Face Mask Detection
Using Image Classification

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1. Introduction

It is a well-known fact that CoronaVirus has become worldwide health pandemic causing 4.55 million deaths around the globe **[1]** and one of the preventive methods that has proven to be effective is to wear filtered masks to cover mouth and nose in order to prevent virus from getting into the body or preventing onward transmission of the virus as this virus is contagious **[2]**. Throughout the crisis, this particular virus has formed various kinds of dangerous variants and although there are numerous vaccinations being introduced, the efficacy rate of them on each variant differ. There are many attributes that serve towards this virus, for example, some people are symptomatic and others are non-symptomatic where the latter one is still capable of spreading the virus. Some people are vaccinated and others are not, but even though the 100% of population of a certain area is vaccinated it is not guaranteed that the vaccinated person cannot be infected as the efficacy rate on each individual may vary.

The related work (further discussed in section 4) emphasizes that a majority of research work has focused on Deep Learning and Artificial Intelligence techniques for facial recognition, whereas, the approach used for this project **aims** to use classification methods to identify if a person is wearing a mask or not. Depending on the timeliness of the project, we hope to be able to incorporate classification labels for input images that yield to figure out if the person is wearing masks correctly or not, such that the nose and mouth are both covered properly.

Therefore, this paper aims to address this issue by using a classification algorithm of neural networks on a labelled dataset. The further information of the dataset is mentioned more in section 3.

2. Problem Definition and Algorithm

The problem is to identify whether the people in the picture are masked or not. To approach this question, we are going to use trained databases with the photos of

people with masks and the same people without masks. It may use some of the computer vision techniques, such as image classification for the algorithm. As the problem approaches, the idea for now would be finding the corresponding section or region where the masks would be, and determining if there is any. From the experiences of painting, the human body has some magical proportion with the position of the face and the body, and this could be a great idea for finding the corresponding section or region of where the masks would be for an image/figure. In a nutshell, the input would be images of people with masks and without masks, and it would be interesting as this could be developed as an interactive, realtime algorithm could determine a person with masks on or not by pointing the camera on the person.

3. Dataset

Dataset (kaggle): https://www.kaggle.com/tapakah68/medical-masks-part1
Dataset (downloaded): https://fs.a0-0.com/cs254a-final-project/data/

Describe your dataset?
We will be using a subset of a 500GB dataset of photos of people's faces. There are four photos associated with each person: wearing a mask, not wearing a mask, wearing a mask without covering their nose, and wearing a mask below their chin.

Is your dataset available?
Since the data subset is very large (about 80GB), we will access the dataset using http within the python code. If this turns out to be too slow, we will end up using a smaller dataset of about 1GB and store it locally.

Is it labeled, or do you need an effort to label it (how? when? how many samples do you need to label?)?
Each photo is labeled with the person ID, the type of photo it is (e.g. wearing a mask, not wearing a mask, etc.) and gender. Many of the gender fields are labeled as none, but many are not. We may decide to scrap the photos with none for gender in order for the field to be useful for us.

Do you need special hardware to process your data?
If we use a small enough subset of the data, probably not. However, if needed we can try using a GPU.

4. Related Work

Answer the following questions for each
piece of related work that addresses the same or a similar problem. What is their problem and method? How is your problem approach could be different or better?

I. **[3]** The problem of the Research article deals with facial recognition and face mask detection using ML techniques. They mention the use of any supervised learning technique where the training dataset input would be images (preferably labeled). Next, any unlabeled images will be classified based on what the model learned from the training dataset. The generic supervised learning algorithm equation used here is Y = f(x) where Y is the predicted output and x is the input. The testing phase incorporated the use of sample test images being passed through a convolutional neural network and classification results being compared for accuracy. Our methodology would focus on facial mask image classification instead of narrowing our focus on facial recognition and object detection.

II. **[4]** This article hopes to resolve the issue of people wearing face masks inappropriately (incorrectly positioned such as under their nose, etc.). Furthermore, the authors suggest approaches to classify images with labels of how the subject's face mask is worn. The described approach employs the use of an image recognition model in PerceptiLabs which would aid in the classification of the different ways in which people wear masks. The methodology incorporated the use of a dataset that included images of numerous different ways of wearing a face mask as input for training the model. The dataset was distributed into subdirectories based on how people were wearing their masks and numeric classification labels were drafted (as a .csv file) to output the appropriate type of mask wearing style as output (for eg, 0 - mask above chin, 1 - mask worn correctly,etc.). While this work aimed at the classification of face mask images to label them as appropriately worn or inappropriately worn and specify how the mask was incorrectly positioned, our project would focus on the

classification of individuals wearing/not wearing face masks. If we have enough time in the semester then we would like to include more classification labels as suggested here, however, all of that would depend on the image analysis and object analysis algorithm that we choose to incorporate for our project.

III. **[5]** This research paper aims to remedy the issue of low accuracy of face mask recognition in real-time performance using the YOLO-V4 object detection algorithm. At first, the work discussed using a CSPDarkNet53 convolutional neural network into the feature extraction network. Next, an adaptive image scaling algorithm was used to reduce computation and redundancy. The object detection algorithm was then used to compare and evaluate the accuracy of the model. While the approach described in this paper did yield a high face mask recognition percentage of 98.3%, the complexity of the algorithm used may be highly complex of us (since it is a deep learning algorithm) which would take a lot of time to effectively code, train, and test on our model. This approach uses object detection and deep learning techniques to get higher face mask recognition accuracy, whereas, our project will focus on the classification of whether or not users are wearing face masks (using output labels) given an input image.

5. Bibliography

Be sure to include a standard, well-formatted, comprehensive bibliography with citations from the text referring to previously published papers in the scientific literature that you utilized or are related to your work. Include references to the public code that you might use for your project.

[1] Worldometers.info. 2021. COVID Live Update: 234,780,398 Cases and 4,801,297 Deaths from the Coronavirus - Worldometer. [online] Available at: <https://www.worldometers.info/coronavirus/> [Accessed 1 October 2021].

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[4] M. Isaksson, “Machine learning use case: Classifying ways to wear a face mask,” *Medium*, 22-Jul-2021. [Online]. Available: https://towardsdatascience.com/machine-learning-use-case-classifying-ways-to-wear-a-face-mask-f90af8562530. [Accessed: 01-Oct-2021].

[5] Yu and W. Zhang, "Face Mask Wearing Detection Algorithm Based on Improved YOLO-v4," Sensors, vol. 21, (9), pp. 3263, 2021. Available: https://login.ezproxy.uvm.edu/login?url=https://www-proquest-com.ezproxy.uvm.edu/scholarly-journals/face-mask-wearing-detection-algorithm-based-on/docview/2530180785/se-2?accountid=14679. DOI: http://dx.doi.org.ezproxy.uvm.edu/10.3390/s21093263.