iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36177

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Masked Face Identification by Ensuring Safe Social Distancing, Temperature Screening and Crime Detection

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Abstract: COVID -19 pandemic is the defining global health crisis of our time which eventually led to the use of face mask and maintaining safe social distancing, which became mandatory for reducing the rate of transmission of virus. This has parallelly raised a challenge in identifying people since most of the face regions are hidden inside the mask. So we came up with a system which identifies maked face along with which it ensures whether people follows safe social distancing or not. For this purpose we are using deep convolutional neural network (CNN) along with this MLP is also used for classification process. We also incooperates an efficient system that makes real time automated monitoring of people to detect safe social distancing and use of thermal cameras for detecting the body temperature. Thus the entire system favours the society by saving time and the automated inspection reduces the manpower to inspect the public.

I. INTRODUCTION

Due to the pandemic humans are facing many difficulties and this has increased number of casualities and man securities problem.To tackle the pandemic everywhere everytime we human beings are wearing masks ,this has made the face recognition a very difficult task since most of the face are hidden. This system is providing us a reliable method by which it is easy to identify the face hidden under the mask . deep learning based approach is proved handy here. CNN is having strong robustness to illuminate facial expression facial occlusions. Efficient quantization based pooling method[22]for face recognition is provided by using VGG-16 pre trained model. The first step is to discard the masked region[1]to do so apply cropping filter just to obtain only informative regions of the masked face. Basically there are four steps discussed in this system for face recognition. In the first step ie ,in preprocessing and cropping filter, what we need to do is rotate the face so that we can remove the regions efficiently. To do so we detect 68 facial landmark and according to the eye location we apply a 2D rotation to make them horizontal. After this we apply cropping filter to extract only the masked regions. For this first we normalize the image and then partition it into different blocks. The principle behind this is to divide the image into 100 fixed sized block and we extract only the block containing non masked region. In the second step that is feature extraction layer[21], deep feature are extracted using VGG -16. Basically in pattern recognition task we need to estimate millions of parameters in the fully connected layer which requires high processing capacity and memory. So to tackle this efficient quantization based pooling method for face recognition using VGG-16 is used. Here we consider the feature maps at the last convolutional layer using bag of features. VGG-16 is consisting of millions of images and classes. Its name shows that it has 16 layers that is activation layer ,pooling layer,convolutional layer,fully connected layer etc . the features extracted in this step are used for quantization. In the third step, that is deep bag of features,the feature are now extracted we need to check or measure the similarities between the extracted features and the vector hence we apply RBF similarity metric. After this the quantization is applied to extract the histogram. The bag of features represents the image as a set of local features[21]. So first we extract the local features from the training image. After this all the features are quantized to a code book. By using bag of features this help to reduce the number of parameters and makes it possible to classify masked face. The RBF layer is measuring the similarities of input face. Finally, in the quantization uses output of RBF and proceeds with the classification process[1]. In the classification stage we assign each test image to the identity .To do this we apply multilayer perceptron classifier. Thus the image is processed.

Along with face recognition it incooperates another system which detect safe social distancing since it is mandatory to maintain atleast 2 meter distance between individuals. The first step in this process is to measure the distance of the person to be detected from the camera. For this purpose we are using triangular similarity technique by taking the distance of the person from camera as D and the focal length of camera as F and height of the person as H. After measuring the distance bounding boxes will be displayed around the people.

There can be more number of people in a sinle bounding box. In order to get the distance of each individual in the same bounding box ,we consider the centre of the bounding box as reference and the vectors are considered for measuring the distance. Individuals who are not following safe social distancing will be bounded by red bounding boxes.if the same individuals are seem to violate the rules frequently then further actions will be taken .

The processed image is obtained through various steps like preprocessing and cropping filter, feature extraction layer, deep bag of features ,fully connected layer and classification.this image is stored in the image database from where the current image is being compared with the reference image to check the criminal history of the detected person.Body temperature is measured using advanced thermal cameras Thermal cameras consists of some tiny measuring devices named as microbolometer which capture the radiation and records the temperature of the object and thereby assign appropriate colour to it . Thermal cameras has the property of absorbing the infrared radiation that is produced by the hotter object by the means of thermal lenses and convert them into image .

II. RELATED WORKS

Newly invented image processing and deep learning based technologies have made good result for identifying the face . The objective of this work is to remove mask objects in facial images. This problem is challenging because (1) most of the time facial masks cover quite a large region of face that even extends beyond the actual face boundary below chin, and (2) facial image pairs with and without mask object do not exist for training. We break the problem into two stages: mask object detection and image completion of the removed mask region. The first stage automatically produces binary segmentation for the mask region. Then, the second stage removes the mask and synthesizes the affected region with fine details . In [18] system adapts a GAN-based network using two discriminators where one discriminator helps learn the global structure of the face and then another discriminator comes in to focus learning on the deep missing region. This model outperforms others representative state-of-the-art approaches both qualitatively and quantitatively.

