VOTER AUTHENTICATION IN POLL BOOTH USING RASPBERRY PI

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***Abstract*- Progress in the area of face recognition has reached great heights in the recent years. Face recognition is considered to be one of the principal tasks in various potential applications like private security, surveillance systems, etc. This project focuses in authenticating the voters in the poll booth using face recognition technique, which is mainly based on image processing performed by Raspberry pi with Open CV library installed in it. Local Binary Pattern (LBP) algorithm is implemented for face recognition. The project clearly distinguishes between the authorised and unauthorised voter, thus contributing in the prevention of unfair voting practices.**

***Keywords*-Face recognition, Raspberry pi, Open CV, LBP, Voter authentication.**

I. INTRODUCTION

Presently most of the countries follow a democratic rule where the citizens of the country can elect representatives of their choice to be the members of the Parliament. This is achieved by a voting system in which a person can cast his/her vote without disclosing to anybody in a completely secretive manner. To ensure a disciplinary process, lot of manpower and time is consumed. At the time of elections, a number of officials are employed in various polling booths to verify if the right person casts his/her vote in the right constituency. In the prevailing system, most of the malpractices happen either by cheating or bribing the officials involved. A completely automated system, which allows only an authenticated voter to cast his/her vote, will serve as a solution to this problem. In order to identify the right person, face recognition technique can be employed. Here, several comparisons are involved between the captured image of the individual and the pre-stored images in the database. This requires complex calculations and algorithms. The availability of low cost, user-friendly embedded systems and well-developed technologies has made the implementation of such complex algorithms easy and efficient.

II. RELATED WORK

In [2], authors have worked towards reliable face recognition technique for a smart doorbell system. Indeed, an integrated camera will capture several pictures of the visitor. The face recently scanned will be verified in the present database. In case of unknown face, a template will be generated then stored. Otherwise, in case of known face, actual template is matched with templates stored in the database. Furthermore, the owner will be notified, through his mobile phone, speakers and an administrative secured website, about all the visiting details. Algorithm for face recognition, based on principal component analysis (PCA), is programmed and implemented in this work. Principle component analysis (PCA) is widely used for dimensionality reduction, Turk and Pentland introduce Eigenfaces in 1991. By this method, the dimensionality of a face model can be reduced from image pixel size to several principle basis, the basis may encode sufficient information about the face. However, it is designed in a way to best preserve data in the embedding space, and consequently cannot promise good discriminating capability.

Another interesting work [12] presents a face recognition system based on discriminant analysis, also referred to as the Fisherface method of face recognition. It makes use of both Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) to produce a subspace projection matrix. Unlike the Eigenface algorithm, the Fisherface method tries to increase the ratio of the between-class scatter to the within-class scatter and also is greatly invariant to light intensity. Thus, we could achieve better accuracy in facial expression using Fisherface when compared to Eigen face approach. However, Fisherface is more complex than Eigenface in computing the projection of face space matrix. Also calculation of ratio of between-class scatter to within-class scatter consumes a lot of processing time. Another possible drawback is if the between-class scatter is large, then the within-class scatter might also still be a relatively large value.

