**A Project Report**

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**Attendly – Face Recognition Attendence System**

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# CANDIDATE’S DECLARATION

We hereby certify that the work which is being presented in the project, entitled

**“ATTENDLY – Face Recognition Attendence System”** in partial fulfillment of the requirements for the award of the B. Tech. (Computer Science and Engineering) submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of August , 2023 to December and 2023, under the supervision of Prof. RAJAKUMAR P. , Department of Computer Science and Engineering, of School of Computing Science and Engineering , Galgotias University, Greater Noida.

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

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## CERTIFICATE

This is to certify that Project Report entitled “……………………...........................................................................................” which is submitted by ………………………….... in partial fulfillment of the requirement for the award of degree B. Tech. in Department of ...................................................... of School of Computing Science and Engineering Department of Computer Science and Engineering

Galgotias University, Greater Noida, India is a record of the candidate own work carried out by him/them under my supervision. The matter embodied in this thesis is original and has not been submitted for the award of any other degree

**Signature of Examiner(s) Signature of Supervisor(s)**

**Signature of Program Chair Signature of Dean**

Date: Nov, 2023

Place: Greater Noida

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ABSTRACT

The Face Recognition Attendance System aims to address several critical issues in traditional attendance tracking. Firstly, it eliminates the need for manual processes, reducing errors and saving valuable time for both educators and employers. This technology enhances security by ensuring that only authorized individuals can mark their attendance, thus preventing proxy attendance fraud. It also provides real-time data and analytics, allowing institutions and organizations to make informed decisions. Additionally, it minimizes the environmental footprint by reducing paper-based processes. Overall, this system enhances efficiency, security, and transparency, making attendance tracking more reliable and efficient for educational institutions and businesses. The Face Recognition Attendance System seeks to bridge critical gaps in the existing attendance tracking methods. Traditional methods, such as manual roll calls or card swiping systems, are prone to errors and proxy attendance, leading to inaccuracies. Our system leverages advanced facial recognition technology to provide a robust, accurate, and automated solution, thereby eliminating these gaps. It ensures real-time data accuracy, improves security by uniquely identifying individuals, and enhances administrative efficiency. Moreover, it offers data analytics and insights, enabling institutions and organizations to make data-driven decisions, which traditional methods lack. This innovation aims to modernize and optimize attendance management, revolutionizing the way we track attendance. Using Facial attendance System Teachers and students Time save.

(Example)

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**CHAPTER 1**

**INTRODUCTION**

* 1. **Introduction**

Attendance is prime important for both the teacher and student of an educational organization. So it is very important to keep record of the attendance. The problem arises when we think about the traditional process of taking attendance in class room.

Calling name or roll number of the student for attendance is not only a problem of time consumption but also it needs energy. So an automatic attendance system can solve all above problems.

There are some automatic attendances making system which are currently used by much institution. One of such system is biometric technique and RFID system. Although it is automatic and a step ahead of traditional method it fails to meet the time constraint. The student has to wait in queue for giving attendance, which is time taking.

This project introduces an involuntary attendance marking system, devoid of any kind of interference with the normal teaching procedure. The system can be also implemented during exam sessions or in other teaching activities where attendance is highly essential. This system eliminates classical student identification such as calling name of the student, or checking respective identification cards of the student, which can not only interfere with the ongoing teaching process, but also can be stressful for students during examination sessions. In addition, the students have to register in the database to be recognized. The enrolment can be done on the spot through the userfriendly interface.

* + 1. **The project features are as follows:**
* College/School: Accurate identification of students for attendance tracking.
* Security: Enhanced access control by recognizing authorized personnel.
* Office: Secure entry by identifying employees for attendance and security purposes.
* Facial recognition restricts access to hospital medicine storage, permitting only authorized medical staff entry for securing sensitive supplies.
* At a concert venue, facial recognition is used to facilitate swift entry for ticket holders, reducing queues and enhancing crowd management.
* In an airport, boarding gates use facial recognition to verify passengers' identities, expediting the boarding process and enhancing security measures

* 1. **Problem Statement**

The traditional methods of taking student attendance face numerous challenges, prompting the proposal of a face recognition-based system as a simpler alternative. Current methods like calling out names, using ID cards, or passing around attendance sheets disrupt the teaching process and cause distractions, especially during exams or in larger classes. However, implementing a face recognition attendance system aims to eliminate these issues by automating attendance without distracting students.

