An Approach to Disinfection using Unmanned Aerial Vehicle/Quadcopter

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Abstract - **Necessity is the mother of invention. The objective of this research paper is to develop a drone which is able to disinfect places and surfaces which can be controlled by a person, who is in distant safer place. According to recent scientific studies, there are evidences that the pathogens are able to reside in different surfaces from few hours to several days. This drone will be able to kill or inactivate viruses and bacteria which cause different infections. The advantage of using drones in this method of disinfection is such that it avoids the risk facing by the person handling the chemical disinfectants, saving time, easy to access difficult sites low costs and less labor. We are designing a quad copter which is a multi rotor, in order to achieve the same.**

Keyword: Disinfection, Unmanned Aerial Vehicle, Quad copter, Drone, Virus.

I.INTRODUCTION

Unmanned Aerial Vehicles (UAV) is aircraft without a human pilot and it is a type of unmanned vehicle. Flight of the UAV can be controlled either directly by a human operator or autonomously by an on board computer. Initially, these drones were mainly used in military application, now its use is rapidly expanding to commercial, scientific, recreational, agricultural and other applications such as aerial photography surveillance etc. Here we are designing a drone which is able to spray disinfectant and also able to emit uv-c rays.

Here we are using sodium hypochlorite as disinfectant to get rid of pathogens. Quad copter is a multi rotor helicopter; advantage of multi rotors over helicopters is such that it will be having more stability compared to former. Quadcopter is lifted and propelled by 4 motors. Frame of quadcopter can be arranged in the form of"×" or "+".Here in this paper, we are designing the drone in the configuration of "x". With rotary motion of the propellers, the quadcopter will be able to lift and able to fly.

Spraying unit includes tank pump and nozzles which are assembled to the basic configuration of drone. UV-C light is assembled to this drone for disinfection using rays. UV-C light is assembled to this drone for disinfection.

II. AIM

Obtaining thrust for flight to carry total load, to built a suitable quadcopter with stable flight control, designing mechanism for spraying disinfectant, mechanism to emit uv-c light rays from uv light ,assembling the uv-c light in the drone.

III.CONSTRUCTION

The configuration of the drone is such that it will be having four ends in the form of "X".4 landing gears will be attached to the frame .Four brushless motors and its propellers are attached to four each legs. Output of each Electronic Speed Controller will be attached to each motor and its one input is connected to fight control board and other to Li-Po battery. There will be receiver attached to it, which is connected to fight control board. Receiver will receive the signal from the transmitter. Transmitter will be controlled by the operating person in whom the person can initiate, change the speed, direction, amount of liquid spraying through the nozzles, time of exposure of light to surfaces .The flight control board will be connected to the battery and they will be placed in the centre of the drone. This is the basic construction of the drone.
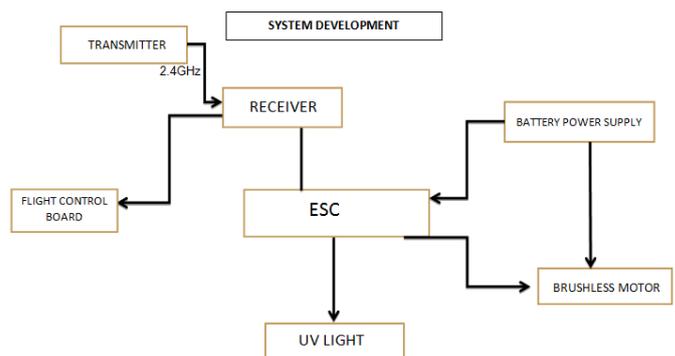

Figure 1: Drone spraying disinfectant

Figure 2: System development

3.1 Battery

11.1V-5200Mah Li-Po battery is used in this quadcopter, which is rechargeable. Rated voltage is 11.1V relatively low self discharge.

Figure 3: Battery

3.2 Electronic Speed Controller

Figure 4: Electronic speed controller

It is an electronic circuit that controls and regulates the speed of an electronic motor. Brushless ESC systems basically create 3 phase AC power like a VFD, variable frequency drive, to run brushless motors. For a quadcopter 4 ESC s are required, one associated with each motor. Each ESC has present rating, which indicates the maximum current; it can deliver to a motor.

3.3 Flight Control Board

Figure 5: Flight control board

KK 2.1.5 multi motor LCD flight control Board is used in this project. Standard 6 pin AVR interface, Processor - Atmel 644 PA. It is a full autopilot capable for autonomous stabilization. Newly designed vibration isolation enables more accurate reading, allowing vehicles to achieve better overall flight performance. The two external SPI buses and six associated chip select lines allow for additional sensors and an SPI Interface payload.

3.4 Transmitter

Figure 6: Transmitter

Avionic RCB OS-10 Transmitter, Drone sender is associate degree device that uses radio signals to transmit commands wirelessly via a group frequency over to the tuner that is connected. It transmits the signals to the receiver helps in controlling the quadcopter.

3.5 Frame

Figure 7: Frame

F330 glass fiber quadcopter frame is used, which is strong. It is having light weight, it decreases the total weight. It is having light weight. It de-creases the total weight Frame has wheel base of 330mm and weights around 170gm.

3.6 BLDC motor

Figure 8: BLDC Motor

Also known as electronically commutated motor or Synchronous DC motor. Have high power to weight ratio, high speed electronic control. Motor spin the propellers to provide the drone with lifting and thrust. Two types of rating will be present on the motor, Kv rating and current rating. Kv rating indicates the RPM for 1V of applied voltage .Current rating indicates the maximum current that the motor may safely draw. Brushless DC motor has low torque and high speed. A2212-1400KV motor is used in this paper.

