Solar-Based Water–Air Cooling System Using Rf Remote Control: A Sustainable Cooling Approach

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***Abstract-* The increasing demand for energy-efficient cooling solutions has placed significant attention on renewable-energy-based systems. Conventional air-cooling and air-conditioning systems consume large amounts of electrical power, contributing to high operational costs and environmental impacts. This paper presents the design and development of a solar-based water air cooler that operates on the principle of evaporative cooling combined with wireless RF-based speed and ON/OFF control. The system utilizes solar energy to power dual exhaust fans, while cooling air through a water-based mud container chamber. An RF module operating at 433 MHz enables remote operation up to 200–300 m. Experimental results indicate a temperature drop of approximately 10°C, demonstrating the system's effectiveness for hot and dry climatic regions. The proposed system is low-cost, energy-efficient, and suitable for domestic as well as industrial use.**

I. INTRODUCTION

Growing energy consumption in residential and industrial cooling systems has led to a pressing need for sustainable alternatives. Solar energy provides a clean and abundant power source, especially in tropical countries like India. Evaporative cooling—one of the oldest cooling techniques—remains effective in regions with high dry-bulb temperature and low humidity.

This project introduces a solar-powered water air cooler designed to reduce electricity usage by utilizing a photovoltaic panel to charge a battery that operates the cooling fans. Additionally, the system integrates a 433 MHz RF remote control for long-distance operation and speed control, providing convenience and automation.

II. BACKGROUND AND MOTIVATION

2.1 Evaporative Cooling Concept

Evaporative cooling works on the principle of adiabatic saturation, where hot air comes into contact with water, causing evaporation and subsequently lowering the air temperature. This method is ideal for dry climatic regions including Rajasthan, Vidarbha (Maharashtra), parts of Bihar, and northern India.

2.2 Limitations of Conventional Cooling

- High electricity consumption
- High installation and maintenance cost
- Not environmentally friendly

Solar-powered evaporative cooling overcomes these challenges by using renewable energy, low-cost components, and providing adequate thermal comfort.

III. SYSTEM OVERVIEW

3.1 System Concept

The system consists of:

- A mud container filled with water acting as an evaporative chamber
- Two DC exhaust fans (air inlet & outlet)
- Solar panel (10 W) charging a 12 V, 7.5 Ah battery
- RF transmitter and receiver modules (433 MHz) for wireless control
- Speed-control circuit using ICs such as HT12E/HT12D, CD4028, and ULN2003 drivers

Hot atmospheric air is drawn through the inlet fan into the water-cooled chamber, where it evaporatively cools to approximately 25°C before being discharged into the room.

IV. METHODOLOGY

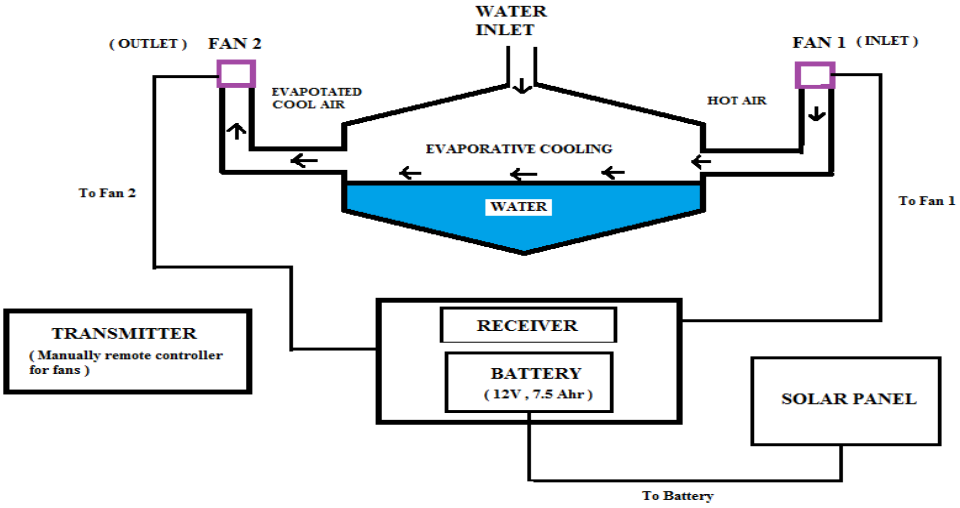


Fig. 1.1 General Block Diagram

4.1 working

The system concept shown in Fig. 1.1 uses a mud container filled with water as the main cooling chamber. Hot air is pushed inside by a DC exhaust fan through the air inlet. As the air passes through the water-cooled mud container, evaporative cooling occurs, reducing the air temperature from about 37°C to 25°C. A second exhaust fan then expels the cooled air through the outlet into the room.

4.2 RF Control Operation.

- User presses one of the 4–8 switches on the transmitter.
- The 74LS147 encoder converts the switch input into a 4-bit binary code.
- HT12E serializes this and transmits it via the RF module.
- The receiver decodes the signal, validates the transmission, and activates relays through a driver circuit.
- Fans can be controlled remotely up to 200–300 m.

4.3 Solar Power System

- Solar panel charges the 12 V battery.
- Battery powers the exhaust fans and circuit components.
- System consumes low power (approx. 1 Ah), ensuring long usage hours.

4.4 Evaporative Cooling Chamber

A mud container maintains naturally cool water temperature (~37°C air inlet goes down to ~25°C outlet).

Air–water interaction triggers evaporation, reducing the temperature by ~10°C.

V. OBSERVATIONS & EXPERIMENTAL RESULTS

5.1 Temperature Measurements

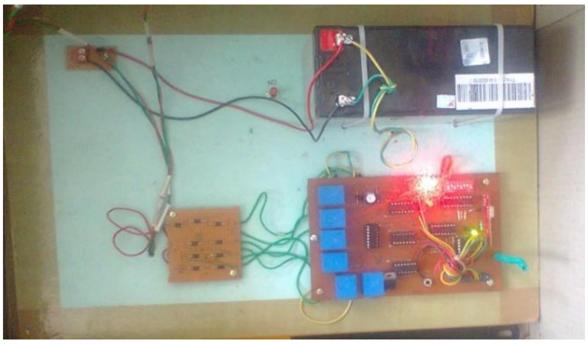
Parameter	Dry Bulb (°C)	Wet Bulb (°C)
Inlet Air	37°C	27°C
Outlet Air	28°C	21°C

Temperature reduction achieved: ~10°C

5.2 Performance Highlights

- Stable cooling in hot, dry environments
- Effective for outdoor temperatures above 35°C
- No external electricity required


Actual Model of Project


Actual Fan Speed Control Kit

VI. APPLICATIONS

- Bakeries
- Foundries
- Laundries
- Steel and glass industries
- Pottery and textile plants
- Homes
- Malls and lecture halls

VII. ADVANTAGES

- Fully solar-powered; no dependence on electricity grid
- Low operational cost
- Compact and easy to install
- No added humidity in the atmosphere
- Environmentally friendly
- Wireless remote operation up to 300 m

VIII. COST ANALYSIS

Component Description	Cost (₹)
Cooling container	1000
Solar-based fan speed control	8000
Pipes & accessories	500
Miscellaneous	500
Total Project Cost	₹10,000

IX. CONCLUSION

This study presents a solar-powered, RF-enabled water air cooler capable of reducing air temperature by approximately 10°C without using external electricity. The system is cost-effective, eco-friendly, and highly suitable for regions with hot and dry climates. Future work may include IoT integration, efficiency optimization, and hybrid cooling mechanisms.

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