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Emphasized Design Thinking Approach of Facemask Detection System

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Abstract: Effective strategies to restrain COVID-19 pandemic need high attention to mitigate negatively impacted communal health and global economy, with the brim-full horizon yet to unfold. Wearing a mask is among the non-pharmaceutical intervention measures that can be used to cut the primary source of SARS-CoV2 droplets expelled by an infected individual. To contribute towards communal health, this project aims to devise a highly accurate and real-time technique that can efficiently detect non-mask faces in public and thus, enforcing to wear mask. In this project, we used deep learning methods for face mask detection, including pooling, and MobileNetV2 architecture, and showed the methods detection accuracy. The implementation is done in Python, and the python script implementation will train our face mask detector on our selected dataset using TensorFlow and Keras. A dataset containing 1500 or more images from various sources taken with a webcam is used to train a deep learning architecture.

Index Terms – MobileNetV2, Dataset, TensorFlow/Keras, Acccuracy Generation

I. INTRODUCTION

COVID-19 mainly spreads through droplets produced as a result of coughing or sneezing by an infected person. This transfers the virus to any person who is in direct close contact (within one-meter distance) with the person suffering from coronavirus. Because of this, the virus spreads rapidly among the masses. With the nationwide lockdowns being lifted, it has become even harder to track and control the virus. Face masks are an effective method to control the spread of virus. It had been found that wearing face masks is 96% effective to stop the spread of virus. The governments, all over the world, have imposed strict rules the everyone should wear masks while they go out. But still, some people may not wear masks and it is hard to check weather everyone is wearing mask or not. In such cases, computer vision will be of great help. There are no efficient face mask detection applications to detect weather the person is wearing face mask or not. This increases the demand for an efficient system for detecting face masks on people for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. This project uses machine learning classification using OpenCV and Tensorflow to detect facemasks on people.

The COVID-19 pandemic is causing a worldwide emergency in healthcare. This virus mainly spreads through droplets which emerge from a person infected with coronavirus and poses a risk to others. The risk of transmission is highest in public places. One of the best ways to stay safe from getting infected is wearing a face mask in open territories as indicated by the World Health Organization (WHO). Wearing a Facemask prevent us from Coronavirus. It will prevent us from dust disease.

Face mask detection refers to detect whether a person is wearing a mask or not. In fact, the problem is reverse engineering of face detection where the face is detected using different machine learning algorithms for the purpose of security, authentication and surveillance. The COVID-19 pandemic is causing a worldwide emergency in healthcare. This virus mainly spreads through droplets which emerge from a person infected with coronavirus and poses a risk to others. The risk of transmission is highest in public places. Recently, a study on understanding measures to tackle COVID-19 pandemic carried by the researchers at the University of Edinburgh reveals that wearing a face mask or other covering over the nose and mouth cuts the risk of Coronavirus spread by avoiding forward distance travelled by a person's exhaled breath by more than 90%. Their results strongly recommend the use of the face masks in general public to curtail the spread of Coronavirus. Further, with the reopening of countries from COVID-19 lockdown, Government and Public health agencies are recommending face mask as essential measures to keep us safe when venturing into public. To mandate the use of facemask, it becomes essential to devise some technique that enforce individuals to apply a mask before exposure to public places. One of the best ways to stay safe from getting infected is wearing a face mask in open territories as indicated by the World Health Organization (WHO). In this project, we propose a method which employs TensorFlow and OpenCV to detect face masks on people. A bounding box drawn over the face of the person describes weather the person is wearing a mask or not.

II. DOMAIN OVERVIEW

2.1 Python

Python is an integrated, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991. Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object- oriented approach aim to help programmers write clear, logical code for small and large-scale projects. It often used to build websites and software, automate tasks, and conduct data analysis. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems.

2.2 Machine Learning Classifiers

These are used to predict the class/target/labels/categories of a given data points. Classification belongs to the category of supervised learning in which the targets are provided with input data. They are used in many applications like medical diagnosis, spam detection, target marketing etc. They use a mapping function (f) from input variables (X) to discrete output variables(Y).

2.3 OpenCV

OpenCV is an open-source library which is primarily used for Computer Vision Applications. This contains many functions and algorithms for Motion tracking, Facial recognition, Object Detection, Segmentation and recognition and many other applications. Images and real time video streams can be manipulated to suit different needs using this library.

