Design and Fabrication of Fire Extinguiser Drone

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***Abstract*:- After many years of being tools used by military, drones have become very popular among commercial uses and public safety. One of the area of application where drones could have a big impact is firefighting. Research is built with the help of qualitative semi- structured interviews that are conducted either face- to-face or via email with several decision makers within Falck Fire Services. In this way it is highlighted experts' opinion within firefighting sector on the current stage of implementation of drones, benefits, possible usage, limitations and future prospects. In addition, it was found necessary to analyze the current stage of legislative developments within several countries within the EU and to identify if there are any drones that are capable of meeting the requirements for firefighting purposes. With the growth of technology and massive city development, firefighting services have become more challenging to cope with a smart-city concept. One of the challenges that firefighters are facing is reaching the top floors of high-raised buildings. Firefighters need heavy and oversized pieces of equipment to reach top floors, which they sometimes fail to deliver on time due to big cities' traffic.**

1. INTRODUCTION

Drones are eye in the sky for fire fighters. They can serve as a essential fire fighting tool for people in the fire fighting service, especially in and around urban centers, where a deadly inferno might occur in a high rise building. Drone for fire fighting can equip fire officials with the latest technology, and add complementary capabilities to the existing resources such as fire trucks, ladders, specialized suits, etc. Firefighters can now acquire aerial information in a quick, cost-effective manner. In 2016, a tragic fire broke out in a warehouse in Oakland, California. The warehouse had been converted into a living space called Ghost Ship. The fire, which claimed the lives of 36 people, is one of the deadliest in the history of Oakland. Drones, equipped with a thermal camera, were used by firefighters to identify hotspots and search the unsafe-building after the fire was extinguished. In today's world drones have been used for photography and in weddings. Why don't we use it to save lives of people and fire fighters. Several studies about the UAS (Unmanned Aircraft System) in fire departments for exploration and saving on decreasing fire burden. The firefighter drones (UAVs) mainly focus on monitoring the site with a camera and do not have a standalone mechanism for fire extinguishing purposes

2. WORKING

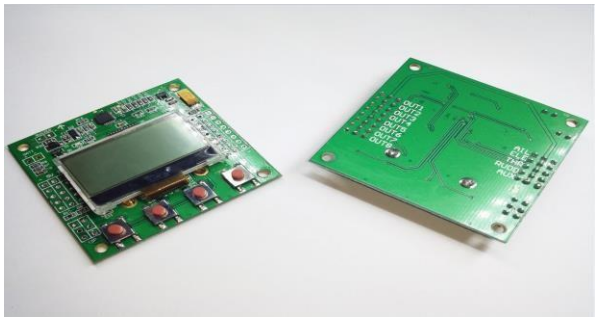
The firefighting drone is controlled manually with the radio receiver allowing the operator to control the movement of the quadcopter in different directions. Its movement is controlled by the speed of the motors
and way in which the propellers move aiming to provide stability. The transmitter from the ground station which is under the control of the user sends signals to the receiver. The receiver in turn relays this information to the flight controller. The flight controller uses the ESCs to control the speed of the motors which causes movement The operator of the firefighting drone will have visual feedback from the quadcopter. The transmitter transmits the feed to the receiver which transmits it to a display device such as a screen or base computer which will help the operator in navigation and decision making regarding the target location (fire location). Multi-Rotor works on the relative nature of force, which means when the rotor pushes the air, the air also pushes the rotor back. This is the basic principle that the Multi-Rotor can go up and down. Furthermore, the faster the rotor rotates, the greater the lift, and vice versa.

3. CONSTRUCTION

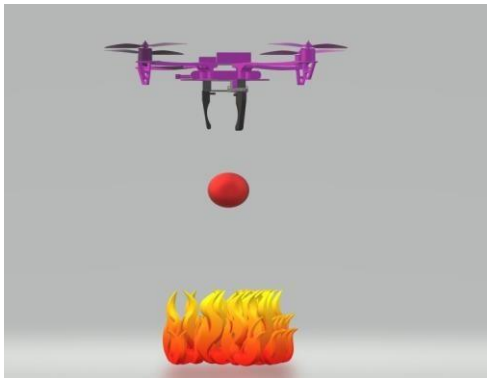
This project describes the implementation of a fire fighting drone equipped with an extinguishing system mounted on the quadcopter. The requirements can be broken down into sub systems namely, mechanical, electronics and software. The requirements in the mechanical system include, firstly, the platform of the drone equipped with payload and the extinguishing system. Secondly, the selection of the container that holds the extinguishing liquid. Further, a pumping system to transport the liquid from the container to the nozzle. The most important electronic requirement is a custom designed printed circuit board or a power distribution board to regulate and control the distribution of electrical power for every sub system. The PDB (power distribution board) and the controller coordinate with each other to control the on-board mechanisms and the signalling between multiple sub systems or devices.
Another requirement is the design of the circuit to operate the pumping system. The software part includes the designing of the drone platform in CAD, establishing the controls of the drone throughMission Planner software.

4. KK2 BOARD

The KK2.1.5 Multi-Rotor controller is a flight control board for multi-rotor aircraft (Tricopters, Quadcopters, Hexcopters etc). Its purpose is to stabilize the aircraft during flight. To do this it takes the signal from the Esc connected to the main frame (roll, pitch and yaw) then passes the signal to the Atmega644PA IC.



