Dust-Free Portable Air Multiplier For Clean Air Circulation

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Abstract- *The main concept of this paper talks about the idea of designing a safe portable Air Multiplier with clean air circulation. Conventional fans and the portable fan does not purify the air and also carry risk factor for children. Our purpose in this work is to create an innovative design to make sure a hundred percent safety for children and provide clean air better than a conventional blade fan. The proposed design in a way of contrast to the traditional fan and chill body temperature also reduces close environment temperature with the operation of IoT. This fan is designed without an observable impeller. The drawn air exhaust out between the bezel all around a frame. This fan contains an air purifier that absorbs the bacteria in the air.*

Keywords- Air Multiplier, bladeless fan, Kaplan turbine blades.

I. INTRODUCTION

The Air Multiplier is a fan with an unusual characteristic. It doesn't have any visible blades. It is based on air-multiplier technology and can generate impressive airflow within the room. The breezed air generated by the air multiplier is more consistent and stable than a standard fan with blades. Since there are no visible rotating blades, the breeze from the fan doesn't buffet you with short gusts of air. Since it is devoid of external blades, it is safer than a conventional ceiling or table fan as there is no fear of cutting yourself with it. While the blades of a conventional fan collect dust easily, it is not the case with our air multiplier. It can be controlled by a remote, voice assistant like google assistant & Alexa. Also can use the fan manually with switches and used as a PC cooling solution. Myriam Francoeur et al [2018] In this research, the article examines to vent tubing technologies can influence the efficiency of extensive duct-and-fan systems. Duct-fan auxiliary ventilation can provide air over great distances. Chuan Qin, Jianguo Guo, Taisheng Kang, Yi Xiong, Zhiguang Xiang, et al [2020] In this research, investigated the bacterial community in HEPA filters (used for 1 year) and that in the floor dust of 12 office rooms in Beijing. Jane Davidson, et al [2010] In this Research, the Performance of filters for the removal of ozone at ambient concentration is characterized. The removal efficiency and pressure drop of 10 commercial filters—including 8 made of granule or powdered activated carbon.

George Demian et al [2017] In this research, a design of scale down an air multiplier fan, more commonly popularized as a bladeless fan by Dyson, and used as a PC cooling solution. Myriam Francoeur et al [2018] In this research George Demian et al[2017] In this research, a design of scaledown an air multiplier fan, more commonly popularized as a bladeless fan by Dyson, speed regulator provided. The bladeless fan is the newest trend in the fan industry.

II. HEAD PART

The design of the head part has two cylindrical elbows with various diameters. In that, the small cylindrical elbow was closed with the cone at the bottom. because the propeller blade sucks the air and blows the air towards the cylindrical duct. The airflow in the duct was between the area of the small and large diameter elbow, which we will
like a nozzle. So, the airflow will decrease the temperature when air comes out from the duct.

III. BASE PART

The base part consists of two layers. The design of both layers was like a rectangular container. The bottom layer contained the three filters, battery, gear motor, fan motor, gear motor, all electronic circuit board, etc. In that, the filters are placed on two opposite sides of the bottom layer and the bottom plate. All side of the filter hole is provided and closely fitted to the filter. The fan speed motor is fixed in the center of the base part by using an aluminum plate to hold the motor using a clamp. The gear motor is placed in the Corner hole provided and clamped with the top layer. The top layer is placed vertically on top of the bottom layer. Both layers are closely fixed with nuts and bolts.

IV. PROPELLER BLADE

The redesigned propeller blade was designed compactly to the head part diameter. This blade was designed from the idea of the Kaplan turbine blades. because Kaplan

blades are mostly to suck the fluid and give out the fluid. The blade is mounted on top of a high fan speed motor rpm of 8000+. Blade & motor are placed in the bottom center of the head part.

V. WASHER

The washer is used in this duct for free rotational motion. And it is the alternate solution for using the bearing. Where the bearing will give the free frictionless motion. But there was no correct fitting bearing for our 146mm diameter duct. So, we have decided to use the washer also called the bush bearing. A bushing bearing is an independent plain bearing that is inserted into a housing to provide a bearing surface for rotary applications.

VI. SPUR GEAR

There are two Spur gears used in the air multiplier for air circulation around 360. On top of the gear motor, the spur gear is mounted and another spur gear is fixed in the head part. The gear ratio is 1:4.52.

VII. DESIGN ANALYSIS & AIRFLOW VOLUME CALCULATION

Here, we have done CFD airflow analysis for propeller blades in ANSYS CFX which we have designed in SOLIDWORKS modeling. We have analyzed the airflow velocity from the duct in which the designed propeller blade sucks the air and blows the air through the 140 mm diameter cylindrical duct.

