

The Hong Kong University of Science and Technology

MATH 4995

Capstone Project for Data Science

Fall 2021 Project Proposal

Project Topic: Workers Supervision for Construction Safety

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Problem Identification:

The construction industry has never been less worth attention with number of giant buildings and skyscrapers significantly growing every year. However, going along with it, the number of workers injured or even died in tragic accidents happened in construction sites is also increasing excessively, making the need to enhance construction safety hotter and hotter. Several preventions and protections have been developed to deal with those accidents for many years, yet they mostly relied on human effort with fatal limitations such as slow reaction ability and inaccurate decision making. Therefore, we need to eliminate that human factor and introduce an automatic approach to cope with the problems. This project will focus on building AI solutions that can monitor the workers working in the construction sites using SOTA Object Detection and Image Classification models. It can help improve workplace safety and increase productivity in construction industry without the need for a human supervisor. This is an interesting topic given its crucial application, and yet the challenge due to lack of training dataset.

Background Reading:

I will examine various famous articles published by MDPI, CVPR, IEEE or ICCV containing important theories, concepts, terms, existing ideas and historical data related to the topic in order to be familiar with the context and background in preparing for report writing and system implementation. Some of the reference may include (There can be many more):

<https://arxiv.org/abs/2005.11623>

<https://arxiv.org/abs/1512.02325>

<https://arxiv.org/abs/2104.00298>

Method and Models:

Given an image, video or real-time camera, **either standard or 360° camera (Figure 1&2)**, the system will monitor the workers appeared in those by firstly detecting all the worker objects inside the input frame(s). The model will be used for this object detection part is:

- Standard type: SSD300 with Resnet18 or Resnet50 backbone.

- 360° type: RAPiD with YOLO backbone

Subsequently, the system will classify for each worker object whether they are wearing protection equipment including safety helmet, safety harness or safety jacket... or not and notify (warn) them if needed. The models will be used for this classification part are different variations of EfficientNet.



Figure 1: Standard frame



Figure 2: 360° or fisheye frames

Data Source:

- Object Detection: We will train our detection model with around 5000 – 10000 images
 1. Standard type: We can use subset of COCO Dataset focusing on person object for our Object Detection part since workers in construction sites are just human.
 2. 360° type: We can use Mirror Worlds, HABBOF, and CEPDOF which are the 3 special dataset for detecting person object in fisheye image and same reason as above, workers in construction sites are just human.

- Classification: To classify whether the person or worker is wearing safety equipment or not, we can perform data scraping from open source like Google Image or ShuttleStock... for images of person wearing according equipment.

Evaluation:

For Object Detection module, mean average precision metric will be used

For Image Classification module, simple precision and recall metric will be used