International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | June 2022 www.irjet.net p-ISSN: 2395-0072

Face Recognition Smart Attendance System: (InClass System)

Abhishek Gavkare[1], Abhishek Mutkule[1], Ashish Mandlik[1], Rajesh Prasad[1]

Students[1], Department of Computer Science and Engineering, School of Engineering, MIT Arts Design and Technology University, Pune, 412201, India

---

Abstract:

A biometric is a study of human features and characteristics. Although no faces can be prevented as a security solution, it helps to some extent. Face recognition is a rising field for object detection. It's also used in various fields like attendance, security, medical, etc. Attendance is vitally important in schools and universities. As we know, Manual attendance systems have various drawbacks, such as being less accurate and difficult to maintain. Nowadays, we see several systems such as IoT and passive infrared sensor (PIR) bases and various models. So, for the sensor, we want to keep it in good condition, so it doesn't become damaged. In diverse models, we confront problems such as selecting which feature to use or, more importantly, managing variance in lighting, postures, and size. As a result, we are attempting to construct an "InClass" solution to address the above mentioned issue and digitally provide a valid attendance sheet. For this, we used a CNN face detector that is both highly accurate and very robust, capable of detecting faces for varying angles, lighting conditions, and occlusion.

Keywords: ***Face Recognition, Face feature, Face selection, Feature Extraction***

I. Introduction

In today's world, the face recognition technique changes the biometrics field. In this technique, we use people's faces for identification. Each person has unique facial traits, so it's very easy to differentiate or uniquely identify an individual. Face recognition, which has gallantly outperformed in various disciplines, has the potential to be employed efficiently for security systems but has not been explored owing to obvious weaknesses. As we know, the traditional pen-paper system has its pros and cons. The manual attendance marking method is susceptible and time demanding, resulting in a setback for the kids. To address this issue, advances have resulted in the widespread usage of biometrics. As we know, the biometric technique for attendance comes at an uncomfortably high cost for users and is very time-consuming on the user's part. So face recognition is a very valuable technology And develops strategies that incorporate it into our system.

Attendance Management with biometrics is being developed and adopted as multi-tech classrooms become more prevalent. In most cases, iris recognition or thumb scanning is used in attendance management. With time, advances are also required to keep up with ever-increasing technology. As marking procedures advance, the notion under consideration is the urgent need to remove impediments, the complexity of devices, delays, and genuine attendance.

Unlike all traditional systems which are comparatively slow and susceptible, the InClass system employs face recognition to identify and note student attendance. In our system, there is no requirement for equipment further than a camera or laptop. The students' presence is validated via the use of their faces. This method is very effective for recording attendance and keeping the record with us or the person taking the attendance (Instructor, administration). Algorithms are employed to match the student's faces with those in the database. In this system, we also use a mail function. We will help to store the attendance on the drive which is also helpful to reduce the usage of paper and whenever the record of attendance is required it can be fetched easily and anywhere.

According to us, reading about older projects like systems using Biometrics and thumb scanners is very time consuming because it will go one by one mark attendance and also such products are very difficult to maintain. With the time begging, as we are in the 21st century and it needs us to upgrade the technology that's why we are coming with "InClass System" to overcome these problems.

II. Literature Survey

Sajid and colleagues (2014) [1] In this study, he developed a model for identifying people when females wear headscarves and males have beards. For face detection, they use a Local Binary Algorithm (LBA). In this, they use

fiducial points for matching the Face. In this system, two databases are used. First, one memory collection includes previously saved photos, while the second database has attendance data used to check attendance.

They use an image for marking attendance, so capture an image. Then they removed Background and noise from that Image, and using the Gabor filter, they marked 31 fiducial points, which will help calculate facial features. Then it will match with the database, and attendance is marked. They capture the images three times in between lectures to validate attendance.

Raghuwanshi et al. (2017) [2] In this paper, they compare two feature extraction methods: Principal Component Analysis(Principal Component Analysis(PCA) and Linear Discriminant Analysis(LDA). Principal Component Analysis(PCA) is used to reduce the number of face recognition variables, and Linear Discriminant Analysis(LDA) is used to minimize the within-class scatter means moving the same faces together. For their comparison, they selected three parameters: Time elapsed, Subspace Projection, and Accuracy based on an oral and class database.

