RC CONTROLLED HEXA-COPTER WITH WET-CHEMICAL SPRAYING MECHANISM FOR EXTINGUISHING FIRE HAZARDS.

(K-Salvo Drone)

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Abstract:
Fire hazards can cause extensive damage to employees and personal property. General fire accidents happen unexpectedly. Indian Times published that, with 27,027 deaths, every fifth fire-related death in the world in 2017 took place in India. About 9 million fires, 1.2 Lakh incidents, and deaths were recorded worldwide that year. Fighting wildfires is one of the most difficult battles to rise in society. It is very difficult for the fire brigade to predict the situation internally for a building or any closed area under fire, so 'Drones' can be an effective solution for firefighters to make manageable decisions about fire breakout, focus on resources, and how to get into the scene. A Drone-equipped with fire extinguishing material or water which employs a spraying mechanism, could be deployed in an emergency where a person's intervention is impossible. A firefighter drone extinguishes class A, B, or C fires. We are using a Hexa-copter structure (6 arms). The Hexa-copter would be adept for weight carrying and lifting mechanisms and is controlled by Radio frequency.

I. INTRODUCTION

To effectively manage the fire breakout and minimize the damage are the main goals of firefighters. Until recently trucks, stairs, and hoses have been used which are only effective in situations where a firefighter can reach without putting himself in harm and manage a breakout. But now fire-fighting drones are used instead of low-tech equipment to assist the fire brigade team in putting out fires. As compared to the old traditional fire extinguishing methods, drone employment is very helpful in overcoming fire where a fire-fighter cannot reach. Due to urban sprawl, traffic, tall buildings, and innovation, hazardous materials used in construction, firefighters are looking for drone technology to help them to achieve their goals [1]. New technologies like electric and gas sensors, heat-resistant materials, advanced cameras, independent operation, and streaming, too an improved range are added to commercial drones. Fighting a blazing fire is one of the biggest challenges of Fire wars. But fire drones help overcome this problem by providing better information about fire scope, value trapped people, and much more. The Fire Department has used these drones of new technology.

In this paper, we propose a detection and extinguishing mechanism with a GPS tracking system mounted on an Unmanned Aerial Vehicle (UAV). And fire extinguishing using a spraying system that is RC-controlled and cost-efficient in contrast to many other papers.

II. Literature Survey:

One of the first steps for any research paper is a detailed survey of the variety of journals related to the selected topic. With this being said other research papers read:
Burchan et al. (2019) [1] demonstrated the use of Drone help fight wildfires using firefighting in addition to traditional fire-fighting methods. Proposed the system was a paid hexa-copter with a payload of 15 kg, weighing 0.5kg each. Contains empty search aviation systems (UAS) to detect local fires and inspect the danger of approaching wildfires in the building. It also sends details related to UAS firefighting to help them control the situation

Manuj et al. (2019) [3] suggested the use of semi-autonomous drones in firefighting operations rather than endangering the lives of firefighters. This paper provides details on the development of the existing hexa-copter to find a stable flight, collect and maintain Global Positioning System data (GPS) and enable auto-detection. The plan was the same fitted with a fire extinguisher and any such device firefighting operations.

III. Design of the firefighting drone:

a) Hexa-copter frame structure:

Hexa-copter design uses six motors to rotate six propellers. This hexa-copter lifting uses thrust generated by the help of propellers. It uses propellers and hexa-copter body integration for flight. The configuration of the framework is commonly identified as two types: Plus (+) and X configuration as in Image. Hexa-copter has 6 lists of freedom (DOF), in which there are six degrees of freedom affecting the rotational speed of all rotors, for this reason, both frames will have fashions for special movements. In these studies, the Plus (+) stop-frame was used [1].

Fig.1 Hexa-copter frame structure

Fig. Indicates that each arm is connected to a brushless DC motor and also has a propeller. hence the Rotor can force air to float down to produce lift pressure. Rotor rotation line has two indicators, namely 3 rotors opposite the clock (Counter Clockwise; CCW) and 3other clock rotors (Clockwise; CW). So, for miles indeed it is evident that the powerful movement of the hexa-copter truly promoted is very effective rotation.

b) Payload:

1) **1800KV Brushless DC Motor:** A brushless DC motor is a high-speed rotor designed specifically for Hexa-copters and Drones. It is an outrunner type where the outer case of the motor rotates while the inside is always fixed. It is one of the most popular models on the market because it is less expensive and Preferred for drones and planes. The model is available at various speeds. We are using 1800kvX6 motors.

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Fig.2 DC brushless motor

2) **ESC (Electronic Speed Controller) 30A:** Electronic Speed Controller (ESC) for Brushless DC Motors. This ESC is designed for hexa-copter that offer faster and better vehicle speed control which provides better flight performance compared to other available ESCs.

Fig.3 ESC

3) **Ardupilot Mega (APM) 2.8 Flight Controller:** APM 2.8 Multicopter Flight Controller is a complete open-source automation system. This is the best-selling technology that has won the prestigious Outback Challenge UAV. Allows the user to rotate any modified, rotating wing.

