FACE RECOGNITION ATTENDANCE SYSTEM

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Chapter 1

Introduction

1.1 Introduction

In this fast-pacing world of technologies, most organizations still spend their time in marking student's/ employees' attendance manually. This is a wastage of manpower, and improper utilization of the organization's time and money. Thus, there is a need to computerize this task with the help of a automatized Face Recognition Attendance Management System.

Everything in the current era has become contactless, from financial transactions to education. Things are carried out without any physical interaction, whether it's making payments to someone or purchasing anything for your business. Now, there is a need to automatize attendance monitoring also.

A face recognition attendance system automatically identifies and confirms a person and records attendance based on their face detection. Face recognition attendance systems are catching the attention of both small and large businesses. It's no wonder that such systems are becoming more popular in workplaces due to their wide range of advantages for both employers and employees.

1.1.1 What Is A Facial Recognition Attendance System?

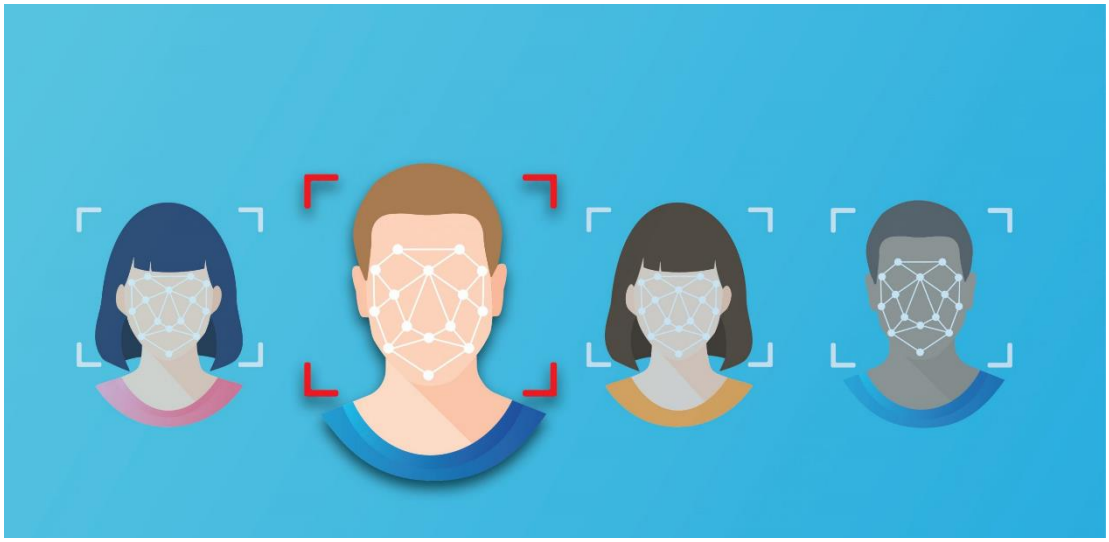

Figure 1: A picture depicting face recognition

A facial recognition attendance system incorporates facial recognition technology to recognize and verify an employee's facial features and to record attendance automatically. Unlike other forms of biometric technology, such as fingerprint recognition, which captures identity by touching, a facial identification system manages employees without the approach of direct contact. Face recognition records the field employee's attendance marking time and geolocation. This touchless method has been a successful preventive measure during the COVID-19 epidemic.

Traditional attendance tracking methods, such as manual sign-in sheets or swipe cards, are often time-consuming, prone to errors, and susceptible to fraudulent activities. To address these challenges, the integration of image processing techniques with face recognition algorithms has emerged as an innovative solution for efficient and accurate attendance management.

The primary advantage of the face recognition attendance system lies in its ability to accurately and rapidly identify individuals, even in dynamic and real-world scenarios.

To achieve efficient and accurate recognition, the face recognition attendance system employs machine learning algorithms, such as deep neural networks. These models are trained on large-scale datasets to learn complex patterns and variations in facial appearances. By utilizing deep learning techniques, the system can adapt and generalize well to different individuals, expressions, and environmental conditions, ensuring robust and reliable performance.

1.1.2 What is Image Processing?

Figure 2: A generalized overview of steps followed in image processing

1.1.2.1 Refers to the manipulation, analysis, and interpretation of digital images using various algorithms and techniques.

