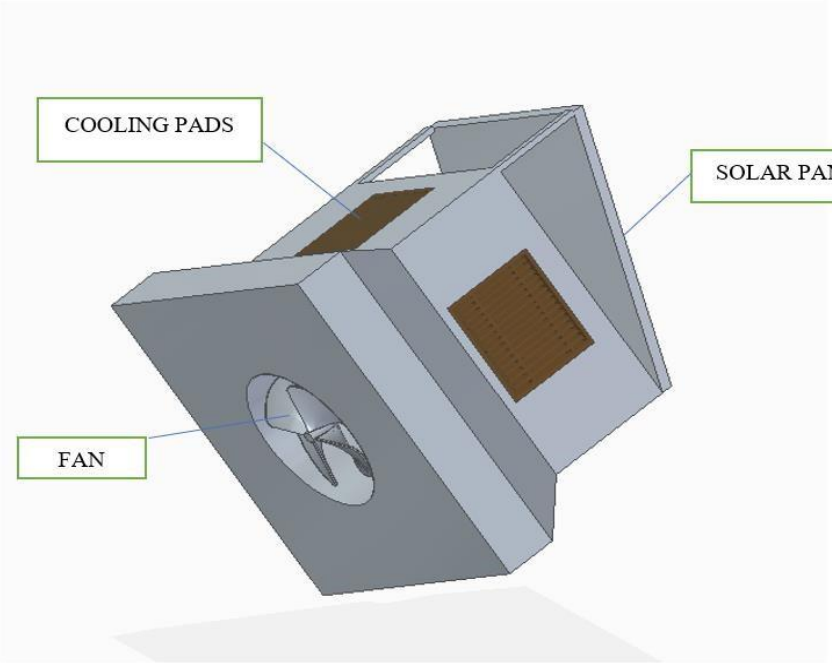


Fig 7.1: 3D Model Of Cooler

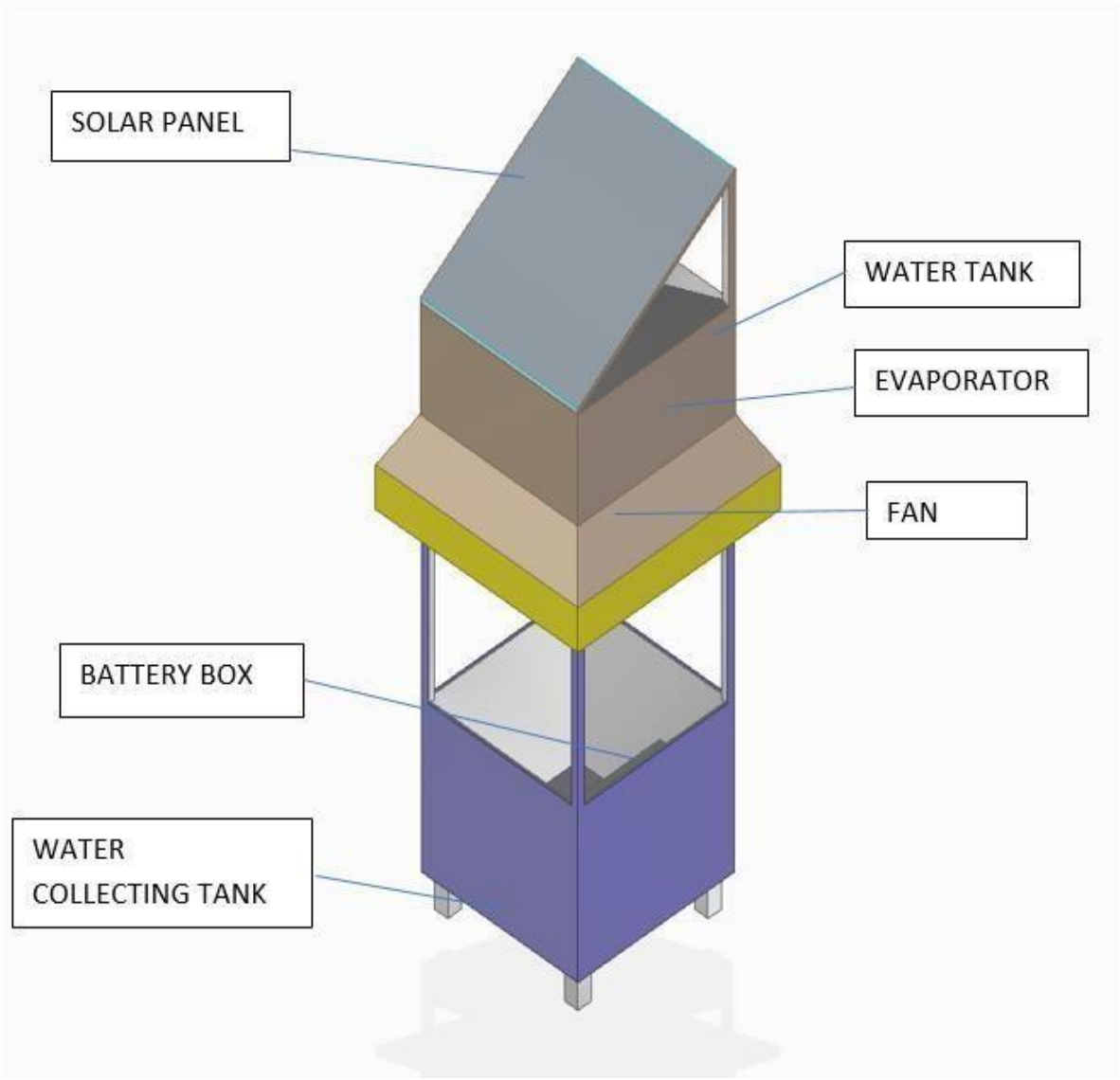


Fig 7.2: 3D Model Of Frame

7.2: PARTS OF SOLAR AIR COOLER SYSTEM

1. Solar panel
2. Battery
3. Charge controller
4. Air cooler

1.Solar panel

Solar panel refers either to a photovoltaic (PV) modules electrically connected and mounted on a supporting structure.

Fig 7.3:Solar panel

2.Battery

Battery store the electric power in the form of a chemical reaction.Without storage you would only have power when the sun is shining or the generator is running.We need battery of 12V.

Fig 7.4: Battery

3.Charge controller

A charge controller is needed to prevent the overcharging of the battery.Proper charging of battery will prevent the damage and increase the life and performance of it .

Fig 7.5: Charge controller

4.Air cooler

Parts of Air-Cooler

1. Fan
2. DC Pump
3. Cooling Pad
4. Re-Circulating Water Pump

Fan

A standalone fan is typically powered with an electric motor.Fans are often attached directly to thr motor's output,with no need for gears or belts.Smaller fans are often powered by shaded pole AC motors or DC motors.

Fig 7.6:Fan

DC MOTOR

- DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy.
- The most common types rely on the forces produced by induced magnetic fields due to flowing current in the coil.

Fig 7.7:DC Motor

Re-circulating Water Pump

A re-circulating pump draws water from the basin under the pumps it through a system of sprays(or water distributors) from which the water is directed onto the tubes surfaces.

Fig 7.8:Water Pump

Cooling Pad

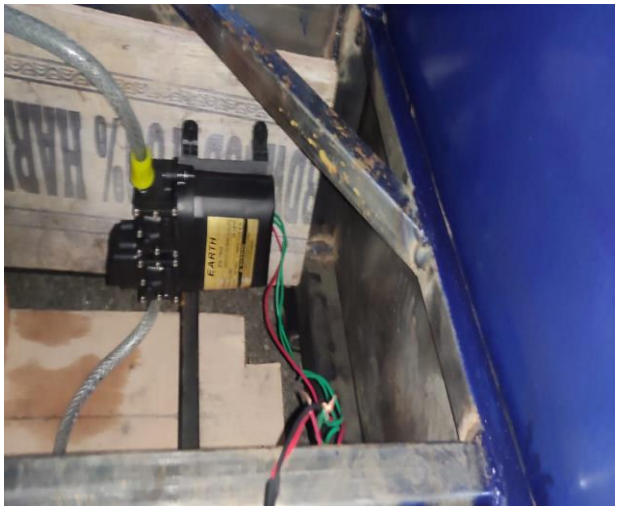
- Most of the cooling pads are made of either aspen fiber or cellulose.A cellulose pad typically needs more air and water flow than does an aspen pad.
