FACE RECOGNITION BASED ATTENDANCE SYSTEM

REPORT OF PROJECT SUBMITTED FOR FULFILLMENT OF THE
REQUIREMENT FOR THE DEGREE OF
BACHELOR OF TECHNOLOGY
In
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By

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4. …….	……

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INTRODUCTION

Taking attendance manually is a lengthy process and it consumes a lot of time. To overcome such problem, there is a need for an automatic attendance system that is highly efficient, reliable and easy-to-use. Attendance can be tracked using various methods, including manual sign-in sheets, barcode scanning, RFID, and biometric systems such as facial recognition-based attendance systems. The choice of method depends on factors such as the number of students, the technology available, and the institutional policies. The identification of a person from his or her facial features is known as face recognition. This report focuses on the implementation of an automatic attendance system using face recognition algorithms to take the attendance of the students and manage the attendance database. We live in a time when technology is improving day by day and it's an essential part of our daily lives. People now enjoy the smart life because it saves time, money and effort. As an example, the school teachers are used to struggle with class attendance. The traditional techniques like passing the attendance sheet and calling students' names are time-consuming and it also gives malpractice in the attendance system.

In this paper our proposed model is discussed. Which is very easy to use, no modern technical knowledge is required to use this model. Though it can be implemented using modern technologies and make it highly efficient, reliable and secure. All this are discussed in this report.

This report will provide a detailed explanation of the various components of the system, including the software used, algorithms and techniques applied for face detection and the database management employed for storing attendance records.

This report will also discuss the advantages of using a face detection-based attendance system, including increased efficiency, accuracy and security. Furthermore, it will address any potential challenges and limitations of the system and provide recommendations for future improvements.

Overall, this project report will provide a comprehensive overview of the face detection-based attendance system and its practical implementations in a real-world scenario.

PROBLEM ANALYSIS

An attendance system is crucial for monitoring performance, ensuring compliance with institutional policies, identifying potential issues, accurate record keeping, and streamlining administrative tasks. In most of the places Attendance is taken manually. A manual attendance system is a traditional method of tracking attendance that involves using paper-based sign-in sheets or other similar methods. It is the simplest and less costly. But it has some limitation. It is Time consuming, have limited security, it can have potential errors. We have discussed every problem briefly in “Problem Discussion” section.

For those above mentioned problem we need an alternative solution. Which is automatic, cost effective and reliable. It can be Magnetic stripe-based attendance system or RFID-based attendance system or it can be biometric based attendance system. Biometric system can be of two types. One is fingerprint based attendance system or it can be face recognition-based attendance system. In this paper we have discussed about Face Recognition based attendance system.

REVIEW OF LITERATURE

There are many people who made their projects and researches in automatic attendance system to enhance the education system. Here is the literature survey about related work done is past to analyse the system. S. Bhattacharya [1] made a system that uses a video as input and using Viola-Jones algorithm the facial expressions are extracted. This algorithm used the parameters like brightness, sharpness and resolution of the captured image. Mayank Srivastava [2] built a system that works in three steps, at first the detected image is extracted. Then the eigenvalues and eigenvectors of the trained image is computed. Atlast the stored images as YML file are compared to recognize the face. Kennedy Okokpujie [3] used a camera module as input. The camera is used to detect face by using Viola-Jones algorithm. Fisherface algorithm is used to create a template of captured images. Samridhi Dev [4] proposed an attendance system in her research paper which uses Haar classifiers, KNN, CNN, and Gabor filters. Attendance reports will be stored in a excel file after face recognition. R. Harnanto [5] proposed a system which captures the face, carries out a face detection process in which the skin colour and face motion is detected and tracked. It also localizes the position of eyes, lips, and face borders. Nandhini R. [6] made a system which captures a video and converts it into frames. The face is detected using the CNN algorithm. These detected faces in the database are then matched with the input to recognise the face. Smitha & Hegde, Pavithra & Afshin [7] built a face recognition based attendance management system which was published in International Journal of Engineering and Research V9.10.175

