

Chapter 6

On the Detection of Faces With Masks Using Tiny YOLOv7 Algorithm

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ABSTRACT

Today every individual is expected to wear a mask, which poses a new challenge to security and surveillance of individuals for any governing body. Though notable work has been done in the area of face mask detection, there still exists a bottleneck of fast detection. Additionally, the complexity of features, size of frames, and inhomogeneity of data poses a challenge to achieve a model with high accuracy. And law offenders are quick to exploit this opportunity to their advantage. Through this work, the aim is to propose a system that combines Tiny YOLOv7 and Jestson Nano which is able to detect faces with or without mask based on the recently introduced Tiny YOLOv7 algorithm. The proposed system was able to achieve a mAP of 55.94% and an average IoU of 53.70%. The average precision achieved for people with masks was 83.80% and 79.67% for specific detection of the mask region. The model uses a total of 5.527 BFLOPs and was able to achieve an average FPS of 71.8, which ensures a higher throughput leading to a faster model both in terms of training and detection.

INTRODUCTION

With the rapid development and application of deep learning algorithms in the recent years, a number of research areas have achieved tremendous results, Computer

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Vision being one of them (Zhou et al., 2017). Object detection, which deals with the problem of locating instances of objects in an image or a video, is one of the many subdomains of Computer Vision. Today in the age of COVID-19 pandemic, every individual is expected to wear a face mask to ensure their own safety. This is a necessary measure but it does impose a challenge to surveillance and security of people as it is hard to detect these faces because of the obstruction caused by the masks. Though, in the last couple of years significant work has been done in this field, most of the proposed methods struggle with the detection of face masks that are too small an object to detect and further achieve low detection accuracy (Kumar et al., 2022).

YOLO (You Only Look Once) is termed as a state-of-the-art object detection model that uses quite a different approach than most other object detectors. While the other models look at different parts of the image multiple times at multiple scales to detect objects, YOLO looks at the entire image only once. YOLO is a fast object detector with high efficiency, making it ideal for computer vision applications. YOLO learns generalizable representations of objects. When trained on natural images and tested on artwork, YOLO outperforms top detection methods like DPM and R-CNN by a wide margin (Redmon et al., 2016). The latest version of the YOLO algorithm which was released in July 2022 added a few new training routines to achieve faster detection with higher accuracy, which were: Extended Efficient Layer Aggregation (E-ELAN), Compound scaling for concatenation based-model, Re-parameterized planning and Coarse-to-fine auxiliary head.

Through this work, we aim to propose a system to detect faces with or without masks, which consists of a camera, a speaker, and a Jetson Nano-based processing unit and can be easily installed to conduct surveillance in real time. The camera provides us with visual input in real time, the feed is then processed by the processing unit which uses weights trained with the recently released Tiny TOLOv7 algorithm to detect faces and face masks. This processing unit generates a signal for the speakers to flag people with or without face masks. The FMD (Face Mask Detection) dataset (Kumar, Kalia, Verma et al, 2021) used to train these weights consists of 52,635 images annotated with 4 classes: with masks, without masks, mask worn incorrectly, and mask region. For each class label the dataset is richly annotated with more than 50,000 tight bounding boxes in total.

BACKGROUND

In the last couple of years, various machine learning and deep learning algorithms including a combination of CNN, R-CNN, ResNet-50, transfer learning, MobileNetv2

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