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Design and Implementation of a Power Efficient Modern Air Cooler

Prof. Nicky Balani[1], Swapnil Gaikwad[2], Pravina Thakre[3], Pradnya Guldhe[4]
[1, 2, 3, 4]*Electronic and Telecommunication Engineering, S.B Jain Institute of Technology Management and Research, Nagpur-441501, Maharashtra, India*

Abstract: ***The World has seen some drastic climatic changes in these recent years and more adverse effects of Global Warming. Due to this there has been an incremental rise in demands of AC's. Air coolers are now more restricted in use due to their biggest disadvantage of humidity levels. It works on the principle of evaporative cooling and hence the water requirement is high and ultimately its performance is not comparable to that of AC's. AC's on the other hand are expensive and their impact on environment is more adverse. The AC unit blows hot air outside thereby making the outside air hotter and it re-circulates air inside the room by cooling it and thereby a cold effect inside the room is retained. Both these systems are extreme ends of technology in their working principle. This paper focuses on an alternate approach of designing a hybrid air cooler which works on thermoelectric principle and also turns out to be more efficient than the existing system. The comparative analysis of the output has to be done in terms of cost benefit and its usability factor. The proposed design makes use of a peltier module for cooling mechanism. For the convenience of users, remote is provided with this system which works through IR technology. Peltier module has a tendency to provide hot and cool effect simultaneously on application of voltage. The cooling effect is used in air coolers to provide cool air to users and the hot air is dissipated out using dc fans, this heat dissipation is very low as compared to AC units. The proposed system is a novel approach towards designing an air cooler which is cost effective as well as safe for our environment.***

Keywords: Air cooler, peltier module, IR remote, AC

I. INTRODUCTION

Luxury and comfort are important but more crucial in today's time is to also analyze any detrimental effects of the electronic or electrical devices on environment. AC is the best example of luxury teamed up with worst effects on the surrounding environment. Coolers working on the principle of evaporative cooling are an alternate option, but it cannot produce same results as that of ACs hence they are popular among people but are not the substitute of the existing cooling methods available. Ducting is another approach where a better cooling effect is obtained in comparison to normal coolers. Ducting is not viable option because it still uses evaporative cooling method with a small difference that a high capacity cooler is used because it has to cater to the needs of more than one room. It is a costly setup and also comes with the same problem of large water requirement and it's not feasible to maintain such systems. There have been a lot of modifications in the basic design of coolers but all these designs haven't been accepted in the market by consumers. Slight modifications with a well engineered design has to be made in order to make an efficient design of air coolers which are both economically and technologically feasible.

II. LITERATURE SURVEY

A. *Evaporative air Cooler*

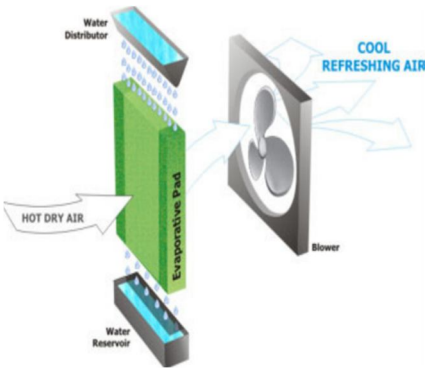


Fig: basic working principle of Evaporative cooling.

It takes the air from outside environment and as its panel is wet, the hot air gets the air evaporated turning it down cool hence in general usage it is recommended to be installed where ventilation like window or door is available. The biggest disadvantage it is literally of no use in humid areas and increases humidity level[1].

B. Conventional Air Conditioner

In these systems, air from the enclosed space is taken inside the AC unit and through a refrigerant cooling fluid, the hot air is turned into cool air thereby allowing to have a relief in summers but it comes with a biggest disadvantage that it greatly affects the environment and its impact must be reduced to a great extent and the only option to reduce it is to avoid excessive use or find an alternate solution for it[3].

