# Template Matching Approach for Face Recognition System

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***Abstract*—Object detection or face recognition is one of the most interesting application in the image processing and it is a classical problem in computer vision, having application to surveillance, robotics, multimedia processing. Developing a generic object detection system is still an open problem, but there have been important successes over the past several years from visual pattern. Among the most influential system is the face recognition system. Face recognition has become a popular area of research in computer vision and one of the most successful applications of image analysis and understanding. Because of the nature of the problem, not only computer science researchers are interested in it, but neuroscientists and psychologists also. It is the general opinion that advances in computer vision research will provide useful insights to neuroscientists and psychologists into how human brain works, and vice versa. Face recognition system have wide range of application like Passport / ID card authentication; Immigration/Customs: illegal immigrant detection; Government Events: Criminal/Terrorists screening, Surveillance; Enterprise Security: Computer and physical access control etc. There are several processes have to done to recognize the face of different people. In this paper, introduce a perfect model for face recognition and compare with other's output. Uses template matching approach for the best matching accuracy.**

***Index Terms*—object detection, image processing, immigrant detection, computer science, Face recognition system**

## I. Introduction

Face recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems [1]. Face recognition is used for two primary tasks:

- Verification (one-to-one matching): When presented with a face image of an unknown individual along with a claim of identity, ascertaining whether the individual is who he/she claims to be.
- Identification (one-to-many matching): Given an image of an unknown individual, determining that person's identity by comparing (possibly after encoding) that image with a database of (possibly encoded) images of known individuals.

In general, based on the face representation face recognition techniques can be divided into Appearance-based technique (uses holistic texture features and is applied to either whole face or specific regions in a face image) and Feature-based technique (uses geometric facial features mouth, eyes, brows, cheeks etc and geometric relationships between them).

### A. Appearance Based

Among many approaches to the problem of face recognition, appearance-based subspace analysis, although one of the oldest, still gives the most promising results. Subspace analysis is done by projecting an image into a lower dimensional space (subspace) and after that recognition is performed by measuring the distances between known images and the image to be recognized. The most challenging part of such a system is finding an adequate subspace and they will be combined with four common distance metrics. It is the general opinion that advances in computer vision research will provide useful insights to neuroscientists and psychologists into how human brain works, and vice versa [2]. Projection methods to be presented are:

Principal Component Analysis (PCA)
Independent Component Analysis (ICA)
Linear Discriminant Analysis (LDA).

PCA finds a set of the most representative projection vectors such that the projected samples retain most information about original samples. ICA captures both second and higher order statistics and projects the input data onto the basis vectors that are as statistically independent as possible. LDA uses the class information and finds a set of vectors that maximize the between class scatter while minimizing the within-class scatter

### B. Feature-Based

Facial feature extraction consists in localizing the most characteristic face components (eyes, nose, mouth, etc.) within images that depict human faces. Extraction of facial components equals to locating certain characteristic points, e.g. the center and the corners of the eyes, the nose tip, etc. Particular emphasis will be given to the localization of the most representative facial features,

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namely the eyes, and the locations of the other features will be derived from them.

Each and every organization wants strong and secure data backup to prevent data loss by any kinds of unexpected fault. Data loss can be a very serious problem to an organization, data backup is an important routine. That is, to make one or more copies of the database files regularly and put them in a safe place, such as another machine or server. It is essential for every organization organizations to make strong and secure backups at specific times regardless of location be it in-house or remotely. Backing up databases in the organization itself is less threatening than backing up databases remotely. In remote backups, greater security measures are needed. One method to enhance security measures for remote backup systems is incorporating facial recognition technology. To maintain the data backup remotely, need more effort and technology. All the data have to save on server remotely.

Face reorganization is required at many places for Security like access control to buildings, airports/seaports, ATM machines and border checkpoints [3], [4] computer/network security [5] email authentication on multimedia workstations. This paper proposes a remote database backup system using facial recognition technology. The aim of the system is to address current needs for reliable identification and verification of individuals.

