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Design of An Aircraft Cabin Automatic Disinfectant Setup

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***Abstract*— Airlines usually clean plane cabins to varying degrees when turning around the aircraft between each flight. When the airplane is finished winged in the course of time, crews customarily present the plane a deeper scrub so it's rejuvenated for the next flight. Airlines are taking precautions to sanitize and prevent the virus from spreading. Aircraft cabin sanitization usually relies on the mass number of human power. In this paper, an attempt has been made to atomize the aircraft cabin cleaning without involving human power. An aircraft cabin automatic disinfectant setup has been designed computationally with sensors to indicate the disinfectant flow through the air conditioning duct pipeline for disinfecting the aircraft cabin.**

***Keywords*—** Disinfectant, Cabin, Sanitize, Aircraft, Air-conditioning, Automation, etc.

INTRODUCTION

During the pandemic situation, every mode of transport including the Aviation Industry was seriously affected. This situation caused about 4.8 million people to lose their jobs in the field of Aviation. Several airlines have declared bankruptcy [1]. By 8th October 2020, more than 43 commercial airlines had gone bankrupt, and many more were expected to follow. To operate the aircraft, the main regulation to be followed is to disinfect the aircraft cabin after every flight [2]. But the process of disinfecting the aircraft cabin is done with the help of manpower which is not only hectic but also kills a lot of time.

A sanitation device that includes a source of ultraviolet (UV) radiation to sanitize the air and surfaces in an aircraft cabin that passengers commonly contact was used to minimize the risk of disease spread [3]. Different Systems and methods for disinfecting/sanitizing disinfecting areas using disinfecting solutions and ultraviolet (UV) light were used [4]. An aircraft potable water disinfection/sanitation system was also used to sanitize the affected surface [5[.

Therefore in this paper, an Automatic Aircraft Cabin Disinfectant System has been designed and fabricated by introducing a disinfectant pathway inside the aircraft air conditioning vent which automatically sanitizes the aircraft without the help of manpower.

I. AIRCRAFT CABIN DISINFECTANT SETUP

The existing Air Conditioning duct of AIRBUS A320 has been taken and the Disinfectant pathway introduced into the Air Conditioning duct of the Aircraft has been designed using the CATIA V5 tool as shown in figure 1 to 3. The aircraft disinfectant system consists of the following components:

A. Inlet Valve

Inlet valves are opened to allow the flow of sanitizer into the cabin through the aluminium pipe. It is opened only during the process of sanitization.

B. Sanitizer Duct

The Sanitizer duct is an aluminium duct that carries the sanitizer over the entire cabin surface. The sanitizer duct is fitted inside the Air conditioning vent.

C. Air-conditioning Duct

Ducts are passages or enactments used in warming, airing, and air-conditioning to give and erase air. As such, air ducts are individual method of guaranteeing agreeable household air quality in addition to warm comfort. A duct system is also called ductwork.

D. Ram Inlet

A ram-air intake is a dynamic air pressure created by vehicle motion. The ram pressure causes a flow of extrinsic air through the heat exchanger of the cabin air conditioning system.

E. Ram Outlet

A cooling system for an aircraft includes an air outlet through which air emerges from the ram air channel. A heat exchanger is organized in the ram air channel.

F. Bleed Air

Bleed air is compressed air captured from the compressor stage of a gas turbine upstream of its fuel-burning sections. Automatic air supply and cabin pressure controller valves bleed air from high or low-stage engine compressor sections.

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G. Compressor

A compressor is a mechanical device that increases the pressure of a gas by lowering its capacity. Compressors are complementary to pumps: two together increases the pressure on a fluid and two together can transport the fluid through a pipe.

H. Disinfectant Tank

Disinfectant tanks are containers that hold liquids, compressed gases, or mediums used for the short- or long-term storage of heat or cold. The disinfectant tank is mainly used to store the sanitizer to disinfect the aircraft cabin interior.

I. Density Sensors

The density sensors are mainly used to check the filter status. In this paper, the sensors are placed on the front and rear sides of the filter. If there is a large deviation in the value of the density filters, then the filter is clogged and has to be changed.

J. DHT Sensor

The DHT sensors uses a capacitive humidity sensor and a thermistor with a basic chip inside that does some Analog-to-digital conversion and spits out a digital signal with the temperature and humidity. The digital signal is quite easily read by any microcontroller. The main purpose of the DHT sensor is to sense the temperature and humidity. In this thesis, the DHT sensors are used to detect the density.

K. BMP Sensor

BMP 180 atmospheric pressure sensor is mainly used for measuring atmospheric pressure or biometric pressure. In this thesis, the BMP sensors are used to sense the density.

L. ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software for building electronics projects. Arduino boards can read inputs, a light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED, or publishing something online. The designs of Arduino boards use an assortment of controllers and microprocessors. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') breadboards (for prototyping) and other circuits. In this thesis, Arduino is used to program the DHT and BMP sensors to find the density values.

