

# Method for secure electronic voting system: Face recognition based approach

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**Abstract** — This paper proposes a simple low cost secure electronic voting system based on face recognition. With the advancement of technologies, it is a requirement to develop a system in which people can cast their vote, from anywhere of region with safe and secure manner. In this regards, we propose electronic voting via face recognition system which doesn't need any special biometric device. The main focuses to resolve the hassle of vote casting system. Face verification based authorization is required for both registration and vote casting. Android framework is used to develop the system. Local binary pattern with combination of chi-square classification is used for face verification. The system only required a smart phone for registration and vote casting. Those who have not smart phone or can't use the smart phone then parallel web based system also is developed. Our propose system has several advantages over conventional manual vote casting and thumb based vote casting systems. First most enormous advantage is that voters can register himself from anywhere of region even can cast vote only using smart phone. Secondly it is secure to two folds people identification number (CNIC) and face feature. As we know, face based verification required less cooperation compare to other biometrics namely iris requires high quality camera, thumb requires special device etc.

Our system also very helpful to handicap people, those in hospital, jail, and travelling, etc to cast their votes and participate to candidate selection process. Due to this reason, the turnout of the overall vote is increased. We use the local binary pattern with chi-square classifier for face recognition. This system produces good recognition accuracy on different databases namely Yale, AR, GT and Home databases.

**Keywords** — voting, LBP, face recognition, android based voting

## I. INTRODUCTION

Democracy is an important part in 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, attempts of fraud etc. Our proposed project overcomes some of these problems, starting from the current democratic situation in Pakistan and other countries. For this

purpose we have developed a software which minimize the above said problems. Our proposed a framework cures the most important aspects of election vote casting problems. The main purpose of this development is to improve the turnout of votes, secure the whole election system, minimize the election cost, minimize the vote counting time and producing the minute report. Due the ease of vote casting, our proposed system improve the turnout the vote casting against the following reasons: (i) bad weather conditions in different areas during election (ii) youngsters' of approx. age group 18

– 24 has no charm to cast the vote (iii) people who are outside the city/town/country (iv) people who are travelling on day of election (v) some people might have emergency duty during election and (vi) disable and ill people can also cast the vote using our system.

Secondly, proposed model makes the secure “registration” and “vote casting” process from fraudulent. Due to above said reasons the “electronic voting via face recognition” is a natural choice over conventional method. Our proposed model also targets to curtail the overall expenditure of election. This system is enough flexible for the individual to view the trend of current status of election area wise, party wise and city wise. In a conventional manual system, there is problem that person (fraudulent) can get himself registered in more than one area, consequently, he can cast the multiple votes. We have developed a centralized online system/database which eliminates the bogus, duplicate, multiple votes casting. Even in some ruler areas, officials of the Election Commission themselves cast votes and adjust these votes to favorable candidates. Consequently, overall election result not stands on truth. Therefore, it is a requirement of a system that could reduce and stop all these frauds, fake, multiple and other vote using safe and secure authentication. Several development on electronic voting via thumb recognition have already been done [1][2][3]. It gives opportunity to people to cast an empty vote if they don't like to give the vote to any of the candidates. In view of above, we have proposed the “Electronic Voting System based on face recognition”. The state-of-the-art Local binary pattern (LBP) [4] is chosen its further details in under section (IV). Our proposed model integrated to android and

web based system. We have developed it on Java (JVM) with image processing tool box. In which, we have implemented two tier securities that are CNIC followed by face recognition [5] for both registration and vote casting. Figure (1) shows registration process of a voter via face recognition. In our knowledge no such system electronic voting based on face recognition yet has not been developed. Before implantation of LBP on home database, it is tested on three known databases with setting of our desired protocol (four images for gallery and one for probe) which is used in our proposed system namely YALE Database [6], AR Database [7] and GT Database [8]. 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%. Initially, these results are satisfactory to implement the system. Further detail of implementation is defined in section (II)

Further paper is spread as follows; in section (II) scope of the project is defined, importance of the face recognition is described in section (III) , description of LBP is given in section (IV) , section (V) is dedicated for the system frame work, work flow of proposed system is described in section (VI) and conclusion in section (VII)

## II. SCOPE

Our product is highly user friendly application and it can be use through android mobile phones and personal computer from anywhere. It does not require any extra software or hardware device for registration or vote casting processes as a voter. People can check the election status, area wise, party wise, country wise etc by using our android based application or web based system. Our system facilitates to a person for registration in voter list via android or web application as shown in figure (1). Candidate can also register as an voter as once he registered as candidate via same process. When election is announced, our system automatically active the vote cast button. Every voter has to pass two layers of security checks for vote casting CNIC and face verification. As described previous in section (I) no any special device is required other than a built-in camera. It is the major advantage of our system over thumb impression based election system.

