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FACE MASK DETECTION

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Abstract

This project intends to develop a Face Mask Detection system using OpenCV, Keras/TensorFlow and Deep Learning. The system can be easily integrated to various embedded devices with limited computational capacity as it uses MobileNetV2 architecture. It will detect face masks in images as well as in real-time videos.

In recent times, where Covid-19 has impacted a domino effect on manufacturing, travel, tourism, hospitality, crippling the global economy. In addition to it, is the growing curve of human deaths across the globe due to the pandemic, this project which relies on computer vision and deep learning, intends to make an impact and solve the real-world problem of safety measures at some significant level.

This project can be used at airports, offices, hospitals and many more public places to ensure that the safety standards are maintained and people are abiding by the rules and regulations to wear protective masks at public places. If the detection system classifies as 'No Mask', reminders can be given as well as actions can be taken against such individuals.

Introduction and Related Work

AIM:

To develop a Face Mask Detection system with OpenCV, Keras/TensorFlow and Deep Learning in order to detect face masks in static images as well as in real-timevideo streams.

OBJECTIVES:

- To train a custom deep learning model to detect whether a person is wearinga mask or not.
- To develop an artificial dataset of masked images with the help pf computervision.
- Datasets will be divided into two classes: 'with_mask' and 'without_mask'.
- To train the face mask detector on the custom dataset using Keras andTensorFlow.
- To implement the trained model to detect masks in static input images andalso in real-time videos.

PROBLEM DEFINITION:

In the present scenario due to Covid-19, there is no efficient face mask detection applications which are now in high demand for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. Also, the absence of large datasets of 'with_mask' images has made this task more cumbersome and challenging.

Therefore, the need of the hour is to generate an artificial dataset of 'with_mask' images with the help of computer vision concepts followed by developing a face mask detection system that is urgently needed as India tries to battle the novel coronavirus that has infected more than 60,000 and has caused more than 2,000 deaths with the figures still increasing at a pace.

RELATED WORK:

- FebriEye, a thermal camera, comes with additional analytics such as face mask and social distancing monitoring system which generates an alarm in case of any violations. It is being developed by Vehant Technologies whichis to be implemented by the Telangana government. [13][10]

- Uber has confirmed to *CNN Business* that it's requiring face masks or similar coverings for both drivers and passengers in countries like the US, and is developing technology to detect whether or not drivers are abiding by those rules. [11]

- Face Mask Alert app which is in development process by LeewayHertz software solutions. It sends an alert to the users enforcing them to wearmasks. [12]

- AIZOOTech face mask detection system which uses dataset composed of WIDER Face and MAFA, but lacks landmark net for the purpose of facealignment.

Proposed Work

A face mask detector developed with the help of computer vision and deep learning using Python, OpenCV, and TensorFlow/Keras.