They use two databases, the first is the oral database which contains 400 images of 40 individuals, and the second is the Class database which includes 25 images of 5 individuals. Also, they plot ROC and CMC graphs for analysis and comparison of databases. The ROC plot is used for different possible cute points of a diagnostic test, and CMC is used to measure recognition performance. Principal Component Analysis(PCA) and Linear Discriminant Analysis(LDA) work well in normal light, Distance from the camera is 1 to 3 feet, with no pose variation.

Winarno et al.(2017)[3] In this paper, we can see they use a 3 WPCA(Three-level model wavelet decomposition Principal component analysis) method for face recognition. Initially, they took images of a person from two cameras on the left and right. After capturing the Image, they normalize the images. Normalization is done in two steps: first is preprocessing, and another is half joint. The half joint is used to minimize the forgery of facial data. They use RGB to Gray conversion and cropping, resizing, and adjusting contrast brightness in preprocessing.

For feature extraction, they use the 3 WPCA(Three-level model wavelet decomposition Principal component analysis), in which they reduce the dimensionality of the images so that feature extraction using Principal Component Analysis(PCA) is done very quickly. For classification, they tested two methods, Euclidean and Mahalanobis distance methods. For testing, they consider two parameters: Recognition Rate and Recognition Time, in which the Mahalanobis gives more remarkable results. They achieve 98% accuracy on a small dataset.

Soniya et al. (2017) [4] In this paper, they proposed an IOT-based system that uses Adriano-UNO and Camera. They are arranging that system to create a student database, which gives the user access to add a new entry, which will help users register new users quickly. They use the Principal Component Analysis(PCA) algorithm for feature detection and face Recognition. They try to establish such a feature if students leave the class in between, and if they do not again enter within 15 min, they are marked absent. For face recognition, they use face tracking and Face location. Face tracking is used for size, length, breadth pixel of Face, and face location to detect suitable location. They plotted an FMR (occurred when a genuine match was obtained), FNMR (when a genuine user is blocked), and a graph.

In this system, they use a camera with an image resolution of 300k pixels and light sensors for switching on 4 LEDs when in the dark. Sharpness, Image control, brightness, and saturation are the features provided by that camera. The main drawbacks are they take attendance one student at a time which is very time-consuming for many people.

Nazare et al.(2016)[5] In this paper, they proposed a system using a combination of Alignment- free partial face recognition and the Viol-Jones algorithm. The Alignment-Free partial Face algorithm uses MKD (Multi-key Descriptor), which is used for prob images and dictionary creation. Each Image in the dictionary is represented in sparse representation and then uses GTP (Gabor Ternary Pattern) for robust and discriminative face recognition. Due to this, we can easily detect a person.

For the creation of data, they gave the feature for registration, and in that, they took three images of each person from the front, left, and right side view. They also arrange a camera at the middle top of the blackboard, covering maximum faces. They consider one lecture for 1 hour, and they take three images of the class in between 20 min gaps. So that they get a valid result. For capturing images, they use a camera having a resolution of 20 Megapixels.

Wagh et al. (2015)[6] This paper is based on Principal Component Analysis(PCA) and EigenFace algorithm. They are addressing the issues like head pose problems as well as the intensity of light. For these problems, they use

techniques like the illumination variant viola-jones algorithm. They also use the RGB-Gray conversion, Histogram normalization, and skin classification to improve face detection accuracy.

Here they use this technique one person at a time, which is very time-consuming and one of the system's drawbacks. Also, they are not addressing the issues when the person with a beard, mask, etc.

Chintalapati et al.(2013)[7] In this paper, they develop a system with a different algorithm for face detection and their classification and their combination. (i.e. are Principal Component Analysis(PCA)+ Distance Classifier, Linear Discriminant Analysis(LDA)+ Distance Classifier,Principal Component Analysis(PCA)+Support Vector Machine(SVM), Principal Component Analysis(PCA)+ Bayes, LBPH+ Distance Classifier). For comparing that technique, they use various parameters: Occluded faces, the false Positive rate, Recognition Rate(real-time video), Distance of the object for correct Recognition, Recognition Rate (static Image), and Training Time.

