Hochschule für Technik
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Text Detection in Natural Scene Images using EAST

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Abstract

To be edited at a later date.

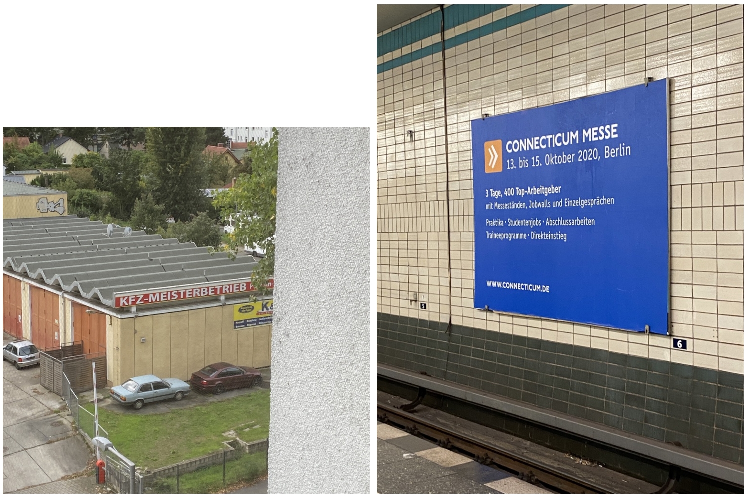
Contents

1 Introduction

Text is arguably one of the most essential form of communication. Along with verbal communication, text is another reliable and effective medium to convey information in order for it to be understood. In this sense, text constitutes the cornerstone of human civilization (Long et al. 2020). In the modern world, text is not only consumed by humans but has claimed its place in the world of technology. However, text detection in natural scene images is proven to be challenging. Compared to detecting text on handwritten materials, the randomness of a natural scene is a big hurdle to overcome.
This paper aims to test and evaluate EAST on its performance in detecting natural-scene texts. EAST is chosen for its speed, efficiency, and accuracy on detecting text. It is widely available in OpenCV without complicated installation and implementation procedure. The paper begins by observing the interference found on natural scenes followed by introducing and giving an overview of EAST. It then provides an explanation of the evaluation dataset. Subsequently, the performance review of the algorithm will be presented, which is obtained by testing it on the aforementioned dataset.

2 Challenges of Natural Text Detection

Natural scene images could be classified as images which are taken in uncontrolled environments, with any device ranging from smartphones to professional cameras. These images are snapshots of things in the real world.



(a) A scenery (b) A billboard

Figure 1: Samples of natural scene images.

The random nature of the real world, combined with the diversity of available devices introduced some factors which make natural text detection a greater challenge than detecting structured text in documents. Mancas-Thillou & Gosselin (2007) mentioned some conditions that are found in natural scene which may significiantly impact text detection procedure. They are:

- Raw sensor image and sensor noise
- Viewing angle
- Blur
- Lighting
- Resolution
- Non-paper objects
- Non-planar objects

Although devices have evolved to a point where most of handheld devices are capable of shooting in a high resolution, low-end handheld cameras and older models still struggle in this sector. Uncontrolled environment, combined with the possible lack of stabilization from the equipment can cause blur (Rosebrock 2018). Also, there are countless factors such as the time of the day, weather, camera flash, and many others which may impact the lighting conditions, further hindering the ability to detect text. Non-paper objects such as glass and plastic may reflect images, and non-planar objects such as text wrapped around a bottle becomes distorted and deformed (Rosebrock 2018). Additionally, there might be patterns that are extremely similar to text, or occlusions caused by foreign objects, which may potentially lead to confusion and mistakes (Long et al. 2020).

3 Methodology

3.1 Overview of EAST

According to Zhou et al. (2017), the key component of EAST is a neural network model, which is trained to directly predict the existence of text instances and their geometries from full images (Zhou et al. 2017). Hence, the abbreviation EAST: Efficient and Accurate Scene Text Detector.

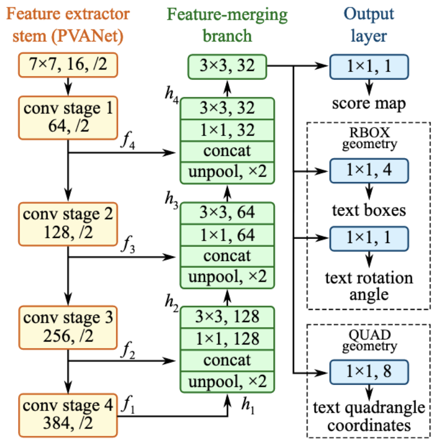


Figure 2: Schematic view of EAST, adopted from Figure 3 of Zhou et al. (2017)

As claimed by Zhou et al. (2017), EAST is among the most efficient text detectors that achieve state-of-the-art performance on benchmarks. The idea of the network is adopted from U-shape (or U-net) (Ronneberger et al. 2015), which simultaneously merges the feature maps and keeps the upsampling branches small.

