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# Increasing the Efficiency of Air Cooler through Automatic Refiller

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**A B S T R A C T**

This paper outlines the design and development of an automatic water refiller system specifically for air-coolers to improve the efficiency and convenience of cooling devices. Air-coolers are widely used tools for low-energy, environment friendly cooling; however, their proper performance is often maintained only when water is replenished frequently, which requires constant monitoring and manual refilling. The proposed system would automate the process by integrating a water level sensor, a solenoid valve, and a microcontroller to ensure continuous water supply and avoid system failures resulting from low water levels. The water level sensor senses the signal of the water tank and sends the real-time values collected to the microcontroller, which invokes an action in the solenoid valve to refill the cooler when the water level drops below a predefined threshold. The system further has a user interface to set desired water levels and maintenance alerts. Prototypes and testing reveal that the system minimizes manual intervention, increases the reliability of air coolers, and optimizes performance, hence being a worthwhile addition to modern cooling technology. The paper also discusses the energy efficiency, cost-effectiveness, and scalability of the design along with potential improvements for broader applications in cooling systems.

Keywords: Automatic Water Refillller System, Water Level Sensor

## 1. Introduction

Air-coolers, also known as evaporative coolers, are widely used cooling devices in both residential and commercial environments, particularly in areas marked by hot and arid climates. While traditional air-conditioning systems give no energy efficiency, environmental sustainability, and cost benefits, air-coolers use the evaporation process to cool down the air temperature. However, the effectiveness of air-coolers largely depends on a steady flow of water to the cooling pads. If the water level in the tank falls below an adequate level, the cooler's effectiveness will degrade further, and running with too low a level may damage the internal parts of the equipment, including the pump.Currently, the water level in air coolers has to be manually maintained. The users have to frequently monitor and refill the water tank in order to ensure proper performance.

This can be very strenuous, especially when dealing with wider setups or when the chiller has been working continuously for extended periods. Further, uneven replenishment can lead to factors like reduced cooling output, increased power usage or, in certain cases, mechanical failure. These challenges highlight the need for a automation-based system to manage the water supply in air-coolers. This paper provides an Automatic Water Refiller System for air-coolers, which tries to address the barriers affecting its infusion by automating the water refilling in air-coolers. In the method, the mechanism will use water level sensors, actuators, and a microcontroller to determine whether the falling water level has reached an established threshold value and initiate the cycle of refilling. This negates the need for continuous user involvement thereby ensuring the air-cooler works in a reliable manner without the threat of its water supply drying out.

Automatic water refilling for air coolers represents a growing trend in the field of home appliances and automation. Despite having gained widespread popularity as one of the energy-efficient cooling devices, users still struggle with having to monitor water levels and refill their water manually. Many studies and technological advancements have been conducted on automating the management of the water in cooling machines with a focus on efficiency, reliability, and user-friendliness. This literature review discusses the existing research and technologies related to automatic water refilling systems, with a particular focus on the key findings, innovations, and the prospects of further research in this domain.

Air coolers rely on constant water supply to properly cool; their current systems also require human observation and replenishment of the water. Low water levels will lead to reduced cooling rates, increased energy usage, and even damage some internal parts. It becomes an even bigger problem with larger or unmanned systems. There is, therefore a need for an automatic refiller system that monitors the water levels and automatically replenishes the tank. Such a system would enhance the efficiency of air coolers, minimize maintenance efforts, and improve reliability, all while guaranteeing optimal performance without necessitating constant user intervention.

The objective of this study is to explore the design, development, and implementation of an Automated Water Recycling System (AWRS) for air coolers, with a focus on its technical feasibility, potential impact on cooling performance, and practical benefits for end-users. To this effect, AWRS aims at enhancing the operational effectiveness of air-coolers by extending their lifespan and decreasing the energy used in the process of monitoring and refilling them manually through the automation of the water management process. In addition, it addresses other aspects of the viability of the system in terms of scalability, cost-effectiveness, and ease of integrating it into existing models of air-coolers, thus encouraging step-by-step development of smarter and efficient cooling technologies.

## 2. Methodology

The Automatic Water Refiller System (AWRS) proposes the installation of a water level sensor, microcontroller, and solenoid valve into the process of an air-cooler, providing automatic refilling. The water level sensor can be one of the types consisting of an ultrasonic or capacitive kind that is used to continuously monitor the water level in the tank of the air-cooler and transfer through it. During specified water level descent, the microcontroller activate the solenoid valve or the water pump to fill up the tank. The system is designed to work at low power consumption, but it will trigger the refill process only when required because it maintains its efficiency. Testing and calibration of devices are done to ensure that there are accurate sensor reads and optimum performance for all scenarios. In addition, the user interface could be added to manually override or change the water level parameters for ease and convenience. This approach ensures that the air-cooler operates at its best without requiring the user constant intervention; this is beneficial for high performance and reliability.

