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Occlusion Invariant Face Recognition System using SVM and near set Theory

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ABSTRACT: Face recognition has acquired a lot of attention in a research community but still remained very approaching in real time applications. It is one of several techniques used for identifying a person. In face recognition there are many factors which affect the performance of a system. The major factor which affects the face recognition system is pose, illumination, ageing, occlusion, expression etc. Among these entire problems an occlusion problem is a most affecting problem in face recognition. In Face recognition due to obstacle like scarf, glasses, palm etc. we are unable to recognize a face. To deal with occlusion problem first we have detected an occlusion by using a SVM (Support Vector Machine) classifier. For that we have first divide a face image into K local patches and extract statistical features like mean, standard deviation, entropy, contrast and homogeneity which we have analyzed in isolation. After detecting an occluded face we go for face recognition. By using near set theory we reduce a set for recognition and recognize a face from that reduced set.

KEYWORDS: Face recognition, occlusion detection, support vector machine, near set, statistical feature, reduced set.

I. INTRODUCTION

Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, such as a photograph or video frame. The output of image processing may be either an image or a set of characteristics or parameters related to the image [1]. Image processing usually refers to digital image processing. Digital image processing is the use of computer algorithms to perform image processing on digital images. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing digital image processing is the only practical technology for classification, feature extraction, pattern recognition, projection, multi-scale signal analysis.

During a last few years face recognition has a significant attention as one of the most successful application of an image processing and analysis. At least two reasons account for this trend: the first is the wide range of commercial and law enforcement applications, and the second is the availability of possible technologies after 30 years of research. Even though current machine recognition systems have reached a certain level of maturity, their success is limited by the conditions imposed by many real time applications [2]. Face recognition is mainly used for person identification. In general scenario we identify a person by his face. Recognizing a face to machine is not an easy task. Machine faces different challenges for face recognition such as in face recognition under illumination condition can changes the appearance of face. When we are working with a video based face recognition posing problem is also important. Some other challenges like an expression, aging, facial hair, cosmetics and facial paraphernalia are also important. One of the most important problems is an occlusion problem in face recognition. Among all these problems associated with a face recognition system, handling partial occlusion is one of the most challenging problems. The problem of occlusion by other objects or apparels such as sunglasses, palm, scarves or masks becomes well-known. Occluded parts in the face images usually reduce the recognition performance and thus a robust algorithm for occluded faces is essential to real time applications. Face detection is a difficult job in real time tracking of multiple objects due to occlusion [3].

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II. RELATED WORK

It is very well known that conventional approaches like LDA [4], PCA[5] and ICA[6] are not robust to partial occlusion detection. In [7], authors solved the problem of face recognition under occlusion due to sun glasses or scarves. Here the presence of sunglasses or scarves was detected and the non- occluded region only was processed. Occlusion can be dealt by selecting non occluded patches from the faces. Occlusion was detected by PCA and support vector machines (SVM). To detect the occluded region in the face, divide the images in to finite number of patches and examine each patch separately. As configuration and size of the patches are important in the performance of occlusion detection they have divided faces in to 6 symmetrical patches. Then dimension of these patches were reduced by using PCA .At the end the recognition of the non-occluded facial part is performed using blocked-based weighted local binary patterns (LBP).In [8], the occlusion detection problem is solved by using Gabor Wavelet, PCA and SVM, while recognition of non-occluded face is performed using a block-based local binary pattern. For occlusion detection, face image is divided into two equal components. Gabor wavelet features are extracted from each component, for dimensionality reduction principle component analysis is used. The choice of using Gabor wavelets is motivated by their biological relevance, discriminative power and computational properties. This feature vector is fed to a SVM classifier for occlusion detection. And at the end local binary pattern (LBP) is used for face recognition.

