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A Novel Air Cooling Device with 360-Degree Coverage for Domestic Environments

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Abstract: *Inefficient electricity usage in government buildings in India results in a 20 to 25 percent energy loss annually, translating to a financial burden of approximately Rs 1.5 billion. Heating, ventilation as well as air conditioning (HVAC) systems constitute nearly half of total building energy consumption. With India's energy demand projected to more than double by 2030, advancing energy-efficient cooling solutions is critical for sustainable development and environmental preservation.*

This study introduces a novel air cooling device engineered for domestic environments, featuring 360-degree airflow coverage to optimize spatial cooling efficiency. Departing from conventional vapor compression and absorption refrigeration methods, the proposed system utilizes evaporative cooling principles. Leveraging the high enthalpy of vaporization of water, the device induces cooling by evaporating water to reduce ambient air temperature with significantly lower electrical energy consumption.

The innovative design ensures uniform air distribution throughout the living space, enhancing thermal comfort by increasing humidity levels in arid conditions while reducing energy use. This approach presents a promising alternative to traditional air conditioning, contributing to reduced greenhouse gas emissions and supporting India's energy conservation goals. The device's scalability and low environmental impact highlight its potential as a sustainable cooling technology for widespread domestic adoption.

Keywords: air conditioning

I. INTRODUCTION

Nowadays, air coolers have become a regular part of our lives. The air cooler market in India is seeing substantial growth, fueled by rising temperatures and greater consumer interest in affordable cooling options. But, this air-cooling system the air is not properly spread in leaving area , so we need of 360 degree air cooling system? Because A 360-degree air cooler is designed to provide uniform cooling in all directions, making it more effective than traditional air coolers. Here are some key needs and benefits of a 360-degree air cooler. Due to this we giving Even Air Distribution , Energy Efficiency, Human Comfort, Portability & Convenience, Better Humidity Control, Environmentally Friendly, Suitable for Various Spaces, Cost-Effective Solution.

One of the first techniques used by humans to condition their homes was evaporative cooling. It has only recently been placed on solid thermodynamic footing. When a 360-degree EVAPORATIVE water spray is created, the air is adiabatically saturated without any heat being transferred to or from the environment. Such a system has a minimal initial investment cost and is inexpensive and easy to use. A flowing air stream and water particles come into direct contact to produce simple 360 EVAPORATIVE cooling. Dry air will get more humid and cool down if water is pumped except source of heat or cooling.

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II. LITERATURE REVIEW

K.V.R. Manikanta :Fabrication of Solar Air Cooler [1]

Without production, mechanical engineering is useless. The production and manufacturing process involves transforming raw materials into final goods that meet specifications, measurements, and modern technologies. We were motivated to consider new advancements in the field of air conditioning engineering by the latest requirements and innovations.

Krishnan Kumar: DC Blower Motor Operated Cooler with Solar Panel [2]

Residential solar-powered cooler In order to prevent the negative effects of viruses, it is crucial to keep food, fish, and other objects at a consistent temperature throughout the summer and throughout life. However, for a guy, air cooling is a crucial component throughout the heat. The cooling process uses a variety of techniques to cool the air. These days, air cooling techniques for fans, dehumidifiers, air conditioners, and AC coolers are highly costly. Electricity and an AC source are needed to run these products. The production of electricity is ultimately to blame for the hot, muggy conditions that contribute to global warming.

Vijay Kumar Kalwa :Modelling and Fabrication of Solar Powered Air Cooler with Cooling Cabin for Household Food Items [3]

The need to feel comfortable and relaxed has become among the few essentials in hot and humid conditions and as a result the use of air conditioning and refrigeration systems has grown significantly. Because of their high product costs and lengthier power outages, these systems are typically not appropriate for villages. Considering sun-cooling systems in villages would have many appealing aspects solar operated systems are seen like one of the routes approaching energy systems that are environmentally conscious.

