**Flight test 3.1**

**Why are we testing and what is the purpose of the planned test?**

This is the first flight test that has three drones connected to one computer. In this flight test, we test the same requirements as 2.1, but this time we use three drones from a USB hub (2 drones in USB hub and 1 drone in USB slot).

The current configuration of the software is mature enough to be tested at this level because at this point, we believe that the software should be able to handle flying one and two drones with video and target detection. By completing this test, we will be able to verify what parts of the software are compatible with the drone, and see what parts need to be fixed before the next test. Before the drone was taken off the string, all pre-mission tests were flown with a string attached to the drone. In addition, all code used in the flight test was unit tested, and if possible, the Parrot simulator. The CV algorithm was tested by running through pre-collected photos from previous test events.

The test event was scheduled on 3/30/2021.

**Requirements Tested:**

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|  |  |  |
| --- | --- | --- |
| **Subsystem** | Requirement | Tested? |
| **Operator Interface** |  | No |
| 1 | The system SHALL display the following: |  |
| 1a | GPS point inputs |  |
| 1b | Video livestream for all drones |  |
| 1c | A map of the area |  |
| 2 | The system SHALL display an image when a person is detected |  |
| 3 | The system SHALL be automatically displayed upon software turn on |  |
| 4 | The computer SHALL be able to identify a drones location |  |
| **Drone Actions** |  | Yes |
| 5 | The drone SHALL follow all GPS points given |  |
| 6 | The drone SHALL send live video feed |  |
| 7 | The drone SHALL return to homebase after a critical battery event |  |
| 8 | The drone SHALL send GPS coordinates to the computer |  |
| 9 | After identifying the target, the drone SHALL send an image of the target |  |
| 10 | The system SHALL accept 1 or more drones |  |
| **Mission Planning** |  | Yes |
| 11 | The system SHALL create a mission for each flight |  |
| 12 | The system SHALL send the mission to each drone |  |
| 13 | The system SHALL designate a leader drone, if there is more than one drone connected |  |
| 14 | The computer SHALL break up the amount of land into the pieces, with the amount of drones being the number of spaces |  |
| 15 | The system SHALL use Wi-Fi or the Parrot SkyController to connect to the drone |  |
| 16 | The computer SHALL remember where the previous drone locations are |  |
| **CV** |  | Yes |
| 17 | The CV SHALL be able to detect a human |  |
| 18 | The CV SHALL be able to process at least 2 frames per second on an Intel I7 processor |  |
|  |  |  |
| **SOS** |  | No |
| 19 | The drone SHALL send an SOS alert after going to the ground, if still connected |  |
| 20 | After a drone send an SOS alert, the remaining drones SHALL receive new GPS locations |  |
| 21 | After the computer receives a SOS alert, the computer SHALL resize the area |  |

## 

**Pre flight checklist:**

* Verify that the battery is charged
* Verify the SkyController is charged
* Verify that the clouds are above 400 feet
  + If cloud coverage is under 400, verify that the software can only go 25 feet under the cloud coverage
* Verify that the wind is under 30 mph
* Verify the laptop is charged
* Verify that the battery is property in the drone
* Verify that the drone’s wings are correctly fitted
* Verify that the location of which we are flying is unrestricted

**Pre-mission tests (All with one drone):**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | Up | SDK | 1. Connect the drone by Wi-Fi or SkyController  2. Input a message in the UI saying that the drone should go up 25 feet  3. Verify that the drone goes up 25 feet from the starting position | Pass |
| 2 | Left | SDK | 1. Connect the drone by Wi-Fi or SkyController  2. Input a message in the UI saying that the drone should go left 25 feet  3. Verify that the drone goes left 25 feet from the starting position | Pass |
| 3 | Right | SDK | 1. Connect the drone by Wi-Fi or SkyController  2. Input a message in the UI saying that the drone should go right 25 feet  3. Verify that the drone goes right 25 feet from the starting position | Pass |
| 4 | Down | SDK | 1. Connect the drone by Wi-Fi or SkyController  2. Manually fly the drone up 30 feet  3. Input a message in the UI saying that the drone should go down 25 feet  4. Verify that the drone goes down 25 feet from the starting position | Pass |
| 5 | Camera | SDK | 1. Turn on the system  2. Connect the drone by Wi-Fi or SkyController  3. Allow the system to accept camera feed  4. Verify that the camera feed is displayed on the computer | Pass |
| 6 | Moving Camera | SDK | 1. Turn on the system  2. Connect the drone by Wi-Fi or SkyController  3. Allow for the system to accept camera feed  4. Verify that the camera feed is displayed on the computer  5. Verify that the user can move | Pass |
| 7 | Take off | SDK | 1. Verify that the drone can take off | Pass |
| 8 | Land | SDK | 1. Verify that the drone is in the air  2. Input a message to allow the drone to land  3. Verify that the drone can land | Pass |
| 9 | Battery | SDK | 1. Verify that the battery level is less than 25%  2. Verify that the drone is coming back home and then landing | Pass |
| 10 | Emergency Landing (Wi-FI) | SDK | 1. Connect the drone by Wi-Fi  2. Input message that allows the drone to fly 20 feet  3. Disconnect the drone from Wi-Fi  4. Verify that the drone can connect to the phone's Parrot App by Wi-Fi | Pass |
| 11 | Emergency Landing (Sky Controller) | SDK | 1. Connect the drone by the SkyController  2. Input message that allows the drone to fly 20 feet  3. Disconnect the drone from the SkyController  4. Verify that the drone can connect to the phone's Parrot App by the SkyController | Pass |

