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DESIGN AND FABRICATION OF SOLAR POWERED MINI AIR COOLER

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Abstract :

Now-a-days, there is rise in pollution which indirectly results in global warming (rise in environmental temperature) and other environmental problems. In this hot and humid condition there is a need to get a fresh and cool surrounding to live comfortably. These needs are satisfied by the air conditioning systems, coolers or the other refrigeration systems. Solar power systems being considered as one of the path towards more sustainable energy systems. This technology can efficiently serve large latent loads and improves the indoor air quality by controlling the power requirement in low cost and giving efficient working. The energy is stored in the battery and then used to run the mechanism this is the energy and cost saving mechanism. This project reviews solar powered air cooler for residential and industrial applications.

Keywords: Solar Panel; Cooler; Battery; Air cooler

I. INTRODUCTION

INTRODUCTION

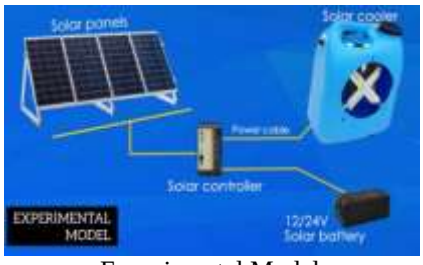
In general a solar air cooler works on solar energy. As the name suggests, it uses solar power to meet its energy requirements. Its operational mechanism is different from the conventional evaporative air cooler and it better than solar air conditioner.

The solar powered cooler uses a simple evaporative cooling principle to lower temperature. The dry and warm air is collected from the outside and pushed inside the cooler body structure. Where the power gained from the solar panel is stored in a device called battery, where it runs the cooler even if the climate condition is not suitable to run the solar panel as per the standard on-going process. The creation of new source of perennial environmentally acceptable, low cost electrical energy as a replacement for energy from rapidly depleting resources of fossil fuels is the fundamental need for the survival of mankind. We have only about 25 years of oil reserves and 75– 100 years of coal reserves. Resort to measure beginning of coal in thermal electric stations to serve the population would result in global elemental change in leading to worldwide drought and decertification. The buzzards of nuclear electric-stations are only two will. Now electric power beamed directly by micro-wave for orbitingsatellite. Solar power stations (s.p.s) provide a cost-effective solution even though workon solar photo voltaic and solar thermo electric energy sources has been extensively pursued by many countries. Earth based solar stations suffer certain basic limitations. It isnot possible to consider such systems and meeting continuous uninterrupted concentrated base load electric power requirements.

EXPERIMENTAL SETUP

The experiment where conducted on a Solar Powered Mini Air Cooler as shown in figure 4.1 The detailed view of our project is displayed in figure 4.2. In our project we used 10 watts solar panel, 12v 7ah battery as a storage device, we used a 5 liter container as a Air cooler body structure to rotate the fan we used a 12v DC Motor and for cooling purpose we used a 12v DC Pump for recirculating the water all over the Container's inner region to fell cool air. In the upcoming section we can discuss about the components that are all used in our project and its description and specification are listed as per the components that are all used. In our project we can able to run the cooler either by using the solar panel power or the solar energy comes from the

solar panel is stored in a battery, where it is used as a primary device to run the cooler if the climatic condition is not suitable to use the solar panel in a proper manner.



Experimental Model


Finalized Set up

COMPONENTS AND DESCRIPTIONS

The term component refers to any specific element of the entirety of the project. Types of components can include specific schedule events, specific tasks, specific locations, and specific rules. Component is somewhat of an uber-term, in that it can refer to many different things within a project. Major components used in our projects are listed below,

1. Solar Panel
2. Empty Container
3. 12V DC Motor
4. 12V DC Pump
5. Propeller Fan
6. Battery
7. ON/OFF Switch
8. Power Connector
9. Water Pipe
10. Wood Wool Pad
11. Plastic Net

SOLAR PANEL

Solar modules are usually made from string of crystalline silicon solar cells. These cells are made of extremely thin silicon wafers and hence are extremely fragile. To protect the cells from damage, a string of cells is hermetically sealed between a layer of toughened glass and layers of ethyl vinyl acetate. An insulating ted lar sheet is placed beneath the EVA layers to give further protection to the cell string. An outer frame is attached to give strength to the module and to enable easy mounting on structures. A terminal box is attached to the back of a module; here, the two ends (positive and negative) of solar string are welded or soldered to the terminals. This entire assembly constitutes a solar panel.

Parameters and Specifications Used

Maximum Power (p max)	10 Wp
Maximum Power Voltage (Vmp)	19.25 V
Maximum Power Current (Imp)	0.52 A
Open Circuit Voltage (Voc)	22.5 V
Maximum System Voltage	600 V
Temperature of Panel	25 ^{0}C

EMPTY CONTAINER

Empty Container Flows. A container is a transport as well as a Production unit that moves as an export, import, or repositioning Flow. Once a container has been unloaded, another transport leg Must be found, as moving an empty container is almost as costly as moving a full container.

