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Implementation towards Face Mask Detection and Sanitization using Sementic Segmentation

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ABSTRACT: Covid19 has given a new identity for wearing a mask. Accurately and efficiently detecting masked faces is in- creasingly meaningful. As a unique face detection task, face mask detection is much more difficult because of extreme occlusions which leads to the loss of face details. Besides, there is almost no existing large-scale accurately labeled masked face dataset, which increase the difficulty of face mask detection. In this system, we propose a method to detect the face mask of individual, recognize the person and fine him if not wearing the mask. The system also includes sanitization tunnel where the individual will pass through sanitization tunnel after going through proper body temperature check. Face mask detection for system uses deep learning as a primary method with sanitization tunnel implemented with IoT. The system helps to find person who is not wearing the mask, with body temperature check as inclusion it helps to find probable covid19 infected person and sanitization tunnel helps to curb more spreading of disease.

KEYWORDS: Covid19,

I. INTRODUCTION

At the end of this decade, face has got a new identification due to rise in COVID19 cases. COVID-19 is a virus which gets inflicted when infected person comes in contact with any other person. Infected person can leave traces of virus on things around him. His spit or touch is observed to be most infectious medium to carry this virus. Hence as way of precaution people all around need to wear face mask to prevent them and everyone around them to get infected by the VIRUS. This discipline has been made compulsory which is helping in curbing the COVID-19 cases. Government have utilized strict law for wearing mask when in public area. People are fined for not wearing mask or not wearing it properly. Keeping the need of time in mind we have proposed a method for detecting the mask on face. The paper proposes a step wise method to detect the block of face in images and surveillance videos. The next step involves detection of mask on this block. Further steps involve whether the mask is worn properly or not. The first step of face detection is one of the longest-researched computer vision problem, which can be traced back about half a century ago. However, most of the early face detection algorithms cannot meet the practical need. In 2001, Viola and Jones's seminal work," Viola-Jones face detector", made it possible for real-time face detection in practice [1]. The Viola Jones face detector consists of a series of classifiers ranging from simple to complex ones. Later researchers continued to study based on it, and many of them apply more complex and descriptive features [2,3,4] to make the detector more powerful. In recent years, deep learning has made great breakthroughs in many computer vision areas, such as general object detection, object classification, object segmentation and of course, face detection. Deep learning does not need to manually design features, the CNN (Convolutional Neural Networks) can automatically take learning useful features from the training images. The proposed system involves use of cascaded CNN for face detection and detection of mask at later stage. The system will help detect the people wearing mask as well people not wearing mask. This in course will help to bring discipline to public as well precaution through which they can easily roam around and help curb the COVID- 19 infection.the system further extends to create sanitization tunnel which involves the IoT part of system wherein tunnel is activated after detection of proper mask.

Paper is organized as follows. Section II describes about the related work done earlier for the system to be developed. Section III presents method used and algorithms used for the detection. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

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II. RELATED WORK

1. Multi-scale feature extraction for single face recognition.

The Single sample face recognition has always been a hot but difficult issue in face recognition. The existing methods solve this issue from selecting robust features or generating virtual samples. By considering selecting robust features and generating virtual samples simultaneously, the paper proposes a multi-scale sup- port vector transformation (MSSVT) based method to generate multi-scale virtual samples for single image recognition. The methods to solve problem are divided into two categories. One is to look for and select features that are robust to the number of samples, from the point of view of feature selection, such as PCA and 2DPCA. But when each person has only one face to be trained, the feature information extracted from the feature extraction algorithm will also be very limited, resulting in a bad recognition performance. The other is to generate multiple virtual samples from the point of view of the extended sample, thus reducing the impact of the sample size [3].

2. Face recognition method based on sparse representation and feature fusion.

The authors propose a multi-feature fusion face recognition method based on sparse representation. The core idea is to find the sparseness through training, and then use the sparse coefficient and training samples to represent the test samples, and then the optimal sparse solution is obtained by solving the l1-norm problem. The recognition results of feature fusion method are better than any single feature algorithm under the condition of non-occlusion or occlusion. When there are less than 10 pictures of each category of people in the training sample and the occlusion type is not controllable, our algorithm can still obtain a high recognition rate [5].

3. Spatial pyramid pooling in deep convolutional net- works for visual recognition

SPP is a flexible solution for handling different scales, sizes, and aspect ratios. These issues are important in visual recognition, but received little consideration in the context of deep networks. Authors have suggested a solution to train a deep network with a spatial pyramid pooling layer. The resulting SPPnet shows outstanding accuracy in classification/detection tasks and greatly accelerates DNN-based detection. Their studies also show that many timeproven techniques/insights in computer vision can still play important roles in deep networks-based recognition [1].

