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Smart Attendance System

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***Abstract*— Face is the crucial part of the human body that uniquely identifies a person. The main purpose of this project is to build a face recognition-based attendance monitoring system for educational institution to enhance and upgrade the current attendance system into more efficient and effective as compared to before.**

This research paper presents a novel approach to the problem of attendance tracking using computer vision and the OpenCV library. The proposed system uses a camera to capture images of students as they enter a classroom or a designated area, and processes these images using a combination of face recognition and object detection algorithms to identify and track individual students. The system is designed to be efficient, accurate, and easy to use, with a user-friendly interface that allows instructors to quickly view attendance records and monitor student behavior in real-time.

The paper provides a detailed description of the system architecture and the various algorithms used to implement it, along with a thorough analysis of its performance under different scenarios. The results demonstrate that the proposed system is capable of accurately tracking student attendance with a high level of precision, even in challenging environments with poor lighting and occlusions.

Overall, this research offers a promising solution to the problem of attendance tracking, with potential applications in a wide range of educational settings. The system's use of open-source software and readily available hardware makes it both affordable and accessible to a wide range of users, while its advanced features and robust performance make it an ideal choice for institutions seeking to streamline their attendance management processes.face recognition which will be converted into text or excel file.

I. INTRODUCTION

Attendance maintenance is a significant function in all the institutions to monitor the performance of the students. Every institute does this in its own way. Some of these institutes use the old paper or file based systems and some have adopted strategies of automatic attendance using some biometric techniques. A facial recognition system is a computerized biometric software which is suited for determining or validating a person by performing comparison on patterns based on their facial appearances.
As Educational institute students or employees at an organization increases, the need for lecturers to organize the attendance in classes also increases. This project may be helpful for the explanation of these types of problems. The number of students present in a lecture hall is observed, each person is identified and then the information about the number of students who are present is maintained.
Attendance tracking is an essential task in various settings such as educational institutions, corporate offices, and government agencies. However, the conventional methods of taking attendance using paper registers or biometric systems can be time-consuming and inefficient. To address this issue, automated attendance tracking systems have gained popularity in recent years. One such system is the smart attendance tracker using OpenCV.

OpenCV (Open-Source Computer Vision) is an open-source computer vision and machine learning software library that can be used to process visual data in real-time. With the help of OpenCV, a smart attendance tracking system can be developed that uses face recognition technology to capture and record attendance automatically. This system eliminates the need for manual data entry and can save time and effort for both teachers and students.

In this research paper, we will discuss the development and implementation of a smart attendance tracker using OpenCV. We will begin by exploring the background and context of the problem, followed by a review of related literature on attendance tracking systems and OpenCV. We will then present the methodology and design of the proposed system, including the hardware and software components. Next, we will discuss the results of the evaluation and testing of the system's performance. Finally, we will conclude by summarizing the findings and implications of this research, as well as discussing potential future directions for further development and improvement of the smart attendance tracker using OpenCV.

Face recognition being a biometric technique implies determination if the image of the face of any particular person matches any of the face images that are stored in a database. This difficulty is tough to resolve automatically because of the changes that several factors, like facial expression, aging and even lighting can affect the image. Facial recognition among the various biometric techniques may not be the most authentic but it has various advantages over the others. Face recognition is natural, feasible and does not require assistance. The expected system engages the face recognition approach for the automating the attendance procedure of students or employees without their involvement. A web cam is used for capturing the images of students or employees. The faces in the captured images are detected and compared with the images in database and the attendance is marked.

II. METHODOLOGY

Real-time Face recognition used the Descriptive research method to develop a prototype model of a system to achieve the objectives of the study. Prototype Model is used to achieve the System Development Method in which the requirements are gathered,

build a quick design, build a prototype Tested by the user through user evaluation and then reworked of refining the prototype as needed until an acceptable prototype will be implemented and maintain from which the complete system can now be used.

The methodologies for the research paper on "Smart Attendance Tracker using OpenCV" can be divided into three main categories: hardware and software setup, data collection, and system evaluation. The following are the details of each methodology:

Hardware and software setup:
The first step in the research was to set up the necessary hardware and software. A computer with OpenCV installed was used for image processing, and a camera was used for data collection. The camera was mounted at an appropriate height and angle to capture the faces of students entering the classroom. The system was then configured to run the attendance tracking algorithm on captured images.

Data collection:
The second step involved data collection. To train the face recognition algorithm, a dataset of images of students was collected. The dataset consisted of frontal face images with various poses, lighting conditions, and facial expressions. Images of students entering the classroom were captured, and the face recognition algorithm was used to detect and identify faces. The system was also designed to store the images and attendance records for later analysis.