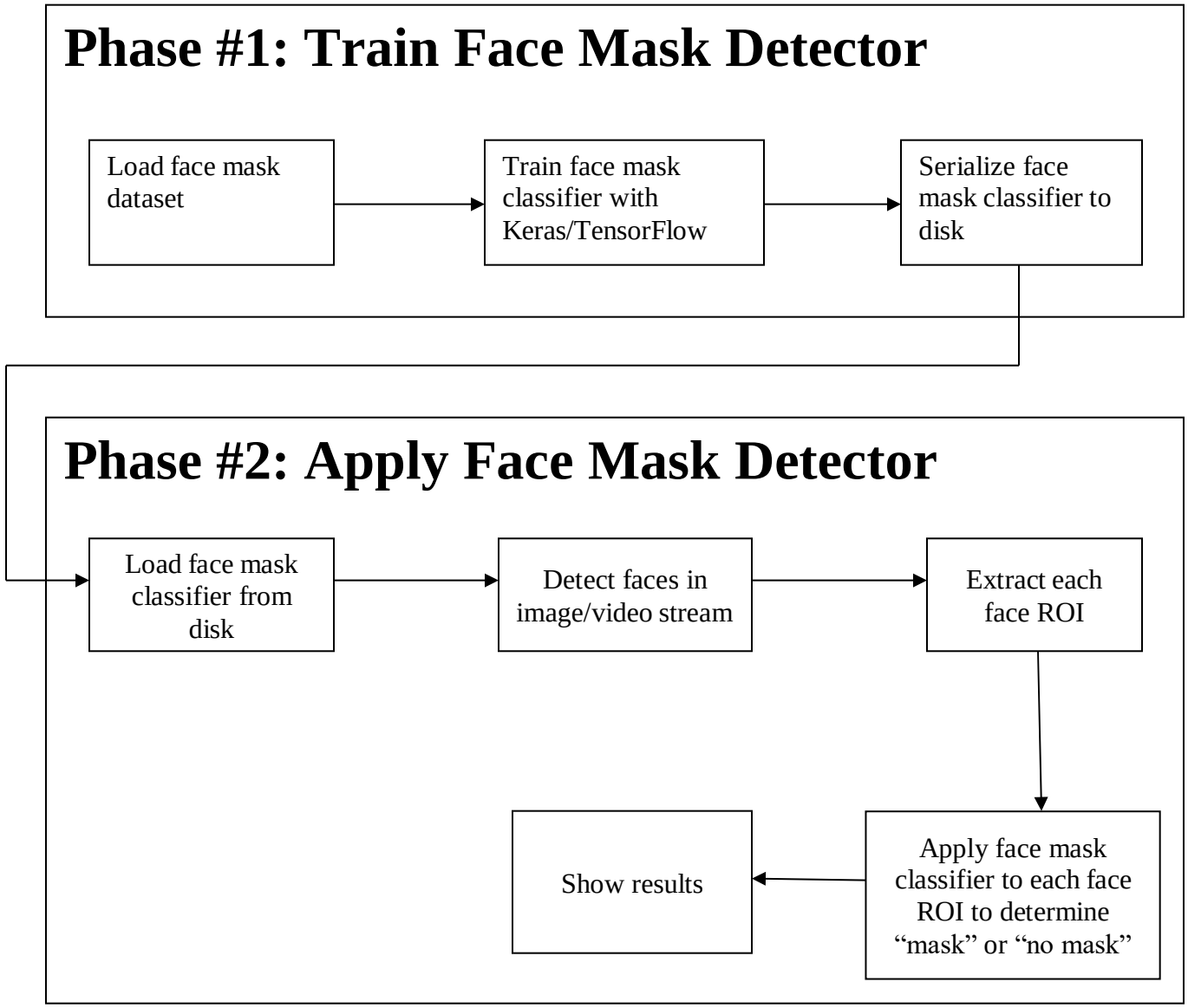

Figure 1: Phases and individual steps for building a COVID-19 face mask detector with computer vision and deep learning using Python, OpenCV, and TensorFlow/Keras.

EXPECTED OUTPUT:

- ✓ The system will be correctly able to detect and distinguish whether aperson is or is not wearing a mask.
- ✓ A custom computer vision python script to add face masks to normal images, thereby creating an artificial (but still real-world applicable) datasetof 'with_mask'.
- ✓ A face mask detector training script in Python, which accepts the input dataset, loads and pre-processes the images, and labels them using TensorFlow.keras and sklearn.
- ✓ It would also fine-tune the model with MobileNetV2 classifier using pre-trained ImageNet weights.
- ✓ Training history plot with accuracy and loss curves produced with the helpof matplotlib.
- ✓ Perform face mask detection correctly in static images in folders.
- ✓ Using your webcam, the system developed applies face mask detection correctly to every frame in the real-time video stream.
- ✓ Outputs the probability of "Mask" or "No Mask" in the static images and real-time video streams examined.

Methodology

Traditional machine learning approach uses feature extraction for images using Global feature descriptors such as Local Binary Patterns (LBP), Histogram of Oriented Gradients (HoG), Color Histograms etc. or Local descriptors such as SIFT, SURF, ORB etc. These are hand-crafted features that requires domain levelexpertise.

But in Convolutional Neural Networks (CNN), instead of using hand-crafted features, Deep Neural Nets automatically learns these features from images in a hierarchical fashion. Lower layers learn low-level features such as Corners, Edges whereas middle layers learn color, shape etc. and higher layers learn high-level features representing the object in the image.

Instead of making a CNN as a model to classify images, we can use it as a Feature Extractor by taking the activations available before the last fully connected layer ofthe network (i.e. *before* the final softmax classifier). These activations will be acting as the feature vector for a machine learning model (classifier) which further learns to classify it. This type of approach is well suited for Image Classification problems, where instead of training a CNN from scratch (which is time-consuming and tedious), a pre-trained CNN could be used as a

Feature Extractor - **Transfer Learning**.

So, we will implement our face mask detector in the following ways:

1. We will customize a pre-trained model using **Transfer Learning**.
2. We will create the base model from the **MobileNetV2** model architecture.
3. The dataset will be downloaded via **Bing Search API** and **Kaggle**.
4. We will use **Keras with TensorFlow** as a backend to provide us all the relevant modules and utilities for deep neural networks (dnn module).
5. The bounding box will be computed via **SSD (Single Shot Multibox Detector)** along with **MobileNet** architecture as its backbone.

Conclusion

To create our face mask detector, we will train a two-class model with images of people ***wearing masks*** and ***not wearing masks***.

We will then fine-tune our model using MobileNetV2 on our ***mask/no mask*** dataset and obtain an image classifier that will be **< 95% accurate.**

Our face mask detector will use the MobileNetV2 architecture, making
it computationally efficient and thus making it easier to deploy the model to embedded systems (Raspberry Pi, Google Coral, etc.).

This system can therefore be used in real-time applications which require face- mask detection for safety purposes due to the outbreak of Covid-19. This project can be integrated with embedded systems for application in airports, railway stations, offices, schools, and public places to ensure that public safety guidelinesare followed.

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