Non-Intrusive Facial Recording System with Convolution Neural Network (CNN) for Attendance Assimilation

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Abstract

In recent years, Machine and Deep Learning technologies have gained significant attention and adoption in various industries and applications. One such use is creation of Face Recognition-based attendance system using Convolution Neural Network (CNN) Algorithm. Traditional systems have been using manual attendance registers, RFID cards and biometric attendance. CNNs based system utilizes deep learning to recognize facial features in real-time. It is capable of learning complex spatial patterns and extracting meaningful features from images captured. These systems capture images or videos. Then CNN layers perform tasks such as feature extraction, feature mapping, and classification. By proper training through a large dataset, the system learns to differentiate and identify facial features. They offer enhanced accuracy and minimize chances of errors and impersonation. By proper training, these systems can adapt to slight changes in lighting conditions, facial poses and expressions. It enables organizations to track attendance automatically and eliminated any need of manual data entry. Hence promoting, faster and more streamlined attendance management. Furthermore, these systems can be used to enhance security of an organization through integration with existing access control systems to ensure that only authorized individuals gain access/entry to specific areas. It can also be used with real-time alert systems and are very user friendly, requiring individuals only to face the camera or if more than one camera is present, it automatically detects faces and marks attendance. In conclusion, the face recognition attendance system using CNNs represents a powerful and efficient solution for automating attendance tracking. The following chapter will delve into the technical aspects of implementing such a system, including data collection, CNN architecture, training, and deployment considerations.

Keywords- Face Recognition, attendance system, Convolution Neural Network

1. INTRODUCTION

1.1 Problem Overview-:

Face Recognition Attendance System using Convolutional Neural Network (CNN) is a software designed to automate the process of marking attendance in various settings including schools, colleges and offices as well. It utilizes deep learning techniques, specifically CNN, to identify and label individuals by recognition of their facial features.

Key Components:

a. **Data Collection**: This is the first step and it involves collection of images of individuals eligible to enroll themselves in the dataset. This dataset is used for training the CNN model.
b. **Preprocessing**: Preprocessing of the dataset helps to enhance the quality of the images and reduce noise, if any. Common preprocessing techniques in use include face alignment, normalization, and resizing to ensure consistency in input data.
c. **Model Training**: Preprocessed facial images are used to train the model. CNN architecture typically consists of multiple convolutional layers, pooling layers, and fully connected layers. During training, the model learns to extract meaningful features from the facial images and classify them into different individuals' classes.
d. **Face Detection**: Face detection algorithm is employed to identify and label faces in real-time. Haar cascades, HOG (Histogram of Oriented Gradients), or deep learning-based detectors (such as SSD or YOLO) are examples of techniques used for this purpose.
e. **Face Recognition**: Upon detection of a face, the model matches the facial features extracted to the ones available in the database to successfully re cognize a face. Techniques such as cosine similarity or Euclidean distance are commonly used for this purpose.
f. **Attendance Management**: After a face has been recognized successfully, the concerned individual is marked present in the database. It can also be exported to a spreadsheet or attendance management system for further processing.
g. **User Interface**: A user-friendly interface can be developed to enable the users to be able to interact with the system, it also allows the administrators to manage enrolled individuals, monitor attendance records, and generate reports.
h. **Deployment**: A suitable hardware platform, such as a computer or embedded system can be used to deploy the system to ensure real-time face recognition and attendance

management. However, the hardware requirements may vary depending on the scale and specific application of the program.

1.2 Motivation-:

Convolutional Neural Networks (CNNs) have been used to develop and implement a face recognition-based attendance system for a number of reasons:

a. **Accuracy:** CNNs exhibit astounding accuracy in person recognition because they are excellent at automatically learning and extracting discriminative characteristics from photos. They can classify, categories, and distinguish between faces by identifying distinctive traits on people's faces.
b. **Efficiency:** These automated methods have proven to be significantly more effective than both RFID-based and biometric-based attendance tracking, as well as manual attendance registers. It does away with the need to queue up to scan cards or call out individual names or IDs.
c. **Non-intrusiveness:** A non-intrusive biometric identification method is facing recognition. It doesn't call for direct interaction or the usage of unique tools like iris or fingerprint scanners. The technology only requires that a face be scanned through the camera before it can finish its work.
d. **Real-time Monitoring:** Such technologies can instantly make attendance available by tracking and recording it in real time. In places like schools, universities, or offices, this kind of time management can be advantageous and productive.
e. **Security:** Comparing these systems to more conventional forms of identification like ID cards or PIN codes, they offer a higher level of security. Since fake faces are challenging to create, imitation becomes nearly impossible. In order to increase overall security, face recognition systems can be connected with already-in place security measures like access control systems.
f. **Scalability:** These systems are easily scalable to support large populations of users. Once taught, the system can identify people accurately and quickly from a huge number of facial photos, making it a good fit for businesses with a large staff or student population.
g. **Data Analysis and Insights:** These systems additionally gather and accumulate data over time. Insightful information about attendance patterns, trends, and behavior can be gleaned from this data, facilitating wise resource allocation and decision-making.

Overall, CNN-based facial recognition attendance systems provide a strong and dependable solution for automating attendance management, boosting effectiveness, boosting security, and delivering useful data for analysis and decision-making.

1.3 Uniqueness of the Work-:

A face recognition attendance-based system using CNNs stands out from competing systems for a variety of reasons. Here are some potential characteristics that draw attention to the system's distinction:

a. **Accuracy and Reliability:** In facial recognition challenges, CNNs have shown outstanding accuracy. The technology is special because it can recognize people clearly even in difficult situations with varying lighting, stance, or occlusions. It can be a favored option because it has higher accuracy and dependability compared to other systems.

b. **Real-time Performance:** CNNs are used to process facial recognition tasks quickly and effectively. When compared to slower systems, the system's real-time or nearly real-time performance enables instantaneous attendance tracking and shortens wait times.

c. **Scalability:** Systems built on CNNs are easily scalable to handle large populations of users. Because of the system's architecture and effective algorithms, it can analyze and identify faces quickly, making it appropriate for organizations with a large number of staff, participants, or pupils.

