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A SOLAR-POWERED AIR CONDITIONER: DESIGN AND FABRICATION

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ABSTRACT :

Modern environmental issues, such as rising temperatures, are a direct outcome of the increased pollution that has recently emerged. A cool, fresh environment is necessary for comfortable living in these hot and humid conditions. Air conditioners, coolers, and other refrigeration systems meet these demands. Cities and other places with developed infrastructure may be good candidates for these systems. The high cost of power sources and the scarcity of available sources have led to widespread power outages in recent years, impacting not only urban centres but also more remote villages and towns.

Keywords: Solar energy, Air cooler, Energy and Cost saving.

1. INTRODUCTION :

Energy consumption levels are now indirectly related to living standards. An increase in the consumption of power sources is a measure of human progress throughout history, which has been driven by advances in industrialization. Yet, we have never before encountered such a magnitude of atmospheric problems as we do today, as well as a dearth of energy resources. The only way to achieve comfortable living is to use a lot of energy. Important concerns for the resources include climate change, ozone depletion, and the rising price of fossil fuels.

Using renewable energy sources is the sole way to address the power source problem. Solar energy, a form of renewable energy, is quickly becoming the most popular and widely used power source on Earth. There are two main types of solar energy systems: (a) thermal systems, which turn solar energy into heat, and (b) photovoltaic systems, which use light to power electrical appliances. (b) systems that use photovoltaic technology to transform the energy from sunlight into electricity. A decrease in the efficiency of electricity conversion might result from using this method.

The scientific community has recently shifted its attention to renewable energy sources as a means to power homes, with the goal of decreasing reliance on traditional power grids and increasing use of solar power. Because it increases the independence of the power source and has zero impact on the environment, solar energy is being used popularly in this way. Those structures account, according to recent research, for nearly 33% of global greenhouse gas emissions and 40% of primary energy consumption.

The purpose of installing air conditioning systems in buildings is to create an environment that is conducive to health and productivity for the occupants. The main functions of an air conditioning system are to provide temperature control, relative humidity control, air purification, noise reduction from the system, transportation of conditioned outdoor air to the conditioned space, and control and maintenance of an energy-efficient indoor environment.

- ✓ "Water Cooler Double purpose: To produce hot and cold water simultaneously" (Adarsh Mohan Dixit, Arjit Raj Sahu (student) 2013). This uses an evaporator and a condenser at the same time. Once the condenser is removed and a new exchanger is installed in the water cooler, the evaporator is no longer needed. Three to four times as much electric power is expended by the compressor as heat is released at the condenser level. For this reason, they connected the water heater and water cooler in this project so the water could be heated to a suitable temperature. In cold weather, it is not possible to heat the water to an appropriate temperature. As a result, we turn to electric supplements, which still fall short of meeting 90% of our yearly demands. The device uses the heat from the compressor's exhaust gas to move cumulus water to an area without air. After passing through an evaporator and a pressure reducer, the heated gas eventually makes its way back to the compressor to begin the process all over again. Their calculations show that the system's total COP is 7, with a refrigeration COP of 3 and a thermal COP of 4.Their research led them to the conclusion that a heat regenerator installed between the condenser and evaporator would improve efficiency. [5]
- ✓ "Design & Fabrication of 360 Cooler Cum Heater" was published in 2018 by Akhilesh Yadav, Rajatkumar Bachan, Dattaprasad Tendolkar, and Sankesh Torashkar. Because many rural areas in India require both heating and cooling systems at the same time. Evaporative cooling is better understood thanks to this paper. The cooling is accomplished by bringing the water particles into direct touch with the air stream in this 360-degree basic evaporative air cooler. For 360° evaporative cooling to work, the outside temperature must be at least 35°C, and

preferably lower. The operational parameters of the 360o evaporative cooler are weather-related, including ambient temperature, humidity, dry bulb temperature, and low wet bulb temperature. Use this only in areas with low relative humidity. The air is actually made more humid by this system, rather than less. This system's operation is described in the following ways:

- ✓ Here are the main goals of our project:
- ✓ My goal is to design a cooling and heating system that is easy to transport, inexpensive, and requires little maintenance.
- ✓ To determine the system's usefulness, one must consider the climate, which aids heating during the winter and cooling during the summer.
- ✓ Keeping the system's investment costs low for maximum efficiency.
- ✓ Since most energy goes into dehumidifying the air, we can run the system on renewable resources and cut down on energy consumption.
- ✓ In an effort to lessen reliance on harmful and environmentally damaging refrigerants. Climate change may be accelerated by these refrigerants. and also result in the depletion of the ozone layer..