4. Face and Gender Recognition System Based on Convolutional Neural networks

The proposed Face and Gender Recognition System realizes the combination of image face recognition and gender recognition module, which enables not only face recognition but also gender recognition in complex background. Based on the ResNet50 neural networks, we use the global average pool (GAP) instead of the fully connected layer before final output, followed by the SoftMax layer, which reduced the size of the networks. By constructing such a simple structure, the accuracy of the system recognition has been improved [6].

5. Cascade Framework for Masked Face Detection

In this paper, authors propose a new deep learning-based algorithm for masked face detection. Their algorithm is based on a newly designed CNN cascade framework consists of three CNNs. Besides, they propose a new dataset called" MASKED FACE dataset" which have 160 images for training and 40 images for testing. In order to overcome the overfitting problem due to the insufficient of training samples, we pre-train our models with the WIDER FACE dataset, and fine-tune them with the MASKED FACE training set. They have evaluated masked face detection algorithm on the MASKED FACE testing set and it achieves very satisfactory performance [2].

6. Dynamic Feature Matching on Partial Face Recognition.

In The partial face recognition is having application in a broad spectrum of different fields. The different approaches used for the partial face recognition are the keypoint-based approach, region-based approach, and CNN-based approach. In keypoint-based, the popular method was MKD-SRC. In regionbased partial face recognition approach, the prominent model is MR-CNN. In the midst of different approaches in partial face recognition, it is concluded that the CNN-based approaches are the comparatively best approach. The current novel approach proposed for partial face recognition. in CNN– based is called Dynamic Feature Matching (DFM). The dynamic feature dictionary correlating to the probe is achieved. DFM is able to yield the advantages of the properties of FCN and generate identifying features more precisely. DFM is having a promising application in various video recognition approaches in the future [6].

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7. Implementation of Principal Component Analysis on Masked and Nonmasked Face Recognition

The paper analyses non-masked face recognition and masked face recognition accuracy using Principal Component Analysis (PCA) to recognize a person. It proved that, a face without mask gives better recognition rate in PCA based face recognition system. But when a person is wearing mask, facial recognition gives poor recognition rate. It is found that extracting feature from a masked face is less than non-masked face. Because of missing features for wearing mask which decrease the recognition rate. Finally, it is concluded that traditional statistical algorithm Principal Component Analysis (PCA) is better for normal face recognition but not for masked face recognition. So in the future, concern to improve the accuracy of masked face recognition using other sophisticated machine learning methods [7].

8. Face Detection Based on Multi-Block LBP Representation

In this paper, we proposed multi-block local binary pat-tern (MB-LBP) features as de-scriptor for face detection. A boosting-based detector is implemented. Aims at the non-metric feature value of MB-LBP features, multi- branch regression tree is adopted to construct the weak classifiers. First, these features can capture more information about image structure than traditional Haar-like features and show more distinctive performance. Second, fewer feature number of the completed feature set makes the training process easier. In our experiment, it is shown that at the given false alarm rate 0.001, MB-LBP shows 15% higher correct rate than Haar-like feature and 8% higher than original LBP feature. Moreover, our face detector gets considerable performance on CMU+MIT database with fewer features [8].

9. An HOG-LBP Human Detector with Partial Occlusion Handling

The authors propose a human detection approach capable of handling partial occlusion and a feature set that combines the trilinear interpolated HOG with LBP in the framework of integral image. It has been shown in our experiments that the HOG-LBP feature outperforms other state-of-the-art detectors on the INRIA dataset. However, our detector cannot handle the articulated deformation of people, which is the next problem to be tackled [9].

10. Rapid Object Detection using a Boosted Cascade of Simple Features

The authors have presented an approach for object detection which minimizes computation time while achieving high detection accuracy. The approach was used to construct a face detection system which is approximately 15 fasters than any previous approach. This paper brings together new algorithms, representations, and insights which are quite gen [10].

III. PROPOSED METHODOLOGY

In this Covid-19 situation it is difficult to go to public places without mask. The system is designed to detect the mask on the face, and type of mask on face and whether the mask is worn properly. If mask is not present, the face recognition of person is done to notify him.

