

Method for secure electronic voting system: Face recognition based approach

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ABSTRACT

In this paper, we propose a framework for low cost secure electronic voting system based on face recognition. Essentially Local Binary Pattern (LBP) is used for face feature characterization in texture format followed by chi-square distribution is used for image classification. Two parallel systems are developed based on smart phone and web applications for face learning and verification modules. The proposed system has two tier security levels by using person ID followed by face verification. Essentially class specific threshold is associated for controlling the security level of face verification. Our system is evaluated three standard databases and one real home based database and achieve the satisfactory recognition accuracies. Consequently our propose system provides secure, hassle free voting system and less intrusive compare with other biometrics.

Keywords: electronic voting, LBP, face recognition, android based voting

1. INTRODUCTION

Democracy is an important part of most modern societies. One of the most important activities within a democracy is the election of representatives. It is also a very delicate process that is the subject of various disturbances, such as inactive citizens, out of station, duplication of votes, attempts of fraud etc. The main concerns of election to increase the voting turnout which directly associated to people come and cast the vote. It is also very important to secure the overall vote casting process from different types fraudulent. Two basic methods are adapted for vote casting system manual process, electronic thumb recognition based method [1], [2]. Several problem associated with these method, if voters are sick can't reach to polling both, outside the station can't approach the polling both, bad weather can't allow to visit polling both, lake of transport and many more.

Our proposed framework focuses some of these problems. We have developed a consolidated smart phone and web based applications which minimize the most of these problems. This application has two tires authentication, person ID followed by face recognition. Our system is developed on Java programming tool and for image processing OpenCV tool box is used. Figure (1) shows some screen shots of smart phone based registration process of a voter using two tier security. In our knowledge no such system electronic voting based on face recognition yet has not been developed. We have tested our system on three known databases namely YALE database [6], AR database [7] and GT database [8] and home based face database. For demonstration purpose four images of a typical class of each database is shown in figure (2). Results produces by LBP on all four databases are shown in Table (1). All databases produce above 93% except AR database which is 84%. Further detail of implementation is defined in section (II)

Further paper is spread as follows; importance of the face recognition is described in section (2), description of LBP and other statistical model are given in section (3), section (4) is dedicated for the system frame work, work flow of proposed system is described in section (5) and conclusion in section (6)

