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Face recognition based attendance system using machine learning with location identification

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Abstract

The paper argues that maintaining regular attendance is crucial for student success, and traditional attendance management methods can be inefficient and time-consuming for teachers and administrators. For example, calling out student names or taking manual attendance on paper can take up valuable classroom time and can be prone to errors or manipulation .To address these issues, the paper suggests that a computer-based attendance management system using Computer Vision technology can be an effective solution. Computer Vision involves the use of cameras, sensors, and algorithms to identify and analyze visual data, including images of individuals. In the context of attendance management, Computer Vision can be used to capture images of students during class and automatically recognize and mark their attendance using facial recognition technology. This approach can offer several advantages over traditional attendance methods. Firstly, it can be faster and more accurate, reducing the time and effort needed to manage attendance manually. Secondly, it can provide real-time updates on attendance status, allowing teachers to track students who arrive late or leave early. Finally, it can generate reports on attendance patterns, allowing administrators to identify and address issues related to student attendance and engagement. Overall, the paper highlights the potential benefits of using a computer-based attendance management system using Computer Vision, emphasizing its ability to streamline attendance management and improve student outcomes.

Keywords: Python; OpenCV and Google API; Student attendance; Face recognition

1. Introduction

There are various face-based attendance systems available in the market, but most of them either store the data locally or require a paid cloud storage service to maintain the attendance records. However, it is possible to develop a cost-effective attendance system using Python packages such as OpenCV and face-recognition to recognize faces, and storing attendance data in a free cloud storage service such as Google Sheets. By using these efficient and user-friendly Python packages, we can simplify the process of recognizing faces and storing attendance data. Additionally, we can use Google API to integrate Google Sheets with our attendance system, allowing us to maintain attendance records in a free and easily accessible cloud storage service. This proposed attendance system has the potential to improve the efficiency of existing attendance systems and make attendance management more affordable for organizations of all sizes. By leveraging the power of Python packages and free cloud storage, ourselves can simplify the attendance management process and reduce the cost of maintaining attendance records.

2. Literature Survey

In the digital age, educational institutions are increasingly focused on student attendance as it is critical for the quality of education. However, the traditional methods of marking attendance, such as calling out names or taking signatures

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on paper, are time-consuming and tedious. To revolutionize this system, a project has been developed called "Student Attendance System using Python based on Facial Recognition."This project utilizes a computer system's camera to capture a photo of the student, which is then processed using an algorithm to extract facial features and recognize the student's face. Upon successful facial recognition, the attendance is automatically recorded., and the record of attendance can be extracted in the form of an Excel sheet.To provide a user-friendly interface, Python Tkinter has been used to develop the graphical user interface (GUI) of the system. This innovative system saves time and effort while also reducing the likelihood of errors in attendance tracking. It represents a significant improvement over traditional methods and can greatly enhance the efficiency of educational institutions. (Shivangi Awasthi, 2Shubhangi Awasthi Facial Recognition Attendance System Using Python at 2022 International Journal of Research Publication and Reviews).

Automatic face recognition (AFR) technology has revolutionized many aspects of our changing world. One real-world application of this technology is in the area of student attendance systems. A face recognition-based attendance system uses face biometrics and high-definition monitor video to recognize students' faces for attendance purposes. In my own face recognition project, I will use deep learning to develop a computer system that can quickly and accurately find and recognize human faces in images or videos captured by a surveillance camera. While many algorithms and techniques have been developed for improving the performance of face recognition, I will be using deep learning to convert video frames into images that can be easily analyzed and used to automatically update attendance databases. This technology has the potential to greatly simplify the process of taking attendance and improve accuracy and efficiency in educational institutions.(Divya Pandey, 2Priyanka Pitale, 3Kusum Sharma Face Recognition Based Attendance System using Python at JETIR October 2020).

The human face is a unique and crucial part of the body that can be used as a biometric identifier for implementing face recognition systems. Attendance marking is a crucial task in any organization, and traditional methods can be time-consuming and tedious. In this project, we propose an OpenCV-based face recognition approach that integrates a camera to capture input images, an algorithm to detect faces from the input image, encode and identify the face, mark attendance in a spreadsheet, and convert it into a PDF file.The system's training database is created by training the system with the authorized students' faces. Cropped images of the students' faces are stored in a database with their respective labels. The features of the images are extracted using the Local Binary Pattern Histogram (LBPH) algorithm.Once the system is trained, it can recognize the faces of authorized students in real-time. When a student's face is detected by the camera, the system matches the detected face with the faces in the database. If the face is recognized, the system marks the student as present in the attendance spreadsheet. If the face is not recognized, the system marks the student as absent.The attendance data can be exported to a PDF file for easy storage and distribution. The proposed system is more efficient and accurate than traditional attendance methods, making it a useful tool for any organization.