O.A.R Salim, R.F Olanrewaju and W.A. Balogun made a Class Attendance Management System using face recognition algorithms. Their research paper was published in International Conference on Computer and Communication Engineering (ICCCE), Kuala Lumpur on 2018.Shizhen Huang and Haonan Luo made an Attendance System based on Dynamic Face Recognition and it was published in International Conference on Communications, Information System and Computer Engineering (CISCE). Hao Yang, Xiaofeng Han proposed a Face Recognition Attendance System based on Real-Time Video Processing, IEEE Access (volume 8).

FORMULATION/ ALGORITHM

A face recognition-based attendance system is a computerized system that uses facial recognition technology to identify and verify individuals for attendance purposes. We have used **Haar Cascade** and **Local Binary Pattern Histogram (LBPH)** which are two popular techniques used in facial recognition systems. Here's how they can be used in a face recognition-based attendance system:

- ## Haar Cascade Algorithm:

It is a machine learning based object detection algorithm. It is used to detect objects in an image or video and is particularly useful for detecting faces. The algorithm was first proposed by Viola and Jones in 2001 and has been widely used since then.

The Haar Cascade algorithm works by using a set of features that are extracted from an image. These features are basically patterns that are commonly found in objects of interest, such as the edges of a face or the corners of eye. The algorithm uses a machine learning technique called AdaBoost to select the most important features for detection.

Once the important features are selected, a cascade of classifiers is created. Each classifier is responsible for detecting a specific feature in the image. The cascade is designed to be efficient by quickly discarding non-object regions of the image that do not contain any of the features.

To detect an object in an image using the Haar Cascade algorithm, the image is passed through the cascade of classifiers. At each stage, the image is analyzed to determine if the specific feature being detected is present. If the feature is present, the image is passed to the next stage. If the feature is not present, the image discarded and the algorithm moves on to the next part of the image.

Haar Cascade has been widely used for a variety of applications, including face detection, object tracking and pedestrian detection. It has also been integrated into many popular computer vision libraries, such as OpenCV, making it easy to use for developers.

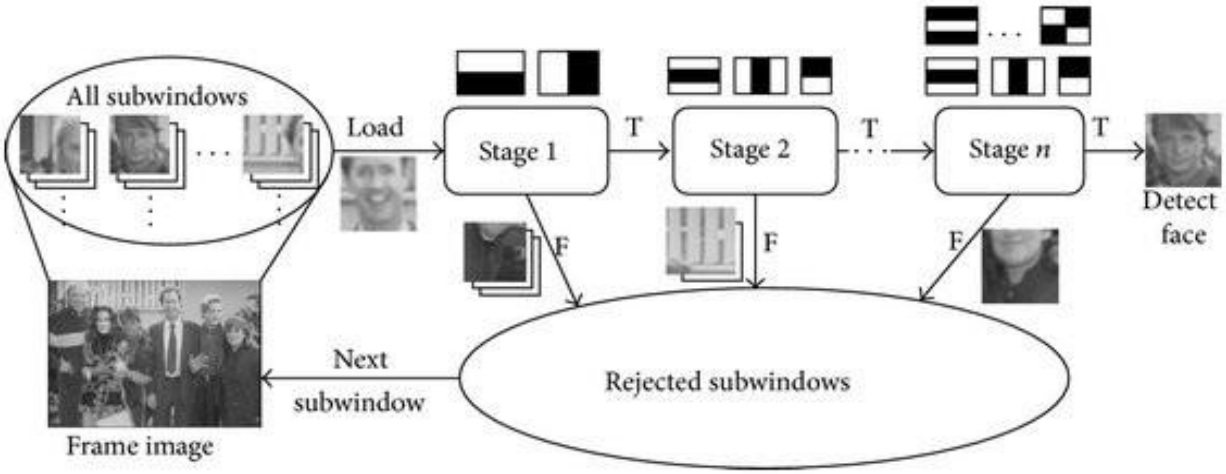

Fig 1: Haar Cascade Algorithm

- **LBPH (Local Binary Patterns Histogram):**

It is a simple yet powerful facial recognition algorithm used in computer vision. It is a texture-based approach that extracts features from an image by encoding the difference between the intensity values of neighboring pixels.