2.4 TensorFlow

It is an open-source machine learning framework to build and train neural networks. It has a collection of tools, libraries and community resources which helps in easy building of deployment of ML powered applications. This is developed and maintained by Google and was released in 2015. It offers multiple levels of abstraction so you can choose the right one for your needs. Build and train models by using the high-level Keras API, which makes getting started with TensorFlow and machine learning easy.

III. EXISTING SYSTEMS

There are several existing systems which uses Machine Learning to find whether the human being is wearing mask or not. These existing system of Face Mask Detection uses existing cameras combined with Trident Computer Vision platform to detect people without masks. These platforms use Artificial Network to recognize if a user is wearing or not wearing a mask. Face mask detection feature uses visible stream from the camera combined with AI techniques to detect and generate an alert for people not wearing face masks. Pattern learning and object recognition are the inherent tasks that a computer vision (CV) technique must deal with. Object recognition encompasses both image classification and object detection. The task of recognizing the mask over the face in the pubic area can be achieved by deploying an efficient object recognition algorithm through surveillance devices. The object recognition pipeline consists of generating the region proposals followed by classification of each proposal into related class. We review the recent development in region proposal techniques using single-stage and two-stage detectors, general technique for improving detection of region proposals and pre-trained models based on these techniques.

The main drawbacks of the existing system are,

- It could not correctly classify partially hidden faces and the model is not able to detect faces if the camera height is greater than certain height.
- Detection is vulnerable. While face detection provides more accurate results than manual identification processes, it can also be more easily thrown off by changes in appearance or camera angles.
- Massive data storage burden. The ML technology used in face detection requires powerful data storage that may not be available to all users.
- There is also a chance for potential breach of privacy.

IV. PROPOSED SYSTEM & MODULES

The model proposed here is designed and modelled using python libraries namely Tensorflow, Keras and OpenCV. The model we used is the MobileNetV2 of Convolution Neural Network. The method of using MobileNetV2 is called using Transfer Learning. Transfer learning is using some pre trained model to train your present model and get the prediction which saves time and makes using training the different models easy. We tune the model with the hyper parameters: learning rate, number of epochs and batch size. We have tested the model for different conditions with different hyper parameters, for which the results are mentioned in the next section. First, we feed the dataset in the model, run the training program, which trains the model on the given dataset. Then we run the detection program, which turns on the video stream, captures the frames continuously from the video stream with an anchor box using object detection process. This is passed through the MobileNetV2 model layers which classifies the image as with or without mask. If the person is wearing a mask, a green anchor box is displayed and red if not wearing a mask with the accuracy for the same tagged on the anchor box. Artificial Intelligence (AI) and Machine Learning (ML) are the new black of the IT industry. While discussions over the safety of its development keep escalating, developers expand abilities and capacity of artificial intellect. Today Artificial Intelligence went far beyond science fiction idea. It became a necessity. Being widely used for processing and analyzing huge volumes of data, AI helps to handle the work that cannot be done manually anymore because of its significantly increased volumes and intensity. This show that AI and ML are used process loads of data to offer better user experience, more personal and accurate one.