1.1.2.2 Involves the application of mathematical operations, algorithms, and filters to images to enhance or extract information from them.

1.1.2.3 Used to improve image quality, adjust brightness and contrast, and perform various other enhancements.

1.1.2.4 Used for image restoration, which involves recovering images that are degraded or corrupted.

1.1.2.5 Image processing techniques are used for feature extraction, which involves identifying and extracting specific features or patterns from images.

1.1.2.6 Plays a crucial role in computer vision tasks such as object detection, recognition, and tracking.

1.1.2.7 Involves tasks like image resizing, cropping, rotation, and geometric transformations.

Chapter 2

Literature Survey

2.1 Introduction

The technology aims in imparting a tremendous knowledge oriented technical innovation these days. Deep Learning is one among the interesting domain that enables the machine to train itself by providing some datasets as input and provides an appropriate output during testing by applying different learning algorithms. Nowadays Attendance is considered as an important factor for both the student as well as the teacher of an educational organization. With the advancement of the deep learning technology the machine automatically detects the attendance performance of the students and maintains a record of those collected data. In general, the attendance system of the student can be maintained in two different forms namely, Manual Attendance System (MAS) and Automated Attendance System (AAS). Manual Student Attendance Management system is a process where a teacher concerned with the particular subject need to call the students name and mark the attendance manually. Manual attendance may be considered as a time-consuming process or sometimes it happens for the teacher to miss someone or students may answer multiple times on the absence of their friends. So, the problem arises when we think about the traditional process of taking attendance in the classroom. To solve all these issues we go with Automatic Attendance System(AAS). Automated Attendance System (AAS) is a process to automatically estimate the presence or the absence of the student in the classroom by using face recognition technology. It is also possible to recognize whether the student is sleeping or awake during the lecture and it can also be implemented in the exam sessions to ensure the presence of the student. The presence of the students can be determined by capturing their faces on to a high definition monitor video streaming service, so it becomes highly reliable for the machine to understand the presence of all the students in the classroom. The two common Human Face Recognition techniques are, Feature based approach and Brightness-based approach. The Feature-based approach also known as local face recognition system, used in pointing the key features of the face like eyes, ears, nose, mouth, edges, etc., whereas the brightness-based approach is also termed as the global face recognition system, used in recognizing all the parts of the image.

2.2 FACE RECOGNITION TECHNIQUES

Principal Component Analysis (PCA): PCA knew as dimension reduction and feature selection, however, PCA used to extract the number of principal components of the data is multidimensional. Human Recognition system using Principal Component Analysis was developed firstly by Turk and Pentland which was to solve face recognition in two-dimensional rather than three- dimensional geometry. Because both the captured image and basic vector constructed by the PCA have the same dimension and reconstruction the human face has been done used for solving the retrieval of large database images. In the Recent development of automatic face recognition, feature extraction has become significant to extract features such as nose, eyes, and mouth. Moreover, the main goal of PCA is to keep the original information of the data, to minimize original loss information and to improve the face analysis. The Principal Component Analysis is that Eigenfaces was extremely large confined to dimension reduction. In has been introduced a way to do calculating the discriminant feature of PCA by using a recursive algorithm

Geometric Approach: This approach is recognized human-based on geometry points on the face. Many features of geometric approach have been conducted: used geometric approach to improve the accuracy of the system in case the images contain the complex background.

2.3 LITERATURE REVIEW

The primary purpose of this paper review is to find the solutions provided by other authors and consider the imperfection of the system proposed by them, give the best solutions. Kawaguchi introduced a lecture attendance system with a new method called continuous monitoring, and the student's attendance is marked automatically by the camera which captures the photo of a student in the class. The architecture of the system is simple since two cameras are equipped with the wall of the class. The first one is a capturing camera used to capture the image of a student in the class and the second camera is a sensor camera used to get the seat of a student inside the class and the camera capturing will snap the image of the student. The system compares the picture taken from a camera capturing images and faces in the database done much time to perfect the attendance.

Chapter 3

Methodology

3.1 In this project we will use data science techniques for developing the project as this helps in breaking the project into smaller parts. Data Science Lifecycle revolves around the use of machine learning and different analytical strategies to produce insights and predictions from information in order to acquire a commercial enterprise objective.