While the face recognition system presents advantages, there are acknowledged difficulties. Zhao, W et al. (2003) highlighted challenges in facial identification, particularly distinguishing between known and unknown images. Pooja G.R et al. (2010) identified slow and time-consuming training processes for this system. Additionally, Priyanka Wagh et al. (2015) pointed out that variations in lighting and head poses can hamper the performance of face recognition attendance systems.

Consequently, the development of a real-time student attendance system becomes essential. Such a system must conduct identification within defined time constraints to prevent delays or omissions. The extracted facial features representing student identities need to remain consistent despite changes in background, lighting, pose, or expression. The effectiveness of such a system will be measured based on high accuracy and rapid computation time. Achieving these objectives will be crucial in evaluating its performance

* 1. **Background**

The process of face recognition involves intricate cognitive steps where the human visual system decodes visual information, analyzes shapes and textures, and compares them to stored memory representations for identification. While replicating this human ability in automated systems is challenging due to the vast memory needed to recognize numerous faces without errors, computers with extensive memory and processing power aid in overcoming these limitations. Face recognition, as a biometric method, identifies individuals by comparing real-time images with stored database images, emphasizing its importance in personal identification and authentication.

* 1. **Tool and Technology Used**
     1. **Python:**

Python leverages OpenCV and dlib libraries, employing LBPH (Local Binary Patterns Histograms) algorithm for precise face detection. Utilizing Pillow for image processing and Tkinter with ttk for GUI, developers can create a comprehensive face detection system, utilizing algorithms, image manipulation, and a user-friendly interface for enhanced functionality and user experience.

* + 1. **Tkinter:**

Using Tkinter and ttk within Python, developers craft intuitive interfaces for the face detection system. These libraries facilitate the creation of interactive GUI elements, enhancing user interaction and accessibility in the face detection application.

* + 1. **TTK:**

With ttk, an extension of Tkinter, developers refine the aesthetics and functionality of the face detection system's GUI. ttk offers modern themed widgets, enhancing the visual appeal and usability of the interface for seamless user interaction.

* + 1. **Pillow:**

Pillow, a Python imaging library, empowers face detection systems by offering extensive image processing capabilities. With Pillow, developers manipulate images efficiently, enabling tasks like pre-processing and enhancing the accuracy of facial recognition algorithms in the system.

* + 1. **Opencv:**

OpenCV, a powerful computer vision library in Python, serves as the backbone for face detection systems. Its comprehensive suite of tools and algorithms enables developers to detect faces, analyze images, and implement machine learning models, forming the core functionality of accurate and robust face recognition applications**.**

* + 1. **Haar Casecade Algorithm:**

The Haar Cascade Algorithm, a feature in OpenCV, specializes in object detection, including faces. This method employs a series of classifiers trained on positive and negative images, detecting patterns like facial features within images through a multi-stage process, enabling precise and efficient face detection in applications.

* + 1. **LBPH Algorithm:**

The LBPH (Local Binary Patterns Histograms) Algorithm, available in OpenCV, is a robust method for facial recognition. It analyzes local texture patterns in images, creating histograms to encode facial features. LBPH's effectiveness lies in its ability to accurately recognize faces despite lighting variations, making it a powerful tool in face detection systems.

* + 1. **Mysql Database:**

MySQL, a popular relational database in Python, serves as a crucial storage component in face detection systems. It efficiently stores facial data, attendance records, and system configurations, ensuring organized and retrievable information essential for managing user identities and system operations.

* + 1. **VsCode:**

VSCode, a widely used code editor, facilitates the development of face detection systems in Python. Its intuitive interface, extensive plugin ecosystem, and debugging tools streamline coding, enhancing productivity and providing a seamless environment for designing, testing, and deploying face recognition algorithms and applications**.**

**CHAPTER 2**

**LITERATURE SURVEY**

**2.1. Student Attendance System:**

Arun Katara highlighted drawbacks of RFID, fingerprint, and iris recognition systems. RFID cards are simple but prone to misuse. Fingerprint systems, though effective, are slow and cause queues. While iris recognition offers detailed data, it raises privacy concerns. Voice recognition is less accurate. Thus, for student attendance, the face recognition system is recommended due to its balance of accuracy and user convenience.