Vijay Kumar Kalwa: Design and Development of Solar Powered Air Cooler [4]

To reduce heat, conventional cooling techniques including air conditioners, blowers, dehumidifiers as well as evaporative coolers are frequently employed. But because of their heavy reliance on electricity, these gadgets aggravate hot, muggy weather and contribute to global warming. The use of air conditioning and refrigeration systems has increased as a result of the growing demand for comfort in these types of climates. However they are less appropriate for rural settings due to their high costs and vulnerability to power interruptions.

Solar-powered cooling systems stand out as an environmentally friendly alternative in this situation. These systems lessen reliance on traditional electrical sources by utilizing renewable energy, which lessens the impact on the environment. In addition to meeting the need for comfort, installing solar cooling in communities encourages energy independence and resilience to power outages. This strategy fits in with the larger objectives of sustainable development and provides a workable answer for rural communities looking for economical and environmentally responsible cooling solutions.

Vishal M.Barde, GovindR.Bathe: Modification and Development in Air Cooler [5]

The water on the cooling pads of a conventional air cooler comes into contact with the ambient air. The water receives latent heat of vaporization from this ambient air. As a result of this, water vapor evaporates and mixes with the air, increasing the air's humidity. This state is not appropriate for patients with asthma since the increased humidity decreases human comfort and increases the likelihood of bacteria and viruses. Therefore, we modified an air cooler that won't raise the air's humidity level. The goal of this research is to create a pan air cooler that unlike conventional air coolers, won't raise the air's humidity. An air cooler is a device that maintains a cold environment.

Srinivasa, H. S. Lohit: Design and Development of a Low Cost Air Cooler [6]

A air conditioner is one tool used for maintaining the air cold. Finding a medium that can manage and transfer heat more effectively than air is the fundamental idea behind water-cooling. While maintaining its liquid state, water has an excellent capacity to hold onto heat. The goal of this project is to create an affordable air cooler that can be utilized in homes and workplaces. To gather information on the current air cooler design, secondary research has been conducted. There are several different kinds of air coolers on the market. To better understand the user product interface, an ethnographic study and questionnaire survey have been conducted. The existing air cooler's problems have been identified. The data gathered is used to prepare QFD and PDS.

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III. PROBLEM STATEMENTS

Design and development of 360 degree air cooling device in leaving area.

POSSIBLE SOLUTIONS

Use two cooler at two opposite corner Costing will be not affordable

1) make holes to upper part of model for supply of air. Disadvantages - velocity will not be proper. So cooling will be less.

2) use upper part as square box with slots for cooling air supply. Again velocity will not be proper.

3) use conical part so velocity will get increase and cooling will be easy.

4) using proper conical tub with small adjustable square slot. That's can supply air to surround.

IV. DESIGN AND DEVELOPMENT OF 360 DEGREE AIR COOLING DEVICE TO GET THE SOLUTIONS OF ABOVE MENTION PROBLEMS ONCE SOLUTION IS PROPOSED AS A 360 DEGREE AIR COOLING DEVICE

Following are the components of this system :

• Battery

It's utilized for solar systems. An automotive battery is a rechargeable battery that provides electric power to a vehicle. An automotive SLI battery (starting, lighting, and ignition) provides power to a vehicle's starter motor, lights, and ignition system. Automotive SLI batteries are typically lead-acid and consist of six galvanic cells connected in series to form a 12-volt system.

• Gear :

We utilize Nakoda brand gear. The capacity of this gear is 20500ml, and its height is 122mm. The length of the gear is 580mm. The width is 440, and the model type is 666. The item in question is a serving tray. We use plastic gears to transfer the power from the dc motor to the hub. A gear or cogwheel is a revolving machine part with cut teeth as well as in the case of a cogwheel inserted teeth (known as cogs) that mesh with an additional toothed component to transfer torque. primarily devices can control the speed, torque, and direction of a power supply. Gears nearly always cause a change in torque resulting in a mechanical advantage via their gear ratio as well as so can be called basic machines.

