RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

CLOUD AUTHENTICATION BASED FACE RECOGNITION TECHNIQUE

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Abstract

The recognition process for a single face can be completed in relatively less time. However, large scale implementation that involves recognition of several faces would make the procedure a lengthy one. Cloud computing service has been employed in this paper to provide a solution for scalability, where cloud computing increases the essential resources when larger data is to be processed. The programming and training of the developed system has been done in order to detect and recognize faces through cloud computing. Viola and Jones algorithm is employed for detecting faces that used integral image, cascaded classifiers, five sorts of Haar-like features, and Adaboost learning method. Face recognition has been done using Linear Discriminant Analysis (LDA), as it is more efficient compared to Principal Component Analysis (PCA) algorithm. Several MUCT database images have been used for assessing the performance of system.

Keywords: Histogram equalization, Cloud computing, Face detection, Viola and Jones algorithm, Linear Discriminant Analysis.

BULUT DOĞRULAMA TEMELLİ YÜZ TANIMA TEKNİĞİ

Öz

Tek bir yüz için tanıma süreci nispeten daha kısa sürede tamamlanabilir. Bununla birlikte, birkaç yüzün tanınmasını içeren büyük ölçekli uygulama, prosedürü uzun bir hale getirecektir. Bulut bilişim hizmeti, daha fazla veri işleneceği zaman bulut bilişimin temel kaynakları artırdığı bir ölçeklenebilirlik çözümü sağlaması için bu araştırmada kullanılmıştır. Geliştirilen sistemin programlanması ve eğitimi, bulut bilişim yoluyla yüzleri tespit etmek ve tanımak için yapılmıştır. İntegral görüntü, basamaklı sınıflandırıcılar, beş çeşit Haar benzeri özellikler ve Adaboost öğrenme yöntemi kullanılan yüzleri tespit etmek için Viola ve Jones algoritması kullanılır. Yüz tanıma, Temel Bileşen Analizi (PCA) algoritmasına göre daha verimli olduğu için Doğrusal Diskriminant Analizi (LDA) kullanılarak yapılmıştır. Sistemin performansını değerlendirmek için çeşitli MUCT veritabanı görüntüleri kullanılmıştır.

Anahtar Kelimeler: Histogram eşitleme, Bulut bilgi işlem, Yüz algılama, Viola ve Jones algoritması, Doğrusal Diskriminant Analizi

1. INTRODUCTION

Computers have become a much significant element of life in current times. They have found applications in almost all areas of life may it be work, fun, research or other similar domains. This constantly increasing computer usage in daily life has resulted in an escalated need of resources relevant to computing (Karthik, 2010). The highly established organizations like Microsoft, Google or similar can easily make use of these resources according to their needs at any point of time (Jagadish, 2014). But, cost is certainly a considerable factor for smaller organizations. A solution has been provided by cloud computing to huge infrastructures for problems such as software viruses, crashing of hard drive, machine or equipment failure etc., so that such issues can be nullified (Younis, 2013). Furthermore, the different shapes and positions as per the circumstances have made the detection of humans within images quite complicated and tricky. Besides this, a lot of resources are needed during the recognition and detection of faces, especially in case of very big databases (Cheng, 2015). There is an increased requirement of computing capabilities because of the usual challenges faced in allocation of resources, which are substantial for bigger corporations. Considering the launch of cloud computing, it has become quite feasible to merge cloud computing with the requirements of resources for facial recognition and detection.

1.1 Face Detection

Face detection has become an interesting topic of research at present. The image processing market is giving considerable attention to face detection (Ogbu , 2013). Face detection has offered an efficient coding scheme in the domain of video calls and teleconferencing. It is basically referred to the procedure of human face identification in images and videos (Kalyani, 2013). It is fundamentally a unique function of image segmentation. The portioning of a digital image or video frame has been done through image segmentation method into different segments i.e. set of pixels. Things are essentially made simple by means of image segmentation, which expresses major elements of digital images, thus leading to easier

detection of face. During face detection, a preprocessing step is required by all the face analyzers as well as face recognition systems (Ian, 2008). The main motive behind image segmentation is to process the image and split it into a number of parts (Puja, 2012). At this stage, the main focus is to split images into elements being connected strongly within objects. A major role is played by segmentation in image analysis applications (Rajesh, 2012). The detection of exact position of human face within provided image is pretty complex (Senthil, 2012). The following sections have covered a comprehensive discussion on face detection process, its importance and encountered challenges.

