

Biometric Authentication in E-Voting through RNN

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ABSTRACT

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In a democratic country the election process and the right to vote are one of the most significant aspects. This is due to the fact that in a democratic country the sole administrator and the decision maker for the entire country needs to be elected in a fair and just manner from amongst the citizens of the country. This procedure has been effectively performed manually and physically by the utilization of ballot elections. This is a highly inefficient form of election that needs to be upgraded in this day and age of information and electronic supremacy. But the considerable concerns for developing an electronic voting scheme was the security concerns regarding multiple voting performed by a single person. Therefore to introduce an effective and useful technique which also addresses the security concerns an effective methodology for electronic voting through facial recognition has been proposed in this research article. The proposed methodology utilizes the open-source open CV library along with Recurrent Neural Networks to achieve highly accurate facial recognition for a secure electronic voting system. This approach has been significantly evaluated for their performance metric which has achieved suitable results.

Keywords : Recurrent Neural network, Deep learning, Voting system, Facial recognition.

I. INTRODUCTION

In the initial stages of the human presence on this planet there were not many humans that were actually together. In the span of a few years humans due to their inherent social nature started forming groups with one another as it increases the likelihood of survivability of the human race significantly. Therefore the early humans started coming together in groups and tribes with specialised tasks given to each individual was good in their own profession.

This led to significant improvements and enhancements in the survivability of the human race which led to a lot more effective and useful implementations and growth.

As soon as the size of the tribe of the civilization kept getting bigger and bigger this led to the the community appoint a leader to sort out various administrative issues as well as take important decisions that can be useful for the betterment and improvement of society in general. In the early days

this has been achieved by the installation of a monarchy for a kingship system. This was usually a concept of nobility that arise due to a pure and royal bloodline which continued ruling the tribes and eventually countries. This was a highly inefficient way of choosing a leader for the various tasks and taking important decisions as a representative of the country. The monarchies have faded off with only a handful few that have been remaining today and have been effectively replaced by a much more efficient and just form of Government called a democracy.

In a democracy the government consists of individuals which are elected from the people and serve to the people. In this form of governments, the populous elects' individuals from amongst themselves that represent the entire population and take administrative and other important decisions regarding the country. Therefore, it can be understood that the election procedure is one of the most important and crucial mechanism in a democracy that needs to be performed highly accurately to achieve a fair and just government. Most of these elections are performed physically through the utilisation of physical ballots.

The physical ballot elections have been performing since decades now and is a highly inefficient and time-consuming process. The ballot elections require the election commission to perform certain tasks well before time to achieve the deadline for the elections. The election commission is a highly useful and an independent organisation that performs these tasks to achieve fair elections. The entire country and the states are divided effectively into constituencies for effective voting procedures. These constituencies need to be prepared for election as various polling booths and other infrastructure need to be provided effectively.

This process also takes a lot of time as individuals need to cast their vote physically on a piece of paper

which also leads to significant amounts of environmental degradation. This type of voting is effectively performed in a matter of a few days after which the ballots are sealed and taken to a secure location for performing the counting by the election commission. Whereas the population of an entire country such as India is extensively used it takes an inordinate amount of time to count the votes accurately. With physical counting of votes performed by individuals there is also the introduction of human error that can be highly problematic as the number of voters increase.

Therefore, there is a requirement for an effective technique that can achieve highly accurate election results that can be used to achieve higher accuracy and increased efficiency. This can be significantly improved through the utilisation of electronic voting schemes that can benefit by improving all sectors of this approach significantly. For this purpose, an extensive amount of research has been performed and a suitable e-voting approach has been depicted in this research paper. The major concern for shifting towards an all electronic voting mechanism were the security concerns around multiple voting by a particular person. For this purpose, this approach introduces biometric authentication through the utilisation of facial recognition approaches. The Recurrent Neural Network along with the open cv implementation has been proposed and also extensively experimented to achieve the error rate which has been highly accurate leading to an effective system for e voting through facial recognition.

This research article is further classified as Literature Survey in the Section 2. The proposed methodology in the section 3. Results are evaluated in the section 4 and finally the research article is concluded in the section 5 with the traces of the future work.

II. LITERATURE SURVEY

Shewen Sun [1] explains that there is been a rapid improvement in the internet platform and the various media that is being shared on this paradigm. This has significantly increased the number of various images and other media that is being shared on this platform by a very large margin. The significant increase leads to a lot of intellectual property problems that can be highly problematic to enforce and deal with. The effort to improve this approach the author's proposed the utilisation of QR factorization and dual pseudo-random circular chain to achieve effective watermarking of colour medical images.