Partial face recognition (PFR) in unconstrained environment is a very important task, especially in video surveillance, mobile devices, etc. The study in [15] combines Fully Convolutional Network (FCN) with Sparse Representation Classification (SRC) to propose a novel partial face recognition approach, called Dynamic Feature Matching (DFM), to address partial face images regardless of size. Based on DFM, we propose a sliding loss to optimize FCN by reducing the intra-variation between a face patch and face images of a subject. The proposed DFM is evaluated on several partial face databases, including LFW, YTF and CASIA-NIRDistance databases. Experimental results demonstrate the effectiveness and advantages of DFM in comparison with state-of-the-art PFR methods

Another model in [11] , a novel occlusion invariant face recognition algorithm based on Mean based weight matrix (MBWM) technique is proposed. The proposed algorithm is composed of two phases—the occlusion detection phase and the MBWM based face recognition phase. A feature based approach is used to effectively detect partial occlusions for a given input face image. The input face image is first divided into a finite number of disjointed local patches, and features are extracted for each patch, and the occlusion present is detected. Features obtained are used for face image recognition. The SVM classifier is used for occlusion detection for each patch. In the recognition phase, the MBWM bases of occlusion-free image patches are used for face recognition. Euclidean nearest neighbour rule is applied for the matching. The experimental results demonstrate that the proposed local patchbased occlusion detection technique works well and the MBWM based method shows superior performance to other conventional approaches.

A trust model was presented in [8] which propose a robust 3D face recognition system which can handle pose as well as occlusions in real world. The system at first takes as input, a 3D range image, simultaneously registers it using ICP(Iterative Closest Point) algorithm. The performance of ICP relies heavily on the initial conditions. Hence, it is necessary to provide an initial registration, which will be improved iteratively and finally converge to the best alignment possible. Once the faces are registered, the occlusions are automatically extracted by thresholding the depth map values of the 3D image. After the occluded regions are detected, restoration is done by Principal Component Analysis (PCA). The restored images, after the removal of occlusions, are then fed to the recognition system for 4classification purpose. The experimental results which were obtained on the occluded facial images from the Bosphorus 3D face database, illustrate that our occlusion compensation scheme has attained a recognition accuracy of 91.30%.

The system in [2] utilizes three dimensional shape information to make the system more robust . Hence a 3D face model is constructed by integrating several 2.5D face scans . The two different modalities are utilized and integrated for face matching. The surface matching component is done on the basis of ICP algorithm. The candidate list from the gallery which is used for the matching purpose is generated based on the output of matching component .

To synthesize new appearance samples, 3D models are used. Experimental results are given for matching a database of 200 3D face models with 598 2.5D independent test scans acquired under different pose and some lighting and expression changes.

An improved technique was used in [25]which propose a nose tip detection method that has the following three characteristics. First, it does not require training and does not rely on any particular model. Second, it can deal with both frontal and non-frontal poses. Finally, it is quite fast, requiring only seconds to process an image of 100–200 pixels (in both x and y dimensions) with a MATLAB implementation . Experimental results show that the proposed method is robust to many scenarios that are encountered in common face recognition applications (e.g., surveillance). A high detection rate of 99.43% was obtained on FRGC v2.0 data set.

A novel geometric framework for analyzing 3D faces, with the aim of comparing, matching, and averaging their shapes is being represented. Here [10] develops a Riemannian framework. This representation, along with the elastic Riemannian metric, seems natural for measuring facial deformations and is robust to challenges such as large facial expressions (especially those with open mouths), large pose variations, missing parts, and partial occlusions due to glasses, hair, and so on. This framework is shown to be promising from both— empirical and theoretical—perspectives . FRGCv2, GavabDB, and Bosphorus, each posing a different type of challenge. From a theoretical perspective, this framework allows for formal statistical inferences, such as the estimation of missing facial parts using PCA on tangent spaces and computing average shapes.

A trust model was introduced by [9] which has put forward a fully automatic 3-D face recognition system which is robust to occlusions. We basically consider two problems: 1) occlusion handling for surface registration, and 2) missing data handling for classification based on subspace analysis techniques. For the alignment problem, we employ an adaptively-selectedmodel-based registration scheme, where a face model is selected for an occluded face such that only the valid nonoccluded patches are utilized. After registering to the model, occlusions are detected and removed. In the classification stage, a masking strategy, which we call masked projection, is proposed to enable the use of subspace analysis techniques 6with incomplete data . Experimental results confirm that registration based on the adaptively selected model together with the masked subspace analysis classification offer an occlusion robust face recognition system.