Our system eliminates the probability of bogus voting up-to 99% and more importantly it allows overseas and outside the their areas voters to cast vote without any hurdle & doubt of corruption. An un-registered fraudulent cannot be allowed to vote because of two levels of security. The registered voters are also restricted to cast vote only once and if they try again they automatically get disqualify.

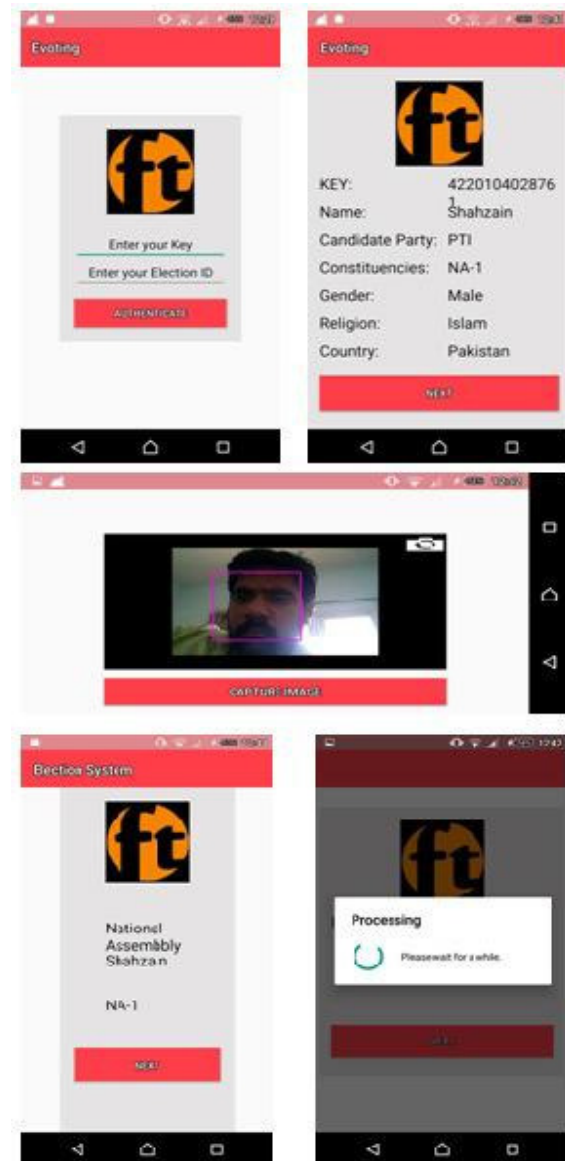


Figure 1: Registration processing in sequential order

Three state-of-the-art techniques have been used for the system development namely; Local Binary Pattern (LBP) for face features extraction [4], for classification Chi-square distribution [7] is used and final decision has been taken from class-specific threshold technique [8].

## III. 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



Figure 2: Yale database image in first row, AR database image in second row, GT database image in third row and home database images in fourth row

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 infra red 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].

Table 1: Accuracy results on four known databases

Database	Subjects	Accuracy
AR database	20	84.20%
GT database	50	96.70%
Yale database	10	93.00%
Home Database	50	96.00%

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.

#### IV. LBP – LOCAL BINARY PATTERN

LBP is a highly efficient texture operator [11]. LBP processes on each spatial pixel of given image by thresholding compared with neighborhood. The current considered pixel assigned as threshold and the neighbor 8 pixels (size 3x3 partition) is replaced by the rule using, if greater than or equal to threshold be 1 else 0. Transform the clockwise 8 bit binary collected number to decimal and substitute it from the current pixel shown in figure (3). Apply same process to all pixels of image to convert the image as LPB image. After this process, image divides 8x8 array of pixels for further process to get spatially enhanced histogram and each histogram is concatenated and produces a texture representation of given image shown in image (4). The most important property of the LBP operator is the 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).

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 distance method [13] is selected for classifying the two vectors defined as

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

$\alpha$  and  $\beta$  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  $j$ .