The LBPH algorithm works by dividing the image into smaller regions and computing the Local Binary Pattern (LBP) descriptor for each region. The central pixel and its neighbors.
To compute the LBP descriptor, each pixel in the region is compared to its neighbors. If the neighbor pixel is greater or equal to the central pixel, it is assigned a value of 1, otherwise, it is assigned a value of 0. The binary values of each pixel are then concentrated to form an LBP code for that region.

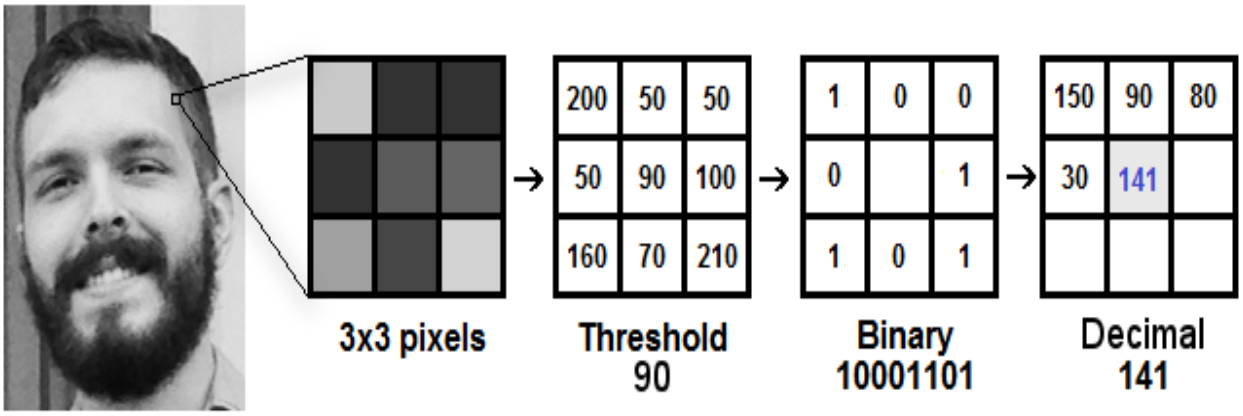

Fig 2: LBPH Algorithm

After computing the LBP descriptor for each region of the image, a histogram of all the LBP codes is generated. This histogram represents the texture features of the image, which are then used for facial recognition.

The LBPH algorithm is robust against changes in lighting and scalable to different image resolutions. It has been used in various applications such as security systems, access control and human-computer interaction. However, it may not be as accurate as more complex algorithms such Deep Learning, especially when dealing with more complex facial recognition scenarios.

