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DESIGN AND IMPLEMENTATION OF A NOVEL SURVEILLANCE DRONE WITH AN INTEGRATED SPRAYING MECHANISM TO AVOID VIRAL TRANSMISSION FOR SMART CITY SAFETY & SECURITY APPLICATIONS.

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Abstract: As the requirements are increasing day by day to survive along with technology growth the contactless needs plays major role. The solution is based on the requirement and also on need basis. So in this connection unmanned aerial vehicles were designed and playing well. Especially for surveillance based applications the drones plays major role and which is the most common feature of it.[1] In this scenario this paper work increasing little features to existing UAV technology called Drones with Surveillance and spraying mechanisms. In this paper a quadcopter type drone design was illustrated with two identical features with good high payload capability. By comparing with remaining drones this design was inexpensive and easy to configure. It can give live streaming at 100 meters altitude and during streaming it is possible to capture images too. It was also intended to be able to carry a payload for lifting a spraying system for sanitization and also used for agriculture spraying purposes to spray pesticides and also it can localize its position with GPS and IMU sensors. This quadcopter can be implemented with inbuilt IR thermometers to detect temperature at various ranges. Based on the reading if it exceeds normal range then it can capture that particular person image and it can spray sanitizer and also it can alert others to avoid viral transmission as a first precautionary step for smart city applications.[2]

Key Words: UAV, Surveillance, Spraying Mechanism, GPS & IMU.

I. INTRODUCTION

The technology advancements are taking human life to another level in near future which is can not be imagined. The aircraft based applications are also increasing day by day so that the technological advancements takes this traditional aircraft based applications to pilot less aircraft services also known as drone applications. The drone is the another definition of aircraft and it doesn't have pilot onboard. By using software application this drone can be controlled and by default its design control based on remote control.[3] So many universities are encouraging students by conducting competitions based on drone design. The another name for this drone usually unmanned aerial vehicle (UAV) can be designed with different features for different fields of applications. The drone can be designed with different shapes which are mostly compatible to fly in air. For flying the major component rotor can be designed as a single rotor, Multi rotor, fixed wing type or hybrid type. The more the speed of the rotor the more height it can fly into air. By using simple remote controls it can fly about 100 meters from ground. So it is sufficient for small range applications like crops inspection and pesticides spraying. Commercially these drones occupied first place as an electronic

toy. But some restrictions are imposed by Aviation department due to security issues. So the toy drones are very small and can fly in air about 50 meters range from ground by simple remote control.[4] Based on the variety of the drone it contains inbuilt GPS module so that it can be tracked. Along with this it can record video and audio and also it can be implemented with a spraying system used for spraying sanitizer and pesticides.[5] The specifications of the drones also considered while its design process. The some of important specifications of the drone are like weight of the drone, payload capacity, maximum flight time, maximum range of transmission etc. But from the various studies the maximum take-off gross weight needs to be less than 2.5 Kg. The maximum airspeed of the UAV cannot exceed 100 knots indicated air speed. To address these issues, this paper presents a lightweight drone capable of performing surveillance while communicating in real time.[6] By giving the GPS track to the drone using a computer or by manual control it will fly and records the surroundings with camera and sends live streaming to the receiver. It is equipped with GPS so that the user can track it with its location. Also integrating a spraying system for spraying sanitizers and pesticides which is used in agriculture sector to the same Quad copter.[7] While spraying pesticides humans have exposed with toxic substances present in the fertilizers, while spraying it takes more time for humans to cover the entire area. This leads to health issues to the farmers. By using drone spraying can be done easily on time and the exposure of highly toxic pesticide to humans can be prevented. But spraying drones are very high in cost so that a normal farmer can‘t afford it. So we are developing a mini drone that could spray pesticides and sanitizer in small quantity in low cost. So that it can reduce the level of risk to farmers from toxic pesticides.[8] Especially in this pandemic situation drones can be used for variety of applications to avoid viral transmission as a first precautionary step. The ministry of civil aviation took one forward step during this pandemic in Varanasi under smart city concept. They have developed sanitizing drones to sanitize containment zones and used to sanitize highly viral infected areas. So this is completely contactless process.[9]

