Implementation of Attendance Management System Based on Text and Face Recognition

Vaithiyanathan Dhandapani, Swathi Majji, Kishore Udata, and M. Manigandan

1 Introduction

Attendance management system is nothing but having a count of the number of students present for the lecture. Nowadays, minimum attendance has become a must for students to appear for end-semester examinations. It is essential for both faculty and students. Conventional attendance marking system, i.e. attendance marking in sheets or books, is used when students are lesser in number. It is a tiresome and time-consuming task. If a class has a significant number of students, it becomes accessible to a proxy. This problem led to the use of automated systems such as biometrics. In the first step, they used fingerprint scanning as the fingerprint of an individual is unique. This issue is inefficient since students should stand in a queue. This process consumes precious individual time. Furthermore, in this pandemic situation, it is not encouraged to use biometrics since this may result in the spread of the virus. This reason can be stated as an added advantage of facial recognition over biometrics.

In recent days, many researchers reported various attendance managing systems based on different sensor techniques. Radio frequency identification (RFID)-based attendance management system was implemented in [1–4]. In paper [5], the author reviewed the fingerprint-based biometric attendance system. The implementations of a wireless iris recognition attendance system were discussed in [6, 7]. The authors in [8] implemented the automated attendance management system using face recognition algorithms. Attendance system with Bluetooth low energy beacon and android devices is presented in [9, 10]. The authors in [11] implemented the IoT-based system on Raspberry Pi 3B hardware. Feedback and complaint management functions were used to develop the attendance system in [12]. The author in [13] discussed the cloud-based system using near-field communication and face recognition. Biometric-based

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systems were presented in paper [14, 15]. In paper [16], authors implemented the face recognition-based attendance monitoring system using Python and OpenCV.

In this paper, our work comes with implementation of the attendance marking system using text recognition and face recognition [17]. Text recognition is done using optical character recognition (OCR). This process is done by scanning individual student ID cards. OCR scans the ID card and converts the data into a documented format. Facial recognition is highly recommended since facial parts of an individual are unique. These methods reduce the time of both faculty and students. Using either of the processes for attendance marking consumes more time, it results in the scanning of massive databases. Using both of the techniques, it reduces time and ends up with fruitful results.

2 Methodology Used in Implemented System

In this work, the attendance marking system implementation uses the scanner. This methodology will now be static where the student can verify his/her identity after the concerned lecturer allows it to do so by entering a passkey, thereby indicating the system to take attendance for the corresponding lecture/laboratory. In the future, the camera for face recognition will be the surveillance camera, a high-resolution one. Text recognition data on the ID card is documented. Facial identification detects a face on the ID card. Facial recognition identifies the unique patterns on the face. The results are verified against the database, and attendance is marked. The flow of the system is shown in Fig. 1. To develop the system, the following software and hardware components such as Nanonets, OpenCV, AWS recognition, Raspberry Pi and camera module are used.

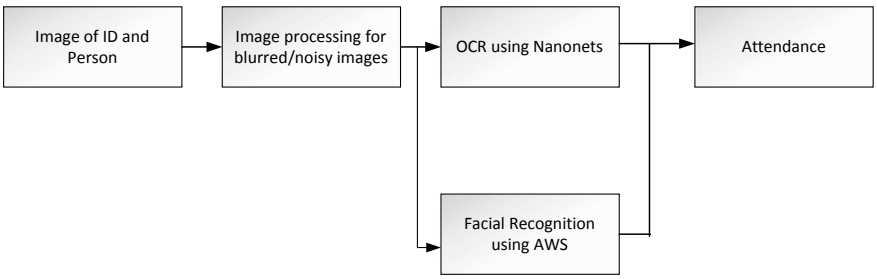


Fig. 1 Flow of the attendance marking system

2.1 Nanonets

It is a Python wrapper that provides an easy way to use the application program interface (API) to communicate with its servers. It is also used to build machine learning models for making predictions on image data. The models that can be built are classification of images, multi-label classification, detection of objects from images and optical character recognition. Nanonets have a cloud service where based on the application, training of the models is required. After creating a user account, the API key is generated and trains our models on respective official websites.

