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FACIAL RECOGNITION AUTHENTICATION

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ABSTRACT

Keycard-based entry has been widely known as the default option for an entry system even though they are considered to be unsafe in today's standards. One can also forget or lose their card. Since entry sometimes takes more time than usual with the user pulling up their card and the system recognizing it, it might cause long lines in front of the keycard reader. This report explores an alternative entry system that is based on biometric authentication, to be more specific, an entry system based on facial recognition technology (FRT). The vision of our team was to create a new entry system that can replace the AUK's old system. A system that works efficiently, only needing one to look at the camera for it to confirm their identity and grant access. As many may know, facial recognition technology works on artificial intelligence. In order to create this system, our team had to study and gain an understanding of Artificial Intelligence, construct the source code for the system and build a small dataset for testing reasons. However, even though the system has been successfully implemented on a smaller scale, problems were faced when the user was wearing glasses or a hat. Furthermore, the AI would have low accuracy where there is a difference of lighting between the pictures of the user in the dataset and the same user waiting to be authenticated in front of the camera. Despite the difficulties initially faced, the project was deemed successful. This report will go into detail of the planning, code, implementation and the results.

Keywords: Artificial Intelligence, Facial Recognition, Biometric Based Entry, Biometric Authentication, Entry System.

1. INTRODUCTION

The American University of Kuwait uses a keycard-based entry system for students, faculty and staff. However, this poses some problems. It can be time-consuming for the user to pull out their ID and wait for the system to authenticate them and grant access, that is why sometimes long lines can be seen. Users can also forget their IDs which may cause difficulties in entering the university. Furthermore, unauthorized people can enter the university since it's very easy to copy a keycard. (Key Card Access Systems | Key Fob Entry Systems | Openpath, n.d.)

This is where the facial-based entry system comes into play, all the problems maintained above would be solved, in addition to making it easier and safer for users to enter the campus. Users would only need to look at a dedicated camera, wait for it to authenticate their identity and then be granted entry. Guards would still be there in case there are guests or a rare case of mismatch.

2. LITERATURE REVIEW

There are a lot of methods and ways to approach Facial Recognition Technology that have been built across the previous decades. In this report, we will be using the latest method which incorporates deep learning. (A Review of Face Recognition Technology, 2020). It creates a "template" of a target's facial image and data. It tries to match that "template" on the target's face on a photograph or a video. That is why it's important for that "template" to be trained on multiple situations or photographs in order to increase accuracy (Facial Recognition Technology - prosecutors' center for excellence, n.d.).

Another approach of facial recognition is to categorize faces by gathering facial contours, determining their standard form, and subsequently classifying additional profiles based on their variations from this standard. This categorization method is multi-faceted, producing a set of distinct values that can be contrasted with other data sets in a repository.

3. RESEARCH METHODOLOGY

Unsurprisingly and with good reason, collecting facial data of everybody who enters the university on a daily basis might constitute suspicions of a privacy breach. However, if it's strictly forbidden to sell or publicize that data outside the university, and if it is also implemented that this data is to be used only for the sole purpose of seamless entry to the campus. Then there should be no ethical problem. As for the legality, as of March 2023, there is no law in Kuwait outright banning facial recognition to be used in private businesses and services.

At first, we used to have an old software that couldn't recognize users wearing makeup which cannot be helped since it would be a hassle for the user to remove it. Now, we are using a new software that could recognize the user regardless of make up since it's based on the facial structure. That way it would fix this oversight. It was immensely important to change the system since that would remove the main reason this system is being implemented. Which is making entry easier and more seamless. Requiring the user to remove their makeup or don the same makeup as the pictures that were taken by the IT is unrealistic and unintuitive. (Ueda & Koyama, 2010)

After successfully implementing the software, we needed a dataset to test the software with. Since this project needs to be tested on a smaller-scale first. We decided to use a smaller dataset. The dataset consists of the team's facial data, the professor and some famous people, so we can be able to determine if the software works reliably and to our satisfaction.