2. METHODOLOGY

Energy from the sun powers the idea. Parts of the model shown above include an AC blower/fan, batteries, an inverter, and solar panels. The photovoltaic effect is used by solar panels to transform sunlight into electrical energy. This energy is then stored in batteries, which eliminate power fluctuations. Reason being that DC is the form of energy that is produced. After the inverter changes the DC power source to AC, the blowers begin to spin. A water pump ensures a constant flow of water to the cooling pads that surround these blowers. The cooling pads work by transferring heat from water to air, which in turn produces cool air. The outcome is a thermally comfortable environment brought about by the entry of cool air.

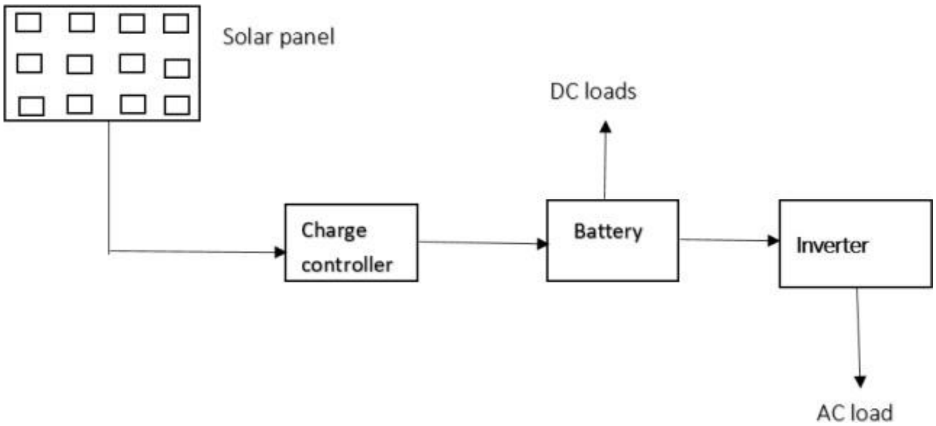


Fig. 1. Solar energy conversion

4.1 COMPONENTS AND WORKING

4.1.1 Solar panel

Solar modules are typically constructed from a series of solar cells made of crystalline silicon. The ultra-thin silicon wafers used to make these cells make them incredibly delicate. Encased in a protective hermetically sealed chamber made of ethyl vinyl acetate and toughened glass, a string of cells is kept safe from harm. The cell string is further protected by placing an insulating tedlar sheet beneath the EVA layers. The module's strength and the ease of mounting on structures are enhanced by an outer frame that is attached. Solar string's positive and negative ends are connected to a terminal box that is fastened to the module's rear. A solar panel is this whole setup.

2.1.2 Charge controller

The building blocks of solar modules are usually arrays of solar cells manufactured from crystalline silicon. These cells are extremely fragile due to the use of ultra-thin silicon wafers in their construction. Within a hermetically sealed chamber constructed of ethyl vinyl acetate and toughened glass, a string of cells is preserved from any potential harm. Underneath the EVA layers, an insulating tedlar sheet is placed to further protect the cell string. An attached outer frame increases the module's strength and makes mounting it on structures easier. On the back of the module is a terminal box that receives the positive and negative ends of the solar string and connects them. Everything you see here is a solar panel.

2.1.3 Battery

To transform chemical energy into electrical energy, an electrical battery uses electrochemical cells. These cells, known as voltaic cells, are made up of two half cells connected in series by a conductive electrolyte that contains anions and cations. The anode, or negative electrode, is the part of the cell that electrolytes and negatively charged ions migrate to, and the cathode, or positively charged ions, migrate to, are both components of the electrolyte-containing half of the cell. Anode states undergo oxidation (removal of an electron) and cathode states undergo reduction (addition of an electron) in the redox reaction that drives the battery. The electrolyte connects the electrodes electrically rather than physically touching them. To store energy for later use, inverter-powered electrical systems rely on batteries. Direct current (DC) at the battery's nominal voltage is the simplest method of drawing electrical power from a battery.

2.1.4 Inverter

The inverter is a tool for transforming low-voltage direct current (DC) from batteries into higher-voltage alternating current (AC). Its main function is to convert the DC power from photovoltaic panels into AC power, which can then be utilised by household appliances and the power grid as a whole.An inverter is necessary for every solar power system to convert the direct current (DC) electricity produced by photovoltaic panels into usable AC power.

2.2 Working

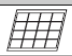
First, a battery and charge controller are used to transform solar energy into electric energy. By utilising the photoelectric effect, solar panels are able to transform the sun's rays into usable electrical energy. Batteries also store chemical energy, which is a form of electrical energy. The solar panel and battery are connected through a circuit that prevents the battery from being overcharged. Afterwards, the air cooler receives power from the battery, which is transformed into AC power by means of an inverter..