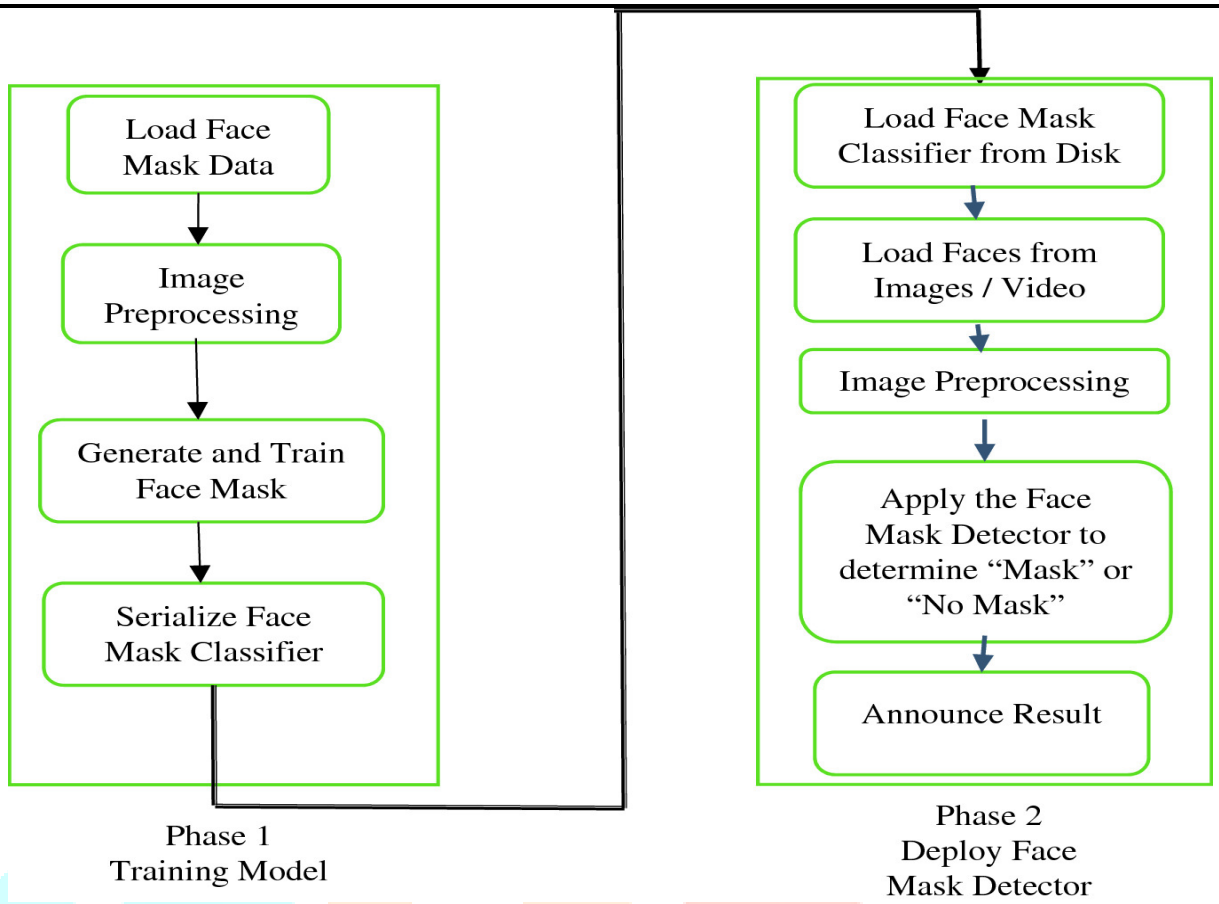

Fig.1 Facemask Detection system Block Diagram

MODULE DESCRIPION

4.1 Dataset Collecting

The dataset was collected from Kaggle Repository and was split into training and testing data after its analysis.