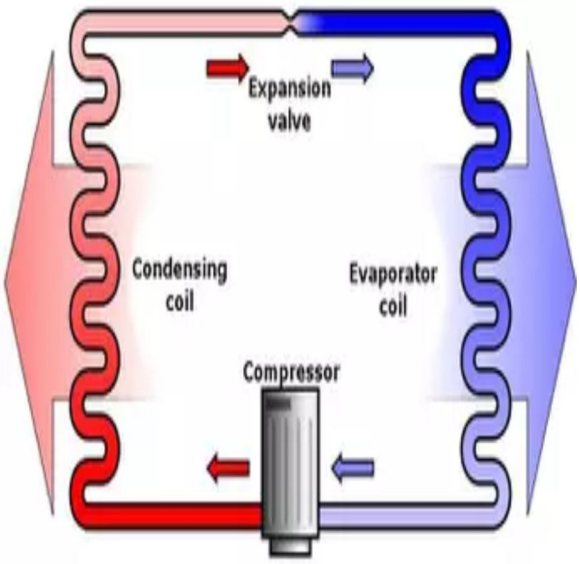


Fig: basic working principle of AC

C. Modern Evaporative Cooler

It brings a small change in the conventional air cooler by replacing the back panel with metal sheet and rest using insulated coatings on two sides. The back panel gets moist as there are some droplets of water on back metal through which hot air will enter the body of modern evaporative cooler and allow cooling mechanism to be followed. This is a different approach between the conventional design and AC mechanisms. The biggest disadvantage is in fabrication of units with insulating material on sides but still the cooling level is not as great that as required[4].

