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A NEW FANGLED SMOKE JUMPER

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ABSTRACT

Smoke Jumper is an unmanned aerial vehicle designed for firefighting. A smoke jumper is interfaced with servo motor gripper to hold the pipeline and a dropper. The pipeline carrying water from the ground level is used to put out the fire. If the intensity of the fire is high, then a fire extinguishing dropper can be used. The Smoke Jumper can also be easily mounted on the top of fire brigades and it has the ability to reach to higher storey of building in very less time as compared to the conventional method of taking a fireman to that storey using a crane. This prototype is an effective one and easy to use.

INDEX TERMS—*Arduino Uno Atmega 328 microcontroller, BLDC motor, ESCs (Electronic speed controller), Propellers, Transmitter and Receiver.*

I. INTRODUCTION

In India, on an average 59 people die daily due to fire accidents. Fire department identifies traffic jams and narrow roads as the biggest problem. They exclaim that the boxy fire trucks and fire engines measure 24-50 feet long and 7-9 feet wide struggle to squeeze through traffic and in lot of areas, the road is less than 10 feet wide which makes the big fire engines difficult to enter if there are incidences of fire. The target of this paper is to explain the working of unmanned aerial vehicle as Smoke Jumper for firefighting which would help to carry away the above stated problems. The Smoke Jumper consists of four arms; each arm holds a motor and the propeller at their ends.

Rotors one and three rotate in a clockwise direction whereas rotors two and four rotate in a counter-clockwise direction. Each rotor produces both a thrust and torque about its center of rotation. If all rotors are spinning at the same angular velocity, the net will be zero, so the angular acceleration will also be zero. A vertical force is created by increasing the speed of all the motors by the same amount of throttle. As the vertical forces overcome the gravitational forces of the earth, the flying unit begins to rise in altitude. The servo gripper is interfaced with the smoke jumper, is programmed in such a way that it holds and release the pipeline and fire extinguishing dropper. This prototype is an effortless technique which is easy to operate,

utilizes very less time, and has the ability to operate smoothly in narrow space.

II. DESIGN AND METHODOLOGY

A microcontroller is required to control the operations like gliding the smoke jumper, checking the fire intensity, water throughput and requirement of fire extinguisher. Arduino is the best choice being a user friendly to program it. A motor is required to make the smoke jumper to fly. At this point, a brush less DC motor is selected in order to reduce the cost. A dedicated speed controller for the DC motor will be used to reduce the complication of control operations. The transmitter and receiver sections are selected based on the distance of coverage of the Smoke Jumper. The blades for the smoke jumper should be of less in weight which makes Aluminum a better option. The ESC utilizes the power from the battery and converts PWM signal received from flight controller and then drives the brushless motor by providing required electrical power. There are four brushless motor each has a propeller mounted on it. The water pipe is attached at the sides of the center frame carrying water from the ground which is used to put out the fire. The fire extinguishing dropper containing the gas is thrown into a specific fire hazards suppressing the fire which is held with the help of dripper at the mid of the centre frame.

