Anti-cheating

by Edy Win

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Anti-Cheating Presence System Based on 3WPCA-Dual Vision Face Recognition

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Abstract — To prevent counterfeit face image on face presence system, we can use dual vision camera in face recognition system. Dual vision camera is used to produce detectable face images from two positions of the left lens and the right lens. Image retrieval at the two corners of the left lens and the right lens can produce a merged face image database of left lens face image and right lens face image. The use of two sides of the face angle taking is used to avoid falsification of facial data such as the use of a face photo of a person or an image similar to a person's face. This research uses a dual-vision face recognition method on its preprocessing and uses 3WPCA (Three Level Wavelet Decomposition - Principal Component Analysis) as its feature extraction model. In dual-vision face recognition, we use half-join method to combine a half of the left image and a half of the right image into an image that is ready to extracted using 3WPCA. This research can produce a presence system based on good face recognition and can be used to anticipate falsification of face data with recognition accuracy up to 98%.

Keywords : Dual-vision, Stereo Vision Camera, Face Recognition, 3WPCA.

I. INTRODUCTION

Face detection and face recognition system can be ed as presence system by using a human face as the object. One of the most reliable attendance systems is the presence system using human face detection and recognition system using a real-time video camera. A camera of face detection system has advantages in application flexibility, so it does not require users to make direct contact with attendance system. To minimize the potential for counterfeit facial data, this study uses a dual-vision camera (stereo vision camera). Stereo vision camera can produce detectable facial image data from two positions from the left lens and right lens [1].

In face recognition systems, the use of cameras as a face image acquisition method is a very important thing. The camera is used to capture face images using face detection and then processed using normalization techniques, feature extraction and classification to identify or recognize facial identity. The camera on the face recognition system is used to produce facial image that will be processed either in the form of a 2D or 3D image. The 2D image acquisition model on face recognition generally uses single vision camera, for 3D image acquisition model is conducted using two vision camera (stereo vision camera) or other image acquisition tools such as a scanner.

In some face recognition studies, stereo vision cameras are widely used in facial recognition processing to produce 3D imagery. A widely used technique is to reconstruct facial dots to produce a 3D face image that can be used for face recognition techniques. From some previous studies, the use of stereo vision cameras has not been widely used to produce a 2D blend of images from the right lens and left lens. The use of stereo vision camera will be very useful to produce a face recognition technique and can be used to anticipate falsification of facial data on the presence system based on the pattern of face recognition symmetry.

Face recognition based on the pattern of facial symmetry uses face geometry consisting of eyes, nose, mouth and cheeks on human face. This pattern of facial symmetry is formed from the arrangement of organs the face based on the vertical axis of the face. Based on the use of face symmetry patterns, face detection and recognition research are divided into half-face, full-face and half-face and full-face research.

Research to reconstruct half-face images into full face images based on density characters from some organ features such as eyes, ears, nose, mouth and cheeks on a facial image taken from a camera from some angle of retrieval is developed by [2]. Face detection research uses the characteristics of facial symmetry patterns in detecting human faces as well as to know the gender of the facial image caught on camera has been done by [3]. Face recognition research based on facial symmetry with the half-face technique used to process 2D imagery as training image is performed by [4].

Face recognition research using half-face technique performed by [4] is then continued and developed on face recognition using the same method but using 3D imagery [5]. [6] conduct faces recognition research using facial symmetry techniques in the training process. [7] continue facial recognition research based on previously performed facial symmetry by [6]. This study also uses the original image mirroring technique and integrates with the original 2D image of a single vision retrieval technique for use in face recognition.

[8] has been conducted the development research of face recognition research that has been done by [6]. The study also utilizes facial symmetry patterns for use in face

recognition techniques. Facial recognition research based on geometry techniques by utilizing facial symmetry types such as eye, nose and mouth points has also has been performed by [9].

This research will develop a face recognition model using dual vision camera to produce two 2D images on each camera lens [10]. Region of interest (RoI) image of face detection that has been resulted using the technique of normalization is then processed using the technique of combining between left and right lens image results. Two images are joined by combining some of the left images of the face detection of the left lens with some of the right image of the face detection of the right lens. The result of this combination can produce a combination image of face detection result on each lens from stereo vision camera, so it can be used in the process of feature extraction and classification. The process of this combination is a new contribution that will be useful in the development of presence system model based on face recognition especially the presence system that is able to anticipate the falsification of face image data.