**2.2. Digital Image processing:**

Digital Image Processing is the processing of images which are digital in nature by a digital computer. Digital image processing techniques are motivated by three major applications mainly:

● Improvement of pictorial information for human perception

● Image processing for autonomous machine application

● Efficient storage and transmission

**2.3. Image Representation in a Digital Computer:**

An image is a 2-Dimensional light intensity function

**𝐟 (𝐱,) = 𝐫 (𝐱,𝐲) × 𝐢 (𝐱,𝐲) -(2.0)**

Where, r (x, y) is the reflectivity of the surface of the corresponding image point. i (x,y) Represents the intensity of the incident light. A digital image f(x, y) is discretized both in spatial co-ordinates by grids and in brightness by quantization. Effectively, the image can be represented as a matrix whose row, column indices specify a point in the image and the element value identifies gray level value at that point. These elements are referred to as pixels or pels.

Typically following image processing applications, the image size which is used is𝟐𝟓𝟔 × 𝟐𝟓𝟔, elements, 𝟔𝟒𝟎 × 𝟒𝟖𝟎 pels or 𝟏𝟎𝟐𝟒 × 𝟏𝟎𝟐𝟒 pixels. Quantization of these matrix pixels is done at 8 bits for black and white images and 24 bits for colored images (because of the three color planes Red, Green and Blue each at 8 bits)[.

**2.4. Steps in Digital Image Processing:**

* Digital image processing involves the following basic tasks:
* Image Acquisition - An imaging sensor and the capability to digitize the signal produced by the sensor.
* Preprocessing – Enhances the image quality, filtering, contrast enhancement etc.
* Segmentation – Partitions an input image into constituent parts of objects
* Description/feature Selection – extracts the description of image objects suitable for further computer processing.
* Recognition and Interpretation – Assigning a label to the object based on the information provided by its descriptor. Interpretation assigns meaning to a set of labelled objects.
* Knowledge Base – This helps for efficient processing as well as inter module cooperation

**2.5. Definition of Terms and History:**

**Face Detection:**

Face detection is the process of identifying and locating all the present faces in a single image or video regardless of their position, scale, orientation, age and expression. Furthermore, the detection should be irrespective of extraneous illumination conditions and the image and video content[5 ].

**Face Recognition:**

Face Recognition is a visual pattern recognition problem, where the face, represented as a three dimensional object that is subject to varying illumination, 13 pose and other factors, needs to be identified based on acquired images[6 ]. Face Recognition is therefore simply the task of identifying an already detected face as a known or unknown face and in more advanced cases telling exactly whose face it is[7 ].

**Difference between Face Detection and Face Recognition**

Face detection answers the question, Where is the face? It identifies an object as a “face” and locates it in the input image. Face Recognition on the other hand answers the question who is this? Or whose face is it? It decides if the detected face is someone .It can therefore be seen that face detections output (the detected face) is the input to the face recognizer and the face Recognition’s output is the final decision i.e. face known or face unknown

**Face Detection:**

A face Detector has to tell whether an image of arbitrary size contains a human face and if so, where it is. Face detection can be performed based on several cues: skin color (for faces in color images and videos, motion (for faces in videos), facial/head shape, facial appearance or a combination of these parameters. Most face detection algorithms are appearance based without using other cues. An input image is scanned at all possible locations and scales by a sub window. Face detection is posed as classifying the pattern in the sub window either as a face or a non-face. The face/non-face classifier is learned from face and non-face training examples using statistical learning methods [9 ]. Most modern algorithms are based on the Viola Jones object detection framework, which is based on Haar Cascades.

Viola-Jones algorithm which was introduced by P. Viola, M. J. Jones (2001) is the most popular algorithm to localize the face segment from static images or video frame. Basically the concept of Viola-Jones algorithm consists of four parts. The first part is known as Haar feature, second part is where integral image is created, followed by implementation of Adaboost on the third part and lastly cascading process

**2.6. Local Binary Pattern Histogram:**

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

It was first described in 1994 (LBP) and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we can represent the face images with a simple data vector.

**LBPH algorithm work step by step:**

LBPH algorithm work in 5 steps.

1. **Parameters:** the LBPH uses 4 parameters:

● **Radius**: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.

● **Neighbors**: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.

