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Masked Face Recognition Based Attendance System Using Deep Learning

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Abstract: A face recognition attendance system uses face recognition technology to spot and verify an individual using the person's countenance and automatically marks attendance. But with the spread of COVID-19, millions don masks across the planet, which affects the accuracy of the face identification system. The existing face recognition solutions are not any longer reliable when wearing a mask and removing masks for passing authentication will increase the danger of viral infection. To this end, this work proposes deep learning structure based on Convolutional Neural Networks (CNN), trained and tested on images of people's faces with and without masks. The system can recognize a person's face and the attendance will only be recorded if the person is wearing a mask. Supervised learning is applied to train the dataset which is collected from various sources. The software can be used for different groups of individuals such as employees, students, etc. The system records and stores the data in real-time with existing dataset.

Index Terms **- Facial recognition, Mask detection, Attendance, COVID-19, Coronavirus, Masked Face, Deep learning.**

I. INTRODUCTION

In this pandemic situation, wearing a mask became essential to avoid getting infected by coronavirus. Coronavirus spreads through contact with contaminated surfaces. At present, organizations using a biometric or card-based attendance system had to switch towards a face-based attendance system to avoid direct contact with the attendance system. But, facial recognition algorithms did not identify 20-50% of images of individuals wearing face masks according to a report from the National Institute of Standards and Technology. As the corona virus spreads rapidly we can't trouble people by removing masks for attendance purposes. Here, deep learning based masked face recognition techniques can play a vital role in handling attendance with a masked face. Our reliable method for face recognition is safer without any need to touch any device. It uses parts of the face that are not covered up, such as eyes, to verify their identity. The system can be used at various places like exam centers, government offices, MNCs, travel industry, wrongful or criminal deception can be reduced, police can monitor whether people are wearing masks.

Two types of tests have been carried out, first one if the system is able to detect whether a person is wearing a mask or not, the other is to determine if it is able to recognize a person if he or she is wearing a mask. The technology is 99% accurate when no mask is present. For the first case, we have trained CNN algorithm so that it can detect whether a person is wearing – or not – wearing – a mask. In the second case, face is compared with possible matches from the dataset and the mapped face is recognized using a deep learning-based method. We use a pre-trained deep-learning based model so as to extract features from the unmasked face regions out of the mask region.

1.1 Proposed System

In this paper, we apply pre-trained deep Convolutional neural networks (CNN) to extract the best features from the obtained regions like eyes, eyebrows, hairline and general shape of the face. Flask support is used for deployment as a python web framework in this project. The system is built in order to manage attendance for students in a class. It contains input images of students which can be collected during the admission process by the admin. If a new student is to be added to the database then the teacher can login and add details with name and image, this data will be saved in the classroom folder. We have set constraints like single face and frontal view for high accuracy. When a teacher wants to take attendance he/she has to login to the system and student simply have to face towards the webcam. First, the face will be detected and a frame can be seen for the face. Faces in existing datasets will be mapped while the camera scans the face. If the student is wearing a mask the system will detect the mask and recognize the person by discarding the masked face region and extract information through the uncovered part. Once, the person is recognized the attendance will be marked. If the person is not wearing the mask then the attendance will not be recorded. Teachers can download the attendance file whenever needed. The dataset used to train the classifier contains (1) masked and (2) unmasked images. In a masked dataset there are frontal face images with masks on their face and an unmasked dataset contains the same faces without masks on their face. So, basically the primary step is to discard the masked face region. Next, we apply pre-

trained deep Convolutional neural networks for feature extraction. Bag-of-features (BoF) paradigm is applied to get a slight representation compared to the fully connected layer of classical CNN. Finally, Multi-layer perceptron (MLP) is applied for the classification process.