II. METHOD

The proposed method in this study is a face recognition method using half-join normalization with dual vision camera as a face image acquisition tool and using 3WPCA as its feature extraction. This method uses several stages of face recognition process, namely face detection, normalization, feature extraction and classification performed at the testing stage. Image Normalization is the stage of image processing of acquisition results to be used in the feature extraction step. Feature extraction is the dimensional reduction of the image after the normalization process. In the extraction process, we use three-level model wavelet decomposition - Principal Component Analysis (3WPCA) [11]. Classification is the stage of image feature matching that is tested based on the trained image features. The proposed face recognition process is seen in Fig. 1.

A. Image Acquisition

Image acquisition is used to capture the human face image that used as information on the face detection process. Face image acquisition uses a stereo vision camera that has two lenses on the left and right. The human face image is taken in real-time from the frontal view with a facial deviation to the camera about 15 ° on the X, Y and Z-axes.

B. Face Detection

Face detection using a stereo vision camera is conducted based on the Viola-Jones face detection technique [12]. Face detection is performed on each of the left and right lenses of the stereo vision camera. Face image that taken from the left and right lenses is a raw image that containing the background image and face image.

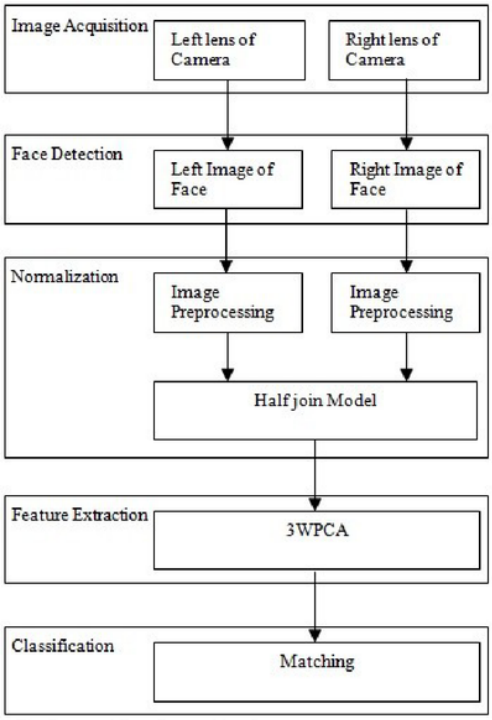

Fig. 1. The Proposed Face Recognition System

The process of detecting and searching facial features on the camera is further marked to be tracked image as output, at this stage the system recognizes the pattern as a face or not. The detected face image that generated by each camera lens is marked by the position of the coordinate point of the region of interest (RoI) of the resulting face image.

C. Normalization

Normalization is a process performed on facial images that have been detected in the face detection. Normalization has two stages of facial image processing: preprocessing stage and half-join stage.

Preprocessing

Preprocessing is the process of combining several models of facial image processing. In the preprocessing, we use the method of cropping, RGB-Gray, resizing, and contrast-brightness adjustment using histogram equalization to produce information that can be used to improve face recognition to be more optimal. The preprocessing method that conducted in this study is used to improve the sharpness of the image and can be used to anticipate the existence of variations of illuminance that will appear at the time of catching the face image.

Half-join

The Half-join method is a human perspective model using two eyes to see and recognize a person. Both eyes in humans are then represented using a dual vision camera that has a left and right lens. This method combines half of the left image and half of the right image into an image that is ready to be extracted. Half-join that used in this research is a method that divides similar width between the face image on the left and right lenses on a camera. We determine the width of the face image (w / width) in pixels and then determine the midpoint of the face image (c / center) by dividing the width of the face image into 2 parts. The point of intersection of the far left (x = 0) up to one pixel before the midpoint of the image (x = c-1) is namely the image of the face of the left lens. The point of intersection of the midpoint of the image (x = c) up to the right-most point of the image (x = w - 1) is namely the image of the face of the right lens. The image of the left half of the left lens of the camera that combined with the image of the right half of the right lens camera will result combined face image. The algorithm of face recognition process using half-join method is seen in Fig. 2.

D. Feature Extraction

The feature extraction method that used in this study is the Three Level Wavelet Decomposition - Principal component analysis (3WPCA) [11]. The image of the preprocessing result is then processed using 3WPCA and then will produce a dimensional reduction of the face image resolution. 3WPCA is used to convert a large variable data into a smaller representation of other variables.

E. Classification

The method of classification that used in this study is Mahalanobis distance method. Mahalanobis distance method is used to determine the level of similarity between features so that it can produce a more optimal face recognition. The determination of facial feature similarity is determined by comparing the facial features of the training that have been stored in the database compared to the facial features at the time of the test. The result is the identification of data which is then stored as the presence data.