A. Modules

1. **Image Capture**

- Image is Captured through Image itself or Video Input. These Images takes in inputs, which are then processed in hidden layers of network using weights that are adjusted during training.
- Then the model spits out a prediction. The weights are adjusted to find patterns in order to make better predictions

2. **Face Detection**

- Face Detection. Locate one or more faces in the image and mark with a bounding box.
- Face Alignment. Normalize the face to be consistent with the database, such as geometry and photometrics.
- Feature Extraction. Extract features from the face that can be used for the recognition task. Face Recognition. Perform matching of the face against one or more known faces in a prepared database.

3. **Mask Detection**

- Training: 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.
- Deployment: 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.

4. **IOT**

- IoT module consist of body temperature check sensor, motor to open the door and Spray to initialize the tunnel.

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B. System Architecture

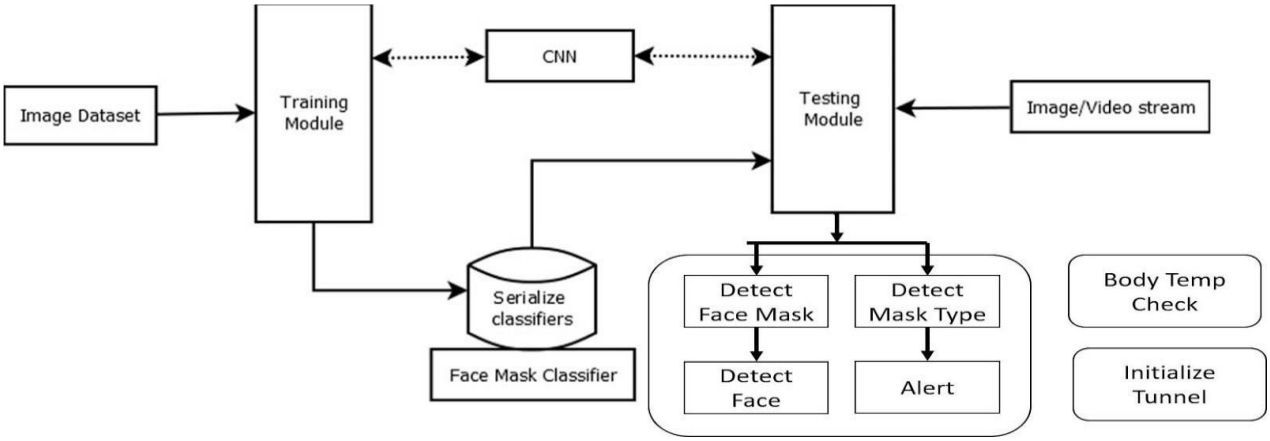

Fig. 1. System Architecture

Dataset

1. Dataset: MySQL Database

MySQL is on open source database which is mainly a RDBMS i.e. relational database management system. As a database server, primary function of this software is to storing and retrieving data as requested by other from end software applications like java which may or may not run either on the same computer or on different computer. This can be across the network either in internet or intranet.

D. Algorithm

1. *CNN:* A Convolutions Neural Network (CNN) is comprised of one or more convolutions layers (often with a sub sampling step) and then followed by one or more fully connected layers as in a standard multi-layer neural network. The architecture of a CNN is designed to take advantage of the 2D structure of an input image (or other 2D input such as a speech signal). This is achieved with local connections and tied weights followed by some form of pooling which results in translation in variant features. Another benefit of CNN's is that they are easier to train and have many fewer parameters than fully connected networks with the same number of hidden units.

- Step 1: Dataset containing images along with reference caption is fed into the system
- Step 2: The convolutional neural network is used a encoder which extracts image features 'f' pixel by pixel.
- Step 3: Matrix factorization is performed on the extracted pixels. The matrix is of m x n.
- Step 4: Max pooling is performed on this matrix where maximum value is selected and again fixed into matrix.
- Step 5: Normalization is performed where the every negative value is converted to zero.
- Step 6: To convert values to zero rectified linear units are used where each value is filtered and negative value is set to zero.
- Step 7: The hidden layers take the input values from the visible layers and assign the weights after calculating maximum probability.

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IV. RESULT & DISCUSSIONS

Fig. 2. Result 1

Fig. 3. Result 2

Fig. 4. Result 3

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V. CONCLUSION

The system is designed as most useful utility in recent times to detect the mask on face. The cascade model study for face detection and further to identify the individual who are not wearing or who are not properly wearing the mask so that proper precaution and discipline can be utilized to stop the spread of virus. The individuals not wearing mask are notified while face detection is also implemented to know the individual. As a social cause this system can be implemented at malls as well at public places to curb spread of virus.

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