- A temperature reduction can be achieved by passing the hot fresh air through the wetted pads.

Fig 7.9:Cooling Pad

7.3:WORK AND COMPONENT IMAGES


realme Shot on realme 5 Pro


EARTH


EARTH

7.4:FRAME FABRICATION

CHAPTER 08:

BILL OF MATERIALS

SL NO.	COMPONENTS	UNITS OR GRAMS	COST PER UNIT OR GRAMS	AMOUNT
1	SHEET METALS	5	8300	8300
2	IRON RODS	10	11800	11800
3	DC MOTOR 12V	1	847	847
4	DC PUMP 12V,PIPE AND WATER TANK	1	2200	2200
5	COOLING PADS	3	3000	3000
6	TEMPERATURE SENSORS	2	290	290
7	SOLAR PANEL,BATTERY AND CHARGE CONTROLLER	1	19000	19000
8	FABRICATION LABOUR COST	-	6000	6000
9	PAINTING,TRAVELLING AND MISCELLANIOUS	-	-	4000
TOTAL AMOUNT				**55,437**

CHAPTER 09:

RESULT

- The air cooler for traffic police booth powered by solar energy is designed and fabricated to the actual scale.
- It was found that the temperature inside the booth is 3-5degree Celsius.

CHAPTER 10:

CONCLUSION

- The project was successful in achieving its goals of designing and developing a solar powered air cooler for traffic police booth
- The model gave us the satisfactory results by lowering the temperature inside the police booth and the same model can be installed in necessary locations according to the traffic police requirement
- By completing this project we have achieved a clear knowledge of comfort cooling system for human by using non conventional source of energy

CHAPTER 11:

SCOPE FOR FUTURE WORK

□ SCOPE OF IMPROVEMENT

This project although fulfilling our requirement has further scope for improvements. Some of the improvements that could be made in this solar air cooler with auto tracking unit are listed below.

□ By adding solar panel auto tracking system

□ By adding some components to make solar heater cum cooler

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