According to their data, Principal Component Analysis(PCA) with Support Vector Machine(SVM) gives excellent results in each aspect. But they do not highlight the Recognition of faces with beards, scarfs, and tonsure heads. Also, when the system recognizes a face up to a 30-degree angle, it will not recognize if it encounters the Face more than a 30-degree angle.

Akay et al.(2020)[8] In this paper, they tested two techniques for face detection, namely HOG (Histogram of Oriented Gradient) and another one is the Haar-Cascade algorithm. HOG is based on contras in different regions, and Haar-Cascade is based on light and dark transitions. They tried both methods based on the parameters; True positive, True Negative, False positive images, Precision, recall, F1-Score, and Training time.

In this, they also introduce medical mask detection due to covid-19, which will also be helpful for mask detection. For Recognition and classification, they use CNN and Support Vector Machine(SVM), respectively. According to their research between HOG and Haar-Cascade, HOG gives more significant results on given parameters and works well in changing lighting conditions.

A biometric attendance management system was developed by Varadharajan et al. (2016)[9] In this paper, they introduce the system using the EigenFace method, which is a set of Eigenvectors. Each Face is represented in Eigenface, and this Face is converted into an Eigenvector with Eigenvalue. They use the Jacobi method to calculate this value because their Accuracy and reliability are high.

They also use different parameters for face detection and Recognition that are Face with a veil, Unveil Face, and beard. So the Unveil Face gives greater accuracy, 93% for detection and 87% for Recognition.

Rekha et al.(2017)[10] In this paper, they integrated two techniques that are Principal Component Analysis(PCA) and an Eigenface database. They address various issues like Image size, Image quality, varying intensity of light, and Face angle. For creating the EigenFace database, they took 15 people to ten images each. For comparing the Training and Testing image, they use Euclidean DistanceDistance in the Recognition part. This uses MATLAB for creating GUI and Training algorithms.

In this paper, Y.Sun et al.(2020)[11], we see that various CNN models will be tested with different parameters. They tested these models on CIFAR10 and CIFAR100. It was also tested on a system with a GPU. In this paper, we see they are tested manually designed, automatic+manually designed, and fully automatic types of systems. According to their results, CNN –GA works well in all parameters and on GPU.

Ammar et al.(2021)[12]In this paper, we see a comparison of 3 object detection methods: Faster R-CNN, YOLOv4, and YOLOv3.This comparison uses the PSU (Prince Sultan University) dataset and the Stanford dataset. They use parameters like Input Size, AP, TP, FN FP, F1 Score, FPS, Interface Time, Precision, and Recall for comparison. Also for Faster R-CNN, YOLOv3, and YOLOv4 use InceptionV2, Barnet-53, and CSPDarknet-53 for feature Extraction. This comparison is used for vehicle detection.

S.Gidaris et al(2015)[13]In this research paper object detection using the CNN model. But for this, they focused mainly on two factors. The first is the diversification of the discriminative appearance and the second is the encoding of semantic segmentation-aware features. The First factor is used for focusing on the various regions of the object.

Yuhan et al()[14] In this paper, we can see the main focus on improving the cross-domain robustness of object detection. They focused on two factors that are Image-level shift and Instance-level shift. They use the state-of-the-art Faster R-CNN model and focus on these two factors to reduce the domain discrepancy. In the Image-Level shift, we can see image style and illumination; in the Instance-

Level shift, we can see the appearance of objects in the image and the size of the image.

D. Varshani et al.(2019)[15]In this paper we can see the application of object detection in medical fields. In this, they used a pre-trained CNN model. They use different classifiers for classification like Support Vector Machine(SVM), k-nearest neighbour's Random Forest, and Naïve Bayes. For feature extraction the uses X Caption, VGG-16, VGG-19, ResNet-50, DenseNet-121, and DenseNet-169.They tested all combinations but according to their result, the DenseNet-169 and Support Vector Machine(SVM) combination is best for X-Ray type images.

III. Methodology

This is a prototype face detection and identification algorithm in real-time. The system is made up of a camera that is mounted in the classroom and captures video frames before detecting several faces. The amount of bits to be processed is reduced by cropping and converting these faces to grayscale. These faces are then matched to those in the database, and the outcome is shown along with attendance.