• DC Motor

A DC motor is a type of rotary electrical machine that converts direct current electricity into mechanical energy. The most popular forms rely on the forces generated by magnetic fields. Almost all DC motors contain an internal mechanism either electromechanical or electronic, that changes the pattern of the electrical current in a portion of the motor on a periodic basis. The first extensively used variety was DC motors, which could be driven by existing direct-current lighting power distribution networks. A DC motor's speed can be varied over a large range by either adjusting the supply voltage or the intensity of current in its field windings. Small direct current (DC) motors are utilized in tools, toys including appliances.

• Blower Fan :

The blower is the key part of our air cooler. It pulls air from the surroundings and delivers it at high velocity. Most air cooling techniques in coolers use forced air. Driven air is routed through cooling components and distributed to the desired destinations. This airflow is provided by a blower.

Fan efficiency is defined as the ratio of power transmitted to the air stream to power delivered by the motor to the fan. The power of the airflow is the product of pressure along with flow adjusted for unit uniformity.

• Bearing :

Pedestal blocks are often housings that include a bearing, eliminating the need for the user to purchase the bearings separately. Pillow blocks are typically mounted in hygienic surroundings as well as are intended for lighter loads in

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general industry. These differ from "Plummer blocks," which are bearing housings provided without bearings and are typically designed for higher load ratings along with harsh industrial conditions.

• Drum :

This the drum used for distributing the air in all direction. There are two slots providing on surface of drum for air flow.

• Water tank :

This tank is used to store water and continuously supply to the system. The material of the water tank is plastic. It is corrosion resistance and light in weight and also easily available in market.

Microcontroller:

The LM2596 series of regulators are monolithic integrated circuits that perform all active operations for a step-down (buck) switching regulator capable of driving a 3-A load while maintaining excellent line and load control. These equipment are available with fixed output voltages of 3.3, 5 , 12 V plus a variable output version. These regulators are simple to operate and require only a few external components. They incorporate internal frequency compensation along with a fixed frequency oscillator.

• Ultrasonic sensor :

The sensor itself sends ultrasonic waves into the air and detects the reflected waves from an object. Ultrasonic waves are sounds that humans cannot hear having frequencies higher than 20kHz. The velocity of wave propagation is calculated by multiplying the frequency as well as wavelength. The velocity of an electromagnetic wave is 3×108m/s but sound wave transmission in air is as sluggish as 344m/s (at 20°C). Ultrasonic waves are reflected on objects and used to detect their presence. Metal, wood, concrete, glass, rubber all papered surfaces reflect nearly 100% of ultrasonic waves, making them easily detectable. Cloth, cotton, wool among other materials absorb ultrasonic vibrations, making them harder to detect. It is typically difficult to discern items with substantial surface undulation due to uneven reflection.

V. CONCEPUTAL DIAGRAM

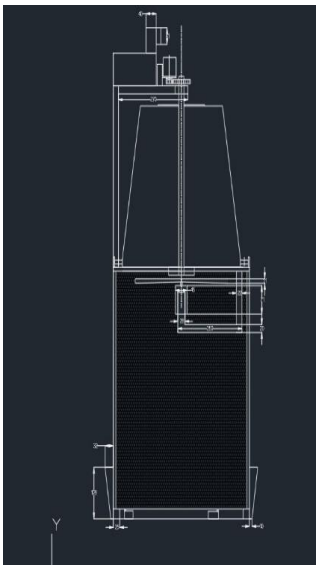

Fig No 1
(2D Diagram)

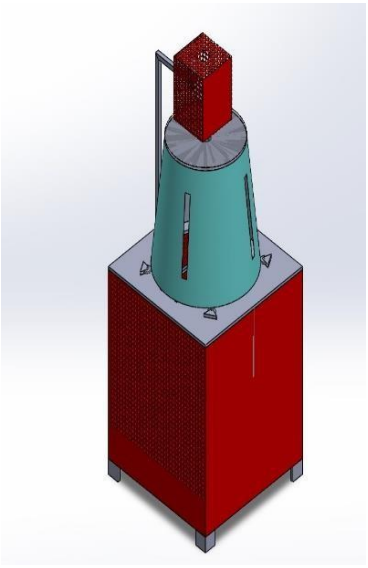

Fig No 2
(Main System Diagram)

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VI. WORKING PROCESS

• 360°air cooler is based on evaporative type cooling principle.
• The cooling of heated air from atmosphere is done by using water.
• The heated air from atmosphere is introduced to cooling water through cooling pads.
• The water present in the cooling pad reduces the temperature of the air.
• The working is completely based on human presence as the human activity is detected by the ultrasonic sensor then the power supply is made on because of which the system will sun and provides cooled air to surrounding.