● **Grid X**: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8

● **Grid Y:** the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8

**2. Training the Algorithm:** First, we need to train the algorithm. To do so, we need to use a dataset with the facial images of the people we want to recognize. We need to also set an ID (it may be a number or the name of the person) for each image, so the algorithm will use this information to recognize an input image and give you an output. Images of the same person must have the same ID. With the training set already constructed, let’s see the LBPH computational steps.

**3.** **Applying the LBP operation:** The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters radius and neighbors

**4. Extracting the Histograms:** Now, using the image generated in the last step, we can use the Grid X and Grid Y parameters to divide the image into multiple grids, as can be seen in the following image:

**5. Performing the face recognition:** In this step, the algorithm is already trained. Each histogram created is used to represent each image from the training dataset. So, given an input image, we perform the steps again for this new image and creates a histogram which represents the image

**CHAPTER 3**

**SYSTEM DESIGN AND METHODOLOGY**

# 3.1. Data Collection:

# Data collection involves sourcing a diverse range of facial images, ensuring variations in lighting, angles, and expressions. Ethical acquisition and storage practices must be followed, gathering a comprehensive dataset essential for effective model training. High-quality images across demographics enhance the system's ability to accurately recognize faces under different conditions, ensuring robustness and reliability in real-world applications.

# 3.2. Preprocessing:

# Preprocessing encompasses standardizing image sizes, adjusting lighting, and aligning facial features. This step normalizes the dataset, reducing variability and ensuring consistency for accurate feature extraction. Techniques like histogram equalization or normalization enhance image quality, mitigating effects of lighting variations. Alignment methods like landmark detection aid in positioning facial elements uniformly, optimizing data for subsequent feature extraction and improving the system's ability to recognize faces across different orientations and conditions.

# 3.3. Feature Extraction:

Feature extraction involves utilizing advanced algorithms, such as Convolutional Neural Networks (CNNs), to discern and isolate distinct facial features from images. This process identifies key facial components like eyes, nose, and mouth, encoding them into numerical representations. Techniques like deep learning or Eigenfaces analyze patterns within facial images, capturing essential characteristics crucial for accurate recognition. Extracting discriminative features enhances the system's ability to differentiate between individuals, ensuring precise and reliable face recognition capabilities.

# 3.4. Model Training:

Model training involves feeding the extracted facial features into machine learning algorithms, such as Support Vector Machines (SVM) or neural networks, to enable the system to recognize and differentiate between individuals. This phase employs labeled data to teach the model patterns and correlations within facial features. Iterative adjustments and optimizations refine the model's ability to accurately identify individuals, ensuring robustness and reliability in real-time face recognition scenarios. The trained model forms the core of the system's ability to make accurate attendance identifications.

# 3.5. System Integration:

System integration merges the developed face recognition model with a user-friendly interface and hardware components. It involves creating a platform that captures live video or images, processes them through the recognition model, and seamlessly integrates with attendance databases or management systems. The interface should enable efficient data handling, providing real-time recognition results, and ensuring compatibility with various devices. This phase ensures the system's practicality and usability in real-world scenarios, facilitating streamlined attendance tracking through face recognition technology.

# 3.6. Testing and Refinement:

Testing involves rigorous evaluation of the face recognition system's performance. Through methods like cross-validation and accuracy assessment, the system's effectiveness, precision, and robustness are measured. Refinement occurs by fine-tuning algorithms, adjusting parameters, and addressing any identified issues or weaknesses. Iterative testing and improvement cycles aim to enhance accuracy, reliability, and efficiency, ensuring the system operates optimally in diverse scenarios before deployment. Regular evaluations and adjustments maintain the system's high performance and reliability over time.

# 3.7. Deployment:

Deployment involves the implementation of the face recognition system into the intended environment. This phase includes installing the system, ensuring its seamless integration with existing infrastructure, and providing necessary user training. Privacy and security measures are upheld to protect user data. Continuous monitoring and support are essential during deployment to address any unforeseen issues and ensure smooth operation. Regular updates and maintenance ensure the system's efficiency, accuracy, and security while meeting the attendance tracking needs within the targeted setting.

**CHAPTER 4**

# IMPLEMENTATION AND RESULTS

**4.1. INTRODUCTION:**

Face detection involves separating image windows into two classes; one containing faces (turning the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background. The face detection task can be broken down into two steps. The first step is a classification task that takes some arbitrary image as input and outputs a binary value of yes or no, indicating whether there are any faces present in the image. The second step is the face localization task that aims to take an image as input and output the location of any face or faces within that image as some bounding box with (x, y, width, height).After taking the picture the system will compare the equality of the pictures in its database and give the most related result. We will use NVIDIA Jetson Nano Developer kit, Logitech C270 HD Webcam, open CV platform and will do the coding in python language.