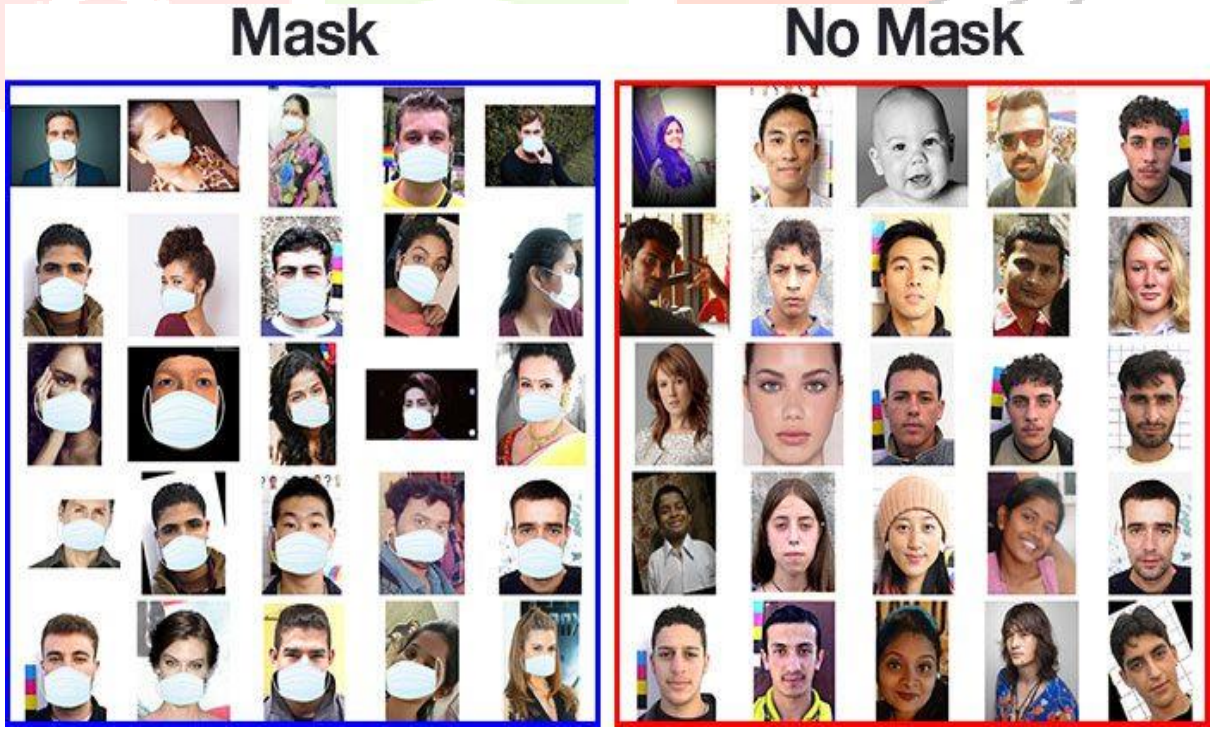

Fig.2 Dataset

4.2 Datasets Extracting

Real-world masked face recognition dataset: it contains 2000 masked faces of various different people and 2000 normal (without mask) faces. In this experiment, we are going to use the dataset after downloading and unzipping it.

