Artifact ID:	Artifact Title:	
TP-001	Thermal vs. Low-Light Camera Comparison for UAS Fire Detection	
Revision:	Revision Date:	
02	2025-03-06	
Prepared by:		Checked by:
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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:**
   a. Confirm that both cameras are operational and capable of recording video.
   b. Ensure proper storage or transmission of recorded footage.
2. **Mounting and Stability:**
   a. Securely attach cameras to a stable platform.
   b. 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.
   a. Record footage using the **thermal camera**.
   b. 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:
    a. **Unfiltered video:** Raw footage from both cameras.
    b. **Filtered video:** Processed footage using fire detection filters.
    c. **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