III. FACE RECOGNITION TECHNIQUE

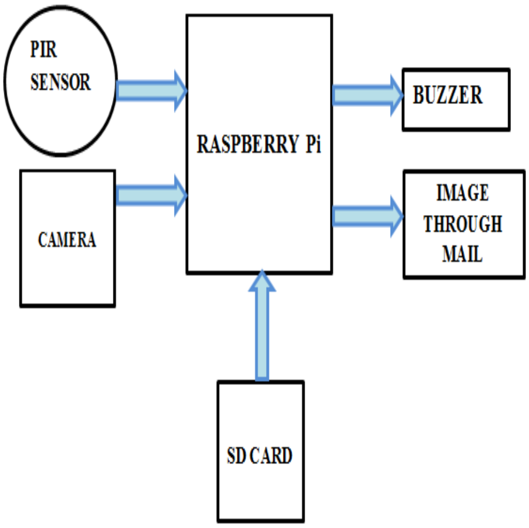

Fig. 1 Block diagram of Voter Authentication

The process of face recognition is initiated by a PIR sensor placed at the entrance of the poll booth. The PIR Sensor is a human detection sensor, which has the ability to detect human presence within the range of 5m to 12m by sensing the infrared radiation. Upon sensing the presence of an individual at the entrance of the booth, the PIR sensor triggers the camera interfaced with the Raspberry pi3 which has a quad-core 64 -bit ARM Cortex A53, an on-board 802.11n Wi-Fi and Bluetooth 4.0 features. When the camera is triggered, it captures the image of the person in front of it. The captured image of the voter is compared with the pre-stored images in the database. The comparison is based on the Local Binary pattern algorithm of face recognition. LBP is an algorithm available in the OpenCv library, an open source software library which has over 2500 different algorithms for various real time applications such as face recognition, object identification, movement tracking, etc. It provides various interfaces such as C, C++, Python, Java, etc. It is a freely available, user friendly library, used here for image processing purposes. After the comparison, if the voter is found to be valid and is identified for the first time, then the person will be allowed to cast his/her vote. A 16x2 LCD is used here to display the status of the voter. In case of the voter being invalid, an alarm rings immediately on the spot and also an alert mail is send to the concerned authority and controlling body reporting about the malpractice.

The following flowchart shows the flow of the various processes involved in face recognition.

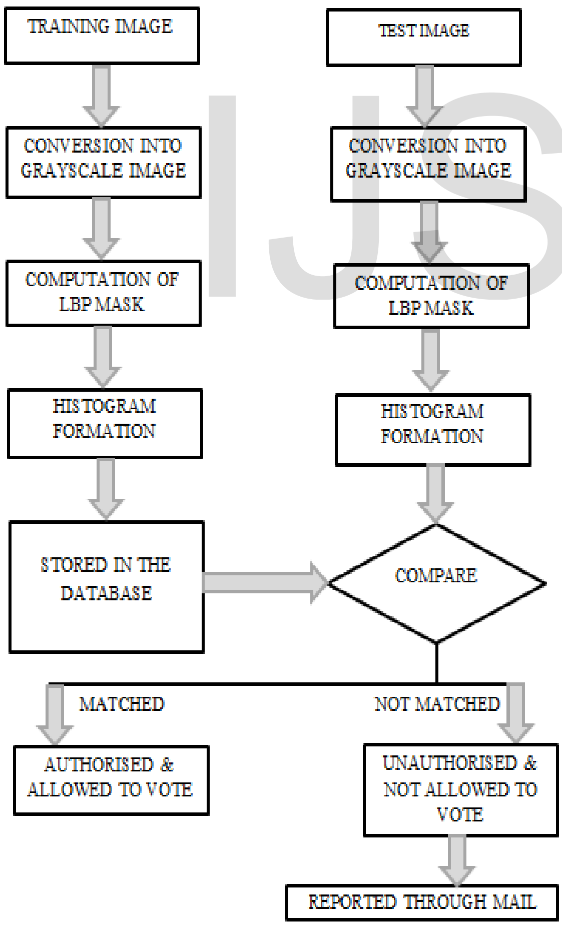

Fig. 2 Flowchart of the proposed work

Local Binary Pattern:

Local Binary Pattern (LBP), a non-parametric method provides tolerance against the monotonic illumination changes has been used in retrieval of audio/video content. Due to its effectiveness, this algorithm is implemented in this project. In order to implement the LBP algorithm, the input image should be a grayscale image. The LBP value is calculated for every pixel in the grayscale image by comparing the central pixel value with its surrounding pixel values. The transversal of the neighbouring pixels can be made either in clockwise or anti-clockwise direction but we must be using the same order for all the pixels. If the current pixel value is lesser than the neighbouring pixel value, the corresponding bit in the binary array is set to 0 else if the current pixel value is greater than or equal to the neighbouring pixel value, the corresponding bit in the binary array is set to 1.Since there are 8 neighbouring pixels – for each pixel, we will perform 8 comparisons. It gives a 8-bit binary value, which is then converted into a decimal value. This value is referred to as the LBP value.