M. The I2C Module

The I2C Module has an deep-seated PCF8574 I2C chip that converts I2C sequential dossier to parallel dossier for the LCD. These modules are now provided accompanying a default I2C address of either 0x27 or 0x3F. The piece has a contrast adjustment pot below the display. In this thesis, the I2C module is used to connect the density indicator with the density sensors.

N. Ultrasonic Atomizer

The liquid in the form of a thin film when allowed to flow on a vibrating surface (frequency >20 kHz) breaks up into fine droplets. This phenomenon is known as ultrasonic atomization. In these atomizers, an electrical signal is converted to mechanical oscillation utilizing a piezoelectric material immersed in a reservoir of water. The ultrasonic waves created by the mechanical vibration of the plate are directed towards the water surface creating a mist of moisture. In this thesis, the ultrasonic atomizer is used to convert the sanitizer from a liquid state to a gaseous state.

O. Filter

The basic function of the filter is to clean the air that circulates through your heating and cooling system. In this thesis, filters are used to avoid the entry of Dust and dirt, Pollen, Mould and mold spores, Fibres and lint, Metal, plaster or wood particles, Hair and animal fur, Bacteria, and micro-organisms into the cabin.

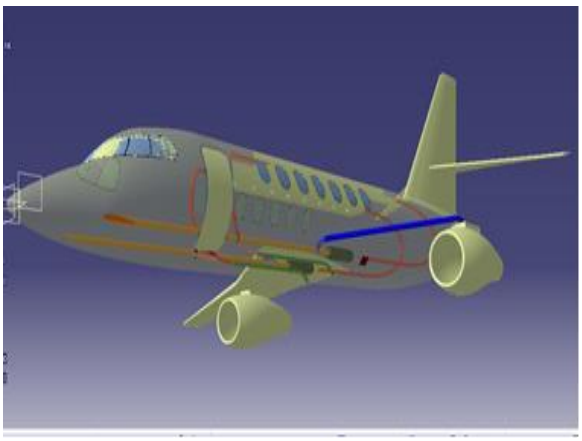

Fig. 1 Computational design of aircraft disinfectant pathway

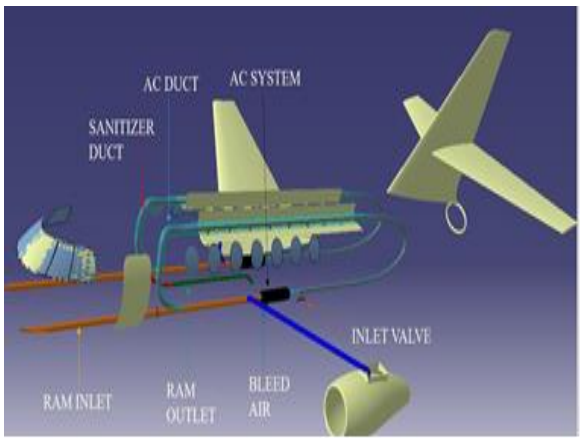

Fig. 2 Disinfectant Pathway

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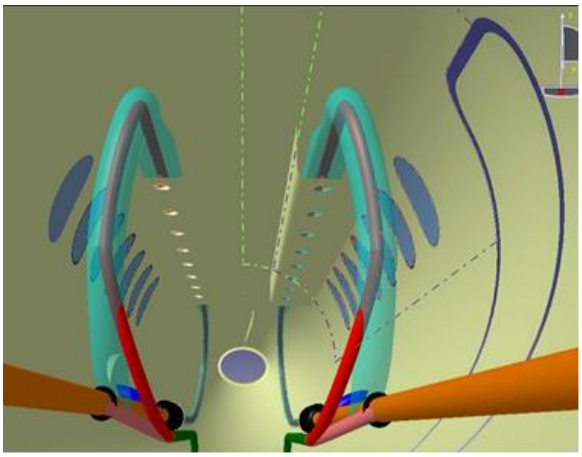

Fig. 3 Cabin Interior View

II. HOW DOES IT WORK

The compressor blows the air into the disinfectant duct, which takes the sanitizer throughout the duct. The compressed air and the sanitizer are sent through the inlet valve from the ground unit. Density sensors are placed inside the sanitizer duct to check the proper flow of disinfectant inside the duct. Filter is placed inside the sanitizer duct which avoids the entry of dust particles into the cabin.

Once the sanitizing process has been completed, the hot compressed air is then allowed to enter into the sanitizer duct to remove excess liquid particles in the passage. The delivery side of the sanitizer duct has been connected to the ram air outlet valve for its expansion into the atmosphere.

III. CONCLUSION

Thus the working of automatic aircraft cabin disinfectant setup has been designed and explained using the above said components, which can be implemented for disinfecting the cabin of the aircraft.

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