Real Time
Face Mask Detector

SYNOPSIS REPORT

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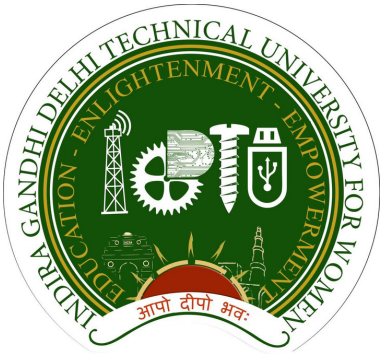

Student Declaration

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BACKGROUND AND OBJECTIVES

Introduction

The year 2020 has shown mankind some mind-boggling series of events amongst which the COVID-19 pandemic is the most life-changing event which has startled the world since the year began. Affecting the health and lives of masses, COVID-19 has called for strict measures to be followed in order to prevent the spread of disease. From the very basic hygiene standards to the treatments in the hospitals, people are doing all they can for their own and the society's safety; face masks are one of the personal protective equipment. People wear face masks once they step out of their homes and authorities strictly ensure that people are wearing face masks while they are in groups and public places. To monitor that people are following this basic safety principle, a strategy should be developed. A face mask detector system can be implemented to check this.

Face mask detection means to identify whether a person is wearing a mask or not. The first step to recognize the presence of a mask on the face is to detect the face, which makes the strategy divided into two parts: to detect faces and to detect masks on those faces. Face detection is one of the applications of object detection and can be used in many areas like security, biometrics, law enforcement and more. There are many detector systems developed around the world and being implemented. However, all this science needs optimization; a better, more precise detector, because the world cannot afford any more increase in corona cases. Thus, our work aims to develop a technique that can accurately detect masks over the face in public areas (such as airports. railway stations, crowded markets, bus stops, etc.) to curtail the spread of Coronavirus and thereby contributing to public healthcare.

Background and Motivation

During pandemic COVID-19, WHO has made wearing masks compulsory to protect against this deadly virus. Wearing a face mask has been an effective social measure in terms of normalizing the curve. It helps avoid any direct contact amongst individuals and assists in reducing any sorts of transmission of the droplets containing the virus via the human breath. Some studies are determined towards the exploration of trajectories that transmit the droplets via human breathing ways such as coughing, talking, sneezing and eating. While a few studies considered the droplet size to be correlated with the pathogens

of the contagious disease, where they considered large droplets to be the ones that were to carry the microorganisms from the infected person, other studies assumed small droplets of the particles that were in the nucleus form to be the ones to spread distantly.

Therefore, considering all these studies and factors, this research project proposes an AI based detection system that helps in detecting whether a person is wearing a face mask in public or not. This research intends on developing a face mask detector that is able to distinguish between faces with masks and faces with no masks and thus help in avoiding the spread of the virus.

Objective

This research project proposes a novel method of an Artificial Intelligence-based face mask detection system. In this research paper, OpenCV and SVM algorithms in the sklearn package are used in the detection of individuals and face masks with the help of bounding boxes. Thus, this paper contributes to developing a novel and unique implementation of a face mask detection system.