1.1.1 Applications of Face Detection

Face detection and analysis in machine vision are required by numerous applications of real world. Some of these applications are as follows (Ganesh, 2013):

- Person identification at time of login
- Interaction between human and computer, such as mouth and eyes tracking etc.
- Video calls while doing video conferences

1.1.2 Challenges in Face Detection

Face detection has become a challenging process due to the following factors (Peter, 2011):

- Scale
- Direction or posture
- Expressions of face
- Resultant brightness owing to variations in illumination
- Video frames or resolution of images
- Facial cover due to beard or glasses etc.
- Variations in background like complicated/basic and still/dynamic.

1.2 Face Recognition

The capability of human beings to interact with objects or with each other is fairly reliant upon their recognizing capabilities (Nilesh, 2016). The identification and recognition of objects becomes easy because of this capability. The development of an automatic system for face detection by using machines would be easier, once a substantial understanding and knowledge has been attained regarding the cognitive aspect of human brain mechanism (Sung, 2010). Presently, the face recognition method has gained noteworthy attention and found various applications in law enforcement as well as commercial areas. For example, the videos captured by security cameras can be reviewed in case of robbery in banks and valuable items shops etc., which can help in the detection of culprits' faces by comparing them with the criminal records maintained by police.

Besides this, active research has been going on in this domain due to the unavailability of an ideal model or approach till date, which can perform the facial recognitions in a perfect manner (Hiroyuki, 2007).

1.3 Cloud Computing

What is exactly meant by the term 'cloud computing'? It is basically a computerized model in which information (data) and functions are established in massive data centers within cloud, which is accessible to every device connected to the network (Alireza, 2013). A demonstration of directly related expressions is required by cloud computing, just like other definitions relevant to this subject. Although there is not any particular definition for this, however, it is possible to define it generally.

Cloud computing is the first thing one can think of while considering the things required by us most of the time. Thus, it has become essential to raise the capability of computing methodology or append extra abilities that are able to perform within advanced infrastructure, allow latest software and offer newest techniques of staff learning. Both paid as well as subscription-based facilities are provided by cloud computing that are helpful in extending the present capacities of real time communications and information technology.

The recent time is considered as a quite essential phase of cloud computing having a broad and extensive range of providers. Small, medium and large groups have offered numerous cloud-based services, including spam filtering, storage facilities, full blown applications and lot more (Zahid, 2012).

The word "cloud" is the origin of term "cloud computing" that refers to the internet-based development, whereas "computing" means the use of computer technology (Alireza, 2013). This computing method can be scaled and involves virtualized resources that effectively offer functions based upon internet. This is not necessary for user to possess complete knowledge or expertise in the cloud technology infrastructure (Ming, 2010).

Cloud computing has lately turned out be one of the most boosted advancements of information technology (Jie, 2015). The cloud computing approach is the latest standard that has opened doors for massive opportunities in several fields. It is in fact a combination of devices and servers that are publically accessible via internet (Blanz; Vetter, 2003). The users are allowed to use uninstalled applications by means of cloud computing, moreover, cloud computing also facilitates users in accessing data from any gadget having access to internet. Several important functions that need internet connection are offered by cloud computing such as infrastructure, programs, hardware and storage of data etc. (Rupali, 2017).

1.3.1 Benefits of Cloud Computing

1. Enhanced capacity: Cloud computing requires less time and smaller workforce for completing huge tasks
2. Lower cost: No expensive devices are required since typical customer's programs, data and computers are employed in cloud computing
3. Ease of access: Cloud computing facilitates users in accessing their data at any corner of the world with any gadget having internet access
4. Less training expenses: Since smaller number of personnel is needed for completion of tasks in cloud computing, therefore, users are only required to have basic knowledge about the issues related to software and hardware.

