Applications in machine learning (ML) have proven useful for analysis of various types of datasets and real-world problems. Their unique capability to process high throughput data with multiple dimensions makes ML especially useful for applications to large volumes of images or video. A thermal camera (infrared; IR) captured an instance of an unwanted leak in a solvent extraction process. Over twenty-five thousand images were extracted from several recordings captured using the IR camera and then sorted manually to create classifications for model training. Testing and comparison of 11 ML models was conducted using Python to determine which ML would be most effective to classify different images, including the ones capturing the leak. A minimum of 2 and a maximum of 10 classes were created and tested with each ML model to compare their performance with increasing complexity when training and testing sets are less than clearly defined to ensure reproduction of potential events. Each ML model included code to report on several metrics to measure accuracy and to determine which classes resulted in the fewest false positives. The best performing models across all metrics and number of classes were then adapted to test for real-time application to monitoring a video feed using OpenCV as a final validation. Results showed identification of the major classes on screen, including the presence of a leak, when using the original recorded videos. Real-time detection of potential future leaks using ML trained on the known dataset was of great interest and the code used can be packaged for remote use by an operator with no experience with Python.