Fig.4 Ardupilot Mega flight controller

4) **Neo M8N GPS Module:** The Global Positioning System (GPS) is a satellite-based navigation system that provides location and time information. The module extracts GPS data in NMEA0183 format.

Fig.5 Neo M8N module

5) **Battery:** 3S 4200mAh Lithium polymer battery Pack (LiPo) batteries have heavy-duty performance with heavy workloads that lead to reduced resistance to maintain high current loads. These batteries withstand the extreme pressure of aerobatic aircraft and RC vehicles.

Fig.6 Battery

6) **12V DC Spraying pump:** Pneumatic air sprayers use compressed air to spray water, produce smooth and dispersible water/fire extinguishers. The cost is very low as compared to airless or HVLP spraying and ours requires a 12v motor for sprayers.

Fig.7 DC spraying pump

7) **Radio Transmitter FlySky CT6B 2.4Ghz 6CH:** The Transmitter and receiver used in the drone circuitry are FlySky CT6B 2.4Ghz 6CH and FS-R6B respectively. This combination provides a file for a width of 1000 meters and has 6 channel capacity.

Fig 8 radio transmitter FlySky

8) **Receiver circuit FS-R6B:** A four-channel coding/decoder pair is used in this RC receiver program. The input signals in the transmission section are taken from four switches and the output signals from the receiver are shown by four LEDs corresponding to each switch.

fig.9 receiver circuit FS

9) **Container:** Can hold 500ml of either water or fire extinguishing chemical.

Fig.10 container 500ml

10) **Fire extinguishing material:** A special and cost-effective wet chemical extinguishing agent used in class A, class B, and class C fires. A wet chemical is usually a mixture of monoammonium phosphate and ammonium sulfate.

- **Payload table**

Equipment	Weight
Motors*6	100gm×6=600grm
ESC	23gm
APM	100gm
GPS module	17gm
Battery	250gm
Spraying Pump	30gm
Receiver circuit	250gm
Container	40gm
Fire extinguishing material	As per the requirement

IV. Construction:

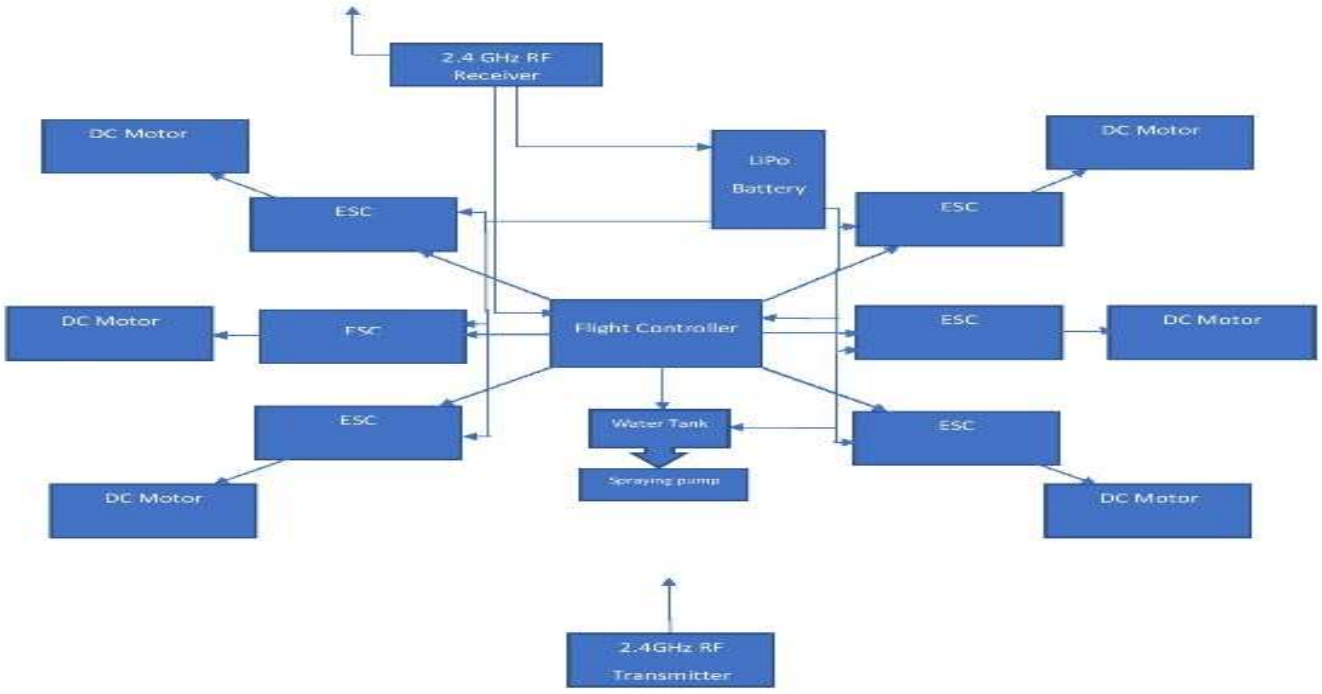
At the end of each hexa-copter arm, a motor will be attached along with propellers. All six motors on the ESC output side will be connected again the input side of the ESC will be connected to the controller. Some ESC inputs will be connected to the file power distribution board where power is supplied with the Li-Po battery. In the same way, all other ESCs, motors, and propellers are connected. The receiver will be connected to the flight controller to receive signals from the module. The air spray operates on the side of 4 motors with the container and pneumatic sprayers. containers are filled with water or a fire extinguisher chemical. The arrival frame of a height of 400 mm is connected in a large frame so that the water storage tank is secure and will not touch the ground.