1.3.2 Characteristics

1. **Self Service available on demand:** The customers are provided with all the requisite computing facilities by cloud

2. Wide Network Access: The customers can easily access the cloud applications by means of laptops, personal computers, smart phones etc. via internet

3. Extensive Resources: The cloud designed funds are provided to customers as per their requirements

4. Quick Turnaround: Requirements are swiftly identified through cloud computing, and identified functions are returned in accordance with requirements

5. Check and Balance on Services – The resources consumption is controlled by the cloud provider (Deniz; et la., 2003).

1.3.3 Offered Services

Data centers: Hardware resources for raw calculations, data storage and networking are offered by data centers, within cloud computing technology infrastructure. In general, the set up of data centers are laid in areas having less population, lower energy charges and minimum possibility of natural calamities. A lot of servers, connected with each other, are included in the data center setup (Deniz; et la., 2003).

1. SAAS Model: Through this model, software applications such as Microsoft office, Turbo C, and so on are offered as a utility by the providers to cloud clients. The software is then finally made available for users in the form of an on-demand facility through application layer, typically in browser. Nearly all organizations involved in e-commerce have embraced this service. This facility is a substitute of applications that run locally and that too with some important additional benefits. The clients are mostly not required to do installation and frequent updating of applications, which are being run on their personal systems through cloud. This service facilitates users by saving their disk space plus time, as a result enhancing ease of access and usage (Deniz; et la., 2003).

2. PAAS Model: A platform for computations is given by cloud providers to the cloud customers under this model, which includes operating systems, database, web servers etc. Platform layer, the second layer, adds on an extra abstraction level to the facilities provided by Infrastructure Layer. This leads to an effective combination that provides a whole platform for application designing, control, implementation, analysis and further improvements. In particular, programming models and APIs for cloud functions are offered by this layer, such as, Map Reduction

3. IAAS Model: Each company has a major objective of reducing charges and timing of operations. These most important goals can be achieved through the implementation of IAAS model. This layer manages the fundamental data center resources and offers them to clients as services in the form of storage space, computational power, virtualized communications, and other essential computing basics that are needed to run software. The companies offering such services are typically called Infrastructure Providers (Deniz; et la., 2003).

1.3.4 Cloud Deployment Models

The classification of cloud infrastructure can be done on the basis of its deployment model. Presently, three main deployment models have been acknowledged by the IT community including public, hybrid and private clouds. However, some other models like community clouds and virtual private clouds are also under consideration.

Public Clouds: Those companies that sell cloud services own the cloud infrastructure in this deployment model. The resources are offered by these companies to large groups of industries including Amazon, Microsoft, and Google, as well as to general public. These types of clouds offer several benefits to the users, as the set up has been done without any substantial investment and the pertinent natural threats have been conveyed to the infrastructure providers. On the other hand, there are certain constraints as well, for instance, lack of fine-grained data control, network settings and security, which hampers the activities within a few business environments (Deniz; et la., 2003).

Private Clouds: Though the development of a cloud network has been done around widespread clouds, but more interest has been shown by corporations in such tools of cloud computing that are open-source, which makes easy for them to create private clouds by using own or rented infrastructures. For that reason, the major motive behind the deployment of private clouds is to provide company clients a flexible, unique and smart infrastructure rather than providing internet based services, and to drive service workloads inside the managerial spheres. The maximum level of control is provided by this model over the performance, precision and privacy of resources (Deniz; et la., 2003).

Hybrid Clouds: A company develops a private cloud over its own infrastructure that retains the advantage of managing aspects related to performance and security, as well as provides the opportunity of using supplementary resources from public cloud according to the needs; such as in case of high demands upon the infrastructure of an online dealer, particular during vacations season. Keeping this in view, a vigilant decision is needed by hybrid cloud for categorization of specific and general parts of cloud, and the charges of implementing interoperability between these two deployment models (Deniz; et la., 2003).

Community Clouds: These clouds occupy a spot somewhere in between the public clouds and private ones. Community clouds are neither entirely accessible for common people like commercial services nor under the control of single company as in the private clouds. This cloud infrastructure is offered to a particularly classified group of companies that have similar concerns and interests.