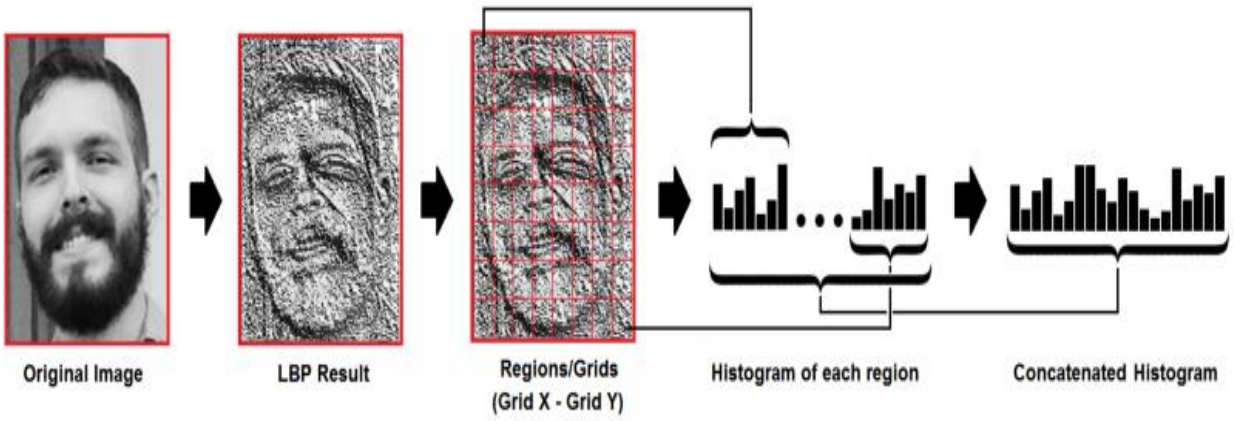

Fig 3: Results from LBPH algorithm

PROBLEM DISCUSSION

1. **Time Consuming:** The process of taking attendance in a traditional setting is undoubtedly time-consuming. However, this problem can be addressed through the use of technology. Teachers can use electronics attendance system that automatically record attendance and eliminate the need for manual tracking. This approach not only saves time but also increase the accuracy of attendance records.
2. **Inaccuracy:** Manual attendance taking is prone to errors, which can result inaccurate attendance records. However, technology can also address this problem. Electronic attendance systems that use biometric identification (e.g. facial recognition, fingerprint scanning) can ensure accurate tracking of student attendance.
3. **Cheating:** Cheating in attendance is a significant issue that can undermine the integrity of the attendance system. However, technology can again be employed to address this problem. Biometric identification systems can ensure that only the registered student is marked as present. Furthermore, some electronic attendance systems can also send notifications to parents or guardians when a student is absent, providing an additional layer of accountability.
4. **Lack of engagement:** The traditional classroom attendance system is often seen as a mundane administrative task. However, by leveraging technology, attendance tracking can become a more engaging and meaningful part of the learning experience. For example, some electronic attendance systems can gamify attendance tracking by rewarding students who have perfect attendance or who show improvement in attendance over time.
5. **Limited data analysis:** Traditional attendance systems provide limited data analysis capabilities. However, electronic attendance systems can generate comprehensive reports that provide valuable insights into attendance patterns and trends. Teachers can use this data to identify students who may need additional support or to adjust their instructional strategies to improve student engagement. Additionally, this data can be used to identify patterns and trends at the school or district level, informing policy decisions related to attendance.

IMPLEMENTATION OF PROBLEM

A facial recognition-based attendance system can streamline attendance tracking and reduce the administrative burden on organizations. However, it is important to ensure that such systems are designed and implemented with due consideration for privacy and security concerns.

To implement our model we need a PC/Laptop with 4 GB+ RAM, i3 5th Generation 2.2 Ghz or equivalent/higher and atleast 128 GB SSD.

Tools we used:

- Python 3.9+
- Python Libraries (Numpy, OpenCV, face_recognition, os, datetime)
- Visual Studio Code

In our proposed model we have taken following steps to implement our model.

- **Database Creation:**

At first database is created manually. A clear picture of every student is added to a folder and each image file is named as their Roll number or enrolment number which should be unique.