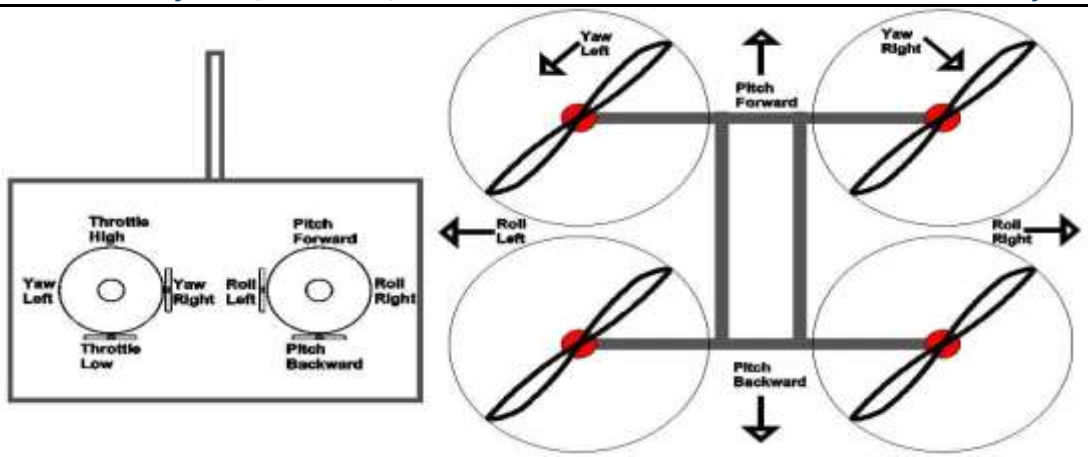
V. Working:

When the transmitter and receiver are switched on the Signals will be transferred from the Transmitter and be detected by the receiver circuit on the drone.
Now, there are 4 ways to control the drone movement using the RC controller.

- Roll (left -right movement)
- Pitch (forward-backward movement)
- Yaw (clock -counterclockwise movement)
- Throttle (controls the power)

From the receiver, the signal goes to the Ardupilot mega 2.8 flight controller where the signal will be processed. When the left stick is set down the drone is ready for a flight. Through the RC controller, drone aviation is controlled. The throttle movement is manually controlled to control the speed of the motors indirectly controlling the speed of the drone. Then the given throttle signal will be sent to the ESC, which allows that a certain amount of rotation in a motor depending on the signal it receives. The propellers are mechanically connected to the motors in the order they turn and produce thrust. this thrust lifts the drone for a flight. Our drone has a 500ml container that carry water for fire extinguishing chemicals. The spraying mechanism is in a forward direction and is controlled by a relay switch. So, when there is a fire breakout a person can switch on the drone and control it and fly it to a height of 30-40 feet. Switch on the spraying and extinguish the fire. The drone is incorporated with the Neo m8n GPS module that tracks the position of the drone.





VI. Future scope:

- Under the current state of COVID19 Pandemic, this drone module can be used for spraying sanitizers and disinfectants in small buildings or offices.
- This manually controlled drone can be turned into automatically driven drones using GPS technology and tracking.
- The lifting capacity can be increased to serve more extinguishing material for larger fire breakouts.
- Can be incorporated with IoT and mobile application control for larger-scale development.

VII. Conclusion:

This paper explains the importance of Drone in the Fireworks Service. our Drone is designed in a way that it carries a maximum load of 2Kg for 14 minutes of battery endurance. It reduces the risk to the employees involved in firefighting operations. Drones need to be smart and quick to develop industrial processes. increasing their usage and can be widely established in future factories. If more emphasis is placed on these methods, drones can be implemented in safety Engineering, management of critical infrastructure and assets, and administrative functions. The implementation of Drone programs in trapped buildings during the fire can reduce the damage of life and property. Drones can be a widespread established field in future industries. Implementation of drone programs in the industry can boost new opportunities and innovative business models. There are about 35 Drone Start-Up companies in India and are trying to force these new technologies in their systems to make their procedures safe, reliable, and can be easily guessed. From the industrial vision, the implementation of this technology can be good at the automotive industry level.

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