SOLAR POWERED AIR COOLER

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Abstract – *This project reviews solar powered air cooler for residential use and industrial applications. A cross-ow direct evaporative cooler, in which the wet durable honeycomb paper which include packing material and further it is investigated. The system is predicted to act as both humidifier and cooling system to make a cushty indoor environment in arid regions.*

***Key Words*: Solar Powered[1], BLDC Hub Motor[2], Controller[3], Cost Efficient[4]**

1.INTRODUCTION

The use of solar power for cooling may be either to supply refrigeration for food preservation or to support comfort cooling. There's less expertise with star cooling than star heating. Many star heated buildings are designed, built, operated for extended periods however solely some short time experiments are rumoured on solar cooling. However, analysis work is anticipated to shut the gap between the two inside few years. Solar air con systems have used two basic approaches in an endeavour to capture the suns energy for cooling: Thermal and electric phenomenon. The electric phenomenon panels to radiation phenomenon systems have two major advantageous attributes. First, they will use standard electrically driven air-conditioning instrumentality, that is wide offered and cheap. Second, they will use the utility grid for backup power throughout dark or cloudy periods.

1.1 PROBLEM STATEMENT

The electricity produced to power air conditioning carryout both personal and global health effects. In burning fossil fuels such as coal to supply electricity to homes and work-places, power plants discharge clouds of soot and other pollutants into the atmosphere. Longer power cut-off durations in country sides and expensive of cooling products.

2. LITERATURE REVIEW

The following papers are being studied and are referred for the following project.

1. Vijaykumar Kalwa, R. Prakash, Design and Development of Solar power-driven Air Cooler, Inter-national Journal of Science and analysis (2012). This paper reviews solar power-driven air cooler for residential and industrial applications. The current air-cooling strategies are phase transition coolers, air-conditioning, fans and dehumidifiers. However running these product would like a supply known as electricity. The assembly of electricity is ultimately to blame for hot and wet conditions i.e. warming. In hot and wet requiring the need to feel relaxed and cozy has become one among of few desires and for this purpose utilization of systems like air-conditioning and refrigeration has exaggerated increased. These systems are most of the time not appropriate for villages thank to longer power cut durations and high value of product alternative energy systems being thought-about jointly of the trail towards a lot of property energy systems, considering solar cooling systems in country sides would comprise of the many enticing options. This technology can expeditiously serve massive latent masses and greatly improve indoor air quality by dominant humidness. Despite increasing performance and obligatory energy potency necessities, peak electricity demand is growing and there is currently no current solar air cooling technology suited to residential application particular for villages and faculties. [1]

2. 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. As an alternative, recent studies have investigated the potential of changing radiation to electricity by method of the Seebeck impact impact within which charge carrier quality is generated by an uneven thermal differential. 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. [2]

3. 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. [3]

4. 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 valorization 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 know each for tiny and settlement scale applications, supporting the angle of a lot economical exploitation of the solar cooling potential. [4]

5. Chun Sing Lai, Levelized price of electricity for solar electric phenomenon and electricity storage, Applied Energy 190 (2017), pp-191-203. This paper reviews the technological maturity and economies of scale for solar (PV) and (EES), there is a possibility for mass-scale deployment of both technologies in grid-connected power systems and standalone. The challenge take place in searching the economic projections on difficult hybrid systems using PV and EES. It is well known that PV energy is of stochastic and diurnal nature, and ample amount of electrical energy is generally available in midday during high irradiance levels. EES doesn't turn out energy because it is not a standard generator supply. Commonly, the price of a generating quality or the facility system is evaluated by victimization levelized cost of electricity (LCOE). During this paper, a replacement metric levelized price of delivery is projected to calculate the LCOE for the EES. [5]

6. According to the paper presented by P. Jeyaraman, V. Praveen, et. al. "Assembly of Solar Electric Tricycle for the Handicapped Persons, "International Journal of Pure and Applied Research In Engineering & Technology, ISSN:2319-507 X, Volume 3(4):285 - 292, 2014 1st December. A hand tricycle was mainly designed to be used by a disabled person who has lower extremity weakness but this tricycles are helping those disabled persons. This tricycle was modified by the addition of an electric motor and battery to help power the vehicle. The functions of the original design were not altered. The battery, motor, speed reducer and clutch were properly arranged. Additionally sprocket was linked to the drive wheel. The motor controller could regulate the speed in five different settings and the tricycle can be driven backward or forward. Patrice Pinel et al., A review of available methods for seasonal storage of solar thermal energy in residential applications, Renewable and Sustainable Energy Reviews 15 (2011), pp-3341-3359. This paper discusses about the seasonal storage of thermal energy. There is a general agreement among the Heating Ventilating and Air Conditioning community that one of the main issues impeding solar thermal technologies from achieving their full potential for space heating and domestic hot water production applications is the development of economically competitive and reliable means for seasonal storage of thermal energy. [6]

