Intelligent Systems Verification and Validation

The idea of the following experiment is to test the changes in behavior experimented by an intelligent system (a system that could adapt to maintain or improve its performance) under certain changes in the system. We are interested in analyzing the behavioral change with respect to:

1. Changes in the fabrication of the components
2. Maintenance of the components
3. Technological refresh

Given the large amounts of publicly available imagery, the intelligent system to simulate is an object detection camera which could be thought of the camera of a drone in warfare scenarios; more specifically we are conceiving the interaction of the sensor, the lens of the camera; and the algorithm that performs the detection. The experiment assumes the following setup:

* The organization that provides the system realizes the assembly of the hardware components and performs the training of the detection algorithm in an offline fashion. After the training, the system is delivered to their respective user. In this setting, the training set is made of clean images whereas the testing set is adulterated to simulate the impact of the changes presented in the section above.
* The organization has decided to allow online training of the algorithm in order to enhance the capacities of the system in their specific operative conditions. In this setup the both the training and the testing datasets are manipulated.

Metrics Definitions:

Given that the interest of the experiment lies only in how these changes impact the algorithm performance, the metrics will compare the performance before and after the manipulation of the images. A baseline is provided to compare the performance.

Since this is a classification task in the domain of supervised classification the confusion matrix will be used to display predictions labels versus ground truth labels for the different scenarios.

Results and Discussion:

Chart, waterfall chart

Description automatically generated

Figure 1: Baseline

1. Changes in the fabrication of the components
   1. Chart, waterfall chart

      Description automatically generatedDead Pixels from Factory:

Figure 2: 10 % of Uniformly Distributed Pixels Get Crushed

* 1. Chart, waterfall chart

     Description automatically generatedVarying levels of Brightness from Factory:

Figure 3: Brightness Reduced

1. Maintenance of the components
   1. Offline Training: Only corrupt the testing data.
2. Technological refresh
   1. Chart, waterfall chart

      Description automatically generatedDoubling Resolution of the Camera: Only corrupt the testing data

Figure 4: Resolution Change, new camera has double of the resolution of the training camera.

* 1. Chart, waterfall chart

     Description automatically generatedHalving the Resolution of the Camera:

Figure 5: Resolution Change, new camera has half of the resolution of the training camera.