2.2.1 SPECIFICATIONS

SPECIFICATIONS

P/No.	SC330	
TYPE	Automatic	
INPUT	12V or 24V solar panel	
MAX INPUT	50V DC, 30A	
MAX LOAD	30A	
LOAD SWITCHING	Negative	
BATTERY	12V or 24V	
CHARGE CONTROL	3 stage charging	
	12V	**24V**
Bulk	14.4V	28.8V
Absorption	14.4V	28.8V
Float	13.4V	26.8V
Start	11.1V	22.2V
	Negative switching	
LVD LOAD DISCONNECT	11.1V	22.2V
LVD LOAD RECONNECT	12.6V	25.2V
MAX PANEL SIZE	360W	
STANDBY CURRENT	9mA	

2.2.2 CONNECTIONS

Symbol	Input/Output
	SOLAR PANEL
	BATTERY
	LOAD

The solar controller has two screw terminals on its base, one for positive (+) and one for negative (-) connections. The terminals are clearly illustrated in the table to the left for easy identification.

Keep in mind that you need to use the right terminals and polarity (+/) when connecting anything. The battery, solar panel, and appliances are all vulnerable to damage during improper installation.

STEP 1 – CONNECT THE BATTERY

Make sure to use the correct cable to connect the battery to the BATTERY terminals on the solar controller.The positive (+) terminal of the battery should be near the fuse's installation. After a proper connection, the SC330 will activate. Whether the battery is 12V or 24V, the SC330 will automatically adjust its output..

Recommended Cable		Recommended Fuse
Up to 3m	3-6m+	
4.58 mm² (10 B&S)	Not recommended	50A

STEP 2 – CONNECT THE SOLAR PANEL

The SOLAR PANEL terminals on the solar controller are where the solar panel should be connected; for the correct cable, check the manufacturer's instructions. Verify that the voltage of the battery connected in STEP 1 and the solar panel are identical. To verify the solar panel's proper connection, go to the settings and look for the input voltage. The voltage displayed should be greater than 3.5V when the connection is properly made.

WARNING: Regardless of whether they are connected or not, solar panels will continue to produce energy whenever they are exposed to light. Sparks, which can occur from an accidental "shorting" of the terminals or wiring, pose a fire and injury risk. When installing the panel(s), it is advised that a soft cloth be used to cover the front face in order to block incoming light.

STEP 3 – CONNECT THE LOAD/APPLIANCE

Connect the load or appliance to the solar controller's LOADterminals

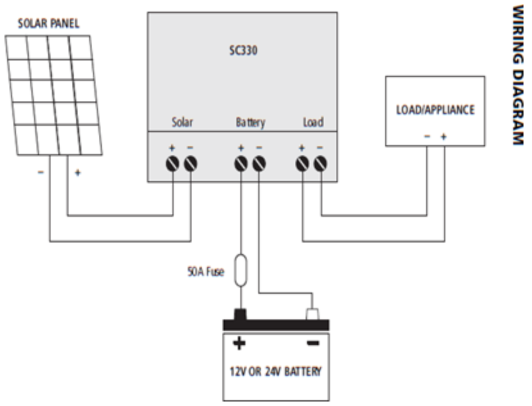


Figure 2 Wiring diagram

2.3 PMDC MOTOR (35W-> 30 W for fan + 5 W for pump)

In the nineteenth century, permanent magnet (PM) DC motors were introduced; however, they failed to gain broad acceptance because the magnetic materials available at the time, such as tungsten and steel, were of low quality. Therefore, electromagnetic field excitation was the go-to for early motor designers and remained so until very recently. Improvements in steady-state performance and power density of a permanent magnet motor were shown by advances in magnetic technology, such as rare earth magnets. Consequently, the permanent magnet DC motor is widely used in today's international markets. Manufacturers of various types of office and medical equipment, as well as computer peripherals, rely on PM motors.