III. Results And Discussion

The comparison of the resulting image of the half-join method with the image of the results of the previous research can be seen in Fig. 3.

The output image of the half-join method is then processed using three level of the wavelet. The wavelet decomposition image is then processed using PCA and produces a dimensional reduction of face image resolution up to 20x20 pixels. The process of incorporating the 3-level wavelet decomposition and PCA methods as shown in Fig. 4.

1. Start
2. Determine w, w ← wide of image
3. Calculate the center of face c, c ← w/2
4. Det. left face area shj_{left}, $shj_{left} \leftarrow \sum_{x=0}^{c-1} c$
5. Det. right face area shj_{right}, $shj_{right} \leftarrow \sum_{x=c}^{w-1} w$
6. Joining process shj, $shj \leftarrow shj_{left} + shj_{right}$
7. End

Fig.2. Half-join algorithm

Three level wavelet decomposition is used to decompose the size of the face image by reducing the image resolution. The resulting image is an image with a very low resolution that will affect the speed of face recognition time before processed using PCA.

The 160x160 pixel of face image that obtained from the preprocessing and half-join stages is then decomposed to 80x80 pixels on the wavelet level 1, then the 80x80 pixel face image will be decomposed to 40x40 pixels on the wavelet level 2, and the last is the 40x40 face image will be decomposed using a wavelet level 3 to 20x20 pixels. The 20x20 pixel of face image will be processed by PCA.

To reduce the dimension (number of variables) on some 20x20 pixel face images that have been processed in the wavelet, but the resulting set of variables must still have properties relatively similar to the previous variables, then the PCA method is used. PCA is used to reduce the dimensions of data by transforming correlated native variables into an independent new variable that is a linear combination of the original variable.

Principal component analysis is used to transform a large variable data into a smaller form of representation of other variables. The PCA method serves to transform information on some face images of the wavelet level 3 results but the resulting information retains almost the same properties as before. The results of the process using PCA will then be passed to the classification stage to determine the similarity between training data on the database and testing data using the Mahalanobis distance method [11].

The comparison of face recognition rate results with other methods can be seen in Table 1. The comparison of face recognition time results with other methods can be seen in Table 2.

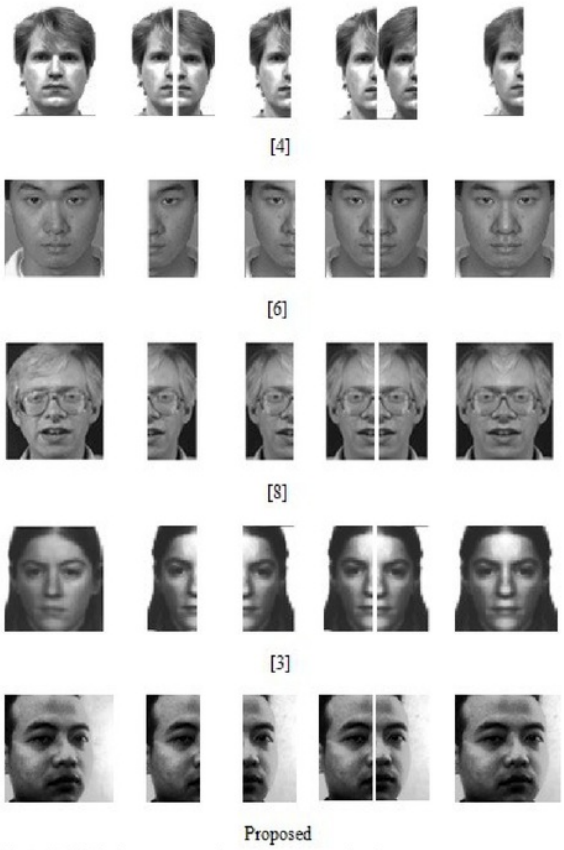

Fig.3. Half-join image comparing with other methods

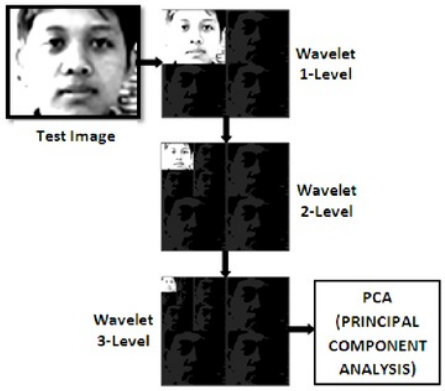

Fig.4. Three level wavelet decomposition [11]