After making the dataset and finishing the software, the actual implementation with a camera is left. To do this, we need a camera, a computer that will run the software and to connect the dataset to the computer locally. When there is a match between the camera and the dataset, the computer will send a signal to the gate signaling it to open. As stated already, since this is a smaller-scale implementation, actually implementing the computer to open the gate is not needed; merely making sure the system has a high accuracy in detecting faces and matching it is most important in this test.

In order to create a facial recognition system, we are going to use Python, a programming language as it has a numerous number of libraries which are designed for machine learning and computer vision. The main libraries we are going to use are OpenCV and NumPy.

- OpenCv is the main library for computer vision which allows us to work with images and videos and manipulate them (Brahmbhatt, 2013, p.4).

- NumPy, allows us to store images as NumPy arrays to make calculations on them and train them (Harris et al., 2020).

A facial recognition system requires two parts, face detection and training. For face detection, we are going to use CascadeClassifier which uses Haar Feature-based Cascade Classifiers to detect faces (Madan, 2021). The second part is training the images with the labels using OpenCv built in recognizer.

Based on Software Engineering guidelines, these diagrams that are listed below had to be created in order to streamline the process and make it easier for our team to approach the project (Sommerville, 2015).

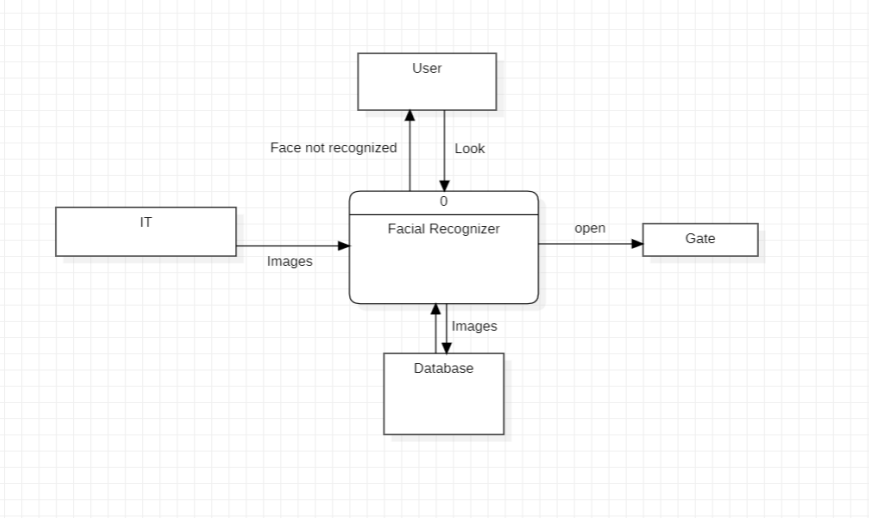

Figure 1: Context Diagram

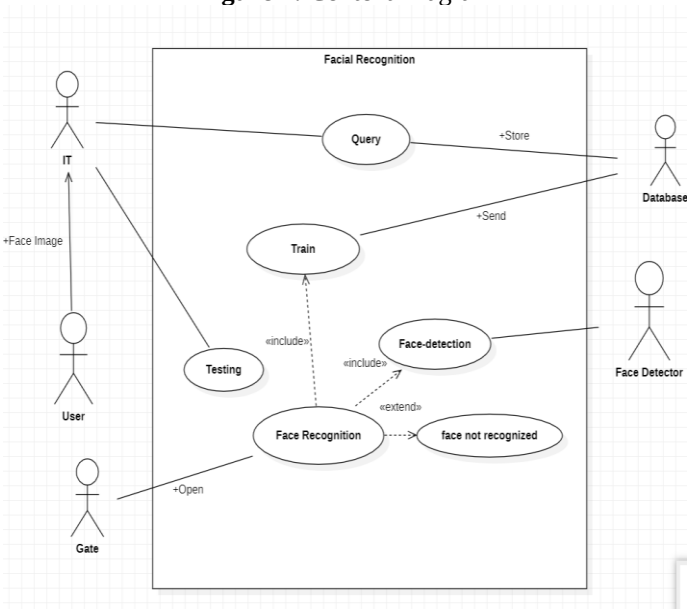

Figure 2: Use case model

As shown in Figure 1 and Figure 2, users will go to the IT department in order to take images for their faces. Then, the IT will store these images in the database. Now the face recognition system will train with the images in the database. The IT department will then test the system with the user and check if it works well. Finally, in real time, a user will come and look at the camera and the face will be scanned by the system. If the face is recognized, the gate will open. Otherwise, the gate will not open.