II. PROPOSED METHOD

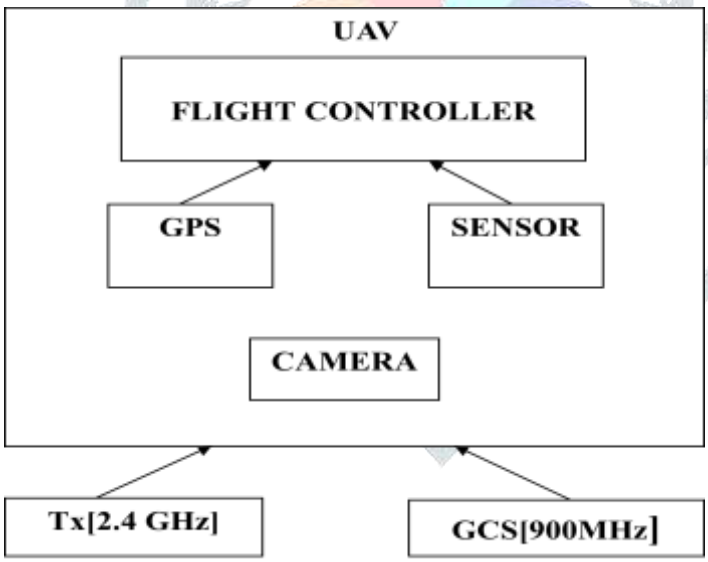

Fig.1: Surveillance Drone Block Diagram

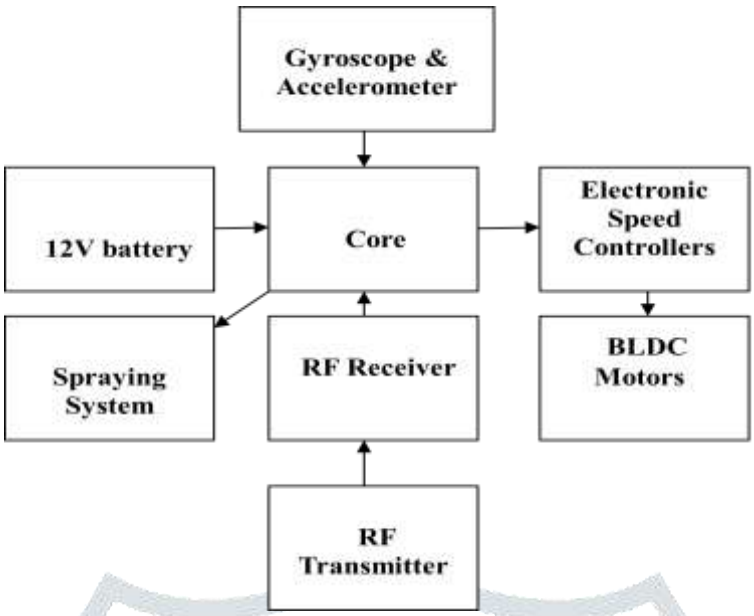

Fig.2: Spraying Quad-copter Block Diagram.

Working Principle:

The design using a multi rotor drone and its working principle is based on the basic principle of law of force, meaning that when the rotor pushes the air, the air also pushes the rotor back. This is the basic principle that drone can go up and down. So higher the rotation can achieve higher altitudes. The movements forward, backward, left, and right directions can be obtained by varying the speeds of the motors and thus it can produce the force or thrust towards the desired direction. This is RC based UAV so that transmission and reception of signals can be controlled by STM32 core. Based on the programmed codes inside the core it can control motors speed and remaining parts of the system. Gyroscope is used for giving the orientation and axis of the drone to the flight controller. The system uses a 10 channel transmitter & receiver. In which 4 channels is used for 4 directions & 2 channels for spraying system and camera which are operated by remote control(RC).

