

Preventing Production Defects with AI!

If you run a business that focuses on manufacturing products, you know product quality is an essential feature for success. Recalls, lawsuits, and regulatory fines are some of the pain points a manufacturer may experience if a product you made turns out to be defective.

So it's understandable that manufacturers dedicate a great deal of time and effort to avoid these defects. Visual inspection is one of the most common methods used by manufacturers to check for errors, anomalies, and defects. Traditionally, visual inspection for quality control of product assembly processes is performed by humans, but humans are often not up to the job, because of the large number of items that need to be inspected.

AimValley has created a tool to automatically detect assembly defects during product manufacturing. In this case, human errors during placement and tightening of screws must be detected. Using traditional algorithm-based methods turned out to be cumbersome, labor-intensive, and inflexible.

Machine Learning algorithms can apply what has been learned in the past to new data using annotated examples to predict future events. Starting from the analysis of a known training data set, the learning algorithm produces an inferred function to make predictions about the output values.

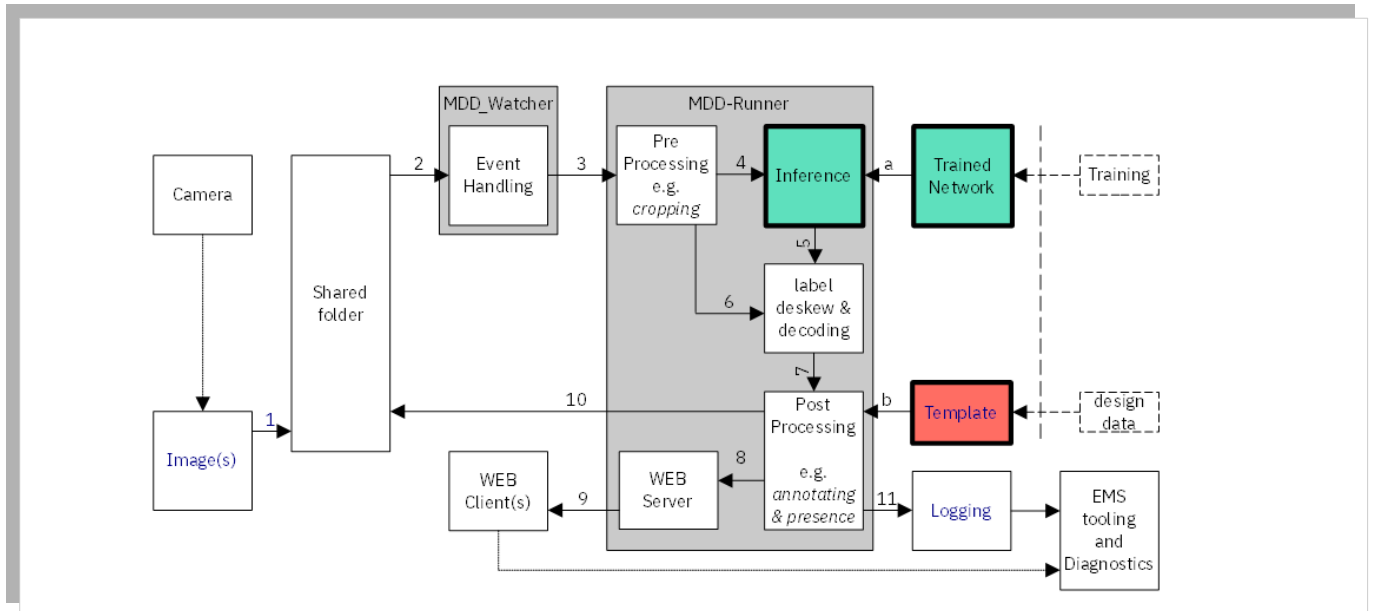
The learning algorithm compares its output with the correct, intended output and finds errors in order to modify the model accordingly. Once the model performance is satisfactory, it is applied in practice, known as inference.

Applying AI gives much better results and covers also assembly aspects such as checking the correct placement of product labels or thermal pads.

Applications

- Face recognition in CCTV
- Behavior detection in crowds
- Number plate detection in traffic
- Fraud detection
- Autonomous driving
- Fault detection at assembly lines

Manufacturing Defect Detection Process Flow



Process Steps

- (1) Camera image(s) are dropped into a local, shared folder – recording start.
- (2) Recording is detected by the MDD-watchers.
- (3) Process which pushes the image towards the MDD-Runner process.
- (4) First the MDD-Runner performs basic image preprocessing e.g. cropping, before ML inference takes over.
- (a) The objects are identified including location and confidence level using supervised training network.

In this particular case a pretrained ResNet50 network, which is trained to identify assembly relevant objects, like screws missing a marker, heat pads and labels.

Note: that screws are only marked if the right amount of torque has been applied.

For flexibility and re-use reasons it is important that the trained network is not biased by location.

The text/1d/2d label objects are normalized and decoded using traditional methods, for which following elements are required:

- (5) Location and (6) High resolution image
- (7) Finally all found objects are checked (using scripting), against an assembly-specific template **(b)**.

The template is derived from the electronic and mechanical design database for the PCB and contains the expected objects and their location.

Note: objects which are not in the template are regarded as unexpected and considered wrong.

The same applies to objects found at a wrong location.

- (11) The PASS/FAIL conclusions and confidence levels are logged, and pushed by a WEB server towards one or more WEB clients (8).

Key parameters of the model

- 2000 PCB images
- 3000 generated artificial PCB images
- 1000 PCB images with fabricated failures
- 150 000 individual, learned objects, ~22 objects per image
- 200 PCB images containing some fabricated failures, used solely for acceptance testing and Machine Learning network selection.
- The generation of artificial PCB images is mostly automated.



[Start MDD Demo >](#)

AimValley's Manufacturing Defect Detection Expertise

Product Development

Product Development is a complex and time consuming process, requiring specific types of expertise and experience. AimValley provides Design Services for the entire development cycle; from product idea to realization.

[> Product Development Process](#)

Factory Introduction

When we talk about end-to-end product development, we include the expertise of our Factory Introduction team. We help you to find a contract manufacturing company that is ideal for the complexity and intricacy of your product.

[> Factory Introduction](#)

Why AimValley?

AimValley is a reliable provider of Edge Technology since 2003, delivering solutions for:

- High speed data processing applications
- Complex FPGA-based accelerated systems
- High speed, low power hardware equipment
- Robust embedded software
- Early adopter of Acceleration Technology

AimValley understands the full complexities as well as the subtle nuances of designing great edge solutions. We excel in building complex systems that are part of your product in the fields of Industry 4.0, Big Data, Healthcare and Transportation markets.