Face Authentication-Based Online Voting System

Emrul Hasan Piam, Ashik Mahmud, Rawad Abdulghafor, Sharyar Wani, Adamu Abubakar, Akeem Olowolayemo
Dept. of Computer Science, International Islamic University Malaysia, Kuala Lumpur, Malaysia
emrul7426@gmail.com, admiral.ashik@yahoo.com, rawad@iium.edu.my, sharyarwani@iium.edu.my, akeem@iium.edu.my

Abstract— Online voting is possible and can be a lot easier than face-to-face voting because it will save money by not having to pay people to manually count votes. It can also make voting easier for people with disabilities, people who live abroad, and people who live in rural areas. Unfortunately, because of the insincerity that is found in politics and politics, doing online voting will give the dubious politicians who always try to cheat during voting a perceived chance to cheat. That is why this research proposed an online voting system that would include features such as election administration, survey administration, and facial authentication. Laravel, a PHP framework, was used to create the online voting system. Deep learning in Python was used to perform face authentication. The system that has been developed can be used to properly conduct elections, conduct surveys, make announcements, and use face authentication for identification prior to casting a ballot, among other things.

Keywords— Online voting system, elections, survey, facial authentication

I. INTRODUCTION

In the university, International Islamic University Malaysia, holds a lot of elections related to different things in different departments and for different positions. Any improvement to the current in-person voting is sorely needed, especially when everyone is experiencing a pandemic.

Elections are an integral part of any democratic society. Making sure the process of holding elections are secure and accessible is highly important to preserve a transparent and working democracy. In International Islamic University Malaysia, there are various elections that are held, either in specific departments/kulliyyahs or in the whole university. This online voting system is tailor made for holding elections for positions among students in IIUM and for students to participate and vote for their preferred candidates, all through a web application. IIUM campuses and kulliyyahs hold elections every so often to elect students for certain positions such as the Student Representative Council (SRC). Generally, these elections are pretty grand in the sense that the university heavily encourages these types of activities and participations. There are leaflets, voter outreach and so on, to let the voters know about the candidates' policies and goals [1]. Here, the system aims to allow students and staffs to vote and participate in these elections at their own convenience, remotely and securely. It will have secure face authentication as security for casting votes.

According to IIUM news portal in [2], Elections being in-person creates a lot of issues but here are a range of issue that students potentially face or issues with current system in general –

- Low voter participation rate in elections.

- Physical or offline voting Can be highly inconvenient because of –
  - Specific venue for ballot casting
  - Long queues
  - Odd timing
  - Not going to Kulliyyah that day for any reason
- Might clash with class timing.
- They could have exams after, leaving them no time to vote physically.
- Sees time wasted voting offline as not worth it to bother to vote.

This project scope includes all functions of holding elections and casting ballots by the user. It has to also include face authentication for extra verification when casting ballot in an election. There has to be a survey function where questions can be asked as a poll and answers can be taken in the form of agreement or disagreement.

Regarding IIUM students, they currently don't engage in student politics all that much. It's inconvenient and often times untimely. Students have classes to attend, assignments to do and so on. Election voting is generally held in kulliyyah during daytime with long queues. Meaning the students that are either busy with coursework or don't find it convenient to stand in line and use a lot of time to vote, end up not voting.

It is also the fact that students who do vote, most of them don't even have any ideas about the candidates or their policies. It's generally gets down to name recognition or popularity contest, rather than policy differences.

This system will help students avoid queues, inconvenient timings and actually participate in the elections and have a voice in what happens onwards. They can engage in fruitful

discussions with their fellow students about the candidates or the policies and the needs of everyone. Students' user information will be taken from IIUM database and with that the students can securely, in their convenience and comfort, vote for their preferred candidates. This could increase voter participation a lot.

II. RELATED WORK

There have been many research papers published related to online voting or remote voting. There are countries like Estonia that have been using online voting system since their past national elections. Those papers were looked at and what their findings was, what types of functions their systems used, results and other notable information and was picked out.

