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Optimisation of Fan Blade Angle

Swaroop M P*, Paul Raphy T*, Varun Menon*, Vivek Balachandran*, Arjun M*, Melvin Raj C R**

**(UG Scholar, Department of Mechanical Engineering, Jyothi Engineering College, Thrissur, India*
*** (Assistant Professor, Department of Mechanical Engineering, Jyothi Engineering College, Thrissur, India*

ABSTRACT
This report represents the optimization of fan blade angle in accordance with the various room temperatures that can be in the tropical area like India. We took this work mainly because cooling is an important factor now a days in every area where construction and rooms are there and ceiling fans are the most common device that is commonly used. So it is of utmost importance to tweak the performance of this ceiling fan so that it can function in its most optimal condition. We have modeled the fan in a modeling software (SOLIDWORKS) and imported that into an analyzing software (ANSYS) and a result is generated on the various blade angles (0, 4, 8 and 12.5) degrees in accordance to room conditions. A trend line curve with the obtained data is expected as the result which can be crucial for designing of future fans.

Keywords : Modeling, optimization.

I. INTRODUCTION

In the present age, i.e. the 21st century, one of the most common seen mechanical devices in every household and office around the globe is the common type of ceiling fan and its variants. Presently we are in a situation where the average global temperature keeps on rising due to various reasons like global warming, pollution and a lot more and the term "being comfortable" has gained a whole new definition.

We human beings have reached a state where these common ceiling fans have become a part and parcel of our day to day things and sadly, the design of it, even though it has improved dramatically in its aerodynamics and its design point of view, it still doesn't meet the expectations of humans, and thus alternate measures like air conditioners, coolers, etc. are all in demand.

Another highlighting factor is that in the age where electronics have taken over a huge share of the common day products and converted them into "intelligent" products, sadly it has not penetrated into this section and thus, our project, i.e. to try to create an intelligent fan, which moves its blade angle in accordance with the temperature, indirectly optimizing the blade angle at every given temperature. That is the project that we are going to analyze and try to make it a reality.

A ceiling fan is a mechanical device, usually consisting of a center hub and 3 to 5 blades. It is electrically powered and suspended from the room. The main working of the ceiling fan is by rotating the hub mounted paddles to circulate the air. Another point to be noted on the ceiling fan is it slowly when in comparison with an electric desk fan, yet it cools the area pretty effectively by introducing slow, circular movement of air and giving rise to evaporative cooling. Fans never actually cool air, unlike air-conditioning equipment, but use significantly less power (cooling air is thermodynamically expensive). Conversely, a ceiling fan can also be used to reduce the stratification of warm air in a room by forcing it down to affect both occupants' sensations and thermostat readings, thereby improving climate control energy efficiency. Heat causes lot of discomfort for us humans. As a growing engineer, this same problem was encountered and we had the thought of why cannot we solve it. The main reason why we took this specific topic for our mini project is because this is still unsolved and we want to know why it is happening and what can be done to prevent it. Our main aim on this project is to optimize the blade angles in accordance with the temperature of the room

I.I Problem statement

Heat can be our very good friend, in some instances and also over worst enemy in other cases. Engineers are supposed to find out and try to solve problems. That is the main and sole purpose of our creation. So, as budding engineers, we had a huge problem with the heat that persisted in our very own classroom. The 6 fans that we had in our room, was totally inefficient and that puzzled us. When we took a small and general survey on this topic, we got to know that this problem was faced by a majority in their households and this problem that we found out

was of great importance and it was indeed having a huge impact in each and every human being. Thus we took this problem and considered its analysis, and possibly an effective solution.

I.II Scope

The scope of the project is by designing a fan whose blade angles can be changed, manually or automatically depending upon the situation in the room. It ensures maximum efficiency for the input current, and making it cost effective as well .The cooling of a room is a particularly important factor when we design a room or building. As global temperatures rise every year, we have to find ways where-by we can give away for a more better and efficient design. Thus this project is a step in that direction that is to find out at which blade angle of a ceiling fan; a standard living room gets cooled faster and better. Various already existing components are combined together to form a new, better product, which makes it cost effective .Intelligent fans and cooling of a room is in the scope of this project. Exhaust systems and heater systems can be replaced in commercial scale to an extent if this technology is developed.

