Smart Attendance

Project report submitted in partial fulfillment
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Bachelor of Technology
in
Computer Science Engineering

by

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CERTIFICATE

This is to certify that the project entitled “Smart Attendance” , submitted by Shivral Somani (20UCS184), Abhay Malvi (20UCS006) and Student 3 (Roll no 3) Student 4 (roll nu 4) in partial fulfillment of the requirement of degree in Bachelor of Technology (B. Tech), is a bonafide record of work carried out by them at the Department of Computer Science Engineering, The LNM Institute of Information Technology, Jaipur, (Rajasthan) India, during the academic session 2020-2024 under my supervision and guidance and the same has not been submitted elsewhere for award of any other degree. In my/our opinion, this report is of standard required for the award of the degree of Bachelor of Technology (B. Tech).

Date	Adviser: Dr. Shweta Bhandari

Acknowledgments

Write your text here, to acknowledge the people who have helped you completion of this project.

Abstract

This project aims to develop a smart attendance system that uses machine learning techniques to automate the process of taking attendance. The system will be designed to recognize and identify individuals using facial recognition technology, and will use machine learning algorithms to analyze and process the data. The system will be customizable and adaptable, allowing for integration with existing attendance management systems. In addition, it will provide real-time attendance reports and notifications to help improve efficiency and decision-making. By leveraging machine learning, the proposed system will increase accuracy and reliability of attendance records, while also reducing the time and resources required for manual attendance management. The project has the potential to significantly improve attendance management in various settings, including schools, colleges, and workplaces.

Contents

Chapter 1

Introduction

1.1 The Area of Work

This project primarily focuses on face recognition and detection using various algorithms, with a particular emphasis on utilizing different labeling techniques to map students to their assigned seats.

1.2 Problem Addressed

The face detection attendance system aims to address the problems associated with traditional attendance systems that rely on manual processes. One of the primary issues with manual attendance systems is that they are time-consuming and prone to errors, which can lead to inaccurate attendance records. Additionally, manual attendance systems are vulnerable to fraudulent practices such as proxy attendance, where someone else marks the attendance on behalf of an absent student or employee. These problems can result in loss of productivity and can hinder decision-making processes that depend on accurate attendance data.

The face detection attendance system solves these problems by automating the attendance process using facial recognition and facial detection technology. It accurately identifies and records the attendance of individuals without requiring any manual intervention, thus reducing the time and resources required for attendance management. The system also eliminates the possibility of proxy attendance, as it requires the physical presence of the individual for attendance to be marked. Overall, the face detection attendance system provides a reliable and efficient solution to attendance management problems.

1.3 Existing System

1.3.1 Physical Signing

The traditional system of taking attendance in college lectures involves a manual process where students sign their names on a paper or a register to indicate their presence. However, with the advent of technology, attendance management systems have evolved to become more efficient and reliable.

1.3.2 RFID

A more recent system is the RFID (Radio Frequency Identification) attendance system, where students are provided with RFID tags that are detected by sensors installed in the lecture room. The system identifies the individual tags and records the attendance automatically.

Chapter 2

Literature Review

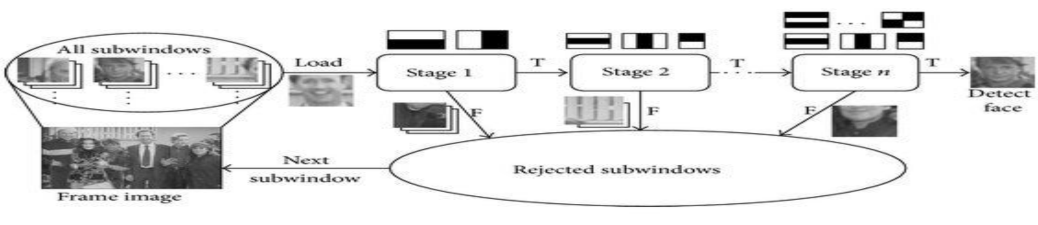
2.1 Introduction

Face detection technology has advanced to the point that it can now be found in commercial products such as smartphones and tablet There has been a moderate amount of research done in this field and we tried to go through a lot of these. Here is a brief of the literary work that we studied and learned from