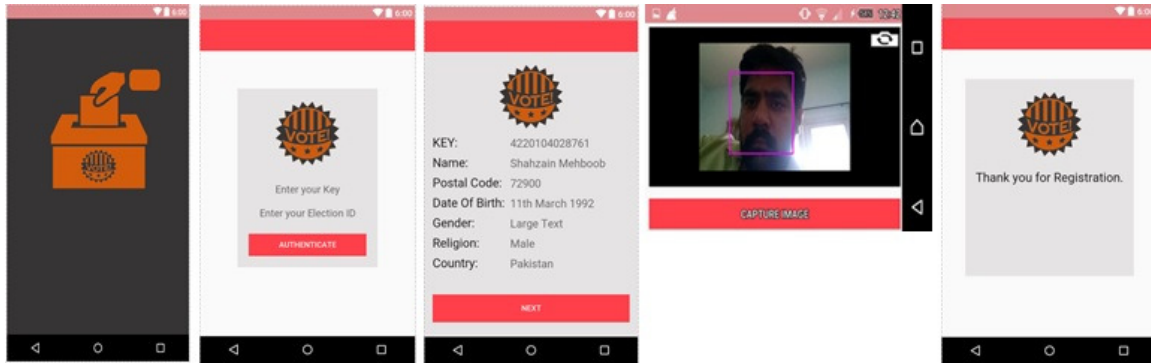


Figure 1: Registration processing in sequential order left to right

3. FACE AS BIOMETRIC

The paradigm of face recognition seeks the spatial geometry of distinct features of faces. It is an application for computer vision and usually used for the identification, authentication, and verification of a person. Due to its physiological characteristic and less intrusive, face is widely used compare with other biometrics. One of the major advantage of face biometric on other biometric that it doesn't require any special type of device for capturing like iris needs special type of camera, finger prints required the extra device for scanning, palm print also needs special infrared device. Face doesn't need the physical contact with capturing devices and required very less cooperation. Iris biometric requires very high cooperation with camera even can't get image away from approx. 5 meters, similarly finger print need high cooperation with device against rotation [9]. The importance of face recognition is highlighted with the widely deployed video surveillance systems [10]. Surveillance cameras capturing images can be used to monitor anomalous activities in sensitive areas. Inside the single image multiple faces can be captured, and each face can be separately detected by detection technique for individual analysis. It is questionable that the performance of face in sense of recognition rate. Although, face has several advantages during implementation but has also some limitations. Due to less intrusive the occlusion, illumination variation, expression, are the most challenging problems in face recognition paradigm.



Figure 2: Yale and AR databases image are in first row, and GT and home based databases image are in second row

4. LBP – LOCAL BINARY PATTERN

LBP is a highly efficient texture operator [11]. Each pixel is transformed by LBP processes in spatial domain. Essentially consider 3x3 subarray with 9 pixels, if neighbor pixels are greater or equal to center pixel to transform 1 else it is transformed 0. The 8 bits binary sequence produces by neighbor pixels then it is converted to decimal number and replace it from center pixel refer to Figure (3). The same process is applied on each pixel of image. LBP transformed image then divides 8x8 subarray for further process to get spatially enhanced histogram and each histogram is concatenated to previous histograms. Finally this process produces a texture representation of given image shown in Figure (4). The most important property of the LBP operator is robustness against monotonic gray

scale changes which is illumination variations [12], other benefit its computational simplicity. LBP can be implemented with numbers of different orientation [11]. We have chosen standard neighborhood method with 8 pixels around radius 1 (R=1, P = 8).

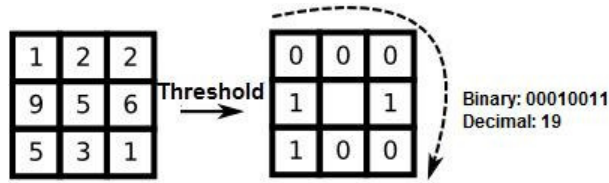


Figure 3: LBP thresholding and decimal conversion process

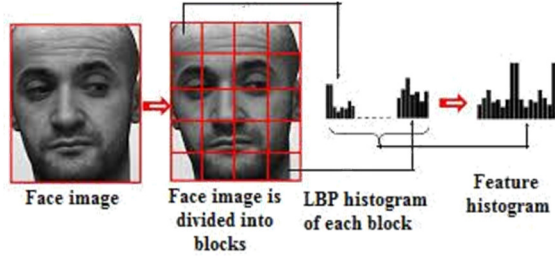


Figure 4: Spatially enhanced histogram of 8x8 block with concatenation

LBP chooses the small area of image for construction of spatially enhanced histogram. Due to this, distance measure between two vectors can be exploited by spatially enhanced histogram. In this connection, feature of some part of human such as eyes or nose are played vital role and contribute the more information compare to other parts. Chi square [13] distance method is selected for classifying the two vectors defined as

$$\chi^2 = \sum_{j,i} \frac{(\alpha_{i,j} - \beta_{i,j})^2}{\alpha_{i,j} + \beta_{i,j}} \quad (1)$$

α and β are two normalized enhanced histogram of query and gallery images respectively. Number of bins of a histogram is represented by i and local region by j . Our system based on the verification, which verify the query image to the specific (ID based) gallery image. Threshold plays the key role for verification and choice of the threshold one of the major part for robustness of verification. There are two major categories of threshold namely Client-dependent and Global threshold [8]. We implemented the client-dependent threshold define in equation (2) and reported in [14].

$$\zeta_j(\Delta) = \mu^c(j) - \alpha \sigma^c(j) \quad (2)$$

where μ and σ are mean and standard deviation of specific class j respectively

5. WORK FLOW OF PROPOSED SYSTEM

The main modules of a face recognition based voting system are registration, authentication, vote casting and counting refer to figure (5).