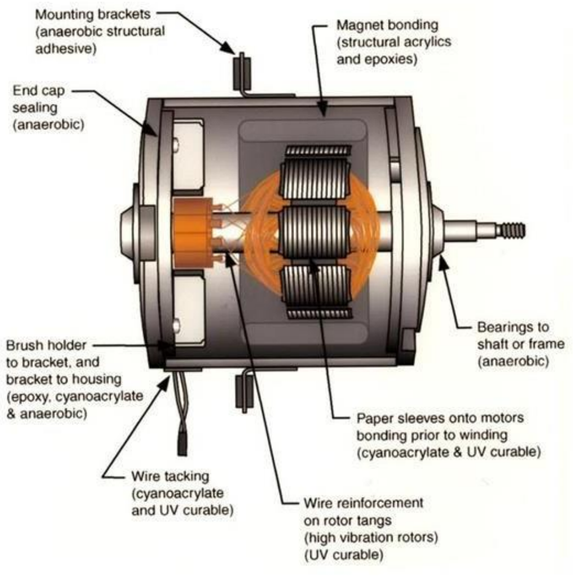


Figure 3 PMDC Motor

2.3.1 CONSTRUCTION

An irreversible magnet By substituting permanent magnets for wound DC motors' field windings, DC motors achieve significantly better efficiency, reduced weight, and reduced footprint compared to similarly sized wound DC motors. There are two main types of permanent magnet DC motors: brushed/commutator and brushless. There are two types of permanent magnet DC motors: commutator motors, which use a rotating armature winding in conjunction with a stationary field of magnets, and brushless motors, which use an electronic control to externally commutate the windings. Motors without brushes and the maintenance required to keep them in good working order are driving sales of permanent magnet DC brushless motors, which are outpacing sales of permanent magnet DC commutator motors. The PM DC brushless motor will be used from here on out.

There are two options for the field PM magnets' mounting position: either on the surface or inside. While surface-mounted magnets are more budget-friendly, they aren't ideal for use at high speeds. When compared to surface-mounted machines, interior-mounted machines have better air gap flux density, harmonics shielding, and, in certain instances, structural integrity. These machines are also known as flux concentrating machines.

There were twelve known alloys of copper, silver, and gold that produced better magnets than the iron used to make them in the nineteenth century. An interest in permanent magnet field excitation was revived in 1932 with the development of Alnico, an alloy of AL, CU, Fe NI, and Co. Rare earth magnets, made of samarium-cobalt alloys, are the most effective magnetic materials that have been developed in the last 20 years. Although rare earth magnets are still quite pricey, they are becoming more affordable. An alternative material that outperforms samarium cobalt alloys by 30% is neodymium-iron-boron alloy. Although protective coatings have been developed to address neodymium's poor corrosion resistance, this is still its sole drawback.

Nowadays, ceramic magnet motors made of barium ferrite and strontium ferrite are extensively used all over the globe. They are more resistant to demagnetization and have substantially stronger coercive forces than alnico.

2.3.2 CHARACTERISTICS

An irreversible magnet When it comes to speed, torque, reversing ability, and regenerative braking, DC motors are very similar to DC shunt wound motors. On the other hand, PM DC motors offer more predictable and linear speed load characteristics and a starting torque that is multiple times greater than shunt motors. The range of torque at different speeds is quite large, starting from zero torque at zero speed (stall torque) and continuing all the way to maximum torque (no load speed). Reducing angular velocity increases torque and vice versa.

2.3.3 ADVANTAGES OVER DC MOTOR:

The benefits 4 of PM field-excited motors over electromagnetically - excited motors include:

- Enhanced performance due to the absence of power consumption and losses associated with creating and sustaining the motor's magnetic field.
- Increased density of torque and power.
- Fifthly, more predictable linear torque speed characteristics.
- The increased magnetic flux density in the air gap improves dynamic performance.
- Ease of construction and practically no upkeep required.
- More compact size

2.4 CENTRIFUGAL DC PUMP

One type of dynamic axisymmetric work-absorbing turbomachinery is the centrifugal pump. To move fluids, centrifugal pumps transform the kinetic energy of rotation into the hydrodynamic energy of the flowing fluid. An engine or electric motor is the usual source of rotational energy. When a fluid enters a pump, it usually does so at or near the rotating axis. The impeller then accelerates the fluid as it flows radially outward into a diffuser or volute chamber (casing), from which it eventually leaves.

Some common applications include pumping water, sewage, petroleum, and petrochemicals. Instead of pumping water forward, a water turbine uses the kinetic energy of the water's potential pressure to turn a mechanical shaft.

2.4.1 WORKING

Centrifugal pumps, like other types of pumps, transfer the kinetic energy of a rotating shaft to the potential energy of a fluid in motion. The fluid's motion converts some of the energy into kinetic energy, and some into potential energy, which can be seen as the pressure of the fluid (hydraulic head) or as the effort to lift the fluid up against gravity.

Centrifugal force is often used to describe the energy transfer from the mechanical rotation of the impeller to the fluid's motion and pressure, particularly in older sources that did not fully articulate the modern concept of centrifugal force as an imaginary force in a rotating reference frame. To understand how a centrifugal pump works, one need not be familiar with the idea of centrifugal force.