Parameters of container is given below

Capacity	5 liter
Color	White
Material	HDPE Plastic
Length	176
Height	280
Width	130

DC MOTOR

A **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 magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing Small DC motors are used in tools, toys, and appliances.

Specification of DC Motor is given below

Input Voltage (V)	12
Retarder Reduction Ratio	1 : 90
No Load Speed (RPM)	180
No load Current (mA)	< 1100
Rated Speed (RPM)	120
Unload Current (A)	20

DC PUMP

DC Powered pumps use direct current from motor, battery, or solar Power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC Power. Solar- Powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sun light.

The Working principle of a water pump mainly depends upon the positive displacement principle as well as kinetic energy to push the water.

DC generally used to carry portable water from below the surface of the ground for residential or commercial use.

Specification of DC Pump is given below

Rated Voltage	12 V
Working Voltage	11 – 13 V
P (max)	4.8 W
Max Water head	300 cm
Max flow rate	240 L/

PROPELLER FAN

A DC, or direct current fan, uses a power source that is connected to a transformer. The transformer then converts the energy to direct current, Or a one-way current. It is a powered machine used to create a flow of Air. A fan consists of a rotating arrangement of vanes or blades made up of Plastic, or Metal which act on the air.

Parameters of fan given below

Size	6 INCH (all sides)
Fan	3 Blade Type

BATTERY

A battery can be defined as an electrochemical device (consisting of one or more electrochemical cells) which can be charged with an electric current and discharged whenever required. Uses of battery include providing backup power during a power outage. At home, the batteries are typically wired to electrical appliances. Its positive terminal is the cathode and its negative terminal is the anode.

Specifications of Battery used is given below

Height	151 nm
Length	94 nm
Width	65 nm
Nominal Voltage	12 V
Nominal Capacity	7 Ah
Temperature	25^0 C
Cycle Use	14.1 – 14.4 V
Max Initial Current	1.4 A

ON/OFF SWITCH

A switch where a definitive click is heard, is called a "Positive on-off switch" A very common use of this type of switch is to switch lights or other electrical equipment on or off. Multiple toggle switches may be mechanically interlocked to prevent forbidden combinations.

POWER CONNECTOR

An electrical connector is an electromechanical device used to join electrical conductors and create an electrical circuit. Most electrical connectors have a gender – i.e. Male component called a plug, connects to the Female component, or socket.

WATER PIPE

A pipe for conveying water it is used to transfer or convey the fluid to the required place or region. Where there are different kinds and forms of pipes are used in industries and also in Household appliances.

WOOD WOOL PAD

Wood wool cooling pads are made from splinters of wood, which are cut from the logs, and are arranged in the form of grass. These are also called as ASPEN cooling pads. Wood wool cooling pads give a reasonably good cooling effect, In fact that these are economical and still very widely used in personal home air coolers.

It gives a reasonably good cooling effect, if measured independently and coupled with the fact that these are economical and still very widely used in personal home air coolers,

This pads in the air cooler absorbs the water. When the hot air passes through the surrounding of the cooler structure and make it feel cool.

PLASTIC NET

A mesh is a barrier made of connected strands of metal, fibre, or other flexible material. A mesh is similar to a web or a net in that it has many attached or woven strands.

This kind of nets are used widely in the rear of outdoor unit of air cooler and conditioner units for protection purpose. Further it is also used in Air cooler to stiffen the air cooling pad.

RESULT AND DISCUSSIONS

The performance of the solar air cooler at different conditions involved is evaluated. The studied parameter involves the performance and temperature that the cooler that changes. The performance of the cooler is discussed with the help of the graph figure were it shows the parameters and values are added in the below.

Experimental observations related to experiment performed on a particular days with the rated 10 watts solar panel, and battery connected with a DC air cooler are presented. The experiment are involved with different situation for different usages. The output the comes from the work is based on the panel location, orientation of the panel fixed, the usage is tracked in the below

In Table 1 shows the readings taken from the use of solar panel as called as Power vs Time the readings are listed below This readings shows the value of Power vs Time without using battery.

TIME (T) mnts	POWER (W) watts
0	0
5	500
10	1000
15	1500
25	2000

Power vs Time (without battery)

In Table 2 shows the readings from the use of battery as the readings are listed below

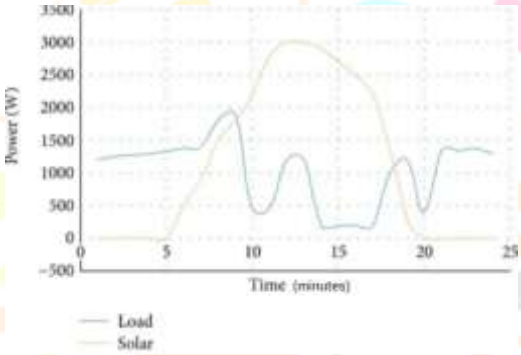
This readings shows the value of Power vs Time with the use of a battery as a primary source as a direct power source.