2.2 OpenCV

Open-source computer vision library is an open-source library offering various computer vision and machine learning algorithms. OpenCV is used to develop real-time computer vision technologies. It was developed in 1999, has over 47,000 community members and provides 2500 algorithms. The OpenCV is used to identify the presence of a face in an image.

2.3 AWS Rekognition

It is one of the Amazon web services that are cloud-based software as a service computer vision platform. It is not open source, and pricing depends on the services that the customer used. Users can also custom train a face recognition model, where a user needs to index the pre-labelled faces and to use this model as a service with an API. Then, the user can upload the new images to the API and receive information about the faces in the image. The model is trained by sending an image to Rekognition using an index_face API call. It sends us unique values for the image called image id and face ID. These face ID to recognize faces in later images and called as indexing. In order to recognize the face from a different image, the Rekognition using a search_face API call, if the previously indexed faces match, it sends us the matched face ID. The flow of API calls to AWS Rekognition is presented in Fig. 2.

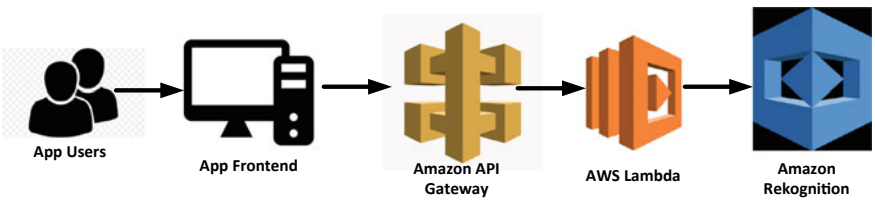


Fig. 2 API Call to AWS Rekognition [Internet source]

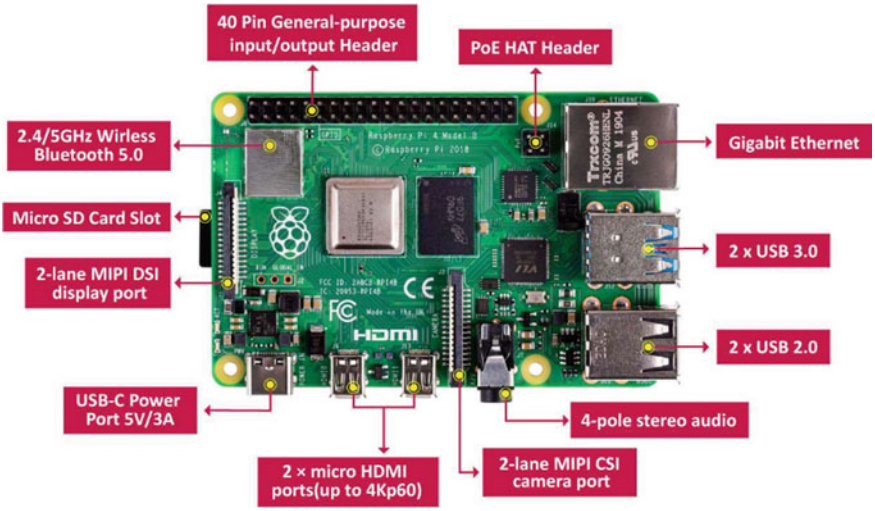


Fig. 3 Raspberry Pi 4 model B [18]