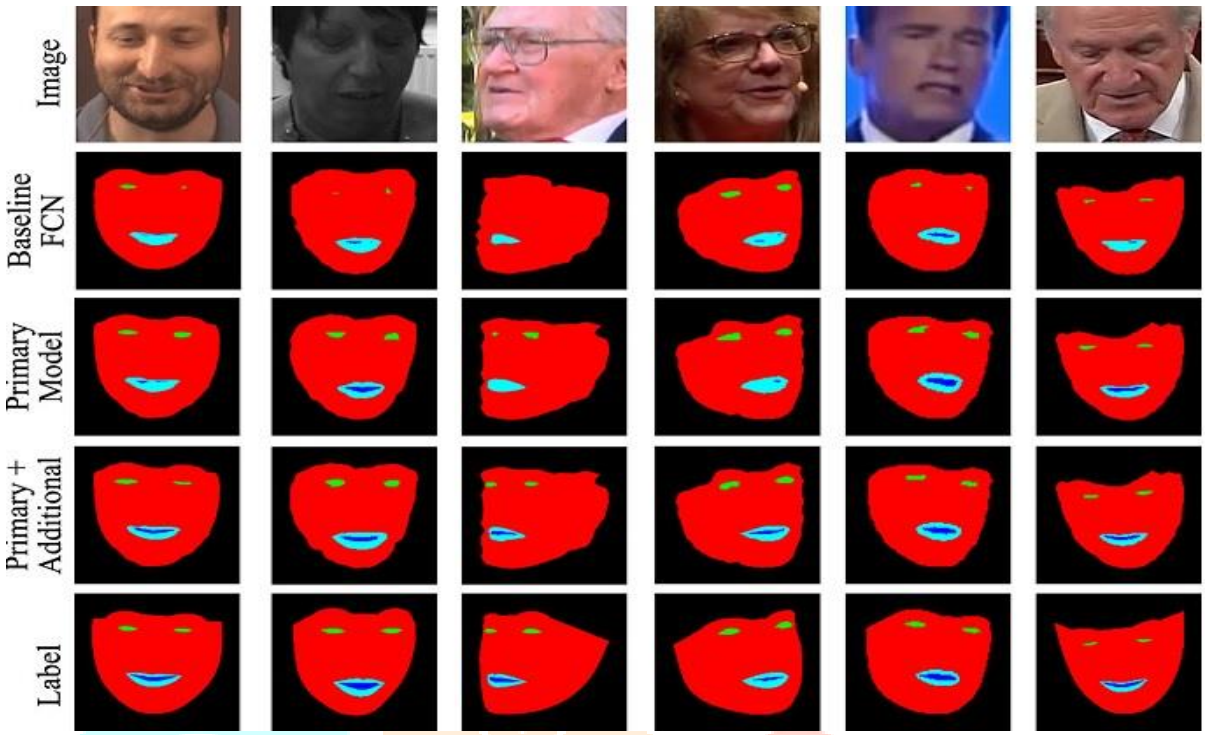

Fig.3 Extraction Output

4.3 Model Training

A default OpenCV module was used to obtain faces followed by training a Keras model to identify face mask. Here, we'll focus on loading our face mask detection dataset from disk, training a model (using Keras/TensorFlow) on this dataset, and then serializing the face mask detector to disk. To use facial landmarks to build a dataset of faces wearing face masks, we need to first start with an image of a person not wearing a face mask.

4.4 Apply CNN

Convolutional Neural Network knows as CNN consists of the Input layer, Middle layers, and the Output layer. Input layer is the one which accepts features as the input, in other words, images are given as input through this layer. The Middle layer consists of the desired number of nodes based on the application. Output layer produces an output. It performs a convolutional operation over the pixel values in it along with the kernel matrix. The kernel matrix is slid over the pixel matrix, and value is determined.

4.5 Facemask Detection

Once the face mask detector is trained, we can then move on to loading the mask detector, performing face detection, and then classifying each face as with mask or without mask. From there, we apply face detection to compute the bounding box location of the face in the image. Once we know where in the image the face is, we can extract the face Region of Interest (ROI). Next, we need an image of a mask and the mask will be automatically applied to the face by using the facial landmarks (namely the points along the chin and nose) to compute where the mask will be placed.

4.6 Accuracy Generation

It is observed that the proposed technique achieves high accuracy (90-97%) when implemented with MobileNetV2. Besides, the proposed model generates 11.07% and 6.44% higher precision and recall in mask detection when compared to the existing models.

```
[INFO] evaluating network...
              precision    recall  f1-score   support

   with_mask       0.99      0.99      0.99       383
without_mask       0.99      0.99      0.99       384

    accuracy                           0.99       767
   macro avg       0.99      0.99      0.99       767
weighted avg       0.99      0.99      0.99       767

[INFO] saving mask detector model...
```

Fig.4 Accuracy Result

V. RESULTS AND DISCUSSION

Face mask detection refers to detect whether a person is wearing a mask or not. In fact, the problem is reverse engineering of face detection where the face is detected using different machine learning algorithms for the purpose of security, authentication and surveillance. Face detection is a key area in the field of Computer Vision and Pattern Recognition. A significant body of research has contributed sophisticated to algorithms for face detection in past. The primary research on face detection was done in 2001 using the design of handcraft feature and application of traditional machine learning algorithms to train effective classifiers for detection and recognition.

The problems encountered with this approach include high complexity in feature design and low detection accuracy. In recent years, face detection methods based on deep convolutional neural networks (CNN) have been widely developed to improve detection performance.

Although numerous researchers have committed efforts in designing efficient algorithms for face detection and recognition but there exists an essential difference between 'detection of the face under mask' and 'detection of mask over face'. An extensive study conducted on available face-related datasets reveal that there exist principally two kinds of datasets. These are: i) masked face and ii) face masked datasets. The masked face datasets are more concentrated on including the face images with a variant degree of facial expression and landmarks whereas face mask centric datasets include those images of faces that are mainly characterized by occlusions and their positional coordinates near the nose and mouth area. The following shortcomings are identified after critically observing the available literature:

(1) Although there exist several open-source models that are pre-trained on benchmark datasets, but a few models are currently capable of handling COVID related face masked datasets.

(2)The available face masked datasets are scarce and need to strengthen with varying degrees of occlusions and semantics around different kinds of masks.

To solve these problems, a deep-learning model based on transfer learning which is trained on a highly tuned customized face mask dataset and compatible with video surveillance is being proposed and implemented.

