

Goal

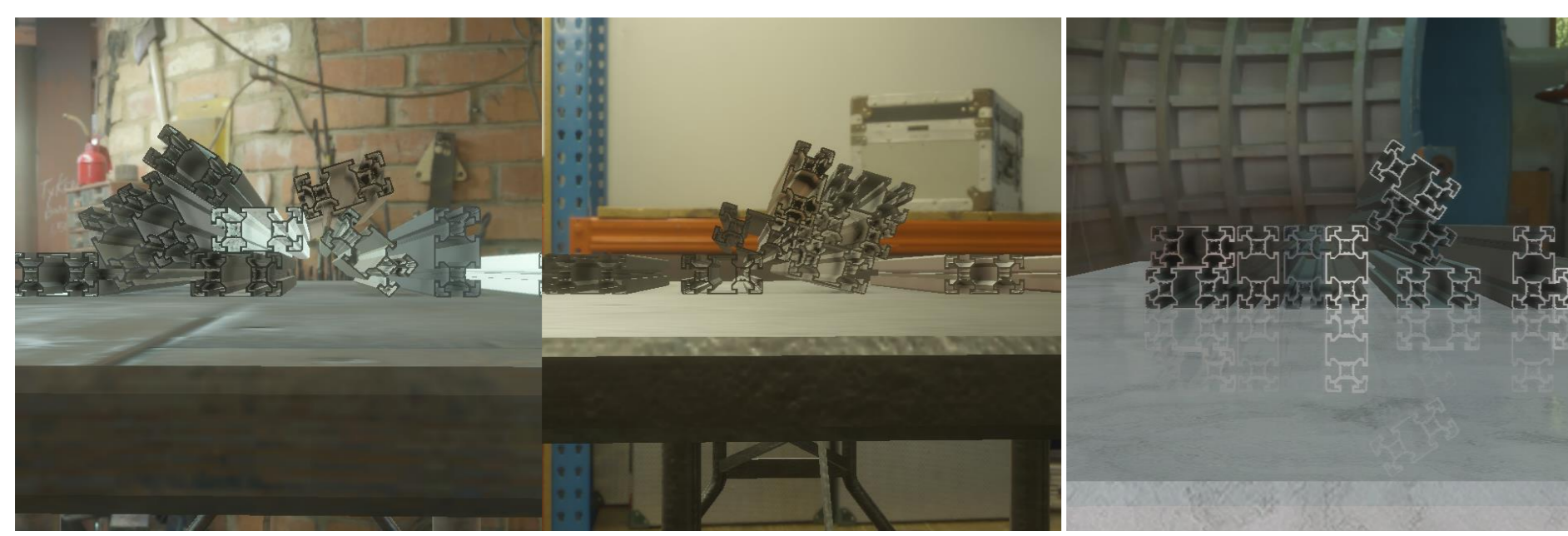
Facilitate Image Dataset Generation for Deep Learning Vision Tasks

Motivation

- Supervised deep learning is commonly used for object detection tasks due to its robustness, inference speed and accuracy.
- A larger dataset will generally improve results, but data annotation is a tedious and time-consuming task.
- Therefore, we developed workflows to quickly generate and automatically annotate data for manufacturing applications such as object counting and defect detection.