The centrifugal force that causes the water to flow in a circular pattern inside the pump is proportional to the pressure at its outlet, which is a reflection of that pressure. In contrast, the claim that the "outward force generated within the wheel is to be understood as being produced entirely by the medium of centrifugal force" makes more sense when viewed through the lens of centrifugal force as an imaginary force with respect to the rotating impeller; the real forces acting on the water, however, are centripetal, or inward, because that's the direction of force required to make the water move in circles. An external pressure gradient, created by the rotation and acting as a reactive centrifugal force on the volute wall, provides this force. This was commonplace in writings from the 1800s and 1900s, when authors casually described the effects of centrifugal force in devices like centrifugal pumps.

There has always been debate and criticism surrounding centrifugal pumps due to the fact that different people have different ideas about how they function. Take the 1873 report from the American Expert Commission that was sent to the Vienna Exposition as an example. One of the points made was that "they are misnamed centrifugal, because they do not operate by centrifugal force at all; they operate by pressure the same as a turbine water wheel; when people understand their method of operating we may expect much improvement." Industry editor John Richards of San Francisco similarly minimised centrifugal force's importance in his article.

2.5 COOLER BODY

- ✓The plastic construction of the cooler
- ✓Plastic is long-lasting and resistant to corrosion.
- ✓Included in the cooler's structure are the fan, water tank, and aspen pads.
- ✓The water drenches the aspen pads, resulting in cooler air.

2.6 RESISTORS

A resistor is an electrical component with two terminals that passively implements electrical resistance. Resistors lower voltage levels in circuits while simultaneously reducing current flow. Thermistors, varistors, trimmers, photoresistors, and potentiometers are just a few examples of resistors that can have either a fixed or variable resistance.

The relationship between the voltage across the terminals of a resistor and the current flowing through it is proportional. In this connection, Ohm's law stands:

I = {V \ R}

where

I is the current through the conductor in units of amperes,

V is the potential difference measured across the conductor in units of volts, and

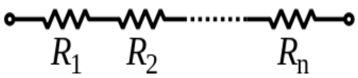
R is the resistance of the conductor in units of ohms (symbol: Ω).

Series and parallel resistors

Here we have a series configuration of resistors, where the current through all of them is constant but the voltage across them is proportional to their resistance. Since the total resistance is just the sum of these voltages, we can say that the network is experiencing a potential difference, or voltage:

If we take N resistors with the same resistance R and connect them in series, we get NR as a special case. So, a 100K ohm and a 22K ohm resistor connected in series will have a combined resistance of 122K ohm, which is the same as a single resistor with a value of 122K ohm; three 22K ohm resistors (N=3, R=22K) will give a resistance of 3x22K=66K ohms.

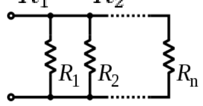
Resistors in a parallel configuration are each subject to the same potential difference (voltage), however the currents through them add. The



$$R_{eq} = R_1 + R_2 + \cdots + R_n.$$

conductances of the resistors then add to determine the conductance of the network. Thus the equivalent resistance (*Req*) of then network can be computed:

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}.$$



So, for example, a 10 ohm resistor connected in parallel with a 5 ohm resistor and a 15 ohm resistor will produce the inverse of 1/10+1/5+1/15 ohms of resistance, or 1/(.1+.2+.067)=2.725 ohms. The greater the number of resistors in parallel, the less overall resistance they will collectively generate, and the resistance will never be higher than that of the resistor with the lowest resistance in the group (in the case above, the resistor with the least resistance is the 5 ohm resistor, therefore the combined resistance of all resistors attached to it in parallel will never be greater than 5 ohms).

The parallel equivalent resistance can be represented in equations by two vertical lines "||" (as in geometry) as a simplified notation. Occasionally two slashes "//" are used instead of "||", in case the keyboard or font lacks the vertical line symbol. For the case of two resistors in parallel, this can be calculated using:

$$R_{eq} = R_1R_2/(R_1+R_2)$$

A resistor network that is a combination of parallel and series connections can be broken up into smaller parts that are either one or the other. For instance, A diagram of three resistors, two in parallel, which are in series with the other

$$R_{eq} = (R_1//R_2) + R_3 = R_1R_2/(R_1+R_2) + R_3$$

However, some complex networks of resistors cannot be resolved in this manner, requiring more sophisticated circuit analysis. For instance, consider a cube, each edge of which has been replaced by a resistor. What then is the resistance that would be measured between two opposite vertices? In the case of 12 equivalent resistors, it can be shown that the corner-to-corner resistance is 5⁄6 of the individual resistance. More generally, the Y-Δ transform, or matrix methods can be used to solve such a problem. One practical application of these relationships is that a non- standard value of resistance can generally be synthesized by connecting a number of standard values in series or parallel. This can also be used to obtain a resistance with a higher power rating than that of the individual resistors used. In the special case of N identical resistors all connected in series or all connected in parallel, the power rating of the composite resistor is N times the power rating of the individual resistors.