d. **Non-intrusiveness:** Comparatively speaking, CNN-based face recognition systems are less intrusive than other biometric authentication techniques like iris or fingerprint scanning. It is an easy-to-use attendance system since people can just put their faces in front of the camera without making eye contact.

e. **Generalization Capability:** CNN-based systems have demonstrated good generalization skills, which means they can reliably identify faces of various people and generalize well to faces that haven't been seen. The system can accommodate alterations in facial look brought on by ageing, facial hair, or changes in hairstyles thanks to its singularity.

f. **Adaptability to Environmental Conditions**: CNN-based systems can adjust to changes in lighting, backdrop, or camera quality, among other environmental factors. The system's capacity to function well in real-world scenarios with many uncontrollable variables is what makes it special.

g. **Integration with Existing Systems:** The system's smooth integration with current attendance management systems or other relevant technologies can increase its distinctiveness. This integration can improve data administration, simplify attendance monitoring procedures, and increase system effectiveness as a whole.

h. **Customization and Flexibility:** The system's adaptability and customizability possibilities might highlight its singularity. Its features, user interfaces, and data analytic capabilities can all be customized to meet unique organizational or institutional needs.
i. **Privacy and Security:** Concerns about facial recognition technologies can be addressed by implementing special privacy and security precautions. This could involve secure face data handling and storage, privacy-preserving algorithms, or encryption methods.
j. **Value-added Features:** By adding more features above and beyond the fundamental attendance tracking, the system's distinctiveness can be strengthened. Features like emotion detection, age estimation, or gender identification may be included, offering organizations insightful data and analytics.

The ability to achieve high accuracy, real-time performance, scalability, adaptability, and easy connection with current systems makes a facial recognition attendance-based system using CNNs special. The system can provide improved capabilities and advantages over existing attendance systems by concentrating on these particular features.

The remaining of this chapter is organized as follows, Section 2 presents Literature review which will cover existing system, Section 3 presents method which will cover datasets description, schematic Layout, methodology, implementation, tools used, evaluation measures used, Section 4 presents result which will cover system specification, parameters used, experimental outcomes and Section 5 presents conclusion.

2. LITERATURE SURVEY

2.1 Existing System-:

Depending on the environment and the policies of the organization, the current mechanism for recording attendance may change. Traditional approaches to tracking attendance include:

1. **Manual attendance register**: In this method, students or employees manually sign in and out of an attendance register that is printed on paper. The attendance data is then recorded in the register, and the attendance rate is computed.
2. **Barcode or QR code attendance system**: Each student or employee in this system is given a unique set of barcodes or QR codes, which must be printed out. To track attendance, the codes are scanned using a barcode scanner or a mobile device as depicted in **Figure 1**.

Figure 1: illustration of barcode-based attendance system

3. **RFID attendance system**: Radio frequency identification (RFID) technology is used by this system to monitor attendance. Each student or employee is given an RFID tag or card, which is then scanned by a reader to track attendance and is depicted in **Figure 2.**

Figure 2: Illustration of RFID-based attendance system

4. **Biometric attendance system**: This system tracks attendance by utilizing biometric technologies, such as fingerprint or facial recognition as depicted in **Figure 3.** To record attendance, the technology collects biometric information and compares it to a database of recognized users.

Figure 3: Illustration of biometric-based attendance system

2.2 Problem Identification-:

The challenge of reliably and effectively recording attendance in various settings, such as schools, workplaces, and events, must be solved by the establishment of an attendance-based system. Traditional means of tracking attendance, including paper registers or barcode scanners, can be labor-intensive, prone to mistakes, and might leave out fraudulent activities like proxy attendance.

One way to quickly and accurately address this issue is by creating an attendance-based system that makes use of facial recognition technology. These systems can recognize people's faces and automatically record their attendance using computer vision and machine learning techniques, saving time and effort compared to manually recording attendance. Additionally, systems based on attendance can offer advantages like:

a. **Improved accuracy:** Face recognition attendance-based systems can track attendance with a high degree of accuracy, lowering the chance of mistakes and dishonest behavior.
b. **Real-time attendance tracking**: Attendance-based systems can offer real-time attendance tracking, allowing businesses to instantly spot patterns, problems, and trends.
c. **Efficiency**: Compared to conventional attendance tracking methods, attendance-based solutions can save time and effort, allowing organizations to concentrate on other crucial responsibilities.
d. **Accountability**: Systems that track attendance using attendance data can offer a transparent and accountable system, lowering the possibility of disagreements or misunderstandings.

e. **Security**: Compared to conventional attendance monitoring methods, attendance-based solutions can offer greater security, lowering the danger of unauthorized access or tampering.

Overall, the creation of an attendance-based system is required to offer an effective, precise, and trustworthy solution to the issue of tracking attendance in varied situations. It is feasible to create systems that are quick, precise, and offer extra advantages like better efficiency, accountability, and security by employing cutting-edge technologies like facial recognition.

3. MATERIALS AND METHODS

3.1 Dataset(s) Description-:

A dataset of face photos and attendance records is needed to create a smart attendance-based system. The dataset ought to be broad, big, and representative of the target audience for the system. A smart attendance-based system's dataset creation should take the following factors into account:

a. **Data collection**: Face pictures and attendance data may be gathered via a variety of devices, including cameras, mobile phones, and paper attendance records. To guarantee consistency in the data, the gathering procedure should be standardized.

b. **Data labelling**: The attendance records that correlate to each person's face image should be labelled, indicating whether they are present or not. For the dataset to be of the highest caliber, the labelling procedure must be precise and reliable.

c. **Data diversity**: The dataset should include attendance records and face images of people from a variety of genders, ages, races, and backgrounds in order to ensure the robustness and accuracy of the system.

d. **Data quality**: High-quality face images with adequate resolution, lighting, and few occlusions are essential for ensuring the accuracy of face recognition systems.

e. **Data privacy**: The dataset shall be collected and used in accordance with all applicable privacy laws and regulations. It is important to take steps to protect people's privacy and personal information.

f. **Data balance**: To guarantee that the system is equally accurate in identifying both scenarios, the dataset should be balanced between the number of present and absent individuals.

g. Data augmentation: To broaden the dataset and strengthen the resilience of the face recognition algorithms, data augmentation techniques including cropping, rotation, and scaling can be used.