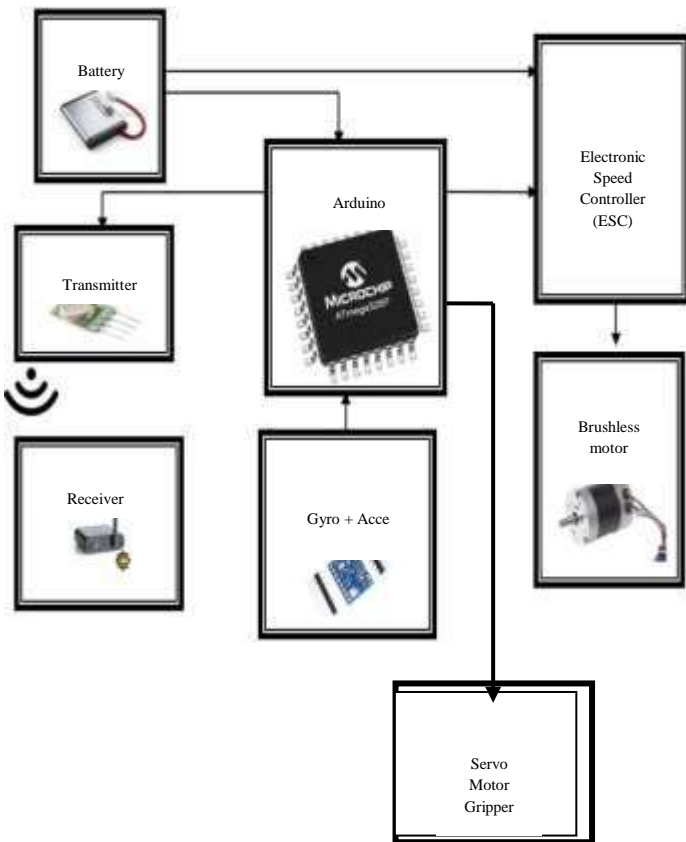


Fig.1 Architectural Block Diagram of Smoke Jumper

1.1.1 Arduino Uno

Arduino Uno is an open source physical computing platform used for building digital devices and interactive objects that can sense and control objects in physical world. It's a micro controller, based on AT mega 328P which consist of 14 digital input/output pins (out of which 6 pin are used as PWM output), 6 analog inputs, a USB connector, 16 MHz quartz crystal, power jack, and a reset button. Arduino IDE (Integrated Development Environment) is used to upload programs to the arduino boards and that can be used to perform intended tasks. In this application, the arduino is programmed in such a way that it takes control of flight of the smoke jumper as well as operation of gripper.



Fig.2 Arduino UNO Controller Board

1.1.2 Chassis

The chassis is in the shape of X. Its length depends on the size of smoke jumper. For the prototype design, the chassis had an angle of 75 degree between the two bars of chassis forming X shape. The length of each bar was 12 inches.



Fig.3 Chassis

1.1.3 BLDC (Brushless DC Motors)

These are dependent on the chassis size. For the prototype four 1000 Kv brushless dc motors were used, each weighing 30 grams. Each motor produce a thrust of 850g which was sufficient to lift flying unit along with the gripper.



Fig.4 BLDC Motor

1.1.4 ESC's (Electronic speed controller)

Four 30A ESCs are used, which converts the PWM signal received from the receiver and then drives the brushless motor by providing required electrical power. Thus ESC is an electric circuit that controls the speed and direction of electric motor by varying the magnetic forces created by the windings and magnets within the motor.



Fig.5 ESC

1.1.5 Transmitter and Receiver

Radio transmitter uses radio signal to remotely control the smoke jumper in wireless way, the commands given by transmitter are received by a radio receiver connected to arduino. The receiver selected operates on 2.4GHz of radio frequency. The number of channels in transmitter and receiver determine how many actions of aircraft can be controlled by pilot. Here, we are using six channel transmitter and receiver. Minimum of four channels are enough to control the flying unit. The remaining two channels are for the control of servo motor gripper.



Fig.6 6 Channel Transmitter and Receiver

1.1.6 Li-Po Battery (Lithium Polymer battery)

Li-Po is a rechargeable battery. They provide higher specific energy and are being used where weight is a critical factor. It is light weight, small size, long life and high

discharge rates required to meet the need of powering the smoke jumper.



Fig.7 Li-Po Battery

1.1.7 Propellers

10 inch carbon fiber propellers were used to keep it light weight.



Fig.8 Carbon Propellers

1.1.8 Servo motor gripper

This is a small volume, simple gripper perfect for getting a grip. It is made up of transparent acrylic material. This gripper is equipped with a 9 g servo which ensures fast gripping speed. Grabs and carries small items less than 60 grams.

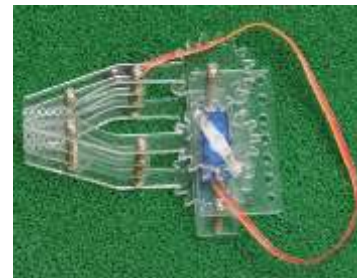


Fig.9 9g Servo Gripper

CONCLUSION

This fire fighting smoke jumper is an effective and effortless technique. It is easy to control. It can reach at those places where sometimes it becomes impossible for humans to reach. It takes very less time to reach higher storey of buildings than the conventional method. It also has the capability to operate in hard and dangerous spots.

FUTURE DEVELOPMENT

- Future improvement involves in supplying the smoke jumper with power through cables to overcome the drawback of battery sustainability.

- Implementing a camera and GPS module on kit for tracking the captives in the fire accident.
- Using temperature sensor, we can enable automation in servo motor gripper.

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