Test Document Report

For Senior Design, Class of 2023.

**Data Analytics at the Edge**

February 22nd, 2023

University of South Florida

S. Sheng, M. Holmquist, L. Barber

# Introduction

This test document report outlines the testing procedures and results for the machine learning vision system designed to leverage edge computing in vision analytics. The purpose of the testing phase is to ensure that the system is at a functional level and is expected to meet all the requirements outlined in this project specification.

## General Summary of the Test Plan

The following test plan, with specific test cases, is designed to show how each equipment is to be tested with a given requirement. A verification matrix has also been created to track the verification of each requirement. Due to the nature of this project, a significant number of test requirements can only be made through visual confirmation.

# Test Plans for Hardware Specifications

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Main Image Sensor and lens configuration** | A camera shall function and capture live video feed. | Observable live feed | Demonstration | Preliminary |
| **Notes:** An operational camera is essential to the success of this project. Although the determination if the main camera is properly working is straight forward, it required. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Verify that the camera is capturing a live feed** | Camera (webcam or pi-cam) shall function properly. | Live video feed with appropriate quality and resolution. | Test | Preliminary |
| **Notes:** Testing if live feed is being received evaluates most of the hardware related configurations in one pass before future troubleshooting. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Verify the correct resolution mode is set on the camera** | Correct resolution shall be set on camera | The right resolution must be displayed when live. | Inspection | Preliminary |
| **Notes:** Inadequate resolution can lead to either poor image data or data too large for the pipeline to handle. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Camera Frame Time** | Frame time shall be set accordingly | System must be able to capture frames adequately | Test | Preliminary |
| **Notes:** Capturing the frame too fast will not allow enough light to be absorbed by the imaging sensor resulting in underexposed images uncorrectable by high sensor sensitivity values (ISO) as the sensor can no longer distinguish between noise and actual image data (SNR). Capturing the frame too slow will result in poor image clarity of moving objects as the sensor does not have enough time to be exposed before the object has changed its position, resulting in blurred images. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Camera Focal Length** | The Camera shall have a focal length such that a sharp image is produced. | Zoom levels will be adequate | Test | Preliminary |
| **Notes:** The focal distance of the lens controls the amount of field of view the image sensor will be exposed to light. This ensures adequate zoom levels to capture the entire scene. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| Physical obstacles | Protectors that hold the camera in place during transportation shall be removed prior to powerup of the camera gimbal assembly | No protectors remain in place | Inspection | Preliminary |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Gimbal Centering** | Camera Gimbal shall be able to center during initial powerup. | The gimbal must be centered (or in a neutral position). | Demonstration | Secondary |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Gimbal motion** | The camera gimbal shall achieve an adequate range of motion in the pitch and tilt axis. | Camera gimbal must be able to rotate accordingly | Demonstration | Secondary |
| **Notes:** Testing is crucial for a camera gimbal system to ensure that the framework that is holding the image sensor and the lens unit can facilitate movements required for surveillance purposes. | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Power input and current carrying capacity** | Power source shall be capable of supplying enough current to the system without voltage sags at critical levels | Power levels required by the Jetson Nano, as recommended in the user manual shall be obtained | Test | Secondary |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| Physical Connections | Physical connections to and from the main communication computer shall be secure. | Proper contact is obtained | Inspection | Preliminary |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| System mounting | The mounting harness for the main communication computer shall be secure. | System is mounted such that no undesired movement is possible | Inspection | Final |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Grounding** | There shall be adequate grounding of the main communication computer | Proper Ground (Zero Potential) is maintained | Inspection | Final |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Image processing capabilities** | The image processing capabilities of the system shall be tested. | System is able to process images in real time | Test | Final |
| **Notes:** It is important to test the image processor, including several physical electrical components, to ensure that the image processor is functioning correctly and ready for data capture. | | | | |

# Test Plans for Software Specifications

Due to the complexity of software specifications, and the volatility nature of prototype software, only the criterion listing is given, and the testing guidelines shall be significantly more holistic compared to hardware specifications. This is to ensure freedom of exploration on future possibilities of more efficient algorithms and approaches as this project continues.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Jetson Nano** | Jetson shall run required software | Run code to confirm libraries are installed correctly | Test | Secondary |
| **Notes:** Jetson nano is required to run Pytorch, OpenCV and YoloV5. If the software is not functioning properly, an error message will be displayed. | | | | |

# Object Recognition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Object Recognition** | Object Recognition shall be successfully implemented. | Recognize at least 10 common objects. | Analysis | Final |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **CSV files** | Anomalous objects shall be recorded and logged into a text/CSV file | CSV file will log time, object, and internal file link to recorded video | Demonstration/Test | Final |

# Response to Anomalies

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Audio-Visual Alarm** | The system shall notify any anomalies | Once an anomaly is detected, the system should emit an audio-visual alarm. | Demonstration | Final |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Gimbal tracking** | Camera gimbal shall track anomalous individuals | When anomalous individual is detected, the gimbal should move to track the individual for one minute before returning to neutral position | Inspection | Final |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title** | **Shall Statement** | **Verification Success Criteria** | **Verification Method** | **Phase** |
| **Recording Anomalous** | The system shall automatically begin recording anomalous individuals | Once an anomaly is detected, the system should begin recording | Demonstration | Final |
| **Notes:** when an individual associated with an anomalous item is detected, the system should begin a 1-minute recording of the individual. | | | | |