2.2 Face Detection

2.2.1 Cascade

Since most of the image region is non-face area, it is important to determine whether a given window falls within a face region or a non-face region. If the window is determined to be in a non-face region, it can be discarded. The Cascade Classifier concept suggests that instead of applying 6000 features to a window, features should be grouped by different stages and applied simultaneously in each stage. If the window fails at the initial stage, it is discarded, but if it passes, the next stage is applied, and the process continues until the final stage. If the window passes all stages, it is considered a face region. The detector in this project had 38 stages of features, with the first five stages containing 1, 10, 25, and 50 features, respectively.
$\sum(Pixelsinwhitearea)$-$\sum(Pixelsinblackarea)$



2.2.2 DLIB CNN

The Dlib CNN face detection algorithm combines Convolutional Neural Network (CNN) with Dlib to analyze input imagery. Dlib is an open-source library with machine learning algorithms, while CNN is a deep learning algorithm. The algorithm uses CNN features along with the Dlib toolkit to detect faces, which gives it an advantage over other face detection algorithms. In addition to CNN features, the algorithm also employs Maximum-Margin Object Detector (MMOD). This algorithm automates the manual selection of filters to extract image features, making it easier to use. Users only need to set the number of filters to be used in the algorithm.

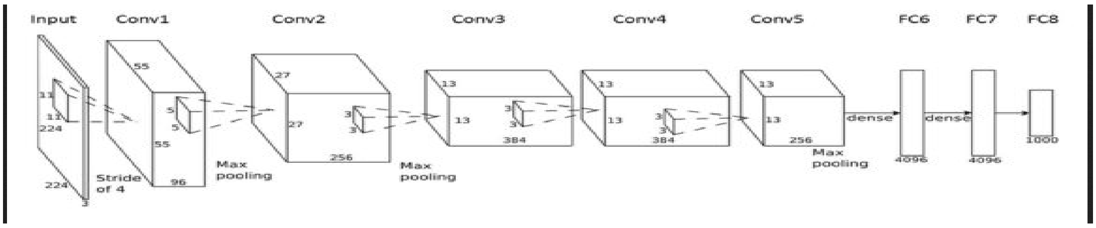


FIGURE 2.1: CNN

2.2.3 HOG linear SVM

The most widely used face detection model is based on Histogram of Oriented Gradients (HOG), which uses a linear SVM Machine Learning to perform face detection. HOG is a powerful and simple feature descriptor that extracts features into a vector and feeds it into a classification algorithm such as Support Vector Machine. The model is built upon five filters: left, back, right, front rotated left, and front rotated right. HOG extracts the distribution (histograms) of the directions of gradients of the image as features. Gradients are most pronounced around edges and corners, making it easier to detect those regions.

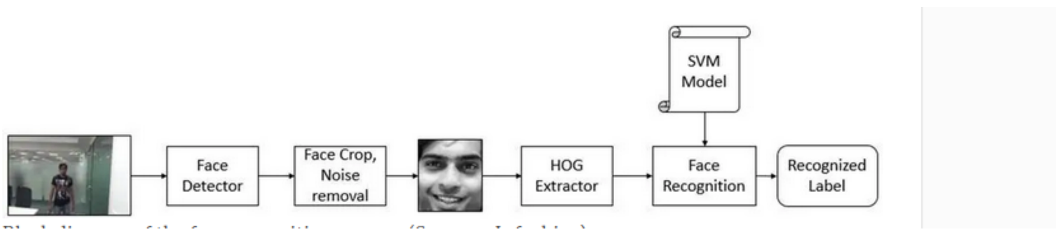


FIGURE 2.2: HOG+SVM

2.2.4 Differences

TABLE 2.1: Pros and Cons of different algorithms

Algorithm	Pros	Cons
Cascade Classifier	• Simple Architecture • Detect Faces at various scales • real time on cpu	• Lots of False Predictions • Don't work on side faces • Don't work under occlusion.
Dlib CNN	• Easy to implement • Works with odd angles • Robust to different face occlusions. • Works on GPU	• Does not work well on real-time images • works slow with CPU • Cannot detect faces below the minimum size
Dlib HOG	• Can work bit frontal face • Light weight model • Can work under different obstruction	• Really slow for real time detection • Does not work for side face • Does not work well under substantial obstruction
MTCNN	• High accuracy. • Supports real time face detection. • It is efficient.	• it may take more time for training. (**Thats why we skipped it)

2.3 Face Recognition

Face recognition is the process of identifying a person from an image or a video frame. It has a wide range of applications, including security systems, access control, and law enforcement. Dlib is an open source library that provides various machine learning algorithms to solve complex problems, including face recognition. Convolutional Neural Networks (CNNs) are a type of deep learning algorithm that is used for analyzing imagery. In this project, we propose a face recognition system based on Dlib and CNNs.

working

The proposed system uses Dlib to detect faces in images and CNNs to extract features from the faces. The extracted features are then used to recognize the faces. The experimental results show that the proposed system achieves higher accuracy and lower computational complexity than other state-of-the-art face recognition systems.