Overall, the creation of a smart attendance-based system that is accurate, dependable, and able to handle a variety of real-world events requires the use of a well-constructed and diverse dataset. It is crucial to make sure the dataset is of a high standard, diversified, and appropriate for the population the system is designed to serve. **Table 1** depicts the representation of the dataset.

Student Name	Associated Image
Balabhadra	
Chiranjib	
Sarthak	
Aditya	

Table 1: Dataset Description Representation

3.2 Schematic Layout-:

Data Entry **Face Recognition** **Attendance Entry**

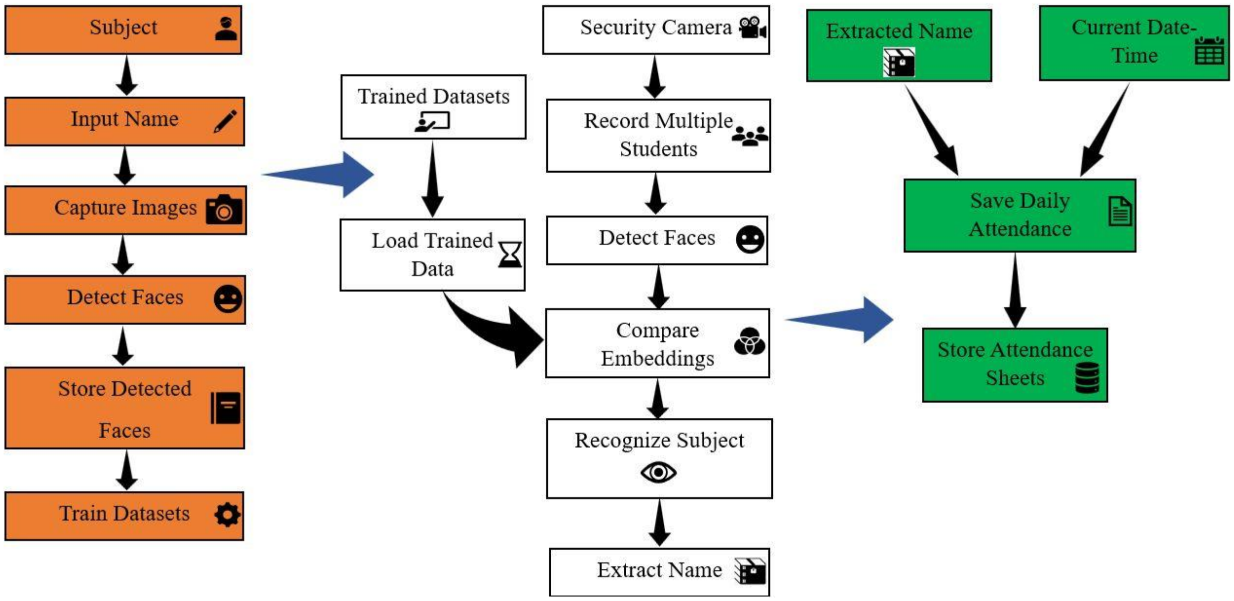


Figure 4: Schematic layout of the system

3.3 Methodology-:

The system calculates attendance subject by subject, that is, the administrator manually enters the data of students such as photos and names, and whenever the time for the corresponding subject arrives, the system automatically starts taking snaps, timing of the class, only when a student stands in front of the camera,

and then updates the data into Excel sheet, this is done by comparing with the registered data as provided by the students to the administrator, and the wand is then used to calculate attendance.

The system's components may be divided into four major stages. These are as follows:

a. **Data Entry:**

The initial stage is to include the students' faces into the system in order to create a dataset. The system takes continuous photos of each of the registered students from a live video feed one at a time, along with their names. It is preferable that students have different head positions throughout this period in order to build a better dataset.

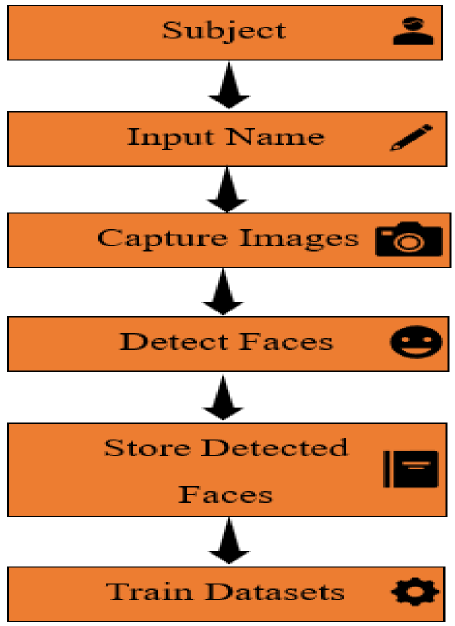


Figure 5: Process of data entry

The parameter can be modified to increase the number of photos captured in order to create a more accurate dataset. A file with the appropriate student's name is produced for each student. Each image of a face is subsequently saved in the student's specified folder. Aside from this, previously taken pictures of the registered students might be added to the dataset to diversify it. In this situation, the new images will be saved in the already created folder for that student. The system is automatically trained after each data entry using the currently available dataset. As a result, the system is already configured to be utilized at any moment once the student's data has been submitted.

b. Algorithm used:

The Convolutional Neural Network (CNN) algorithm is a deep learning technique primarily used for processing grid-like data, such as images, and extracting relevant features for tasks like image classification, object detection, and image segmentation.

Neural networks have a remarkable ability to extract context from complex or approximated data. They are used to extract patterns and discover trends that are too complex for humans or other traditional computer methods to understand. Neural networks have a nonlinear character and are preferred over traditional linear models. This is trained on a single dataset in a certain domain may be easily re-trained to forecast at a comparable level of circumstances. Furthermore, since the framework under consideration is constantly changing and updating, neural networks may adjust their weights accordingly.