1.2 Flow Chart

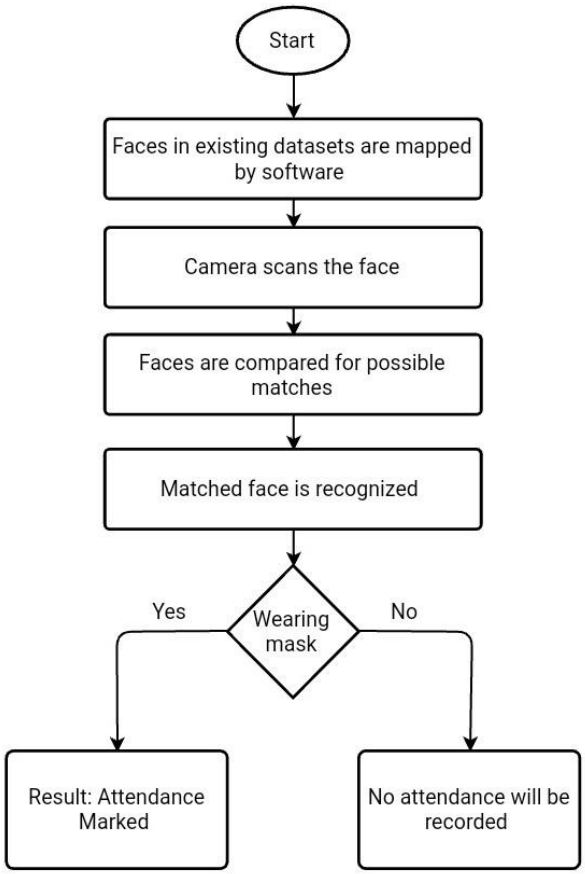


Fig 1: Flow chart of the system

1.3 Software Development Tools

The following software tools were used during the development process.

- Visual Studio
- Python 3.6.8
- Flask web framework
- XAMPP server
- HTML
- MS-Excel

II. System Implementation

2.1 System Prerequisites

The proposed model focuses on recognizing the person with a mask on their face using deep learning structure based on CNN. The training of the network was carried out on a core i5 8th Generation PC with 8GB physical memory and standard webcam. In order to handle masked face recognition tasks, we used two types of masked face datasets, including Real-World Masked Face Recognition Dataset (RMFRD) and Simulated Masked Face Recognition (SMFRD). These datasets consist of many images of 1024 x 1024 dimension renamed with proper labels in folders named 'mask' and 'no-mask' that have been collected from various social networks and search engines[1]. The most important part of this dataset is for feature extraction using CNN. The database is created using phpMyAdmin which contains login information of two modules namely (1) Admin (2) Teacher. There is no student module so that he/she cannot login to the system to prevent proxy attendance. Then, a database is to be created of enrolled students. This is our testing data, where the images collected are without masks and the folder is named classroom. This step can be as a part of the admission process while collecting the student's information. This is accomplished using a dashboard on the web deployed using flask. Here, student's details like Name, Roll number, class, image of student, etc. to be uploaded by clicking on 'Upload Student Data'. This is stored physically in JSON format for faster access to image data and to recognize it.

2.2 Face Mask Detection

The face detector used Haar cascade algorithm to train the classifier, we used 'haarcascade-fronfalface-default.xml' file in this project. We proposed a model that uses MobileNetV2 for image processing. It can classify images into 1000 categories. The captured face or video stream in real-time from the webcam will show the bounding box location of the face and detect face mask with OpenCV and Keras/Tensorflow. Once the mask is detected the input image will label 'Mask' as an output on top of the bounded box, but if the person is not wearing the mask then it will label 'No-Mask'. The system achieved an accuracy of 99% on detecting the face as 'mask' or 'no-mask'.

2.3 Face Recognition and Cropping

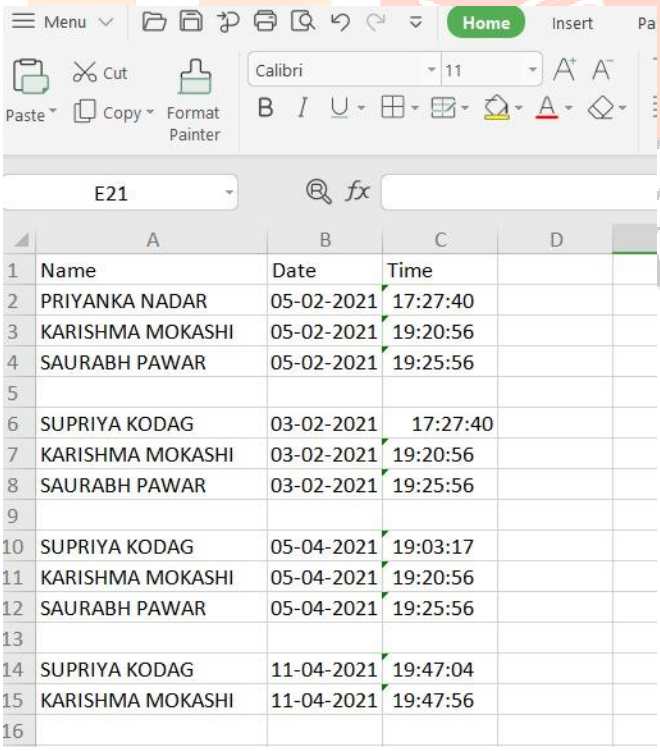
When a person wearing masks is streamed on a webcam the masked region is discarded completely from the feature extraction and classification process. A cropping filter is applied in order to obtain only the informative regions of the masked face which are eyes and forehead. Then, we apply a deep learning model which is more suitable in real-world applications compared to restoration approaches. To do this we first extract local features from training images, each feature represents a region from the image. We extract deep features using VGG-16 face CNN descriptor from images. BoF is largely used for image classification tasks. The sigmoid function is used by the Multi-layer Perceptron classifier (MLP) for representation of faces in terms of vectors. Each image in the classroom folder will be taken and its face encodings will be generated, basically, a cross-validation strategy will be used to evaluate the recognition performance. When a masked face is recognized it will display a name inside the bound box also the attendance will be recorded for the identified person. The accuracy on the test dataset is 95%, the highest to our knowledge.