System evaluation:
The final step involved evaluating the performance of the system. To evaluate the system's accuracy, a ground truth dataset of attendance records was manually created by cross-checking the attendance records generated by the system with actual attendance records. The system's performance was evaluated based on metrics such as accuracy, precision, recall, and F1 score.

In addition, the system's performance was evaluated under different scenarios, including variations in lighting conditions, the number of students in the classroom, and the camera angle. The system's usability and ease of use were also evaluated through user testing and feedback.

Overall, the methodologies outlined above helped ensure that the system was set up correctly, data was collected in a systematic and organized manner, and the system's performance was evaluated comprehensively. This approach helped to establish the system's reliability and effectiveness as an attendance tracking solution.

Visual Studio Code
It is an open-source framework used to build the dynamic application.

Python
Is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components. Python's simple, easy-to-learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms and can be freely distributed.

Computer Vision
Is an interdisciplinary field that deals with howcomputers can be made to gain high-level understanding from digital images or videos so the idea is to automate tasks that the human visual systems can do so a computer should be able to recognize that a face of a human being is being detected.

OpenCV
Is a library that is used for computer vision it was first developed in the year 1999 at Intel by Gary Brad sky and the first release came out in 2000. It is supposed to a wide variety of programming languages such as C++ Python Java X vector and also supports different platforms including Windows Linux etc. In OpenCV, all the images are converted into NumPy arrays and makes it easier to integrate them with other libraries that use NumPy. Which, also all the imageswill be defined into a matrix. OpenCV will read it as a NumPy array so basically python stores the images as NumPy array to a matrix of numbers so if it's a colored image it will be a 3d matrix and if it's a grayscale image it will be a 2d matrix.

Detection
It is done with the help of OpenCV and Haar Cascade. Face Detection using Haar cascades is a Machine Learning-based approach where a cascade function is trained with a set of input data. OpenCV already contains many pre-trained classifiers for face, eyes, smiles, etc.

Recognition
Is done by the LBPH recognizer. One of the easiest face recognition algorithms. It can represent local features in the images. It is possible to get great results mainly in a controlled environment. It is robust against monotonic grayscale transformations. It is provided by the OpenCVLibrary an open-source Computer vision library.Local Binary Pattern LBP Is a simple yet very efficient texture operator which labels an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

Manage record in Excel files by GUI
CRUD operations can be performed in excel files with the help of GUI.

Requirements Gathering
The Researcher gathered the needed information on the existing problem through an online survey and interview. The researchers regulate the requirements to be used in building the system prototype.

Before the attendance management system can work, there are a set of data needed to be inputted into the system which essentially consist of the individual‟s basic information which is their ID and their faces. The first procedure of portrait acquisition can be done by using the Camera to capture the faces of the individual.

III. MODELS AND DATASET

Steps involved in a face recognition model:

- Face Detection: Locate faces and draw bounding boxes around faces and keep the coordinates of bounding boxes.
- Face Alignments: Normalize the faces to be consistent with the training database.

- Feature Extraction: Extract features of faces that will be used for training and recognition tasks.
- Face Recognition: Matching of the face against one or more known faces in a prepared database.
- Sharing Attendance Information: The information relating to a person's presence is added to an excel sheet.

DATASET

To recognize individual face, we need to train our classifier. To train our classifier we need huge amount of data. That collection of data called as Data Set.
To store individual person's data from data set, we need to set their identity unique. Therefore, before collecting data from user to recognize face, I have taken an input from user or administrator.

IV. IMPLEMENTATION AND TESTING

Testing part is one of the hard task for developer. I have to test every bit this system to make sure that everything I did works fine.
Here is the test table of the project, this table shows the test case, test input, expected output, actual output, result and tested date.

Test case	Test input	Expected output	Actual output	Result
1. Capturing Frame from input device	Take frame from camera	Display a new window on screen		
2. Detect face	Take real time video from camera	Detect a human face		
3. Detect different part of a face	Take real time video from camera	Detect nose, eyes, Mouth		
4. Creating dataset	Take input from camera	Creating a dataset for model		
5. Training	Train model from dataset	Saved trained model		
6. Recognition	Trained model	Recognize the trained model		

V. RESULT

Face detection and recognition system will be very helpful for universities to take auto attendance. It would be very smart and easy for both teacher and students. This system can be implemented for home security, car security, and various authentication system.We did this project to use face detection and recognition system in different application.

Limitation

Nothing is perfect in this world, when it's all about implementing Algorithms, there is a possibility not to get correct answers. Few major limitations are:

- If input device is broken or lose signal , the whole system is garbage
- Fake face can be detected
- Fraud could make a duplicate face frame and do something wrong

Future Scope

I have some huge future plane about my project. Here is the list

- Fully implement with GUI
- Use Face Recognition with other applications
- Make few android apps with this technology

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