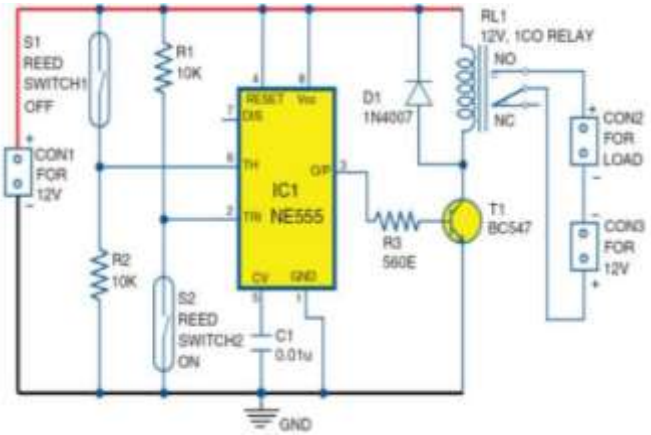


Figure 1: Circuit diagram of automatic water refiller

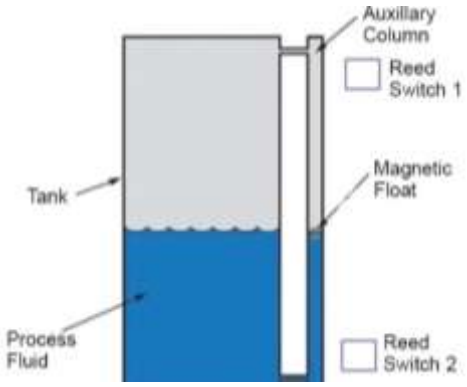


Figure 2: Water tank sensors arrangement

Figure 1: Circuit diagram of the automatic water refiller designed for an air cooler. The circuit incorporates IC1, an NE555 timer, T1, BC547 transistor, and reed switches S1 and S2, among other constituents. IC1 is set up like a bi-stable arrangement, though switch S1 is connected to pin 6 rather than to pin 4. The two reed switches, S1 and S2, are at top and bottom of the tank, as shown in this figure. 2. The circuit operates intuitively. When the water level drops below the set level, the magnetic float actuates reed switch S2. This, in turn, connects pin 2 of IC1 to ground. The voltage at pin 2 is thus less than 1/3 Vcc; hence a high output is obtained from IC1. The relay energising the solenoid valve is now energised. Thus, water flows to the tank. At its full level, the magnetic float would activate the reed switch S1. Pin 6 of IC1, therefore, is above 2/3 Vcc and causes the output to go low. As a result, relay de-energizes due to having the solenoid valve shut off, which subsequently stops the flow of water to the tank of the cooler.

## 3. Results and Discussion

Thus, the Automatic Water Refiller System for air coolers has effectively demonstrated its capability to maintain the required water levels without any manual intervention. This water level sensors and microcontroller-based control unit installed water refilling system effectively detects the low water levels and initiates refilling through the activation of a solenoid valve or pump. During testing, the AWRS allowed for uninterrupted running of the air-cooler, which enhanced cooling efficiency and avoided potential damage due to dry running. The system proved to have dependable performance in various environmental conditions with accurate water level detection and prompt refilling. Moreover, the automated system reduced the need for manual checks and refills, thus enhancing user convenience. However, sensor calibration under extreme conditions had identified some limitations and was thus needed further refinement to make it long term durable and also for integration with other models of air coolers. Conclusion: In short, AWRS has significantly improved operation efficiency with reduced maintenance and increased overall system reliability.

The Automatic Water Refiller System(AWRS) itself, which was meant to be applied to the air-coolers, however has some drawbacks. Such sensors as water level, including ultrasonic and capacitive types, can lose both accuracy and reliability due to harsh ambient conditions, either temperature, humidity, or deposits of minerals in the water. For one, the system may require adjustment or maintenance to ensure it remains effective in the long run, especially in systems that consist of mechanical devices like valves or pumps, which are subjected to wear and tear. Additionally, connecting the system to air-coolers already installed within a facility may necessitate adjustments for the fitting of sensors and control mechanisms, a complicated procedure for certain models. Ultimately, although the system seeks to achieve energy efficiency, the power consumption associated with sensors and controllers, particularly in extensive installations, may influence overall energy savings.

## 4. Conclusion

The Automatic Water Refiller System functions to successfully address the issue of maintaining adequate water levels within air coolers, thereby ensuring seamless and effective performance without any human interaction. A water level sensor, a microcontroller, and an automated refill mechanism allow the process to significantly enhance the performance of air-coolers by reducing the danger of water level-induced damage and energy expenditure. Test results prove that the AWRS delivers reliable and accurate monitoring of water level with improvement in cooling effectiveness and convenience of use. With a few drawbacks like calibration problems at extreme values for sensors, the system, nevertheless, has enormous potential in the minimization of effort spent in its maintenance and lengthened air-cooler life cycle. The next future steps include increased precision in sensors, integration into models of different air coolers, and optimization in terms of energy consumption.

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