Huajian Liu [2] expresses that there is an increased interest in the watermarking approach that has become an intensely active field of research that has been quite promising to improve the the approach for securing intellectual rights on the images. This has been largely an effective approach but requires large number of complexities to attain the the required sensitivity for tamper detection and reduction. Therefore to improve this approach the authors of proposed utilisation of an effective and useful watermarking approach for to achieve localisation and image authentication by the utilization of embedded watermarks by random permutation process.

A. M. Hassan [3] elaborate on the concept of image authentication techniques that are being used predominantly in the recent years to improve the integrity and privacy of the image effectively. Most of the images that are being shared are highly susceptible to various manipulations and tempering that can be highly problematic ensure the ownership of the image effectively. For this purpose the author is a proposed Neemuch authentication techniques that utilizes self recovery along with variable block size for the purpose of effective localisation and image authentication.

Che-Wei Lee [4] discusses the paradigm of of digital images that has been growing exponentially in the recent years. This is caused due to the proliferation of information in this information age that has reached considerable improvements in the sharing capabilities across the world. This approach has contributed considerable e which has led to to a lot of problems to identify and authenticate images with a degree of certainty. Therefore the authors of proposed an effective method for secret sharing and authentication of grey scale images of documents along with a capability for repairing the data.

Vishakha Kesarkar [5] introduces the concept of electronic voting systems that has been an improvement over the traditional physical voting systems. With the dawn of the information is there is a requirement for an improvement in this approach of voting which can be significantly enhanced by the utilization of electronic means. This has led to a large number of electronic voting schemes that have been utilised but have certain problems of authentication and other implementations of security. Therefore in this research article the authors of presented and effective technique for authentication in electronic voting system through the utilisation of an embedded rice verify and the utilization of biometric approaches for authentication.

XIE Jianquan [6] narrates that there's been considerable development in the image processing approach due to significant improvements in the multimedia technology and enhancements in this field. This is a significant improvement in the amount of images across the world where creators of the images need to extract some amount of control over these images that are being shared without their permission. There is a requirement for an effective authentication approach that can significantly identify if it is authentic or not through the utilization of watermarking. The researchers in this

article proposed the utilisation of fragile watermarking that is achieved through image juggling the purpose of tamper detection and authentication of the image accurately.

Chin-Pan Huang [7] explains that with the improvements in the communication networks and the rise of the information age there has been significant information that is being generated across the world simultaneously. This formation is highly useful which can be effectively useful for various implementation a lot of different implementations. The fourth authors have proposed an effective authentication technique for stego images in this research article. This authentication approach utilizes wavelet transformation and hamming code to achieve effective authentication and secret sharing capabilities.

Chung-Huang Yang [8] elaborate on the concept of electronic voting and the increase interest in electronic voting due to the improved implementations of security and privacy compared to the traditional approach. These have been significantly useful and highly effective enhancing the current approaches by large margin. But there are certain privacy and security concerns that are required to be addressed to achieve effective implementation. For this purpose the researches in this paper we propose the utilisation of contactless cards for effective authentication an electronic voting system on a small scale approach.

Adria Rodriguez-Perez [9] expressions that there are large number of problems that are required to be addressed in the electronic voting system to provide effective implementation in a large-scale manner. These implementations need to be considered to achieve the secret suffrage that consists of various principles that are considered to be covered for an effective election procedure. Therefore the authors of proposed ineffective and anonymous voting system for performing remote internet voting for the

candidates with effective authentication and implementation of e-governance.

Yao-Chung Lin [10] discusses that authentication of the media is highly needed in this age of information. This is because there are a lot of tempering and other manipulation that are being done on images which can be very difficult to identify by an untrained eye. This has led to a lot of problems and misleading information given to various news outlets and other implementations and has led to problematic scenarios. Therefore the authors in this approach a proposed utilisation of distributed source coding for the purpose of image authentication through a distributed system effectively. The research achieves effective results for extensive experimentation.

Nighat Jamil [11] introduces the concept of video and image authentication that has gained a lot of interest recently. This is because there is a requirement for an effective technique that can authenticate videos and images which can be highly useful and a lot of different scenarios. Therefore to solve this problem the authors have proposed an effective approach that utilizes discrete wavelet transformation along with robust hashing to achieve effective authentication and time per detection through a contraception screen and discrete cosine transformation. The main drawback of this approach is an increased competition complexity that has been observed in this implementation..