In [10], they use a fast weighted principle component analysis (FW-PCA) for occlusion detection and use this occluded region as weight for matching face image. To reduce the computation time of estimating the principal component score, FW-PCA directly calculates the principle component score First we detect the occluded region in input image using FW-PCA and then comparing the occluded region of input image and registered image, the coefficient or mask for face recognition algorithm. In this paper they use local binary pattern (LBP) and phase only correlation (POC) [11] algorithm for face recognition. They use three databases for experiment as AT&T face dataset, yale face dataset and FERET dataset. In [2], the proposed algorithm is composed of 2 phase- occlusion detection phase & MBWM based face recognition phase. This algorithm is worked on partially occluded face image. The occlusion detection is based on patch based MBWM features & SVM classifier. A given input face image is first divided into local patches. The features exhibit highly localized characteristics in spatial domain, so the occlusion affects only the features of corresponding local region. For detecting occlusion detection of a face image is done by detecting an occlusion from each local patch. SVM is used for occlusion detection by using features like mean and standard deviation of each local patch. After detecting occlusion in each patch a patch which contain occlusion we discard that local patch and based on remaining patch it recognize a face. They use a GTAV face data base for experimental purpose.

III. PROPOSED ALGORITHM

The main aim of this paper is to improve the performance of a face recognition system under varying conditions such as partial occlusion. For solving this partial occlusion problem we have proposed an algorithm. A proposed algorithm will be developing in mainly four phases as Capture image from dataset, Face detection, Occlusion Detection and Face recognition. And flow of our proposed algorithm scheme as shown in figure 2.

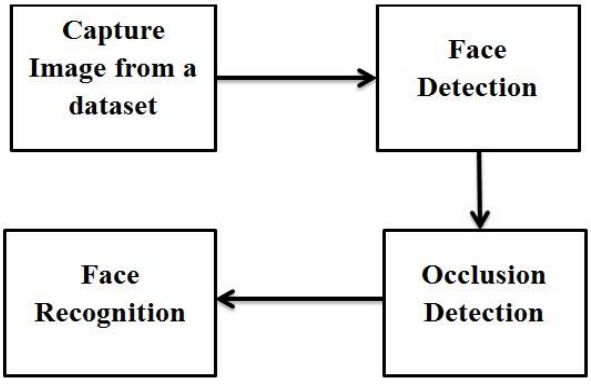

Fig.2 Flowchart of proposed work

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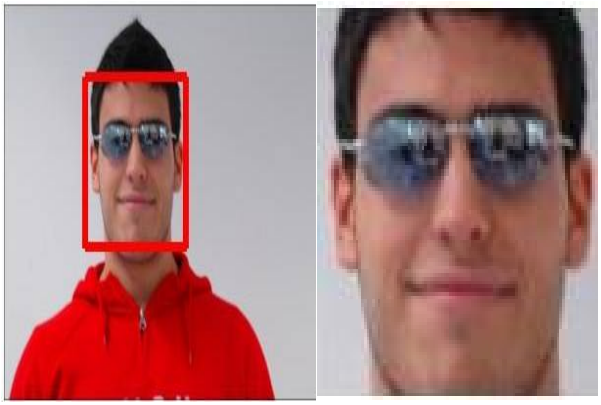
3.1 Face detection

From a given input image we require only face image so first we have detect a face from input image as shown in figure 3a and crop that specific face image and ignore the background as shown in figure 3b. All working of occlusion detection and face recognition is performed on this face image.



(a) (b)

Fig.3 Face is detected and cropped

3.2 Occlusion detection from face

Our main goal is occlusion detection, for that first we have divided a face image into local patch as shown in figure 4. We have extracted statistical features like mean, standard deviation, entropy, homogeneity, and contrast from each local patch which is used for occlusion detection. By using this statistical features and SVM classifier we have detected an occlusion. For that we train a system using SVM [12] classifier and based on that training we have detect partial occlusion from face image.

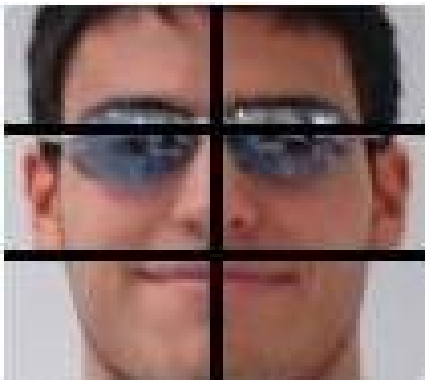


Fig.4 Divided into local six patches

3.3 Face Recognition

The performance of our system is mainly depending on the recognition module. For recognition purpose we have used near set approach [13]. The basic idea in near set approach to adaptive learning is to compare behavior description. In general, there are two set X and Y are considered near to each other if the set contains object with at least partial matching description. So the performance of face recognition will increase. For face recognition we have used previously extracted statistical features like mean, standard deviation, entropy, homogeneity and contrast. Based on these statistical features we will recognize a face. Flow of occlusion detection and face recognition will be as shown in figure 5.

