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Mechanical and Control Engineering,
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Image Processing with Deep Learning

Autoencoder-Based Defect Detection System for Metal Nuts

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Problem Definition and Goal

Background

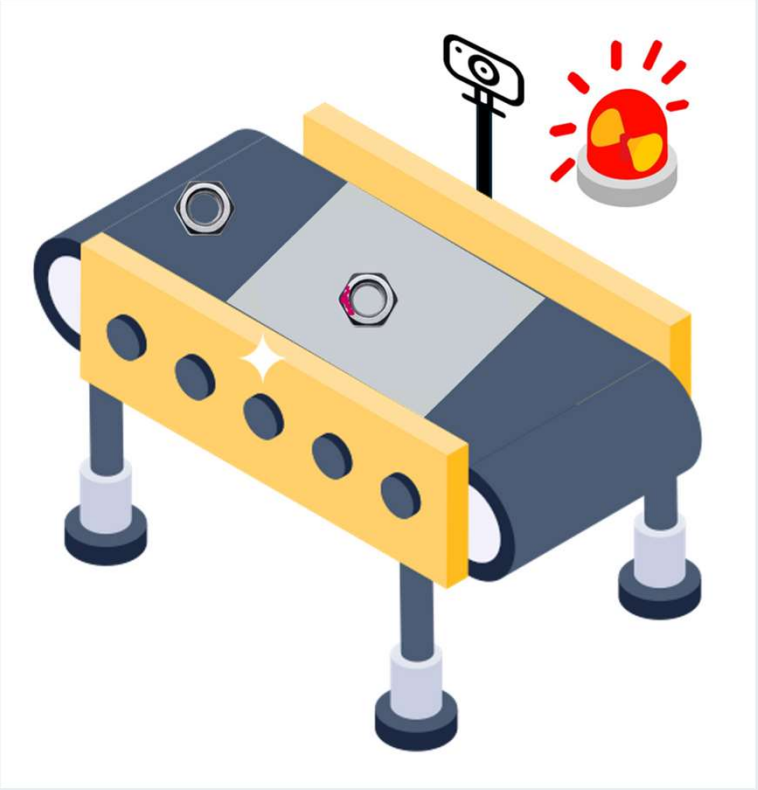
Metal nuts are widely used in industries, where structural reliability is critical. Defects in metal nuts can lead to serious safety issues. Also, hard to classify with humans eyes.

Objective

To reduce human errors, develop an **anomaly detection system** based on an Autoencoder trained exclusively on normal patterns

