L-Università ta' Malta
Faculty of Information & Communication Technology

B.Sc. IT (Hons.)
Artificial Intelligence

A Study on the Effect of Target Object Size in Object Detection

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INTRODUCTION

Small object detection is considered as one of the biggest challenges in object detection for several reasons. One in particular is due to the resizing of the feature maps within the pooling stage resulting in the loss of the small target object's features. Moreover, accuracy diminishes as these networks struggle to distinguish between foreground and complex backgrounds such as rough terrain.

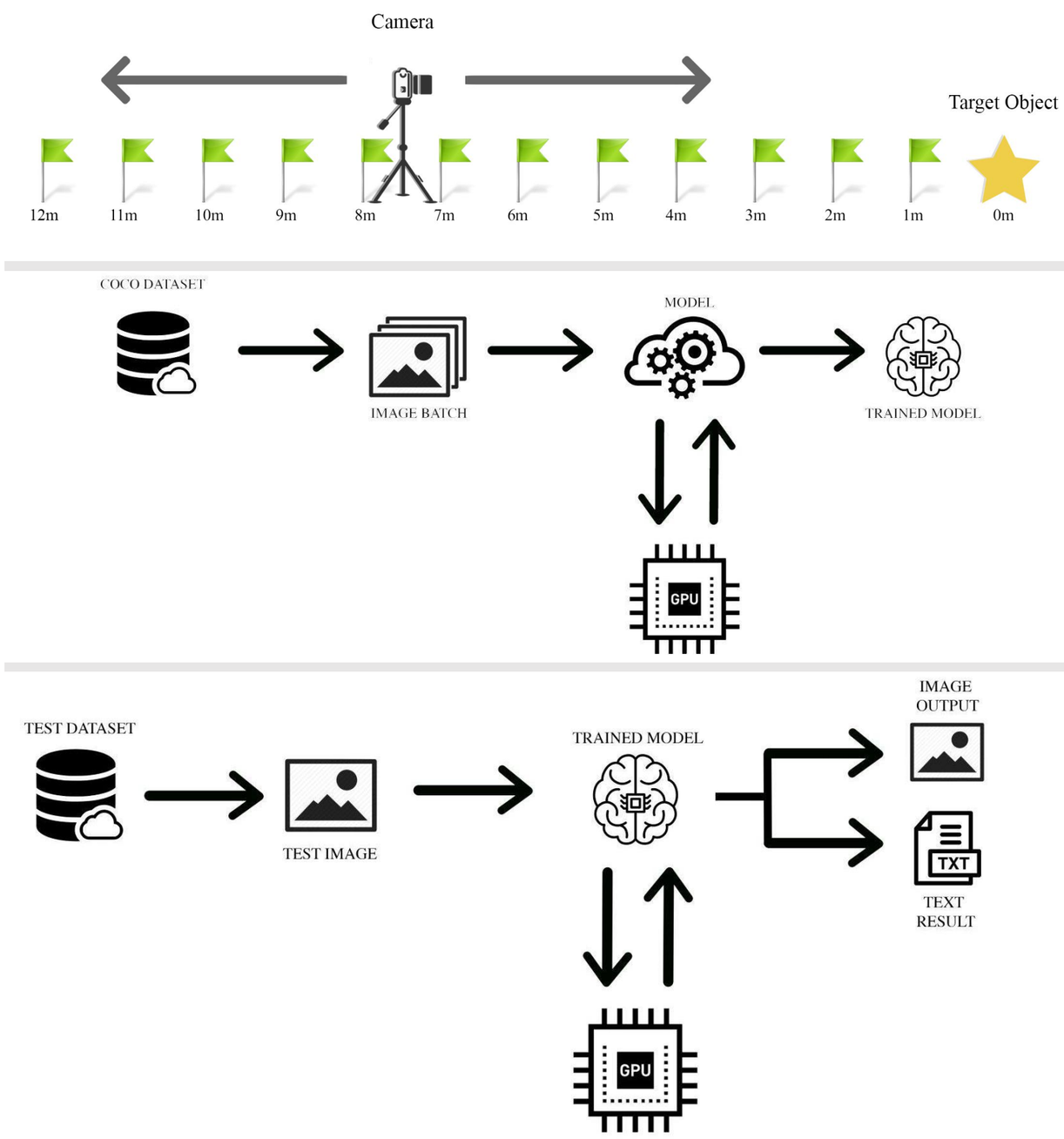
An experiment was designed to investigate a selection of deep neural networks and analyse the effects that the distance between the capturing device and the target object. The set up requires a custom dataset, containing object instances that are identifiable by the selected models, each with an object instance at a varying distance.

AIM

The aim of this project is to investigate the impact of spatial resolution in small object detection by varying the distance between target object and capture device. In order to achieve this goal, the following objectives have been identified:

1. Research and evaluate current state-of-the-art object detection models.
2. Design and build a dataset for small object detection at varying distances based on the COCO [1] dataset.
3. Investigate the accuracy of the chosen models over varying distances from the object instance.

ARCHITECTURE DESIGN



METHODOLOGY

Research Foundations of Object Detection and existing datasets for model training → **Research and Obtain the current state-of-the-art models.** → **Create a Custom Dataset to test for the effect of target object size in object detection** → **Evaluate selected models against the custom dataset**

RESULTS

The Precision and Recall for each model was calculated. Although YOLOv3 [2] provided the lowest total positive count the model is still very precise obtaining 56% in terms of precision. Efficientdet-d7 [3] provided the highest precision overall with a score of 61% whilst the Faster R-CNN [4] achieved a score of 20%. However, YOLO was the least successful at classifying and correctly labelling each object instance with an overall recall score of 46%. The second best performing model is the Faster R-CNN model which although had a very low precision, produced a recall score of 65%. Finally, Efficientdet-d7 was the best performing, achieving a recall score of 71%.

For this experiment, a bias was implemented to give more weight to the recall results. The FBeta measure was obtained for each model. Results show that EfficientDet produces an average FBeta measure of 67.2%, a 20.7% increase from the second best performing model, YOLOv3 with a measure of 46.5% for the custom dataset when measuring over all distances. The Faster R-CNN implementation performed the worst with an FBeta measure of 44.8%.

CONCLUSIONS AND FUTURE WORK

The results obtained could provide a different point of view to tackle the issue of small object detection. A possible improvement could be achieved by training specifically for objects over varying distances. Resulting in each model being better equipped at carrying out the experiment presented.

In conclusion, this dissertation provided an analysis on the effect of target object size in object detection. Using the results obtained, each model can be compared to each other directly at the distance labelled on the x-axis.

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