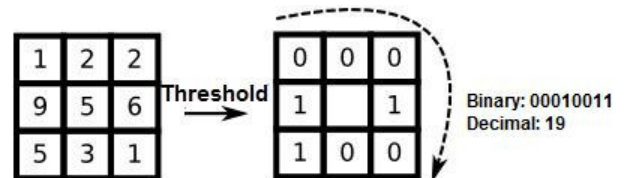


Figure 3: LBP thresholding and decimal conversion process

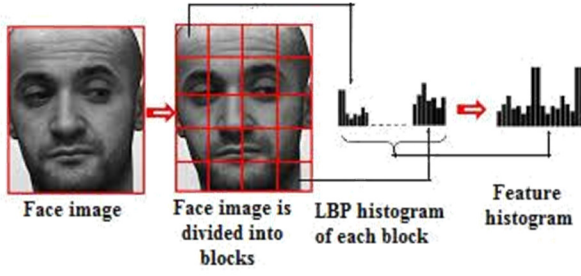


Figure 4: Spatially enhanced histogram of 8x8 block with concatenation

Our system based on the verification, which verify the query image to the specific (ID based) gallery image. Thresholding plays the key role for verification and choice of the threshold one of the major ingredient 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].

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

where  $\mu$  and  $\sigma$  are mean and standard deviation of specific class  $j$  respectively

## V. SYSTEM FRAMEWORK

Our proposed system framework for secure electronic voting comprises of an android based smart phone with 5-megapixel camera, a computer with webcam for registration and vote casting process. From developer perspective, Java development tool, image process tool box, database, web programming tool are used. A quick explanation of system flow is shown in Figure (5). Our proposed system has three main modules namely (i) Developer: who develops the system, also responsible to debug, modify and changes in system as per requirement. (ii) Administrator: who is the responsible to manage the proposed election voting system, and configure the system according to need, Voters: who can register himself for vote casting and cast a vote.

The role of administrator is versatile, administrator is super admin and has power to create, update, and delete the election details as per requirement. We have developed a customize electronic voting system which has flexibility to deploy in any environment like University, organization, communities, and country etc shown in figure (6).

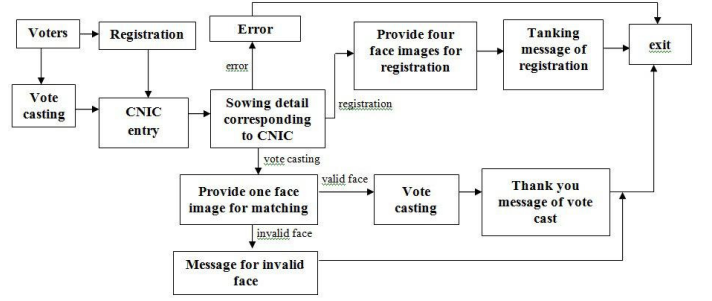


Figure 5: System flow diagram

Some attributes are required to on or off during deployment for different environments. Example; when it deploys in a University, might be it nor require to mark the provincial and national assembly (we can hide it).

## VI. WORK FLOW OF PROPOSED SYSTEM

The main components of a face recognition based voting system are registration, authentication, accessibility, vote casting and counting.

### A. Registration

In this section the importance of registration has been described in “user” and “system development” perspectives. User can register himself to election commission using proposed android or web based system shown in figure (1). For this purpose user has to follow the following steps; (i) enter CNIC in first step, related details appear, verify and go to next step for face entry. (ii) submit four face images by android phone camera or webcam. Technically, we create a folder with name of CNIC number, and store these images in same folder in texture feature format after LBP processing. Simultaneously, we calculate the threshold for this facial image by using equation (2) and store it in a text file name CNIC and store in same folder. After completion of registration, a message is generated, “you have successfully been registered”.

Candidates can also be registered himself by using separate page with some extra information specific for candidates like from which party candidate belong to etc.

### B. Authentication

Authentication has two easy steps namely CNIC and face verifications at user end, a step feature extraction and matching of test image at technical side. When election is announced, the button on vote cast page is enabled