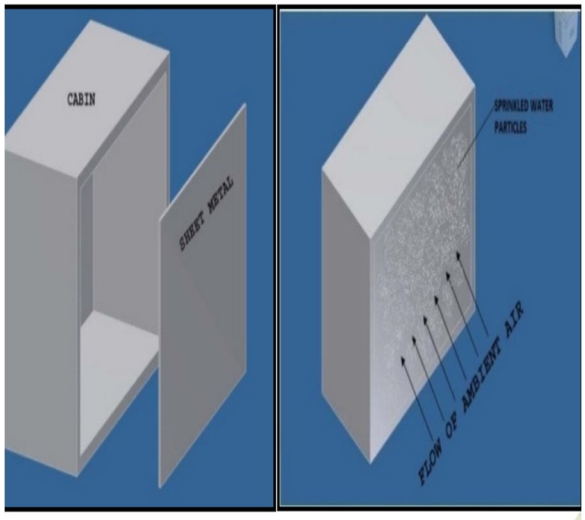


Fig: basic working principle of modern Evaporative Air Coolers

III. METHODOLOGY

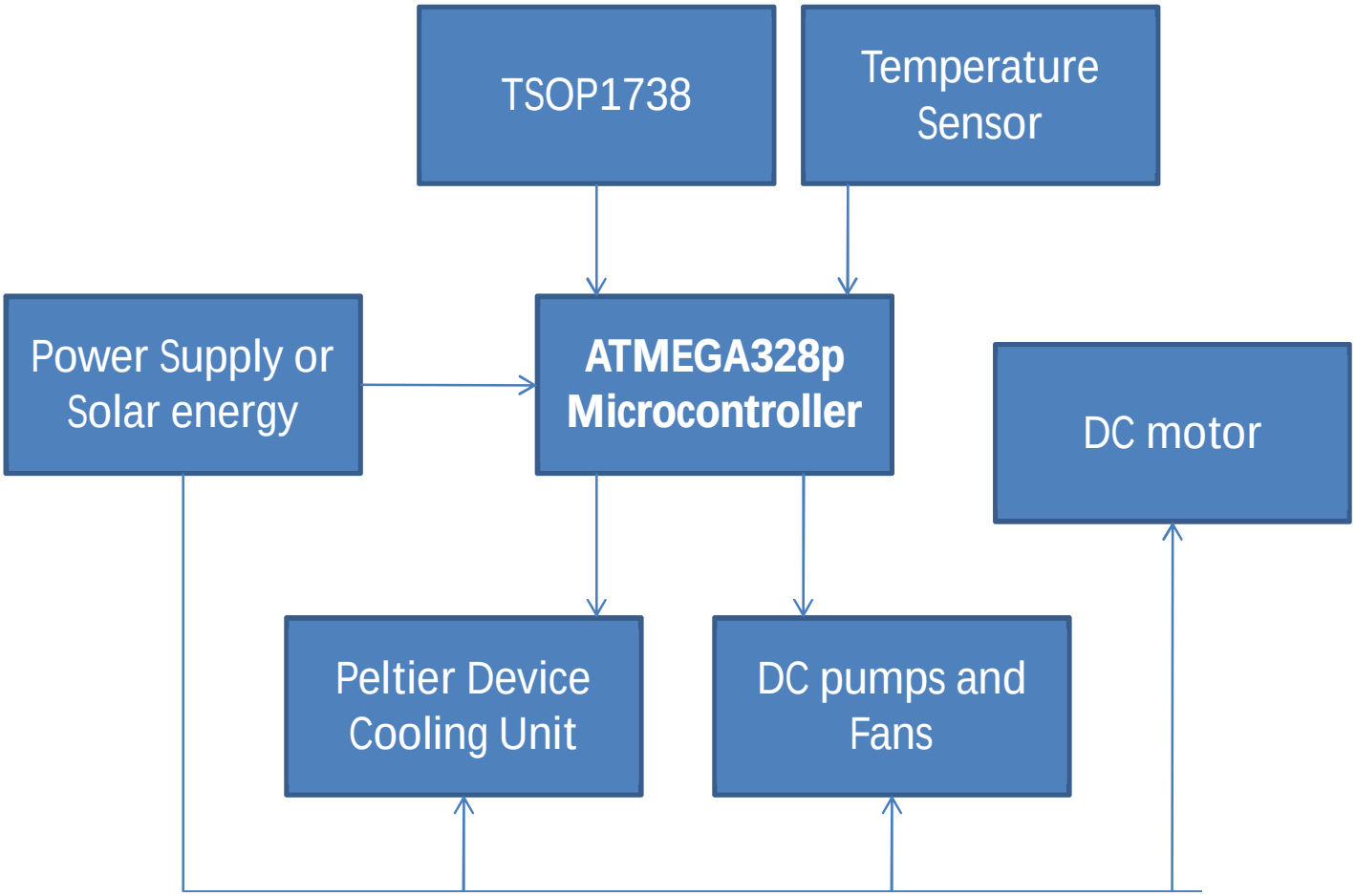


Fig: Block diagram of proposed system

A. Working

When the system is turned on, the fan is connected to the DC motor shaft and it starts rotating, the supply can be taken from either a power supply board or it can be powered up by solar energy and hence dc system has been employed to ensure smooth working with solar energy as well. AC tends to take more energy as compared to DC and has more stable operation as well at low voltages also. The IR sensor remote circuitry is provided to control the working of air cooler through remote as well. The designing part is done all internally and fabricated to look like a normal cooler but the main designing is well engineered and several trials were taken to ensure smooth working of this proposed model. Peltier module is used to provide cooling mechanism where the whole principle of working is dependent on this module. When the circuit is switched on the controller sends desired signal to the peltier module, which will then generate hot and cold air on either of its side. The cooling effect is used by allowing water to pass in the pipe which is connected to the cold side of peltier module in a proper designed manner so that the water remains cooled and doesn't evaporate as it does in conventional coolers.

The hot side of peltier has to be cooled or at least the heat should be allowed to dissipate else it will accumulate in the cooler and also heat up the air inside the room. For the purpose of dissipating heat, a set of DC fans as used in PCs are installed which will be switched on only when the temperature gets above a certain decided threshold value as set in the programming. A temperature sensor is provided to always monitor the temperature and in case if it exceeds a threshold value, the control action of switching on small dc fans at the back of system is taken into consideration. This acts as a feedback of the system. An important parameter to be considered is the maintenance of cold water at a particular temperature to ensure peltier module is not loaded unnecessarily and in long term use, cooling effect is not degraded. For this the water container is made of an insulated material- thermocol, which will not allow heat to enter the medium and it will keep the water cold. Aluminum and copper pipes should be used for the water cooling mechanism owing to its robustness in such applications and the conductivity of these metals ensure cooling of the water through peltier module.

B. Internal Designing Structure

Fig : DC fans for heat dissipation

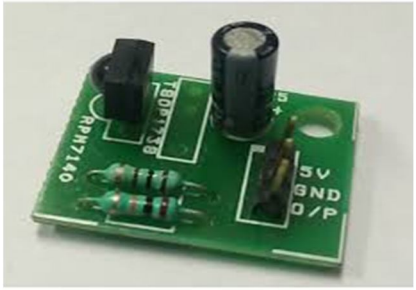
Fig: Piped lining at back with insulated water container

IV. HARDWARE

A. Peltier Module

It works on thermoelectric effect, when voltage is applied; a hot and cold effect is obtained on either side of the modules. This effect is very useful in cooling and aero refrigeration works at low voltage with greater efficiency.

B. TSOP 1738



It is an IR transmitter receiver circuit which is used to design remotes for small applications. This module can be purchased or can be designed according to users need. It shall help the cooler to be controlled through remote.

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C. DC fan

This fan is a dc fan, it works on dc voltage. As this system should also work on solar energy DC output modules are chosen which give the good output efficiency and in this project it is used to dissipate heat.

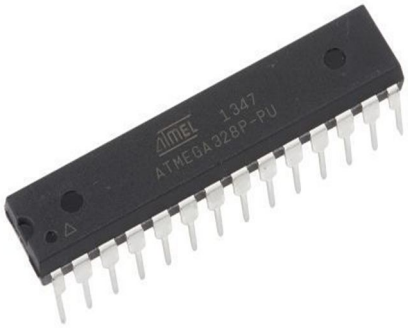
D. DC Motor

DC motor is used to rotate the blades of air cooler. This provides good output efficiency at low output voltage and also helps to reduce the electricity bills as it is also compatible directly with solar panels.

E. DC Water Pumps 12V.

It is a submersible pump which will help o transfer water from tank to pipes and circulate it through back linings of the air cooler. It can operate at a low voltage of 12V hence it is an efficient system.