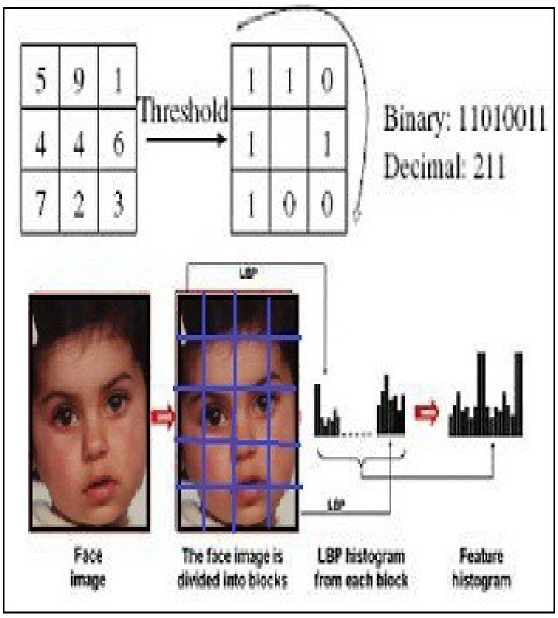

Fig. 3 Computation of LBP mask value

After calculating the LBP value of the current pixel, we update the corresponding pixel location in the LBP mask (It is of same height and width as the input image.) as shown in the above figure. Now the LBP Histogram is computed using the LBP mask values obtained. In order to obtain histogram, the LBP mask values are grouped into subparts called bins. This grouping, which is shown as in the following figure is based on the range in which the mask values fall.

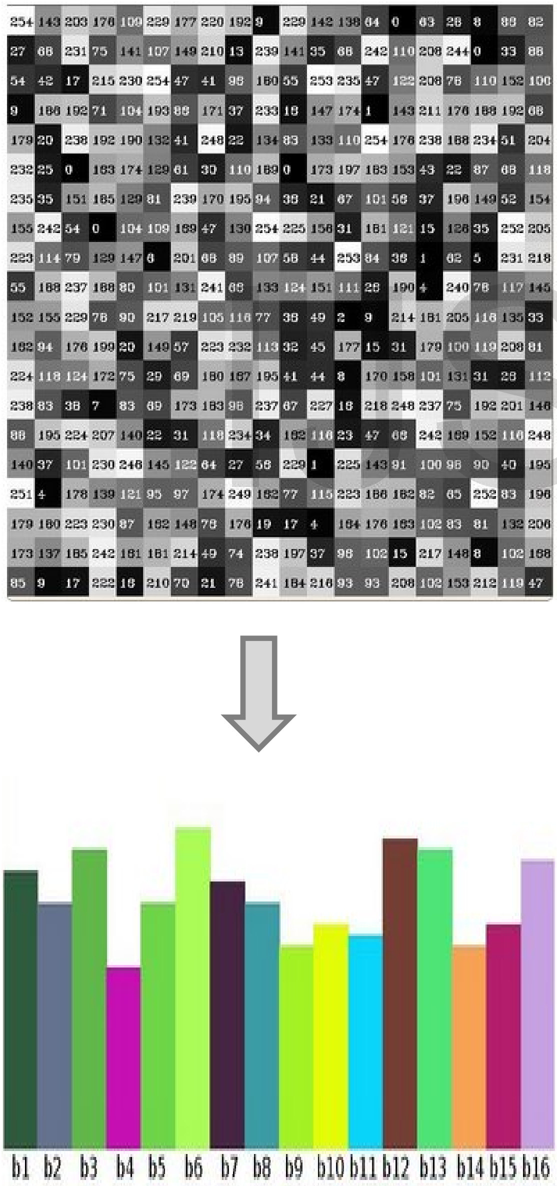

Fig. 4 Conversion of LBP mask into histogram

In the histogram, the x-axis corresponds to bins of increasing ranges whereas the y-axis corresponds to the number of pixels in that particular bin. Such histograms are created for all the images in the database. When an image is to be verified, its histogram is calculated in the same way and compared with the database histograms.