VI. CONCLUSION

To moderate the spread of the COVID-19 pandemic, measures should be taken. We have demonstrated a facemask detector using Convolutional Neural Network and move learning techniques in neural organizations. To train, validate and test the model, we utilized the dataset that consisted of 1900 masked faces pictures and 1900 exposed faces pictures. These pictures were taken from different assets like Kaggle and RMFD datasets. The model was induced on pictures and live video transfers. To choose a base model, we assessed the measurements like precision, accuracy, and recall and chose MobileNetV2 architecture with the best exhibition having 90%-97%.

VII. FUTURE WORK

- To ensure portability and compatibility.
- To ensure our system moves with time i.e., allow for maintenance, upgrades and periodic backups by developed and authorized personnel.
- This system makes it simpler to extract, serialize and manage the facemask detection with higher efficiency and easiness.
- The accuracy generation process of facemask detection will be going to implemented with advanced features.

VIII. REFERENCES

[1] Nanni L., Ghidoni S., Brahnam S. Handcrafted vs. non-handcrafted features for computer vision classification. Pattern Recogn.2017;71:158–172. doi: 10.1016/j.patcog.2017.05.025.

[2] Y. Jia et al., Caffe: Convolutional architecture for fast feature embedding, in: MM 2014 - Proceedings of the 2014 ACM Conference on Multimedia, 2014, doi: 10.1145/2647868.2654889.

[3] P. Sermanet, D. Eigen, X. Zhang, M. Mathieu, R. Fergus, and Y. Lecun, OverFeat: Integrated Recognition, Localization and Detection using Convolutional Networks, 2014.

[4] Erhan D., Szegedy C., Toshev A., Anguelov D. Proceedings of the IEEE conference on computer vision and pattern recognition. 2014. Scalable Object Detection using Deep Neural Networks; pp. 2147–2154.

[5] J. Redmon, S. Divvala, R. Girshick, A. Farhadi, You only look once: Unified, real-time object detection, in: Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2016, vol. 2016-Decem, pp. 779–788, doi: 10.1109/CVPR.2016.91.

[6] M. Jiang, X. Fan, and H. Yan, RetinaMask: A Face Mask detector, 2020, http://arxiv.org/abs/2005.03950.

[7] Inamdar M., Mehendale N. Real-Time Face Mask Identification Using Facemasknet Deep Learning Network. SSRN Electron. J. 2020 doi: 10.2139/ssrn.3663305.

[8] Qiao S., Liu C., Shen W., Yuille A. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2018. Few-Shot Image Recognition by Predicting Parameters from Activations.

[9] Kumar A., Zhang Z.J., Lyu H. Object detection in real time based on improved single shot multi-box detector algorithm. J. Wireless Com. Netw. 2020;2020:204. doi: 10.1186/s13638-020-01826-x.

[10] He K., Zhang X., Ren S., Sun J. Spatial Pyramid Pooling in Deep Convolutional Networks for Visual Recognition. IEEE Trans. Pattern Anal. Mach. Intell. 2015 doi: 10.1109/TPAMI.2015.2389824.

[11] G.J. Chowdary, N.S. Punn, S.K. Sonbhadra, S. Agarwal, Face Mask Detection using Transfer Learning of InceptionV3, in: International Conference on Big Data Analytics, Springer, Cham, 2020, pp. 81-90, pp. 1–11, doi:10.1007/978-3-030-66665-1_6.
[12] Chakraborty, B.K.; Sarma, D.; Bhuyan, M.K.; MacDorman, K.F. Review of constraints on vision-based gesture recognition for human-computer interaction. IET Comput. Vis. 2018, 12, 3–15.

Website-Link References:

[1] https://github.com/balajisrinivas/Face-Mask-Detection/tree/master/dataset
[2] https://www.youtube.com/watch?v=jUyJujpizh0&t=0s
[3]https://www.youtube.com/watch?v=36_HuAHue0&list=PLUc_7x68VCSP8a9mSpBG1Z lomFwKw2BcP&t=0s
[4] https://www.youtube.com/watch?v=ejT7oNtySbo&t=0s
[5] https://www.youtube.com/watch?v=Ax6P93r32KU&t=6s
[6] https://www.kaggle.com/wobotintelligence/face-mask-detection-dataset
[7] https://www.youtube.com/watch?v=Gz_PsRRxrHM&t=1634s