## II. Literatur Review

Face recognition is a specific and hard case of object recognition. The difficulty of this problem stems from the fact that in their most common form (i.e., the frontal view) faces appear to be roughly alike and the differences between them are quite subtle. Consequently, frontal face images form a very dense cluster in image space which makes it virtually impossible for traditional pattern recognition techniques to accurately discriminate among them with a high degree of success [6]. Though it is much easier to install face recognition system in a large setting, the actual implementation is very challenging as it needs to account for all possible appearance variation caused by change in illumination, facial features, variations in pose, image resolution, sensor noise, viewing distance, occlusions, etc. Many face recognition algorithms have been developed and each has its own strengths [7], [8]. Many studies have been done in this area and several algorithms have been used and one of them is Neural Networks.

To model our way of recognizing faces is imitated somewhat by employing neural network. This is accomplished with the aim of developing detection systems that incorporates artificial intelligence for the sake of coming up with a system that is intelligent. The use of neural networks for face recognition has been shown by Fax and Pang [9], [10]. It's a very popular and important tool for image recognition and data classification, it can be implemented in many applications to fulfill the requirement. Multilayer Perceptron (MLP) with Backpropagation (BP) algorithm very useful for facial recognition BP shows very strong ability to solve many complex problems in different domain. In order to apply Neural Networks on images (face images) an extraction methods should be applied first to extract the features from the images.

Kabeer proposed a study using artificial network for face recognition [11] where a new approach to model face images using a state space feature was presented. Feature extraction was performed from the grayscale images of the human faces. For classification activities, Multi-layer feed forward with Back propagation algorithm was used. For training set, 200 images were used and testing was performed on the set. The model managed to obtain accuracy around 98%. The important point in the study is that dimensionality reduction was used on the data set which is useful to reduce processing time [12]. Hsieh at al. presents a novel posture classification system that analyzes human movements directly from video sequences and demonstrate that the proposed method is a robust, accurate, and powerful tool for human movement analysis, Specifically, the method comprises the following. [12**]**.

1) A triangulation-based technique that extracts two important features, the skeleton feature and the centroid context feature, from a posture to derive more semantic meaning. The features form a finer descriptor that can describe a posture from the shape of the whole body or from body parts. Since the features complement each other, all human postures can be compared and classified very accurately.
2) A clustering scheme for key posture selection, which recognizes and codes human movements using a set of symbols.
3) A novel string-based technique for recognizing human movements. Even though events may have different scaling changes, they can still be recognized.

Face verification is also a useful approach for template matching that performed using an edginess-based representation of the face image [13]. To complete the experiments used a set of face images with different poses and different background lightings. The approach used is proved to be a promising alternative to other methods when dealing with problems with different poses and background lighting. Yang used 30 standard face images, focusing on the eye regions as templates for face detection. Template matching approach is applied together with 2DPCA algorithm, an algorithm developed by Yang [14], [15]. The results of the experiment conducted produces accurate rate of face detection in a short time.

## III. Challenges in Face Recognition

### A. Change in Illumination

Variable illumination is one of the most important problems in face recognition. The main reason is the fact that illumination is the most significant factor that alters the perception of faces. Lighting conditions change largely between indoor and outdoor environments, but also within indoor environments as shown in Fig. 1. Thus,

due to the 3D shape of human faces, a direct lighting source can produce strong shadows that accentuate or diminish certain facial features. Moreover, extreme lighting can produce too dark or too bright images, which can disturb the recognition process. Although, the ability of algorithms to recognize faces across illumination changes has made important progress in the recent years, but illumination still has an important effect on the recognition process.