3.1. Face Database Creation of Students:

Each student can register on the system and their information is also gathered. This information is stored in the database and their Photos are stored on the computer itself. All the attendance is also stored on the server.

3.2. Face-Recognition:

The recognition technique revolves around face recognition. *Face recognition* is a computer vision technology that analyses a person's facial characteristics to determine their identity. Face recognition has two components: detection and matching. Face recognition takes into account a person's facial features and a face photograph or video feed. If a human face is present, determine each major facial organ's position, size, and placement. To determine the identity of each face, the identifying attributes provided in each face are retrieved and matched to known faces.

Face recognition is a sort of biometric recognition that comprises four steps: face picture collection, face image preprocessing, face image feature extraction, matching, and combining hard recognition.

3.2.1 Neural network:

In membrane recognition, a neural network is a widely utilized approach. Its concept is constructing a hierarchical structure out of a huge number of simple calculating units. Each basic unit can only perform simple calculations, but a system of units in complex structures might be a difficult problem to solve. Face recognition has also been successful using the neural network approach. There are enough training examples to theoretically recognize all faces, as long as the network is large enough. BP networks, self-organizing networks, convolutional networks, and other regularly used algorithms are examples.

While neural networks have some advantages in face recognition, they also have significant flaws. Neural networks have a large and complex structure, necessitating a large sample library for training. Days or even months of training are not uncommon. There is insufficient speed. As a result, when it comes to facial recognition, neural networks are rarely used.

3.2.1.1 CNN:

CNN is a modified feed-forward ANN that can extract significant properties from input pictures to characterize each. Feature extraction is not required with CNN. It learns by extracting significant features from the input photos during the training process. CNN keeps vital details while also accounting for spatial and temporal errors. It is invariable for rotation, translation, compression, scaling, and other geometric changes.

Scaling, shifting, and distortion invariance are three designs that CNN integrated. Back propagation neural networks were used to train the CNN network. CNN uses a collection of connection procedures to classify the input. Face recognition uses a CNN architecture with five convolutional layers, a pooling layer, and fully linked layers, as illustrated in the diagram.

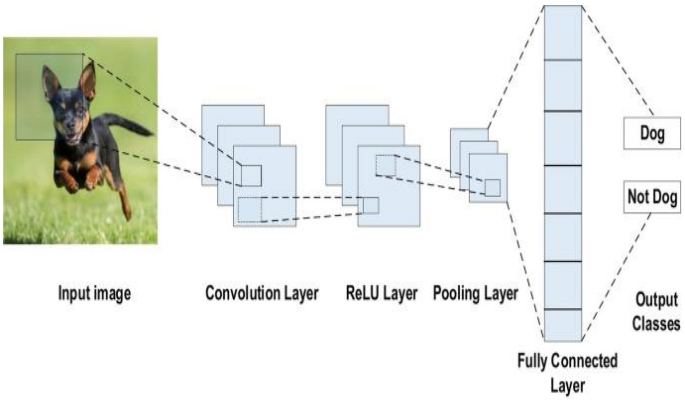

Fig. 1 CNN Architecture

The convolutional operation between the input picture and the 3x3 kernel was done in the convolutional layer. The feature map with the reduced size is the convolutional network's output. Because feature maps are linear, keeping them that way is critical. To make a convolutional mask, you may use many types of filters.

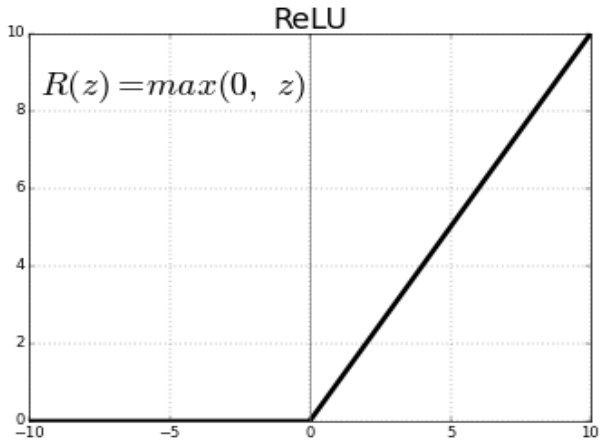

Fig. 2 ReLU

The Rectifier Linear Unit (ReLu) is used to augment the non-linearity of a feature map. The system becomes unstable due to linear function. The pooling layer is used to keep the image's properties. Image size is reduced by grouping. Mean, maximum, sub-sampling, and more types of pooling exist. The cluster's minimum value is taken from the minimum pool. The sampling reduction process is the same as the maximum grouping.