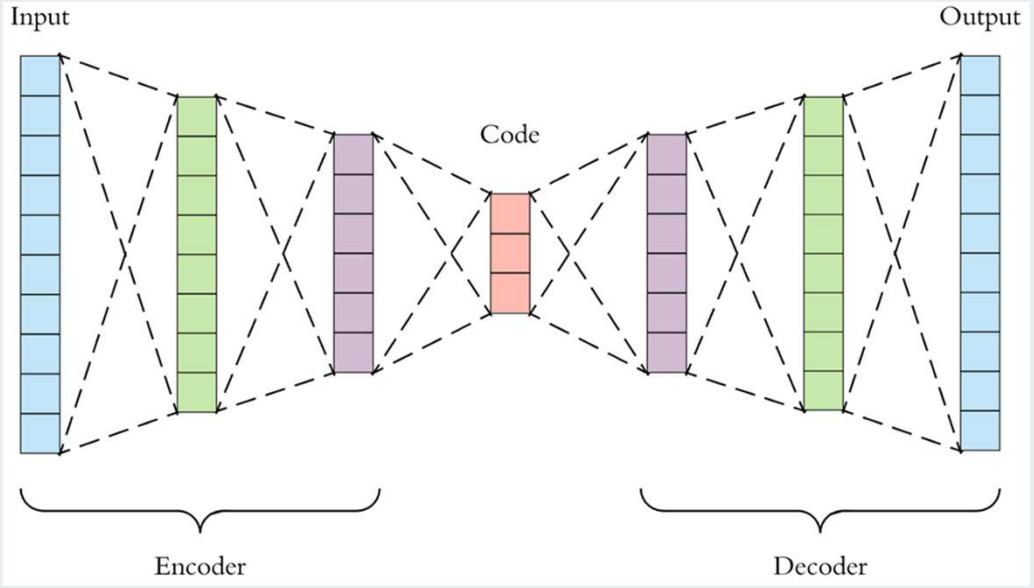
Goal

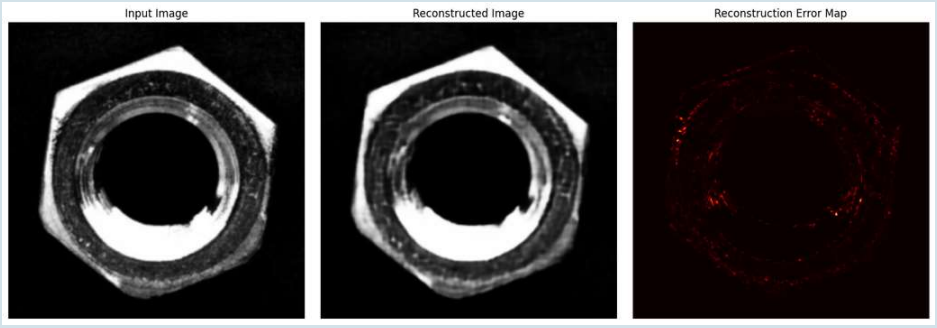
The system detects anomalies with over **75%** accuracy, enabling real-time quality control.

