Helium Micro Air Vehicle (MAV)

By

Fawaz Alenezi, Hamoud Alkhaldi, Abdulrahman Almuqhawi, Matthew Kohr, Conrad Nazario, Randal Spencer

Operations Manual

May 6, 2016

Submitted towards partial fulfillment of the requirements for Mechanical Engineering Design I – Fall 2015



Department of Mechanical Engineering Northern Arizona University Flagstaff, AZ 86011

Operation Manual

Operating the blimp requires 2-3 people.

Introduction

Dealing with a pressurized tank is dangerous and the guidelines of the Occupational Safety and Health Administration (OSHA) guidelines should be followed to ensure no accidents take place. Air vehicles are dangerous if used improperly so when operating take precaution. Liability safety, and damages fall on the operator so take precautions. The FAA has a general safety guide when operating Air vehicles this can be seen at faa.gov and look for safty and aviation handbooks. A general discription can be obtained from

http://www.faa.gov/documentlibrary/media/advisory_circular/91-57.pdf

Tank Installation

Tank insulation can be dangerous due to the weight of the tank and possibility of explosion.

1- Make sure the wall mount is bolted and secured to the wall or stable structure.



Figure 1 Wall Mount

2- Strap helium tank to wall mount. Tighten strap so that the helium tank will not move this can be done from the clips attached to the wall mount.



Figure 2 Wall Mount Strap

3- To install regulator make sure the tank valve is fully closed, then screw in the regulator into the fitting where the valve is. Tighten regulator end with a crescent wrench.



Figure 3 Regulator

- 4- Once tightened fully open valve on the regulator counterclockwise.
- 5- Slowly open tank valve, gas should not come out at this point, you will see a pressure rise on the right gauge.
- 6- Make sure hose if firmly attached
- 7- Then slowly turn the regulator valve clockwise until you hear the gas being released. Adjust regulator valve to desired pressure.



Figure 4 Final Tank Setup

- 8- Start filling the blimp by inserting the hose to the back end of the blimp, while filling the blimp make sure to hold tightly to the blimp tail to minimize leakage of helium during the filling procedure.
- 9- Once the helium is filled to the desired level twist the blimp tail to obstruct any leakage then add rubber bands and tape to secure the tail.

System assembly

- 1. Adjust the height of the enclosure by using the nuts at each corner.
- 2. Attach the electronics in the enclosure using a Velcro based on the diagram below:-



Figure 6 Electronics within Enclosure

Installing the propellers to the motors

1. Screw in the shaft adapter



Figure 7 Motor with Shaft Adaptor Attached

- 2. Run the motor shaft through the propeller hole.
- 3. Put the black washer on the propeller.



Figure 8 Washer for propeller

4. Secure the propeller by screwing in the nut.



Figure 9 Motor with Propeller Nut Attached



Figure 10 Final view when the propeller connect with motor

- 5. Attach the enclosure to the blimp using Velcro and Ropes (tie rope from the tethers through the enclosure lid and fasten the enclosure to the bottom make sure knots are tight and the Lid is completely pressed against the bottom)
- 6. To detach either untie or unbolt the bottom from the lid



Figure 11 Final Enclosure Attached to the Blimp

Quadrino Electronic Setup

- 1. Plug in micro USB to Quadrino power port and make sure the other end is plugged into 5V portable battery
- 2. Quadrino should light up with blue LEDS this shows it is powered.
- 3. Plug radio wiring from radio transmitter into a serial port (doesn't matter which one) on the Quadrino
- 4. Should be a white harness with only a red and black wires coming out of the end, plug that into the bottom of the Quadrino radio port then plug red and black wires into the ground and positive points of the receiver (this supplies power to the receiver).



Figure 12 Quadrino Nano

Battery Setup

During battery setup make sure electronics and the switch is off, connect wires to their same color for instance red goes with red and black goes with either blue or black which represents the ground. Battery are dangerous so make sure to read the owner's manual and warnings. In case of smoke immediately disconnect the battery sources. Refer to Figure (17) for final system and outline of components

- 1. There are two batteries the 7.4 volt and 22.8 volt plug both ends to their counterparts on the Rocker switch.
- 2. Once connected there are two open ends on the rocker switch, one connects to the servo spit and the other the esc's.
- 3. The esc split, has a yellow casing with brass in the middle, this connects to the rocker switch counterpart. (Refer to figure)
- 4. The other is a smaller white connection just plug it in, make sure the wires are red to red or black to blue/black. (Refer to figure)
- 5. This supplies powers both to the servo and the motors that are located at the bottom of the enclosure.
- 6. Make sure all power is off before messing with the wiring on the esc and servos
- 7. Make sure ground and positive wires are connected to the ESC with the red and black wire (remember black to blue and red to red)
- 8. On the opposite end of the ESC needs to hook up to the motors (attach ABC connections to the motors if this applies an upwards force reverse the cables to CBA this will rotate propellers in counterclockwise direction)



Figure 13 Electronic Speed Controller (ESC)

9. To test if power supply is connected turn rocker switch on and you will hear a beep from the esc's this means they are receiving power.





Camera setup

This is how to set up the camera with a preprogrammed raspberry pi, to look at the code follow the manufactures recommendation. To change how many pictures the raspberry pi takes go into the "main" file in the raspberry pi's code and change the number in the range function to your specified number. If the delay is too long or short this can also be changed in the "main" file.

- 1. The Raspberry Pi is already preprogramed
- 2. Connect Micro SD card to port on Raspberry Pi (this has the program installed, it won't work without SD card)
- 3. Connect 64 GB USB to USB port on raspberry pi
- 4. Connect Camera to USB port
- 5. Plug in micro USB to Raspberry Pi, once plugged in it will automatically run the code the green led should flash every so off this mean the code is running, if just the LED red and a solid green LED stay on then there is an error.
- 6. There is a time delay of 8 seconds then it starts taking picture approximately every second
- 7. During anytime the USB can be unmounted and plugged into a computer to see the images taken



Figure 15 Final Camera Setup

Control

Refer to the Figure (21) at the end if there is trouble determining the different channels

- 1. Have servos signal wires connected to the Rudder and Aileron Channels on the receiver
- 2. Have ESC signal wires connected to Throttle and Elevator channel



Figure 16 Receiver with ESC and Servos Plugged in

- 3. Make sure all power is on (flip the rocker switch and make sure the Quadrino is plugged in)
- 4. Turn on controller to the saved mode (servo will automatically turn to 45 degrees and ESC should beep if nothing happens make sure the light on the receiver is on otherwise you may have to rebind it)
- 5. If ESC are not working you will have to recalibrate the channels, you can look at the ESC calibration guide to solve this problem or set the trim function all the way down
- 6. Refer to figure () to see where to stick controls are

- 7. For servo the move the sticks left or right simultaneously or separately. (left positions the servo down while right positions servos up
- 8. Using
- 9. Positon servos up for downward thrust and down for forward thrust
- 10. Push throttle and elevator up on the controller to start propellers (do this slowly because the propellers are powerful and will start immediately this can be done simultaneously or separately)
- 11. If any problems occur turn off controller and everything should stop and return to the initial position



Figure 17 Spektrum DX6i RC Transmitter

Storing

- 1. Detach the system from the blimp
- 2. Deflate the blimp
- 3. Unmount the propellers
- 4. Remove the electronics from the enclosure
- 5. Store the electronics in their designated casing then store them in a cool place
- 6. Store the enclosure and pipe system at any desired not cramped space