

Using synthetic data for Object Detection on the edge in Hazardous Environments

Damil Sabotic - da4754sa-s@student.lu.se
Faraz Azarnoush - fa8540az-s@student.lu.se

December 18th 2023

1 Introduction

The process of teaching a computer to visually recognize items is object detection in a nutshell. Collect the images you need, feed an object detection model a lot of these images and you hopefully you will be able to get some good results, however what happens when there are no images on the objects you wish to detect? For example: what if we have a hazardous environment, such as a factory, where we simply can't collect these images?

2 About this thesis

When collecting data from a hazardous environment, it's important that the equipment adheres to intrinsic safety regulations. Normal electrical equipment might produce sparks or thermal heat which could start a hazardous event like a fire or explosion. This process is both expensive and time consuming.

This is where synthetic data enters the picture. Synthetic data is data that is human made, fabricated data, not real collected data. In this thesis we experimented with what would happen if we recreate a hazardous environment in a 3D design program such as Unreal Engine in order to create synthetic data that we can use to train our object detection model with.

But will an object detection model be able to recognize real-life objects when being trained on synthetic data created in Unreal Engine? Not only is there a gap between real images and synthetic images, but the edge devices are not strong enough to run the most advanced neural networks.

With some techniques used such as texture randomization, augmentation and parameter fine-tuning, we managed to get very good results! Large objects were easy to detect and the model managed to detect them 100% of the time, while the smaller and more complex objects got a score of 90%.

This shows that there can be a big opportunity to shift from collecting real data to generate synthetic data for modern object detection models used on edge devices. Instead of sending an employee to a dangerous location to collect data, one could recreate the scene with a 3D design tool to save time and money, and still expect high performance.