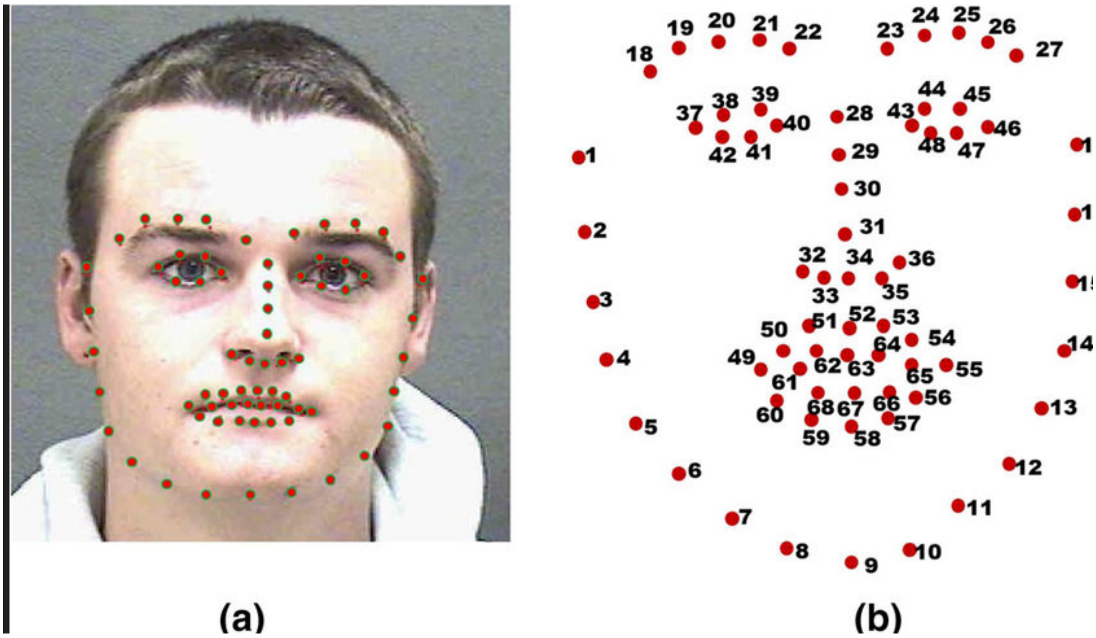


FIGURE 2.3: Features in DLIB CNN

Chapter 3

Proposed Work

Introduction

The proposed solutions for attendance both involve the use of face recognition/detection technologies.
The first solution suggests mapping faces to seats. In this solution, each student's face would be detected and mapped to their seat in the classroom. During each lecture, the system would capture an image of the classroom and compare it to the mapped faces. If a face is present at a particular seat, the system would assume that the person occupying the seat is the student mapped to that face and mark their attendance.
The second solution is more computation-heavy but offers more accurate attendance tracking. In this solution, each student's face would be recognized individually, and their attendance would be marked based on their presence in the classroom. The system would capture an image of the classroom and identify each individual face, matching it to the faces of students enrolled in the class. Once a face is recognized, the attendance of the corresponding student would be marked as present. This approach would require more processing power and storage capacity to store and compare each individual face, but it would provide more accurate attendance tracking and prevent errors that may occur with the mapping of faces to seats approach.

3.1 Face Detection / Mapping Method

3.1.1 Preprocessing

An empty image of the lecture hall is captured to identify the seating arrangement, and a list or mapping of students with their corresponding seats is created. This enables us to accurately map the detected faces to their respective seats during attendance taking.

3.1.2 Detection Algorithm

Various algorithms such as HOG+SVM, MTCNN, and Harcascade are used for face detection. These algorithms analyze the input image to identify regions containing human faces. Upon detection, the face's location is represented by its (x, y) coordinates within the image, which are further processed to provide an accurate positional representation in subsequent steps.