The CNN algorithm involves several key steps:

1. **Input:** The algorithm begins with an input image represented as a grid of pixels. Each pixel typically contains intensity or color information represented by numerical values.
2. **Convolution:** The input image is convolved with a set of learnable filters (also called kernels) to extract local features. Each filter is a small matrix that slides over the input image, performing element-wise multiplications and summations at each position to produce a feature map. The convolution operation captures spatial patterns by detecting edges, textures, or other visual features.
3. **Activation:** Each element of the feature map is passed through an activation function, introducing non-linearities into the network. The activation function, commonly ReLU (Rectified Linear Unit), applies a threshold operation, setting negative values to zero and leaving positive values unchanged. This step allows the network to learn complex representations and make the model more expressive.
4. **Pooling:** To reduce spatial dimensions and make the learned features more robust to translations and distortions, pooling operations are applied. The most common pooling operation is max pooling, where a small window slides over the feature map, selecting the maximum value within each window and discarding the rest. Pooling helps in reducing computation and retaining the most salient features.
5. **Repeat Convolution, Activation, and Pooling:** The convolution, activation, and pooling operations are typically repeated multiple times in consecutive layers. This repetition enables the network to learn hierarchical representations, capturing increasingly complex and abstract features at different levels.
6. **Fully Connected Layers:** After several convolutional layers, the network often includes one or more fully connected layers. These layers are similar to traditional neural networks, where each neuron is

connected to every neuron in the previous layer. Fully connected layers learn high-level relationships between the extracted features and make predictions based on them.

7. **Output:** The final fully connected layer produces the network's output, which depends on the specific task. For example, in image classification, it might generate a vector of probabilities representing the likelihood of each class. In object detection, it might output bounding boxes and class labels for detected objects.

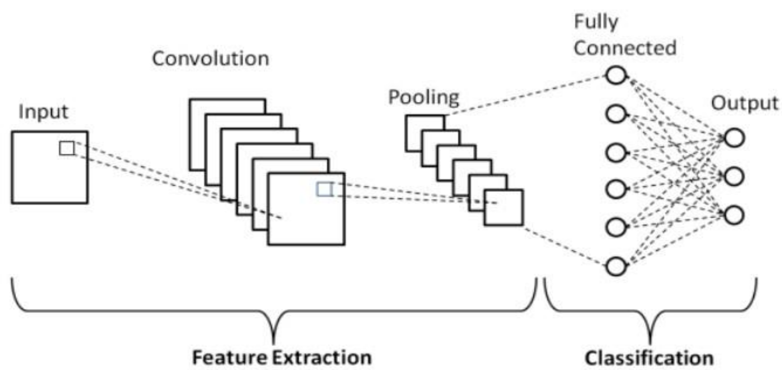


Figure 6: Illustration of layers in the CNN algorithm

8. **Dataset Training:** On the training dataset, CNN model is trained. This involves optimizing the model's weights to reduce the difference between the expected and actual output. The CNN adjusts the weights of the two photos belonging to the same person to bring the vectors closer while simultaneously moving them somewhat further away from the third image. The face_encodings function of the face_recognition library is used throughout this procedure. This phase also automatically generates a spreadsheet with the names of all the students in the class whose information was submitted in the previous stage.
9. **Face Recognition:** In this phase, the system may be configured by positioning a video camera in a good location, preferably on the classroom entryway or within the classroom itself, with a clear view of the pupils. The technology can then recognize the kids' faces from the camera's continuing video stream. After that, the identified faces are compared to the training dataset Each of the matches is assigned a

confidence level. The match with the highest confidence is chosen, and the label, which is the student's name, is extracted. If there is no match of sufficient precision, the student is classified as Unknown. This is shown in the **Figure 7.**

10. **Attendance Entry:** The names of recognized students are automatically updated on a daily attendance spreadsheet together with the date, time, and subject name throughout each session of the video feed, i.e., each period of courses. **Figure 8** depicts how attendance is stored.

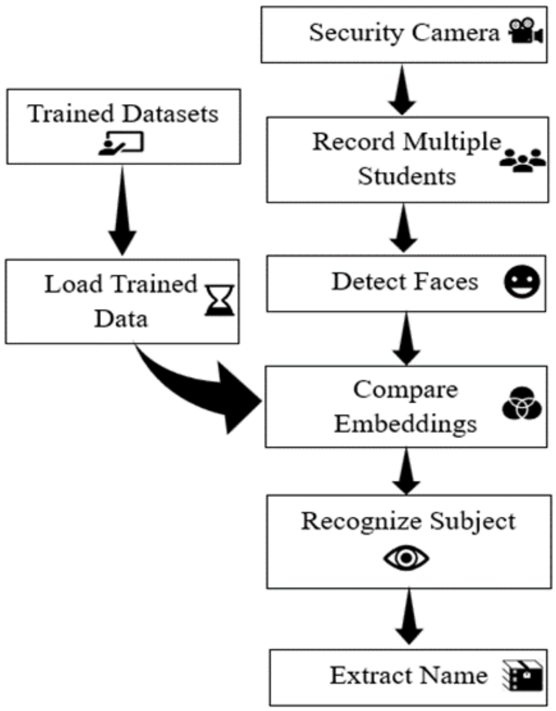


Figure 7: Process of recognition of faces by the system

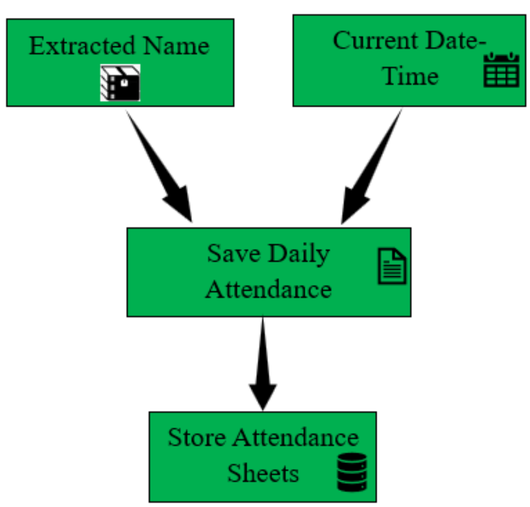


Figure 8: Process of storing attendance in excel files/database

3.5 Implementation-:

Adding the student's data: - To add student's details, we require two types of python programming code.

- Image capture python code
- Face recognition python code

At first, the student's data is added by using python programming, in python IDLE 3.8.10 as shown in the figure. The image is captured by using image capture python code then after hitting the run button the administrator has to add the name of the student, after which a video stream pops up where we can take picture of respective students and saving them in a file. **Figure 9** depicts the screenshot of how a student can get himself registered.