In the study [3], Estonian online voting system that has been in place for a long time, was researched. They thoroughly researched about all the elections held after the introduction of internet voting and how their voting system works. The research concludes that the method of internet voting has been very successful. Estonian government made strict, unique, highly secure and reliable voting system. It is well done and through research and with well put together report providing all the necessary information on Estonia's Internet voting.

In the research paper [4], the case for internet voting in Switzerland was looked into and found to be quite effective. The contrast can be easily seen between this study on Switzerland and the previous one on Estonia. Here the swiss are ahead in doing referendums using internet voting while Estonia fully generalized it. This literature shows the difference in implementation, their methods and such pretty well.

In the paper [5], There is discussion on the requirements of biometric systems, their advantages and disadvantages of different type of face authentication, using different sensors and specialized chips for better and more secure authentication et cetera. They come to the conclusion that if enough specialized methods or chips are used then it can be very secure and scarce to vulnerabilities.

In the research paper [6], the voting scheme of Estonia is discussed, where voters can check the cast-as-intended and recorded-as-cast properties of their vote. It discusses the behind-the-scenes mathematics and system calculations and how the system operates to do all the things securely and without leaving any means for breach. It shows possible manipulation for votes and such in great length.

In the study [7], effect on voter turnout or voter participation with internet voting availability in an election is researched on data from a referendum and related surveys in Brazil. They also try to find out the demographics of the online only voters. Result shows, voter participation is higher and generally, those who previously voted offline,

continue to do so and those who voted online this time, have not participated previously. This research using data and survey shows favorable results for online voting systems.

The paper [8] covers DWT – Discreet Wavelet Transform – and DCT – Discrete Cosine Transform – in HFR – Human face recognition. It has in depth analysis of these in face recognition and discussion about the results. The analysis on the methods and the results are all given for relatively easy understanding.

The research paper in [9]. This research looks to find out the changing of e-voting over time by using Rogers' theory of the diffusion of innovations. The result is, there was age difference in usage, but it gradually narrowed because of widespread use among all age groups in consequent elections.

In the research paper [10], support vector model classifier and its use are discussed and then presents face recognition model with distributed facial features. They conducted experiments for its effectiveness. They produced accuracy of 89%.

III. METHODOLOGY

Hybrid-agile methodology is used for this project (see Figure 1). Since this is a software development project and within a small group of 2 person, using agile methodology seemed to be the best course of plan.
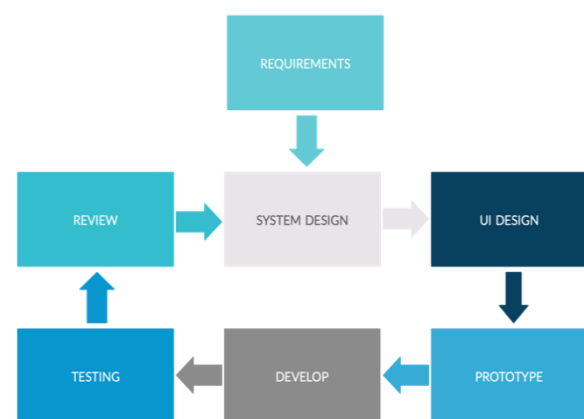

Fig. 1 System development cycle

Started with gathering all the requirements, designing the system was planned. Then, moved on to UI design and prototyping using HTML and CSS directly instead of prototype builders. After that, the PHP framework Laravel and SQL database was used to develop the system. Further, all the functionalities were tested to see if they work properly. Finally, everything was reviewed, and changes were made wherever needed.

The architectural design of the proposed System is presented in Figure 2. It includes different types of users and

with different privileges. Users are admin and students. To implement Voting system, Laravel, a PHP framework was used. And alongside Laravel, phpMyAdmin have been used for database. The user interfaces were also taken from the prototype interface that was made in designing phase using markup languages HTML and CSS. Laravel is a proper framework and a very popular one for web-development. It's clean, organized, well supported and very intuitive to use. Which is this framework was chosen for the project implementation.