2.4 *Raspberry Pi*

Figure 3 is Raspberry Pi 4 models B, and it is similar to a micro-computer, compact-sized and mighty. In our work, the low-end devices such as ESP32 were used. It was created and developed by Espress if systems, a microcontroller with integrated wireless connectivity and very cheap compared to the Raspberry Pi. But it has I/O pins rather than interfacing ports such as USB, HDMI, LAN and some more features. The robustness and high flexibility of Raspberry Pi for high-end performance make us choose this hardware. Raspberry Pi 4 model has Broadcom BCM2711 as system-on-chip (SoC) with four Cortex-A72 processors with 1.5GHz. In our work, it is decided that the 4GB variant, although other options with 1GB, 2GB is also available. It has 2 USB2.0 ports and 2 USB3.0 ports, 1 LAN port with 1Gbps capability. It also has Bluetooth with dual-band Wi-Fi connectivity. It has GPIO pins that can be used for wired communications such as UART, SPI and I2C communications. It has a full HD 4K resolution capability. It also has a camera and stereo audio ports.

2.5 *Camera Module*

The camera used is the Raspberry Pi camera module version 2 is shown in Fig. 4, which is compatible with our chosen hardware. The camera module has a Sony IMX219 8MP sensor. These can be used for taking the still photographs as well as high-definition video. It is easy to use for beginners and also has plenty to offer

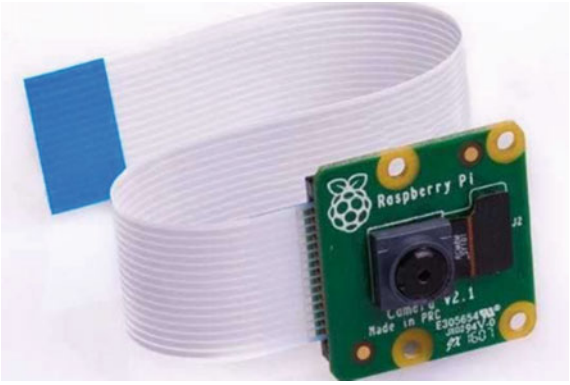


Fig. 4 Raspberry Pi camera module v2 [18]

advanced users. This can also be used for slow motion, time lapse and another video cleverness.

3 Optical Character Recognition

The flow of optical character recognition (OCR) in Fig. 5 is used to scan the printed documents or hand-written documents that contain numerals, letters or symbols. The scanned text is converted into computerized text in the form of word documents. Then, these converted documents can be formatted or reused in other documents. Documents therefore can be easily readable and reused. If a page is scanned using a scanner, it is generally stored as a bit-mapped file in tagged image format file (TIF/TIFF). Humans can view this image, but the computer stores it in the form of 0 and 1, the information is just a series of black and white dots.

OCR was initially developed to assist visually impaired people. Now, the same technique can be used to make the computer understand the text in an image. It is not only useful for visually impaired people but also for several applications, scanning a vast number of documents in search of some information which when done manually is tedious. Also, this work includes a considerable investment of time,

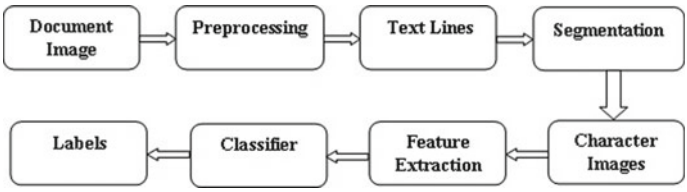


Fig. 5 Flow diagram of OCR

payrolls and may lead to several human errors. Recently, OCR finds many applications such as conversion of all offline documents to online by capturing images, business documents, number plate recognition for vehicles, translating the text of unknown language to known one and many other applications.

3.1 Training Nanonets OCR Model for ID Card Data Extraction

In this work, text recognition is a student ID card. The several labels are present in the ID card such as roll number, name, date of birth, branch, program, valid up to. The reason we need to go for another model different from the basic model is that this new model identifies the text in the image containing student ID cards. This text is extracted in the form of different labels where the output in the form of JavaScript object notation (JSON) response, which is then provided to the database. The process of identifying a student is easy. Thus, it makes sense of the data extracted while the basic model just extracts data from an image where the machine could not understand what type of information it is. In our experiment, fifty ID images of different students in our college were trained. In this, some images are uploaded in different angles, and upright positions so that the model can be trained well and could quickly identify the ID cards whose images are taken in real-time. The following are some of the ID images taken from the students that are uploaded on our own while training the data is shown in Fig. 6.