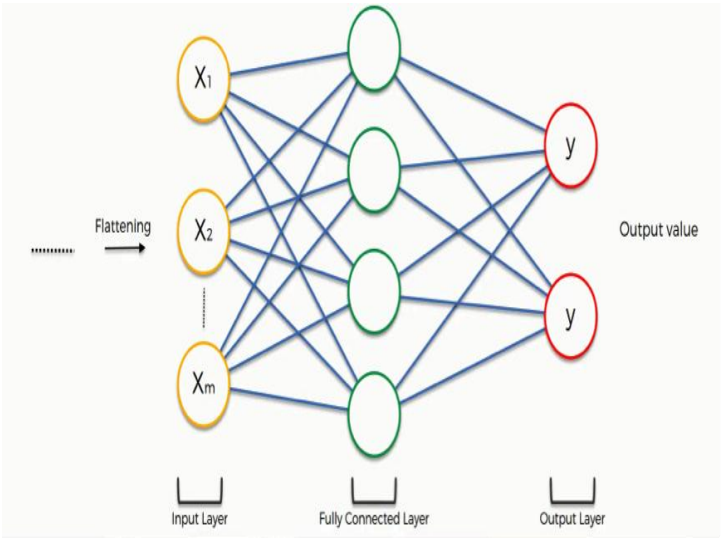

Fig. 3 Fully Connected layer CNN

To minimize over-processing, the maximum combination limits usable parameters. The type of mean pooling used is a sub-sampling. The average value is used to create this. Flattening is converting a two-dimensional picture into a single one-dimensional vector. Each cell has a unique vector placed into the completely linked layer. An artificial neural network is another name for the fully linked layer (ANN). Each neuron in one layer communicates with each neuron in the following layer via completely related layers. Softmax is a method for predicting a class from mutually exclusive classes.

3.3. Comparison / Recognition:

The face with the highest degree of correlation is recognized as the matched face, and the related name of the face is collected from the database using the classifier.

3.3.1Speed comparison of the methods

We used 300*300 image for comparison of the method that are :

1. Haar Cascade Face Detector in OpenCV (Haar)
2. Deep learning based Face Detector in OpenCV (DNN)
3. HOG Face Detector in Dilb (HoG)
4. Deep Learning based Face Detector in Dilb (MMOD)

We run each method 1000 times on the given image and take 10 such iterations and the time taken.

Here we run MMOD in normal CPU and NVIDI-GPU

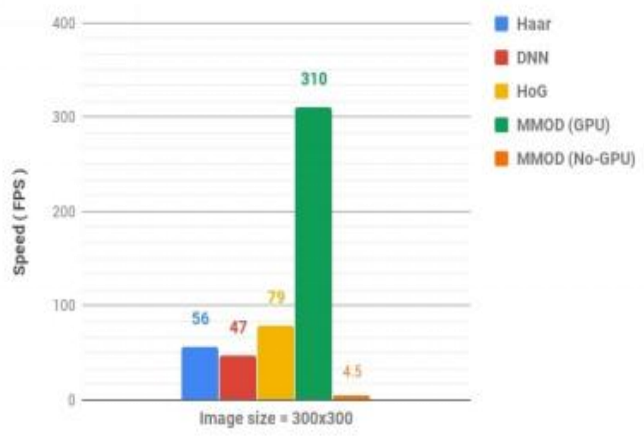

Fig. 4 Speed Comparison

3.3.2 Accuracy Comparison:

We compare these 4 models on the FDDB database. Given below are the Precision scores for the 4 methods.