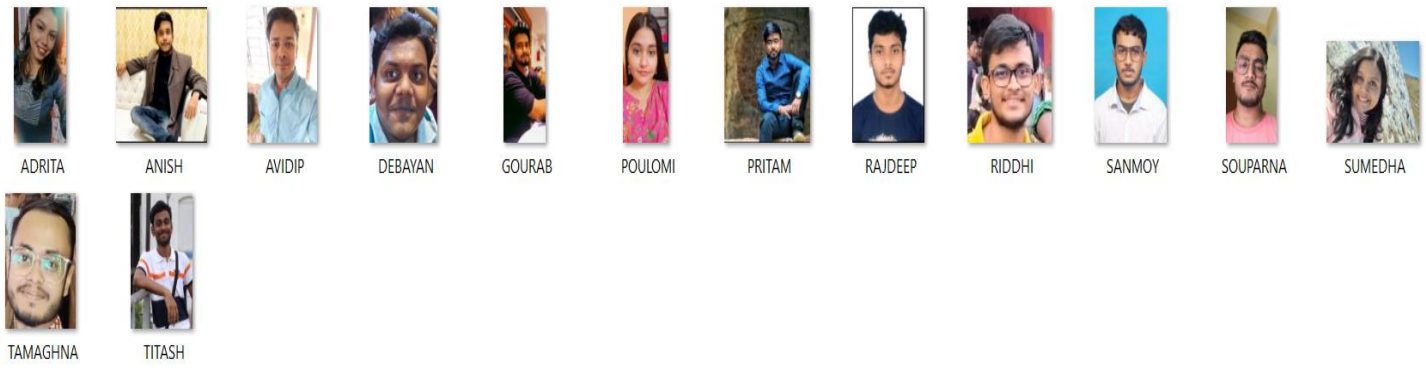

Fig 4: Students' Database

- **Image Amelioration:**

  In a classroom every student may not be in idle position. Due to movements, image captured by the camera may get blurred. So generative adversarial networks can be used to get the texture information from images.

- **Face Detection:**

  One of the most important steps in this system. Input is taken from a video sequence which is generally in RGB format which is converted to grayscale. Using Haar Cascade algorithm face detection process is done. We have certain features to detect a face like eyebrows, bridge between two eyes or lips. In **Haar Cascade algorithm** almost 6000 features are used to detect a face. At first, a combination of features is applied to images pixel by pixels. These features will match only if a face exists. Those pixels with which features got matched is saved and by this the face is detected. Then a face boundary box is drawn.

- **Face Recognition:**

  Feature extraction and matching is done with **LBPH (Local Binary Patterns Histogram)**. In LBPH 9 pixels (3x3 matrix) is taken. Central pixel is compared with its surrounding 8 pixels. The range of intensity of a pixel is 0 to 255. The central pixel value is considered as the threshold. Among surrounding pixels, if intensity of a pixel is equal to or higher than the threshold value then it is marked as 1 or else 0. Now we get a binary number for a combination of 8 pixels. This binary value is converted into decimal and set into the central pixel. By doing this to the whole image we get similar values for each 3x3 matrix. Now we plot a histogram based on those decimal value for each region and later all these are concatenated to get a bigger histogram which represents the characteristics of an image. This histogram is unique for any faces. After extracting the features it is compared to the images in the database.

- **Report Generation:**

  Faces from video sequence input from the camera are compared to the images in the database. If any face matches its roll no. is shown and the attendance is marked in the CSV file.

SAMPLE OUTPUT

After executing the program we got a result where we can see that the compiler gives an output of detected image like Fig 5. The Fig 6 shows the status of updated attendance in VS Code editor. Finally the attendance is marked in the excel sheet as shown in the Fig 7.

Fig 5: Image Detected

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL Code

```
[Running] python -u "c:\Users\dell\OneDrive\Desktop\FINAL
PROJECT\Face-recognition-Attendance-System-Project-main\AttendanceProject.py"
['ADRITA.jpeg', 'ANISH.jpg', 'ARNAB.jpg', 'AVIDIP.jpg', 'DEBAYAN.jpeg', 'GOURAB.jpeg',
'POULOMI.jpg', 'PRITAM.jpg', 'RAJDEEP.jpg', 'RIDDHI.jpeg', 'SAHEB.jpg', 'SANMOY.jpg',
'SOUPARNA.jpg', 'SUMEDHA.jpeg', 'TAMAGHNA.jpeg', 'TITASH.jpeg']
['ADRITA', 'ANISH', 'ARNAB', 'AVIDIP', 'DEBAYAN', 'GOURAB', 'POULOMI', 'PRITAM',
'RAJDEEP', 'RIDDHI', 'SAHEB', 'SANMOY', 'SOUPARNA', 'SUMEDHA', 'TAMAGHNA', 'TITASH']
Encoding Complete
```