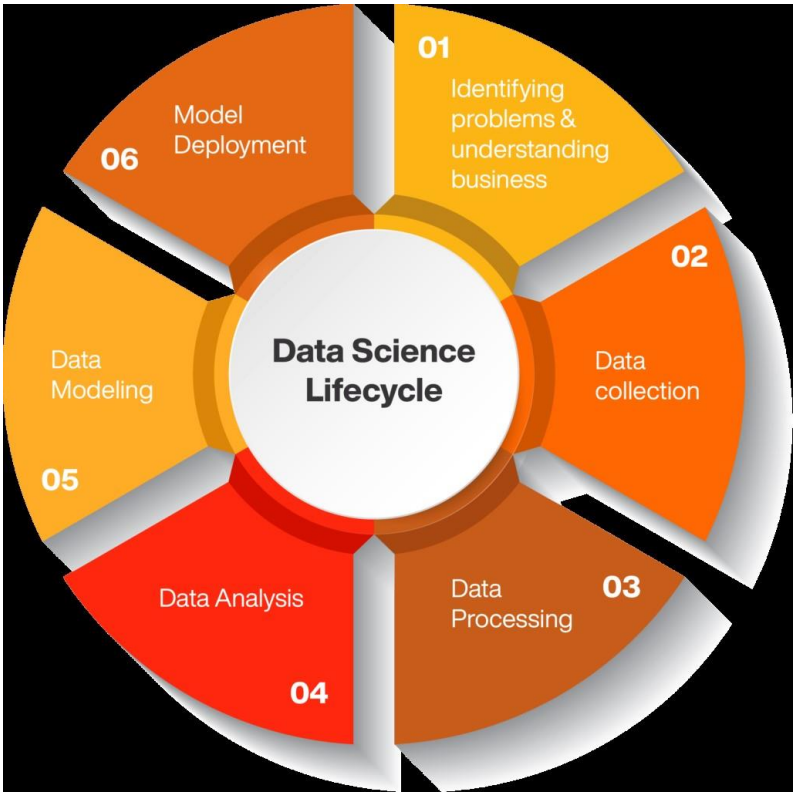

Figure: 3 Data Science Life Cycle

3.1 1 Data Collection: The system requires a collection of student images for training the face recognition model. This involves gathering data from multiple sources, such as student photographs or image samples.

3.1.2 Data Preprocessing: Prior to training the face recognition model, data preprocessing steps may be required, such as resizing the images, converting color formats, and normalizing the data. These steps are common in data science projects to ensure consistency and optimize the data for further analysis.

3.1.3 Feature Extraction: The face recognition system extracts facial features and encodes them into numerical representations, enabling efficient comparison and recognition. This step involves feature extraction techniques, which are a common aspect of data science projects.

3.1.4 Machine Learning: The face recognition system utilizes machine learning algorithms to compare face encodings and determine matches. The training phase likely involved using labeled data to train a face recognition model, which is a classic machine learning task.

3.1.5 Data Analysis and Decision-Making: The system retrieves student information from a database and performs analysis, such as calculating time differences for attendance tracking.

This analysis and decision-making process based on the data aligns with the core principles of data science.

3.1.6 Integration of Technologies: The project incorporates various technologies and tools, such as OpenCV for image processing, face_recognition library for face recognition tasks, Firebase for data storage, and CVzone for displaying information on images. The integration and utilization of different technologies is a common aspect of data science projects.

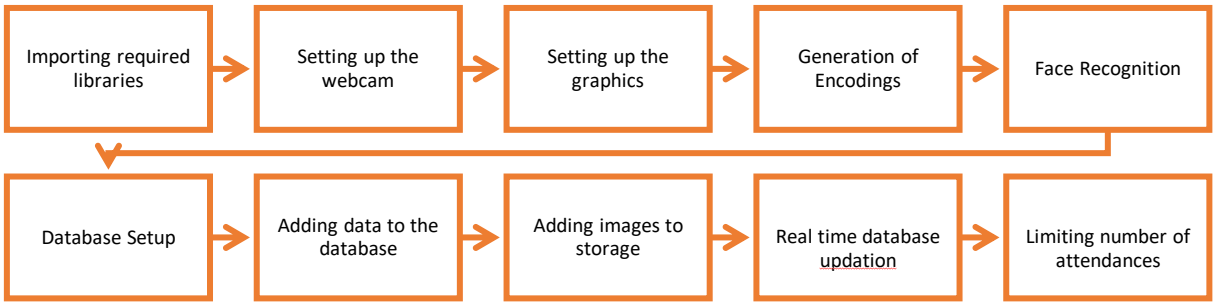

Figure 3:Flowchart depicting Steps followed

Here is a step-by-step explanation of the methodology followed:

3.2 File adddatatodatabase.py

Data is added to Firebase Realtime Database.

3.2.1 Importing of necessary modules from the firebase-admin package: credentials and db.

3.2.2 Initializing the Firebase Admin SDK using a service account key file (serviceAccountKey.json) and the database URL.

3.3.3 Creating a reference to the "Students" node in the database.

3.3.4 Defining a dictionary data containing student information.

3.3.5 Iterating over the items in the data dictionary.

3.3.6 For each key-value pair in data, it sets the value under the corresponding key in the "Students" node of the database.

In summary, this code adds student data to the "Students" node in the Firebase Realtime Database.

3.3 File encodegenerator.py

Utilizes the OpenCV (**cv2**) and face_recognition libraries to perform face recognition tasks, and connecting to Firebase Realtime Database and Firebase Cloud Storage.

3.3.1 Importing the required modules from various libraries: **cv2**, **face_recognition**, **pickle**, **os**, **firebase_admin**, **credentials**, **db**, and **storage**.

3.3.2 Initializing the Firebase Admin SDK using a service account key file (**serviceAccountKey.json**) and providing the database URL and storage bucket URL.

3.3.3 Importing of student images.

3.3.4 Iterating over each filename in the **pathList**.

3.3.4.1 Reading the image using **cv2.imread** and appending it to **imgList**.

3.3.4.2 Extracting the student ID (filename without the extension) and appending it to **studentIds**.

3.3.4.3 Uploading the image to Firebase Cloud Storage.

3.3.5 Defining function **findEncodings** that takes list of images as input and returns list of face encodings for each image using **face_recognition library.**

3.3.6 Creating a list **encodeListKnownWithIds** that combines **encodeListKnown** and **studentIds**.

3.3.7 Saving the **encodeListKnownWithIds** list to a pickle file named "EncodeFile.p" using **pickle.dump**.

In summary, this code reads student images from a folder, performs face encoding on those images using face_recognition library, uploads the images to Firebase Cloud Storage, and saves the corresponding face encodings along with student IDs to a pickle file.

3.4 File main.py

Utilizes OpenCV (**cv2**), face_recognition, connection to Firebase Realtime Database and Firebase Cloud Storage, and CVzone for drawing text and rectangles on images.

3.4.1 Importing of necessary modules from various libraries: **os**, **pickle**, **numpy** (as **np**), **cv2**, **face_recognition**, **cvzone**, **firebase_admin**, **credentials**, **db**, **storage**, and **datetime**.

3.4..2 Initializing the Firebase Admin SDK using a service account key file (**serviceAccountKey.json**) and providing the
database URL and storage bucket URL.

3.4.3 Retrieving the bucket from Firebase Cloud Storage.

3.4.4 Capturing video using camera and resizing the captured frame.

3.4.5 Loading the background image and the mode images into a list.

3.4.6 Loading the face encodings and student IDs from the pickle file.

3.4.7 Starting loop to process each frame from the video capture.

3.4.8 Inside the loop:

3.4.8.1 Reads a frame from the video capture.

3.4.8.2 Resizes the frame and converts it to RGB color format.

3.4.8.3 Detects face locations and encodings in the current frame.

3.4.8.4 Overlays the current frame onto the background image.

3.4.8.5 If a face is detected:

3.4.8.5.1 Compares the face encodings with the known encodings and calculates the face distance

3.4.8.5.2 Identifies the index of the best matching face.

3.4.8.6 If a match is found:

3.4.8.6.1 It highlights the face on the background image.

3.4.8.6.2 It updates the mode and counter variables.

3.4.8.7 If the counter is not zero:

3.4.8.7.1 If the counter is 1, it retrieves the student information and image.

3.4.8.7.2 Updates the attendance data in the database if the last attendance time is more than 30 seconds ago, otherwise selects mode already marked.