Virtual Private Clouds: These clouds are one more strategy for dealing with the typical and particular weaknesses of could. A platform has been established under this model over the infrastructure of public cloud, with the purpose of replicating a private cloud that manages the technology of Virtual Private Network (VPN) (Deniz; et la., 2003).

1.4 Authentication Types

Password authentication is considered to be the most common method of authentication. This form of authentications requires the users to create a specific key (password) that is known only to them. However, there are numerous limitations of password based authentication, like weak password strength. Moreover,

not just the handling of passwords is tough but it is also a quite insecure approach as they can be guessed or cracked effortlessly by professional hackers. The hacking tools have also developed with the constant growth of technology, thus making it simpler to crack credentials of individuals. Along with the hit and trial method, an established technique named brute-force attack is also typically used by the hackers. The hackers use a software program under this technique, which runs through all possible password passwords cannot be remembered easily thus this authentication approach is generally regarded as weak and less user-friendly (Killoran, 2018).

Smart card based authentication is another important authentication type, where a pin code is used that is printed at the back side of card. But this can become quite critical if the card is lost somewhere as it will become vulnerable to attack.

The third form of authentication is known as biometric authentication, in which image verification is done through fingerprint scan that is matched with the information stored in database. Biometric authentication is recently replacing the password based authentication system. This technique is preferable since it is quite fast and easier for users as they are not required to create and remember complex and lengthy passwords. Furthermore, this authentication type offers more security with respect to password authentication, as the unique genetic features cannot be cracked or duplicated quite easily (J. L, 2018).

Another major type of authentication involves face recognition approach, where the expected ID is basically the output of face recognition process. This ID has to be matched with the stored details of authorized individual in the records. This type of authentication is considered to be a promising approach for providing improved security. The face recognition software takes help of aliveness detection and facial data points for authenticating the users in a precise manner (Onespan, 2018).

2. METHODOLOGY

Human beings recognize numerous faces effortlessly on daily basis. The ease of access, embedded systems and inexpensive desktops have led to increased interest in involving digital image processing in a lot of functions and applications, such as management of multimedia, interactions between human and computers, and biometric authentications. This has resulted in the analysis and enhancement of approaches based on dynamic face recognition. A number of benefits have been noticed in the face recognition approach as compared to other modalities of biometric like fingerprint or iris scan. Furthermore, face recognition is more normal and non-invasive. The major plus is that it is possible to capture and detect face at any point or under vague situations. Amongst the biometric characteristics described by Hietmeyer (Stan, 2011), the most amount of conformity has been witnessed by face features within Machine Readable Travel Documents system (Scott, 2000).

The elementary dynamic system for recognizing faces has been developed by Takeo Kanade during PhD research, back in the year 1973 (Dufaux, 2006). No substantial developments have been witnessed by the automated face recognition field until Kirby and Sirovich carried out research on a miniature portrayal of facial dimensions, by using Principal Component Analysis (PCA) or Karhunen– Loeve convert. The research interest in this domain is aggravated by the Pentland and Turk work related to Eigen faces (Phillips,2010).

Other major advancements in the area of faces recognition take in Fisher face method (Avidan, 2006); (Paula, 2009) involving Linear Discriminant Analysis (LDA).

