ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

DAY – 21

Date: Jul 21, 2025

PROJECT: Face Recognition Attendance System

Tools and Technologies Used

1. Programming Language

Python

- Python is the core language used for face recognition systems because:
- It has powerful libraries for image processing and machine learning.
- It is easy to write and maintain, especially for beginners and academic projects.
- It supports real-time applications when combined with OpenCV and other libraries.

2. Libraries and Frameworks

a. OpenCV (Open Source Computer Vision Library)

A highly optimized library focused on real-time computer vision.

Key Uses:

- Capturing video from webcam: cv2.VideoCapture(0)
- Displaying video frames: cv2.imshow()
- Drawing rectangles around detected faces: cv2.rectangle()
- Converting color spaces: cv2.cvtColor()

Without OpenCV, working with camera input and frame-by-frame analysis would be difficult.

b. face_recognition (Built on Dlib)

Simplifies face recognition using deep learning (HOG + CNN models).

Key Features:

- face_locations(): Detect faces in an image.
- face_encodings(): Convert face into a 128-d numerical vector.
- compare_faces(): Compare two faces to see if they match.
- face_distance(): Find how similar faces are by Euclidean distance.

Behind the scenes, it uses a pre-trained deep learning model for extremely accurate recognition.

c. NumPy

- Used for efficient numerical operations on images and encodings.
- Face encodings and image data are stored as NumPy arrays.
- **Helps in:** Handling matrices of image pixels. Calculating similarity between face vectors.

d. OS module

- Built-in Python module used for interacting with the file system.
- **Used for:**
  - Reading all image files in the dataset directory.
  - Extracting filenames (which are used as names of individuals).

Example:

```
myList = os.listdir('dataset')
```

e. datetime

- Used to capture the current date and time during attendance.
- Helps generate a timestamp like:

```
now = datetime.now()
dtString = now.strftime('%H:%M:%S')
```

Ensures each person is marked once per session, and their timestamp is recorded.

f. Pandas

A powerful data analysis library used for:

- Creating a DataFrame to hold attendance logs.
- Writing/reading CSV files.
- Checking if a person is already marked present.

3. Data Storage

a. Dataset (Local Folder of Known Faces)

- A directory like dataset/ stores images like Amit.jpg, Sara.png.
- The system loads these images and learns the facial features.
- These encodings act like a digital signature to recognize each person.

b. CSV File

A file like Attendance.csv stores data in tabular form:

Name,	Date,	Time
Sara, 2025-08-05, 09:12:34		

- CSV is easy to manage and compatible with Excel, pandas, etc.
- You can append to it every time someone is recognized.
- Advanced users may replace CSV with a database (like MongoDB, MySQL) for scalability and querying.

4. Hardware

- Webcam / External Camera
- A basic USB camera or laptop webcam is sufficient.
- **Used for:**
  - Real-time video stream.
  - Capturing frames for face detection.
  - Connected via OpenCV's cv2.VideoCapture().