### B. Recognition from Higher Mega Pixel Images

Computer analysis of face image deals with a visual signal (light reflected from the surface of face) that is registered by a digital sensor as an array of pixels. The pixel may encode color or only intensity. If resolution of an image is m*n pixels it can map on mn-dimensional image space. Each pixel is mapped on a point in mn-dimensional space. A critical issue in the analysis of such multi-dimensional data is the dimensionality, the number of coordinates necessary to specify a data point. Since space derived this way is highly dimensional, recognition in it is unfeasible. Therefore, recognition algorithms usually derive lower dimensional spaces to do the actual recognition while retaining as much information (energy) from the original images as possible. I will further clarify this on the example from this research: the original FERET images (after preprocessing) are the size of 60*50 pixels, thus the image space dimensionality is. It will be shown that projection methods presented here will yield (for LDA) subspace in which the recognition will be done and in these 270 dimensions 97.85% of original information (energy) is retained. [16] So this is clear that if resolution of face image is higher (in mega pixels) dimension of image space will be very high. So this will be very challenging to map image space to low dimensional space by keeping original information (energy) retained.


Figure 1. The same person looks like different due to different lighting position

### C. Facial Gesture and Expression

As shown in Fig. 2 the same face appears differently in different gesture. The particulars of facial gestures are frequently used to qualitatively define and characterize faces. It is not merely the skin motion induced by such gestures, but the appearance of the skin changes that provides this information. For gestures and their appearance to be utilized as a biometric, it is critical that a robust model be established. [17] The pose problem has been divided into three categories

1) The simple case with small rotation angles
2) The most commonly addressed case when there are a set of training image pairs (Frontal and rotated images)
3) The most difficult case when training image pairs are not available and illumination variations are present. [18].

Having all these challenges due to facial gesture and expression it is very difficult to design a robust model for face recognition system.

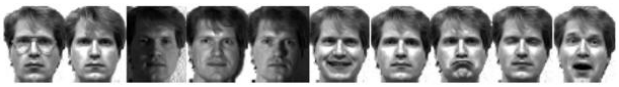

Figure 2. The same person looking different due to different gestures

### D. Age Progression

Human faces undergo considerable amount of variations with aging. While face recognition systems have been proven to be sensitive to factors such as illumination and gesture, their sensitivity to facial aging effects is yet to be studied. How does age progression affect the similarity between a pair of face images of an individual? What is the confidence associated with establishing the identity between a pair of age separated face images?

## IV. Proposal

Complete the task in 3 steps, first maintain the database. To maintain the database take some pictures in four different poses (position of face towards the camera), background and lighting conditions and save in .bmp format and save in separate folder. Second, use neural network and template matching to detect a face and verify user and produce model that produce the highest percentage of accuracy. Third, evaluation that can be done in 3 ways scenario evaluation (to evaluate the overall capabilities of the entire system for a specific application scenario), operational evaluation (to evaluate a system in actual operational conditions) and technological evaluation (to determine the underlying technical capabilities of the facial recognition system) [19]. The system architecture and the phases of development are shown and described here.

### A. System Architecture

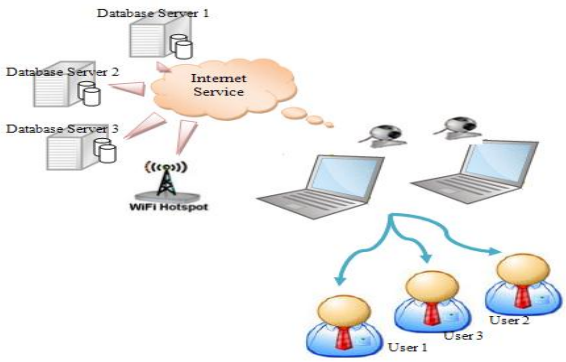


Figure 3. Remote database backup system

As shown in Fig. 3 the architecture of the remote database backup system, a webcam can catch the pictures or motion of the object and that webcam connected with a computer that must be used to enable the face recognition system to function properly. The machine must also be connected to the internet though LAN, WAN etc to enable the system to access the database servers remotely.