2.1 Proposed Methodology

The method of face recognition is generally started by taking a video or picture as an input. The target is to detect or recognize some object existing inside the input. Figure1 has shown the major steps that form the proposed face recognition system.
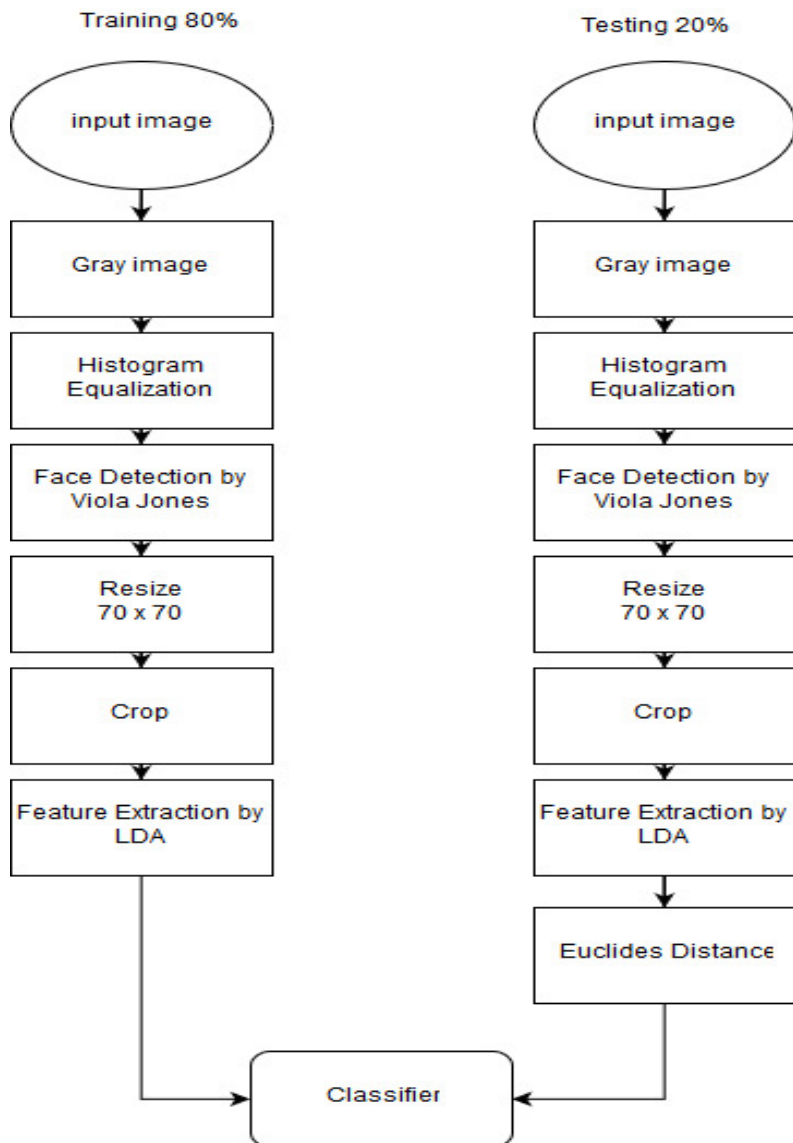
Figure 1. The Proposed System

2.2 Image Preprocessing

A number of researchers have been showing keen interest in the domain of image processing and numerous applications have involved the image analysis process. The scientists have been successful in accomplishing new objectives in this area such as segmentation of images, restoration and compression etc.; so that the existing procedures of image processing are improved and new techniques are discovered to solve the limitations of this field. Image processing has most recently found applications in different areas like processing of satellite, molecular and clinical images by using different image processing techniques (Stan, 2011).

2.3 Gray image

In various domains, it has been considered a useful application of image processing to translate a colorful image into a grayscale one. Three main colors including Red, Blue and Green form a pixel in case of a colored image. All these three colors are applied along the three dimensions i.e. XYZ axis concisely by considering the attributes of brightness, hue and purring. Under the brightness factor, the image color quality is provided by the number of bits based upon color indication (Stan, 2011). 8 bits and 16 bits are used for representing basic and high-quality colored images respectively. Moreover, an actual colored image is indicated by 24 bits but it takes 32 bits to denote a dusky one.

Bit number represents the maximum value of various color numbers that are given by the digital appliance. For instance, if every color in RGB (Red, Green and Blue) takes 8 bits then the integration of these colors will be shown by 24 bits, offering a broad range of around 16,777,216 colors. Within the colored picture, the pixel color is basically denoted by this 24-bit representation. In case of a grayscale image, the intensity of light is symbolized by an 8 bit value. The pixel amplitude intensity of grayscale images is within 0 to 255. The translation of a colored image to that of grayscale version is actually to transform RGB (24 bit) into grayscale (8 bit) (Stan, 2011). This similar process, involving 3 stages, is employed by every grayscale method, i.e.