III.HARDWARE IMPLEMENTATION

The Hardware Components required for the design are Propellers, BLDC Motor, Battery, Pixhawk Flight Controller, Transmitters and Receivers, Electronic Speed Controllers, Frame, GPS Module, Nozzles, FPV Camera. The Quad-copter is operated by switching on pixhawk Controller power button and then open Q ground Control software in the desktop or laptop. Now pixhawk and Q ground control will be connected by a data cable and gyroscope calibration will be done by clicking the compass option in the Q ground control, and select the quad-copter option of the given list of UAV‘s. The GPS equipment status is also known by checking the status of GPS in Q ground control software. Radio calibration and status is also known by giving the instructions from transmitter and observing the Software. The quad-copter is ready to fly once the setup button is clicked on the software. Out of 10 channels 4 channels are used for controlling Quad-copter, One of the other channel of the receiver is assigned to servo motor for switching on the spraying system. This motor will be worked under the control of remote. When switch is on sprinkling starts, and when we switch off sprinkling stops. A separate 9 Volt power supply is given to camera. After switching on the camera it will generates a Wi-Fi signal. Then download the tp-link software in a laptop or mobile and create an account by giving e-mail. After that select the camera model and connect it using Wi-Fi. Then the camera will be connected to our device and the live streaming will be seen on our mobile app. and thus surveillance will get started.

Fig. 3A: Modules used in the Drone construction.

Fig 3B: Modules used in the Drone Design.

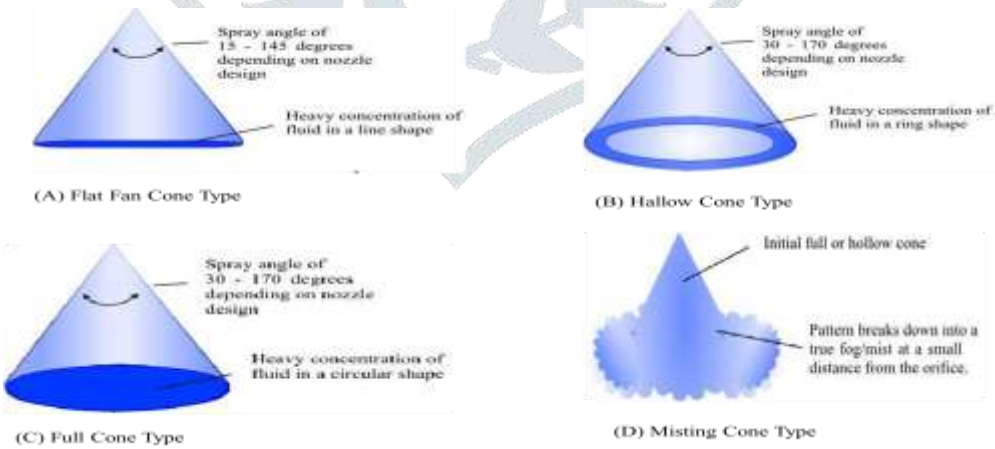

Fig 3C:Types of Sprayer Nozzles.

Electronic Speed Controller for Drone

In most of the drone's applications, the spread is constantly rising in a different range of applications which ranges from the hobbyist, industrial and commercial & in most applications. The main benefits of Drones are, they can be operated remotely, so flying over regions is very difficult, inconvenient, or dangerous to attain in person. The commercial applications of the drone are many like monitoring buildings, plants, agriculture, shooting areas & delivery of medicines, packages otherwise essential goods. Generally, the high-range of drones mainly equipped with BLDC motors but these motors need cautious & continuous speed regulation for the relative direction of revolution. For that, the ESC circuit is responsible. So the ESC design mainly includes the following features.

- The topology utilized for controlling the motor
- Compromise among efficiency & cost
- The kind of battery used on the drone
- Necessary performance
- EMC (electromagnetic compatibility) and resistance to interference

In drones, there are two kinds of brushless motors are used like BLDC, BLAC and also called PMSM or permanent magnet synchronous motors. So the choice of motor mainly depends on the preferred control algorithm like trapezoidal otherwise FOC (field-oriented control).

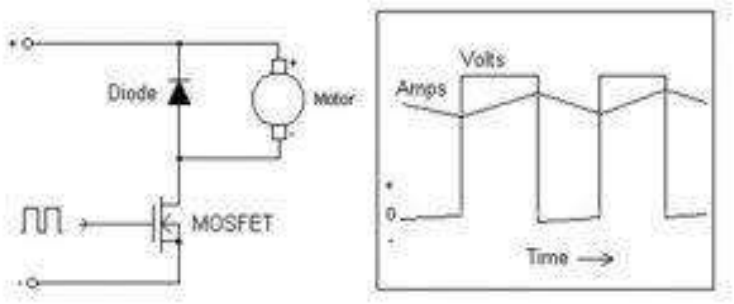

Fig 4 : ESC Schematic Circuit

The above figure illustrates the Electronic speed control for brushless DC motor movement in the drone applications. The simple circuit can capable of controlling motor rotation. The switching speed of the FET determines the current in the motor windings so that its speed can be controlled by controlling its magnetic field. This circuit contains a microcontroller with PWM channels and MOSFET arrangements. It have three connections one is for PWM channel of the rotor control, one is for MOSFET control and another one is to power up the motor as shown in the figure.