The attendance system is a critical component of maintaining discipline and ensuring that students receive a quality education in schools, colleges, and universities. Traditional methods of taking attendance, such as calling roll numbers or collecting signatures on paper, can be time-consuming and inefficient. However, with advancements in technology, there is an opportunity to implement an automated system that is user-friendly, efficient, and minimizes time wastage. This project proposes an automated attendance system using Raspberry Pi 3B+ with OpenCV/Python libraries and a recognizer algorithm to assist faculty in taking attendance without any disruptions or time wastage. The system utilizes face recognition technology to save time and accurately identify and eliminate the chances of proxy attendance. This proposed system has the potential to be deployed in various domains where attendance tracking is crucial and serves as a key component of project objectives and design criteria. Upon meeting the project objectives and design criteria, it can be concluded that this project provides an engineering solution for universities and colleges to effectively track and manage attendance. Additionally, the proposed system ensures accuracy, eliminates manual errors, and saves valuable time. (Source: Ghalib Al-Muhaidhri [1], Javeed Hussain[2] "Smart Attendance System using Face Recognition" in the 2019 International Journal of Engineering Research & Technology (IJERT)).The Internet of Things (IoT) is revolutionizing attendance tracking in schools and colleges with its cost-effective and efficient solutions. A cloud-based Smart Attendance System prototype has been developed using IoT technology to automate attendance record generation, reporting, monitoring, and alert generation for educational institutes. This system aims to reduce the time required to take attendance, and the portable attendance device can be easily passed among students. The system has been tested successfully, showing promising results that can save time for teachers and staff. The implementation of this system opens up opportunities for further research and development in this area, highlighting the potential of IoT in addressing challenges in traditional attendance systems and improving efficiency and effectiveness in various domains. (Yadav, V., & Bhole, G. P., 2019, International Conference on Machine Learning, Big Data, Cloud and Parallel Computing)

3. Methodology

3.1. Cmake

It can generate a native build environment that can build libraries, compile source code, produce wrappers, assemble executable binaries, and store data that can be edited by the user before the native build files are generated. This feature offers users flexibility and control over the build process, making it easier to modify and customize the built environment as needed.

3.2. Dlib

Dlib is a popular machine learning library that enables the detection of 68 coordinates (x, y) on a person's face, corresponding to various facial landmarks. This library is widely used for developing practical machine learning and data analysis applications and has easy-to-use Python bindings. As a result, it has been my go-to tool for facial landmark detection in face-related projects. I find it extremely efficient in detecting facial features and landmarks with great accuracy.

3.3. Face Recognition

Dlib is a powerful and straightforward face recognition library that uses advanced facial recognition technology to achieve remarkable accuracy. With a 99.38% accuracy rating on the Labeled Faces in the Wild benchmark, it is considered one of the most reliable face recognition libraries in the world.In addition to its high accuracy, Dlib also offers a command line program that can be used to perform face recognition on a folder of photographs. This feature makes it easy for users to implement face recognition technology into their projects, regardless of their level of experience.Overall, Dlib's combination of accuracy and ease of use make it a popular choice for facial recognition applications.

3.4. OpenCV

OpenCV is a powerful and free software library designed for computer vision and machine learning applications. It provides users with access to more than 2500 optimized algorithms that can be used to perform a wide range of tasks, including finding similar images in an image .Since its release, OpenCV has been downloaded over 18 million times and has become a popular choice for developers looking to incorporate artificial intelligence into their products. It is versatility and wide range of functionalities have made it a go-to tool for computer vision and machine learning applications across multiple industries.

3.5. Google API

Google APIs are a set of application programming interfaces designed by Google to simplify communication and integration between Google services and other services. Some examples of these services include Google Search, Gmail, Translate, and Google Maps. These APIs provide developers with access to user data, analytics, machine learning, and other services, such as embedding Google Maps on a website. One of the most useful features of Google APIs is the ability to read and write data to Google Sheets using the RESTful interface provided by the Google Sheets API. This allows developers to connect to Google Sheets using a wide range of programming languages, such as JavaScript, PHP, or Python, and access and manipulate data in real time.