5. MODEL DRONE

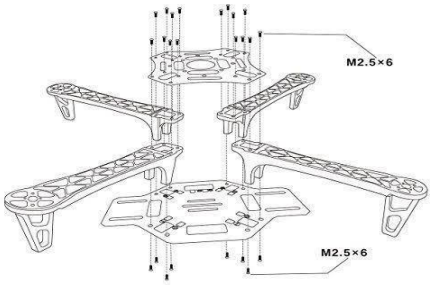


6. RELEASE MECHANISM

The main objective of the design is to extinguish fire using a fire extinguisher ball which is achieved by the use of a morphological fire fighting drone. Fire extinguisher is ;loaded to the drone with help of a dropping mechanism fabricated using aluminum. Aluminum is used because its light and easy to fabricate. It also serve purpose shielding the payload and electronic components from the fire, so it is fabricated as a metal box and dropping of the payload is controlled by the servo motor. The material of the mechanism is aluminum, which has a light weight and is easy to manufacture. The disadvantage of this design is the close distance to the fire the quad copter has to get at the releasing point, since not only the ball has to be protected from the fire during the flight but also the motors and electronic components need to be isolated for high temperatures. The Release Mechanism is actually a remotely activated micro-servo motor It is actuated by using a micro-servo motor and remotely triggered using the remote controller.We are using a LED control module to power the Release Mechanism.

7. FABRICATION OF CHASIS

With that being said, carbon fiber frames can still be used and they often are but you should just be aware that the carbon fiber blocking the transmission signals is always a possibility. Frames can also be custom built in a do it yourself fashion at home using balsa sheet or aluminum. However, the results will vary from manufactured frames specifically in terms of flight attributes and aesthetically.The integration of power distribution circuits into the frame plates is common. Battery connections typically get soldered directly to pads that are built into the carbon fiber material and power can be tapped at additional solder points without the need for messy, extensive wiring. Even though it is by no means necessary, a clean setup is usually less likely to fail and when all said is done more satisfying, which makes distributing frames an investment worthy of your time and money. Depending on your budget or own aspirations you could either purchase a premade quadcopter frame, buy the parts of one and assemble your own, or create yours custom in the comfort of your own home. No matter which route you decide to go down, you should always do your research so that you know exactly how to build the frame and exactly how to.Arms of the quadcopter attach to the frame and these can also be built at home using hard plastic tubing or aluminum.



8. DRONE DESIGN

9. COMPONENT REQUIRED

Selection of the components depends on the requirements of the project and the application of the drone. The process of selection starts by assuming the estimate weight of the drone as per requirement to determine the type and size of the frame and propellers and thereby calculating the thrust that each motor has to provide to preserve a stable flight. Based on the power and current specifications of the motor an appropriate power supply and ESCs have to be chosen. While deciding on the propellers we have to consider factors like number of blades, current drawn, weight and the stiffness. As for the selection of the frame, the size, material, configuration and geometry will have to be taken into account. The description of components used in this project are given below.

10. SOLDERING

The soldering work is done in our electrical laboratory. The cable from the esc's are being soldered in the main frame following the positive and negative sign and the cables from the esc is connected to the motor the motor and the esc are being fixed in the main frame. The quadcopter frame is fixed to main frame and aligned to the dimension listed above. The soldering work is done for the esc and the battery connector to the main frame according to the positive and the nergative terminal.The battery power gets supplied to the main frame(Metal Frame) the esc take the power supply and take it to the flight controller and it gives the proper thrust to the motor.

11. FUTURE SCOPE

The Drone is basic model which can be used asa demo for the future technology. This drone has a temporary gripper which holds a extinguisher ball but the gripper cannot be operated remotely due to the high cost and maximum weight we just present the demo of it. But with further technology the drone can be equipped with camera and a remote controlled gripper and it can even be fixed with fire detecting sensor and motion senso

12. STRUCTURAL DESCRIPTION

The model of the Drone is designed in Catia V5 software. The Arm length is determined based on some of the factors like the Propeller dimensions, Clearance between two rotating Propellers and the Clearance between the parts of the drone from rotating propellers. The Main Frame is designed H-shaped to have more space between the arms. When the payloads are mounted on the Main Frame, then there will be change abruptly in the Center of Gravity, when the Fire Extinguisher balls are dropped or the Water storage tank gets drained. So, to avoid this problem, another frame is designed to mount payloads. The shell designed to hold the Fire Extinguisher ball will have a slope bottom instead of the flat, so that the ball will be released easily

13. CONCLUSION

Fire has always been a devastating phenomenon but with the technological advancements it becomes easier to tackle it. This paper describes one such solution to the problem of firefighting with the help of drone technology and an appropriate extinguishingsystem. It maps out and demonstrates the process of constructing a drone that is capable of extinguishing small- scale fires. In conclusion, there are many possible ways to put out fires but it's always safer to use the constantly evolving drone technology to reduce the involvement of firefighters thereby decreasing the risk of physical injuries and life threats. Comparing this prototype with the existing technology used by the fire department, which only utilizes the drones for the purpose of surveillance, proves the efficiency of this project. One advantage with drones is that the payloads are dynamic. Multiple loads can be equipped based on the requirement of the user. With proper funding, this prototype can be further developed by equipping it with thermal imaging and GPS modules which will enable them to detect fires and navigate through the flames, completely automating the functioning thus eliminating the need of a human controller. It can be further developed by integrating multiple drones by using flying Ad-Hoc Networks thus creating an interlinked network of Drones, i.e. a swarm of drones in-order to extinguish large scale structural fires as well as wild fires.

14. REFERENCE

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