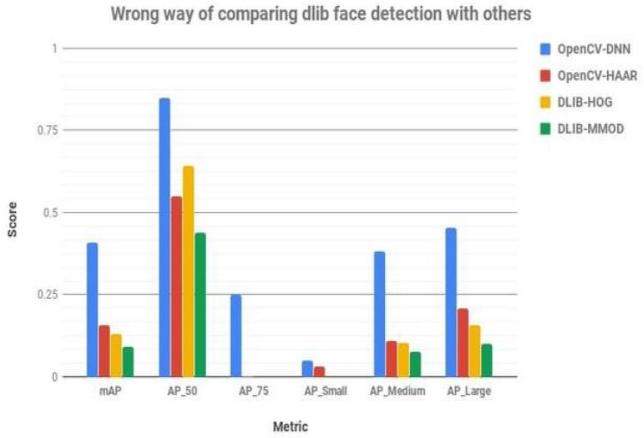

Fig. 5 Accuracy Comparison

Where,

AP_50 = Precision when overlap between Ground Truth and predicted bounding box is at least 50% (IoU = 50%)

AP_75 = Precision when overlap between Ground Truth and predicted bounding box is at least 75% (IoU = 75%)

AP_Small = Average Precision for small size faces (Average of IoU = 50% to 95%)

AP_medium = Average Precision for medium size faces (Average of IoU = 50% to 95%)

AP_Large = Average Precision for large size faces (Average of IoU = 50% to 95%)

mAP = Average precision across different IoU (Average of IoU = 50% to 95%)

IV. Flow chart

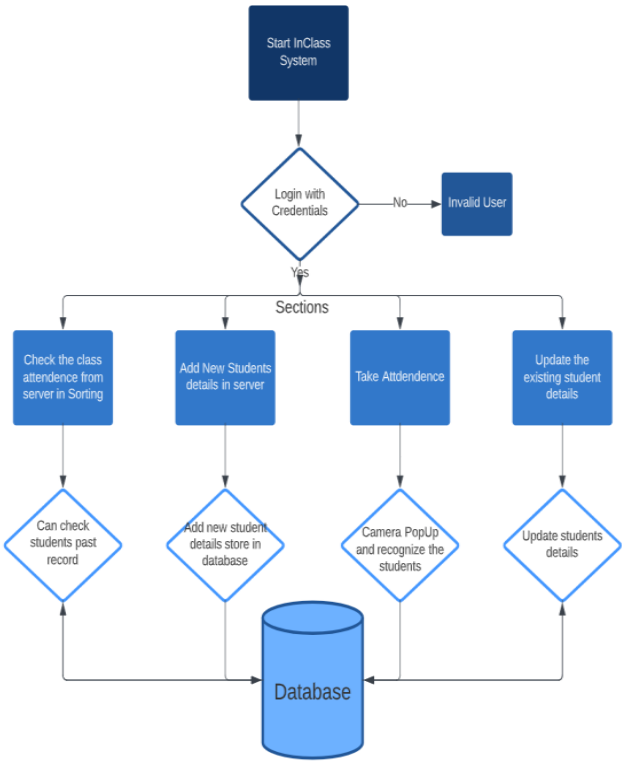

Fig. 6 Flow chart

V. Result

When we login into the system then this page occurs, in which there are four sections:

1. Take attendance
2. Add new student details
3. Update existing student details
4. Search attendance.

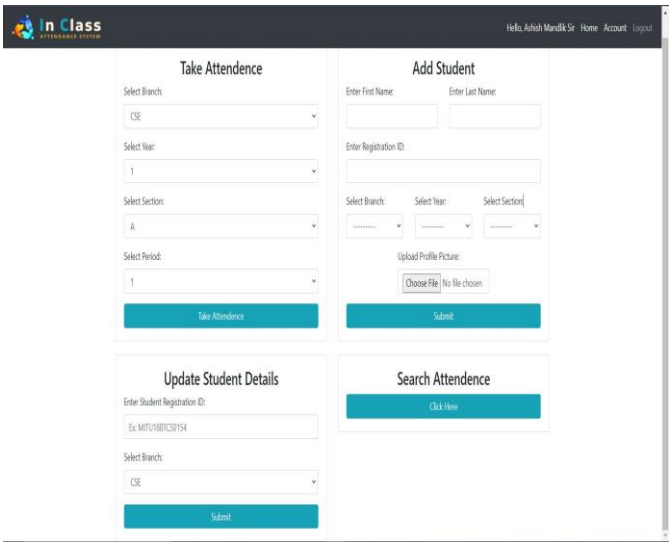

Fig. 7 UI

1. Take attendance:

After filling in all the details in that field, we have to click on the take attendance button.