3.6. Google API - Authentication and authorization

Authentication and authorization are essential components of any API, including Google APIs. The OAuth 2.0 protocol is commonly used for this purpose, providing a secure and reliable means of authentication and authorization. To use a Google API, developers must first obtain credentials from the Google Developers Console. Once credentials are obtained, the client app can then request an access token from the Google Authorization Server. This access token is then used to authenticate and authorize the client app when it attempts to access a Google API service. The OAuth 2.0 protocol is designed to be straightforward, making it easy for developers to implement in their applications.

3.7. Google Sheets API

The Google Sheets API is a RESTful interface used for reading and modifying spreadsheet data. Common uses include retrieving cell values, updating cell data, and creating new sheets.

- Create spreadsheets Input and output spreadsheet cell values.

- Update spreadsheet formatting
- Manage Connected Sheets

3.8. Work flow

Fig.1 The proposed methodology involves collecting a dataset from classmates and using it as input for a face recognition project. The project requires the installation of certain software, which is explained in the documentation. Once the project is completed, the OpenCV activates the camera and captures real-time face images as input. The Face Recognition python package is used to recognize the faces in the input image, and the recognized faces are stored in a python array. The face recognition process generates face encoding and compares it with the known students' python array. If a known face is detected, it is saved in a local CSV file. The objective of the system is to store attendance data in a free cloud source, for which the Google API is used. The Google Sheets API is linked to Google Sheets, and a Key file is generated to connect the Python project to the Google API. The attendance data is stored in a Google Sheets document with the user name and time, and the data is cleared every day. The attendance sheet is downloaded every day for later usage, and a local backup is also made for that day. When the system starts the next day, any detected faces are recorded in a new CSV file with that day's date as the file name. This methodology provides both local and cloud storage for free, making it a useful and cost-effective solution.

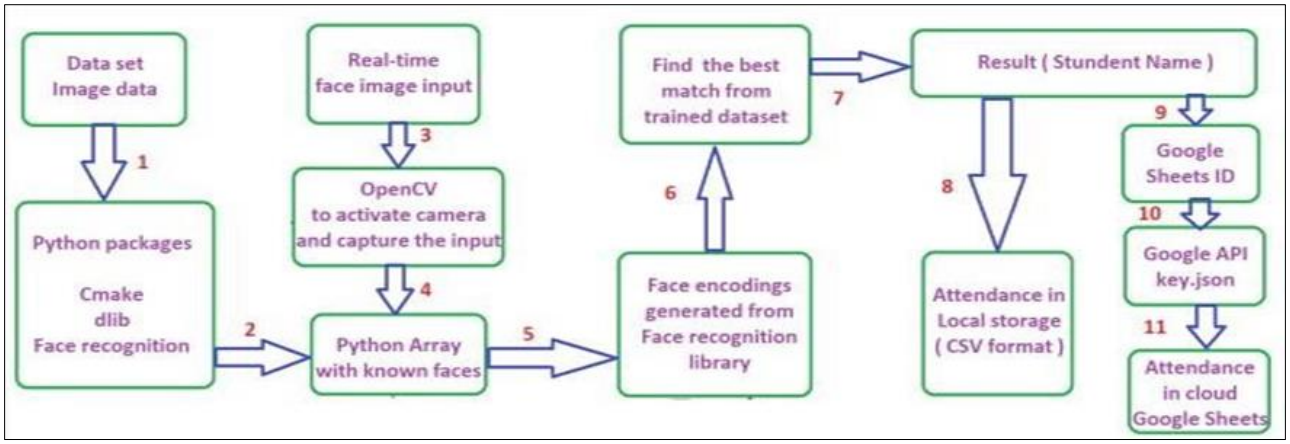

Figure 1 Workflow of Face attendance system using Python, OpenCV and Google API

3.9. Implementation

Fig.2 detecting the image and uploading it to a database for monitoring it.

Figure 2 The student photos have to be uploaded in the student's folder.

Fig.3. The OpenCV activates the camera and received the real-time face image as the input.