TABLE 1. THE COMPARISON OF FACE RECOGNITION RATE

Images	Recognition Rate (%)			
	Euclidean		*Mahalanobis*	
	PCA	*3Wavelet-PCA*	*PCA*	*3Wavelet-PCA*
100	96.00	95.00	98.00	97.00
200	96.77	95.50	98.25	97.50
300	97.33	96.00	98.33	97.67
400	97.75	96.50	98.50	98.00

TABLE 2. THE COMPARISON OF FACE RECOGNITION TIME

Images	Recognition Time (ms)			
	Euclidean		*Mahalanobis*	
	PCA	*3Wavelet-PCA*	*PCA*	*3Wavelet-PCA*
100	16.31	6.84	15.24	2.45
200	18.87	7.57	16.76	2.66
300	20.45	8.42	18.69	3.48
400	22.41	8.76	20.65	4.76

IV. CONCLUSION

To minimize the potential for forgery of facial data on facial presences system, this research uses two lens camera (stereo vision camera). Stereo vision cameras can produce detectable facial image data from two capture positions ie from the left lens and the right lens. The half-join method is used to generate a merging image of half of the left lens image and half of the right lens image. 3WPCA is used as a feature extraction method to produce images with small dimensions without compromising the resulting information.

The half-join method that used in preprocessing and 3WPCA methods that used in the feature extraction process can produce a face recognition with high accuracy and shorter face recognition times. This method can be used in a face presence system so as to minimize forgery of facial data such as the use of facial photos of a person or an image similar to a person's face. In the comparison test results of face recognition accuracy, this method can produce face recognition accuracy up to 98% and better than the face recognition method based on other half face image pattern.

REFERENCES

[1] E. Winarno, A. Harjoko, A. M. Arymurthy and E. Winarko, "Development Of Face Recognition System And Face Distance Estimation Using Stereo Vision Camera", Journal Of Theoretical And Applied Information Technology, 67, 3, 652-657, 2014.

[2] W. Chen, T. Sun, X. Yang & L. Wang, "Face detection based on half face-template", In Electronic Measurement & Instruments, 2009. ICEMI'09. 9th International Conference on (pp. 4-54). IEEE, 2009.

[3] J. E. Tapia, & C. A. Perez, "Gender Classification Using One Half Face and Feature Selection Based on Mutual Information", Systems, Man,

and Cybernetics (SMC), 2013 IEEE International Conference on (pp. 3282-3287), IEEE, 2013.

[4] J. Harguess & J. K. Aggarwal, "A case for the average-half-face in 2D and 3D for face recognition", Computer Vision and Pattern Recognition Workshops, CVPR Workshops 2009, IEEE Computer Society Conference on (pp. 7-12), IEEE, 2009.

[5] J. Harguess & J. K. Aggarwal, "Is there a connection between face symmetry and face recognition?.", Computer Vision and Pattern Recognition Workshops (CVPRW), 2011 IEEE Computer Society Conference on (pp. 66-73), IEEE, 2011,

[6] Y. Xu, X. Zhu, Z. Li, G. Liu, Y. Lu & H. Liu, "Using the original and 'symmetrical face' training samples to perform representation based two-step face recognition", Pattern Recognition, 46(4), 1151-1158, 2013.

[7] Y. Xu, X. Li, J. Yang, & D. Zhang, "Integrate the original face image and its mirror image for face recognition", Neurocomputing, 131, 191-199, 2014.

[8] M. Qiu, W. Liu & J. Cao, "Integrating the original face images and "symmetrical faces" to perform face recognition", Optik-International Journal for Light and Electron Optics, 125(11), 2665-2670, 2014.

[9] J. Choi, Y. Dumortier, S. I. Choi, M. B. Ahmad & G. Medioni, "Real-time 3-D face tracking and modeling from a webcam", Applications of Computer Vision (WACV), 2012 IEEE Workshop on (pp. 33-40), IEEE, 2012.

[10] E. Winarno, A. Harjoko, A. M. Arymurthy and E. Winarko, "Face Recognition Based on Symmetrical Half-Join Method using Stereo Vision Camera." International Journal of Electrical and Computer Engineering (IJECE) 6.6 (2016): 2818-2827.

[11] E. Winarno, A. Harjoko, A. M. Arymurthy and E. Winarko, "Improved Real-Time Face Recognition Based On Three Level Wavelet Decomposition-Principal Component Analysis And Mahalanobis Distance", Journal of Computer Science, 10, 5, 844-851, doi:10.3844/jcssp.2014.844.851, 2014.

[12] P. Viola & M. Jones, "Rapid object detection using a boosted cascade of simple features", Proceeding IEEE Conference on computer vision and pattern recognition 2001 (1-9), 2001.

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