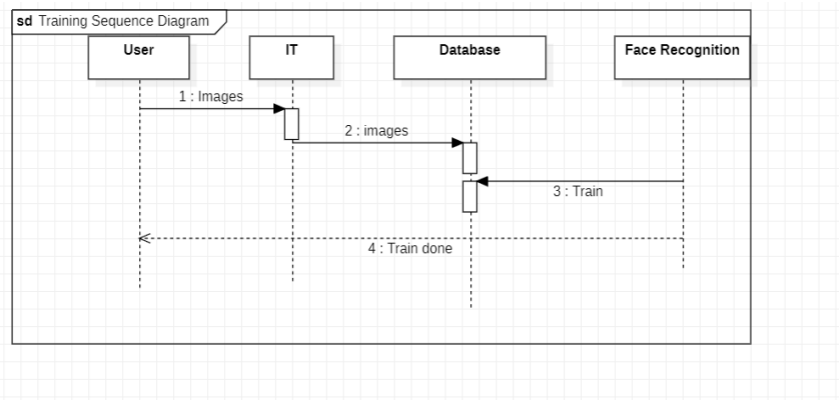

Figure 3: Training Sequence Diagram

In Figure 3, the user will send their pictures to the IT, so the pictures can be saved in the database and then the software can be trained and recognize the people in the pictures. Figure 4 will illustrate the process of how the user is granted access to the university.

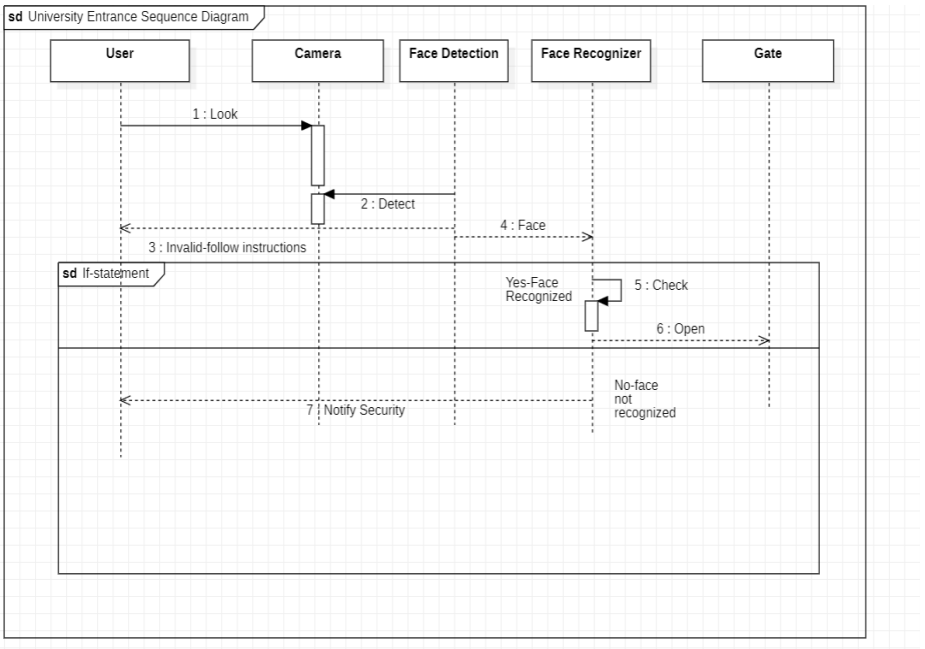

Figure 4: University Entrance Sequence Diagram

In Figure 3 the process of training the system on the pictures that were taken of the user by the IT. In Figure 4, it will illustrate how the system will interact with information the database has. Here you can see that the users will look at the camera so it can scan their face. The system will then compare the scan with the dataset. If the face is invalid the security staff shall ask them to follow the instruction which may include removing their glasses, mask or look at the camera clearly. If the face is valid then it will look up the database to recognize the user. Then, the system will check if the face is recognized or not . If the face is recognized then the gate will open. However, if the face is not recognized the system shall notify the security staff to check with the visitor and take their information before entering the campus.