**4.2. Modal Implementation:**

The main components used in the implementation approach are open source computer vision library (OpenCV). One of OpenCV’s goals is to provide a simpleto-use computer vision infrastructure that helps people build fairly sophisticated vision applications quickly. OpenCV library contains over 500 functions that span many areas in vision. The primary technology behind Face recognition is OpenCV. The user stands in front of the camera keeping a minimum distance of 50cm and his image is taken as an input. The frontal face is extracted from the image then converted to gray scale and stored. The Principal component Analysis (PCA) algorithm is performed on the images and the eigen values are stored in an xml file. When a user requests for recognition the frontal face is extracted from the captured video frame through the camera. The eigen value is re-calculated for the test face and it is matched with the stored data for the closest neighbour

**4.3. Design Requirements:**

We used some tools to build the system. Without the help of these tools it would not be possible to make it done. Here we will discuss about the most important one.

**4.3.1. Software Implementation:**

**1. OpenCV**: We used OpenCV 3 dependency for python 3. OpenCV is library where there are lots of image processing functions are available. This is very useful library for image processing. Even one can get expected outcome without writing a single code. The library is cross-platform and free for use under the open-source BSD license. Example of some supported functions are given bellow:

● Derivation: Gradient/Laplacian computing, contours delimitation

● Hough transforms: lines, segments, circles, and geometrical shapes detection 24

● Histograms: computing, equalization, and object localization with back projection algorithm

● Segmentation: thresholding, distance transform, foreground/background detection, watershed segmentation

● Filtering: linear and nonlinear filters, morphological operations

● Cascade detectors: detection of face, eye, car plates

● Interest points: detection and matching

● Video processing: optical flow, background subtraction, camshaft (object tracking)

● Photography: panoramas realization, high definition imaging (HDR), image inpainting So it was very important to install OpenCV. But installing OpenCV 3 is a complex process. How we did it is given below:

**CHAPTER 5**

# CONCLUSION

* 1. **Performance Evaluation**

The performance evaluation confirms the face recognition attendance system's robust accuracy, ensuring reliable identification within the database. Real-time processing capabilities facilitate swift attendance tracking, while its seamless integration and user-friendly interface underscore practicality in diverse settings. Continuous refinement remains crucial to sustain and elevate its efficiency and adaptability in evolving environments, promising a reliable and efficient solution for attendance management through facial recognition technology.

* 1. **Comparison with existing State-of-the-Art Technologies**

In comparison to existing state-of-the-art technologies, the implemented face recognition attendance system showcases competitive accuracy and real-time processing. While some systems might boast marginally higher precision, our system demonstrates commendable performance in swiftly identifying individuals. Its integration and user-friendliness align with modern standards, offering practicality in diverse environments. However, continuous advancements in technology warrant ongoing improvements to match the rapidly evolving landscape and ensure sustained competitiveness against other cutting-edge face recognition systems.

* 1. **Future Directions:**

Future directions in face recognition attendance systems may include:

**1. Enhanced Accuracy:** Advancements in machine learning algorithms and deep neural networks to further improve accuracy, especially in challenging conditions like low light or occlusions.

**2. Privacy Measures:** Developing techniques to ensure user privacy, such as encryption methods or privacy-preserving algorithms, while maintaining effective identification.

**3. Multimodal Integration:** Integration of multiple biometric modalities (facial, iris, voice) for more robust and secure attendance tracking systems.

**4. Edge Computing:** Implementing face recognition models on edge devices for faster processing and reduced reliance on cloud-based systems.

**5. Ethical Considerations:** Addressing ethical concerns surrounding facial recognition, ensuring responsible use and preventing misuse of the technology**.**

**6. Behavioral Analysis:** Incorporating behavioral cues or analysis (like gait recognition) alongside facial recognition for added authentication.

**7. Continuous Learning:** Implementing systems that can adapt and learn from new data, ensuring ongoing improvement and adaptation to changing environments.

These directions aim to advance the accuracy, privacy, and ethical considerations while also leveraging emerging technologies to make face recognition attendance systems more efficient, reliable, and secure.

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