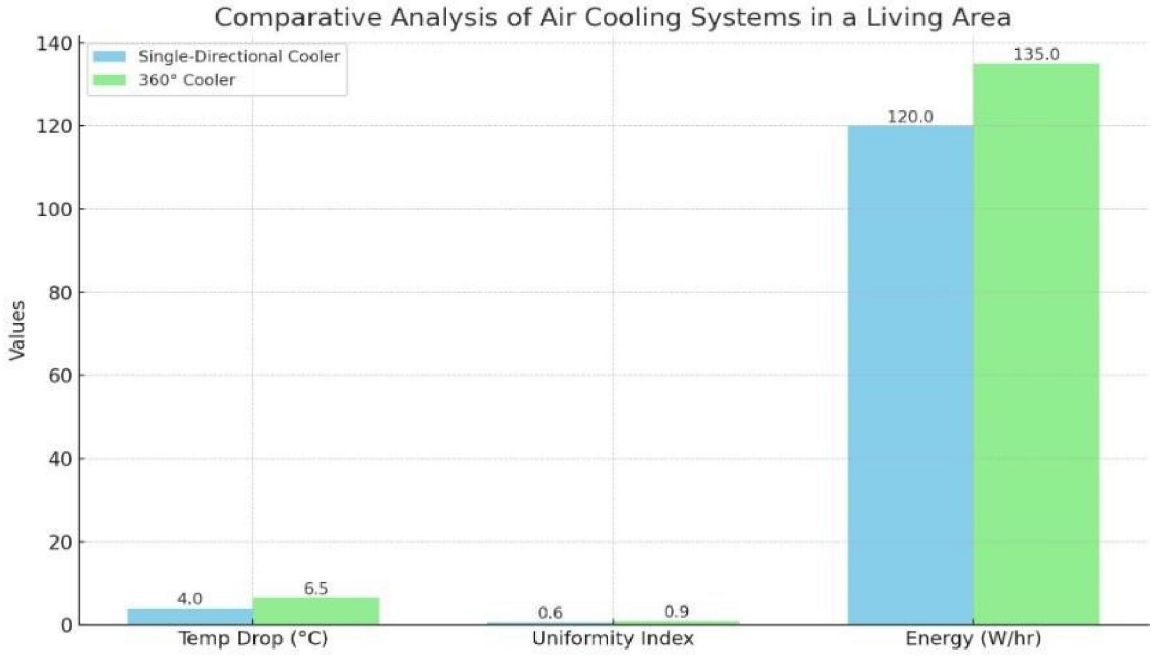
VII. OBSERVATION AND RESULT

Comparative Performance Analysis of Cooling Systems

To evaluate the effectiveness of the proposed 3600 multi-directional air cooling system, a comparative study was conducted against a conventional single-directional air cooler typically used in living spaces. The analysis considers three key performance indicators: temperature reduction, air distribution uniformity and energy consumption

Table 1: Performance Comparison between Single-Directional and 360° Cooling Systems

Parameter	Conventional Cooler	360°Multi-Directional Cooler
Average Temperature Drop (°C)	4.0	6.5
Air Distribution Uniformity (0–1)	0.6	0.9
Power Consumption (W/hr)	120	135



Cost benefit comparison or CO savings

Here is a visual comparison chart illustrating the cost-benefit and environmental impact of the 360° multi-directional cooler versus a conventional cooler.