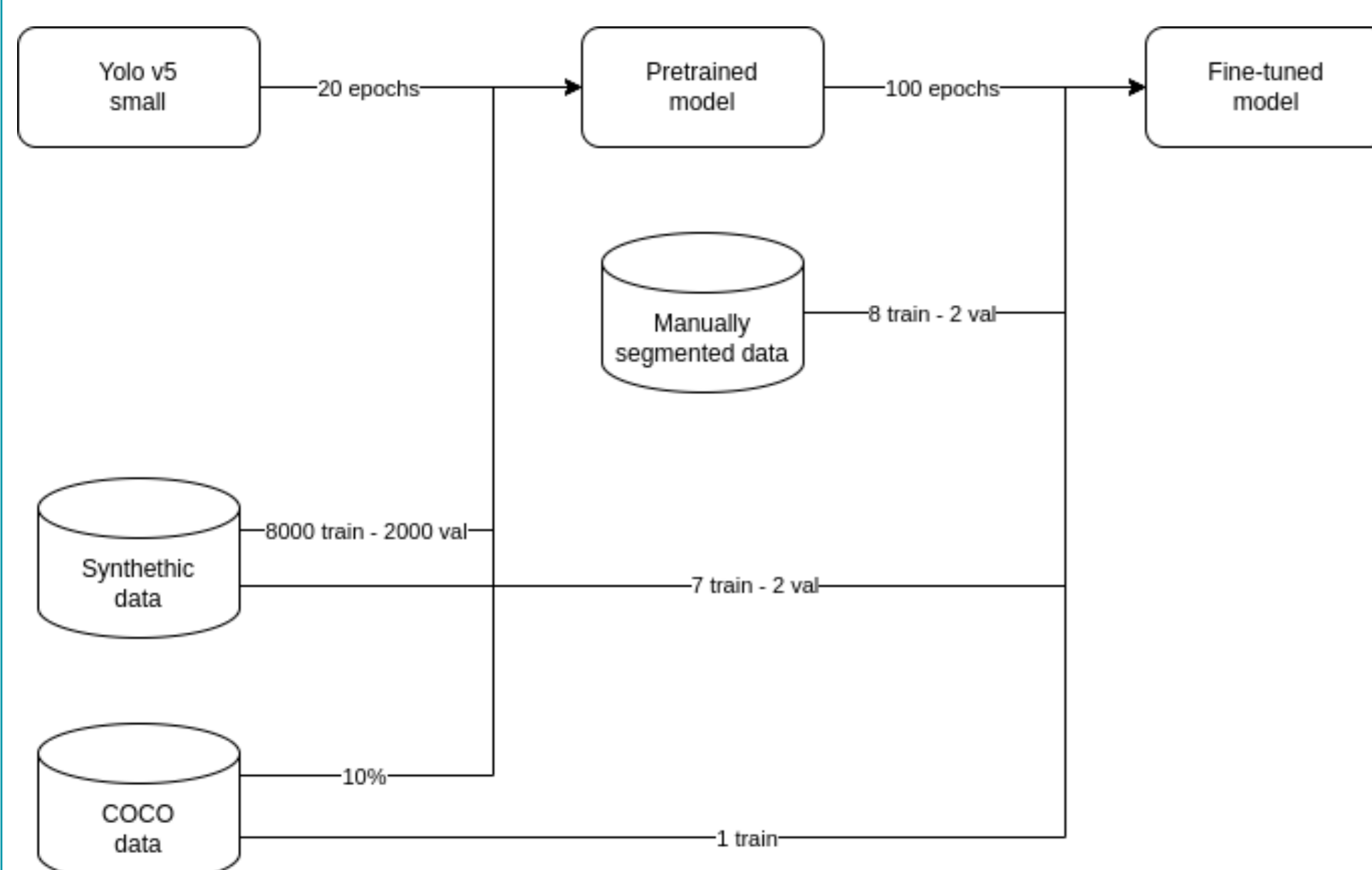
Synthetic Data for Object Counting

- We modified the CAD2RENDER[1] software to create synthetic images from a side view, for an object counting application

