



Powered By VISIONAERY

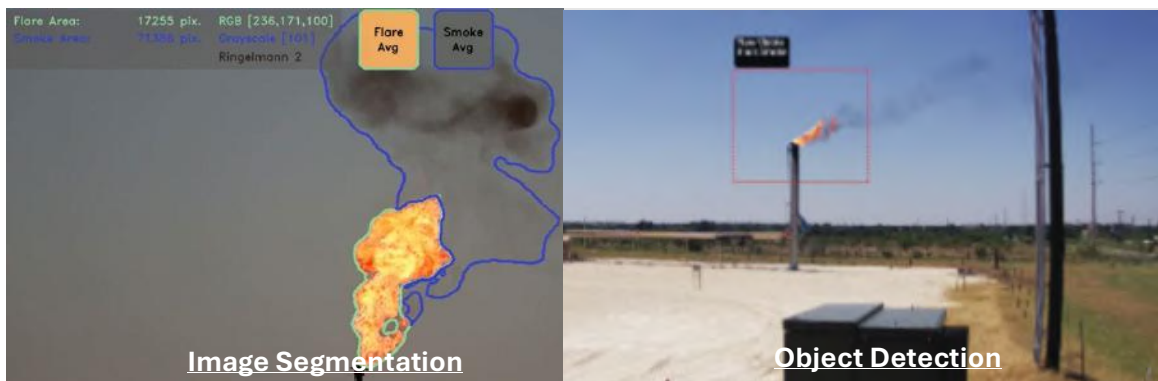
Streamlining Method 22 Compliance with the EagleVision Flare Monitoring Analytic

Twin Eagle Solutions has engaged with the Environmental Protection Agency (EPA) to develop and refine an innovative solution for automating Method 22 reporting processes for flare monitoring. Our efforts have culminated in a design that meets the EPA's requirements for Method 22 reporting, incorporating advanced computer vision analytics that are powered by the VisionAery Flare Monitoring Solution, sensors, and a comprehensive dashboard and reporting system.

How the EagleVision Flare Monitoring Analytic was Built and Overview of Image Segmentation vs Object Detection

What is Image Segmentation:

EagleVision's flare monitoring solution leverages the power of image segmentation in computer vision to accurately outline and analyze flare flames and smoke emissions. Unlike traditional detection methods that provide bounding boxes around objects, image segmentation offers pixel-perfect outlines, allowing for precise measurements and detailed analysis of the flare and smoke characteristics.



Advantages of Image Segmentation Over Object Detection:

Precision in Shape and Size Estimation: Image segmentation's pixel-perfect accuracy facilitates exact measurements of the flare and smoke, crucial for detailed monitoring and reporting.

Understanding of Object Composition: This approach provides insights into the structure and composition of flames and smoke, surpassing the capabilities of simple object detection algorithms.

Enhanced Handling of Overlapping Objects: Image segmentation excels in scenarios where objects overlap, such as dense smoke plumes, offering clear, individual outlines.

Improved Background-Foreground Separation: Accurate object-background separation is vital for analyzing flare operations in complex environments.

Fine-grained Analysis: Image segmentation enables a level of detail necessary for comprehensive environmental monitoring and compliance.

How the EagleVision Flare Monitoring Application Calculates Analytics.

The Eaglevision flare monitoring application provides the following information about flare process:

1. Image segmentation of pixels of Flare, with estimates for Area of Flare on the camera frame and average color
2. Image segmentation of pixels of Smoke, with estimates for Area of Smoke on the camera frame, average Color and Ringelmann Scale Value

Image Segmentation of Flare and Smoke:

Computer vision model identifies, and extracts contours of flare and smoke detected on the image. We draw these contours on application live view so that operators could see them in real-time. Additionally, these contours serve as inputs to algorithms, providing valuable data for further analysis and insights into the flare process.

Measuring the areas occupied by Flare and Smoke:

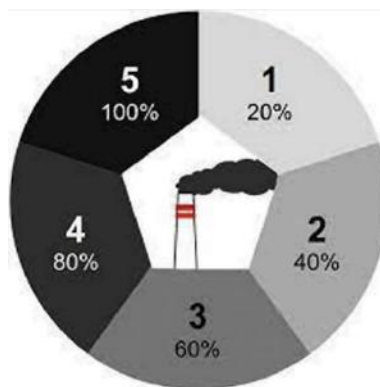
The algorithm takes the contours of flare and smoke as input and calculates the number of pixels enclosed within each contour.

Calculating average color of Flare and Smoke:

The algorithm receives flare and smoke contours as input and computes the average color of the pixels contained within each individual contour.

Ringelmann Scale Value Calculation:

The Ringelmann scale quantifies the apparent density or opacity of smoke and assesses the degree of smoke opacity based on the input smoke contour.



The algorithm for calculating Ringelmann Score:

1. Get smoke contour as input.
2. Calculate the average color of pixels inside this contour.
3. Determine the Ringelmann category based on this value.

How the EagleVision Flare Monitor will comply with Method 22 Reporting Requirements

Our solution employs a meticulously trained image segmentation neural network model, developed through extensive labeling of flare footage across various conditions. Below is the basic procedure for what the system will look like, what data will be collected, and how we will use the data to create a method 22 report.

- Deploy the EagleVision camera system including:
 - o A fixed camera
 - o EagleVision Flare Monitoring Analytic
 - o An edge server (**If deployed on an Axis ARTPEC-8 Camera, edge server is not needed**)
 - o A weather sensor
 - o Custom EagleVision dashboard for flare monitoring
- The camera will record footage of the flare 24/7.
- The analytic processes the camera's RTSP stream at a minimum rate of 1 frame per second, analyzing the data points of the flare and smoke (equating to a minimum of 86,400 times a day).
- Data from the flare monitoring analytic is exported to the flare dashboard on the edge server, which tracks this data over time.
- The dashboard also receives and processes weather data from the on-site weather sensor and maintains permanent data of the flare, site, and company ownership.
- For continuous flares, a 15-minute Method 22 test is conducted at the same time every day. For intermittent flares, a 15-minute test is performed at the first start of the flare in a 24-hour period, with only one test conducted per 24-hour time frame.
- A flare test includes the collection of:
 - o Static data (company, observer, flare ID, site)
 - o Date and time of the test.
 - o Weather conditions during the test (wind speed, wind direction, precipitation levels, sky condition)
 - o Smoke output measurements during a 15-minute window, providing two values:
 - Total time smoked in seconds and minutes.
 - Emission frequency in percentage
 - o A photograph of the flare at the time of the test
- Post-test, the EagleVision dashboard compiles all collected data into a PDF report, which is then either uploaded to a shared folder for the end user or sent as an email attachment to the specified recipients.

Conclusion

We are currently working with the EPA to certify the EagleVision Flare Monitoring Solution as a recognized method for automating Method 22 compliance. By achieving this, we aim to reduce compliance costs for operators and provide the EPA with more consistent, accurate data on flare operations across the United States.