IV. SOFTWARE REQUIREMENTS

Q Ground Control

Q Ground Control provides full flight control and vehicle setup for PX4 or ArduPilot powered vehicles. It provides easy and straightforward usage for beginners, while still delivering high end feature support for experienced users. The main feature is autopilot option with video streaming and it can transfer wirelessly at 100 meters distance. Its features are shown in the below figures. This is open source platform and compatible with Windows, Linux and Android OS platforms. Its plan view, Planned home position, firmware controls also shown the figures below. It allows user friendly setup configuration for various drone flight controls for variety of applications as mentioned.

(A) (B)

(C) (D)

Fig.5: (A) Q Ground quick start, (B) Plan View, (C) Q ground Control Planned Home Position, (D) Flight Firmware.

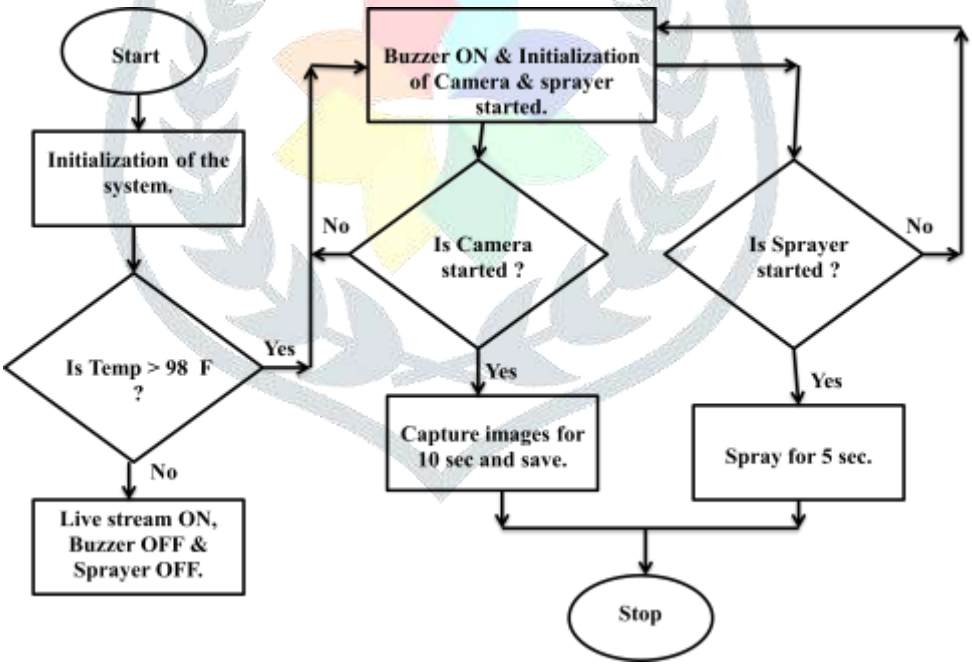

Fig 6: Flowchart illustrates proposed system working procedure.

The proposed system working is illustrated in the above flowchart. The main objective of the system is to sanitize persons by identifying their temperature as a first precautionary step at various public places under smart city concept.[10][11] The system starts with reading temperature by using IR contactless thermometers integrated in drone itself. This is the challenging task to drone technology. Then by using camera live monitoring and also capturing images also another challenging task. By this design the entire process of surveillance and sanitization can be done with single module and which is completely contactless and safe and it can avoid viral transmission. The drone must have good payload capacity and it must carry camera and sanitizer spraying system. This the new idea and a good challenging task to all drone designers as of now. The integrated applications may increase payload on drone. So multi rotor drones can be used for this

configuration by satisfying cost attribute. Hybrid drones can do it but they are expensive.

V. RESULT

Fig. 7: (A) Drone with GPS Module, (B) Drone with Sanitization & (C) Drone with Surveillance Variants.

