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Bladeless Fan

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Abstract: ***A Bladeless fan is a novel type of fan with an unusual geometry and unique characteristics. This type of fan has been recently developed for domestic applications in sizes typically up to 30cm diameter. In the present study, a Bladeless fan with a diameter of 60cm was designed and constructed, in order to investigate feasibility of its usage in various industries with large dimensions. Firstly, flow field passed through this fan was studied by 3D modelling. Aerodynamic and aero acoustic performance of the fan was considered via solving the conservation of mass and momentum equations in their unsteady form. Moreover, the experimental results in the present study showed that this fan is capable to be designed and used for various industrial applications. A bladeless fan blows air from a ring with no external blades. The air is drawn by a compressor in the base and directed up into a ring. The fan contains a electric brushless motor and this motor rotates blades that are attached with the rotor. Usually the upper frame of this fan is a ring shaped. The air flows through the channel in the pedestal of the fan when the motor is turned on.***

Keywords: 12V DC Brushless Motor, 12V 10A SMPS, PVC Pipe, DC fan

I. INTRODUCTION

Bladeless fan is a novel type of fan with an unusual geometry and unique characteristics. This type of fan has been recently developed for domestic applications in sizes typically up to 30cm diameter. In the present study, a Bladeless fan with a diameter of 60cm was designed and constructed, in order to investigate feasibility of its usage in various industries with large dimensions. Firstly, flow field passed through this fan was studied by 3D modelling. This fan has invisible blades to multiply the inlet flow. Less depreciation and more safety are other significant characteristics of Bladeless fans. However, nowadays this type of fans is merely used for typical domestic applications. A bladeless fan blows air from a ring with no external blades. Its vanes are hidden in its base and direct the collected airflow through a hollow tube or toroids, blowing a thin high-velocity smooth airflow from holes or a continuous slot across the surface of the tube or toroids. Although all fans are typically classified into axial and radial groups, Bladeless fan mechanism differs from both. It is a bladeless fan that is spherical in shape and takes in air through one side and blows it out the other.

II. LITERATURE REVIEW

Passing air through a Bladeless fan has been illustrated in Fig.2.1. Surrounding air is sucked into the fan by rotation of radial impellers driven via a DC motor. Afterwards, the air is passed through an annular section and exited from a narrow ring-shape zone. The area reduction at the exit side increases the outlet velocity of airflow. Difference between the air velocity upstream and downstream of the fan leads to a pressure gradient according to Bernoulli equation. This created pressure gradient sucks the air from the back of the fan (upstream) towards the front side (downstream). The outlet flow of the fan includes the inlet flow (passed through the impeller), sucked flow from the upstream which passes through the annular part, plus surrounding airflow. So, total output flow rate measured at a distance of 3D (D is fan diameter) downstream is several times of the inlet flow rate. In consumer terms, a bladeless fan blows air from a ring with no external blades. Its vanes are hidden in its base and direct the collected airflow through a hollow tube or toroids, blowing a thin high-velocity smooth airflow from holes or a continuous slot across the surface of the tube or toroids.

The air is drawn in by a compressor in the base and then directed up into a ring. It comes out of a slit around the ring and passes over a shape like that of an aircraft wing. The fan contains a brushless electric motor and this motor rotates nine asymmetrical aligned blades that attach with a rotor. Usually, the upper frame of this fan is ring shaped. The frame is not flat; rather it is manufactured such that the edge can create a curve of a 16-degree angle slope. The air flows through the channel in the pedestal of the fan when the motor is turned on.

After that, the air flows through the hollow tube. Then the air is shot out through 16-mm slits. This air flows smoothly, rather than turbulently as with a traditional fan (fan with blades). The curvature of the inner wall of the fan creates an area of negative pressure - like an airplane wing - to draw more air into the flow, hence "multiplying" it. This property of the air is called inducement. Further, the air surrounding the edges of the fan also begins to flow with the direction of the breeze, or is "entrained" to it. The air-multiplier technology increases the output of the air flowing through the tube by at least 15 times compared to the airflow put out by

a traditional bladed fan. Due to the new technological advances, there is more innovation on the various functions of the fan on the market today. A lot of improvements have been made based on the original fan technology. The bladeless fan, which resembles a giant ring, can produce a strong cool air. The fact that it lacks blades makes it safer as compared to the traditional electric fans. Besides, it is easier to clean up than the traditional ones. Besides, bladeless fans have become more popular in the world today.

III.PROPOSED SYSTEM ARCHITECTURE

Required Materials and Tools:- The tools and materials required for this project are easily available. The material required for this project is a bunch of PVC pipes measuring 6, 5,and 3.5 inch in diameter , a plastic bowl and a 3mm sheet of fibre glass etc. There is no need of a 3d printer as used in most of the DIY bladeless fan projects out there. Moreover I have used a miter saw to make most of the cuts as it made the job a bit accurate and easier but the same job can be done by using a handsaw and some patience so need of expensive tools to make a neat bladeless fan.

