

Manufacturing Safety – Oil leakage/Spill Detection for Oil Pumps



SITUATION

A US Oil Pump manufacturer with numerous oil pumps installed in several oilfields wanted to find an intelligent solution to monitor oil leakage/spillage in oil pumps. Their current process involved manual activities of inspecting the images of Oil Pumps captured in the Oil Fields through camera installed at strategic zones in the oil field sending pictures at a 15 minutes interval spanning the set of Oil Pumps

IMPACT

Due to significant manual activities involved in the entire process, the customer was incurring huge operating costs in monitoring the massive corpus of images in detecting and identifying a possible leak/spillage of the Oil Pumps.

RESOLUTION

ITC Infotech designed a computer vision solution using Deep Learning technique involving Image Processing and Convolution Neural Networks, which provided the probability of a pump having a leak and also the leak localization zone for an Oil Pump. The solution provided a manifold improvement of the existing manual process in saving both operational cost and time.

The Customer

US based Oil Pump manufacturer



The Need

Oil leakages pose compliance and economic risks for oil manufacturers. The effects of leakage go beyond repair expense and cost of lost oil or gas, it also significantly affects the human lives and environment. The customer sought a cost-effective monitoring solution that does not compromise on accuracy. They wanted to explore a solution wherein images are analyzed by machines and in case of leakages, the machines issue alerts. To impede these huge costs, a reliable leak detection technique is crucial. Many researches have been done during last decades to find the location and size of the leakage with high accuracy. In this work, we devised Deep Learning based solution using Convolution Neural Networks(CNN) and image processing techniques to detect and localize the leakages in oil pumps.

The Solution

The modelling was done in two-stage process, where the first stage was identification of leak using CNN and second stage was leakage localization using sliding window technique in OpenCV. For CNN we used Keras, a Python library for deep learning that wraps the efficient numerical libraries TensorFlow and Theano. Historical images of Oil Pumps with supervisory tags on leakage status were pre-processed using Image Data Augmentation techniques where images were horizontally and vertically flipped, rotated (zoom in and zoom out) to detect leaks at various directions. Further a Convolution Neural Network model was trained using the transformed images by deciding on optimal number of different type of layers suitable to develop the network given the context, viz. Convolution Layer, Max Pool Layer. For the task of defect localization of the leakage we have used Sliding Window Technique from OpenCV. Sliding windows play an integral role in object classification, as they allow us to localize exactly "where" in an image an object resides. In the context of computer vision, a sliding window is a rectangular region of fixed width and height that "slides" across an image. For each of these windows, we would normally take the window region and apply an image classifier to determine if the window has an object that interests us in this case, a leak/non-leak. Further the model was validated and parameter tuned to make it production ready.

Business Benefits

- Significant reduction in manpower cost.
- Mostly-automated monitoring reduced workforce requirement for monitoring-specific roles and retained manpower for ongoing training of the model
- Significant reduction in the economic losses
- Near real-time monitoring of the leakages leads to well-timed / preventative repairs
- An end-to-end knowledge repository and documentation library for the data infrastructure along with data lineage ITC

ITC Infotech's Data - Infrastructure to Insights Practice

ITC Infotech provides Analytics, Big Data and Information Management services through its "Data – Infrastructure to Insights" line of business. Driven by strong leadership in domain and technology consulting, ITC Infotech provides modern solutions to help organizations harness the value of data. With a strong focus on design and differentiated delivery, ITC Infotech provides cost effective solutions, innovative offerings and customer delight.

In the areas of Industry 4.0 or IoT, ITC Infotech focuses on Analytics and Business Intelligence solutions that help organizations provide superior quality of care, enhanced patient engagement, accurate regulatory reporting, and financial and operational excellence.

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