**PROJECT ABSTRACT**

Paracopter

(Quadrotor with Paraglider Application)

**OVERVIEW:**

Our aim is to add-on a parafoil onto a quadcopter with the required control network. The project involves the making of an autonomous aerial surveillance vehicle. The vehicle is designed to provide maximum range and extended battery life for long distance, prolonged real time monitoring of various subjects of interest. The vehicle is thus, a hybrid of a quadcopter and a paraglider.

**RATIONALE:**

The proposed hybrid aerial vehicle aims to combine the manoeuvrability and versatility of a quadcopter with the low power operation facilitated by a paraglider.

**OVERVIEW OF PROPOSED CONTROL SYSTEM COMPONENTS AND DESIGN:**

Since this hybrid aerial vehicle has a completely new system architecture, we are going for custom flight controllers as well as transceivers. The system will also use an array of sensors to achieve stability and autonomous operation. A major part of the work involves the switching between the paraglider and quad modes. The control system consists of two processors; an Arduino Due which sports a powerful Cortex-M3 core and a rich set of peripherals and a Raspberry Pi Single Board Computer(SBC) which has an ARMv8 core capable of handling heavy processing loads.

The Due mainly takes care of the time critical operations such as flight stability and parafoil control with the help of 9-DOF sensors. It also does obstacle avoidance and altitude hold using IR sensors and Ultrasonic sensors respectively. A MEMS barometer and a GPS enable navigation. The Raspberry Pi takes care of the camera real time streaming over WiFi and image processing algorithms. It also enables mission planning and optimal path calculation. The system uses LoRa technology based MRF24J40ME Microchip transceivers to communicate between base station and the vehicle. All parameters such as coordinates, altitude, battery level etc. are relayed back to ground station in real time.

The parfoil will provide an extra lift to the system when quadcopter is pitched forward: as the quadcopter is pitched the air fills in parafoil and the airflow along boundry shape will provide lift to the system. When quadcopter is at some altitude the parafoil will open and it paraglides, and whenever required the parafoil can be retracted back. Thus, a suitable mechanism for **opening, retracting and maneuver control** will be implemented.

**Opening mechanism:** A parachute will be tied on the parafoil, when quadcopter is pitched forward and parachute is filled with air will pull out the parafoil.

**Retracting mechanism:** A suitable string network will be added to retract the parafoil. A stepper motor will pull the main actuating string.

**Maneuver control:** Strings from both ends of parafoil will be attached to either servos or steppers, and pulling them will provide maneuver as required.

**PREDICTED BENEFITS:**

Reduction in battery usage per unit time:

1. As the lift provided by the parafoil will add up to the rotor lift, therefore rotors should be effectively with lesser speeds, so less power input is required.
2. Increase in average flight time: because of less power input, same battery can be used for longer time.
3. Because of increased lift, higher altitudes can be achieved.

**MATERIALS AND COMPONENTS USED:**

**--Raspberry Pi**

**--Arduino mega (2)**

(Microcontroller; Brain of the vehicle. One is used on the copter and the other used in the transmitter. Allows for custom manoeuvres, self-stabilisation and custom programming of the transmitter)

**--Zigbee pro (2)**

(Long range RF transciever. One is used on the vehicle and other in the transmitter. Thus control data can be sent to the vehicle and also collected data from the vehicle can be sent back to the transmitter.)

**--20x4 LCD**

(Display module used in the transmitter.)

**--GPS module (1)**

(To get the current coordinates of the vehicle and report it back to the pilot. Can be used in auto-pilot mode and mission planning.)

**--3 axis accelerometer**

(To auto-stabilize the vehicle by monitoring its orientation.)

**--Bluetooth module**

(Can be used to connect the vehicle to a smart phone over short distances to transfer back the collected data to an app which can upload it to the internet.)

**--Temperature sensor**

(To sense the temperature inside the vehicle.)

**--20A current sensor**

(To measure the power consumption of the system excluding the motors. Data is sent back to the pilot who can infer the available flight time and endurance of the vehicle.)