2.6.1 Power dissipation

At any instant of time, the power P consumed by a resistor of resistance *R* (ohms) is calculated as: $P = I^2R = IV = \frac{V^2}{R}$ where *V*(volts) is the voltage across the resistor and *I* (amps) is the current flowing through it. The first form is a restatement of Joule's first law. Using Ohm's law, the two other forms can be derived. This power is converted intoheat which must be dissipated by the resistor's package.

The total amount of heat energy released over a period of time can be determined from the integral of the power over that periodof time:

$$W = \int_{t_1}^{t_2} v(t)i(t)\,dt.$$

Therefore, one could write the average power dissipated over thatparticular time period as:

$$\bar{P} = \frac{1}{t_2 - t_1}\int_{t_1}^{t_2} v(t)i(t)\,dt.$$

If the time interval $t1$ - $t2$ is chosen to be one complete cycle of a periodic waveform (or an integer number of cycles), then this result is equal to the long-term average power generated as heat which will be dissipated continuously. With a periodic waveform(such as, but not limited to, a sine wave), then this average over complete cycles (or over the long term) is conveniently givenby

$$\bar{P} = I_{rms}V_{rms} = I_{rms}^2R = \frac{V_{rms}^2}{R}$$

where I_{rms} and V_{rms} are the root mean square values of the current and voltage. In any case, that heat generated in the resistor must be dissipated before its temperature rises excessively.

Maximum power dissipation is the metric by which resistors are evaluated. You don't need to worry about the power rating of discrete resistors in solid-state electronic systems because they typically consume less than one watt of power. Most of the packages described below contain discrete resistors with ratings of 1/4 watt, 1/8 watt, or 1/10 watt.

It is common practice to refer to resistors with power ratings of 1 watt or higher as "power resistors" when they are meant to dissipate large amounts of power; this is especially true for resistors utilised in power supplies, power conversion circuits, and power amplifiers. Physically, power resistors are bigger, and they might not employ the recommended values, colour coding, or external packaging that are detailed below.

A resistor's resistance can be irreversibly changed if the average power dissipated by it exceeds its power rating; this is different from the change in resistance that occurs when the resistor warms up, which is caused by its temperature coefficient. If the resistor loses too much heat, it could melt the circuit board, scorch nearby components, or even start a fire. In order to prevent flames, some flameproof resistors open circuit before they get too hot.

It is possible to specify resistors with a higher rated dissipation than what will actually be experienced in service due to factors such as poor air circulation, high altitude, or high operating temperatures.

There may be a limit to the amount of power that can be dissipated by resistors with higher ratings or types due to their maximum voltage ratings.

2.7 POWER CONSUMPTION AT VARIOUS SPEEDS

- ✓ Speed control can be carried out by introducing resistors between the input and the motor
- ✓ The speed can be varied by varying the input current by connecting the resistors in different ways.

2.7.1 POWER CONSUMTION AT HIGH SPEED (330 RPM)

-The incoming voltage is constant at 12v
-2 resistors of resistances 1 ohm and 1 ohm are connected inseries
-Equivalent resistance R= R1+R2=> 1+1= 2Ohms
-Value of current obtained from ammeter = 2.58 amps
-Power P= V*I=> 2.58*12= 30.96 W

2.7.2 POWER CONSUMTION AT MEDIUM SPEED (250 RPM)

-The incoming voltage is constant at 12v
-2 resistors of resistances 5 ohms and 10 ohm are connected inparallel
-Equivalent resistance R= R1*R2/(R1+R2)=> 10*5/ (10+5)= 3.3Ohms
-Value of current obtained from ammeter = 1.96 amps
-Power P= V*I=> 1.96*12= 23.52 W

2.7.3 POWER CONSUMTION AT LOW SPEED (204 RPM)

- ✓ The input voltage remains steady at 12 volts.
- ✓ The only component needed is a single 5-ohm resistor.
- ✓ R= 5 ohms is the equivalent resistance.
- ✓ A reading of 1.60 amps was taken from the ammeter.
- ✓ The power P is equal to the product of V and I, which is 19.2 W (1.60-12).

2.7.4 ADVNATAGES OF USING RESISTORS FOR SPEED CONTROL

- ✓ Circuits are less complicated
- ✓ Cost is less
- ✓ The values obtained are precise.
- ✓ Significant decrease in power consumption is observed with a decrease in speed.