Fig. 6 Data sets for training the model

An application ID (model ID) is created after the model is trained, which is later used to access it during testing and usage. It is observed from our model was hosted and got an accuracy of 68.22%, which is quite acceptable one. This model is successful for the ID card images. It is observed for the experimental results, and it could identify the images which are currently uploaded from local storage due to lack of hardware components, which are in low lighting conditions and even when the ID is in an upright position.

4 Facial Recognition

The face of an individual plays a crucial role in the identification and emotion of the person. Each individual has a unique face that can be used for identification purposes. The facial recognition system is a part of biometrics. It can identify an individual from an image by scanning against the trained data. Billboards have been designed with software that recognizes the ethnicity, gender and estimated age of onlookers to deliver targeted marketing. The system involves three steps, namely pre-processing, face detection and face recognition.

4.1 Pre-processing

Before sending the image for face recognition, the images are entered into the initial process. So that the images with noise, blurred images, were taken in poor lighting conditions, and many other factors can be identified easily without misleading us to incorrect data. To achieve this, brightness and contrast of the image are adjusted, and by use of filters, the image enhancement is performed, edge detection techniques such as Laplacian of Gaussian, canny edge detector or any other techniques, and many noise removal techniques can be adopted.

4.2 Face Detection

Face detection is a major step in the facial recognition system. It is mainly locating the face of an individual in an image. After detecting the face, facial features are extracted. After identifying the face, facial recognition algorithms are applied. In general, detecting faces from an image is smooth, but when the image is a group image, detecting faces becomes difficult.

4.3 Face Recognition

Face recognition is the process of recognizing the distinctive patterns on an image of an individual face and stores the data as a trained set. When a face is scanned, then the system looks for patterns, verifies across the trained set and gives the information of the individual stored in the database.

5 Experimental Results and Discussion

5.1 Accomplishments

5.1.1 Output of Basic OCR Model

This is the output when a new image is uploaded to the basic OCR (text recognition model) is shown in Figs. 7 and 8.

Fig. 7 OCR-based text extraction and its JSON response output

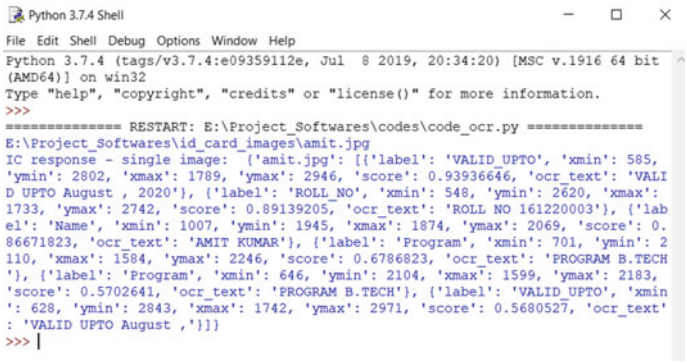


Fig. 8 JSON response output for student database

5.1.2 JSON Response for Image Uploaded from Local Storage to Nanonets

The response that it can identify the text in the image in the form of different labels that are predefined for which the model is trained, and its corresponding face identification using OpenCV is shown in Fig. 9, and OCR-based text extraction from the student ID card and its corresponding data values are stored in database for verification purpose as shown in Fig. 10.

5.1.3 Face Identification Using OpenCV

See Fig. 9.

5.1.4 Output for OCR

In the above images, as shown in Fig. 10a–d, it is clear that the model can identify the images even when given to the camera in inverted or different angles. Therefore, extracting the text from the images in the form of predefined labels is obtained. Further, Fig. 11 shows outputs for face recognition using OpenCV, AWS Rekognition with the help of API requests.