3.1.3 Mapping coordinates

The process of mapping a person to a seat involves comparing the coordinates (x, y) of the detected face with the coordinates (x_i, y_i) of the seats in the lecture hall. If the absolute difference between the x-coordinates of the detected face and the seat is less than a certain threshold value and the absolute difference between the y-coordinates of the detected face and the seat is also less than the same threshold value, then the person is considered to be seated at that particular seat. The threshold value determines how close the detected face needs to be to the actual seat coordinates for the mapping to occur.

$$|\mathrm{x} - \mathrm{x}_i| \leq \delta \ \ \& \ \ |\mathrm{y} - \mathrm{y}_i| \leq \delta \tag{3.1}$$

Here the δ is also dependent on the (x, y) as we go up the image the δ keeps decreasing .

3.2 Face Recognition / Identification Method

3.2.1 Preprocessing

In order to perform face recognition using a Convolutional Neural Network (CNN), we need to have a database of students enrolled in the class. For each student, we extract distinct features of their face and map them to a vector of size 128 bits using a feature extraction algorithm. This vector is then stored in the database along with the student's name and other relevant information. Having a database of students and their corresponding feature vectors is crucial for accurate recognition and attendance marking using a CNN-based approach.

3.2.2 Data Streaming

To use an IP camera for face recognition, the first step involves establishing a network connection with the camera and retrieving its video stream. This video stream is then analyzed frame by frame to detect any faces present in the stream. This is achieved by applying a face detection algorithm such as DLIB CNN to each frame of the video.

Once a face is detected, the face recognition algorithm is used to extract 128-dimensional feature vectors from the face. These vectors are then compared to the vectors of previously enrolled students in the database to recognize them.

This process is repeated for each frame of the video stream, allowing the system to mark the attendance of recognized students. However, this process can be computationally intensive, especially when dealing with high-resolution video streams. To ensure real-time processing, specialized hardware or algorithm optimization may be required.

3.2.3 Recognition

Dlib-based face recognition uses a Convolutional Neural Network (CNN) to extract features from a face image. The features are stored in a 128-dimensional vector called the 128-bit vector. To recognize a face, the CNN first detects and aligns the face in the input image. Then, it extracts 128 features and compares them to the vectors of enrolled students using the Euclidean distance metric. If the distance is below a certain threshold, the face is considered a match, and attendance is marked. The threshold is adjustable and depends on the application's specific requirements.