For face authentication, python deep learning was used, to build and then implement on the website. Password Hashing and Authentication Middleware – When it comes to a secure system, it is very important to protect sensitive information even from the authorized hands of the system. For example, database administrator or system admin. The hashing technique is implemented in this project to develop a successful voting system that is enabled to secure the voters' password. Secure Bcrypt and Argon2 hashing algorithms are used in the system.

After the application of the hash function, the password is stored as a hashed value in the database. While the user attempts to log in to the system, the hashed value is compared with the input password. If the values match, then the user gets access to the system. For URL security three different middleware is used, which ensures that only the right person can access the right URL based on their role.

1. Auth: This is to get access to any page of the system, all the users need to pass this middleware, which verifies whether the user has logged in or not.
2. Admin: This middleware is similar to a group middleware to verify that only admin can get access to any URL for administration site. No regular user will be able to access them.
3. User: This middleware is used on user URLs so that no one including the admin will not get access to the user site for casting vote.

Voter Identity Hide is a functions that is required to hide the vote casting details, for instance, which candidate was voted by the user and at the same time it is essential to keep records of the voters so that the same users are ineligible to vote for more than once for a particular election. To solve this issue, the user's ID and election number will be recorded in a separate table so that the user will not be able to vote multiple times and only the voter will know whom he voted for.

The Face Authentication was conceptualized to dwells on deep learning approach (see Figure 2). Everyone is concerned about their security when it comes to using sensitive systems such as a voting system or banking system. But in this busy world, it is kind of expected for everyone to use these types of the digital platform so that people can save their time. A biometric authentication is a suitable approach in order to solve this problem.
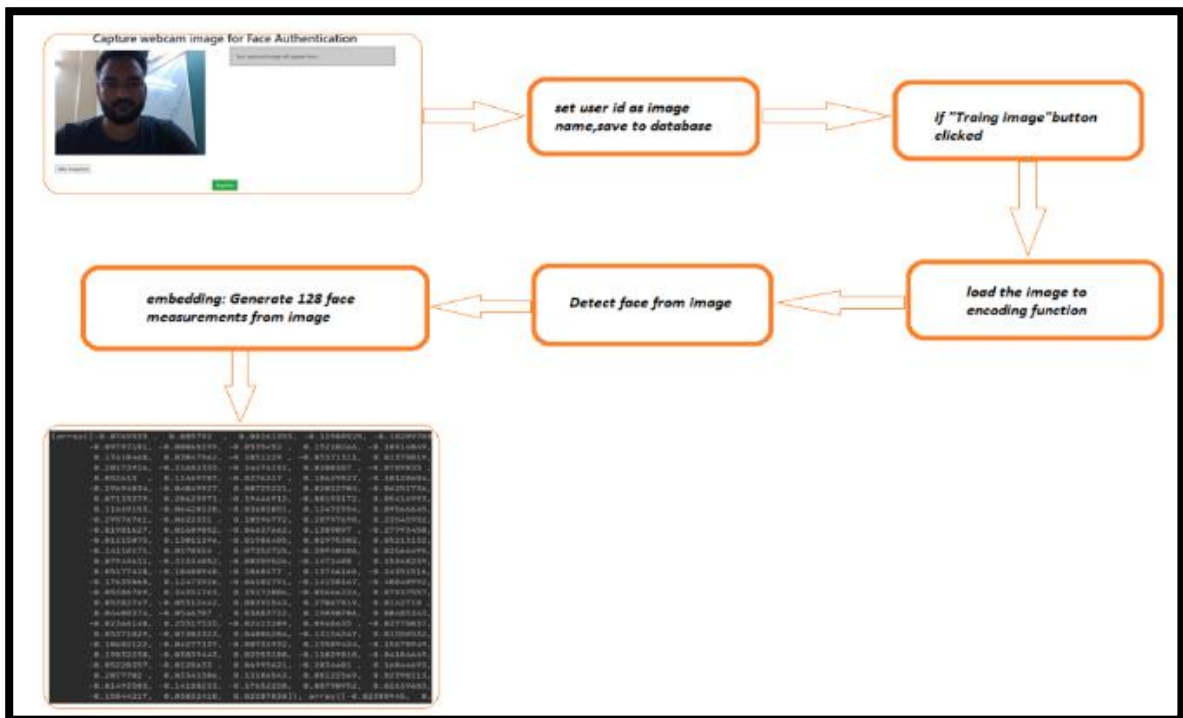