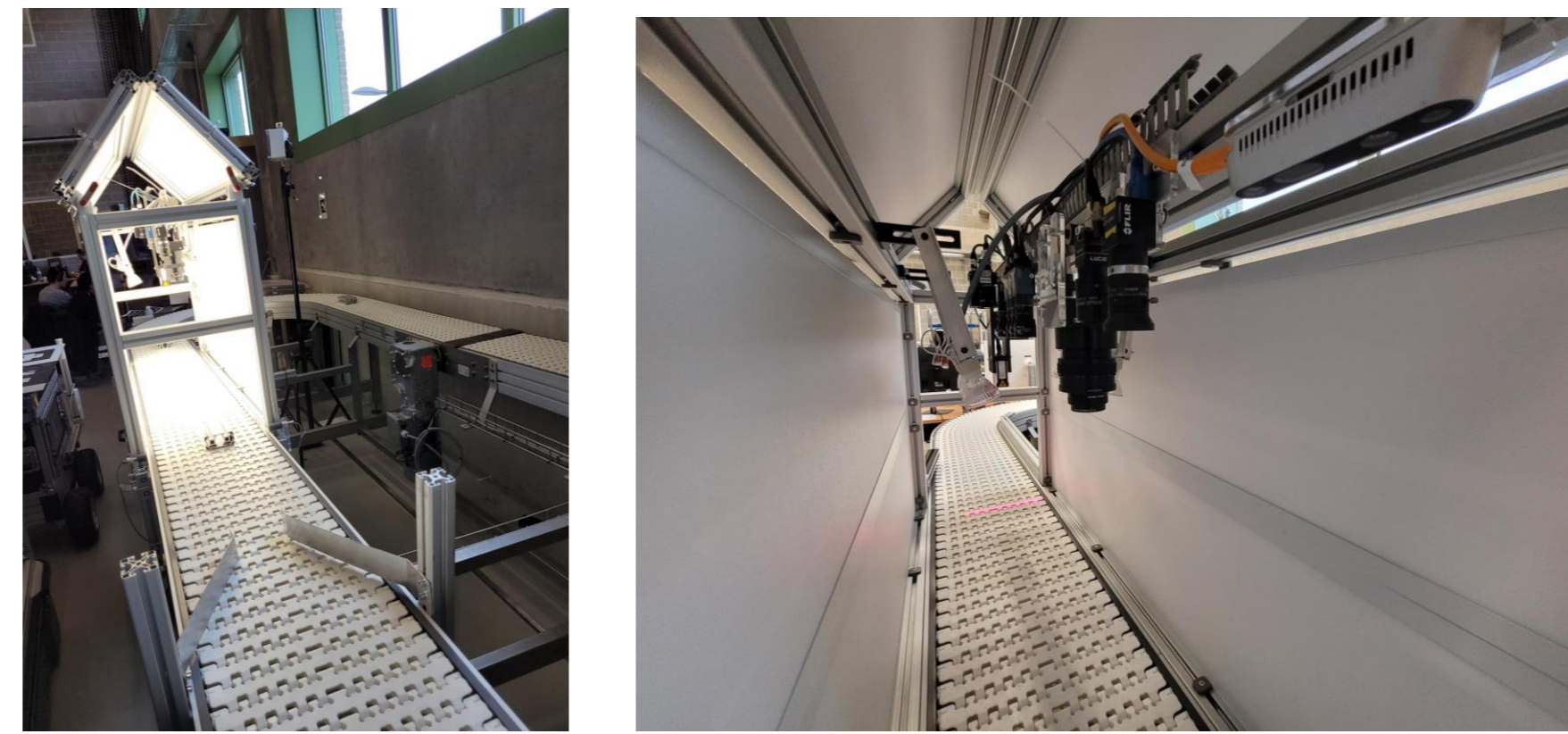


Example samples from the synthetic dataset

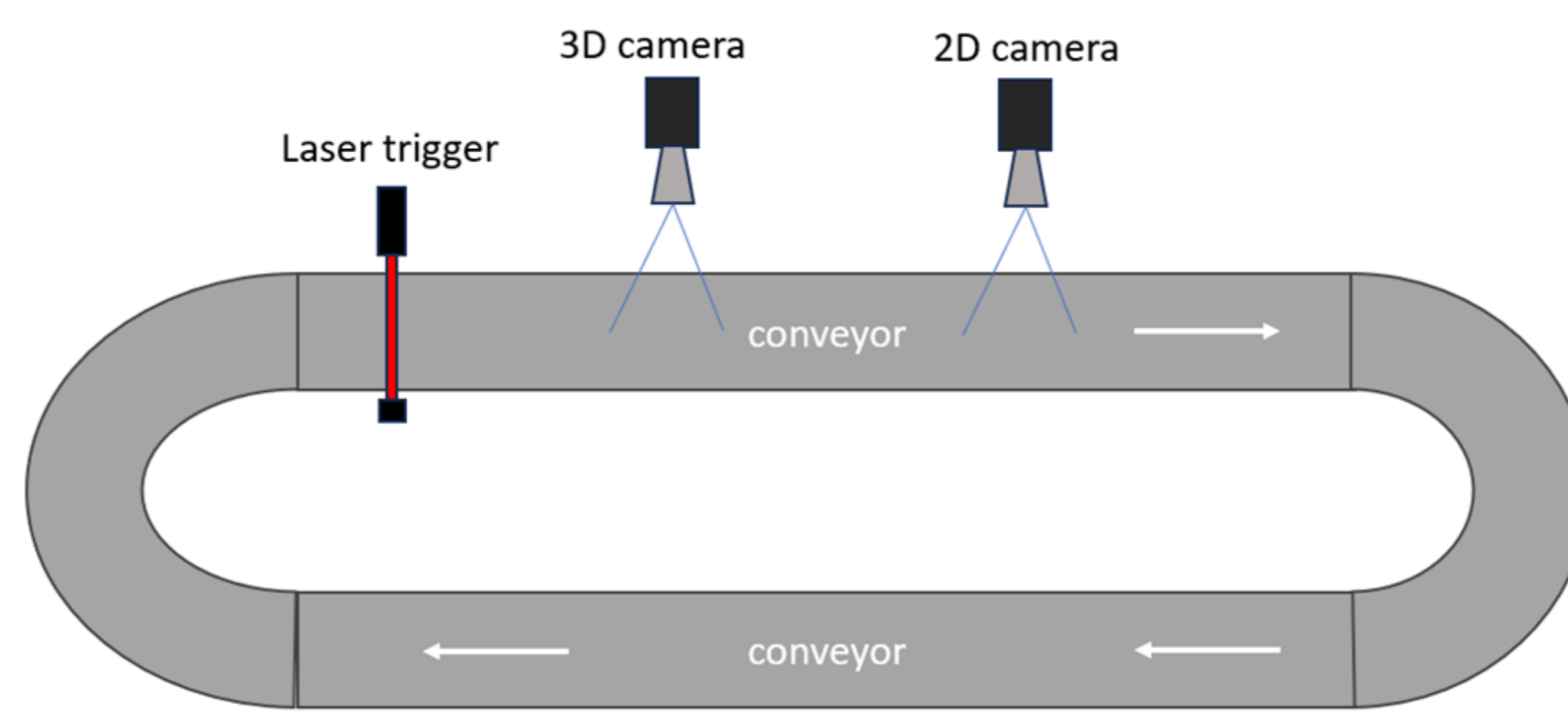
- To enhance generalizability of the model a small amount of real data with annotations (10 images) was used in the training of the model [2,3]