Making the pedestal:- To begin with we started by making the main body and for that we used PVC Pipe. The main outlet is made of 6 inch diameter PVC pipe which is cut 4 inch wide to form the outer casing of the air outlet enclosure. To form an air pocket inside the main air outlet I have used a tapered shape bowl that fits the 6 inch PVC pipe perfectly with its collar sitting on the edges of the pipe. So I cut the bowl from 1 inch above its bottom so that it forms a nice tapered collar inside the main outlet housing which allows the air to rotate inside the outlet cavity uniformly before leaving it. The inner collar for the air outlet is made out of a 5 inch diameter PVC pipe. This pipe forms a narrow opening that is nearly 0.5 inch wide for the air to uniformly spread out of the cavity/ air outlet. The three parts namely the outer 6 inch PVC pipe, the tapered inner casing made out of plastic bowl and the inner collar made out of 5 inch PVC pipe together forms the air outlet housing.

To form the base we have used a 3.5inch PVC pipe cut down to 5 inch height. To make the base perfectly fit the air outlet housing I have cut down one end of the base pipe in curved shape which I have traced by using some electrical tape and the outline marked with the 6 inch PVC pipe. The pipe is then cut down using a jig saw and then sanded using a sand paper to perfectly fit the outer 6 inch pipe without any gaps in between.

Mounting the Fan:- Well behind every bladeless fan there is actually a fan with blades. So to power this bladeless fan I am going to use a 12v DC high speed fan that I have got from old computer scrap. More specifically that is a server fan which is way more powerful than a usual PC fan So I would highly recommend you using this type of fan. The fan is mounted inside the base just beneath the air outlet housing using four wood screws to hold the fan firmly in place. The fan is mounted such that to force the air in upward direction and thus we need the fan to have quite a bit of extra muscle.

IV. WORKING

The fan contains a brushless electric motor and this motor rotates nine asymmetrical aligned blades that attach with a rotor. The air flows through the channel in the pedestal of the fan when the motor is turned on. After that, the air flows through the hollow tube. Then the air is shot out through 16-mm slits. This air flows smoothly, rather than turbulently as with a traditional fan (fan with blades). The curvature of the inner wall of the fan creates an area of negative pressure - like an airplane wing - to draw more air into the flow, hence "multiplying" it. This property of the air is called inducement. Further, the air surrounding the edges of the fan also begins to flow with the direction of the breeze, or is "entrained" to it. The air-multiplier technology increases the output of the air flowing through the tube by at least 15 times compared to the airflow put out by a traditional bladed fan.

V. HARDWARE DESCRIPTION

A. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic to periodically change the direction of current flow in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Fig.1 DC motor

B. 12V, 10A SMPS

Power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. There is no adjustable current limiter in this unit, although R1, R2, R3, Q2, R8, R9, C5 and Q4 set the current limit to approximately 10 amps. As you can see, the design is very similar to that of a linear power supply, except that L1, and D1 have been added, and U1 operates in a switching mode as a comparator with a small amount of hysteresis. The switching frequency of this unit varies with the output current drawn by the load. This is an undesirable feature, which is why PWM regulators are used today. With a PWM regulator, the switching frequency is constant and will produce spurs only at known discrete frequencies rather than spurs at all frequencies. The Darlington-connected pass transistor block in the schematic is there twice (in parallel) for robustness. R4 in an internal trim-pot that can set the output voltage anywhere between 5 to 15 volts

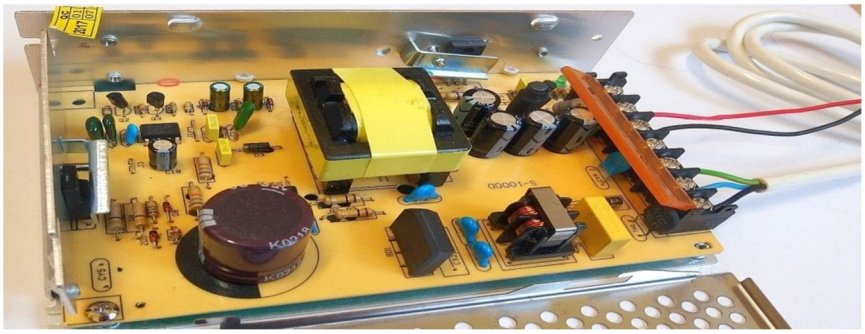

Fig. 2 SMPS

VI. CONCLUSION

During the course of this project I was able to apply quite a few skills and concepts that I'd learned during my B.S.M.E. The design utilized CAD modelling software in Solid Works and basic MATLAB scripting for the plots. Processes taught in my Design of Mechanical Components, Concepts of Design, and ME Lab courses were also directly applicable to determining design constraints and feasibility as well as providing exposure to the 3D printing process. An understanding of concepts such as Bernoulli's Principle, which is the centre of this design, as well as convective heat transfer were critical to this project and also picked up during my coursework. This idea of making Bladeless Fan is effective in almost every aspect mainly the safety considerations and noise intensity as compared to a normal table fan.

VII. ACKNOWLEDGMENT

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REFERENCES

[1] http;//wikipedia.org/Wiki/List of Dyson products
[2] Dyson bladeless air multiplier , http;//www.dyson.com /fans
[3] Richard W johnson,''The handbook of fluid dynamics'' Springer verlag- 1998
[4] www.instructable .com
[5] Tritton , D.J, physical fluid dynamics, van nonstral reinhold, 1997 reprinted(1980).
[6] "Dyson fan: was it invented 30 years ago?". Telegraph. Retrieved 2014-01-09.
[7] "How the Dyson Bladeless Fan Works". *How Stuff Works*. Retrieved 2017-01-27.