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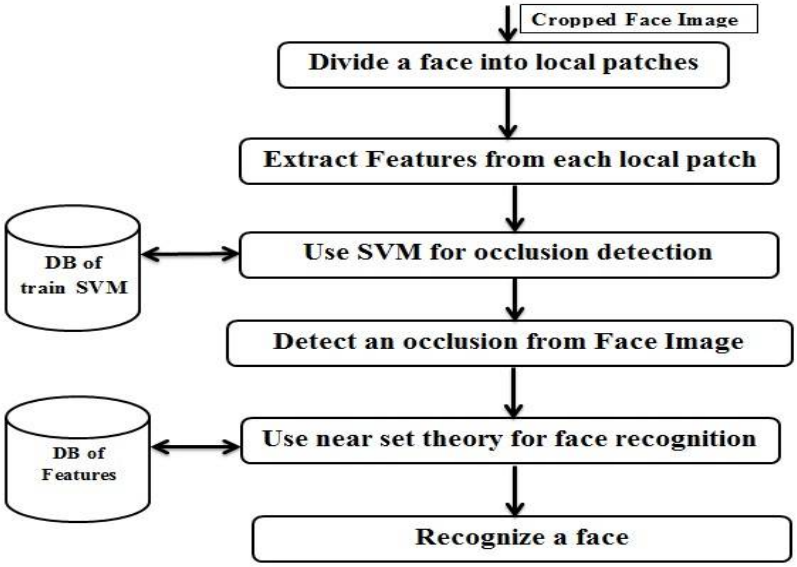

Fig.5 Flow of occlusion Detection and Face recognition

IV. EXPERIMENTAL RESULT

4.1 GTAV faces Database:

For our experimental purpose we required an occluded as well as a non-occluded faces. There are a lot of a datasets like yale faces, AT & T, GTAV etc. are available but we have chosen GTAV for our experiment [9]. This dataset is created for a testing a robustness of an algorithms against strong pose, occlusion and illumination variations. This data set includes 44 persons with 27 pictures per person. The samples of images from GTAV data set as shown in fig 6.

Fig. 6 GTAV face database

4.2 Divide a face into local patches:

To perform occlusion detection we first divide a cropped image into patches and based on that patches we have detected an occlusion as shown in figure 7.

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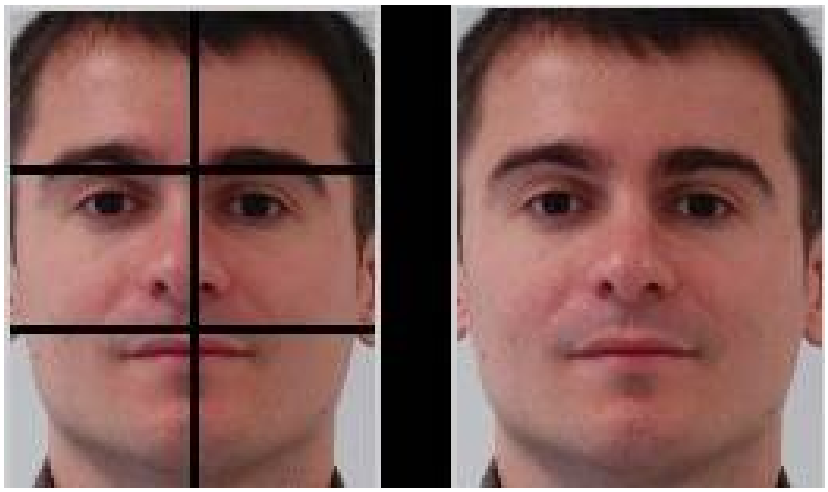

(a) (b)

Fig.7 Divide into six Patches

4.3 Detect an occlusion:

For occlusion detection SVM classifier is used. SVM classifier is worked in two stages as training and testing. First we need to train SVM classifier and based on that training we test an image. Result of occlusion detection phase as shown in figure 8a and 8b.