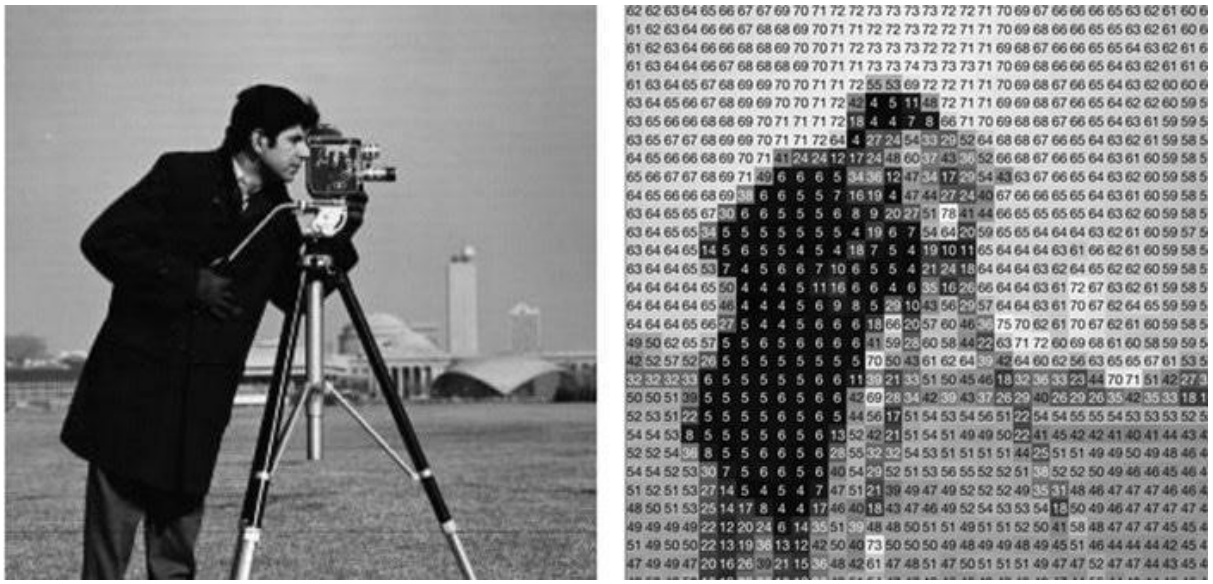
Outcome

In this work, a deep learning-based approach for detecting masks over faces in public places to curtail the community spread of Coronavirus is presented. This project makes use of OpenCV, and SVM algorithm in sklearn package for the prediction and detection of face masks on humans. The testing was done on 25% of the data and out of which 400 images have people with masks in them and 400 people without masks in them. The results show that there is an accuracy of 0.995 in determining whether a person is wearing a mask or not.

DESCRIPTION OF PROJECT

Introduction to Image Processing

Before applying the face mask detection problem, we must first understand how to handle the image. The pictures are just a collection of colors in red, green and blue format. As human beings we see an image with an object or shape, but for a computer it is only a range of color values from 0 to 255.



The way a computer sees anything is different from the way a human sees a picture. But this is good news for us because if we get an array of image, it will be easier for us to apply any algorithm on that array.

Steps for image processing:

Load images using Python or any other programming you are working on.

Convert images to array

Finally apply some algorithm on that array

Another good thing is that we have a library called OpenCV, which helps us to read the image and give back an array of color pixels.

Introduction to OpenCV

- OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library.
- The library has over 2500 optimized algorithms.
- It has C ++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS.
- Helps us to load images into Python and convert them into array.
- Each indicator in the range (red, green, blue) represents a color pixel ranging from 0 to 255.

Features of OpenCV

1. Facial recognition
2. Geometric transformation
3. Image Threshold
4. Smooth images
5. Virgin edge identification
6. Background removal
7. Image splitting

Installing OpenCV directly using Jupyter Notebook

```
In [1]: !pip install opencv-python
```

Now we are ready to perform basic image processing using OpenCV Package. So first load OpenCV package like this :

```
In [1]: import cv2
```

Facial recognition using OpenCV

So now we are going to see how to do face detection from image. The face detection algorithm was introduced in 2001 by Viola and Jones. He divided the algorithm into four stages:

1. Haar Features Selection
2. Integral Images
3. AdaBoost
4. Cascading Classifier

We have an XML file used directly in our project that can help us identify faces from the image.

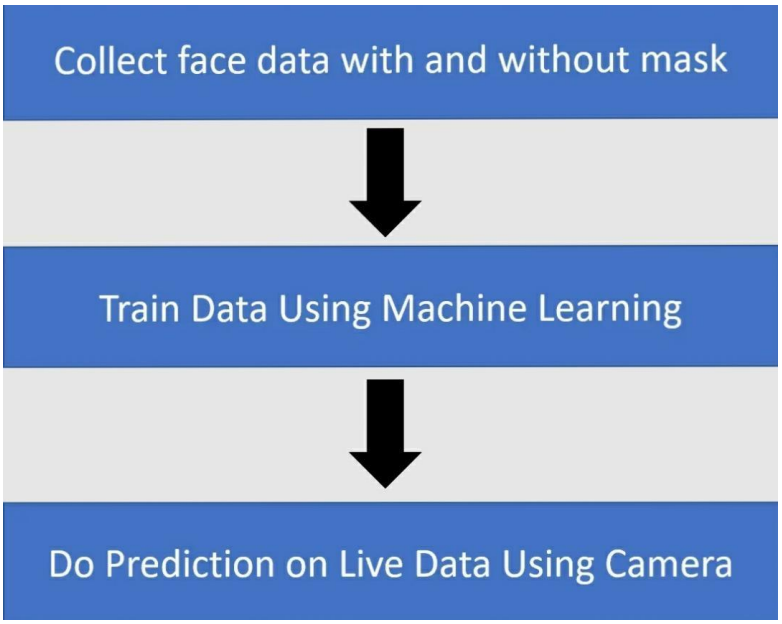
```
In [11]: haar_data = cv2.CascadeClassifier('data.xml')

In [12]: haar_data.detectMultiScale(img)

Out[12]: array([[110,  50, 135, 135],
                [413,  71, 122, 122]], dtype=int32)
```

Process followed is---

Collect face data with and without mask -> Train Data using Machine learning-> Do prediction on Live Data using Camera



DESCRIPTION OF WORK DIVISION

Nancy Som - She has handled the coding part of the project. All the research about how to implement the idea, what to code, what flowchart to be used to implement the idea, which library and machine learning algorithm to be used in the project was researched by her. Her idea was to capture images with masks and no mask and then using ML algorithm, training the data on some part and then test the prediction on the other part of data.