These tests are a prerequisite to any flight test without the string. Without these tests, the drone could cause serious damage to itself or others. To verify that all of these tests work, the drone will be tethered to a string to verify that the drone will not fly off and cause damage. In theory, by allowing the drone to fly tethered on this, flying untethered will be more successful by knowing that all basic features work.

**Safety:**

Before flying the drone, we completed all pre-mission tests successfully and the flight was recorded in the flight log. In addition, the flight test was observed by one sUAS pilot and two visual observers in different locations to verify the drones were going in the correct direction. We were able to see the drone the entire time, as complaint with Part 107.

**Location and Set-Up:**

We will be flying at Mendon Ponds Park for this flight test.

We plan on flying at 150 feet for one drone, 155 feet for the second drone, and 160 feet for the third drone.

**Results:**

|  |  |  |
| --- | --- | --- |
| **Operator Interface** |  | Pass/Fail/NA |
| 1 | The system SHALL display the following: | N/A |
| 1a | GPS point inputs |  |
| 1b | Video livestream for all drones |  |
| 1c | A map of the area |  |
| 2 | The system SHALL display an image when a person is detected |  |
| 3 | The system SHALL be automatically displayed upon software turn on |  |
| 4 | The computer SHALL be able to identify a drones location |  |
| **Drone Actions** |  |  |
| 5 | The drone SHALL follow all GPS points given | Pass |
| 6 | The drone SHALL send live video feed | Pass |
| 7 | The drone SHALL return to homebase after a critical battery event | N/A |
| 8 | The drone SHALL send GPS coordinates to the computer | Pass |
| 9 | After identifying the target, the drone SHALL send an image of the target | N/A |
| 10 | The system SHALL accept 1 or more drones | Fail |
|  |  |  |
|  |  |  |
|  |  |  |
| **Mission Planning** |  |  |
| 11 | The system SHALL create a mission for each flight | Pass |
| 12 | The system SHALL send the mission to each drone | Fail |
| 13 | The system SHALL designate a leader drone, if there is more than one drone connected | Pass |
| 14 | The computer SHALL break up the amount of land into the pieces, with the amount of drones being the number of spaces | Pass |
| 15 | The system SHALL use Wi-Fi or the Parrot SkyController to connect to the drone | Pass |
| 16 | The computer SHALL remember where the previous drone locations are | Pass |
| **CV** |  |  |
| 17 | The CV SHALL be able to detect a human | Fail |
| 18 | The CV SHALL be able to process at least 2 frames per second on an Intel I7 processor | Fail |
|  |  |  |
| **SOS** |  | N/A |
| 19 | The drone SHALL send an SOS alert after going to the ground, if still connected |  |
| 20 | After a drone send an SOS alert, the remaining drones SHALL receive new GPS locations |  |
| 21 | After the computer receives a SOS alert, the computer SHALL resize the area |  |

During the test, we were able to successfully pass 8 out 12 tests (67%).

The requirements failed were 10,12,17,18. This has been our lowest flight test since we started the project.

Requirement 10: This requirement failed because when we flew the drones in the first flight test, the third drone went up in the air, but did not fly anywhere.

Requirement 12: This requirement failed because when we flew the first time, the third drone did not follow any mission plan and hovered in place.

Requirement 17: This requirement failed because the CV failed to detect a human in a live setting or after the mission was over.

Requirement 18: This requirement failed because the CV failed to process any live video of all three drones. In fact, the CV caused several memory issues that caused the entire software to crash.

**Lessons Learned:**

In this test, we failed some previously passed requirements (10 and 18) due to issues with the CV. During the test, we ran the software on a VM with 8 GB of RAM, in which the software crashed due to the VM running out of memory. This caused the drones to hover in place, not going to the next points. After reading the log files, there were no issues with the software itself, but rather the CV consumed too much memory. For the next test, we plan on increasing the memory on the VM to 12 GB to see if that is enough memory. If it is not, we plan on either scaling down all tests to two drones, or scaling down the CV.