Table 1 Air Flow analysis

Airflow velocity (m/s)	Airflow	Airflow Volume (CFM)
20.7 (max)	4074.8	440.48
12.7	2500	270.25
7.9	1555.12	168.1
3.4(min)	669.29	72.35

From analysis,

Airflow velocity (max) = 7.945e+001 = 21.59 m/s
Airflow velocity = 5.297e+001 = 14.39m/s Airflow velocity (avg) = 2.648e+001 = 7.19 m/s

Airflow velocity (min) = 7.388e-004 = 0.135 m/s

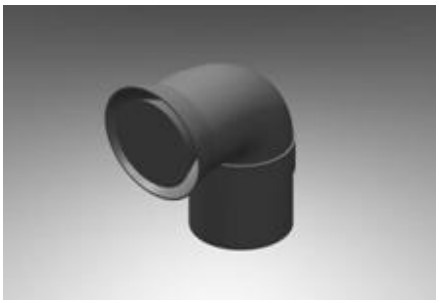

Figure 1 Head Part

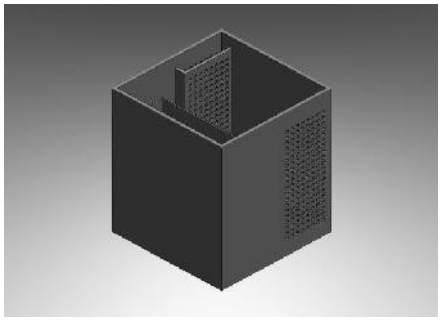

Figure 2 Base Part

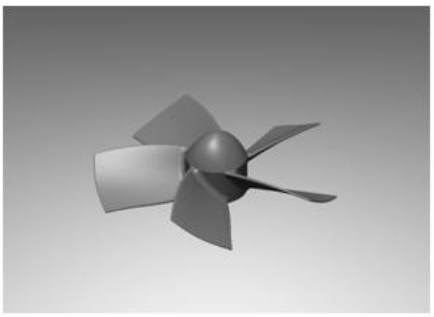

Figure 3 Propeller Blade

Figure 4 Washer

Figure 5 Spur Gear

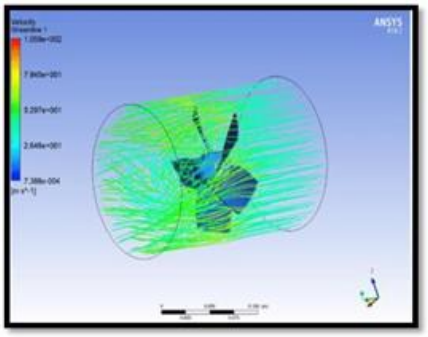

Figure 6 Duct Meshing

The meshing of the duct Airflow analysis Airflow VOLUME

For duct cross-sectional area,
Outer radius of duct (r1) = 90mm =0.2952 feet Inner radius of duct (r2) = 70mm =0.2296 feet

Area for outer radius = π*r1^2
=3.14* 0.08714
= 0.2736 sq. feet

Area for inner radius = π*r2^2
= 3.14* 0.05271
= 0.1655 sq. feet
duct cross-sectional area = area for outer dia. – area for inner dia.
=0.2736–0.1655
= 0.1081 sq. feet
∴ CFM = FPM * Duct cross-sectional area

The above value is the propeller blade's airflow velocity, which sucks and blows the air from the cylindrical duct with a maximum airflow velocity of 21.59 m/s, an average airflow velocity of 14.39 m/s and a minimum airflow velocity was 0.135m/s. The airflow velocity from the duct was measured by an anemometer and the values are in the graph. Here the airflow velocity is measured in m/s but we need the values in FPM (Foot Per Minute).

Model of the Air multiplier Conclusion & Future scope

The proposed design is efficient and safe for everyone and hand free to portable. Introducing the new generation of air multiple reduces the temperature of the closed room and improves clean air in the surrounding. we can convert it to an air cooler and mini air conditioner for more cooling. In case we need hot air we can include it.

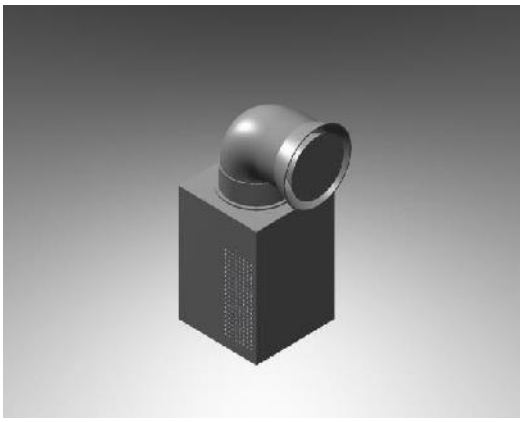

Figure7Air Multiplier Modes

VIII. RESULT

All the parts and electronics are assembled The air is sucked through-the holes past the filter that cleans the airflow & then it will get exhausted in the bezel (In between the two elbows) to the outside providing seamless Clean airflow. The head can rotate by the gear system. So, that air circulation will cover 360° around the air multiplier. It is cent percent secure for everyone and it is portable anywhere, very compact, and efficient. The analysis result is attained in the physical test of the airflow using an anemometer it measured.

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