When we click the take attendance button, the camera will open and start recognizing students.

2. Add students:

In this section, we add new student details like student's name, registration ID, branch, class, year, and profile photo and store them in databases.

3. Update student details:

This section updates student details like profile photo, branch, etc.

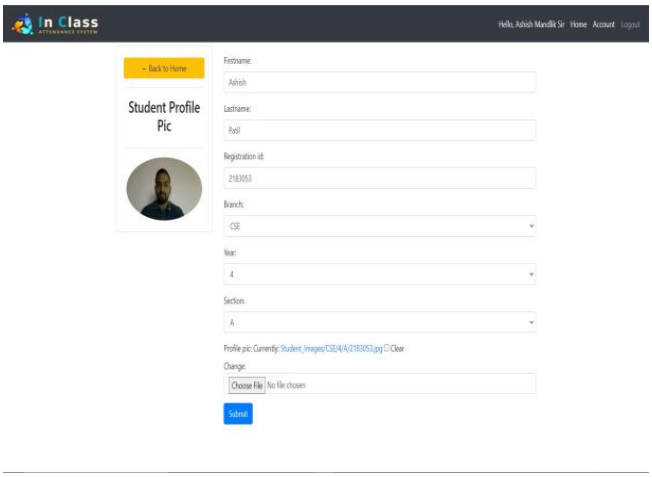

Fig. 8 Update section

4. Search attendance:

In this attendance section, we search the student's attendance using various filters such as Registration ID, name, date, section, and year.

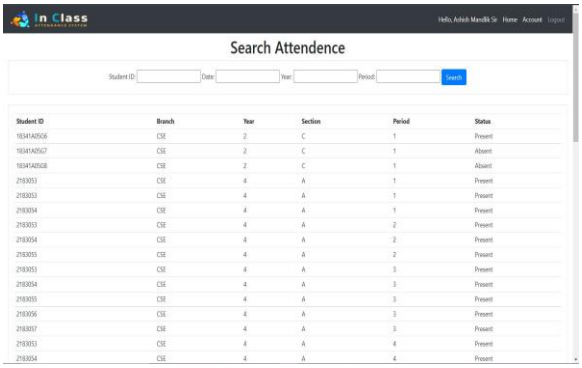

Fig. 9 Search Students Attendance

VI. Challenges

We all know that human faces are unique and stiff things. Several aspects influence the appearance of the structure of faces. The origin of the diversity of facial appearance can be classified into two kinds of appearance. They are intrinsic factors and extrinsic factors. So intrinsic factors are related purely to the physical traits of the face and are independent of the observer. This intrinsic factor is further split into two categories that are intrapersonal and interpersonal. The intrapersonal aspects can affect the facial appearance of the same person, with some examples such as age, facial stuff like glass, facial hair cosmetics, and so forth, and facial expression. Interpersonal aspects, one

on each hand, are essential for the variance in facial appearance—for example, ethnicity and gender. Extrinsic factors contribute to the appearance of the face-changing due to the interplay of light with the face and the observer. These elements include resolution, imaging, noise, and focus.

Assessments of state-of-the-art techniques undertaken in recent years, such as FRVT 2002 as well as FAT 2004, have demonstrated that lightning, age, and pose variation are three fundamental issues with current facial recognition.

VII. Conclusion

The primary goal in establishing this system was to eliminate all of the shortcomings and unusual techniques of manually handling attendance. The face recognition attendance system is designed to solve the issues with manual methods. We used the facial recognition idea to track student attendance and constructed a web-based application to improve the user experience and the system. The method works effectively in a variety of stances and variations. It may be argued that utilizing human face recognition technology in a classroom to automate student attendance works reasonably effectively. It can certainly be enhanced to produce a better outcome, especially by paying attention to the feature extraction or identification process.

A **CNN face detector** that is both *highly accurate* and *very robust*, capable of detecting faces from varying viewing angles, lighting conditions, and occlusion. But the face detector can run on an NVIDIA GPU, making it super fast!. So we required high-end computation power devices to achieve greater accuracy. This system can be used in various places like validation of employees in offices, car detection, security purpose, and criminal detection. As we are using the pre-train model, we define features for recognition, so in some cases, our system may fail. Like in-car detection, our model is trained with a human face so it is not proper in-car detection.