3. SYSTEM COMPONENT DETAILS

- **COMPONENTS INVOLVED**

1. Solar Panel

2. Diode Sensor

3. Battery

4. Pump

5. Cooling Pad

6. Motor

7. Fan

3.1 SOLAR PANEL: Solar power panels are one of the very main technical innovation of our period and it is commencing to make the way we make glance at our energy wants, currently and within the years to come in near future. One of our quickest enhanced technologies are found in the (PC) that power solar PV systems and provides the electricity and heat used in our businesses and homes.

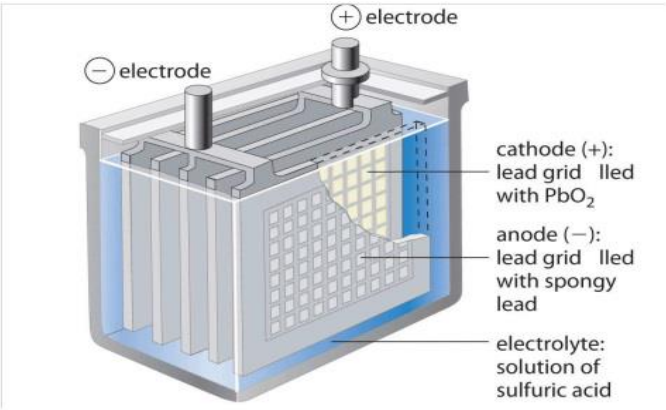
Developers and Researchers are working very harder than ever to bring the price down and invent new technologies that mitigate our support on fossil fuels. That means solar PV systems are becoming more and more important as renewable energy producing technology.

3.2 DIODE SENSOR : A diode which uses a semiconductor material, usually silicon, with two terminals which are attached to it. Its application is very simple in which electricity is passed in only one direction but not the other direction.

Types of Diode Sensors:

There are two different types of diodes which may consist of an important role in the working of solar panels actually the diodes themselves may be identical; it has two possibilities which we can use.

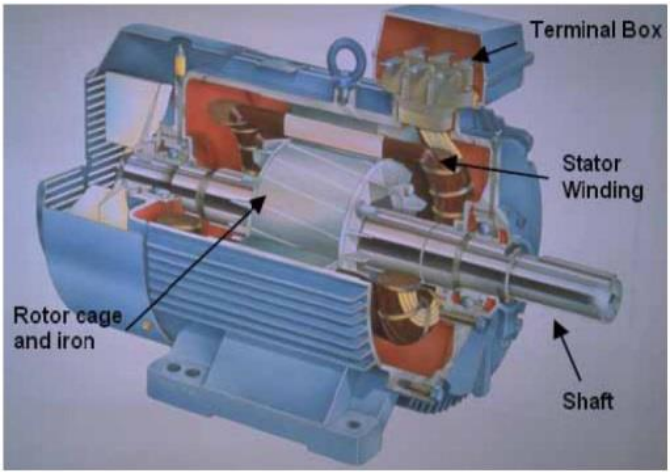
3.3. BATTERY : The basic batteries explained are secondary batteries. These are the most popular of all batteries. Those batteries are rechargeable batteries; those batteries are mostly used in Electrical Vehicles. Over the long term applications they are very cost effective. For high-drain applications Secondary batteries are most suitable and preferable. Primary batteries do not fulfill the requirement of Electronic Vehicles. Also primary batteries are not rechargeable; once you used them. For high-drain applications owing to their short lifetime primary batteries are not suitable.



3.4 PUMP: The device which moves fluids like liquids or gases, or sometimes slurries, by mechanical actions and motions called as pumps, According to the method they use to move the fluid pumps are classified in three major groups. Displacement, gravity lifts and gravity pumps. Pumps operate by mechanism like typically reciprocating or rotary, and to perform mechanical work by moving the liquid it consumes the energy. Pumps operate via many energy sources, including manual electricity, operation, wind power or engine, comes in different sizes, from microscopic use in pharmaceutical and medical applications to large scale industrial all type of pumps.