1. To acquire values of RGB pixel
2. To perform mathematical calculations for translating these obtained values to one gray value
3. To use following equation to substitute RGB values with the gray ones

    Gray = 0.2989 (Red) + 0.1140 (Blue) + 0.5870 (Green)

2.4 Equalization of Histogram

It is a general technique adopted for enhancing a poor quality image. Histogram equalization is somewhat same as histogram stretching, but usually more visually satisfying outcomes are offered by it with an extended range of images (Roger, 2010). The outcome of histogram with a mount that has been closely assembled, in order to unfold or smooth histogram, creates a profound interpretation of dark pixels while a trivial display of lighter ones. Appearance is a major concern, as it is not possible for dark pixels within images to go extra dark, however, they will be shown as darker one because of those pixels that are comparatively lighter to them.

The process of histogram equalization can be divided into 4 major steps for digital images (Roger, 2010):

1. To identify the values of histogram
2. To normalize the values attained at the first step
3. To multiply the normalized values with the gray level value and round off.
4. To use 1-1 correspondence for mapping the 3rd step outcome to gray level

    The cumulative distribution function (CDF) is given by the equation below:

$$C.D.F. \ (y) = \sum_{j=1}^{y} H(j)$$

2.5 Face Detection

The latest face verification applications are in need of efficient face detection procedure. The image of a face is seldom normalized prior to storing it in the database. The face detection system is aimed to determine if any face is present in an image, and if yes, then to validate and locate that. It has been observed through numerous analyses that the major challenges in detecting faces are due to posture, expressions, color of skin and ethnicity. In addition to this, a number of other external causes that may affect the detection system include quality of image, complex background and inaptness with lighting conditions (Brown et al. 2000). The important approaches that can be adopted for performing face detection include appearance based approach, template matching approach, feature invariant approach and knowledge-based approach.

2.5.1 Viola Jones

The first method that allowed the quick detection of objects was put forward by Paul Viola and Michael Jones, back in the year 2001 (Neeti, 2014). This method used Adaboost machine learning for facilitating the quick and precise object detection. It has been considered as a most important mechanism for object detection, where sufficient detection rate has been offered in real time. Viola Jones method is capable of learning various object classes through Haar-like feature, in order to identify a range of objects. This method is mostly recommended to solve the problems in face detection process (Neeti, 2014).

Following are the main aspects of Viola and Jones algorithm:

1. The integration of images was first and foremost done by Papageorgioun (Paul, 2001), which helped in indicating Haar-like features during fast rectangular calculations of face detection tool. At the place *u, w,* the fundamental image has involved the pixel addition in the left and on top of *u, w* (Stan, 2011):

$$jj(u, w) = \sum_{\acute{u} \leq u, \acute{w} \leq w} j(\acute{u}, \acute{w}),$$

2. The process of filtering Haar-like features depends on how the images are classified by the Viola and Jones' process, where the pixels are not put in use directly. However, a whole selection process is carried out for implementing characteristics, which facilitates in the adaptation of ad-hoc field and code knowledge of functional properties. Besides this, it is also possible to rapidly increment the system using pixels. Moreover, a broad significant impact of Haar-like features has been observed in face detection. Once the primary image is identified, this will be followed by immediate detection of each Haar-like property at all places or scales. Figure 2 has displayed the types of Haar-like features.

Edge features

(a) (b) (c) (d)

Line features

(a) (b) (c) (d) (e) (f) (g) (h)
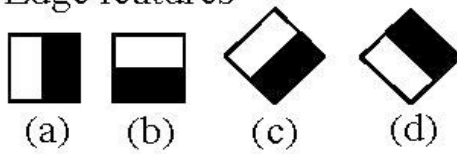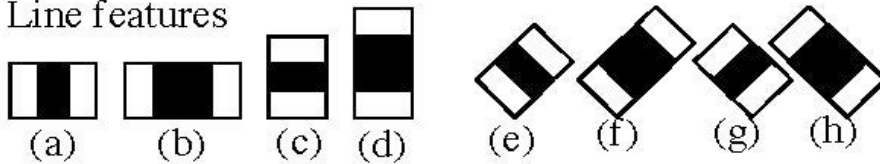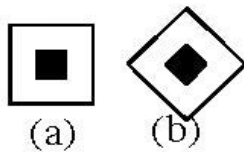
Center-surround features

(a) (b)

Figure 2. Examples of Haar-like features

3. AdaBoost training is basically a machine learning technique. In this process, some weak classifiers are selected that are then perfectly specified by one Haar- like feature, which are eventually combined to develop a strong classifier (Jensen, 2008).