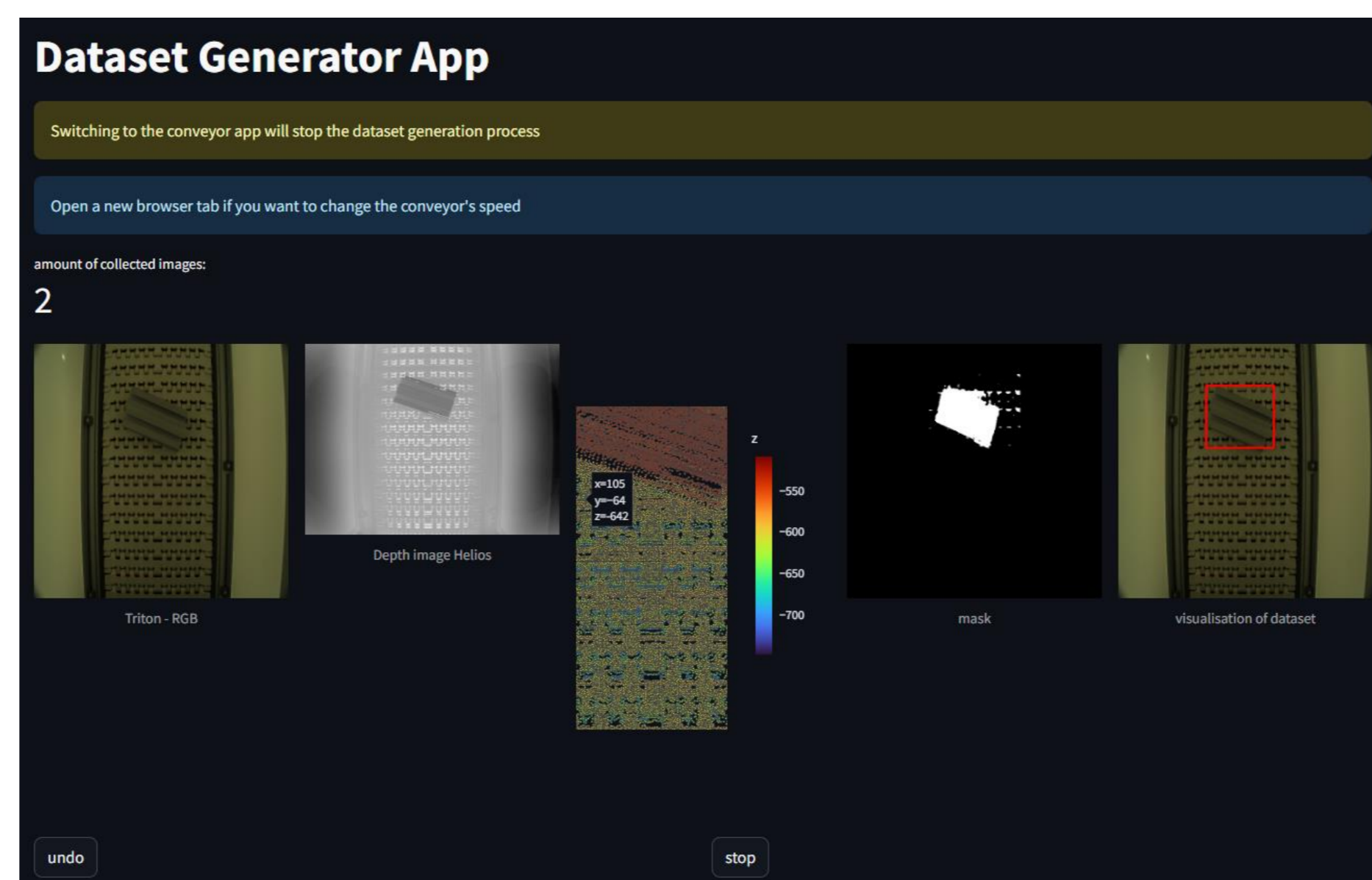
Conveyor Dataset Generator



- We have built a sensor tunnel on top of a conveyor system to easily record objects with different sensors and test production applications.
- We developed an application that uses the 3D sensors to auto annotate the object location in the image.



- Our sensor setup includes a Lucid Helios 2+ sensor, which is primarily used for generating 3D point clouds.
- A laser trigger and the speed of the conveyor are used to trigger the recordings from the sensors, such that the object is in the center. A calibration of the two sensors, can align the sensor data further.
- A GUI was developed to make the system an easy to be used infrastructure: It is accessible in the web browser and the dataset can automatically be downloaded



- From the 3D information a segmentation mask or oriented bounding box can be extracted.
- By running the generator with multiple objects on, multiple sets of images can be generated for a classification datasets.

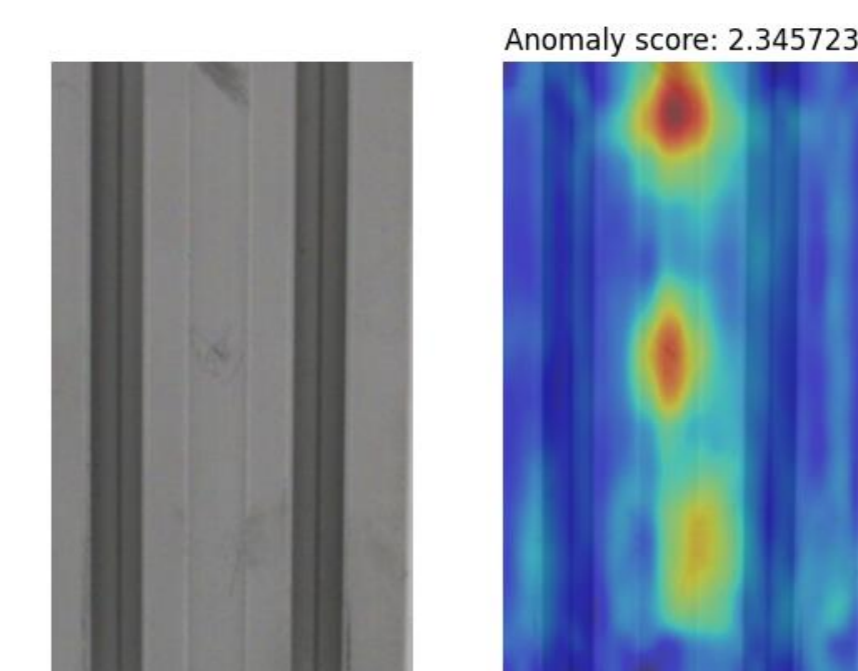
Results

Infrastructure and easy workflows to generate datasets and train AI models fast. The whole training can be done in one day.

- Using the dataset generator is quite straightforward, typically getting a dataset of +-100 images will only take about 30mins of time.



Datasets with wide variability of objects have been made on the conveyor



- We used the dataset generator to record images of undamaged profiles and train an oriented bounding box detector and anomaly detector[4] on the crops.

- For synthetic images: It takes 6 to 8 hours to generate 10000 images.

- We used the synthetic dataset generator to train detectors in a non conveyor setting, such as counting stapled profiles on a pallet.



Key take-aways

- Dataset generation and annotation is often time consuming
- Our developed infrastructure and workflows allow a quick generation of image datasets
- This allows fast training of
 - Oriented Bounding Box Detection and Segmentation Tasks
 - Classification and Anomaly Detection Tasks

Further reading

1. CAD2Render: <https://arxiv.org/abs/2211.14054>
2. Yolov5: <https://docs.ultralytics.com/yolov5/>
3. Yolov7: <https://arxiv.org/abs/2207.02696>
4. PatchCore: <https://arxiv.org/abs/2106.08265>