3.4.8.7.3 If attendance is not marked, it displays the student information on the background image.

3.4.8.7.4 It increments the counter and handles the counter reaching a threshold.

3.4.8.7.5 If the counter reaches the threshold, it resets the counter, mode type, and clears the student information and image.

3.4.8.6 If no face is detected, it resets the mode type and counter.

3.4.8.7 It displays the background image with overlaid frames.

3.4.8.8 It waits for key events and handles the exit condition.

In summary, this code continuously captures video frames from the camera, performs face recognition on the frames, retrieves student information from Firebase Realtime Database and student images from Firebase Cloud Storage, and updates the attendance data based on the recognized faces. It also displays the student information on the screen during the recognition process.

Chapter 4

Result and Discussion

4.1 Result

The resulting project is a well working face recognition attendance management system that labels the face by the person's name when the code is executed.

4.2 Advantages

4.2.1 Time Saving System: As great people say, "time-saving = money saving." Time saving at work can increase productivity. The time required to mark the attendance of the employees can be used more productively for the growth of the organization.

4.2.2 Increased Efficiency and Capability: Manual attendance management can be time-consuming and vulnerable to human errors. As an automated attendance-management system, facial recognition provides precise time records, reducing costly mistakes.

4.2.3 Cost Cutting And Saves Money: Because the overall process is automated, human intervention is limited. As a result, there is no requirement for additional employees to perform this work manually. It reduces costs while enhancing operational efficiency.

4.2.4 Enhances Workplace Security: Automated face recognition attendance system is more secure as as it is contactless attendance marking system, also it can prevent unauthorized individuals from entering into the organization.

4.2.5 Automated Time Tracking: Entry and exit monitoring can be totally automated with facial recognition attendance systems. Each employee's attendance, overtime, and leave can be reliably tracked using a face recognition attendance system. As an outcome, deception via proxy attendance is not feasible.

