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Hybrid Intelligent System for Face Recognition from Surveillance Camera

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Abstract— *Intelligent systems have been widely used for face recognition. Among them Support Vector Machine (SVM) was recognized as a powerful recognition model. However, handling the problem of recognizing a faces from surveillance camera is difficult task due to that it encounter a variation in pose, resolution, as well as illumination. In this work, evolutionary constructed SVM-based intelligent system will be developed. Particularly, the developed system comprises the hybridization of Gray Wolfe Optimizer (GWO) [1] with SVM. DE is used to construct an efficient SVM recognition model by performing simulations parameters tuning, training instances selection, and features selection. To evaluate the performances of the presented model, a number of benchmarks for surveillance-based face recognition problem will be used such as ChokePoint, UCSD/Honda, CMU, and YouTube Faces (YTF) database.*

Keywords— *Intellgient system, gray wolfe optimization, support vector machine, hybrid system, face recognition, surveillance camera.*

I. INTRODUCTION

Face recognition has gained a lot of attention during the last decade. Nevertheless, recognizing faces under uncontrolled situations remains a challenge and open problem for further research [2]. To demonstrate the difficulty of this problem, Figure 1 shows some examples of face images that were captured by surveillance camera. As can be seen, the presented faces demonstrate variation in their resolution, pose, and illumination.

II. RELATED WORK

In the literature there are a lot of approach were introduced for face recognition. Binary gradient-based face recognition system was proposed by Haung and Yin [3]. In their work, a novel texture descriptor technique that is able to detect and encode low level micro face edge at different orientations. The proposed scheme was evaluated on different face recognition benchmark problems and the outcomes demonstrate the proposed feature extraction techniques significantly improve over other existing state-of-the-art methods. Another work studied in [4]. The main idea of this work is to enhance the recognition performances by increasing the number of training samples. Particularly, different methods are adopt to increase the training samples including landmark perturbation and four synthesis methods i.e. hairstyles, glasses, poses, illuminations. The conducted experiment shows superior performance for the models trained with the augmented training samples. A 3-D based approach was proposed in [5] and applied for face recognition from surveillance camera. In their work a 3-D model was employed to generate virtual training faces at different poses. The results shows that the average recognition rate was increased with virtual training faces from 10% to 23.28%. A similar approach was proposed by Ding and Tao[6] to tackle the problem of pose variation in face recognition. The developed scheme adopt a 3-D based model to reconstruct the frontal face view. The scheme was evaluate on PIFR database and the reported results shows that the proposed scheme was effectively handles the pose challenges in PIFR benchmark images. Illumination invariant face recognition approach was proposed in [7]. In their work a new gradient based feature descriptor named as Logarithm Gradient Histogram (LGH) was proposed. The outcomes of the experimental results analysis demonstrate the effectiveness of our proposed model on tackling face recognition under serious illumination problems from the homogeneous lighting to heterogeneous lighting.

Besides that, numerous SVM-based models have been developed to solve the problem of face recognition[2].As an example, SVM classifier has been integrated with wavelet transform for face recognition [8]. In their work, SVM was trained with both low-resolution and high-resolution images. The proposed scheme was able to report a recognition rate over 97%. Nevertheless, the experimental analysis shows that SVM is sensitive to its parameters. Another work proposed by Arigbabu et al. [9]. Particularly, SVM was employed in the recognition process. The outcomes of this approach demonstrate that SVM was outperforming other CI-based models in terms of recognition accuracy.

III. THE METHOD

The main aim of this work is to developed an intelligent system is to recognize faces captured by surveillance camera. Unlike the recognition of static images, surveillance images posses the challenge of pose variations, as well as the variation in image resolution and illumination. Intelligent face recognition system from surveillance camera have a wide range of real-world applications such access control, authentication, and monitoring applications.

A. Support Vector Machine (SVM)

Nevertheless, adopting SVM classifiers to handle pattern recognition problems still face difficulties such as:

- SVM parameters selection: it has been proven that a proper selection of SVM parameters is required to enhance its performance [11].

