# Test Plan / Procedure

**Autonomous Drone USF 2019**

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# Analysis

## System Verification Requirements

1. The drone shall fly in a predetermined path autonomously using GPS and a gyroscope
2. The predetermined path shall have the capability to be set by the operator.
3. The drone shall have the capability to be flown manually via a remote.
4. The drone shall take optical and thermal images of power lines.
5. The drone shall remain stable while taking aforementioned images.
6. Upon reaching 60% battery, the drone shall return to “home base”.
7. Upon sensing winds exceeding 20 mph, the drone shall return to “home base”.
8. System shall send alerts to the user if thermal readings are past a certain threshold.
9. The drone shall use ultrasonic sensors to detect obstacles in front of it
   1. The drone shall stop and change course upon detecting an obstacle
10. The drone shall take thermal and optical images every one second
    1. The system shall send these images to the control center and save them into an onboard SD card
11. The drone shall be resistant to water

### Primary Subsystems

* Motor System
  + Motor
    - Size, weight, power, blades
    - Withstand weight of payload
  + ESC (Electronic Motor Control)
* Autonomy System
  + Gyroscope sensor
  + GPS Module
    - Detect waypoints
* Communication System
  + Transmitter
* Flight Control
  + Pixhawk microcontroller
  + Ardupilot software
* Frame/Exterior
  + Hexacopter
  + Landing pad
* Battery
  + Size, weight, power
  + Withstand 4-6 motors
* Wiring
  + PCB design, soldering
  + Resistors, transistors, diodes,
* Software
  + Ardupilot

### Secondary Subsystems

* Camera System
  + Gimbal
    - Camera stabilizer
  + GoPro
  + Runcam
* Anti-collision System
  + Ultrasonic Sensors
  + Size and weight
* Thermal Camera
  + Heat sensor
* IR Sensor

# Testing

## Pass or Fail Criteria

The following tests shall receiving a pass criteria before demonstration onto public property. Failure to successfully pass any of the following tests will not be cleared to be demonstrated in public.

## Communication Test

Communication between the transmitter and receiver will occur accurately and seamlessly. There will be no delay in response time between the transmitter and receiver. The transmitter and receiver will successfully function at its specified range

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Tested:** | **Criteria** | **Pass** | **Fail** |
| 2/15/19 | Transmitter communicates to the receiver | x |  |
| 2/15/19 | Transmitter has flight model constructed and uploaded | x |  |
| 2/15/19 | Transmitter has the most up to date firmware installed | x |  |
| 2/15/19 | Receiver is correctly installed to the flight controller (pixhawk) | x |  |
| 2/15/19 | Receiver is binded to the transmitter (FrSky Taranis x90D Plus) | x |  |
| 2/15/19 | Receiver (x8R) is binded to the correct model (model 1) for flight test | x |  |
|  | Transmitter and Receiver can communicate up to its maximum range (1 mile) |  |  |

## Motor Test

The motors will perform successfully in the following pass / fail criteria. Failure to do so, will limit the drone from performing a flight test.

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Dated Tested:** | **Criteria** | **Pass** | **Fail** |
| 2/24/19 | Motors spin / perform at maximum capacity |  |  |
| 2/24/19 | Motors spin when prompted/communicated to |  |  |
| 2/24/19 | Motors communicates to the transmitter |  |  |
| 2/24/19 | Motors are correctly spin clockwise / counter clockwise |  |  |
| 2/24/19 | Motors are setup correctly with alternating legs as clockwise, counterclockwise, clockwise, counterclockwise, clockwise, counterclockwise, |  |  |
| 2/24/19 | Motor beeps correlate to transmitter control |  |  |
| 2/24/19 | Motor communicates to the GPS module |  |  |

## GPS Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Dated Tested:** | **Criteria** | **Pass** | **Fail** |
|  | GPS will communicate to the flight controller (pixhawk) |  |  |
|  | GPS Module can detect gps location |  |  |
|  | GPS Module accurately detects GPS location |  |  |
|  | GPS Module can detect multiple GPS locations |  |  |
|  | GPS Module can save return to home location |  |  |
|  | GPS Module can save desired gps location |  |  |

## Flight Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Tested:** | **Criteria** | **Pass** | **Fail** |
|  | Drone communicates precisely to the transmitter |  |  |
|  | Transmitter to receiver to motor to drone lift perform seamlessly |  |  |
|  | Transmitter to drone communicates precisely/accurately within range (1 mile) |  |  |
|  | All motors are performing at the same level of power |  |  |
|  | Drone Thrust level is exactly the same as on the transmitter |  |  |
|  | Drone Rudder level is exactly the same as on the transmitter |  |  |
|  | Drone Roll level is exactly the same as on the transmitter |  |  |
|  | Drone is leveled |  |  |
|  | Landing gear deploys when activated |  |  |
|  | Landing gear will retract up when activated |  |  |
|  | Transmitter communicates to the landing gear |  |  |