4.2.6 Easy To Manage Records: You can scroll back and retrieve details of any employee, anytime with just a few clicks.

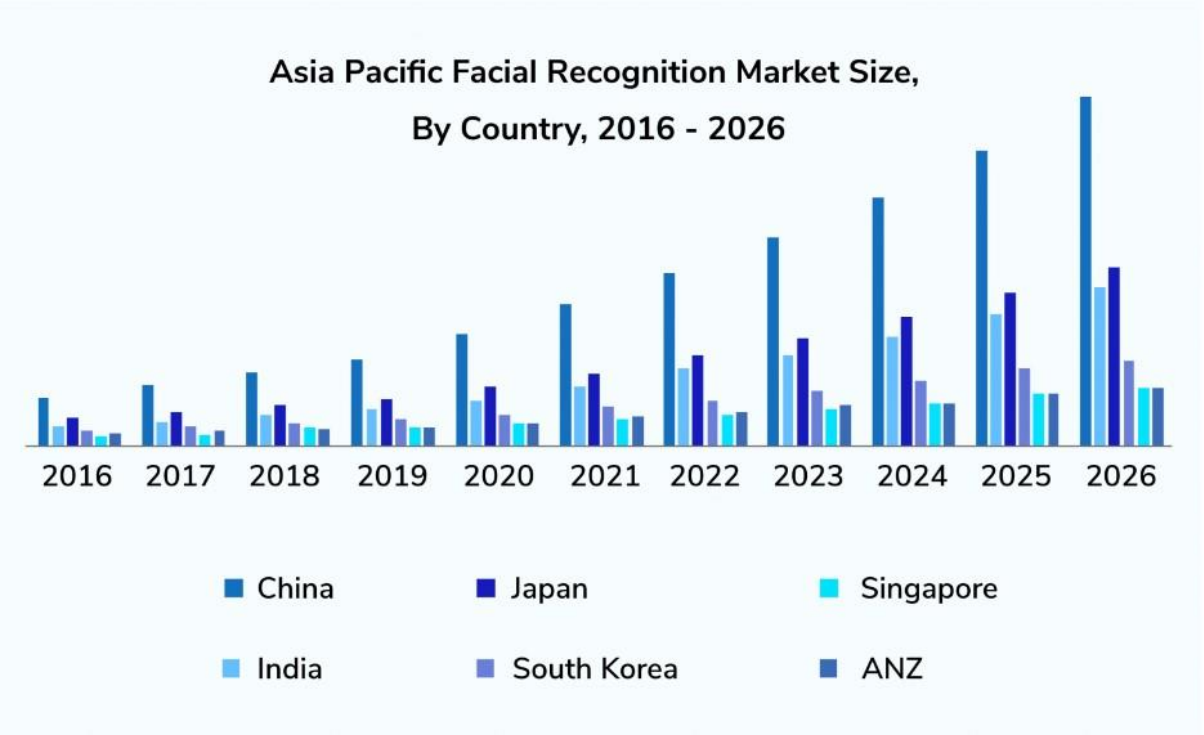

Figure 4: Graph depicting facial recognition needs

4.3 Disadvantages

4.3.1 Careful considerations must be given to privacy and security aspects, ensuring compliance with applicable regulations and ethical practices.

4.3.2 If there are 2 people in the same frame it will mark attendance (recognise) only one person.

4.3.3 Also, the system is not able to distinguish between a real person and an image.

4.4 Discussion

Since, the face recognition attendance system has more advantages, and can be made to work more efficiently if worked on the disadvantages properly. This has a great implementation in real-life working systems.

Chapter 5

Conclusion and Future Work

5.1 Conclusion

In conclusion, the face recognition attendance system using image processing represents a significant advancement in attendance management, providing an efficient, secure, and accurate solution for various industries. By harnessing the power of computer vision and machine learning, organizations can streamline their attendance tracking processes, reduce administrative overhead, and enhance overall productivity. With advances in digital technology, the quality of facial verification in face recognition attendance systems has improved, and the acceptance rate is relatively high. Face recognition attendance systems' appeal is enhanced further by their fast image processing time and ease of integration.

5.2 Future Work

5.2.1 The project can be improved to work on the disadvantages. We can make the data more secure by using cloud based secure data management.

5.2.2 We can add better front-end and back-end systems to the project.

5.2.3 We can add login features to the project.

5.2.4 We can use different models to make the recognition better.

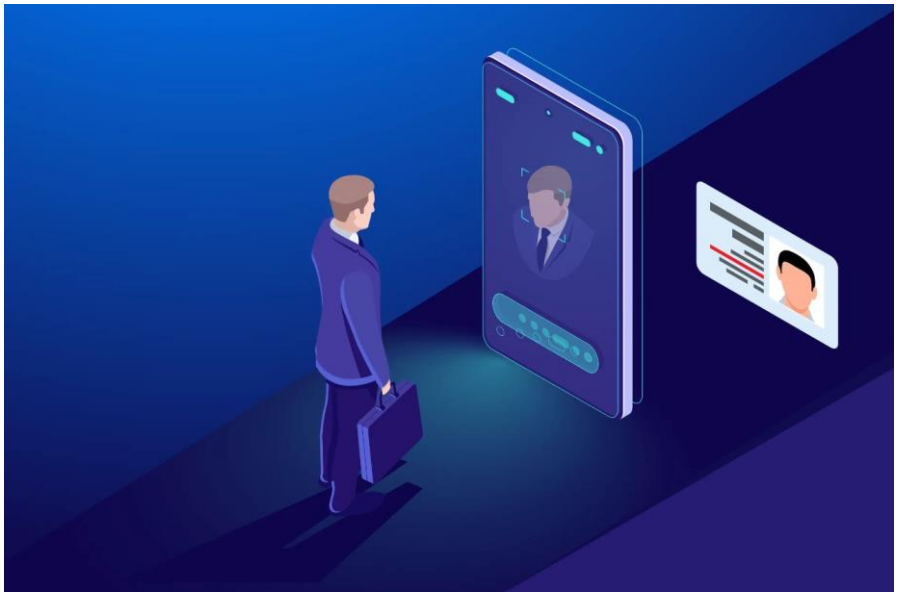

Figure 5: A picture depicting face recognition.

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Online Resources:

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