5.1. Registration

In this section, registration process and its development has been discussed. User can register himself for future election using proposed android application or web based system shown in figure (1). User follows three simple steps, social security number, credentials and four facial images. Technically, given faces are passed to LBP and converted it to texture representation and calculate the class specific threshold by using formula (2).

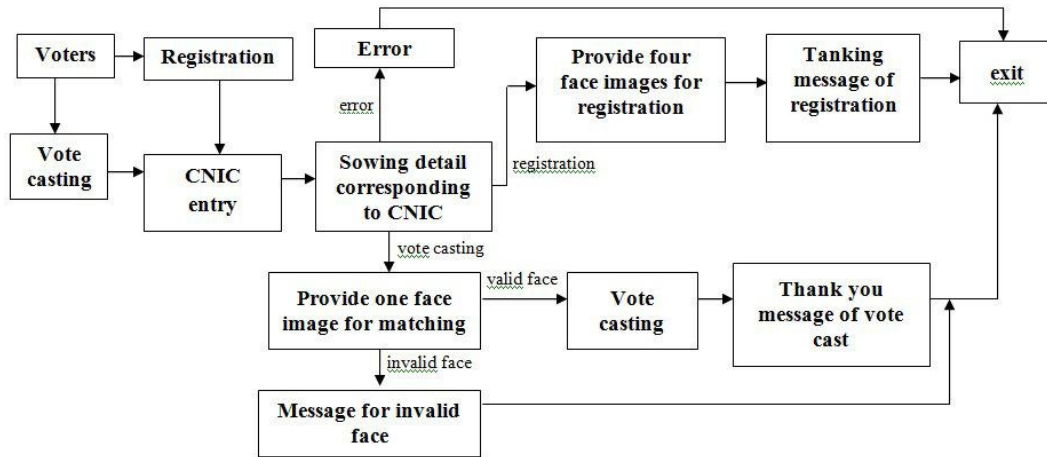


Figure 5: System flow diagram

5.2. Authentication

Authentication plays key role for accessing the concerned information, stop the intruders etc. Strong authentication system provides the more secure access of sensitive information. Several method has been reported password, card punch and others and several issues are associated with these system. It is dire requirement to improve the authentication system. The biometric verification is a natural choice to improve the authentication process. We have used face biometric for authentication. Only registered users can access the system for vote casing, viewing results, update personal information. Technically state-of-the-art LBP algorithm and class specific threshold is used for implementation.

Table 1: Accuracy results on four known databases

Face DB	Subject	Recognition rate
AR	20	84.20%
GT	50	96.70%
Yale	10	93.00%
Home	50	96.00%

5.3. Vote Casting

Our proposed secure vote casting system provides to voter that can cast vote from anywhere using smart phone or web based system. Our system is helpful to disable and ill persons, travelers, out of station peoples, and bad weather condition, voter can cast the vote. The two tier security authentication “person ID and face verification” improve the rejection the bogus votes, fake voters etc. We have introduced dynamic generation of area/department wise ballot paper.

5.4. Votes Counting

In manual vote casting system, vote counting is a time taking process, some time it takes whole day or more if re-counting needed. Voters don’t know about the status of their areas, whole party status, etc. Our proposed system overcomes these issues and provides the status of election every second and minimizes the vote counting time. We have provided a page to voters in android and web based system to watch the status of election with different parameters. Election administrator can also generates the final results by using proposed system.

6. CONCLUSION

In the domain of electronic voting based system, a face recognition based e-Voting is proposed. Proposed algorithm

is generic can be deployed for any size of organization and country vote casting system. Essentially, the LBP is used for face verification and provides the secure authentication. The proposed system is developed for smart phones and web based have several advantages over conventional methods in regards of turnout, easy to vote cast, give opportunity to disable, ill and traveler persons. Several improvement is still required to implement concern to accuracy, distributed servers, system security.

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