A weak classifier $[M_i(u)]$ that is $N_i(u)$ multipart is shown as:

$$M(u) = \begin{cases} 1 \ if \ P_i N_i(u) < P_i \varphi_i \\ 0 \qquad\quad otherwise \end{cases}$$

Here φ_i symbolizes ideal threshold and p_i refers to equality. The unequal sign is due to this reason which minimizes the unclassified number of cases. The parameter u indicates a subnet window of image pixel (24 x 24)

At every turn, the algorithm collects just one weak classifier that can do effective categorization of negative and positive case examples within the learning set. A bigger value weight is provided in the following rounds through the negative address cases, while the right ones will offer a smaller value weight (Paul, 2001).

The following resultant strong classifier $M(u)$ is the output of linear integration of weak ones:

$$M(u) = \begin{cases} 1 & if \ \sum_{t=1}^{T} \alpha_t h_t(x) \geq \gamma \sum_{t=1}^{T} \alpha_t \\ 0 \ otherwise \end{cases}$$

4. Cascaded Classifiers

A cascaded classifiers configuration has been created by Viola and Jones, where a chain of strong classifiers are involved, in order to swiftly discard the poor areas of an image. These strong classifiers are put within cascaded form in an increasing order with respect to complexity. This helps in disposing of several areas that are rare for compound faces in an effortless manner, as lengthy calculations are to be done subsequently on the contender's regions (advanced classifiers). This approach helps in incrementing the detection performance and reduces the calculation time as well. Viola detector based AdaBoost learning is both fast and precise; moreover, its application is easy and yields high efficiency. Along with these advantages, the main drawbacks are more amount of time needed for training and the deep search done by it all through the feature space (Jensen, 2008).

2.6 Crop

Face cropping is considered to be an important step to achieve an effective rate of recognition. In this section, a smart graphic tool is employed for removing the unwanted portions of an image. Extraction of an area of interest is done by cropping the actual picture) (Dharavath et, al., 2014).

2.7 Resize

Resizing is another important pre-requisite step of image processing for an efficient face recognition system. The images being detected through various face detection procedures are resized using interpolation method, in order to give particular sized output images (Dharavath et, al., 2014). In the process of image interpolation, the image is resized and shifted from one pixel grid to another. The resizing of images is important for decreasing or increasing the number of pixels. The effect of different scaled image resizing has been noticed during the recognition process. As images of different size carry different information, therefore, the in-depth analysis of optimal image size is critical. Image resizing has been done to produce lower data size that in turn accelerates the processing time. Images are generally resized at a scale ranging from 0.1 to 0.9 (Barnouti, 2016). In this work, this step is carried out

to normalize the dimensions of image at 70 x 70, after face detection through Viola Jones algorithm for carrying out linear discriminant analysis.

2.8 Linear Discriminant Analysis (LDA)

This analysis has been done in statistics, pattern recognitions and machine learning, in order to compute integration of linear features, which divides or point sup two or more classes of object or events. The resultant may function as a linear classifier, or to minimize the dimensions prior to LDA correspondence with the principal component analysis (PCA), since both of them rely upon multiplication of matrix and linear conversions (Jindong, 2016). For PCA, this conversion is dependent on reducing mean square error within initial data vectors and its assessment with respect to the reduced dimensions of data vector. In addition to this, principal component analysis does not consider any class variation. But in LDA, the conversion depends on enhancing the rate of "within class variance" relative to the rate of "between class variance". It is focused on reducing changes in data within same class and increasing the division amongst classes (Li, Cheng, and Bingyu Wang, 2014). The linear discriminant analysis is initiated by calculating total mean (μ) using following equation, where class mean (μi) is calculated as follows:

$$\mu = \frac{1}{N}\sum_{I=1}^{N} x_i$$

$$\mu_i = \frac{1}{x_i}\sum_{x_j \in x_1} x_j$$

The following equations are used to identify scatter matrixes, which are denoted by S_b and S_w.