Fig. 2 The Proposed Architectural Design

In this system, only an authenticated person can access the vote casting page by using face authentication. This function is divided into two parts first; the model is trained with a user image then the user is verified by using a webcam before the vote is cast.

The Training data was captured from the users' real-time picture to be taken while the admin registers a new user to the system. The next task is to preprocess the image for face detection, which is a complicated process which includes resizing the image, converting BGR to RGB, etc.

However, with the help of the python OpenCV library, all these tasks can be done within a few lines of code. Face from the image will be detected by using a face recognition model ([11],[12]). This model is trained with Deep Convolutional Neural Network with numerous images to detect the perfect match face and will give an output of "128 faces measurements", which is called embedding in the machine learning world. The obtained measurement will be saved in the database with the username as known face details.

The authentication process is the final and most exciting part where a user can vote after face authentication. At first, the user image will be taken automatically using a webcam. The webcam will run until it detects any face. After detecting the face, the webcam will shut down and the taken image will go through the same process as the training process to get the 128 face measurement values. The value will be saved in a variable named unknown face. The previously stored training data will be imported as known face details. The next step is to compare the unknown face details with

all known face details to check if the user is registered in the system or not. If the user registered, then it will return the user id, or else it will return "no match found" for this comparing process, again face recognition model will be used. The user will not be allowed to cast his vote if the model return "no match found "or if the returned id number does not match with the account owner id number. On the other hand, if the returned id matches with the account's owner id number then the user will be redirected to the vote casting page.

The email notification is proposed in order to add one more step of security, hence email notification functionality is used in the system. This is a simple process where a user will be notified if any vote is casted from the user's account. The notification will be sent automatically to the users' email address which is taken during user registration.

IV. RESULTS AND DISCUSSION

The outcome of this research yielded a product, a voting system that uses face recognition system. Hence the details of The layout, functions, look and feel, of the web application of online voting system include all parts of voting, authentication and surveys. There are many parts to the system that all have its intricacies

For designing user interface, HTML, CSS and bootstrap was used to design the UI. Figure 3 depicts the administration dashboard. It includes all of the administrative tasks that are required for the system to function properly.
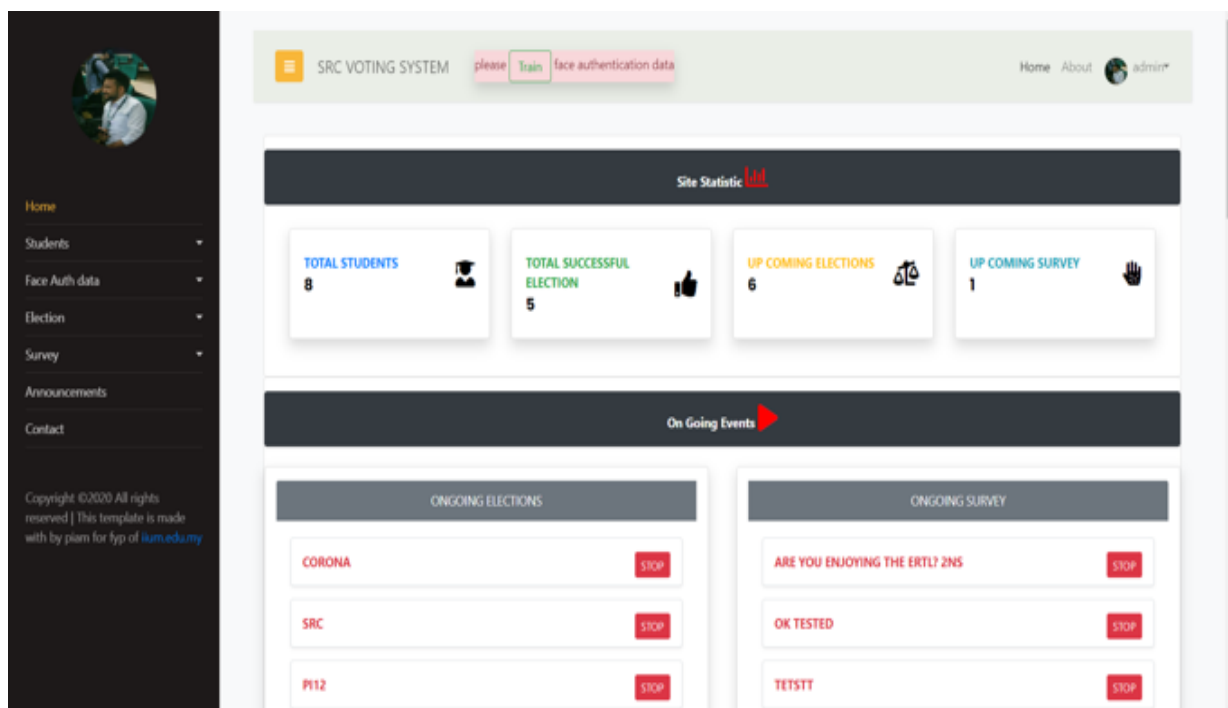