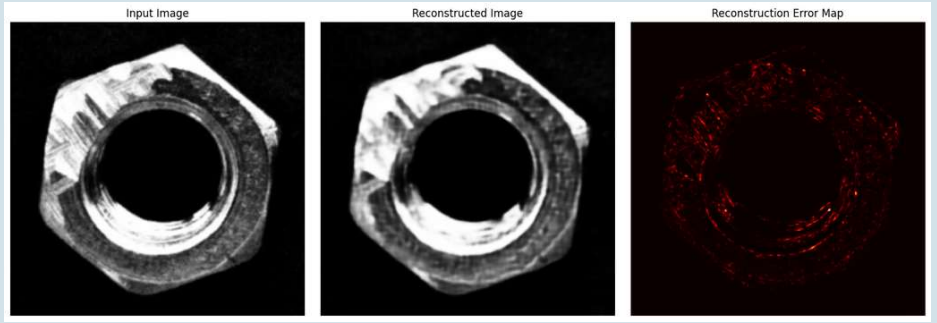


02

Proposed Method: Convolution Autoencoder

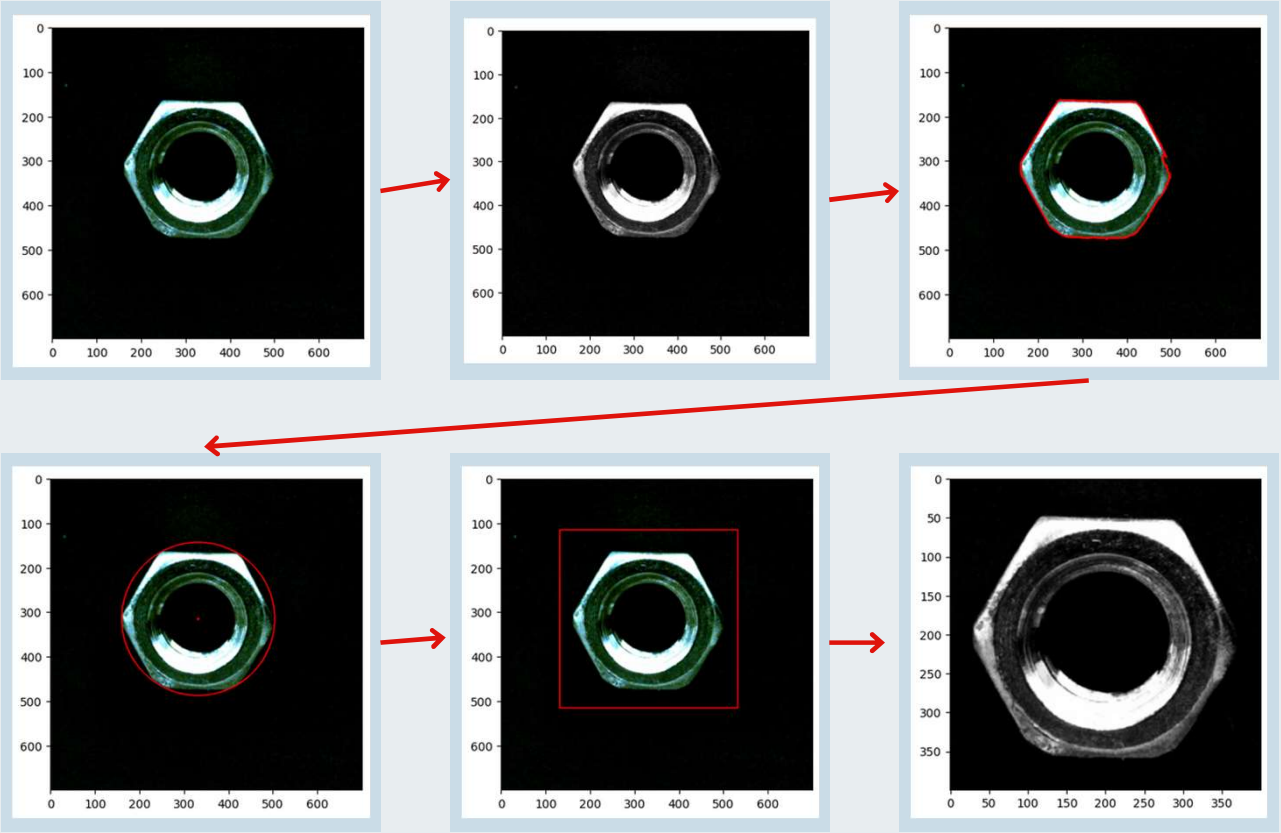






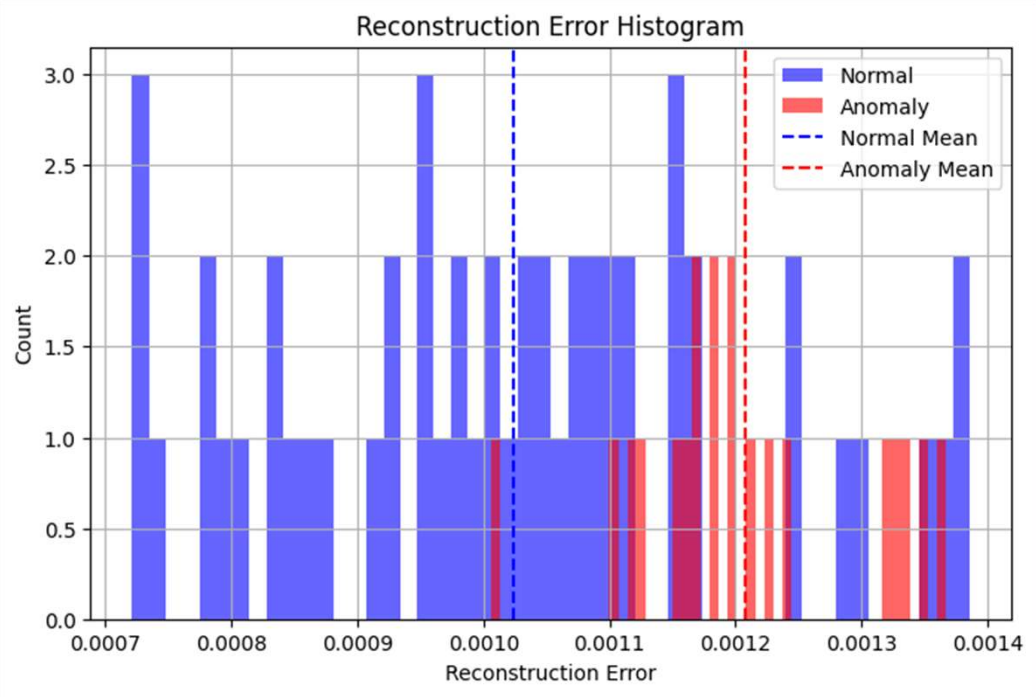
03

Dataset & Preprocessing

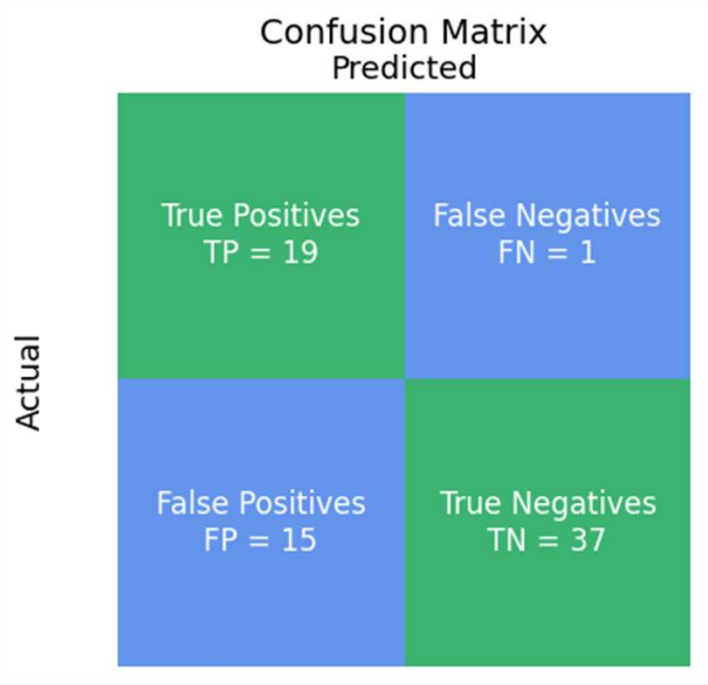


04

Model Evaluation & Thresholding



Threshold = 0.0011

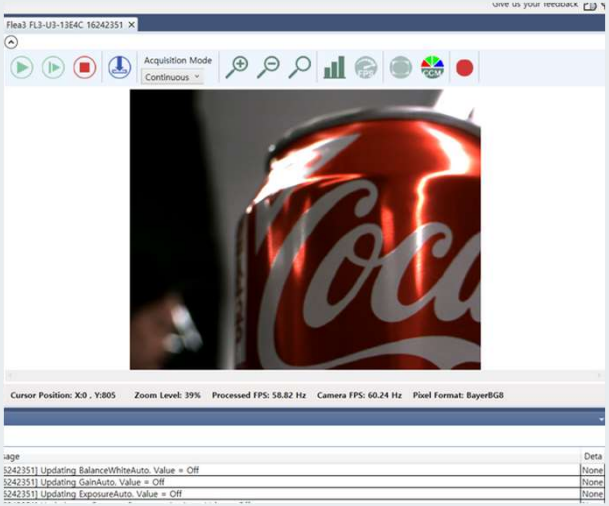


Accuracy = 0.778
Precision = 0.559
Recall = 0.950
F1-score = 0.704

05

Machine Vision Camera

Camera: Point Grey e2v EV76C560