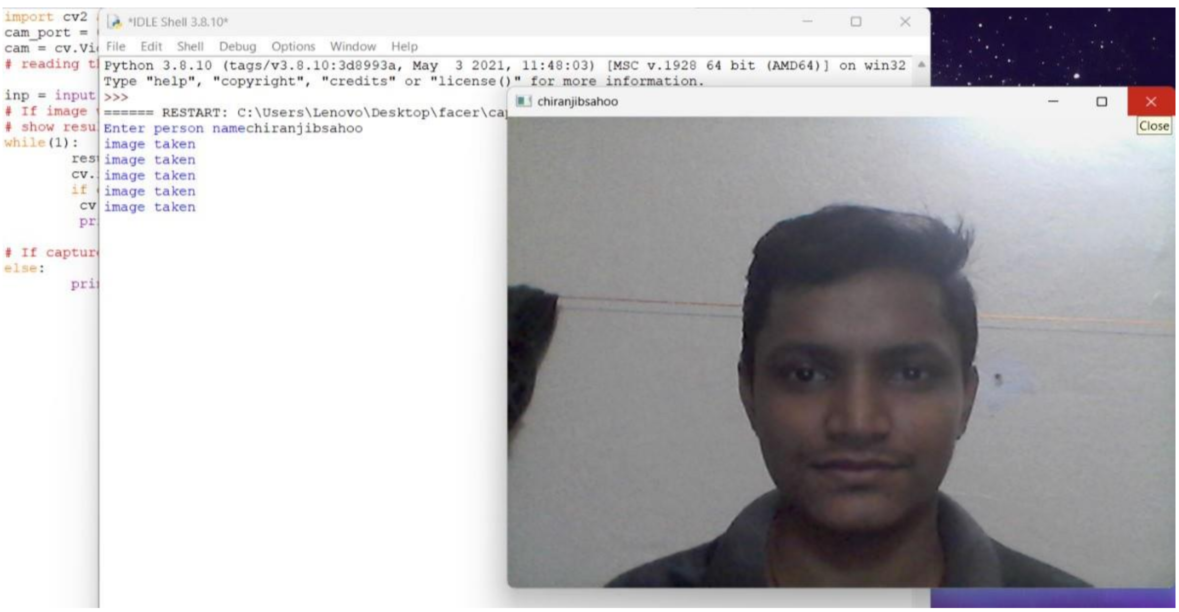


Figure 9: Student getting himself registered

Student's image view: - In this face recognition code, student's image that is captured by the camera is being compared with the file which was saved by using image capture code. During class, the camera is already turned on. The students' faces are discovered and recognized from the video stream. As seen in the diagram below. Two pairs of students' faces are recognized in rectangles and identified by displaying their matching names within the red box. The system then begins to label and record attendance. This process is repeated for each class, and the current student's attendance is automatically recorded.

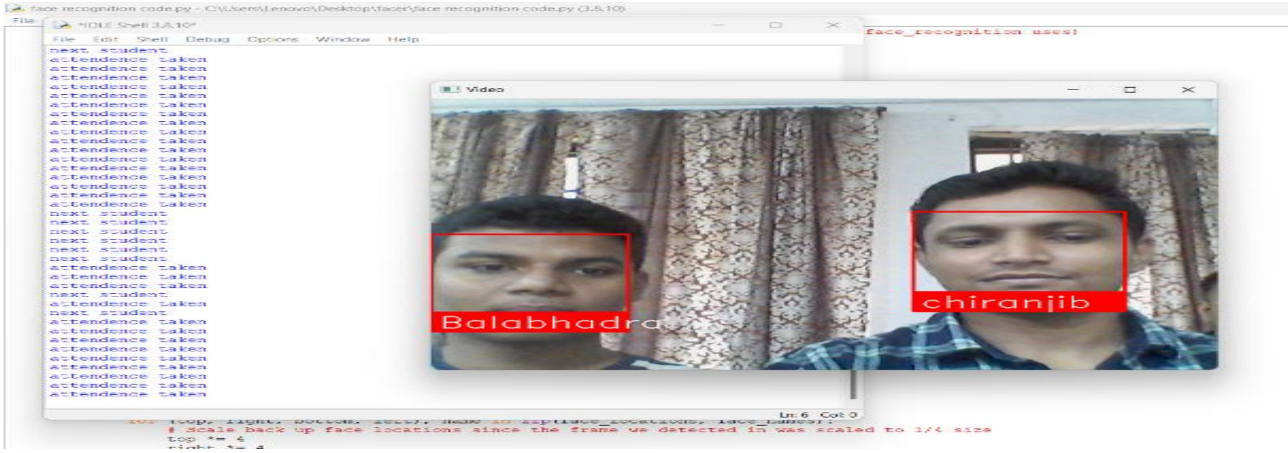


Figure 10.1: Illustration of system identifying and labelling registered students