Fig. 4 The Admin dashboard

In all cases, User or Admin functions are implemented for holding elections, surveys and facial authentication. Only the admin fills out the details of the announcement and submits to make it go live. The admin can modify or delete any announcement and can make any of them online or offline. The elections option requires adding election Admin keys in all the details of an election and submits. At the time fixed, the election automatically commences and ends. Admin can hide, view or publish results from this page. Users can vote from the dashboard or in election menu. Survey can be added by the admin by submitting the survey section with all the details. Admin can start, end or delete surveys in here. Admin can publish results or hide them in here. Users can vote in the surveys by either agreeing or disagreeing right from the dashboard. *The Facial authentication scene is shown in Figure 4.*
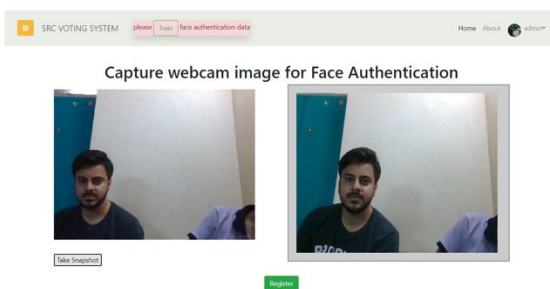

Fig. 4 Adding student face authentication

When admin adds a student, he has to take image for face authentication and train it. When a user goes to cast their ballot in an election, the web app shows a warning message to use camera if facial authentication is required to vote in that election. When the user agrees to let the website authenticate by using the webcam, the model does facial recognition in the system and authenticates the user.

V. Conclusion

The online voting system is an easy to use and reliable way of holding elections and casting ballots securely. Facial authentication provides added layer of security verification when casting votes. This system provides efficiency and convenience to the voters. They do not have to waste their time lining up in queue, do not have to go to any polling station which could be far away, and can avoid many other inconveniences. Time constraint is a major issue for many voters, who cannot go to the polling stations at the specified time. Online voting system is a direct solution to all of those problems. Voters can cast their ballots very easily, from wherever they are, just using a computing device connected to the internet.

Online voting system alleviates most of the problems faced by physical voting systems. With functionalities like surveys, alerts et cetera, voters can voice their agreement or disagreement to certain opinions and policies. They can find out important information that only they have relevance to. Suffice to say, this is a major step up and evolution from the currently used system which hasn't evolved much in the last few decades of technological advancements and leaps. System like this will benefit the voters, help voice their opinions and ensure a vibrant democracy.

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