3.6 Propeller

Figure 9: Propeller

It is a type of fan, which rotates in order to create thrust. Its motion will be according to its diameter and pitch. One pair will be clockwise rotating and another will be anticlockwise rotating.

3.7 Receiver

Figure 10: Receiver

Avionic OS-10 Receiver is used. It receives the signals from the transmitter. No of channels: 10. RF range: 2.405 - 2.475 GHz.

3.8 Brushed ESC

Brushed ESC is used to for controlling 12 V water pump. At the output of ESC, water pump is connected.

3.9 12V DC submersible water pump

Figure 11: Water pump

It is used for pumping disinfectant. It is attached to disinfectant tank. It pumps out disinfectant into the nozzles and thus sprays the disinfectant.

3.10 UV light

This emits UV-C radiation, which can kill or inactivate microorganisms by destroying nucleic acid and disrupting their DNA, thus they will be unable to perform vital cellular functions. According to recent research, UV light is very efficient in destroying the microorganism.

3.11 Disinfectant Storage

It is a plastic tank which is capable of storage of 1L of disinfectant. It is tilted to the side of the pump, in order to spray whole disinfectant.

3.12 FPV Camera and transmitter

This is First Person View camera which is connected to the transmitter and it can transmit the video signals to the receiver at the ground.

IV. MECHANICS OF FLIGHT CONTROL

Motors on one diagonal rotate in the clockwise direction and on the other in the anti clockwise direction. Quadcopter movement is controlled by varying the relative thrust of each of the 4 rotors.

1. Moving forward

To move forward the power of the front motor to be reduced. This tilts the quadcopter forward and rotors provide sufficient thrust to move forward.

2. Moving backward

To move backward the power of back rotor will be reduced, tilting the quadcopter backwards.

3. Other degree of freedom of movement

1. Yaw: It is the movement of turning left and right. It is controlled by turning up the speed of a regular rotating motors and taking away power from the counter rotating.
2. Roll: It is the tilting towards left and side. Done by increasing the speed on one motor, and lowering on the opposite side.
3. Pitch: It is the movement towards up and down. It uses 2nd set of motors.

$$FLIGHT\ DYNAMICS$$
$$U_1 \rightarrow affects\ altitude$$
$$U_2 \rightarrow affects\ rotation\ in\ roll\ angles$$
$$U_3 \rightarrow affects\ pitch\ angle$$
$$U_4 \rightarrow affects\ yaw\ angle$$

$$Six\ Ouputs$$
$$X, Y, Z, \theta(roll), \Psi(pitch), \phi(yaw)$$

Propeller speed

1. *Throttle*:

$$U_1 = b\left(\Omega_1^2 + \Omega_2^2 + \Omega_3^2 + \Omega_4^2\right)$$

$$U_2 = bl\left(\Omega_4^2 - \Omega_2^2\right)$$

$$U_3 = bl\left(\Omega_3^2 - \Omega_1^2\right)$$

$$U_4 = d\left(\Omega_2^2 + \Omega_4^2 - \Omega_1^2 - \Omega_3^2\right)$$

On transformation using Inverted Matrix Method

$$\Omega_2^2 = \frac{1}{4b}U_1 - \frac{1}{2bl}U_3 - \frac{1}{4d}U_4$$

$$\Omega_2^2 = \frac{1}{4b}U_1 - \frac{1}{2bl}U_2 + \frac{1}{4d}U_4$$

$$\Omega_3^2 = \frac{1}{4b}U_1 + \frac{1}{2bl}U_2 - \frac{1}{4d}U_4$$

$$\Omega_4^2 = \frac{1}{4b}U_1 + \frac{1}{2bl}U_2 + \frac{1}{4d}U_4$$

V. MECHANISM OF ACTION OF DISINFECTANTS AND UV RAYS

Disinfectants are chemical agents which in activate or destroy microorganism on inert surfaces. They kill of the bacteria by causing the proteins to become damaged and outer layer of the bacteria cell to rupture. They kill the virus by, destroying the outer lipid layer. UV-C rays kill microorganisms by destroying the nucleic acid and disrupting their DNA, leaving them unable to perform vital cellular functions. These two units can be activate separately or both at the same time.

VI. DISINFECTANT MECHANISM OF SODIUM HY-POCHLORITE

Sodium hypochlorite is a strong disinfectant, which is a pale greenish solution. It liberates chlorine, which helps in its disinfectant action. It has broad spectrum antimicrobial activity.

VII. SPRAYING METHOD USING SPRAYING NOZZLES

Nozzles cause dispersion of liquid into droplets, which increases the surface area of distribution of liquid. We are using two fluid nozzles for its distribution.

VIII. RESULT ANALYSIS

The final result of this paper is a drone, which is able to disinfect places by spraying and using uv light.

Figure 12: Disinfectant drone

We are assembling different components with at most care ad caution for attaining better results.

IX. CONCLUSION

In this research paper, we are developing a drone, which is able to spray disinfectant, along with emitting uv-rays which helps in disinfection, which can be controlled by a person from a distant safer site. It reduces the risk of the laborers by avoiding direct contact with disinfectant and uv rays, less time and low labor cost.

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Citation of this Article:

Sanad S, "An Approach to Disinfection using Unmanned Aerial Vehicle/Quadcopter" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 4, Issue 8, pp 1-5, August 2020. https://doi.org/10.47001/IRJIET/2020.408001

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