- SVM training: the difficulties of training an SVM when the size of both training instances as well as the number of features are large. In this case, the SVM classifier needs a large memory requirement for the quadratic programming solver [12].
- SVM complexity: the SVM classifier will be more complicated when it is constructed with large numbers of instances and features. As a result, the classifier can be very slow when it is applied to pattern recognition [13].

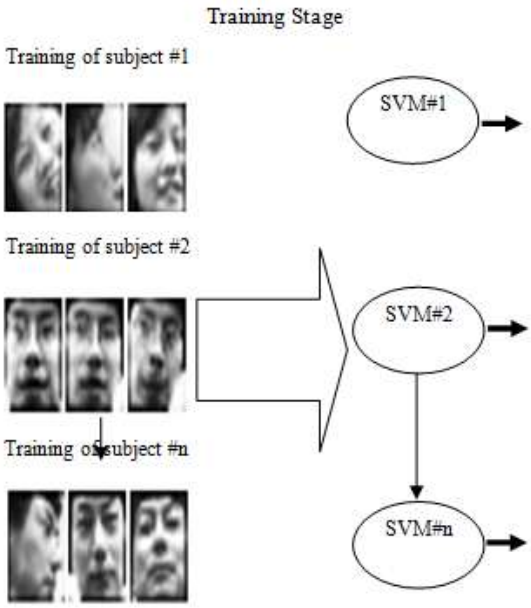


Fig. 1. The flowchart of the training stage of the proposed approach.

To overcome the aforementioned problems, the hybridization of SVM with GWO will be studied in this work. This stage is focusing on introducing a hybrid intelligent system to solve the problem of face recognition from surveillance camera. Mainly, the developed system integrates GWO optimizer with SVM. The general structure of the proposed model is illustrated in figure 1. Moreover, the main steps of the construction procedure are demonstrated in figure 2.

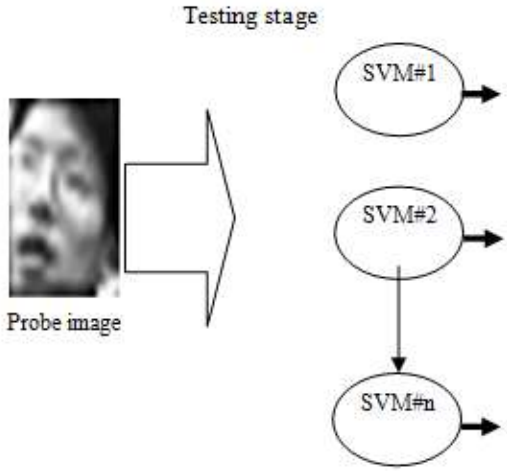


Fig. 2. The flowchart of the testing stage of the proposed approach.