In the future, other applications of OCR/text recognition are invoice recognition to help visually impaired people, number plate recognition of a vehicle violating traffic rules, Aadhar/PAN card/other document detail extraction without manual process. Furthermore, the face recognition accuracy can be improved using several machine learning algorithms. It can further be extended to find the emotions of a student and how interested he/she is in a particular course. In the second step, iris recognition is recommended since individual eyeballs are unique, making this model a multimodal authentication system in need of highly secure systems.

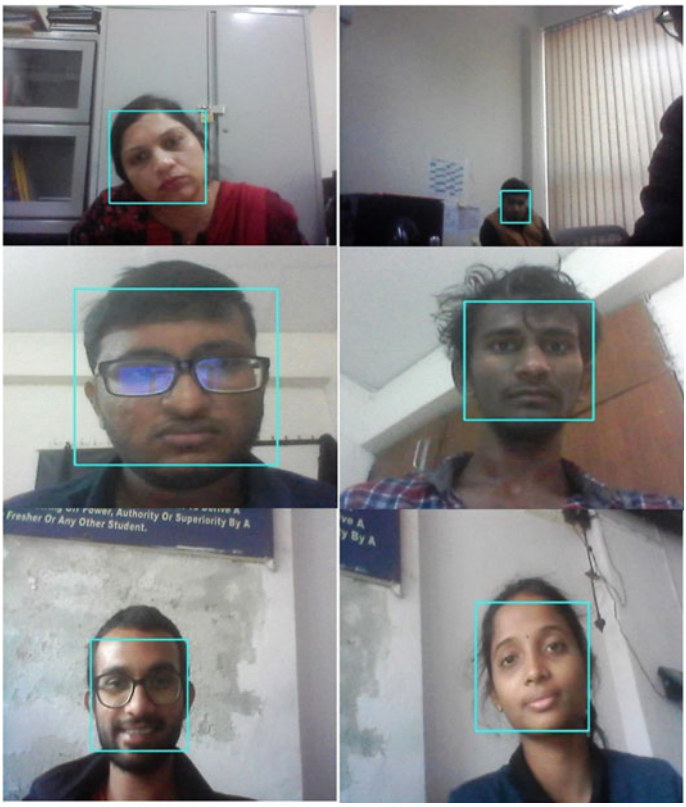


Fig. 9 Face identification using OpenCV

6 Conclusions

The use of this system provides automated data capture, which can save organizations considerable time and labour costs. The system thus provides automation, effective use of time and high adaptability to new data with only a few patterns to calculate. One has to notice a point that the model's accuracy depends on the resolution of the camera, clarity of the image and of course, the network equipment apart from algorithms. So, the cost estimation increases as quality improves. Thus, this work achieves text recognition and facial recognition of the input data.