## Autonomy Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Tested:** | **Criteria** | **Pass** | **Fail** |
|  | Drone will go to selected location with user control with the transmitter |  |  |
|  | Landing gear will deploy and retract by itself at certain amount of thrust speed |  |  |
|  | Drone takes on-frame images of power lines |  |  |

## Battery Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Tested:** | **Criteria** | **Pass** | **Fail** |
|  | Battery powers all systems (motors, flight controller, receiver, camera) |  |  |
|  | Battery holds its efficiency |  |  |
|  | Battery level decreases at a normal rate |  |  |
|  | Battery can charge up to its maximum |  |  |
|  | Battery Charger can be powered and can charge the Lipo 6S battery |  |  |

## Camera Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Tested:** | **Criteria** | **Pass** | **Fail** |
|  | Camera communicates to the flight controller (pixhawk) |  |  |
|  | Camera takes pictures and videos |  |  |
|  | Camera takes pictures and videos when communicated to |  |  |
|  | Camera takes pictures and videos when drone is deployed |  |  |
|  | Camera is capable of taking pictures and videos autonomously |  |  |
|  | Camera takes clear images of area |  |  |
|  | Thermal camera takes accurate relative temperature readings |  |  |

# Demonstration

Test flight will be at advisor’s site. Final testing possibly at TECO powerline training site.

# Inspection

The following systems will be inspected by going through all the pass / fail criteria tests for each system on a bi-weekly basis. The inspection will occur after all testing criterias have been successfully passed and the drone has been demonstrated on the field (public).

## Communication

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | Transmitter communicates to the receiver |  |  |
|  | Transmitter has flight model constructed and uploaded |  |  |
|  | Transmitter has the most up to date firmware installed |  |  |
|  | Receiver is correctly installed to the flight controller (pixhawk) |  |  |
|  | Receiver is binded to the transmitter (FrSky Taranis x90D Plus) |  |  |
|  | Receiver (x8R) is binded to the correct model (model 1) for flight test |  |  |

## Motor

The motors will perform successfully in the following pass / fail criteria. Failure to do so, will limit the drone from performing a flight test.

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| Check one of the following: | | | |
| **Dated Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | Motors spin / perform at maximum capacity |  |  |
|  | Motors spin when prompted/communicated to |  |  |
|  | Motors communicates to the transmitter |  |  |
|  | Motors are correctly spin clockwise / counter clockwise |  |  |
|  | Motors are setup correctly with alternating legs as clockwise, counterclockwise, clockwise, counterclockwise, clockwise, counterclockwise, |  |  |

## 

## GPS Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Dated Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | GPS will communicate to the flight controller (pixhawk) |  |  |
|  | GPS module is correctly connected to the Pixhawk |  |  |
|  | GPS Module can detect gps location |  |  |
|  | GPS Module accurately detects GPS location |  |  |
|  | GPS Module can detect multiple GPS locations |  |  |
|  | GPS Module can save return to home location |  |  |
|  | GPS Module can save desired gps location |  |  |

## Flight Test

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| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | Drone communicates precisely to the transmitter |  |  |
|  | Transmitter to receiver to motor to drone lift perform seamlessly |  |  |
|  | Drone Thrust level is exactly the same as on the transmitter |  |  |
|  | Drone Rudder level is exactly the same as on the transmitter |  |  |
|  | Drone Roll level is exactly the same as on the transmitter |  |  |
|  | Landing gear deploys when activated |  |  |
|  | Landing gear will retract up when activated |  |  |
|  | Transmitter communicates to the landing gear |  |  |

## Autonomy Test

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| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | Drone will go to selected location with user control with the transmitter |  |  |
|  | Landing gear will deploy and retract by itself at certain amount of thrust speed |  |  |

## Camera Test

|  |  |  |  |
| --- | --- | --- | --- |
| Check one of the following: | | | |
| **Date Inspected:** | **Criteria** | **Pass** | **Fail** |
|  | Camera communicates to the flight controller (pixhawk) |  |  |
|  | Camera takes pictures and videos |  |  |
|  | Camera takes pictures and videos when communicated to |  |  |
|  | Camera takes pictures and videos when drone is deployed |  |  |
|  | Camera is capable of taking pictures and videos autonomously |  |  |