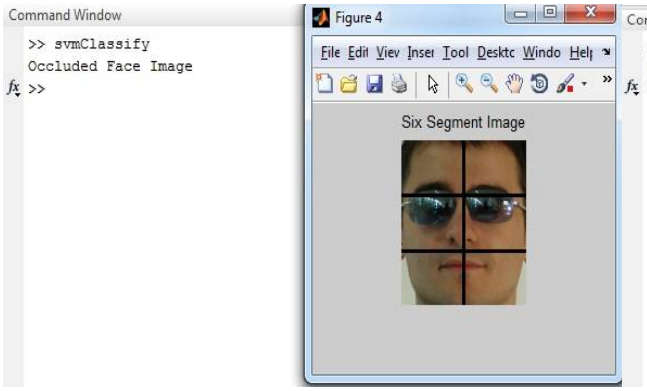

Fig.8(a) Occluded Face Image

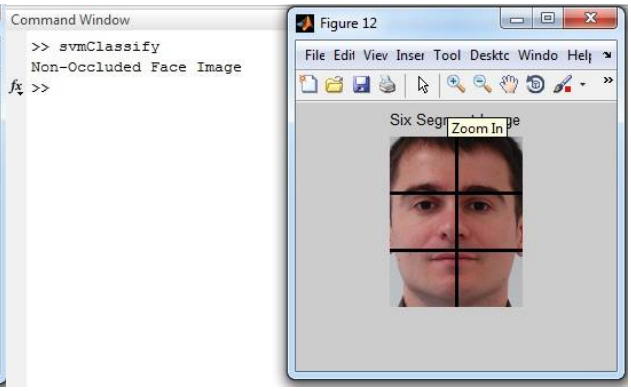

Fig. 8(b) Non-Occluded Face Image

4.4 Recognize a Face:

For face recognition we used a near set theory. For Implementation of near set theory we have calculated a tolerance class of a feature vector. Based on that tolerance class we find out a nearer set for a test image by using a nearness measure like a tNM. And at the end we have used Euclidean distance for face recognition. A face with a minimum Euclidean distance is considered as a recognize face. As shown in figure 9.

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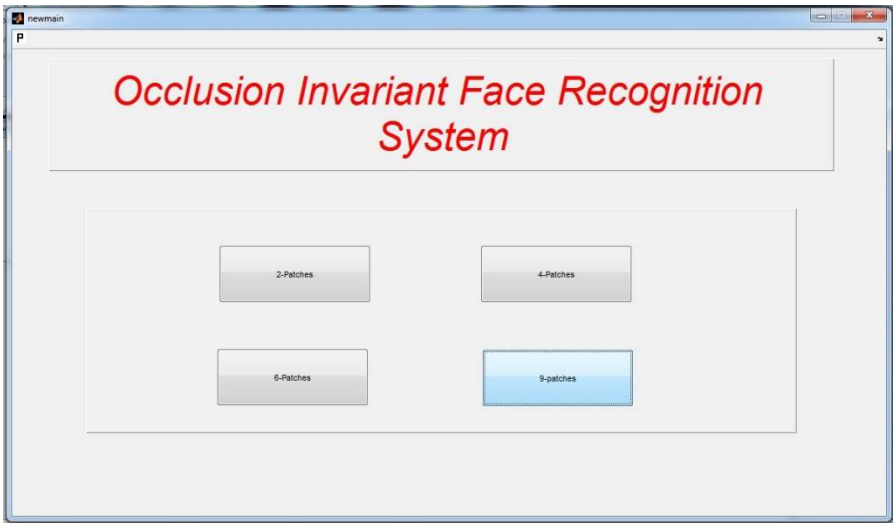
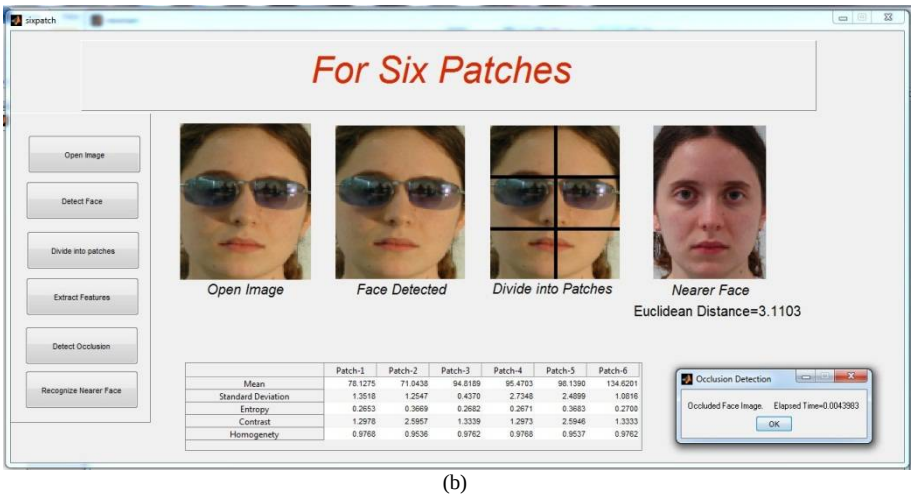
(a) (b)

