cdbb

Centre for Digital Built Britain

Open ML Training Data For Visual Tagging Of Construction-specific Objects (ConTag)

Benefits to infrastructure owners, asset owners, researchers

Summary

ConTag has generated open datasets for visual machine learning (ML) specific to the construction industry. ML technology has enabled a revolutionary leap in many digital economies generating growth in activity and business mainly for the ITC sector. Part of the growth is generated through sharing of IP, knowledge, tools and datasets. We want to adopt this approach for the digital construction sector. ConTag provides visual and 3D training datasets for training deep neural networks (DNNs) and provides weights for pre-trained networks. The research output is to support visual tagging of assets from reality capture data. Such automatically generated semantic information can be used to generate or populate digital twins in the example scenarios. The first dataset is a collection of fire safety equipment typically found in indoor environments. The dataset contains the classified images, per-pixel label images and bounding box data for object detection. The second dataset is a synthetic 3D point cloud of an outdoor urban street scenario. The dataset contains the point cloud data and per-point label data.

Impact and Value

We have generated SynthCity an open, large-scale synthetic point cloud. We release this dataset to help aid research in the potential use for pre-training of segmentation/classification models on synthetic datasets. Impact of such research outcomes are in the automated tagging of urban assets. Owners or stake holders in urban infrastructure can take stock, monitor change and generate digital twins through automatically classified reality capture data.

In addition we have generated FireNet an open ML training dataset for visual recognition of fire safety equipment. We release this dataset to kick-start further ML developments in both academia and industry and as a seed point for collaborative research. Impact of such research outputs is in the automatic asset tagging for fire safety equipment form (mobile phone) imagery. Building owners or asset managers can populate digital twins with this automatically generated tagging information.

Next Steps

FireNet has been designed as a ML training dataset for experimentation and therefore fulfills multiple machine learning scenarios (classification, object detection, sematic segmentation). The dataset itself is not big enough to train a modern DNN from scratch. It is intended as a domain specific dataset to refine pre-trained standard architectures. There is a remaining class imbalance and a small number of images that were not successfully labelled. As part of a continuous maintenance to the dataset we are exploring options to revisit the remaining images.
SynthCity has been designed primarily to be used for semantic per-point classification. Whilst this is useful for a range of applications, currently the dataset does not contain instance IDs for individual object extraction. With SynthCity being an ongoing project we plan to implement this in future releases.

Research Acknowledgements:

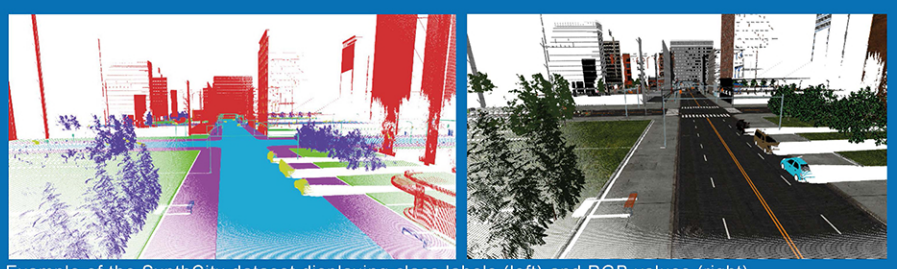
David Griffiths, Fabio Panella, Victor Melatti

Key Findings

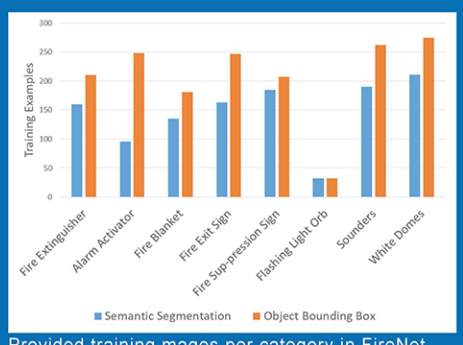
We explored crowd-sourcing of semantic labels for technical equipment in images. We have shown that even relatively small teams can generate relevant sized datasets with a quick turn-around. Our tool chain has proven successful and we are able to generate further domain specific datasets with future collaboration partners.

Example of the FireNet dataset: image with classification label, object with bounding box and segmented object (left to right).

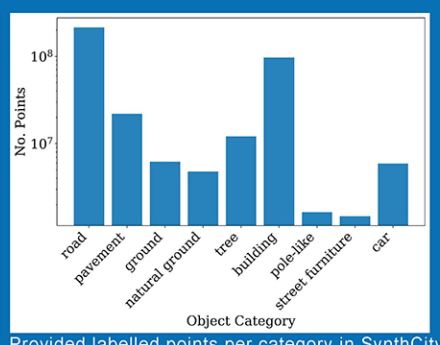
Per-point 3D segmentation requires highly skilled users and manually generating perfect labels for even the most advanced users is non-trivial. We argue an ability to generalise from synthetic data to real world data is immensely beneficial to the community as a wealth of existing synthetic 3D environments exist. The primary purpose of our dataset is therefore to offer an open dataset to aid further research assessing the potential of synthetic datasets for pre-training Deep Neural Networks (DNNs) for automatic point cloud labelling.



Example of the SynthCity dataset displaying class labels (left) and RGB values (right).



Provided training mages per category in FireNet



Provided labelled points per category in SynthCity

Long-term Vision

We expect this shared and open datasets to kick-start further ML developments in both academia and industry. It is intended as a seed point for collaborative research.

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