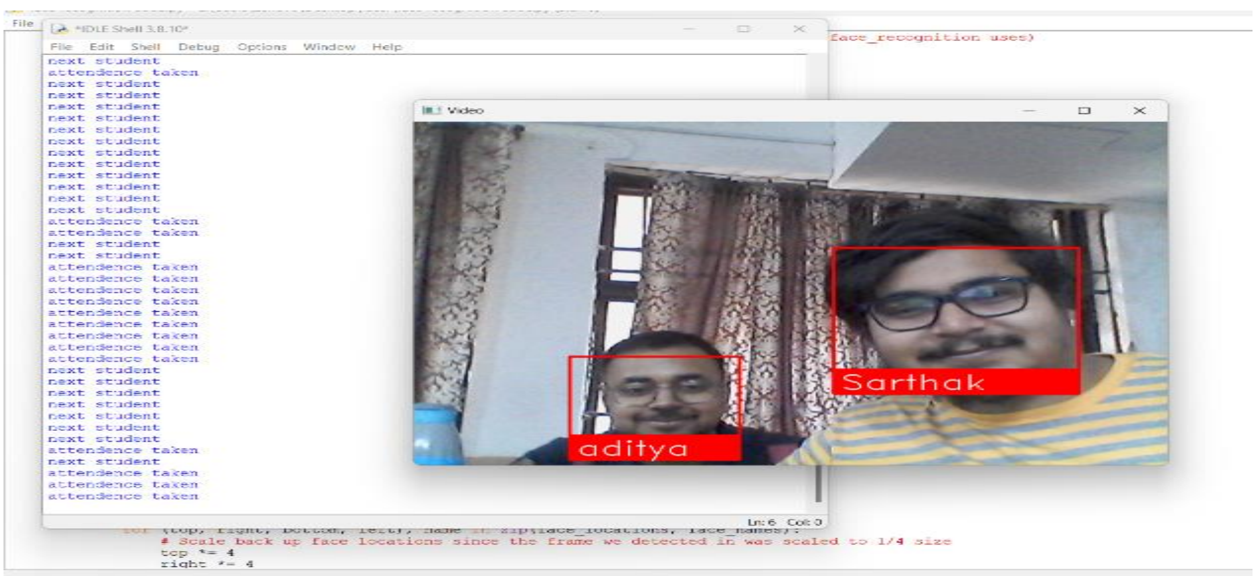
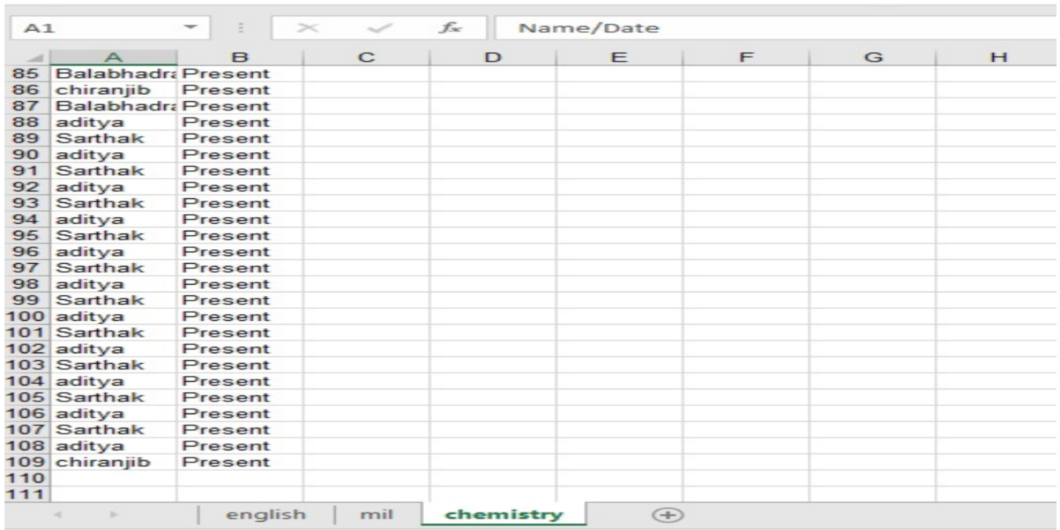


Figure 10.2: Testing system identification and labelling registered students

Student's attendance records: - When the image is captured by the biometric or the camera before every class, the captured image including date, time, name and respective subject name are updated in Excel sheet simultaneously. Due to which the records are stored hassle free.



	A	B	C	D	E	F	G	H
85	Balabhadra	Present						
86	chiranjib	Present						
87	Balabhadra	Present						
88	aditya	Present						
89	Sarthak	Present						
90	aditya	Present						
91	Sarthak	Present						
92	aditya	Present						
93	Sarthak	Present						
94	aditya	Present						
95	Sarthak	Present						
96	aditya	Present						
97	Sarthak	Present						
98	aditya	Present						
99	Sarthak	Present						
100	aditya	Present						
101	Sarthak	Present						
102	aditya	Present						
103	Sarthak	Present						
104	aditya	Present						
105	Sarthak	Present						
106	aditya	Present						
107	Sarthak	Present						
108	aditya	Present						
109	chiranjib	Present						
110								
111								

Figure 11: Recording of attendance in excel file

3.6 Tools Used-:

In order to effectively create and implement the solution, the facial recognition attendance-based system employing CNN depends on a combination of different tools and technologies. Among the important resources employed in this study are:

a. **Python**: Python is a popular programming language for computer vision and machine learning tasks. It offers a comprehensive selection of libraries and frameworks that make system building easier.
b. **OpenCV (cv2):** OpenCV is a free and open-source computer vision library that offers a variety of tools and techniques for face recognition, facial feature extraction, and image processing. It is heavily utilized in the system for face-related functions and image editing.
c. **Dlib**: Dlib is a flexible library that provides a variety of machine learning tools and methods, such as face recognition and facial landmark identification. It offers pre-trained face recognition models that can be used for precise face identification tasks, such as the "dlib_face_recognition_resnet_model_v1".
d. **Face Recognition**: A high-level wrapper constructed on Dlib, the Face Recognition library. For face detection, facial feature extraction, and face recognition, it offers a straightforward and practical interface. It is renowned for being user-friendly and handles both image and video processing.

e. **NumPy** is an essential Python package for scientific computing. It offers effective numerical operations and the ability to work with multi-dimensional arrays, both of which are necessary for model training and data preprocessing.

3.7 Evaluation Measures Used-:

Convolutional Neural Networks (CNN)-based facial recognition attendance systems are evaluated using a variety of assessment metrics to gauge their effectiveness. The following are some crucial tests for facial recognition systems:

a. **Accuracy**: The facial recognition system's overall correctness is gauged by accuracy. It is the proportion of faces that were correctly identified to all the faces in the dataset. The performance of the system is frequently evaluated using accuracy as the key evaluation metric.
b. **False Acceptance Rate (FAR)** is a measurement of the frequency with which a face that does not match any enrolled identities is mistakenly accepted by the system. It is the proportion of incorrectly accepted faces to all the non-matching faces the system received. lesser FAR values suggest a lesser likelihood of unauthorized access.
c. **False Rejection Rate (FRR)** is a measurement of the frequency with which a face that should have been recognized as a match to an enrolled identity is inadvertently rejected by the system. It is the proportion of incorrectly rejected faces to all the matching faces the system received. A lower FRR denotes a higher likelihood of a successful identification. The FAR and FRR trade-off at various operating points is depicted graphically by the receiver operating characteristic (ROC) curve. It aids in visualizing how well a face recognition system performs at various threshold levels.
d. **Equal Error Rate (EER):** The ROC curve's intersection points where the FAR and FRR are equal is represented as EER. It offers a single value that may be compared between various facial recognition programs. Better performance is indicated by a lower EER.
e. **Precision and Recall**: The ratio of correctly identified faces to all positive faces identified by the system is known as precision. Recall is the proportion of faces that were correctly identified to all the faces in the dataset that were expected to be identified as positive. When assessing the system's performance for particular classes or categories, these metrics are helpful. These assessment criteria can be used to evaluate the efficiency and performance of a CNN-based facial recognition attendance system. When choosing proper evaluation measures, it's crucial to take the system's specific requirements and goals into account.