2.8 CIRCUIT FOR POWER CONSUMPTION AND CALCULATION OF PAYBACK

- ✓ The time it takes for our product to become free is called payback.
- ✓ A solar panel now serves as the input power source.
- ✓ Our 75 Pw solar panel is a high-efficiency model.
- ✓ Rs 65 is the cost per watt. Consequently, the sum total for the solar panels is Rs 4850.
- ✓ The power unit is 1000 watts.
- ✓ A cost of Rs 6 is associated with one unit of electricity.
- ✓ Since 1000/75=13.3, one unit charges a 75w panel for 13.3 hours of usage.
- ✓ We can anticipate a return on investment after 1075 days of using the cooler at an average usage rate of 10 hours per day.
- ✓ Therefore, it will take about 2,343 days to recoup the initial investment.

2.9 COST EFFECTIVENESS BY ELIMINATION OF PUMP

We propose a solar cooler system in which water flows downward from a higher potential, wetting the cotton and cooler grass instead of the pump that was previously used in conventional coolers. So, the damp cotton and grass cools the air; the solar cooler continues to function normally regardless of the water's potential to evaporate.
Capillary tube theory (Meniscus height) is the basis for cotton's operation.
The height h of a liquid column is given by:

$$h = \frac{2\gamma\cos\theta}{\rho g r},$$

where is the liquid-air surface tension (force/unit length),

θ is the contact angle, ρ is the density of liquid (mass/volume),

g is local gravitational field strength (force/unit mass), and r is radius of tube (length).

For a water-filled glass tube in air at standard laboratory conditions,

γ = 0.0728 N/m at 20 °C, θ = 20° (0.35rad),

ρ is 1000 kg/m3, and

g = 9.8 m/s2. For these values, the height of the watercolumn is

$$h \approx \frac{1.4\times10^{-5}}{r}\ \mathrm{m}.$$

A 4 m (13 ft) diameter tube with a 2 m (6.6 ft) radius would cause the water level to rise by an insignificant 0.007 mm (0.00028 in). Nevertheless, the water level would increase by 0.7 mm (0.028 in) for a 4 cm (1.6 in) diameter tube with a radius of 2 cm (0.79 in) and by 70 mm (2.8 in) for a 0.4 mm (0.016 in) diameter tube with a radius of 0.2 mm (0.0079 in).

3. RESULT AND DISCUSSIONS

Table 5.1 Reading on the atmospheric vs room temperature

S.No	Atmospheric Temperature in °C	Room Temperature in °C	Solar Power in (V) Volts	Inlet air temperature in °C	Outlet air temperature in °C	Temperature of air outlet with copper tube air circulation in °C	Temperature of air outlet without copper tube air circulation in °C
1.	33	28	12	33	33.1	27.5	28
2	33	28.5	14	33	33	30	28.5
3.	35	30	15	35	35	28.5	30

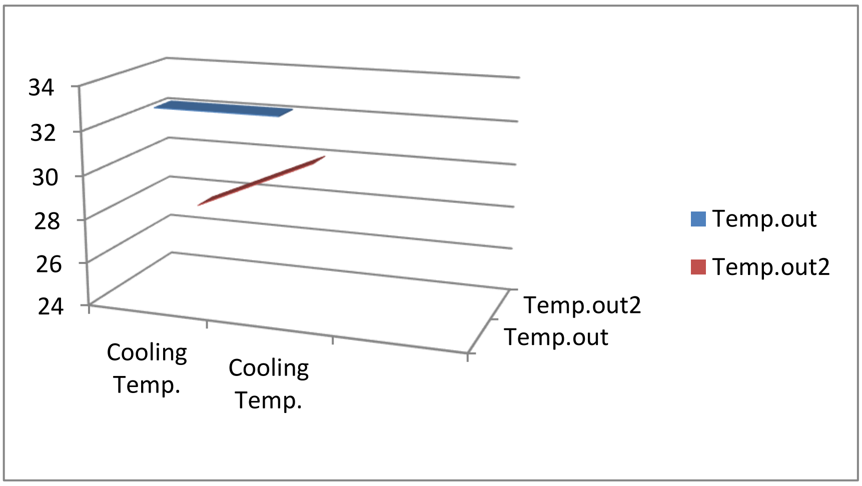


Figure 4 Cooling temp vs Temp out

As seen from the temple atop You can get temperatures as low as 20 degrees Fahrenheit (approximately 11 degrees Celsius) using an air cooler, which is also called an evaporative cooler or a swamp cooler.

It is on this principle that evaporative coolers, sometimes known as swamp coolers, work. Air is cooled by 15–40 degrees Fahrenheit before entering a house via a process that involves passing outside air over pads that are saturated with water.