F. ATmega328p



It is a microcontroller IC which helps the project to function properly. It is programmed according to users need and it shall be connected to the input and output devices accordingly. It is known as the heart of a system which will help to control and co-ordinate all the tasks of the project.

V. SOFTWARE

Microcontrollers have to be programmed for functionalities and generally it can be programmed through free open source platform Arduino IDE.

VI. RESULTS AND CONCLUSION

A novel approach for designing efficient air cooler has been undertaken which involved designing of a hybrid mechanism which can be cost effective and also be sustainable over a long period of time. The main focus of this project was to achieve better results than that of evaporative air cooler and be somewhat near the most popular cooling device AC.

It should be seen as an alternate to the existing system because it has quite worst impact on environment. We would like to thank our guide for constant guidance and support in this undertaken project work.

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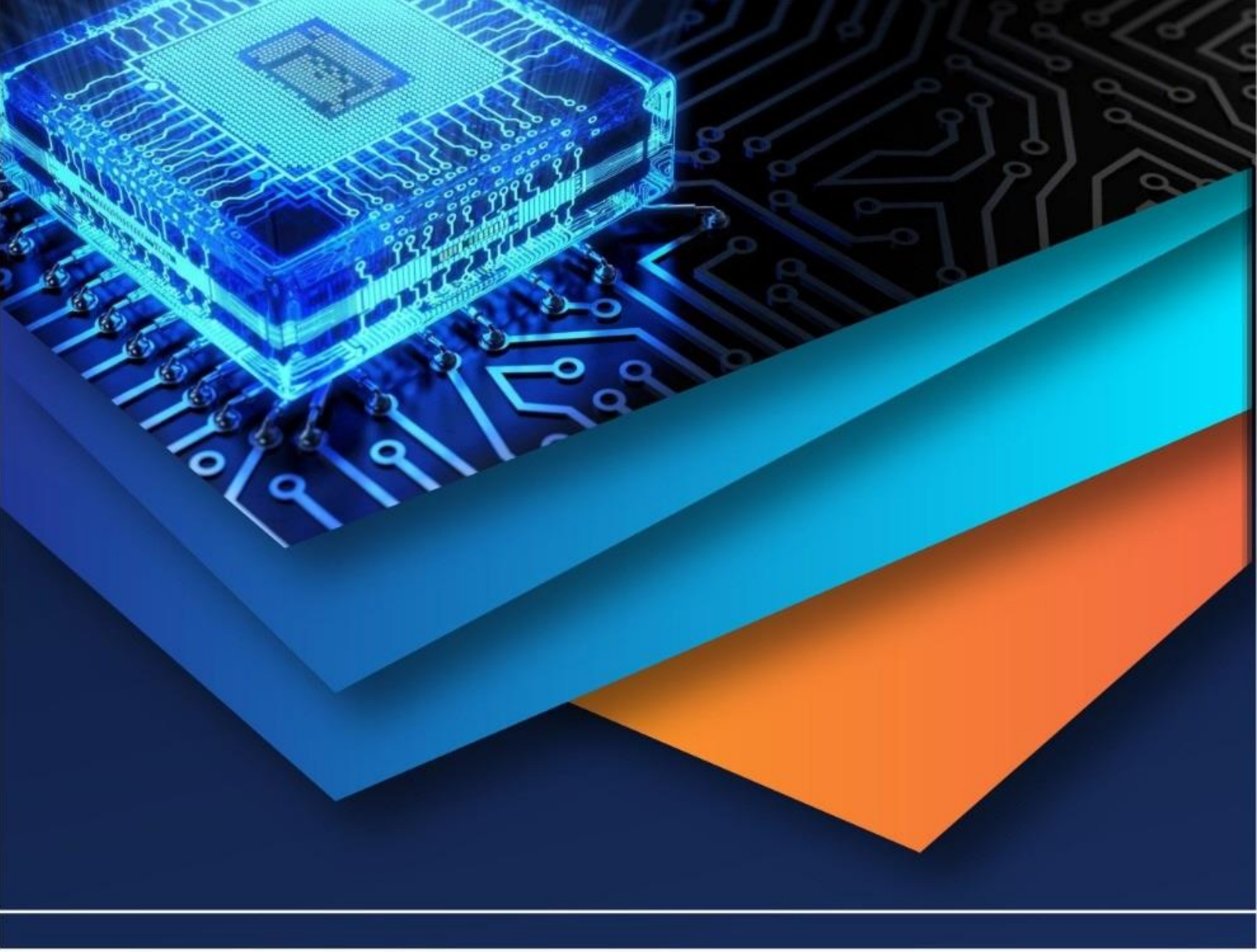

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