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People Identification based on Geometric Face Features for Cloud Services

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***Abstract:** Recently, the services provided by cloud computing play an important role in many areas of life. The security component represents the major challenge that hinders the adoption of cloud services in banking, healthcare and other transactions. In this paper, secure identification approach is proposed to use cloud services by recognizing authorized persons based on facial features. In the proposed approach, the face image is sent to the cloud side without any processing. When it is received in the cloud side, the image is processed and the geometric features are extracted using moment features extractor. The features of the face are used during the matching phase by using two different classifiers to make the final decision to grant authorization to access cloud services. The experimental results showed the efficiency and accuracy of the proposed approach. The performance is test using many facial images with online applications. Where an overall accuracy level of approximately 96% was obtained.*

***Keywords:** Identification, Cloud Services, Geometric Face Features, Zernike Moments.*

1. INTRODUCTION

People identification, also mentioned as identity recognition or verification, includes the procedure of determine the identity of the individuals based on several characteristics, information and attributes. Fingerprints, voice patterns, retinal scans, facial features, and other biometric data can be used to achieved this purpose. Facial recognition methods predict the similarity between two different faces to determine and verify individual's identity. In the case of people identification by using the geometric face features, the emphasis is happening using the spatial relationship and the measurements of the facial landmarks for people identification [1]. Geometric face features consider one of the most famous methods that used in the domain of face recognition process. In this method, the relationship between the facial landmarks and spatial configuration of extracted features is specified. The main geometrical

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features to recognize the face of human are the eye's color and their shapes, the nose shape, the mouth and the distances between these facial landmarks. The collection of the polygonal features and the distances consider the basic input to the robust algorithm that design to recognize the individual's identity [2]. Cloud computing became one of the most predominant technology that can achieve essential scaling in the recant years. Cloud Computing gives several resources such as services, application and storage under the concept of pay as use and on demand, without needing to download the expensive platforms and resources. In cloud environment data is store in logical pools and cloud service provider is responsible for maintaining the data availability any time to the clients. A facial recognition system which is hosted in the cloud environment appears as the embodiment to expand the capability of cloud computing services [3]. This paper has been organized as follows: A basic introduction to was provided in Section 1. Section 2 includes the related works. While section 3 enlightens the basic stages of traditional face recognition system. Section 4 explains the basic concepts of geometric face features. Section 5 shows all steps of the proposed system. Section 6 contains the results. Finally, Section 7shows the conclusion.

Related Work

In 2016, R.Prema and P.Shanmugapriya proposed a system for person authentication in the Cloud environment by using face recognition. Their system divided in to two stages, the first stage called New User Registration while the second stage called Registered User Login. In the first stage the user fills a form supplied by the clod provider to register his information and email to store the image of the face. In the second stage the face recognition system checks the validation of the user and allow to access cloud services [4]. In 2018, Sorapak Pukdesree and Paniti Netinant suggested adaptive biometric- authentication and multimodal approach to access cloud services by using iPhone. The first step was gained the image of the person by digital camera of the iPhone and performs the process of face detection using Local Binary Pattern technique while the second step was face preprocessing for noise reduction from face image. In the third step a machine learning technique used to be learned for the facial data. Finally, the process of face recognition performed by principle component analysis and stores the facial features in cloud storage [5]. In 2020, Manjunath Reddy, et, al. presented an exploratory study about several techniques for face detection and face recognition on cloud environment. They provide a detailed summarization about the most topical and cutting-edge approaches that developing to handle with the challenging tasks of face recognition systems on cloud environment. Also the analyzed the limitations and the benefits of those techniques and classify them along with representational tabular for each one [6]. In 2022, Paul P. Oroceo, et, al. suggested an edge-cloud communication to reduce the latency time and increase the speed of inference by implement a real time face recognition method. In their method all tasks of face detection are controlled on edge device by forwarding face images, while the face recognition task processed in the cloud environment. The both devices connect via the TCP/IP protocol [7].

Traditional Face Recognition System

There are primarily six steps involved in any facial recognition system:

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Acquired Face Image: by suitable sensor device such as digital camera from any smartphone or laptop or other devices that can capture the individuals images [8].

Face Detection: to locate and then extract the faces area from the overall image that identifies the face region from the background. There are different techniques used for this purpose such as Haar Cascade Classifier, Single Shot Multibox Detector (SSD), Convolution Neural Network (CNN), Local binary Pattern (LBP) and Histogram of Oriented Gradients (HOG) [9].