4.RESULTS

4.1 System Specification-:

Depending on the individual objectives and implementation choices, the system specifications of a facial recognition attendance-based system using CNNs can change. Here are some general system requirements to take into account, though:

a. Hardware Requirements:

CPU: A contemporary multi-core processor that can manage the computational load required for operations like face recognition.

GPU: The training and inference phases of CNN-based models can be greatly accelerated with a dedicated graphics processing unit (GPU).

Memory: The CNN model, input images, and intermediate computations can all be stored in enough RAM.

Storage: Enough room in which to keep the dataset, the preprocessed pictures, and the trained models.

Camera: Clear facial photos may be captured using high-resolution cameras under a variety of lighting circumstances.

Network Connectivity: For cloud-based services, remote access, or data synchronization, internet connectivity may be necessary.

b. Software Requirements:

Operating System: The choice of the operating system may depend on the compatibility of the development framework and libraries being used. Common options include Windows, Linux, or macOS.

Image Processing Libraries: Libraries like OpenCV can be used for face detection, image preprocessing, and other image-related operations.

4.2 CNN Model Specifications:

Architecture: Select a CNN architecture like VGGNet, ResNet, or Inception Net that is appropriate for face recognition. Depending on the amount of the dataset and the difficulty of the problem, the network's depth and configuration can be changed.

Input Image Size: Determine the input picture size that the CNN model anticipates. Images are frequently square, although the size might change depending on the technology limitations and model architecture.

Hyperparameters: Through experimentation and optimization, determine the values for hyperparameters such learning rate, batch size, weight decay, and dropout rate.

4.3 Performance Considerations:

Real-time Performance: If the system needs to track attendance in real time, speed up processing by optimizing the model, algorithms, and hardware.

Accuracy: Define the required accuracy level based on the dataset's properties and the application's requirements. Aim to train the model to attain high accuracy while taking into account any system performance trade-offs.

Scalability: Design the system with scalability in mind, taking into account hardware resources, model architecture, and software implementation to manage the projected number of users or students.

These requirements offer a framework for creating and putting into use a face recognition attendance-based system employing CNNs. It's crucial to remember that exact requirements can change based on the goals, restrictions, and target environment of the system.

4.4 Parameters Used -:

In a face recognition attendance-based system using Convolutional Neural Networks (CNNs), several parameters are typically used. Here are some important parameters commonly utilized in such systems:

a. **Image Size-:** The image size is 400 to 500 kb depending on the light condition while under the low light image size is approximately 400 kb and in case of bright light the image size is about 500kb.Its width is 640 pixel and height is 480 pixel.
b. **Frame Size-:** Number of faces recognized can be increased by increasing the frame size but it will also escalate the time complexity of the model, resulting in slower recognition process. So, for better efficacy frame size is set to 1:4 ratio. Its width is 640 pixels and height are 480pixel. The code is written in such a way that it will Resize the video to 1/4 size for faster face recognition processing
   fx=0.25, and fy=0.25 both are where
   fx: Scale factor along the horizontal axis of frame

fy: Scale factor along the vertical axis of frame

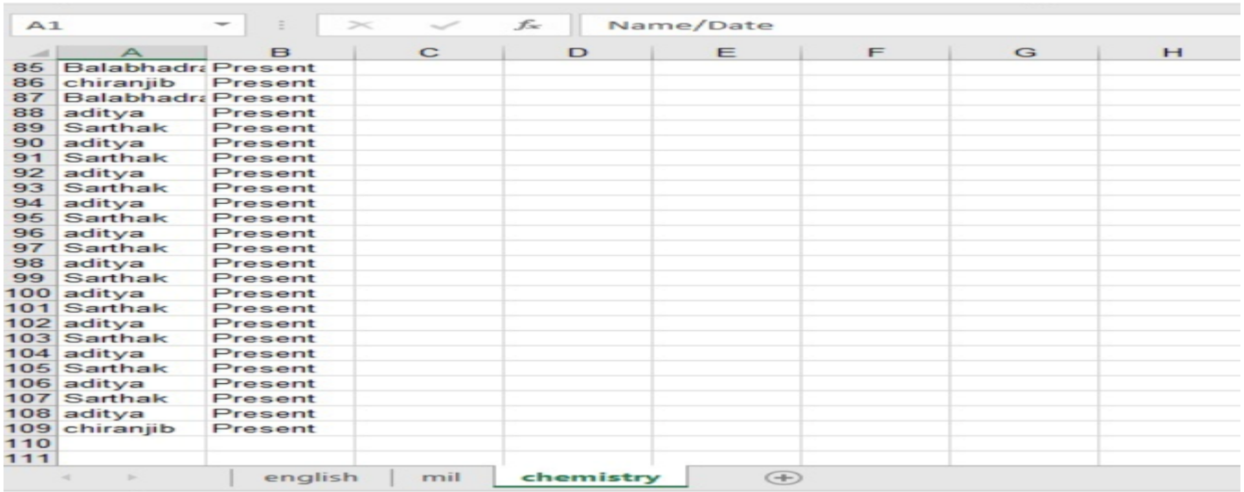
- **c. c. Image Resolution-:** The resolution of the input images plays a crucial role in face recognition accuracy. Higher resolution images generally contain more details, allowing for better feature extraction. However, higher resolution images also require more computational resources.
- d. **Convolutional Neural Network Architecture-:** The architecture of the CNN model determines the network's structure, including the number and configuration of layers, filter sizes, and the presence of pooling and normalization layers. Popular architectures for face recognition include VGGNet, ResNet, and Inception Net.
- **e. Pooling Layers-:** The number of pooling layers and their placement in a face recognition attendance system using CNNs can be customized based on the specific requirements of the application. The parameters that control the size and stride of the pooling operation used to down sample the feature maps.
- f. **Fully connected layer weights-:** The specific values of the weights in the fully connected layers are determined through an optimization process such as gradient descent. The weights of the fully connected layers that map the extracted features to the output classes.
- **g. Training Data-:** The quality and size of the training dataset are essential for training an accurate face recognition model. The dataset should encompass diverse facial variations, including different poses, lighting conditions, and backgrounds, to ensure robust performance**.**
- **h. Distance and Angle-:** The distance up to which it will recognize the face is 90cm and angle is 60 degrees but a condition must be satisfied i.e., both eyes should be visible. we also tested a special case where if your image stored in database is without specs and your current image is with specs it will still recognize.