Fig 6: Updated status at VS Code

	Name	Time	Date
2	TAMAGHNA	22:58:29	15-05-2023
3	RIDDHI	22:58:30	15-05-2023
4	GOURAB	22:58:35	15-05-2023
5	TITASH	22:58:35	15-05-2023
6	DEBAYAN	22:58:50	15-05-2023
7	ADRITA	22:58:54	15-05-2023
8	SUMEDHA	22:59:00	15-05-2023
9	PRITAM	22:59:08	15-05-2023
10	SANMOY	22:59:12	15-05-2023
11	AVIDIP	22:59:16	15-05-2023
12	RAJDEEP	22:59:20	15-05-2023
13	POULOMI	22:59:23	15-05-2023
14	SOUPARNA	22:59:27	15-05-2023
15	SAHEB	22:59:31	15-05-2023
16	ARNAB	22:59:34	15-05-2023

Fig 7: Attendance marked in Excel sheet

FUTURE SCOPE OF WORK

The future scope of work for a face recognition-based attendance system project depends on the specific goals and objectives of the project and the technologies used. However, here are some potential areas of expansion or improvement:

1. **Integration with other systems:** The face recognition-based attendance system can be integrated with other systems such as payroll, HR, and time and attendance tracking systems. This would allow for seamless data sharing and efficient management of employee records.

2. **Improved accuracy:** There is always room for improvement when it comes to accuracy in face recognition systems. The project team can work on enhancing the algorithm's accuracy and making it more reliable.

3. **Multi-factor authentication:** Multi-factor authentication (MFA) adds an extra layer of security to the system. The team can work on incorporating additional authentication methods such as biometric scanning or a PIN code.

4. **Cloud-based system:** A cloud-based system can provide the flexibility of accessing data from anywhere and enable easy scalability for the system.

5. **Real-time tracking:** The system can be enhanced to provide real-time attendance tracking, which can help managers and supervisors keep track of employee attendance and work hours.

6. **Integration with mobile devices:** The system can be integrated with mobile devices, allowing employees to mark their attendance using their smartphones. This can be especially useful for employees who work remotely.

7. **Privacy and data security:** As with any system that collects and processes personal data, privacy and data security are critical considerations. The project team can work on ensuring the system is compliant with relevant data protection regulations and implementing robust security measures to protect the data from unauthorized access or misuse.

8. **Real-time notifications:** The system can be enhanced to send real-time notifications to the relevant parties, such as managers or HR, when an employee arrives or leaves the workplace.

9. **Customizable reports:** The system can be designed to generate customizable reports that can be used for analytics, performance evaluation, and compliance purposes.

10. **Mobile app development:** The project team can work on developing a mobile application that allows employees to access their attendance data, update their information, and communicate with their managers and HR department.

11. **Integration with access control systems:** The face recognition-based attendance system can be integrated with access control systems, which can allow employees to access secure areas of the workplace only when their attendance has been marked.

12. **Multi-language support:** The system can be designed to support multiple languages, which can help in organizations where employees come from different linguistic backgrounds.

13. **Integration with other biometric systems:** The face recognition-based attendance system can be integrated with other biometric systems such as fingerprint scanning, iris scanning, or voice recognition, which can help increase accuracy and security.

14. **Continuous improvement:** The project team can work on continuously improving the system by collecting feedback from users and incorporating new features and enhancements. This can help ensure that the system remains relevant and useful in the long run.

CONCLUSION

Based on the information provided, the face recognition-based attendance system project is a viable solution for automating the attendance tracking process in various settings. The system uses advanced technologies such as computer vision, machine learning, and facial recognition algorithms to identify individuals and record their attendance.