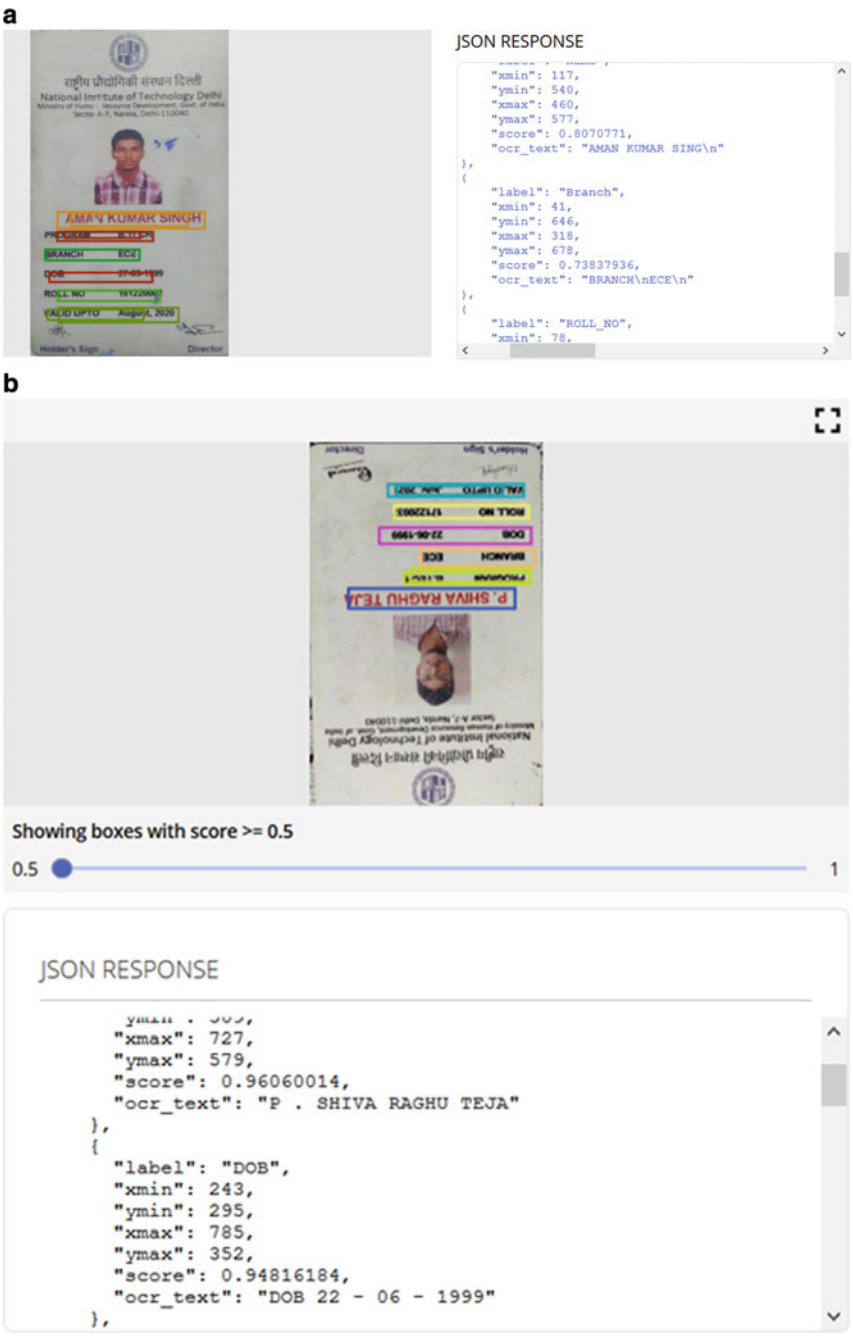
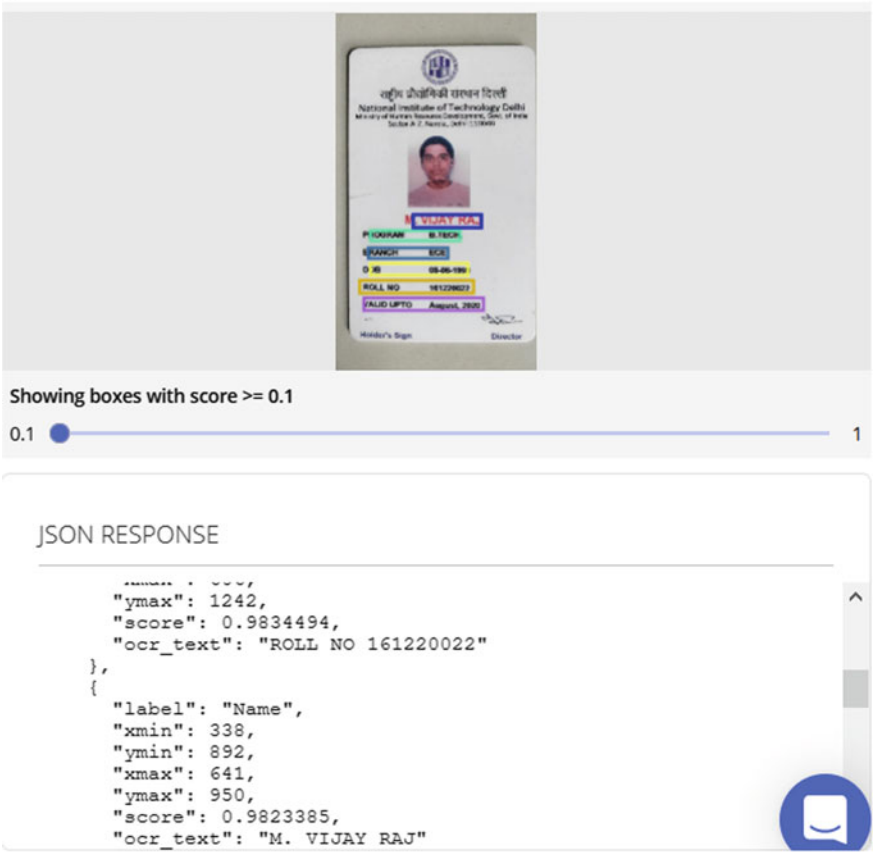