4.3 Experimental Outcomes-:

In this section, the results of the work of this model have been discussed. It informs us about the end results of the process and also the way to analyze or read the information acquired.

The model when run, automatically clicks pictures through the camera of the device used in the implementation. Hence, it updates the system whether ‘attendance taken’ or ‘attendance not taken’. Attendance is successfully taken if a person already is a part of the database of registered students/ employees, whatever the case may be. In the following screenshots, registered students have been recognized by the system and attendance has been successfully taken.

Figure 12.3 is illustrating the outcome produced by the system. The attendance so taken is then saved in an excel file in a well-organized manner. It is saved both date and subject wise along with the names of the students which is being shown in the image below.



A1 | Name/Date

	A	B	C	D	E	F	G	H
85	Balabhadr	Present						
86	chiranjib	Present						
87	Balabhadr	Present						
88	aditya	Present						
89	Sarthak	Present						
90	aditya	Present						
91	Sarthak	Present						
92	aditya	Present						
93	Sarthak	Present						
94	aditya	Present						
95	Sarthak	Present						
96	aditya	Present						
97	Sarthak	Present						
98	aditya	Present						
99	Sarthak	Present						
100	aditya	Present						
101	Sarthak	Present						
102	aditya	Present						
103	Sarthak	Present						
104	aditya	Present						
105	Sarthak	Present						
106	aditya	Present						
107	Sarthak	Present						
108	aditya	Present						
109	chiranjib	Present						
110								
111								

english | mil | chemistry

Figure 12: Outcome of the System

5. CONCLUSIONS

Through this project work, it has been our narrative to bring out the need and advantages of an automated Face Recognition and Attendance System. In the present context, the scarcest resource one can come across is time. Thus, implementation of such technologies can save an enormous quantity of time wasted in name calling or standing in queues waiting for card based or fingerprint based biometric attendance which can be utilized for more economically beneficial causes. Modified/Advanced versions of this software can also be used for counting attendance in online classes and a time period can be specified as a criterion for getting attendance. Ex: in a 1-hour class, a face detection of not less than 45 minutes will automatically award attendance of the student for that class. Another application is that it can also be connected with a CCTV camera to easily detect employees/students entering an institution and award attendance accordingly. It can also check whether the concerned person is leaving on time or early. We envisage this research paper to be used by students of future generations as a basis for their research and we encourage them to go beyond this system and create a newer, better version of this system as new technologies keep being invented. This system provides better accuracy, efficiency, security, and convenience by utilizing the strengths of deep learning and computer vision. This topic is susceptible to more and more research and development and can be modified to make great gadgets and functions in the welfare of mankind.

References

[1] Kawaguchi, Y., Shoji, T., Lin, W., Kakusho, K., & Minoh, M. (2005, October). Face recognition-based lecture attendance system. In *The 3rd AEARU workshop on network education* (pp. 70-75).

[2] Bhattacharya, S., Nainala, G. S., Das, P., & Routray, A. (2018, July). Smart attendance monitoring system (SAMS): a face recognition-based attendance system for classroom environment. In *2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT)* (pp. 358-360). IEEE.

[3] Hl, D. G., Vishal, K., Dubey, N. K., & Pooja, M. R. (2020). Face recognition-based attendance system. *International Journal of Engineering Research & Technology (IJERT)*, *9*(6).

[4] Selvi, K. S., Chitrakala, P., & Jenitha, A. A. (2014). Face recognition-based attendance marking system. *International Journal of Computer Science and Mobile Computing*, *3*(2), 337-342.

[5] Damale, R. C., & Pathak, B. V. (2018, June). Face recognition-based attendance system using machine learning algorithms. In *2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS)* (pp. 414-419). IEEE.

[6] P. Chakraborty, C. Muzammel, M. Khatun, Sk. Islam and S. Rahman, "Automatic Student Attendance System Using Face Recognition", International Journal of Engineering and Advanced Technology (IJEAT), vol. 9, pp. 93-99, 2020. Doi: 10.35940/ijeat. B4207.029320.

[7] Tata Sutabri, T. S., Pamungkur, P., Ade Kurniawan, A. K., & Raymond Erz Saragih, R. E. S. (2019). Automatic attendance system for university student using face recognition based on deep learning. *International Journal of Machine Learning and Computing*, *9*(5), 668-674.

[8] Balcoh, N. K., Yousaf, M. H., Ahmad, W., & Baig, M. I. (2012). Algorithm for efficient attendance management: Face recognition-based approach. *International Journal of Computer Science Issues (IJCSI)*, *9*(4), 146.

[9] Chin milli, B. T., Anjali, T., Kotturi, A., Kaipu, V. R., & Mandapati, J. V. (2020, June). Face recognition-based attendance system using haar cascade and local binary pattern histogram algorithm. In *2020 4th international conference on trends in electronics and informatics (ICOEI) (48184)* (pp. 701-704). IEEE.

[10] Raj, A. A., Shoheb, M., Arvind, K., & Chethan, K. S. (2020, June). Face recognition based smart attendance system. In *2020 International Conference on Intelligent Engineering and Management (ICIEM)* (pp. 354-357). IEEE.

[11] Madhu, S., Adapa, A., Vatsavaya, V., & Pothula, M. P. (2019). Face recognition-based attendance system using machine learning. *Int J Mang, Tech and Engr*, *9*.

[12] Yang, H., & Han, X. (2020). Face recognition attendance system based on real-time video rocessing. *IEEE Access*, *8*, 159143-159150.