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Probabilistic Machine Learning & Graphical Model 2022

Project Report on

Real Time Face Mask Detection Model

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1 Introduction

1.1 Abstract

The rapid outbreak of COVID-19 has caused serious harm and infected tens of mil lions of people worldwide. Since there is no specific treatment, wearing masks has become an effective method to prevent the transmission of COVID-19 and is required in most public areas, which has also led to a growing demand for automatic real-time mask detection services to replace manual reminding

To contribute towards communal health, this paper aims to devise a highly accurate and real-time technique that can efficiently detect non-mask faces in public and thus, enforce the wearing of masks. We have used deep learning and open CV to develop our face detector model.

The trend of wearing face masks in public is rising due to the COVID- 19 coro navirus epidemic all over the world. Before Covid-19, People used to wear masks to protect their health from air pollution. While other people are self-conscious about their looks, they hide their emotions from the public by hiding their faces. Scientists proved that wearing face masks works on impeding COVID-19 transmission. COVID19 (known as coronavirus) is the latest epidemic virus that has hit human health in the last century. In 2020, the rapid spreading of COVID-19 has forced the World Health Organization to declare COVID- 19 as a global pandemic.

Here we introduce a mask face detection model that is based on computer vision and deep learning. The proposed model can be integrated with surveillance cameras to impede the COVID-19 transmission by allowing the detection of people who are wearing masks not wearing face masks. The model is integration between deep learning and classical machine learning techniques with open cv, tensor flow and as. We have used deep transfer leering for feature extractions and combined it with three classical machine learning algorithms. We introduced a comparison between them to find the most suitable algorithm that achieved the highest accuracy and consumed the least time in the process of training and detection.

Figure 1: Various configurations related to the mask wearing.

1.2 Machine Learning

Machine learning (ML)is the study of computer algorithms that improve automati cally through experience. It is seen as a subset of artificial intelligence. Machine learn ing algorithms build a mathematical model based on sample data, known as ”training data”, in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop con ventional algorithms to perform the needed tasks. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning.

1.3 CNN

A convolutional neural network (CNN, or ConvNet) is a class of Artificial Neural Network (ANN), most commonly applied to analyze visual imagery.They are also known as Shift Invariant or Space Invariant Artificial Neural Networks (SIANN), based on the shared-weight architecture of the convolution kernels or filters that slide along input features and provide translation equivariant responses known as feature maps.

1.4 Computer Vision

Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human

visual system can do, Computer vision tasks include methods for acquiring, processing, analyzing and understanding digital images, and extraction of high dimensional data from the real world in order to produce numerical or symbolic information, e.g. in the forms of decisions, Understanding in this context means the transformation of visual images (the input of the retina)into descriptions of the world that make sense to thought pro cesses and can elicit appropriate action. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.

1.5 Dataset

A dataset (or data set) is a collection of data, usually presented in tabular form. Each column represents a particular variable. Each row corresponds to a given member of the dataset in question. It lists values for each of the variables, such as height and weight of an object. Each value is known as a datum.

2 Methodology

The proposed system focuses on how to identify the person on image/video stream wearing a face mask with the help of computer vision and deep learning algorithm by using the OpenCV, Tensor flow, python google colab dataset. We have used the following steps for our project:

1. The main task of our project is to recognize faces correctly and to do that we need to build a dataset of faces wearing face masks.

2. In the dataset, we apply face detection to compute the bounding box location of the face in the image.

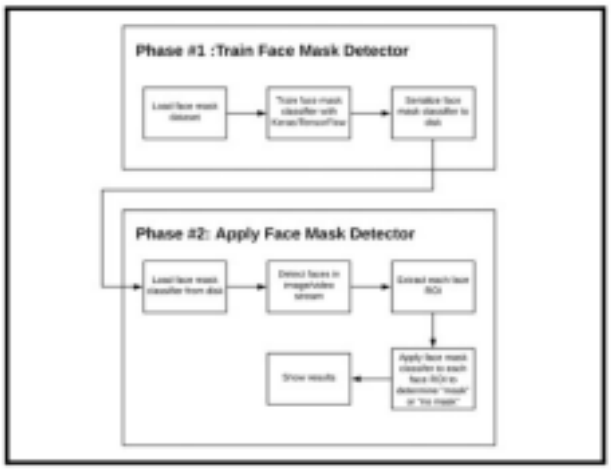
3. Once we know where in the image the face is, we can extract the face Region of Interest (ROI):

4. And from there, we apply facial landmarks, allowing us to localize the eyes, nose, mouth,

etc.

5. Then we will again use facial landmarks to find if the person is wearing a mask or not.

Language Used: Python
Libraries Used: Tensorflow, Keras, Imutils, Numpy, OpenCV, Matplotlib, Scipy



2.1 Data Source

The majority of the images were augmented by OpenCV. The set of images were already labeled “mask” and “no mask”. The images that were present were of differ ent sizes and resolutions, probably extracted from different sources or from machines (cameras) of different resolutions.