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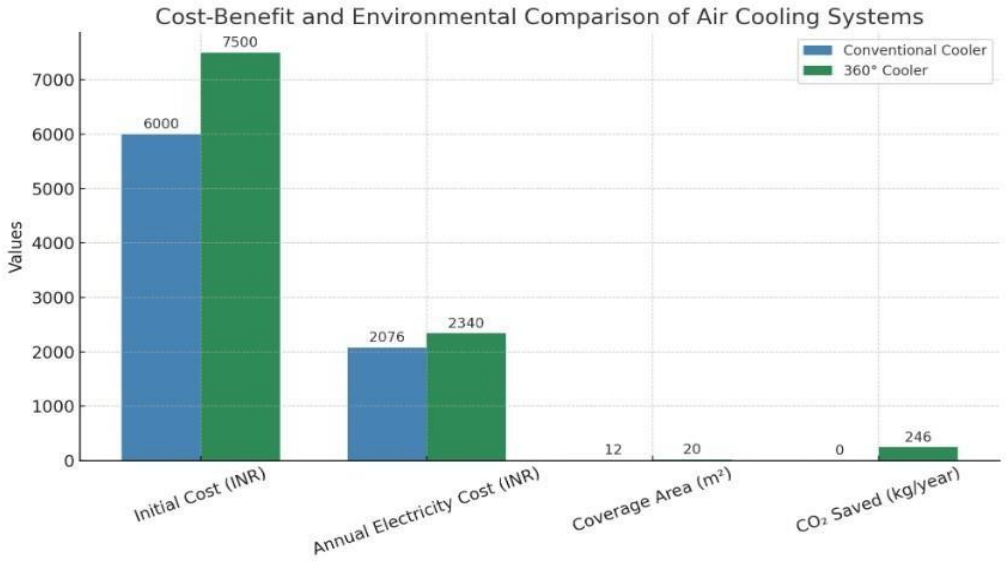

Results

1. The theoretical velocity of the air = 41.93 m/sec.
2. The actual velocity of the air flowing from the drum = 16.77 m/sec.
3. For cooling the room, it takes some time.
4. The ambient temperature of the room 280 c before cooling and the 24.50 c after cooling for this process it takes 5 minutes.
5. The ambient temperature of the room 310 c before cooling and the 25.50 c after cooling for this process it takes 8 minutes.

The ambient temperature of the room 290 c before cooling and the 250 c after cooling for this process it takes 6 minutes.

VIII. CONCLUSION

The results of the current study clearly show that the performance features of drip type 360-degree air conditioning can be linked to atmospheric circumstances like comfort and humidity management as well as variables like thickness. Determining the parameters is also feasible, but one must optimize the design parameters for the appropriate outside conditions.

IX. ACKNOWLEDGMENT

We would like to express our deepest gratitude and appreciation to everyone who has supported and contributed to the successful completion of our final year group project titled " Design and Fabrication of 360 Degree Air Cooling System." It has been an incredible journey, and we are thankful for the guidance and assistance provided by various individuals throughout this project. First and foremost, we extend our sincere thanks to our esteemed project guide, Dr. P. D. Patil, for their invaluable guidance, support, and expertise. Their dedication, patience, and willingness to share their knowledge played a pivotal role in shaping our project. Their encouragement and feedback were instrumental in keeping us motivated and focused during the entire duration of the project. We are also grateful to our project coordinator, Prof. S. A. More, for their constant support and guidance. Their insights and suggestions significantly contributed to the overall development and execution of our project. Their involvement and coordination helped us

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streamline our efforts and ensured the smooth progress of our work. We would like to extend our heartfelt appreciation to the Head of the mechanical department, Dr. S. N. Khan, for their continuous encouragement and support throughout the project. Their guidance and motivation were crucial in fostering an environment of academic excellence and provided us with a platform to undertake this research. Finally, we would like to express our gratitude to the Principal of JSPM'S Rajarshi Shahu College of Engineering, Dr. S.P. Bhosle, for providing us with the necessary resources, facilities, and infrastructure to carry out our project. We would also like to thank all the faculty members of the mechanical department for their support, advice and expertise whenever required. We acknowledge that this project would not have been possible without the combined efforts and support of all the individuals mentioned above. Thank you all for your valuable Contribution.

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