|  |  |  |  |
| --- | --- | --- | --- |
| Artifact ID:  TP-001 | Artifact Title:  Thermal vs. Low-Light Camera Comparison for UAS Fire Detection | |  |
| Revision:  02 | Revision Date:  2025-03-06 | |
| Prepared by:  Anthony Cardenas, Isaac Davies | | Checked by:  Tristan Mott | |
| Purpose:  The purpose of this test is to compare the performance of a thermal camera and a low-light camera for fire detection in various lighting conditions. The results will determine the most suitable camera for use on our UAS, evaluating its effectiveness at different distances during both daytime and nighttime conditions. Additionally, this test aims to establish light threshold values for fire detection based on filtered footage analysis. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Revision History | | | |
| Revision | Revised by | Checked by | Date |
| 01 | Isaac Davies | Tristan Mott | 2024-10-22 |
| 02 | Joshua Crookston | Tristan Mott | 2025-03-06 |

|  |  |  |  |
| --- | --- | --- | --- |
| References | | | |
| Artifact ID | Revision | Title |  |
| ART-006 | 01 | Detection Code Overview |  |

**Test Procedure: Thermal vs. Low-Light Camera Comparison for UAS Fire Detection**

## **1. Test Objective**

The purpose of this test is to compare the performance of a thermal camera and a low-light camera for fire detection in various lighting conditions. The results will determine the most suitable camera for use on our UAS, evaluating its effectiveness at different distances during both daytime and nighttime conditions. Additionally, this test aims to establish light threshold values for fire detection based on filtered footage analysis.

## **2. Test Equipment & Setup**

### **2.1 Required Equipment**

* Thermal camera
* Low-light camera
* Stable mounting platform for cameras
* Fire source (controlled, 2 ft (0.6 m) in diameter)
* Fire-starting materials (wood, fire starter)
* Fire suppressant (water, extinguisher)
* Computer with image processing software and filtering code
* Safety equipment for fire handling

### **2.2 Setup Steps**

1. **Verify Camera Functionality:**
   1. Confirm that both cameras are operational and capable of recording video.
   2. Ensure proper storage or transmission of recorded footage.
2. **Mounting and Stability:**
   1. Securely attach cameras to a stable platform.
   2. Ensure cameras are properly aligned for consistent fire detection testing.

## **3. Test Execution**

### **3.1 Fire Setup & Observation Distance**

1. Safely ignite a controlled fire measuring **2 ft (0.6 m) in diameter** in a designated fire pit.
2. Maintain environmental safety and confirm wind conditions do not interfere with the test.

### **3.2 Camera Comparison Procedure**

1. Position the first camera **100 meters away** from the fire.
   1. Record footage using the **thermal camera**.
   2. Switch to the **low-light camera** and record footage.
2. Move to **200 meters away** and repeat the process for both cameras.
3. Move to **400 meters away** and repeat the process for both cameras.
4. Ensure each camera records for a sufficient duration to capture usable data.

### **3.3 Data Collection & Image Processing**

1. Download recorded footage from both cameras.
2. Apply the fire detection filtering code to each video.
3. Analyze detection performance using filtered images:
   1. **Unfiltered video:** Raw footage from both cameras.
   2. **Filtered video:** Processed footage using fire detection filters.
   3. **Auto-scaled video:** Adjusted contrast and brightness for better fire visibility.
4. Evaluate fire visibility at each distance based on filtering results.

## **4. Test Validation Criteria**

|  |  |  |  |
| --- | --- | --- | --- |
| **Camera** | **Distance** | **Fire Detected? (Y/N)** | **Filtered Visibility (Y/N)** |
| Thermal | 100m |  |  |
| Low-light | 100m |  |  |
| Thermal | 200m |  |  |
| Low-light | 200m |  |  |
| Thermal | 400m |  |  |
| Low-light | 400m |  |  |

### **Additional Analysis**

* Compare detection accuracy for both cameras before and after filtering.
* Assess the effectiveness of fire detection filtering algorithms.
* Identify the maximum reliable detection distance for each camera.

## **5. Test Completion & Documentation**

1. **Record Observations:** Document test results, including video analysis and detection accuracy.
2. **Log Errors & Issues:** Note any hardware/software failures, latency, or video quality problems.
3. **Save Processed Footage:** Store unfiltered and filtered videos for reference.
4. **Shutdown Procedures:** Safely power down all equipment.

## **6. Safety Considerations**

* Ensure fire safety measures are in place (fire extinguisher, controlled burn area).
* Maintain a safe distance from the fire.
* Follow all capstone safety guidelines.

## **7. Test Status & Reporting**

Upon test completion, document results and submit a test report detailing:

* Camera performance comparisons
* Observed video feed quality
* Detection accuracy at different distances
* Effectiveness of filtering in enhancing fire detection
* Identified issues and recommendations