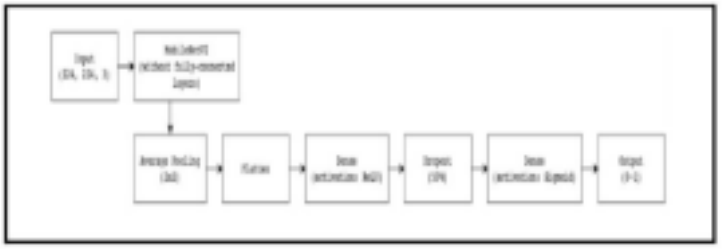
2.2 Purpose of the model

Considering the covid-19 outbreak, we think this is the best project that we can work on as a python developer. Today everyone is aware of taking precaution and safety measures regarding covid-19, so face mask detection will play a huge role to avoid coronavirus. This project helps us to spread awareness among people using face masks properly. It detects the face mask on your face whether the person is hiding his/her face by mask or not. It also checks if the face mask properly covers both your face, nose and mouth.

2.3 Architecture of the Model

In this project, we'll examine our two-stage COVID-19 face mask detector, specifying how our PC vision/profound learning pipeline will be carried out. From that point, we'll survey the dataset we'll use to prepare our custom face mask detector. We'll then, at that point, tell you the best way to execute a Python content to prepare a face mask detector on our dataset utilizing Keras and TensorFlow. We'll utilize this Python content to prepare a face mask detector and audit the outcomes. Given the prepared COVID-19 face mask detector, we'll continue to carry out two more extra Python scripts used to Detect face masks continuously video transfers.

2.4 Dataflow Process



3 Software and Hardware Requirements

3.1 Software Requirements

1. Operating System - Linux, Windows7,8.1,10
2. Programming Language - Python.
3. Libraries used - Tensorflow, Keras,Imutils,Numpy,OpenCV,Matplotlib,Scipy
4. Database - Google DATASET
5. Other Technologies used - MobileNetV2, Caffe-based Face Detection, Scikit.

3.2 Hardware Requirements

1. Processor - Dual Core i3
2. Display
3. Hard Disk - 80 GB
4. Ram - 2 GB
5. Key-Board

6. Mouse

4 System Analysis

4.1 Experimental Study

Experiments have been conducted by exploiting resources in design engineering and in image analysis accessible in Android and OpenCV environments. We observe that the use of Haar-like feature descriptors for detecting face and face features is sensitive. Indeed, various false detections can occur according to the condition of illumination during the acquisition, and to objects or textures that are visible out of the face.

4.2 Face-Mask Detection Dataset

The dataset consists of 2000 images belonging to two different

classes: 1. with-mask : 1000 images.

2. without-mask : 1000 images.

Our Goal is to train a custom deep learning model to detect whether a person is or not wearing a mask. For this project, we use the dataset, which consists of 1000 masked faces and 1000 normal pr without-mask with a minimum size of 32×32. The faces in this dataset have different orientation and occlusion degrees. The dataset is divided into 3 parts for training and validation and a test set with 700, 100 and 200 images, respectively.

4.3 Process the data

```
#After execution of this cell all the necessary modules will be imported and the version
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import MobileNetV2
from tensorflow.keras.layers import AveragePooling2D
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Input
from tensorflow.keras.models import Model
from tensorflow.keras.models import load_model
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.applications.mobilenet_v2 import preprocess_input
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.utils import to_categorical
from sklearn.preprocessing import LabelBinarizer
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
import imutils
from imutils import paths
import matplotlib.pyplot as plt
import numpy as np
import argparse
import os
import cv2
from google.colab.patches import cv2_imshow
from imutils.video import VideoStream
import time
import sys
import tensorflow as tf
```

5 Conclusions

In this project we will implement a face mask detection model using CNN for detecting masks over faces in public places to curtail the community spread of Coronavirus is presented.

6 References

[1] Liu, C., and Wechsler, H. (2002). Gabor feature based classification using the enhanced fisher linear discriminant model for face recognition. IEEE Transac tions on Image processing, 11(4), 467-476.

[2] https://iopscience.iop.org/article/10.1088/1742-6596/1916/1/012084/pdf (pp. 583-586)

[3] https://pdfs.semanticscholar.org/ac5b/55449022eb5516920572c2c6e00a0f7783b2.pdf

[4] R. Arulmurugan and H. Anandakumar, Early Detection of Lung Cancer Using Wavelet Feature Descriptor and Feed Forward Back Propagation Neural Net works Classifier, Lecture Notes in Computational Vision and Biomechanics, pp. 103–110, 2018. doi:10.1007/978-3-319-71767-89.

[5] https://iopscience.iop.org/article/10.1088/1742-6596/1916/1/012085/pdf

[6] https://www.researchgate.net/publication/221304726-Face-Recognition-with-Patterns of-Oriented-Edge-Magnitudes.

[7] https://www.pyimagesearch.com/2020/05/04/covid-19-face-mask-detector-with opencv-keras-tensorflow-and-deep-learning/.

[8] https://towardsdatascience.com/review-mobilenetv2-light-weight-model-image classification-8febb490e61c

[9] https://medium.com/analytics-vidhya/face-mask-detection-system-using-artificial intelligence-52afd27b0a4e