Nidhi Mitra - She carried out extensive research for references and background of the project. And, brainstormed ideas on how to improvise on the gaps. She further collected the information from various links, research papers and PDF's available on the internet and sourced them together. She also shared the motivation and objectives about the project and how it can help in the current scenario and future and thus helping to contain the spread of coronavirus by sharing the idea of equipping machines with face mask detection systems to perform the role of a human personnel thereby reducing human contact.

Nikita Mogha - She handled the part of description and flow of the project.She deep dived through various resources available on internet and gathered the information of 'HOW IMAGE PROCESSING' takes place, is stored in the computer,how the system is going to handle the image with mask and without mask through the concept of light hitting the parts of face .Further the compilation, editing and formatting part was done by her.

Nisha - She has described the various technologies and platforms used in this project like research about open CV ,image processing and its application.Also acquired information about Numpy library and svm algorithm in machine learning and its uses.

Titiksha Saini - She has researched about the project from different sites and pdfs available on the internet in terms of Strengths, Weaknesses, Threats and Opportunities and described the swot analysis of the project.

TECHNOLOGIES AND FRAMEWORK

OPEN CV

OpenCV is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects, faces, or even the handwriting of a human. When it is integrated with various libraries, such as Numpy which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV.

This OpenCV tutorial will help you learn the Image-processing from Basics to Advance, like operations on Images, Videos using a huge set of Opencv-programs and projects.

NUMPY

NumPy is a Python library used for working with arrays.

It also has functions for working in domain of linear algebra, fourier transform, and matrices.

NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely.

NumPy stands for Numerical Python.

NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently.

This behavior is called locality of reference in computer science.

This is the main reason why NumPy is faster than lists. Also it is optimized to work with latest CPU architectures.

NumPy is a Python library and is written partially in Python, but most of the parts that require fast computation are written in C or C++.

IMAGE PROCESSING

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.

There are five main types of image processing:

Visualization - Find objects that are not visible in the image
Recognition - Distinguish or detect objects in the image
Sharpening and restoration - Create an enhanced image from the original image
Pattern recognition - Measure the various patterns around the objects in the image
Retrieval - Browse and search images from a large database of digital images that are similar to the original image

APPLICATIONS:

-medical image retrieval
-traffic sensing technologies
-image reconstruction
-face detection

SVM

A support vector machine (SVM) is a supervised machine learning model that uses classification algorithms for two-group classification problems. After giving an SVM model sets of labeled training data for each category, they're able to categorize new text.

Compared to newer algorithms like neural networks, they have two main advantages: higher speed and better performance with a limited number of samples (in the thousands). This makes the algorithm very suitable for text classification problems, where it's common to have access to a dataset of at most a couple of thousands of tagged samples.Support vector machines (SVMs) are a set of supervised learning methods used for classification, regression and outliers detection.

The advantages of support vector machines are:

-Effective in high dimensional spaces.

-Still effective in cases where the number of dimensions is greater than the number of samples.

-Uses a subset of training points in the decision function (called support vectors), so it is also memory efficient.

-Versatile: different Kernel functions can be specified for the decision function. Common kernels are provided, but it is also possible to specify custom kernels.

SWOT ANALYSIS

What Is a SWOT Analysis?

SWOT stands for strengths, weaknesses, opportunities, and threats. It's a strategic planning technique that project managers use to help them analyse their projects' strengths and weaknesses, as well as to analyse and review any opportunities and threats they may face in the upcoming future.

This popular technique allows project managers to identify areas that need improvement and to select the right methodology for work, which can benefit a company by gaining a better understanding of what areas they should focus on, as well as identify how likely they are to succeed at a given project.

Strengths and opportunities

As a key element in facial imaging applications, such as facial recognition and face analysis, face mask detection creates various advantages for users, including:

- Improved security.

Face mask detection improves surveillance efforts and helps track down people without masks fast and efficiently.

- Personal security.

Personal security is also enhanced since there is nothing for hackers to steal.

- Easy to integrate.

Face mask detection and facial recognition technology is easy to integrate, and most solutions are compatible with the majority of security software.

- Automated identification.

In the past, identification was manually performed by a person; this was inefficient and frequently inaccurate. Face mask detection allows the identification process to be

automated, thus saving time and increasing accuracy.

Weaknesses and threats

- Massive data storage burden.

The ML technology used in face mask detection requires powerful data storage that may not be available to all users.

- Detection is vulnerable.

While face mask detection provides more accurate results than manual identification processes, it can also be more easily thrown off by changes in appearance or camera angles.

- A potential breach of privacy.

Face mask detection's ability to help the government track down people without masks creates huge benefits; however, the same surveillance can allow the government to observe private citizens. Strict regulations must be set to ensure the technology is used fairly and in compliance with human privacy rights.