

# Development of Air Multiplier for Application in the Automotive Industry

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**Abstract:** *An experimental study on the application of air multiplier popularly known as bladeless fan in the automobile field and in the process comparing it with the conventional bladed fan that is used on a large scale in the industry are investigated. It consists of a brushless electric motor along with asymmetrically-aligned blades attached to a rotor. The frame is sloped at such an angle that by this pressure is increased. The surrounding air is rapidly sucked or 'entrained' inside resulting in a stronger air flow. By this process the air multiplier, multiplies the flow of air. This is how the air multiplier increases the flow of air by 15% compared to a conventional fan. The results of the comparison between the mainstream bladed fan and the bladeless fan are shown with the important factors such as efficiency, quietness, speed of the air flow and nature of the air flow are shown. These findings are then incorporated to apply the air multiplier in use in automobile industry to eliminate the use of bladed fans in the applications of HVAC fans, radiator fans, headlight cooling fans. The theoretical assumption is that the air multiplier will have a higher air flow output with a lower energy consumption. It will also have a continuous air flow and the issue of buffeting that is evident in the case of bladed fans will be nominated.*

**Keywords:** Entrained, HVAC (Heating, Ventilation and Air Conditioning), Buffeting, etc.

## I. INTRODUCTION

Dyson corporation worked and developed a fan that works without any visible impeller or blades. This technology has many benefits which retire the use of normal blade fan and can be used very easily even under the control of children due to its bladeless design. The fan due to this design has higher visual appeal compared to the conventional fan and the principle of operation behind it is also very simple. This is the first fan that can flow air very smoothly without using exposed blades which in turn is why the reason sooner or later will be used as very reliable technology looking at its application in the Automotive industry.

While advancements have been made in cooling systems of (ICE) internal combustion engines and electric vehicle batteries, which allow them to run smoothly via minimizing the problems of engine overheating in ICEs and deliver more power and require less frequent charges in the EVs, it still lacks to achieve its best with tons of work to improve cooling systems in ICEs where as in electric vehicles one of the biggest challenges that remain for battery safety is the ability to design an effective cooling system of their own. Since internal combustion engine cars have been around for decades and are already equipped with the air-cooling system even though it has its imperfections, the demand is achieved by the present technology and isn't in the serious need to as much as the EVs. Talking specifically about electric vehicle and its cooling systems, air cooling uses the principle of convection to transfer heat away from the battery pack.

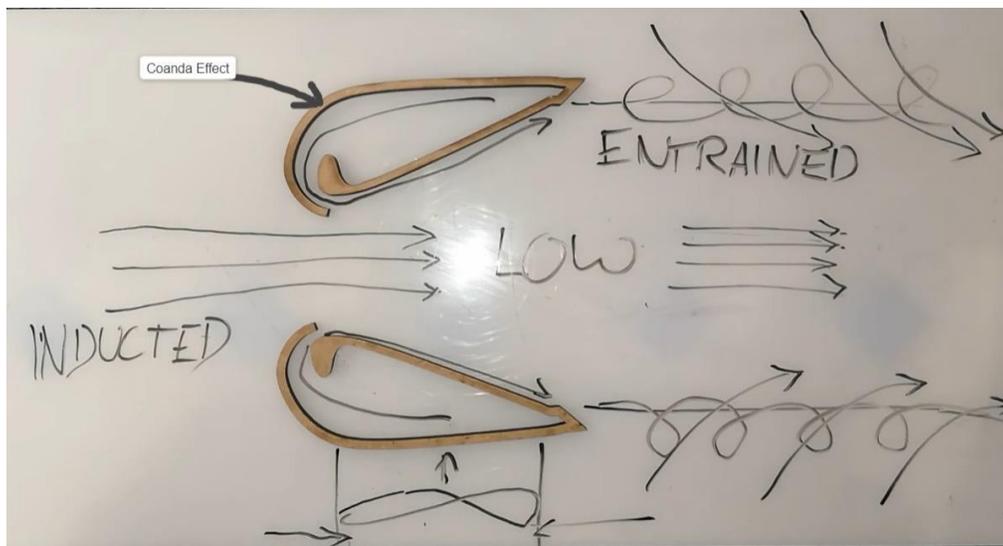
As ambient passes through the surface, it will dissipate the heat emitted by the battery pack. Air cooling is simple and easy, and a technology like an Air Multiplier can result in a significant change to its use with replacing the old conventional fan as it has proven to be inefficient and relatively crude compared to liquid cooling because of its acceptable limitations of size and weight. Air cooling was the predominant form of cooling in earlier versions of electric cars. As electric cars are now being used more commonly, safety issues have arisen with purely air-cooled battery packs which we believe can go in a positive trajectory after its replacement.