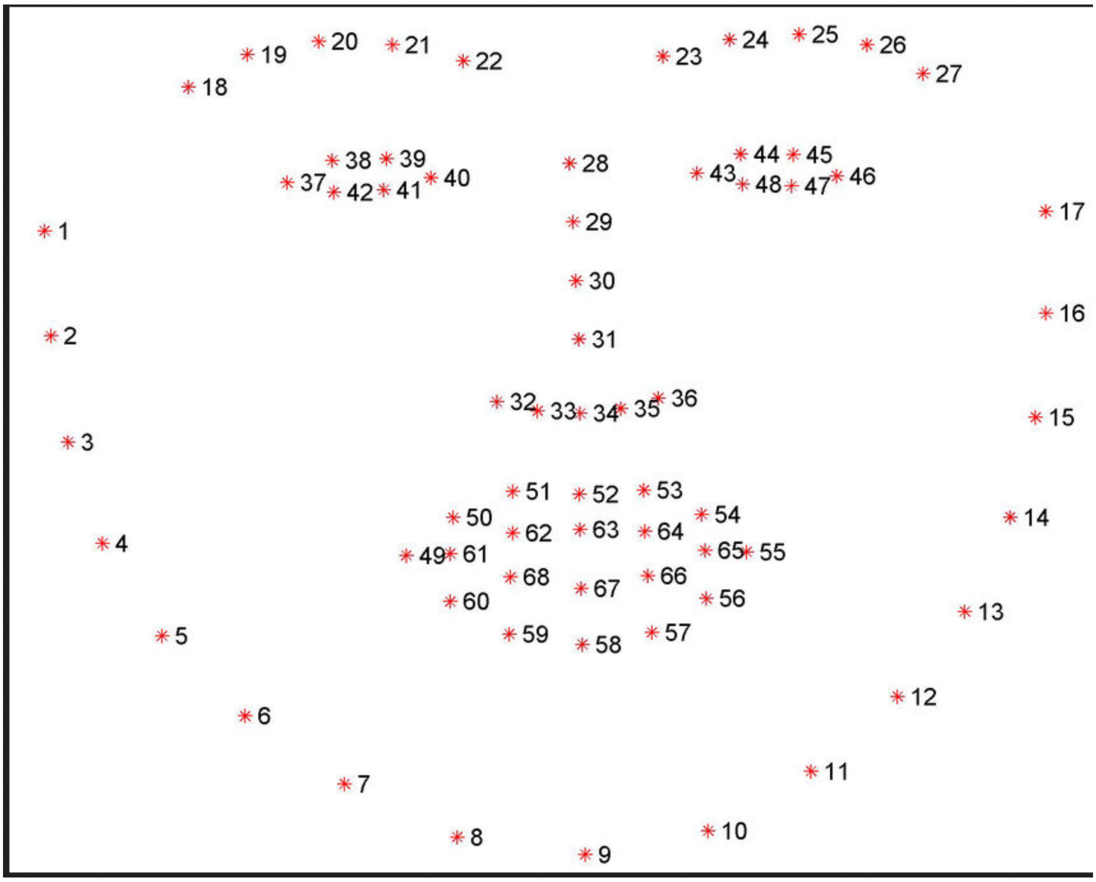


FIGURE 3.1: cascade

3.3 Marking attendance

Once a face is recognized and matched to a student in the database, their attendance can be marked as present. This is usually done by updating a record in a database or spreadsheet with the student's name, timestamp, and any other relevant information.

Chapter 4

Simulation and Results

4.1 Requirements and Specification

Here are the requirements on a modern computer

- Operating System: Windows, macOS or Linux
- Python 3.5 or newer
- CMake 3.12 or newer
- dlib (19.7.0 or newer)
- face_recognition 1.3.0 or newer
- numpy (1.13.3 or newer)
- openCV (4.0.0 or newer)

To access live streaming from a CCTV camera in a lecture hall , it is necessary to have the camera's IP address and port number. This information can be used to establish a network connection with the camera and retrieve the video stream that it generates.

TO ADD Results images

Chapter 5

Conclusions and Future Work

5.1 Conclusion

In conclusion, using face recognition technology for attendance management can greatly improve efficiency and accuracy. By combining various algorithms and tools, such as Dlib, CNN, and IP cameras, the system can detect and recognize faces in real-time and mark the attendance of enrolled students automatically.

Implementing such a system requires careful consideration of various factors, such as hardware and software requirements, data privacy and security, and the specific needs of the application. However, with proper planning and execution, the benefits of such a system can be significant, saving time and reducing errors associated with manual attendance management.

Overall, face recognition technology has a wide range of potential applications, and attendance management is just one of them. As the technology continues to evolve and improve, we can expect to see even more innovative and impactful use cases in the future.

5.2 Future Work

5.2.1 Ease of access

An API (Application Programming Interface) endpoint is a communication channel that enables different software applications to interact with each other. In the context of the attendance project, having an API endpoint for both face detection and recognition methods means that any authorized application or user can request attendance reports for a particular class from anywhere within the university network or the web.

To achieve this, the attendance system should expose a web API with two endpoints, one for face detection and another for face recognition. These endpoints should be secured with proper authentication and authorization mechanisms to ensure that only authorized users can access them.

When a user sends a request to the face detection endpoint, the system should respond with the detected faces and their corresponding coordinates in the image or video stream. Similarly, when a user sends a request to the face recognition endpoint, the system should respond with the list of recognized students and their attendance status.

Having these API endpoints can provide many benefits, including easier access to attendance reports, real-time monitoring of attendance, and seamless integration with other university systems such as student information systems or learning management systems. Additionally, this can help reduce the workload of teachers and administrative staff who would otherwise have to manually collect and process attendance data.

5.2.2 Report Generation

In order to ensure accuracy and transparency in the attendance system, it is important to provide each student with a notification of their attendance status. This can be done by sending a message or email to the student's registered contact information, informing them of their attendance in the class and the dates on which they were marked present.

In cases where there may be false negatives or inaccuracies in the attendance record, the notification provides an opportunity for the student to bring this to the attention of the relevant authorities and have the issue resolved without much hassle.

Providing regular updates and notifications also encourages students to be more engaged and involved in their attendance and academic progress, leading to better academic outcomes. Additionally, it promotes transparency and accountability, which is important in maintaining the trust of both students and faculty in the attendance system.