The proposed system of Surveillance Drone is with wireless remote controller. Camera is attached to the system for surveillance.[12] Camera gives live feed on mobile app and we can also record videos and capture images. These drone applications have several usage especially to minimize viral transmission in this present pandemic situation. In transport field also they can reduce delivery time along with regular vehicle road transport.[13] Drones can be used in remote areas more easily than traditional modes of transportation.

Table 1: Specifications of Constructed Drone.

S.No	Parameter	Specification & Range
1	L X W X H of Drone	1.5 X 1.5 X 1 in Feet's
2	Weight of the Drone	2.5 Kg
3	Payload of the Drone	1 Kg
4	Flight Time of the Drone	20 Minutes
5	Speed of the Drone	50 KMPH
6	Max. Altitude of the Drone	100 Meters from ground
7	Battery Capacity	Orange 3S 35C/80C Lithium polymer 3300mah/ Output = 11.1 Volts
8	RC capacity	Operated at 2.4 GHz @ 1KM range/10 channels
9	Camera Module	1080 pixels/128 GB Memory storage/2.4 GHz Operating frequency/40ms delay
10	BLDC Motors	A2212-6T 2200KV, 4 No. Each gives >=20000 RPM
11	Propellers	4.5 Inches
12	Sprayers	Bronze Nozzle with 15 to 140 Degree spray angle(adjustable)
13	GPS Module	Top Mounted, Operated L1 = 1575.42 MHz, up to 18000 Meters range.

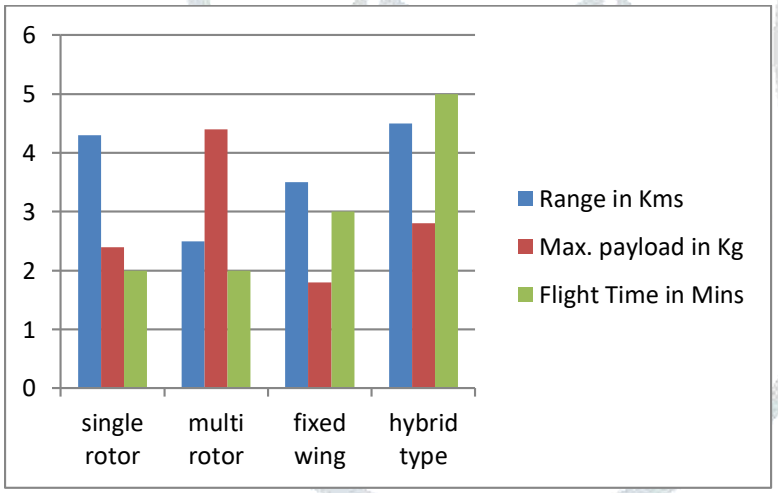

Fig.8: Comparison between different types of Drones in various parameters.

According to the comparison between different kinds of drones, the multi rotor drone have highest payload. The stability is also more for this category of drones. In this paper we have designed similar kind of drone with highest payload capacity for various smart city applications.[14] That is the drone itself can carry camera and sanitizer bottle and also acts as surveillance drone and sanitizing sprayer without any contact. In addition to these features the Temperature detection is also possible by installing long range IR based contactless thermometer. So based on the reading it has taken the audio can be enabled and sanitizer can be sprayed at safest distance. By using camera module the entire process can be live streamed and it can capture images during streaming. So in this process it is possible to identify Covid-19 symptomatic persons as a first precautionary step at various places like Bus, Train stations, Airports, colleges, Schools, shopping malls, movie theaters, Parks and seminar halls etc without any contact.

VI. CONCLUSION

The paper entitled with "Design and Implementation of Real Time Surveillance Drone with An Integrated Spraying Mechanism As A First Precautionary Step to Avoid Viral Transmission for Smart City Security Applications" was successful implemented and affective spraying of sanitizer application was achieved. One of the special feature automatic landing also successfully achieved. The FPV camera also working greatly such that surveillance also achieved with live streaming video. The flight controller also working efficiently and perfectly compatible with the designed drone with different variety of applications.

VII. FUTURE SCOPE

Drone technology is continuously increasing with progressive improvements. The drone in this paper can further implemented with under water applications. Using hand gestures also it can be controlled. With more research and technological advances, it is possible that the UAV may use in land monitoring, surveillance and agricultural spraying using artificial intelligence and machine learning. Using hand gestures drones can be controlled and will play a major role in almost all fields in near future.

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