III. PROPOSED METHODOLOGY

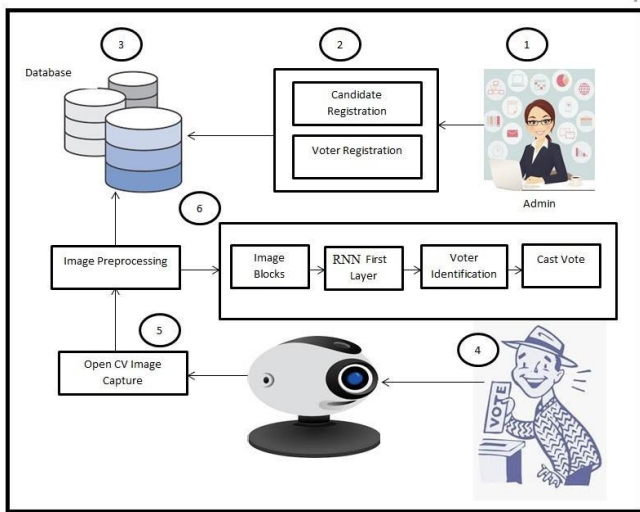


Figure 1: System overview of the voting System

The presented technique for an electronic voting system using facial recognition is illustrated in the figure 1 above. The steps that are performed to develop the presented model are enlisted below.

Step 1: Registration – This is the Initial step in the presented technique and the achieve system that requires the voter and the election candidate to register. The system only gives access to the registered candidate and the voter into the system. The swings approach has been utilised to achieve an interactive user interface that takes in the various attributes such as financial assets, party symbol, party name along with the name and age of the candidate.

The information entered by the candidate effectively link to the particular ID and stored effectively into the database. This is useful for retrieving the information for effective authentication and allowing access to the candidate. The voters are also registered similarly but with attributes such as Aadhar Card facial image along with the name and age of the voter. Official image of the voter required during the registration is linked to their Aadhar card show the process of renaming the image to the Aadhaar card ID.

This is repeated for all of the voters along with the requisite candidates.

Step 2: Image Capture – This step of the procedure captures the images for the goal of effective authentication of the facial features of the voter. The image is captured through the effective use of the open CV approach. The images are captured through a webcam and effectively extracted using an effective code written in Java. The open source implementation utilised in this approach by the use of open CV is highly useful for achieving this step in our system. This allows the effective extraction of the frames that are utilised as an object of the matter class in the open CV implementation for the goal of effective facial classification. The output from this step is provided as the input to the consecutive step.

Step 3: Image Pre-Processing – The image captured in the previous step are utilised in this step for the use of effective preprocessing. The preprocessing approach effectively resize the image through the utilisation of graphics2d class contained in the awt package of Java programming language. This resizing is done to effectively evaluate and normalise the image for effective processing of the voters facial image for the goal of authentication through the realization of Recurrent neural network.

Step 4: Recurrent Neural Network – The Recurrent neural network is the most important step in the presented approach. The images of the voters faces are provided as an input to this module and this approach authenticates the voter and identifies it for the purpose of authentication. RNN algorithm is performed through the realization of of two types of layers that are elaborated below.

First Layer – The stored and the current images provided to the algorithm are resized in the first layer. The slayers also perform the leveraging of the RGB colour channels to achieve an effective black and

white image which are then utilised for the goal of pixel fixing. The image is then segregated into a predetermined number of blocks called image blocks and then these blocks are utilised for comparison between the facial features in the next layer.

Deep Layer – The image blocks that are achieved in the previous layer serve as an input to this deep layer. The average brightness of the blocks are compared between the the stored images and the current image captured. The absolute difference of the average brightness is evaluated for every block in the images. The condition for the matching of the block is that the difference between the brightness of these block should not exceed more than 25. This is done iteratively for all the blocks and the count for the matched blocks is achieved. The max count achieved by the matches between the stored image and the current image is utilised for the purpose of authentication effectively and the algorithm for this entire procedure is provided below in algorithm 1.

Algorithm 1: Face Authentication

// Input: Captured Image C_{IMG} , Database Image D_{IMG}

// Output: Boolean FLAG =TRUE or FALSE

Function: faceAuthentication(C_{IMG} , D_{IMG})

0: Start

1: FLAG=FALSE

2: K=0

3: $BLx = C_{IMG} / 8$

4: $BLy = C_{IMG} / 6$

5: **for** i=0 to 8

6: **for** j=0 to 6

7: $SUBC_{IMG} = C_{IMG} [BLxi, BLyj]$

8: $SUBD_{IMG} = D_{IMG} [BLxi, BLyj]$

9: BR1= avgBrightnessOf($SUBC_{IMG}$)

10: BR2= avgBrightnessOf ($SUBD_{IMG}$)

11: **if** ($|BR1 - BR2| <= 25$), **then**

12: K++

13: **end if**

14: **end for**

15: **end for**

16: **if** ($K == 48$)

17: FLAG=TRUE

18: **end if**

18: return FLAG

19: Stop

The authentication of the voter is effectively performed to through the entire procedure given above. Only after the successful authentication of the voter the vote casting procedure is allowed. The Aadhar card number is the unique identification number for the voting process of the authenticated voter and the matching image which is then stored effectively along with other attributes such as party name, candidate name, Booth number, time and date of vote casting into the database. Once the vote to the voters choice of the candidate has been successfully casted the interactive user interface displays the accurate casted vote along with the respective attributes that were utilised for the verification to the voter.