The system offers several advantages over traditional attendance tracking methods, such as reducing errors and the possibility of fraud, saving time, and improving accuracy. It also eliminates the need for manual record-keeping, which can be time-consuming and prone to errors.

However, it is important to consider certain limitations of the technology, such as privacy concerns and potential inaccuracies in recognizing individuals in certain lighting conditions or with different facial features. The implementation of the system must be done carefully and with appropriate safeguards in place to ensure that it complies with applicable laws and regulations.

Overall, the face recognition-based attendance system project has the potential to streamline attendance tracking and improve efficiency in various settings, but it must be implemented and managed carefully to ensure its effectiveness and compliance with legal and ethical standards.

PUBLICATION

Titash Banerjee, Riddhideb Chakraborty & Sarbojit Mukherjee, "Face Recognition Based Attendance System", has been accepted by the International Conference on MULTIDISCIPLINARY APPROACH IN TECHNOLOGY AND SOCIAL DEVELOPMENT (ICMATSD-2023).
This conference is set to be organized by Nagarjuna Institute of Engineering Technology & Management, Nagpur, India on 26th & 27th May 2023.

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APPENDIX

```
import cv2
import numpy as np
import face_recognition
import os
from datetime import datetime
path='Face-recognition-Attendance-System-Project-main\Images_Attendance'
images = []
classNames = []
myList = os.listdir(path)
print(myList)
for cl in myList:
    curImg = cv2.imread(f'{path}/{cl}')
    images.append(curImg)
    classNames.append(os.path.splitext(cl)[0])
print(classNames)
def findEncodings(images):
    encodeList =[]
    for img in images:
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        encode = face_recognition.face_encodings(img)[0]
        encodeList.append(encode)
    return encodeList
def markAttendance(name):
    with open('Face-recognition-Attendance-System-Project-main\Attendance.csv',
    'r+') as f:
        myDataList = f.readlines()
        nameList = []
        for line in myDataList:
            entry = line.split(',')
            nameList.append(entry[0])
        if name not in nameList:
            time_now = datetime.now()
```

```
            tString = time_now.strftime('%H:%M:%S')
            dString = time_now.strftime('%d/%m/%Y')
            f.writelines(f'\n{name},{tString},{dString}')
encodeListKnown = findEncodings(images)
print('Encoding Complete')
cap = cv2.VideoCapture(0)
while True:
    success, img = cap.read()
    imgS = cv2.resize(img, (0, 0), None, 0.25, 0.25)
    imgS = cv2.cvtColor(imgS, cv2.COLOR_BGR2RGB)
     facesCurFrame = face_recognition.face_locations(imgS)
    encodesCurFrame = face_recognition.face_encodings(imgS, facesCurFrame)
    for encodeFace, faceLoc in zip(encodesCurFrame, facesCurFrame):
        matches= face_recognition.compare_faces(encodeListKnown, encodeFace)
        faceDis = face_recognition.face_distance(encodeListKnown, encodeFace)
        print(faceDis)
        matchIndex = np.argmin(faceDis)
        if matches[matchIndex]:
            name = classNames[matchIndex].upper()
            print(name)
            y1, x2, y2, x1 = faceLoc
            y1, x2, y2, x1 = y1*4, x2*4, y2*4, x1*4
            cv2.rectangle(img, (x1, y1), (x2, y2), (0, 255, 0), 2)
            cv2.rectangle(img, (x1, y2-35), (x2, y2), (0, 250, 0), cv2.FILLED)
            cv2.putText(img, name, (x1+6, y2-6), cv2.FONT_HERSHEY_COMPLEX(1,
           (255, 255, 255), 2)
            markAttendance(name)
           cv2.imshow('webcam', img)
    if cv2.waitKey(10) == 13:
        break
    cap.release()
    cv2.destroyAllWindow()
```