Control tool: Spinnaker 4.2.0.83



Sensor type: CMOS

Sensor model: e2v EV76C560

Resolution: 1280 × 1024 (1.3 MP)

Pixel size: 5.3 µm × 5.3 µm

maximum frame rate : 60fps

Optical Format: 1/1.8″

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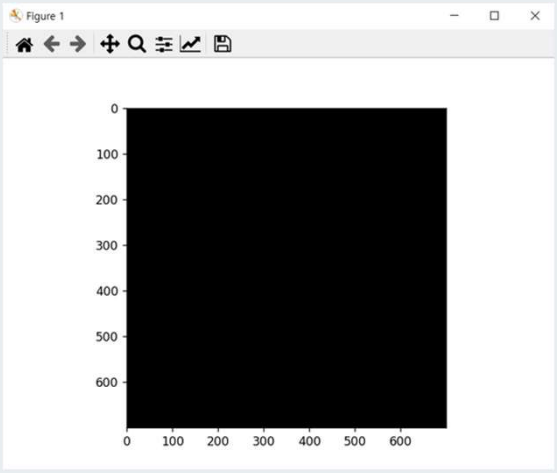
Object Detecting Algorithm

cv.absdiff(before_frame, current_frame)

Returns a new image by computing the absolute difference between the pixel values of previous frame and current frame.