IV. RESULT AND DISCUSSIONS

The presented technique for the goal of a secure electronic voting system to the utilization of facial recognition by the implementation of Recurrent Neural Networks has been effectively realised in this research paper. The presented technique has been realised in a development environment based on the NetBeans IDE. The Java programming language has been used to realise this approach. The development machine that has been used for achieving this approach is equipped with an Intel core i5 processor along with 4GB of Ram and 500gb storage. This machine is a laptop that has an inbuilt webcam with the resolution of 2.2 megapixel which is utilised for capturing the facial images of the voter. The facial

recognition technique has been catalyzed through the utilisation of the open cv-library along with the database requirements fulfilled by the MySQL database.

Performance Evaluation through Root Mean Square Approach

Experimental evaluation of the prescribed approach has been realised through extensive experimentation. This experimentation has been performed for the evaluation of error achieved by the the facial recognition approach stipulated in the presented technique. For this purpose the RMSE approach is utilised.

The root mean square error or RMSE is an effective measure of the degree of error that is achieved for the recognition of facial images in the proposed electronic voting system through biometric authentication. For the effective extraction off the error rate two dependent parameters are utilised for this purpose. This parameters include the number of phrases recognised by the system and the number of of faces expected to be recognised by the system. These two values are correlated continuously and are used for the assessment it in this publication. The error it is effectively realised to the equation 1 given below.

$$RMSE = \sqrt{\frac{\sum_{i=1}^n (x_{1,i} - x_{2,i})^2}{n}} \tag{1}$$

Where,

Σ - Summation

$(x_1 - x_2)^2$ - Differences Squared for the summation in between the expected No of facial recognition and the obtained No of facial recognition

n - Number of samples or Trails

Table 1 : Mean Square Error measurement

Experiment No	Expected no of Facial Recognition	Obtained no of Facial Recognition	MSE
1	12	11	1
2	11	9	4
3	9	8	1
4	7	6	1
5	10	7	9

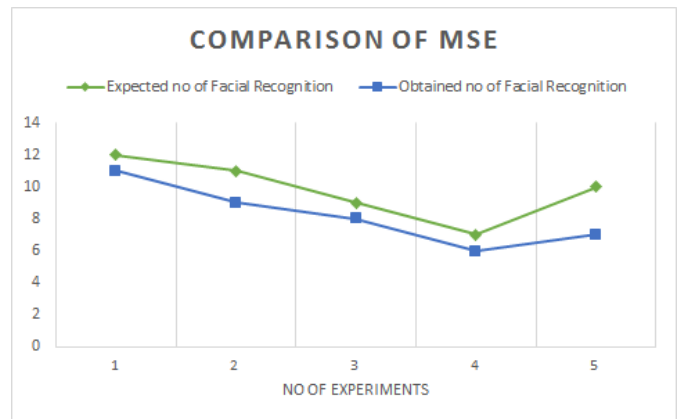


Figure 2 : Comparison of MSE in between Expected No of Faces Recognized V/s Obtained No of Faces Recognized

The outcomes of the experimentation have been exhaustively listed in the table given in table 1 above. The respective outcomes have been effectively utilised for plotting the graph provided in the figure 2 above. As it is evident from the results obtained for the mean square error rate and the root mean square error rate for the achieved official recognition and the expected facial recognition of the system, the respective values of MSE and RMSE are 3.2 and 1.78 repectively. A number of trials are performed for the purpose of experimental evaluation which has been effective in displaying the accuracy of the facial recognition module in the proposed electronic voting system. The values achieved are expected and are good enough for a first-time implementation of such a system.

V. CONCLUSION AND FUTURE SCOPE

The methodology for an effective electronic voting system secured through the utilisation of facial recognition approaches has been completely outlined in this research article. The methodology utilizes a webcam to capture the image of the voter that is stored along with the other attributes of the voter. The candidates are also respectively registered along with their attributes which can be selected by the voter at the start of voting. When the voter decides to vote an image of the voter is captured and provided to the system for the authentication. This image is then compared to the stored image which is stored as the filename of the Aadhar ID of the individual in the database. This comparison is performed through the realization of Recurrent Neural Network that divides the image into blocks which are effectively compared in the Deep layer of RNN to count the matching blocks according to the luminance level of the blocks. After the effective realisation of the authentication the voter is allowed to vote and the respective details of the voting are displayed to the voter and their votes are stored in the database for further counting. The accuracy of the image processing approach is realised through extensive experimentation for achieving the error rate through the root mean square error approach which achieves the value of 1.78.

For future research on this approach the entire system can be effectively utilised as a web application for easier access to the election officials.

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