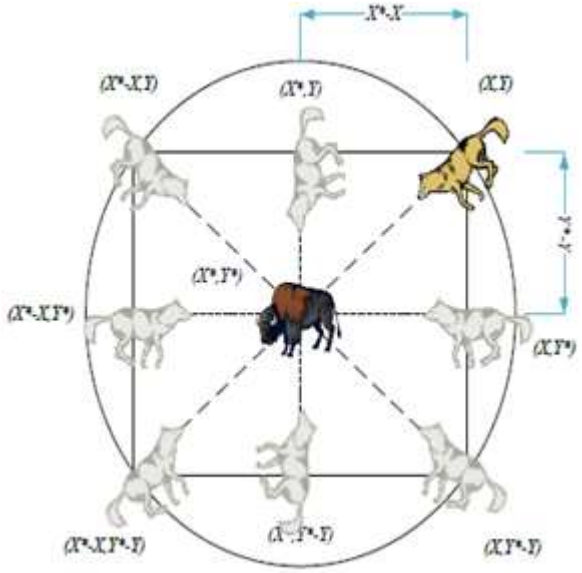
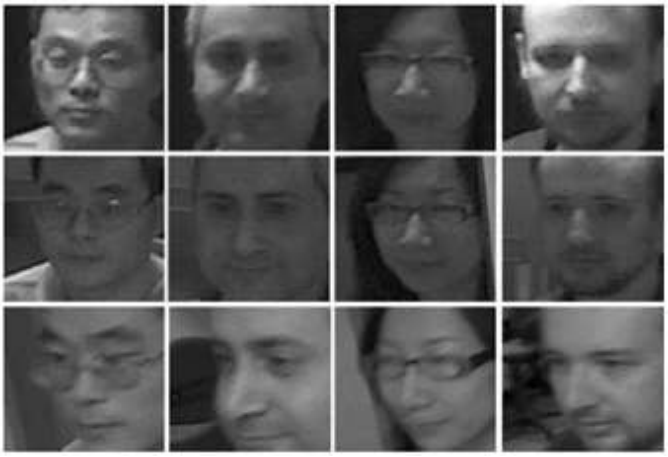


Fig. 3. The hunting nature of the gray wolves.

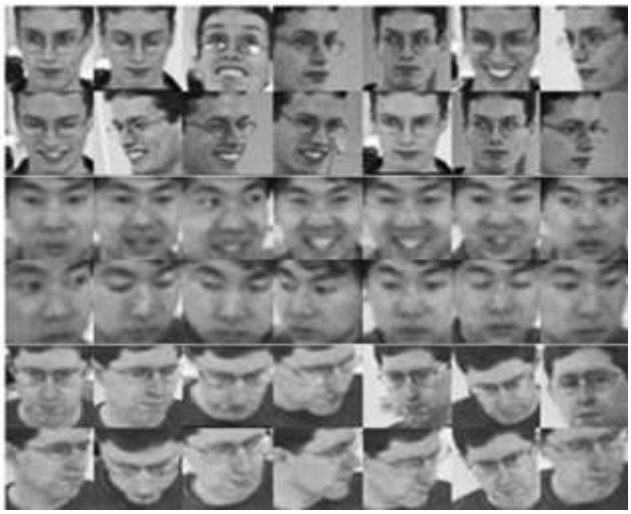
B. Grey Wolf Optimizer (GWO)

GWO [1] was inspired by the hunting mechanism of the grey wolves in real nature as indicated in figure 3.



(a)

(b)



(c)

Fig. 4. Illustrated sample images (a) ChokePoint dataset samples, (b) Honda/UCSD dataset samples, and (c) CMU dataset samples.

IV. THE RESULTS

To evaluate the effectiveness of the developed hybrid model, a three publicly available bench mark images will be used namely Choke Point [10], Honda/UCSD [14], CMU [15], and YouTube Faces (YTF) database[16].

The main characteristics of each dataset are shown in in table I. A number of sample images from each database are shown in Figure 4.

TABLE I. Dataset benchmark images of unconstrained face problems.

Dataset	#of subjects	# of images/videos
ChokePoint[10]	29	149
Honda/UCSD[14]	20	59 video sequences
CMU[15]	24	96 sequences
YTF[16]	1595	3, 425 videos

V. CONCLUSION

We presented a component-based framework of face processing applied for surveillance system. Face detection and face classification algorithms base on the developed system integrates GWO optimizer with SVM method are implemented and tested with respect to the processing time and recognition rate. The result shows that the testing system can perform as the best effort nice cameras in parallel with high recognition rate.

This study encompasses the effect of hybridization of SVM with GWO for classifying of face recognition from surveillance camera. The developed system has been evaluated with three publicly available bench mark images will be used namely Choke Point, Honda/UCSD, CMU, and YouTube Faces (YTF) database. The reported results positively show a superior performance of the presented system over other variant methods. Additionally, from the statistical point of view, the proposed system was able to achieve significant results as compared with other models.

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