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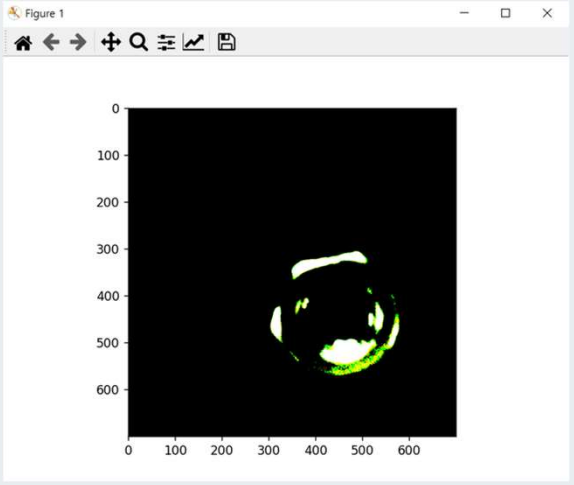
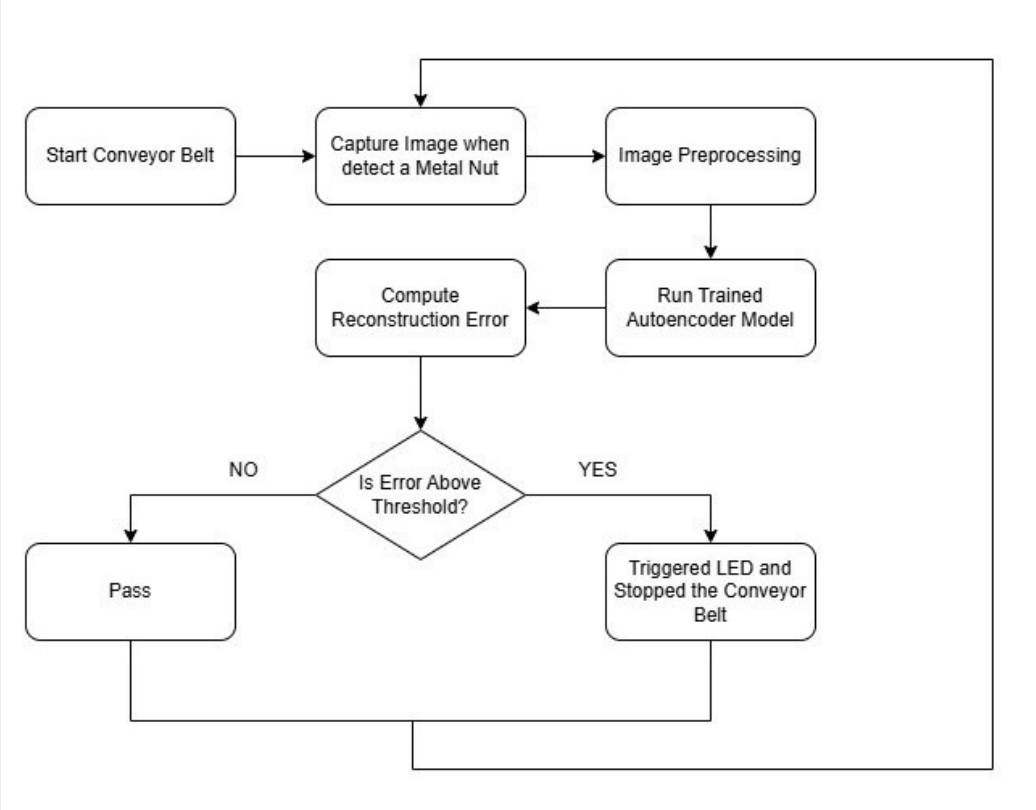