Fig. 10 **a** OCR-based text extraction from the student ID card-1, **b** OCR-based text extraction from the student ID card-2, **c** OCR-based text extraction from the student ID card-3 and **d** OCR-based text extraction from the student ID card-4

c



d

Fig. 10 (continued)

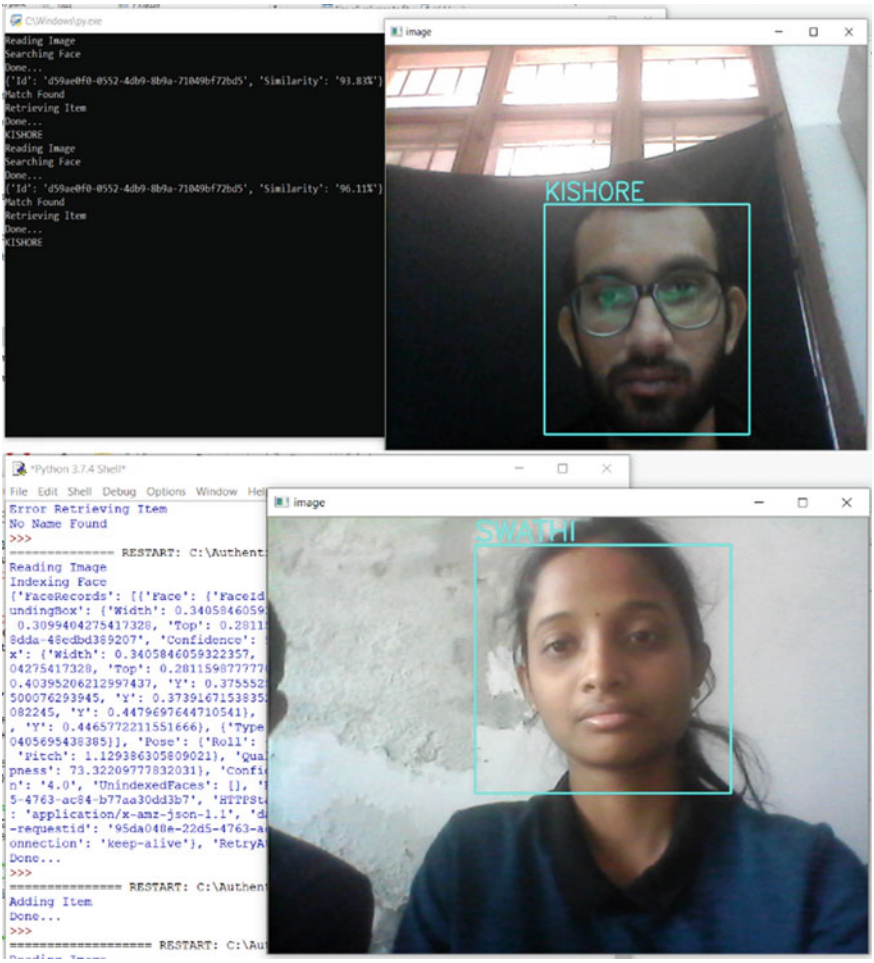


Fig. 11 Face recognition using Open CV, AWS Rekognition with the help of API requests

References

1. Agrawal A, Bansal A (2013) Online attendance management system using RFID with object counter. Int J Inf Comput Technol 3(3):131–138
2. Nainan S, Parekh R, Shah T (2013) RFID technology based attendance management system. IJCSI Int J Comput Sci 10(1):516–521
3. Patel UA, Priya RS (2014) Development of a student attendance management system using RFID and face recognition: a review. Int J Adv Res Comput Sci Manage Stud 2(8):109–119
4. Arulogun OT, Olatunbosun A, Fakolujo OA, Olaniyi OM (2013) RFID based students attendance management system. Int J Sci Eng Res 4(2):1–9
5. Sarkar A, Banerjee RK (2020) A review on fingerprint based biometric attendance system. Prepare 1(1), 1–8

6. Kadry S, Smaili K (2007) A design and implementation of a wireless iris recognition attendance management system. Inf Technol Control 36(3):323–329
7. Seifedine K, Smaili M (2010) Wireless attendance management system based on Iris recognition. Sci. Res. Essays 5(12):1428–1435
8. Chintalapati S, Raghunadh MV (2013) Automated attendance management system based on face recognition algorithms. In: 2013 IEEE International conference on computational intelligence and computing research. Enathi, pp 1–5
9. Noguchi S, Niibori M, Zhou E, Kamada M (2015) Student attendance management system with bluetooth low energy beacon and android devices. In: 2015 18th International conference on network-based information systems. Taipei, pp 710–713