### *B. Face Recognition System*

Attached webcam can take the picture and motion of object and will saved and to verify user, the system will trigger every time a user wishes to perform database backup. Image of user's current position will be captured during login via a webcam. The image captured (test image) must be in the same format and size as the reference image. This approach is an exhaustive matching process, which performs complete scan of source image and comparing each pixel with corresponding pixel of template. Therefore here, it will match the pixels between the test image and the reference image. If a match is found, the user can start performing backup on the desired database remotely. For neural networks algorithm, the features of the user's image will be extracted and normalized. This means that the image must be standardized in terms of size, pose, illumination, etc., relative to the images in the gallery or reference database. Fig. 4 a and Fig. 4 b shows the facial recognition steps using neural networks and template matching.


Figure 4. a. Facial recognition steps using neural network algorithms b. Using template matching algorithms

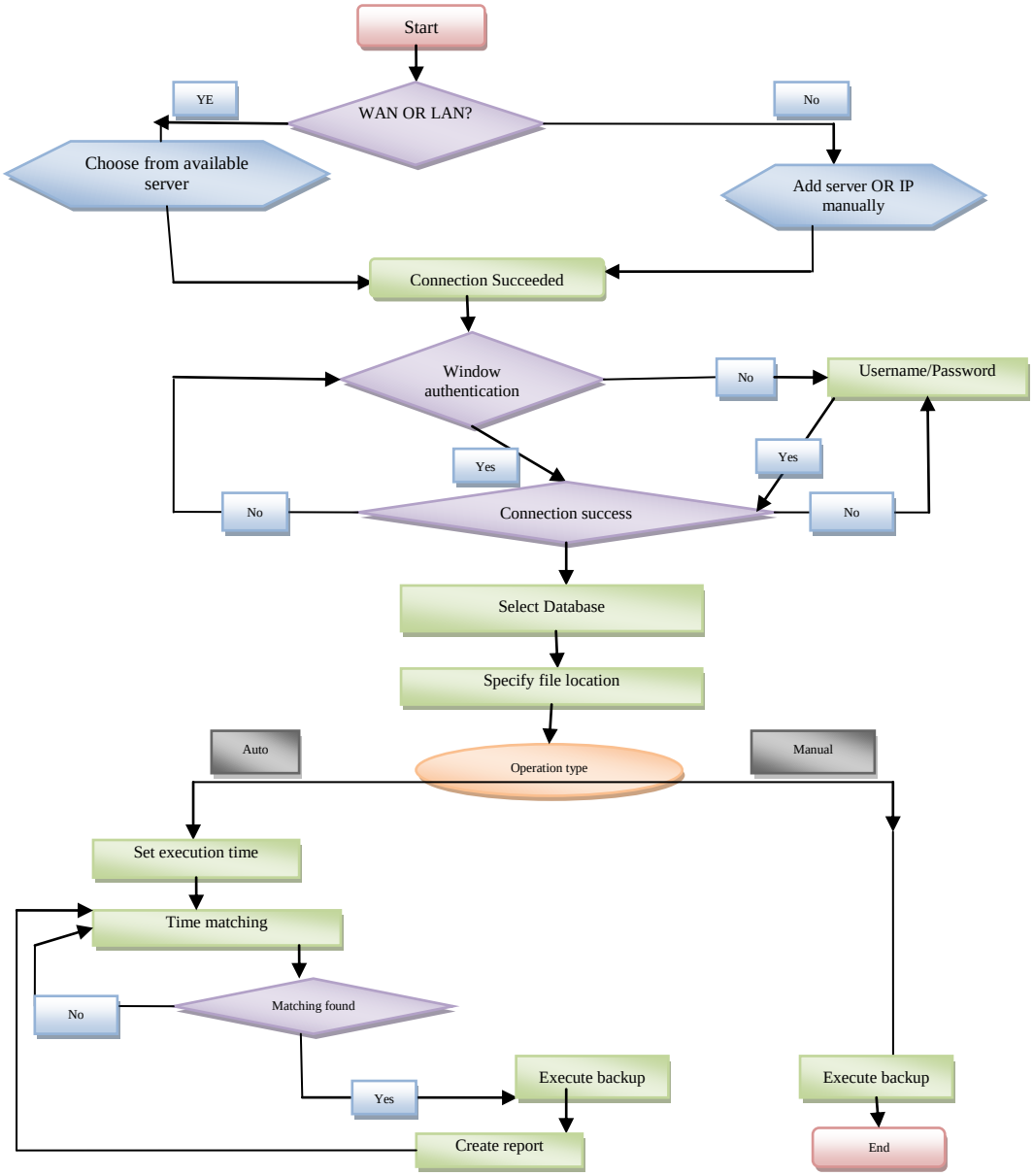


Figure 5. Flow diagram of database backup system

### C. Database Backup System Modeling

Database backup system is where users can backup and compress their database servers remotely as shown in the flow diagram in Fig. 5. If the application is run on a machine connected to LAN or WAN, all the servers' names will appear in the server list. Otherwise, the user can add a server name or IP manually. After a connection to a server is made, all the databases' names will be listed in the database list view and users can choose the database that they wish to backup. This application will generate the backup file in compressed format by default.

For automatic backup, a user can set all the parameters similar to a manual backup. Then, check the check-box titled 'Daily Auto Backup', where a time setting component will be enabled to set the time for daily backup. A report of the scheduled backup dates and list or errors, if any, that occurs during the connection to server, database selection or backup failure can be generated for reference.