<Object detected>

07

Real-Time Classification System



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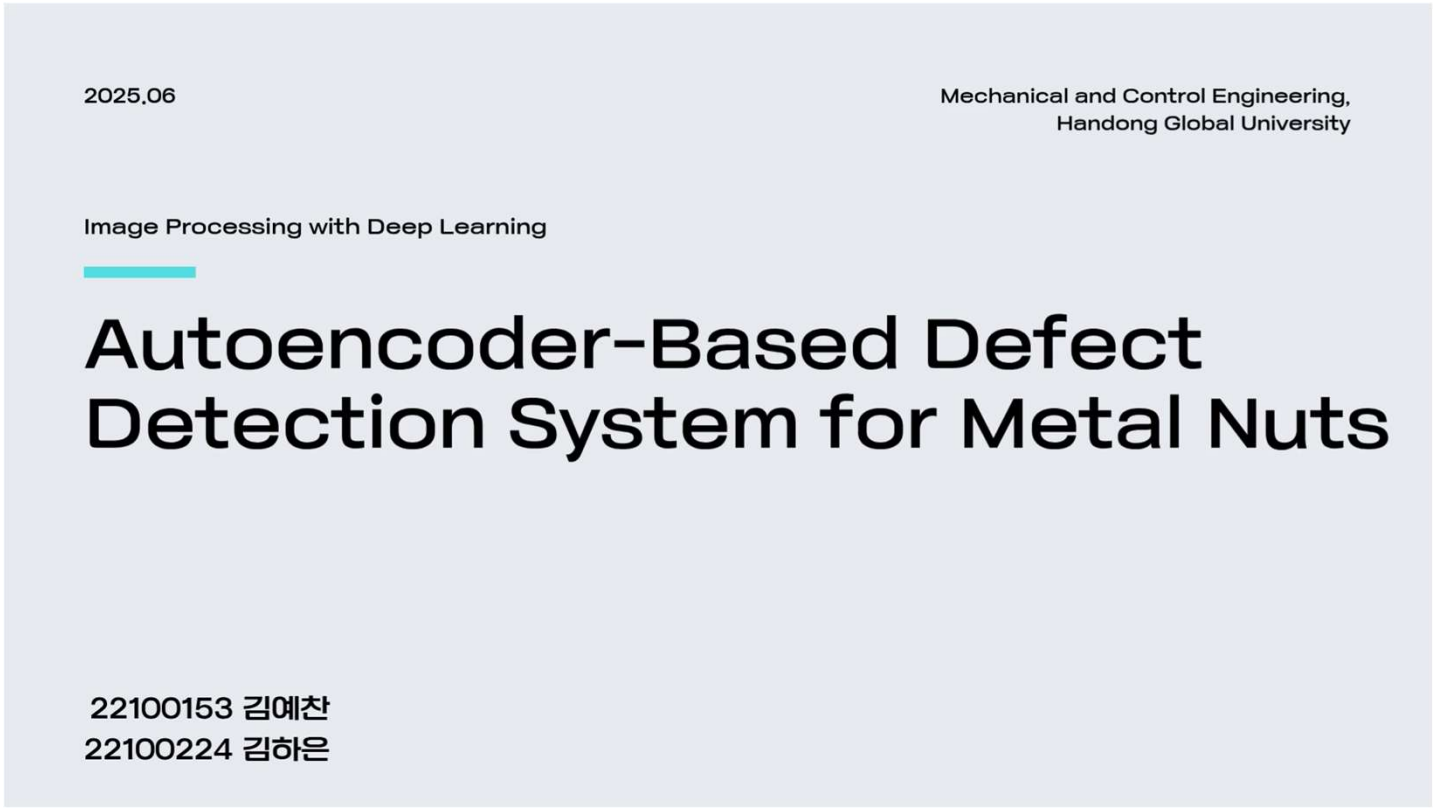
Demo Video



감사합니다!