2.4 Store Recognized Entries

Whenever the algorithm finds a match, the name of the person identified is stored as a .csv file with the name, timestamp and date. The attendance will not get recorded if the person is not wearing the mask; otherwise the attendance will be recorded and will display 'Attendance Marked' on the screen.

2.5 View the Attendance

The attendance sheets are often downloaded by clicking on the 'Download Attendance' button from the dashboard. The downloaded attendance sheet will be viewed as an excel file with the name, date and timestamp.



	A	B	C	D
1	Name	Date	Time	
2	PRIYANKA NADAR	05-02-2021	17:27:40	
3	KARISHMA MOKASHI	05-02-2021	19:20:56	
4	SAURABH PAWAR	05-02-2021	19:25:56	
5				
6	SUPRIYA KODAG	03-02-2021	17:27:40	
7	KARISHMA MOKASHI	03-02-2021	19:20:56	
8	SAURABH PAWAR	03-02-2021	19:25:56	
9				
10	SUPRIYA KODAG	05-04-2021	19:03:17	
11	KARISHMA MOKASHI	05-04-2021	19:20:56	
12	SAURABH PAWAR	05-04-2021	19:25:56	
13				
14	SUPRIYA KODAG	11-04-2021	19:47:04	
15	KARISHMA MOKASHI	11-04-2021	19:47:56	
16				

Fig 2: Sample of downloaded attendance sheet

III. RESULT

We have built the face recognition attendance system for masked faces. The dataset contained 800 images which have a single and frontal face. These 800 images comprise 400 unique unmasked images and 400 masked images. Once the system is trained with this dataset and tested with unmasked faces, its accuracy was 95%. The system performance and accuracy when the person is without a mask increased by 99%. Thus, high-quality frontal face images are readily acquired, in order that the masked face recognition task is not any longer so difficult. Moreover, dealing with only the informative regions (unmasked ones) and the high generalization method proposed makes it applicable in real-time applications.

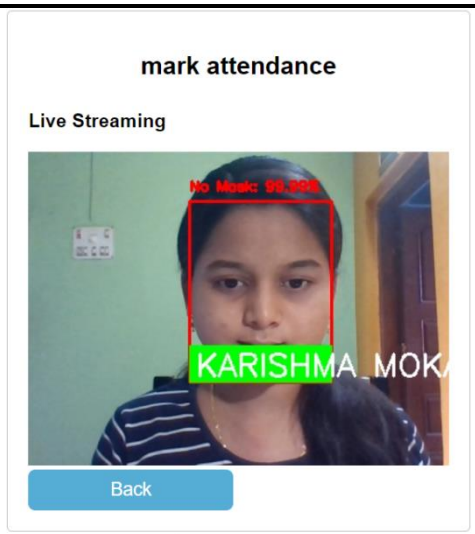


Fig 2: Result on a real-time image with no mask

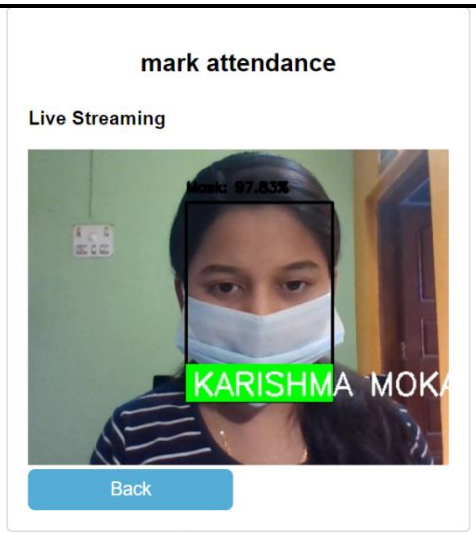


Fig 3: Result on a real-time image with a mask

IV. CONCLUSION

During this pandemic situation existing face recognition technology will easily fail to make efficient recognition. The proposed system improves the face recognition attendance process in the presence of masks using deep learning-based methods. Moreover this is not limited to this pandemic as people wear masks to take care of their health and protect themselves against pollution. In the proposed system, mask detection technology can be used to identify faces in the crowd wearing masks or not. In future, notification to the student can be sent once the attendance is marked.

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