3.5 COOLING PAD: The cooling pad material play requires cooling the air. The high temperature air is passed through cooling pad where cold pads which are made through absorbing water absorbs the heat from air and cools down it. And at outlet cool air gets out.

3.6 MOTOR: the machine which converts kinetic energy into mechanical energy is called as motor. And generator does this reverse of these which converts mechanical energy into kinetic energy. Which has much in common with a motor? The principle of working of a DC motor is when a current carrying conductor is placed in a magnetic field; mechanical force is experienced by it.



3.7 FAN: A fan is a machine used to create rotation within a fluid, typically a gas such as air. It consists of a revolving arrangement of blades or vanes which act on the air or liquid or any fluid. Blades and hub creates a rotating assembly which is called as impeller or a rotor or a runner. Fans produce flows with high volume and low pressure which is also higher than natural pressure, which produce high pressures at a comparatively low volume in opposition to compressor.

4. DESIGN:

4.1 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 1000 x 0.3/60

P = 31.4 W

Hence, we used the motor of 1000 rpm and 32 watts.

4.2 Design of Solar Panel:

Solar panel selected is 10 W, used to charge battery.

Battery is 12 V, 7 A- hrs that is 80 W approximately.

Battery is discharged means its voltage gets down to 10 volt, Battery charging cycle requires 14 volts, the deficiency in voltage is 4 volts

Charging power required is,

P = 4 V _7A -hrs

= 28watt i.e approximately 30 watt

So for a Solar panel of 10 W, the battery charging time is about 3 Hours in sunlight.

4.3 Design of Motor and Pump:

Assume, Pump Discharge, for water to be ushed on Cooler pads,

Q = 0.2 liters /s

Q = 0.2 X 10^{-3} m^3 /s

The velocity of pump is given by;

V = Q=A

Where, A-cress sectional area of pipe carrying water= 11:03x10 3m2

V = (0:2 _ 10 3=11:03 _ 10 3)

V = 0:018m=s

Power required to lift water,

Power = F _ V

P = 735:75 _ 0:018

P = 14 Watt

Hence, we have selected the motor of 12 V and 1.2 A= 15Watt.

CONCLUSION:

From the information, design and assembling of all components, we conclude that the Solar Powered Air Cooler compared to existing air conditioning systems and all cooling equipment's is more eco-friendly and does not require any external electricity supply. The solar energy is utilized for other purposes than air cooler which will decrease the electricity consumption of other equipment's. The Solar Powered Air Cooler provides a handful in conserving and protecting the nature from the harmful effects of other sources of energy. This Solar Powered air Cooler solves the problem of power cut in rural areas. The Solar Powered Air Cooler provides comfort conditions for human to perform any type of work and operation, while not depending on the outdoor conditions.

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REFERENCES

[1] Vijaykumar Kalwa, R. Prakash, \Design and Development of Solar Powered Air Cooler", International Journal of Science and research (2012).

[2] Anh-Khoi Trinh et al., \Solar Thermal Energy Conversion to Electric Power", Applied Thermal Energy 70 (2014) pp.675-686.

[3] Chris Dixon et al, Progress of Thermoelectric Power Generation Systems "Prospect for small to medium scale power generation ", Renewable & sustainable Energy Reviews-33(2014) pp-371-381

[4] Fabio Maria Montagnino et. al, Solar cooling technologies. Design, application & performance of existing project", Solar Energy 2017

[5] Chun Sing Lai et. Al, Levelised cost of electricity for solar photovoltaic and electrical energy storage", Applied Energy 190 - (2017) pp-191203.

[6] Patrice Pinel et al, A review of available methods for seasonal storage of solar thermal energy in residential applications", Renewable and Sustainable Energy Reviews 15 - 2011, pp.3341-3359.

[7] Rajat Subhra Das et al, Experimental investigations on a solar assisted liquid desiccant cooling system with indirect contact dehumidifier, Solar Energy 153 - 2017 ,pp-289-300.

[8] Albert Al Touma et al, Solar chimney integrated with passive evaporative cooler applied on glazing surfaces, Energy 115 - 2016, pp.169-179.

[9] Y.J. Dai, K. Sumathy, Theoretical study on a cross-ow direct evaporative cooler using honeycomb paper as packing material", Applied Thermal Engineering 22-2002 pp-14171430.

[10] S. Sadhishkumar et al., Performance improvement in solar water heating systems - A review, Renewable and Sustainable Energy Reviews-37 - 2014 pp-191198.

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