VIII. Reference

[1]M. Sajid, R. Hussain and M. Usman, "A conceptual model for automated attendance marking system using facial recognition," Ninth International Conference on Digital Information Management (ICDIM 2014), 2014, pp. 7-10, doi: 10.1109/ICDIM.2014.6991407.

[2]A. Raghuwanshi and P. D. Swami, "An automated classroom attendance system using video based face recognition," 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2017, pp. 719-724, doi: 10.1109/RTEICT.2017.8256691.

[3]E. Winarno, W. Hadikurniawati, I. H. Al Amin and M. Sukur, "Anti-cheating presence system based on 3WPrincipal Component Analysis(PCA)-dual vision face recognition," 2017 4th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI), 2017, pp. 1-5, doi: 10.1109/EECSI.2017.8239115.

[4]V. Soniya, R. S. Sri, K. S. Titty, R. Ramakrishnan and S. Sivakumar, "Attendance automation using face recognition biometric authentication," 2017 International Conference on Power and Embedded Drive Control (ICPEDC), 2017, pp. 122-127, doi: 10.1109/ICPEDC.2017.8081072.

[5]N. K. Jayant and S. Borra, "Attendance management system using hybrid face recognition techniques," 2016 Conference on Advances in Signal Processing (CASP), 2016, pp. 412-417, doi: 10.1109/CASP.2016.7746206.

[6]P. Wagh, R. Thakare, J. Chaudhari and S. Patil, "Attendance system based on face recognition using eigen face and Principal Component Analysis(PCA) algorithms," 2015 International Conference on Green Computing and Internet of Things (ICGCIoT), 2015, pp. 303-308, doi: 10.1109/ICGCIoT.2015.7380478.

[7]S. Chintalapati and M. V. Raghunadh, "Automated attendance management system based on face recognition algorithms," 2013 IEEE International Conference on Computational Intelligence and Computing Research, 2013, pp. 1-5, doi: 10.1109/ICCIC.2013.6724266.

[8]E. O. Akay, K. O. Canbek and Y. Oniz, "Automated Student Attendance System Using Face Recognition," 2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), 2020, pp. 1-5, doi: 10.1109/ISMSIT50672.2020.9255052.

[9]E. Varadharajan, R. Dharani, S. Jeevitha, B. Kavinmathi and S. Hemalatha, "Automatic attendance management system using face detection," 2016 Online International Conference on Green Engineering and Technologies (IC-GET), 2016, pp. 1-3, doi: 10.1109/GET.2016.7916753.

[10]E. Rekha and P. Ramaprasad, "An efficient automated attendance management system based on Eigen Face recognition," 2017 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence, 2017, pp. 605-608, doi: 10.1109/CONFLUENCE.2017.7943223.

[11]Y. Sun, B. Xue, M. Zhang, G. G. Yen and J. Lv, "Automatically Designing CNN Architectures Using the Genetic Algorithm for Image Classification," in IEEE Transactions on Cybernetics, vol. 50, no. 9, pp. 3840-3854, Sept. 2020, doi: 10.1109/TCYB.2020.2983860.

[12]Ammar, A.; Koubaa, A.; Ahmed, M.; Saad, A.; Benjdira, B. Vehicle Detection from Aerial Images Using Deep Learning: A Comparative Study. Electronics 2021, 10, 820. https://doi.org/ 10.3390/electronics10070820

[13]S. Gidaris and N. Komodakis, "Object Detection via a Multi-region and Semantic Segmentation-Aware CNN Model," 2015 IEEE International Conference on Computer Vision (ICCV), 2015, pp. 1134-1142, doi: 10.1109/ICCV.2015.135.

[14]Domain adaptive faster R-CNN for object detection in the wild. (n.d.). Retrieved June 4, 2022, fromhttps://www.researchgate.net/publication/329750553_Domain_Adaptive_Faster_R-CNN_for_Object_Detection_in_the_Wild

[15]D. Varshni, K. Thakral, L. Agarwal, R. Nijhawan and A. Mittal, "Pneumonia Detection Using CNN based Feature Extraction," 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), 2019, pp. 1-7, doi: 10.1109/ICECCT.2019.8869364.