Fig. 9 Non-Occluded Face Recognize



(a)

Fig. 10 Main GUI



(b)

Fig. 11 GUI for Face Recognition System

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V. PERFORMANCE EVALUATION

We have evaluated performance of the system with respect to two parameters first is time required for execution of input and second is a result of a used methodology. First of all we compare our methodology by using a different number of patches like for two patches, four patches, six patches and nine patches. By analyzing it we can conclude that time required for six patches is most use full as shown in fig 12.

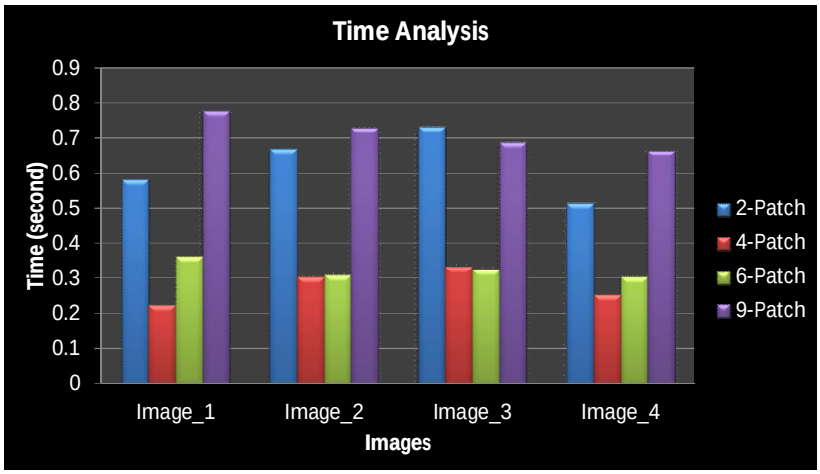

Fig.12 For Different number of patches

For comparing our near set method we used a LBP method for face recognition. A face recognition rate is compared even if a face is occluded. For performance analysis false recognition rate and recognition rate parameters have been used. As shown in figure 13 and from table 1 we can say that a performance of near set theory is better than a LBP for occluded face recognition.

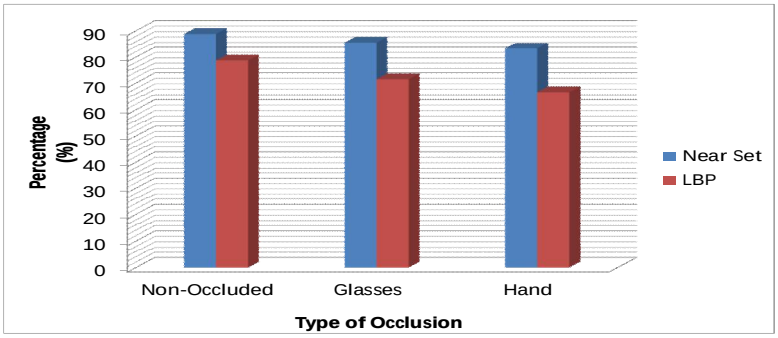

Fig 13 Face Recognition rate on different type of images

Table 1 Performance evaluation on both methods

Result	Near Set	LBP
Recognition Rate	85.99	72.02
False Recognition Rate	14.01	27.98

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VI. CONCLUSION AND FUTURE WORK

The occlusion problem which has been researched moderately less in face recognition than the pose, illumination, ageing and expression. So we have proposed a new robust face recognition algorithm to the partial occlusion, based on dividing the face image into local patches. We will detect an occlusion by using support vector machine classifier. After detecting an occlusion from face image we have recognized a face by using a near set theory. By using a near set theory we get a reduced set for matching a face. Hence we have improved the performance of a face recognition system In future work, we can give a solution for a pose, illumination, ageing and expression problem by using a same methodology and also we can try to perform it on video based face recognition.

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