I.III Result expected

At the end of the project, the result that we are expecting is that we can find out an optimum angle and various temperatures that we see in tropical region like ours. We plan to get the result from the velocity profile that would be generated by the analysis software (ANSYS) and compare with the already existing journals and papers, to validate the result.

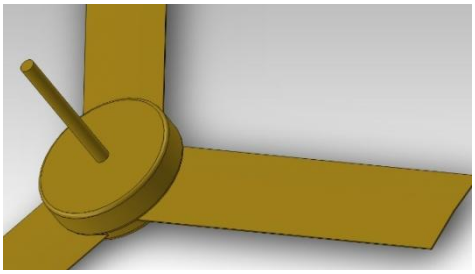
II. METHODS

The first step in the research was collect data and understand the aerodynamics of the ceiling fans and model one of them in any of the modelling software and embed it into a standard living room.

The next step was to import this design onto an analysis software and check the design in various conditions and parameters and obtain the result. Finally we compare the result with the already obtained velocity of fans and compare it.

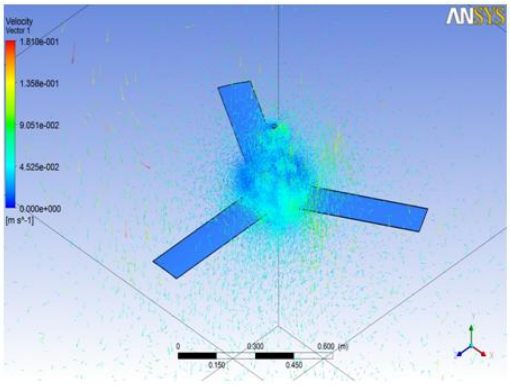
III. DESIGN

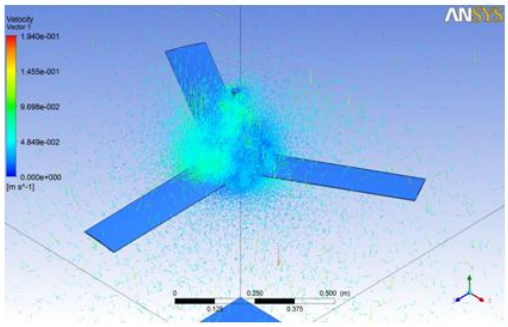
The basic design of the fan is shown in the picture below attached. We can see that the given fan is at 0degree inclination to the normal. With this as the base, we have created more designs and various other blade angles and shapes.



IV. RESULT & DISCUSSION

We can see that the velocity changes drastically as we change the blade angle and its curvature. We can see some of the results that were obtained in the analysis.





The drastic change in the velocity change can be easily observed and likewise we obtained a result as we expected from the first itself. Although there wasn't a drastic change, the result was indeed positive.

Sl. No	Blade Angle	Average Velocity Obtained
1	0 degrees	0.07416 m/s
2	4 degrees	0.081464 m/s
3	8 degrees	1.40091 m/s
4	12.5 degrees	0.071432 m/s

From the above seen results we have summarized a graph in correspondence with blade

angle and velocity obtained. From the graph, it is well evident that the air velocity increases at first and then attains a maximum. This maximum is when the blade is at 8 degrees and then the velocity drops back. That is one of the results that we have obtained and it is as expected.

V. CONCLUSION

From the analysis that we have conducted, we can see that there is certainly an effect on air flow as the blade angle changes. The thing that struck us the most is that the velocity of air which comes through the outlet keeps on increasing upto a certain blade angle and then the velocity decreases after the optimum blade angle is reached. From the 4 different analysis that we have conducted, we have found out the most effective blade angle to be at 8 degrees.

That is the conclusion that we have come after extensive research and analysis on this specific topic.

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