## II. WORKING

The air multiplier works in a way such that the rings of the fan work similar to the principle of wings in aviation industry. The fan doesn't have any visible blades as they are placed in the bottom structure. The air is sucked from the bottom

vents and forced to the top structure called as a mixed flow impeller, which acts as an air pump and it blows the air upwards in the structure. Placement of impeller is critical. If placement of impeller is proper, it can develop a significant negative pressure effect to get the air flow going. A negative pressure area is created when the air reaches the ring above the joint structure of ring and cylinder. This negative pressure that is now present above the ring forces the air that is present over the back side of the ring forward. This further creates a negative pressure at the back, and air starts flowing from the back to the front due to this, demonstrating what is called the Coanda effect.

The air flowing forward direction is in a circular cross section. Due to viscous shearing, the air around the flow also starts to move resulting in an increased speed up to 15% compared to ordinary fan. It works on a simple and effective technology, as mentioned in the figure (1), the working of air-multiplier. It consists of a brushless electric motor as the main motor with aligned blades asymmetrically aligned and attached to it. To create more pressure the frame is slightly sloped at an angle that its curvature can now create more pressure. As the air continues to flow, entrainment can now be evident as the surrounding air is rapidly sucked into the mechanism, creating a stronger airflow. This is the process by which it multiplies the flow of air.



**Figure 1: Coanda Effect**

**1. Suction:**

The brushless motor draws in up to 27 litres of air per second. The technology incorporated in the fan has similar working to that of a turbocharger and jet engine. Thus, a very powerful stream of air is generated.

**2. Acceleration:**

As the air continues to flow in, it gets accelerated through an annular aperture. Passing over a 16° aerofoil-shaped ramp, the air is channeled into the hollow ring.

**3. Inducement:**

The air flows inside the hollow ring in a circular motion and is pushed through small slits. Entrainment: Ambient air around the fan ring starts to flow in the direction of the breeze. This process is called entrainment. Through the process of inducement and entrainment, the Air Multiplier is evident to aggrandize the airflow output by 15 times the intake amount through the pedestal's motor.



**Figure 2: Air Flow**

### III. APPLICATIONS

1. Air Multiplier in Thermal Management System of Electric vehicles.
2. Air Multiplier as HVAC vents.
3. Incorporating Air multiplier to cool Automotive Heat Exchangers

### IV. CONCLUSION

The main goal of this work was to develop a preliminary study of Air Multiplier, in a way which could be applied in the Automotive industry. Moreover, a research study was needed in order to assess the effectiveness, quietness and the nature of air flow of the device. Through state-of-the-art research, it can be demonstrated that the air multiplier can be applied in various aspects in the automotive industry and stand out as a new innovation. This is because it provides reasonable amount of continuous air flow with little to none turbulent flow at silent levels with high efficiencies.

Nevertheless, the technology of air multiplier can be incorporated in the automotive industry as an application to improve the cooling of radiators by using its innovative yet effective design. It can improve the effective cooling inside the vehicle cabin as it could replace the conventional vents and ducts. Another application of air multiplier is to be a more efficient way of cooling the battery packs of the electric vehicles that are on an all-time high now. All in all, it can be concluded that air multiplier is an unknown technology that can work wonders if applied in the automotive industry and it can bring about innovation and do wonders in the betterment of the industry.

### ACKNOWLEDGEMENT

We would like to express of gratitude and deep regards Prof. Shambhuraje Jagtap, who gave us the golden opportunity to pursue this dissertation. We would also like to thank Prof. Bhushan Karamkar, our co-ordinator to allowing us to undertake this research and provide necessary help. We are also extremely grateful to Prof Siddharaj Allurkar (HOD), Automobile Engineering Department for the technical guidance.

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