4. TESTING

"Testing is the process of executing a program with the purpose of finding errors" (Singh, 2019 p.1) For the first testing phase, we used a data set called "*Celebrity Face Image Dataset"* which has photographs of famous western celebrities. Each celebrity has a set of 100 to 200 photographs, which is considered a low range for this kind of

Facial Recognition Method. Using this dataset, the facial recognizer trained on it. To test the accuracy of the system, we raised different photographs of each of the celebrities in front of our facial recognizer software. Figure 5 is an example of our software recognizing American Actor Brian Smith.

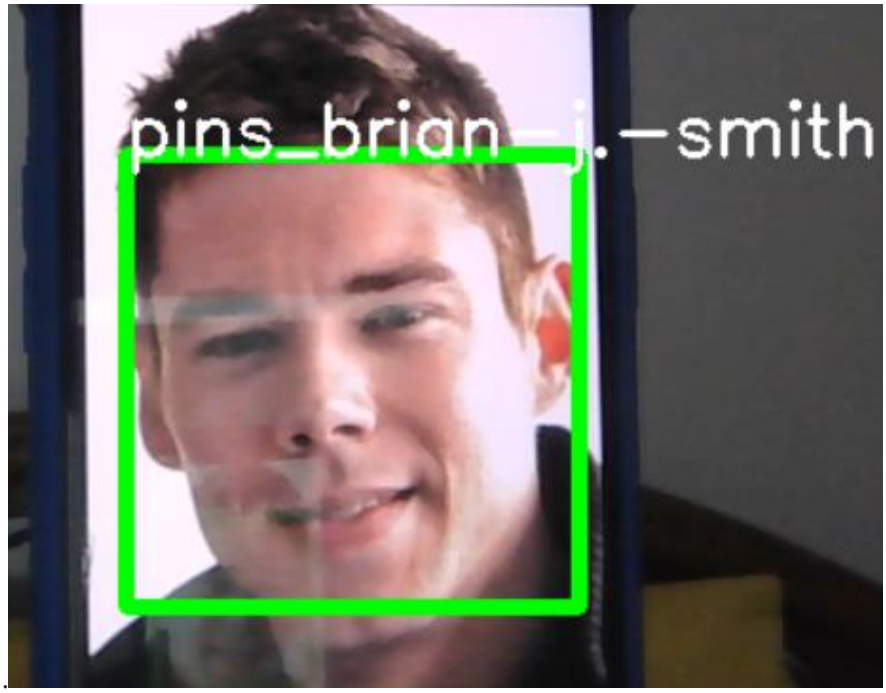

Figure 5: The Facial Recognizer Detecting Smith's Face

For the second and final phase, the team has decided to mount a camera in one of the classrooms. Since the dataset consists of the team members, we have decided to test the Facial Recognizer by having the members enter the room one by one, and seeing if the software detects our faces. At first, we had limited success. Fortunately, when different photographs of each of the team members were added with different lighting conditions and angles, the accuracy of the recognizer was greatly increased. We expect that with a better dataset, equipment and lighting for the entrance, the accuracy can be increased even further to a reliable level.

5. CONCLUSION

To conclude, implementing this biometric-based entry system on a campus scale would greatly benefit the university, the overall security would improve along with the efficiency of the authentication in entering the university. It would solve many problems which include losing the keycard and the copying of the keycards. With this system, unauthorized people entering the university through the gate would be almost impossible. This system might be hard to set up at first, since it requires all of the current students and faculty to go to the IT department in order to record and take pictures of their faces, but once that is done, the process of entering the university would be incredibly safe and immensely comfortable for the user.

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