The end result is a network which is able to utilize different levels of features while keeping the computation cost low (Zhou et al. 2017). It is capable of predicting text on 720p images, running at an average of 13 FPS. The fastest setting, which reached a speed of 16.8 FPS was achieved on a combination of their algorithm with PVANET on 720p images using NVIDIA Titan X graphics card. (Zhou et al. 2017).

The network undergoes and end-to-end training using ADAM (Kingma & Ba 2014) optimizer. 512x512 crops from images are uniformly sampled to form a minibatch of size 24 to accelerate the learning process. Learning rate of ADAM starts from 1e-3, decays to one-tenth every 27300 minibatches, and stops at 1e-5. The network is trained until performance stops improving (Zhou et al. 2017).

3.2 Testing

The test will be done on three different data groups with varying degrees of difficulties. They will be divided into easy, intermediate, and hard. The aim of this test is to see how the method performs on detecting text in natural scene images, determined by the detection rate and speed.
The grouping criteria of the dataset are as follow: the 'easy' group consists of images which are not natural scene. These are scanned images from item packaging and books.

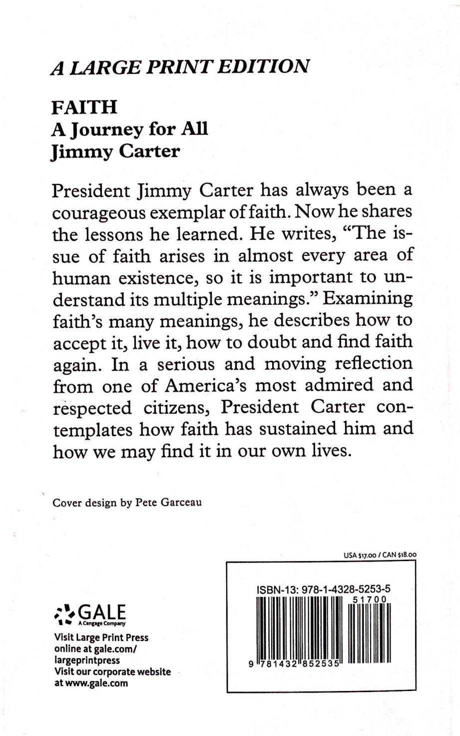


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Figure 3: A sample image from the 'easy' group

The 'intermediate' group is classified as such because it contains natural scene images which are taken relatively close to the camera with optimal lighting conditions and one obstructing factor from the following:

- Condensed, small texts
- Mirroring effects
- Movement
- Object is far from the camera
- Old camera effect
- Poor lighting conditions
- Text is obstructed behind something else

- Wrapped text / distorted text

The 'hard' group consists of natural scene images with two or more of the aforementioned factors.

(a) A sample image from the 'intermediate' group

(b) A sample image from the 'hard' group, from Lannuier (2007)

Figure 4: Samples of image from intermediate and hard dataset group.

Each dataset group contains approximately six images with similar criteria, which are grouped in their own folders. The images will be resized to a multiple of 32. For the sake of consistency, every image will be resized to a square of 640 pixels regardless of their original dimensions.
A binary large object will be created for every image and passed into the network. A forward pass will then be executed, which returns two maps: scores and geometry. Scores will be the probability of a text being present in a region and geometry will be used to derive the bounding box coordinates of text in the input images (Rosebrock 2018).
For each rows in the scores map, the probabilities and geometrical data containing potential bounding box coordinates will be extracted. For each column in the scores map, the algorithm will predict whether the score has a sufficient probability to contain a text. It will do some calculations and get the width and length of the bounding box from the geometry volume. Both the start and end coordinates will be calculated and they will be added into a list along with the probability score.
Non-maxima suppresion will be used to overwrite weak bounding boxes. The remaining boxes will be scaled using the image ratio and drawn onto the original image.
The network will then run through each dataset group and the total time that it needs to detect everything will be counted and save. The resulting images and total time will be presented in the following chapter.

4 Results and Evaluation

As the name suggests, EAST is an efficient and accurate scene text detector. The aim of this chapter is to present the results obtained from the previous chapter and evaluate them based on the time needed and its detection rate. The presented results will be of the best and the worst from each dataset group.

4.1 'Easy' Group

The following is the best-detected image from the easy group:

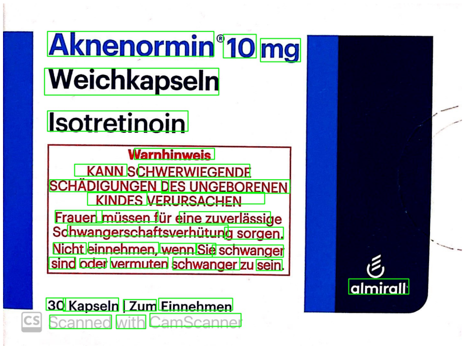

Figure 5: The best-detected image from the 'easy' group.

4.2 'Intermediate' Group

asdasd

4.3 'Hard' Group

asdasd

5 Conclusion

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