For testing, new images of the personnel are taken via a webcam. The image format must be in the same format as the templates, which are in .bmp format, 122 x 160 pixel, and 32 bit depth. However, the background, light and illumination can be different than those in the template images because a user could login from a different location and environment. Based on the sensitivity value specified to control the similarity acceptance during the matching process, the percentage of accuracy for the image classification is in the range of 80% to 85%. If a closer image of the face is captured, better accuracy can be achieved.

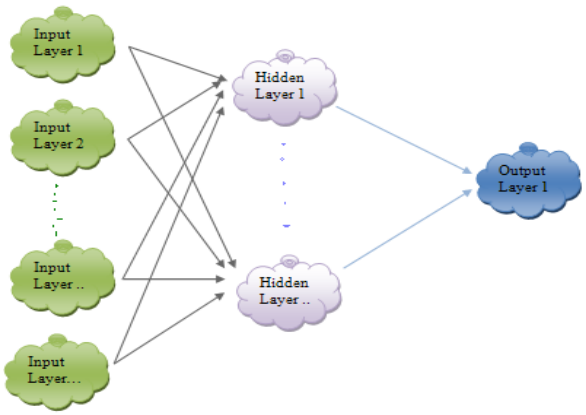


Figure 6. Structure of a multiplayer perceptron model

The difference in performance is probably due to the ability of template matching to match any image with template images by doing a complete scan of a new image and comparing each pixel with the corresponding pixel of a template. Therefore, this technique is practical for a situation when we do not want to bother with features extraction and understand which features to be selected for certain type of images. Results can also be obtained in a short time as no learning process is required in this approach. A structure of a Multilayer Perceptron is shown in Fig. 6.

## V. Conclusion

Face recognition is a specific and hard case of object recognition. The difficulty of this problem stems from the fact that in their most common form (i.e., the frontal view) faces appear to be roughly alike and the differences between them are quite subtle. This paper addresses current needs for reliable identification and verification of individuals. It shows three steps reference database construction, development of facial recognition system and evaluation for face detection. Models with the highest percentage of accuracy will be chosen for developing the remote database backup system. Template matching approach is much better then MLP as its gives good matching accuracy in less time.

The method for acquiring face images depends upon the underlying application. Although there are lot of research is going on for face detection. This research also can be extending for future work on face recognition domain.

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