10. Bhalla V, Singla T, Gahlot A, Gupta V (2013) Bluetooth based attendance management system. Int J Innov Eng Technol (IJIET) 3(1):227–233
11. Ruhitha V, Prudhvi Raj VN, Geetha G (2019) Implementation of IOT based attendance management system on Raspberry Pi. In: 2019 International conference on intelligent sustainable systems (ICISS). Palladam, Tamil Nadu, India, pp 584–587
12. Ahmed FYH, Aik KLT, Radzi AS, Salleh MD (2019) Develop attendance management system with feedback and complaint management function. In: 2019 IEEE 7th conference on systems, process and control (ICSPC). Melaka, Malaysia, pp 248–252
13. Rana A, Pugaokar V, Sawant A, Gore A (2019) Cloud based employee attendance management system using NFC and face recognition. Int J Adv Res Ideas Innov Technol 5(2):988–991
14. Gupta A, Kundu A, Das R (2019) Automated attendance system for efficient employee management: a biometry based approach. Int J Recent Trends Bus Tourism 3(3):117–121
15. Shoewu O, Idowu OA (2012) Development of attendance management system using biometrics. Pacific J Sci Technol 13(1):300–307
16. Kowsalya P, Pavithra J, Sowmiya G, Shankar CK (2019) Attendance monitoring system using face detection and face recognition. Inter Res J Eng Technol (IRJET) 06(03):6629–6632
17. Anith S, Vaithiyanathan D, Seshasayanan R (2013) Face recognition system based on feature extraction. In: 2013 International conference on information communication and embedded systems (ICICES). Chennai
18. Raspberry-Pi,https://www.element14.com/community/community/raspberry-pi/blog/2019/02/05/image-classification-using-nanonetsio-with-raspberry-pi. Last accessed 05 Feb 2019