A. Comparison Table

Serial no	Existing system	Pros	cons
1	A novel GAN based network for unmasking of masked face	Capable of producing high perception uality result	Accuracy of output remains inconsistent
2	Dynamic feature learning for partial face recognition	DFM can be easilt extended to other visvual recognition task such as partial face reindetification	Cant detect the face if the person wears sunglasses
3	A training free nose tip detection method from face range images	It doesn't reuires any training and has a high detection rate	Ambiguous regions of the face profile are falsely detected as nosetip
4	3D face recognition using geodesic facial curves to handle expression,occlusions and pose variations	Handle deformations of a face caused by large facial expressions	Challenges like large expressions,presence of occlusions or pose variation
5	3D face recognition under occlusion 8using masked projection	Good performance under substantial occlusions,expressions and small pose variations	If the occlusions are so large that the nose area is totally invisible the initial alignment become impossible
6	Robust 3D face recognition in presence of pose and partial occlusions of missing parts	The proposed system can handle substantial occlusion and small pose variation	If the face is rotated by more than 30 degree it becomes difficult to accomplisth the intial allignment

Table 1;comparison analysis

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III. CONCLUSION

This system improves the generalization of face recognition process in the presence of mask. The system will operate in a efficient manner in the current situation when the lockout is eased and help to track public places easily in an automated manner. This method can also be extended to richer applications such as violence video retrival and video surveillance.

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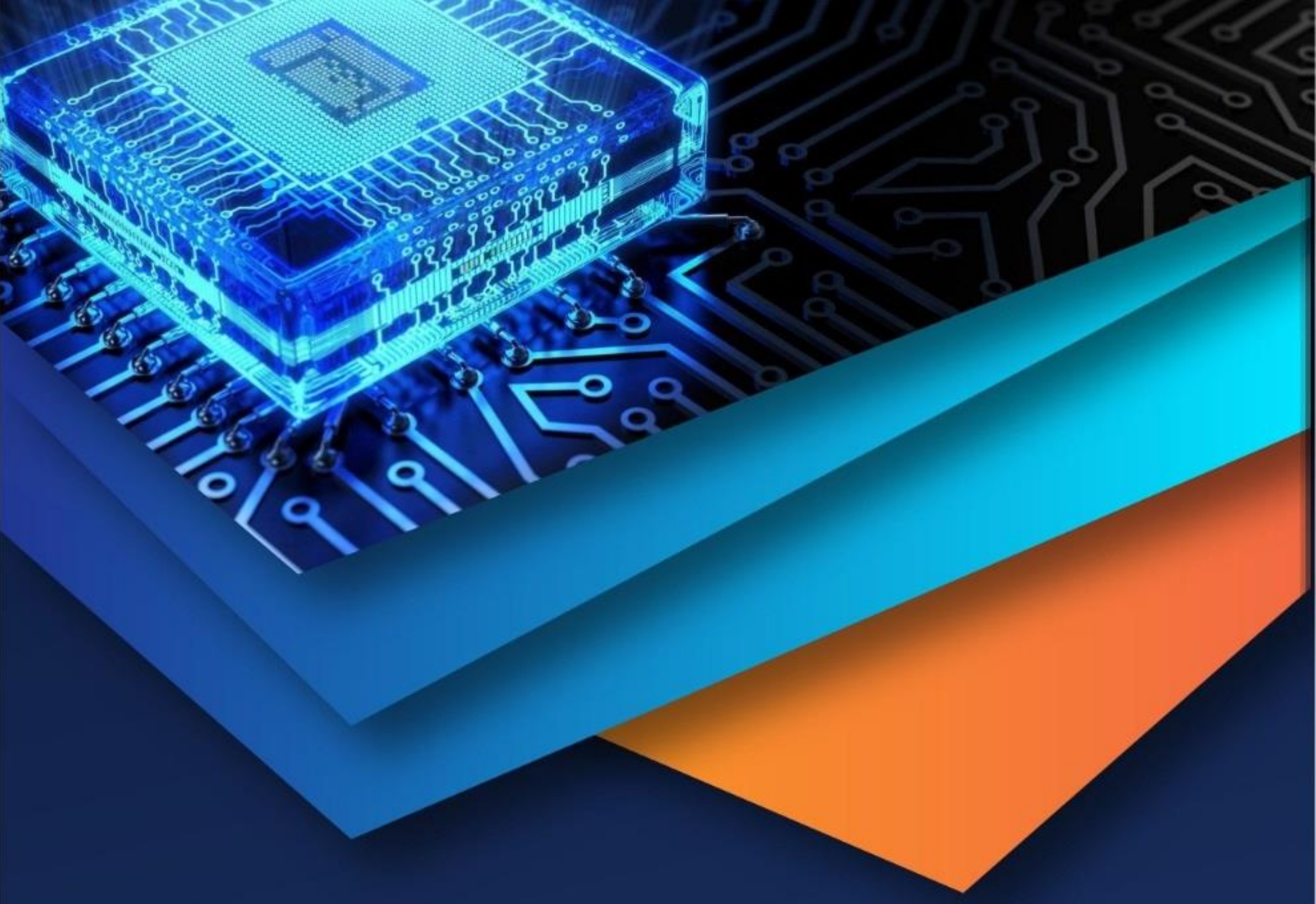

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INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

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