The process of water evaporation is used in a solar cooler to lower the air temperature. The components include a water tank, a fan, and a filter, pad, or wick that is wet. Cool, dry air is drawn in by the fan and directed through the damp wick, pad, or filter. Some of the water evaporates as it absorbs heat from the air, causing the temperature to drop as the air flows through. A cool, humid breeze is created by releasing the cooled air into the room.

3.1 BENEFITS OF solar AIR COOLERS

- Among their many advantages is the fact that solar air coolers can efficiently and effectively cool your space. Soalr air coolers have the following benefits:
- For hot and dry climates, efficient cooling is essential:Locations with high temperatures and low humidity, like solars, semi-arid regions, or tropical zones, are perfect for solar air coolers. They are better suited for milder climates because of their increased air cooling capacity compared to personal or tower air coolers. In addition to providing a more comfortable and refreshing environment, solar air coolers have the added benefit of producing a natural and pleasant airflow.
- Solar air coolers include a large water tank and a high air delivery rate, allowing them to quickly circulate a large volume of air. A big area can be efficiently and rapidly cooled using this. A large water tank, capable of holding fifty litres or more, is also included with solar air coolers. There will be no need to refill the water as often, and the cooling performance will be consistent and sustained.
- Castor wheels: These wheels make moving your solar air cooler a breeze, and some models even have them built in. Depending on your requirements and tastes, you can relocate the solar air cooler from one room to another or even outside. By manipulating the knobs or using the remote control, you can also change the fan's speed and direction, as well as the water level and flow.
- Solar air coolers are more cost-effective than traditional air conditioners and other cooling options because of their efficiency. There are a number of air coolers available for less than 10,000 ruppee, while air conditioners tend to be more expensive. Keep in mind that air coolers aren't the same as air conditioners, and that they might not work as well in really hot weather. Nonetheless, solar coolers are a great and more cost-effective option compared to other devices that use solar systems during the middle of summer.

3.2 LIMITATIONS AND CONSIDERATIONS

- ✓ You should know that solar air coolers have some limitations and drawbacks, and that they aren't flawless. Solar air coolers aren't without their problems, though:
- ✓ Solar air coolers are bulkier and heavier than their smaller and lighter personal air cooler counterparts. Because of this, solar air coolers may not be suitable for certain rooms or locations due to their larger size. If your solar air cooler doesn't come with handles or wheels, it might be a pain to store and move around.
- ✓ Commercial and industrial settings benefit more from solar air coolers because of their ability to efficiently cool expansive indoor and outdoor spaces. Cooling down smaller rooms like bedrooms, living rooms, or offices might be a bit of a challenge with these. Because of the powerful and audible airflow they produce, solar air coolers might not be suitable for use in some home or office environments.
- ✓ Due to their higher water consumption and number of components, solar air coolers necessitate more frequent cleaning and maintenance than personal air coolers. Bad odours, bacterial growth, or mineral deposits can result from stagnant or dirty water, so it's important to change the tank water on a regular basis. The wick, pad, and filter can also become dirty and mouldy over time, so it's important to clean them regularly. Also, make sure the motor, fan, and electrical components are in good working order.
- ✓ Because of their superior capacity, performance, and quality, solar air coolers are typically much more costly than personal air coolers. Depending on the manufacturer, model, and features, solar air coolers can range in price from 10,000 to 20,000 rupees or even higher. Similarly, the price of a personal air cooler can range from three thousand to ten thousand rupees, or even lower.

Figure 5 Experimental design

4. Conclusion

The project's end result is a living room with comfortable thermal conditions. At a relative humidity of 60% and temperatures up to 25°C, that is room temperature. When compared to competing products on the market, this solar product is more appealing and within most people's budgets. Villages, schools, offices, and industries can all benefit from this solar product, which provides a solution to the summertime power outages. Its cost is lower than that of a standard air conditioner. Our planet will be grateful. It works well for cooling down compact spaces. Although it has a high installation cost initially, it ends up being environmentally friendly in the end. One kind of air cooler that does a good job in hot and dry climates is the solar air cooler, which is also called an evaporative cooler. They have a large water tank and a high air delivery system that allows them to effectively and continuously cool the air by evaporation. Castor wheels are included with some models for added convenience when moving. Solar air coolers have many advantages, but they also have some disadvantages, such as being too big, needing more frequent maintenance, being more expensive, and being more suited to commercial or industrial settings. Room air coolers, personal coolers, tower coolers and window coolers are a few more options in the industrial and commercial air cooler market. These are comparable to solar coolers, but designed for bigger areas and industrial settings, and they provide powerful cooling performance.

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