TIME (T) mnts	POWER (W) watts
0	4200
5	4050
10	8200
15	8000
25	7600

Power vs Time (with battery)

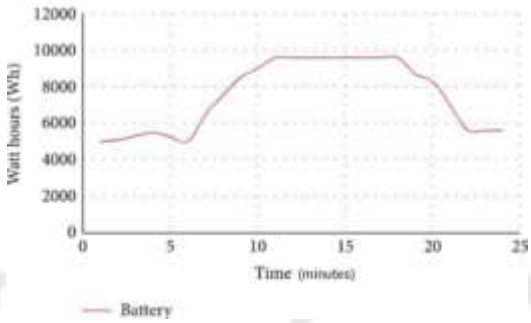
The values shows that the Air cooler can run with both Panel and Battery too. Where the cooler runs with approximately between 20-25 minutes continuously. If connected with the battery the cooler runs continuously, but if we connect with solar panel according to the climatic conditions changes will occur, if the solar radiation will come when having the clear sky we can able to run the cooler with the solar panel without using the battery in a very proper manner.

With the help of the readings we can manage to illustrate graph in the form of Power vs Time without using battery, The graph is shown below,



Power vs Time (1)

In this graph we can analyze that the panel can manage to run the cooler without any external power required or connected. We can able to see the difference between Load condition by using any added connection, where in the peak condition without any load the panel will go to maximum performance of 3000 W, where with load connection i.e., air cooler is connected the performance that undergo is 1950 W due to the external load is connected in the solar panel the changes will occur due to the DC load is added the Power (W) will occur.



Power vs Time (2)

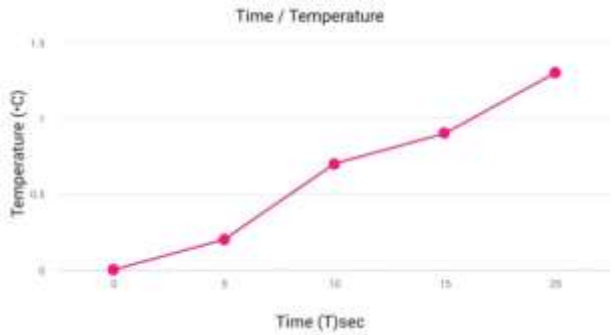
In this graph we can analyze that the power stored in the battery can able to run the cooler when the climatic conditions are not suitable for the working of the solar panel, where the readings shows that the power stored in the battery can able to run with the maximum watt hrs of 9000 Wh in the period of 15-20 minutes, So we can able to conclude with the final verdict that in both with battery and without battery condition we can able to run the air cooler in a proper manner.

In this work we can able to see the temperature changes where if the air cooler is used, the ambient temperature changes according to the circumstances were the cooler in use. The readings taken for the finalization with Temperature vs Time.

In Table 3 we can see the readings that are taken between Temperature in ^{0}C and Time in minutes, The readings are listed below,

TIME (T) Sec	Temperature ^{0}C
0	0
5	.2
10	.7
15	.9
25	1.3

Temperature vs Time



Where in the graph we can able to see the changes occur according to the usage of the air cooler in the used circumstance the ambient temperature of the place or the user can feel some slight temperature drop the air cooler is able to reduce the users temperature up to 1.3 to 1.4^0 C. So we can able to see changes that are happening with the help of the air cooler where it is used and involved.

DISCUSSIONS

Although the main moto of our project is to get the changes in used circumstances were the cooler is used, discussion about the usage about the solar panel and air cooler are combined to get a complete outcome by reducing or not involving in external power supply, the outcome of our work is using the unused natural energy resources i.e., Solar power in a useful manner by the help of the solar panel.

CONCLUSION

We are concluding that we can able to get maximum outcome if we use the higher components to get the work in next level. There is a scope of further work to optimize the solar panel capacity, battery backup requirement and the motor rotating speed for the developed cooler according to the climatic parameters of the location. Both simulation and experimental studies will be taken up to another level to develop the more efficient performance model of solar powered mini air cooler.

SCOPE OF IMPROVEMENT

This project although fulfilling our requirement has further scope for improvements.. And in future uses we can add some improvements in the size and range of uses the equipments that are all used in the work. For addition we can add sensor for automatic on/off features, and other features like automatic sensor for temperature and many other features for utilization purposes.

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