IV. ANALYSIS

The following comparison depicts the effectiveness of LBP when compared to the other algorithms.

Algorithm	Eigenface	Fisherface	LBP
Total no. of facial images	20	20	20
Total no. of unrecognized facial images	3	2	1
Total no. of incorrectly recognized facial images	4	3	2
Total no. of correctly recognized facial images	13	14	17

Table. 1 Comparison table

The recognition rate is an important parameter which decides the effectiveness of an algorithm. The recognition rate of an algorithm can be calculated as shown below

Recognition rate = (Total no. of correctly recognized images /Total no. of facial images)*100.

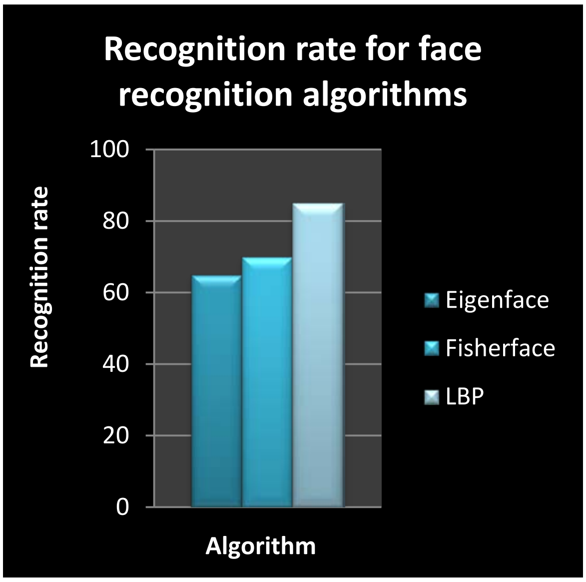

Fig. 5 Comparison chart based on recognition rate

The Peak signal to noise ratio (PSNR) is an important parameter which determines the efficiency of an algorithm. Higher is the PSNR, greater is the efficiency of the system. The PSNR value can be obtained using the following formula,

$$\text{PSNR} = 10 \times \lg\left(\frac{255^2}{\text{MSE}}\right)$$

$$\text{MSE} = \frac{1}{M \times N}\sum_{i=1}^{N}\sum_{j=1}^{M}\left[I(i,j) - I'(i,j)\right]^2$$

V. RESULTS

In this project, image processing is based on Local Binary Pattern algorithm, which yields the results based on the comparison of the database histograms and the histogram computed from the image of the voter to be authenticated. Compared to the other algorithms used for face recognition LBP is highly robust to monotonic grayscale changes caused by illumination, rotation, scale, image degradation. Another important aspect of LBP is that it reduces the computational complexity, which makes it possible to analyse images in challenging real-time settings.

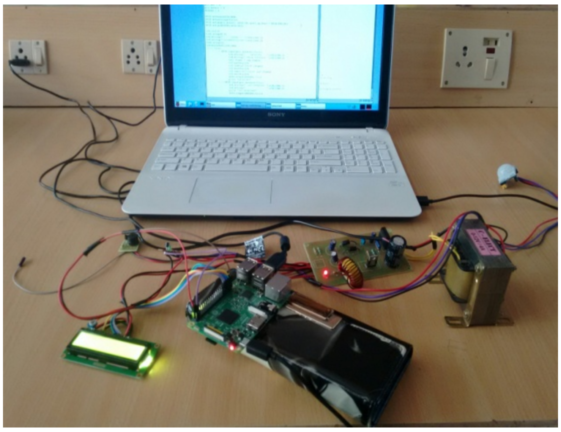

Fig. 6 Experimental result of Voter Authentication system

VI. CONCLUSION

This project emphasizes the use of face recognition technique in authentication of voters in the poll booth. It is highly efficient in identifying the unauthorised voters thus preventing the occurrence of illegal voting to a greater extent. Since it is a completely automated system, it greatly helps in reducing the necessity of human contribution. This concept can also be implemented in applications such as attendance recording, security and surveillance systems in offices, industries, educational institutions, etc.

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