Preprocessing and Face Alignment: after faces detection step is performed, this region must be aligned to standardize the orientation. This lead to normalize the position of the face and the size to make it easy comparison of the features through several images. Geometric transformation or landmark detection can be used to achieve this purpose [10].

Features Extraction: the most distinguished features are extracted from the aligned face region for creating the representation that can captures the unique and the valuable characteristics. This can be done using techniques such as Linear Discriminant Analysis (LDA), Principal Component Analysis (PCA) and Neural Networks [11].

Features Comparison: in this step compared the features that are extracted and stored in the database. There are many distances metrics such as cosine similarity and Euclidean distance can be used for determining similarity between the input face image and the stored face image [12].

Decision Making: to determine if the input face image matched with the stored face image a decision threshold must be setting depending on technique that used. The decision threshold assign to determine if the similarity score is close enough to be match or not [13].
Figure 1 show the primarily steps in the facial recognition system:

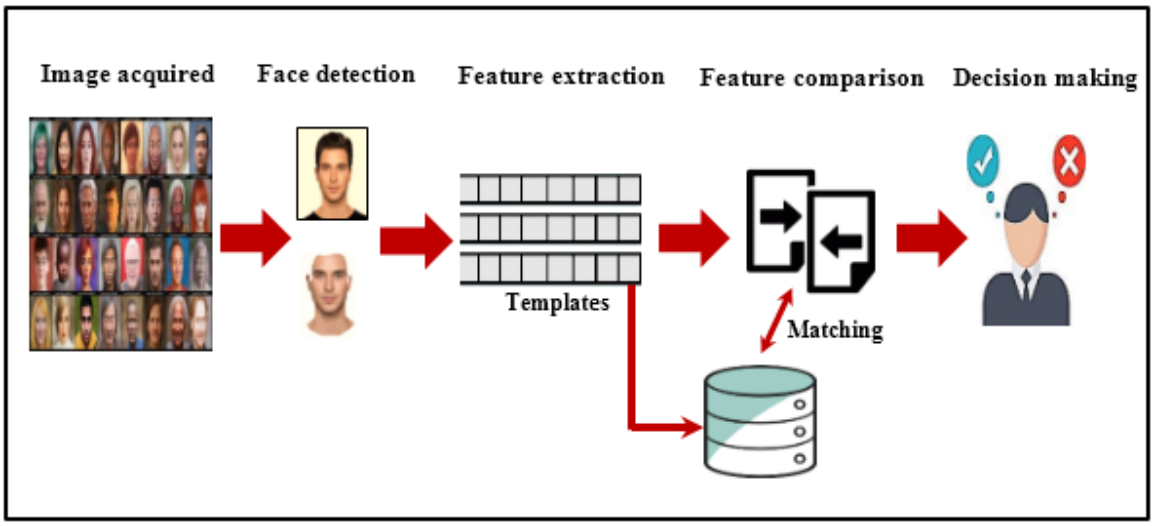

Fig. 1 Face Recognition General Steps

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Geometric Face Features

Face recognition system is technique or algorithm employed for people identification and verification depends on the facial features. This system is commonly used in numerous applications, for example surveillance, security systems, client authentication, and more [14]. There are different methods for face recognition but they fall into four main categories as shown in figure 2:

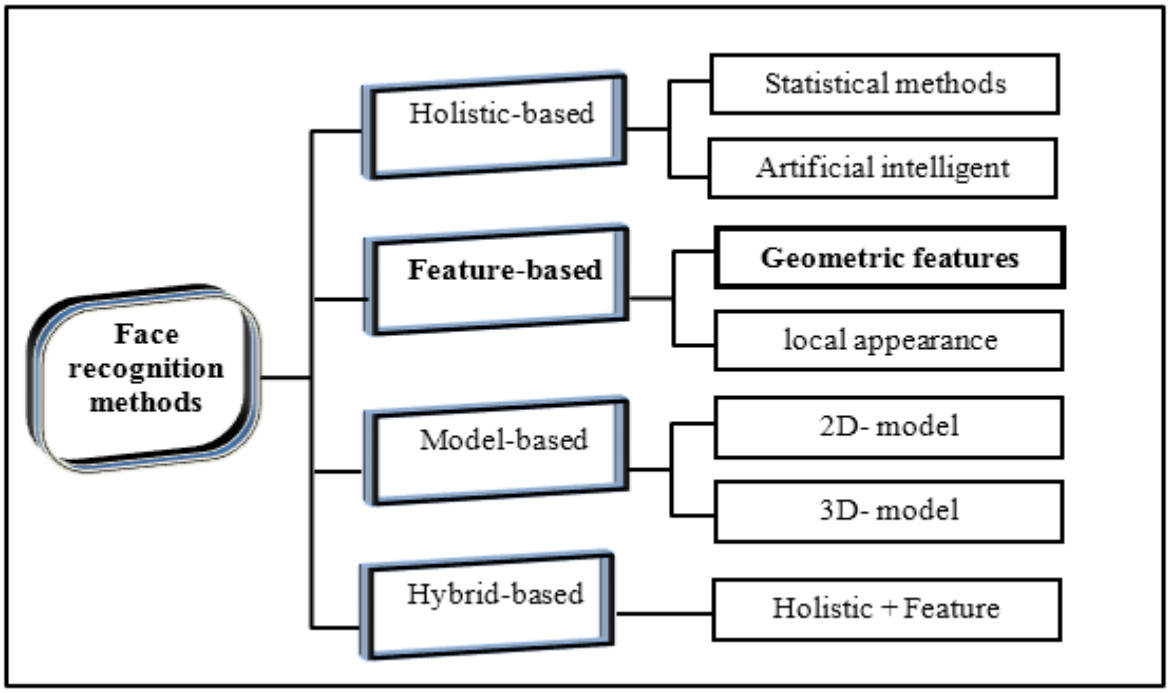

Fig. 2. Face Recognition Methods

Feature-based method calculates set of geometric features of the face such as, a mouth, eyes and the nose. Both of outline of the human face and the positions of different facial features produce the feature vector. Usually, for optimal extraction result, many feature points are selected according to their reliability for the automatic extraction and their significance for facial representation. To figure the geometrical relationships, the locations of these points are used. However, the geometric features represent the locations and the shape of the facial parts that are extracted to configure the feature vector which represents a human face [15].

These features represented as sequences of numbers called moments that can be used to distinguish the object in the face images. Moments descriptors can be categorizing as Algebraic, Geometric and Orthogonal moments depending on the polynomial basis that used and amount of information that carry them. Face image moments are very useful for providing an elegant style for describing the face area through small number of descriptive and highly intuitive values [16].

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Proposed System

The proposed system was implemented in two phases, each phase taking place in different side. In the first phase, the process of face detection from the entire image is performed. After the image is taken by the smartphone camera, only the face that represent the Region of Interest (ROI) will be detected from the captured image, while ignore the other objects in the background. This procedure reduces the size of the image that transmitted to the cloud and thus increases the speed of the proposed system.

The cropped image part that contains only the face area is transferred to the cloud by transmission protocol. When this part reaches the cloud, the facial recognition process in all its stages will be performed, and this is the second phase of the proposed system. Figure 3 explain the proposed system details:

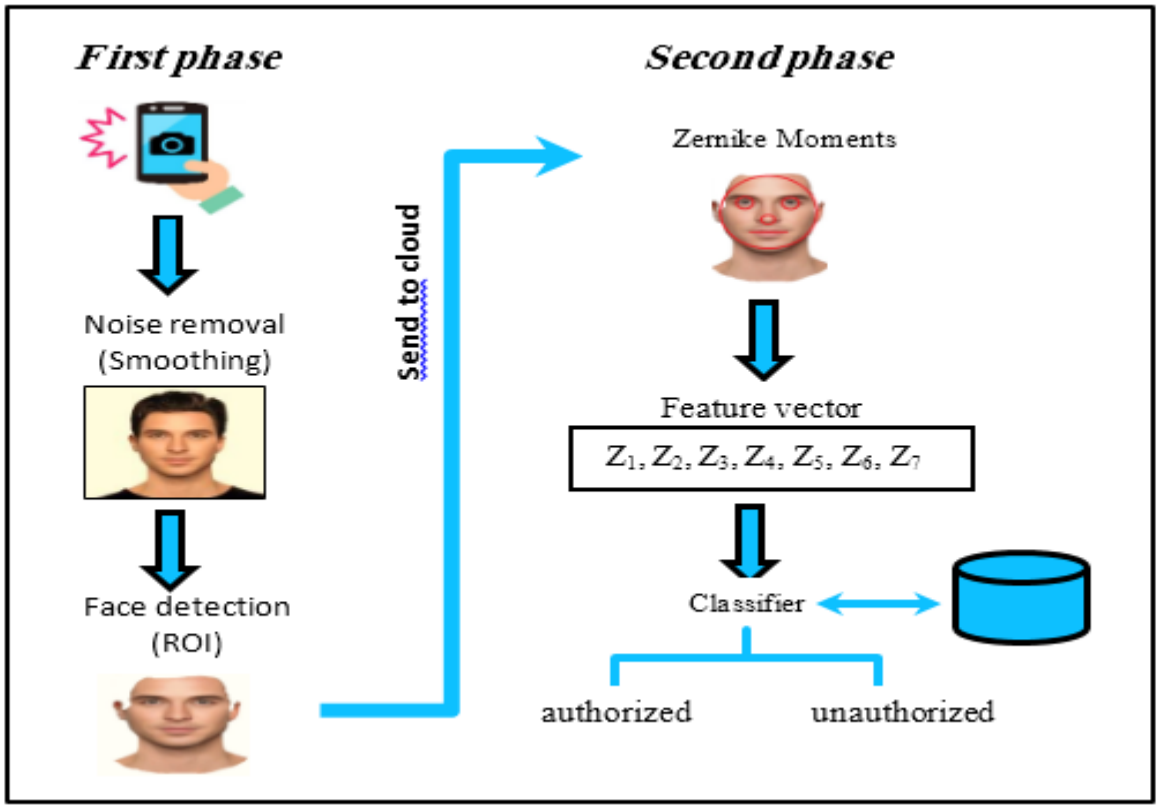

Fig. 3 Proposed System

To reduce the noise in the face image, preprocessing procedures must be performed to obtain batter detection result. For preserving the edges during remove the noise, median filter is used to smooth the image. Median filter takes any pixel in the image with its nearer neighbours to determine if it is representing the surroundings pixels or not. To detect the face, Canny fitter used to segment the face region and Skin Color pixels' detection method used to reduce the misclassification pixels. The segmented area for the face that represent the region of interest will have separated from the original image using mask then sent to the cloud to complete the

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face recognition phase. To extract a set of discrimination geometric features, Orthogonal Zernike Moments method was used. This method achieves the beast classification outcomes. For classification process, both Minimum Distance Classifier to calculate the Euclidean distance and K Nearest Neighbor classifier are used and compare between the results of these classifiers for the same feature vectors. The result of the comparison between the accuracy results of the two classifiers determine which one is better in the face recognition task for the proposed system.

We can summarize the proposed system in the following steps:

- Enter face image
- Apply preprocessing procedure to smooth the image and remove the noise by using median filter with kernel size 5*5
- Apply Canny filter to detect the edge in the image by find the maximum local gradient in the image
- Apply skin color segmentation method to extract ROI
- Send detected face (ROI) to the cloud
- Extract feature vectors using Zernike moments method
- Face identification by using Minimum Distance Classifier once and K Nearest Neighbor classifier another time for the same feature vectors

2. EXPERIMENTAL RESULTS

The performance of Zernike moments as a feature descriptor is evaluated via calculate the length of vector from the center if image (origin) and the axis of the vector. Table 1 contains five feature vectors for five images:

Tab. 1 Zernike moment features

Image no.	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7
#1	0.6534	0.7649	0.6537	0.8763	0.0665	0.3475	0.2327
#2	0.8675	0.3574	0.2379	0.7743	0.1375	0.2365	0.6539
#3	0.4656	0.9854	0.7642	0.5663	0.6527	0.1886	0.1358
#4	0.8762	0.6534	0.9863	0.9853	0.1259	0.6636	0.5435
#5	0.2579	0.2485	0.1358	0.5887	0.3552	0.5375	0.3532

Zernike moments provide significant independent face information beside the image intensity details that consider very remarkable references for face recognition process.

The results of using the Zernike moments are very good because as it noted in table 1 that the variations in the Zernike moments are very small in the feature vector with size 7. For classification process the minimum Euclidean distance classifier was used then the K Nearest Neighbor classifier was used separately for the same feature vectors. Table 2. Explain the deference between the minimum distance classifier and K Nearest Neighbor classifier.

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Tab. 2 Classifiers Accuracy

Classifier	Minimum Euclidean distance	K Nearest Neighbor
Accuracy	96%	94%

As shown in table 2, the classification accuracy of Minimum Euclidean distance classifier is higher than K Nearest Neighbor classifier using the same method for face detection and feature extraction. Therefore, it can be considered Minimum Euclidean distance classifier the best in achieving the aim of the proposed system.

3. CONCLUSION

In the proposed system, a novel method for people identification was suggested Canny edge and skin color detector used to separate the face region from the people images. For extract a distinctive features of the face, Zernike moments were used. Then two different classifiers used for the same feature vectors. From the outcomes of the experimental results we can note that the Minimum Euclidean distance classifier achieve the higher classification accuracy and it can be guarantee an authorize and secure access to the cloud services.

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