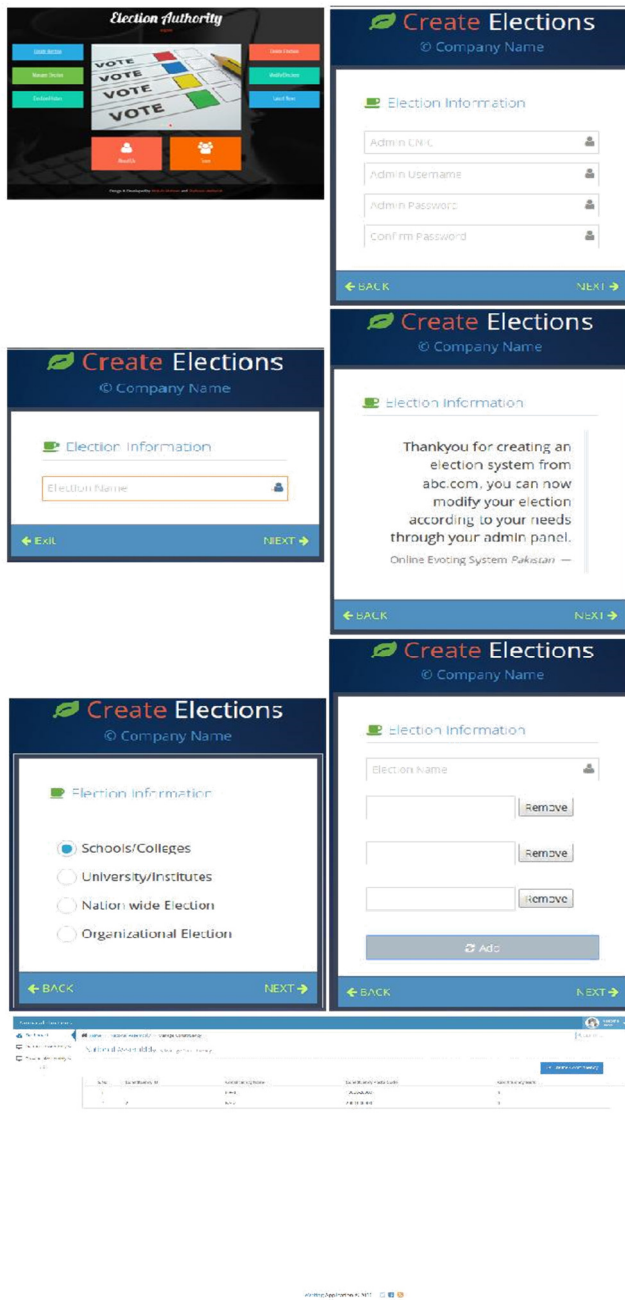


Figure 6: Election creation diagram from up to down

for vote casting, user provides CNIC first, after verification of CNIC, a face image is required, which user provides by android camera or webcam, in verification step LBP is applied on provided test image and match the texture converted test image to already stored texture at corresponding CNIC folder. The matching result is compared with threshold which already

calculated at the time of registration. If current matching score is less than to store threshold, user is valid otherwise user is invalid and no able to cast vote. Due to this process user can cast vote from anywhere of world. In case of valid user, the next screen is appeared for vote casting where only those candidates are shown that is registered in respective area.

### C. Vote Casting

Our proposed model of secure vote casting system is designed in a way that, a voter can cast vote anywhere of the world using smart phone or desktop based computer. If a voter has not a smart phone, he can cast vote from any based station throughout the country or region of election commission and cast his vote. We have implemented a state-of-the-art algorithm (LBP) which also provides robust result on unconstraint environment. Due to local region based processing, LBP is very easy to handle for implementation compared to holistic based system. A disable person, ill person, travelers, out of station peoples, in office hours and any other condition, voter can cast the vote. The security checks improve the rejection the bogus votes, fake voters etc. Due to these reason, the turnout of the votes increase.

### D. Votes Counting

In manual vote casting system, vote counting is a time taking process, some time it takes whole day or more if re-count it.. 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 monitor the status of election with different parameters. Election commission can also generate the final results by using proposed system.

### E. Accessibility

The usage of our system is very simple and easy for voter and administrator. Voter can registration himself by using two easy steps and cast the vote also four easy steps. Both are highly secure and minimize the fake, bogus, duplicate and other types of votes. Minute minute status of election can be viewed by proposed model. Our system also helps to administrator with easy steps for creating the election shown in figure (6), setting the election criteria, acceptance and rejection of candidates application, compile the results etc.

## VII. CONCLUSION

E-voting based on face recognition is an emerging model with advancement the technology. Our proposed system is significant alternatively conventional system namely “manual vote casting system” and “vote casting based on thumb impression”. The main focus of proposed system is to secure the election system and makes easy the vote casting process for voter. We have successfully implemented our system and evaluated. The state-of-the-art local binary pattern (LBP) is used for face verification which produces above 90% result. In future it has been planned to incorporate the voice verification for improvement of security level. Finally the proposed E-voting system would enable to conduct the fair election. Our system precludes the illegal practices like rigging, fake votes, bogus votes, and duplicates votes, etc

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