AI Contaminant Detection

Exploring AI capabilities for contaminant detection in X-ray images

Student

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Introduction: In the area of food safety, X-ray systems play a critical role in identifying and mitigating potential contaminants in packaged food products. Current systems often use deterministic algorithms with fixed detection thresholds to analyze X-ray images, ensuring the identification of contaminants such as metal, glass, stones and bones, while minimizing false rejection rates. A disadvantage of this approach is that a lot of use-case specific work needs to be done for a new inspection.

Problem: In the quest to improve contaminant detection capabilities, there is a growing interest in exploring the application of artificial intelligence (AI) to image analysis.

The objective of this project is the evaluation of the effectiveness of AI algorithms in the detection of contaminants in images.
Specifically, the task is to detect contamination in X-ray images of milk bottles while maintaining low false rejection rates. The dataset provided for this project consists of 2380 X-ray inspections, each with two images taken from two different perspectives.

Result: Both supervised and unsupervised machine learning methods were evaluated on the dataset. It was found that a supervised approach was not suitable for the problem. Instead, an unsupervised representation-based anomaly detection method called Patch Distribution Modelling (PaDiM) was used.
With a PaDiM model and a fine-tuned pre- and post-processing pipeline, an overall accuracy of 94.9\% was achieved on the test set.

A Python package called anomalxray was implemented to allow easy training and evaluation of PaDiM models, as well as saving and loading of models for datasets with multiple views.

Raw X-Ray Image With Contamination
Own presentment
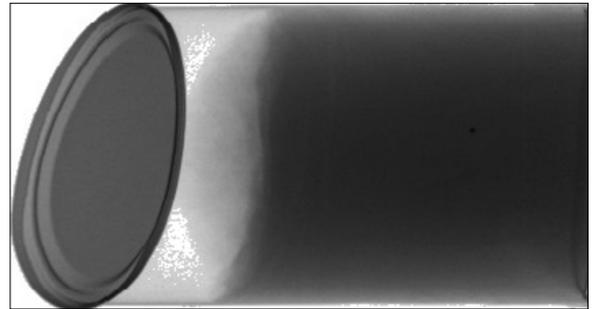
Model Output - Anomaly Map
Own presentment
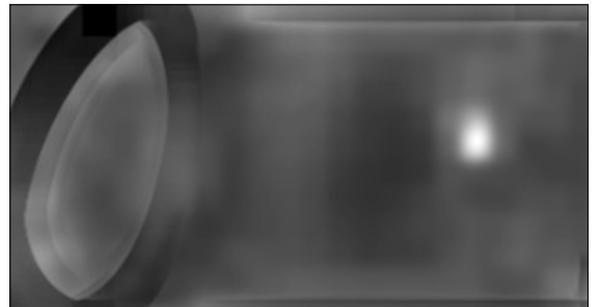
PaDiM Model Architecture
https://arxiv.org/abs/2011.08785
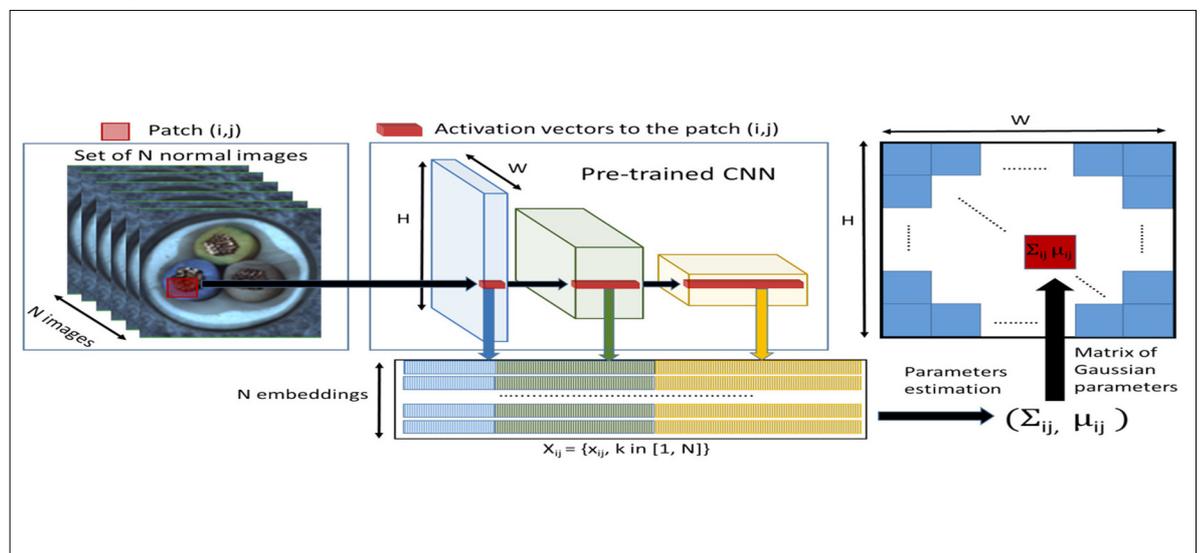
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Subject Area
Data Science

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