$$S_b = \sum_{i=1}^{c} N_{i(}\mu_i - \mu)(\mu_i - \mu)^T$$

$$S_w = \sum_{i=1}^{c} \sum_{xj \in xi}(x_j - \mu_i)(x_j - \mu_i)^T$$

Finally, the maximization of class separation criterion is achieved using the LDA algorithm through the following equation:

$$W_{opt} = arg\,max_W \frac{|W^T S_B W|}{|W^T S_W W|}$$

2.9 Classifier

After doing feature extraction using LDA algorithm, the system stores them as a file, termed as classifier. The Euclidean distance is then found by comparing it with that of test image. The Euclidean distance is defined as the standardized direct line distance that has been calculated between the two points in

Euclidean space. The space is represented in Euclidean plane by the following equation, provided that $p1 = (P_{x1}, P_{y1})$, $p2 = (Px_2, P_{y2})$:

$$d(p1, p2) = \sqrt{(P_{x2} - P_{x1})^2 + (P_{y2} - P_{y1})^2}$$

3. RESULTS AND DISCUSSION

This research work is aimed at developing a cloud computing based system for face recognition, in order to validate users. The faces have been detected using Viola and Jones algorithm that employed Adaboost learning method, cascaded classifiers, Haar like features (5 types) and integral image. The faces have been recognized with the help of Linear discriminate analysis (LDA). The LDA algorithm was preferred over PCA since it yields better performance. Furthermore, this approach offered improved results because of its lower lightning sensitivity, quick processing and less features. It has been found that conversion of images to grayscale is essential prior to the face detection step as it increases the speed and subsequently moves across the histogram equalization step. Histogram equalization in image processing is a procedure where contrast has been adjusted with the help of image histogram. The contrast of various images is raised on the whole by this approach, especially when close contrast values are used for the characterization of integral image data. This adjustment helps in having an improved intensities distribution on histogram. The low contrast areas are also allowed to have improved contrast through this adjustment. The edges of images are identified through cropping and eventually resizing is carried out to unify the size of used image. A database cloud is established to validate the faces inside image.

3.1 Proposed method

The elementary layout of the proposed face recognition system has been shown in the figure 3 . Two interfaces are involved in this system:
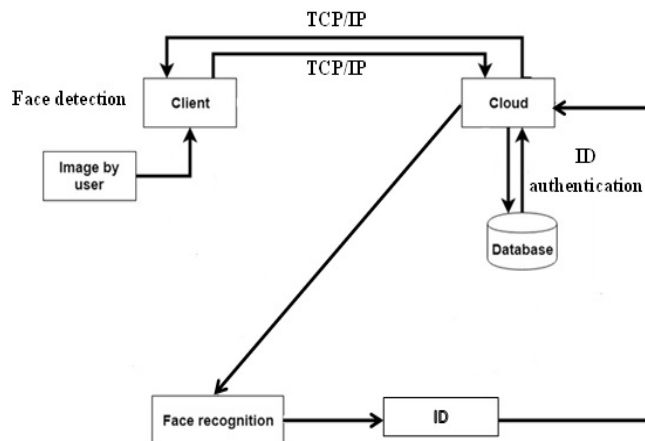
    i. cloud interface

    ii. client interface

Figure 3. General Model of the System

3.2 Discussion

In order to develop an efficient system that is capable of detecting effortlessly and accurately under various situations, a dataset comprised of twenty individuals is taken. All these individuals have different complexions (black or white), different face features and belonged to varied origins. The following table shows the results attained by this system.

Total trains	Total tests	Total hit	Total miss	Precision
160	80	79	1	98.75%

Table 1. System Results

4. CONCLUSION

The dataset employed for this research work is able to produce a very authentic and precise system. The security will improve as only client will be having information regarding the port. The accuracy will be high since complete server training has been done using images that are verified previously; thus the original image cannot be replaced by any unknown one. The TCP/IP protocol integrated system will facilitate in getting acknowledgments upon sending. The potential of this face detection system has been incremented by using Viola & Jones algorithm. The results achieved by this system have an accuracy of about 98%.

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