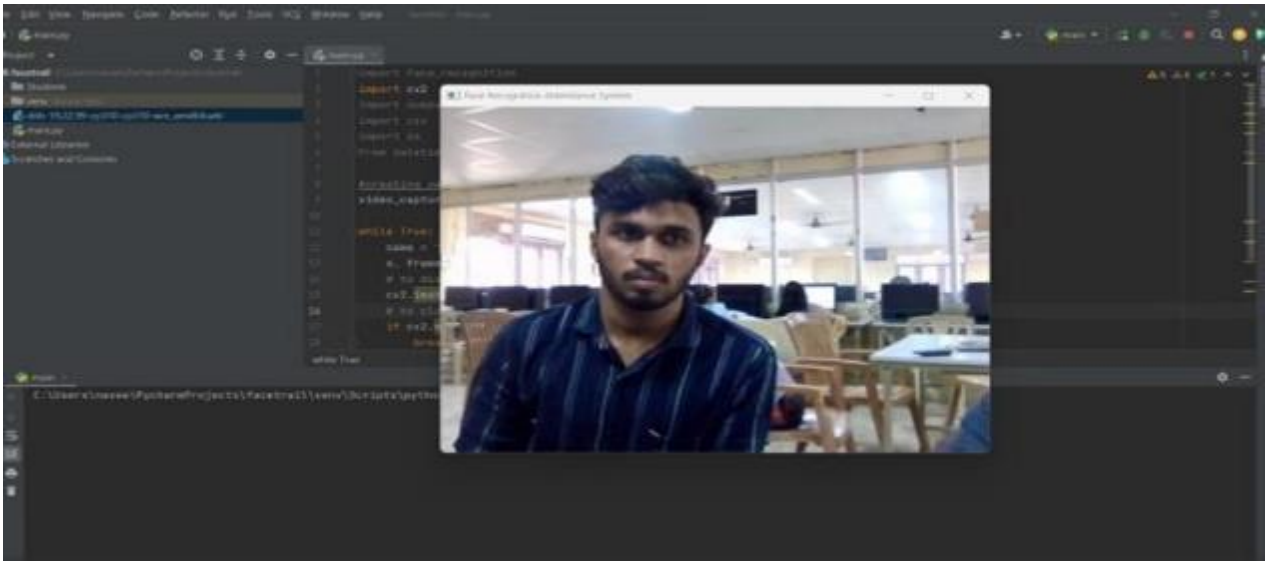

Figure 3 Activating the camera

Fig.4. Face encodings generated from the Face recognition library and finding the best match from the already created python array of the known student list.

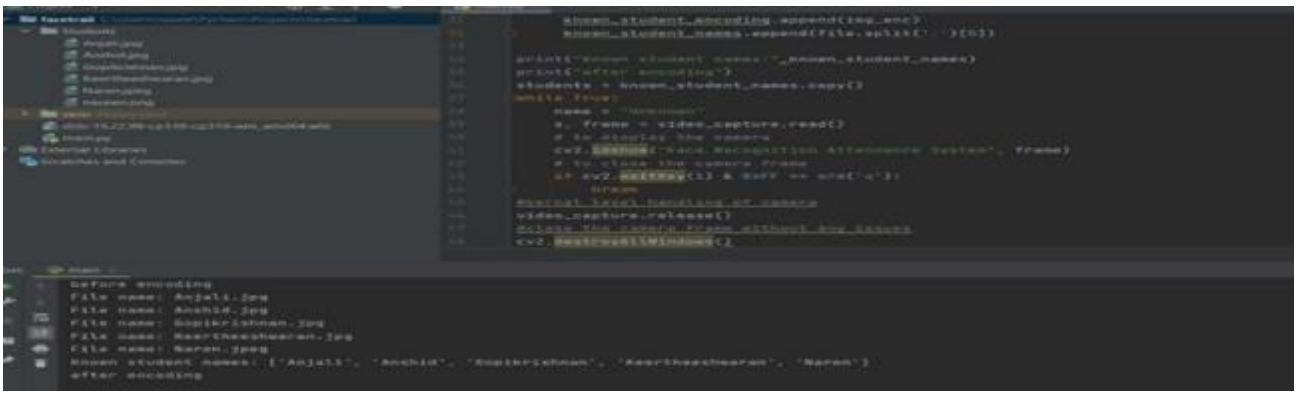

Figure 4 Detecting the face

Fig.5. backend imaging method followed by real-time face surveillance and image verification.

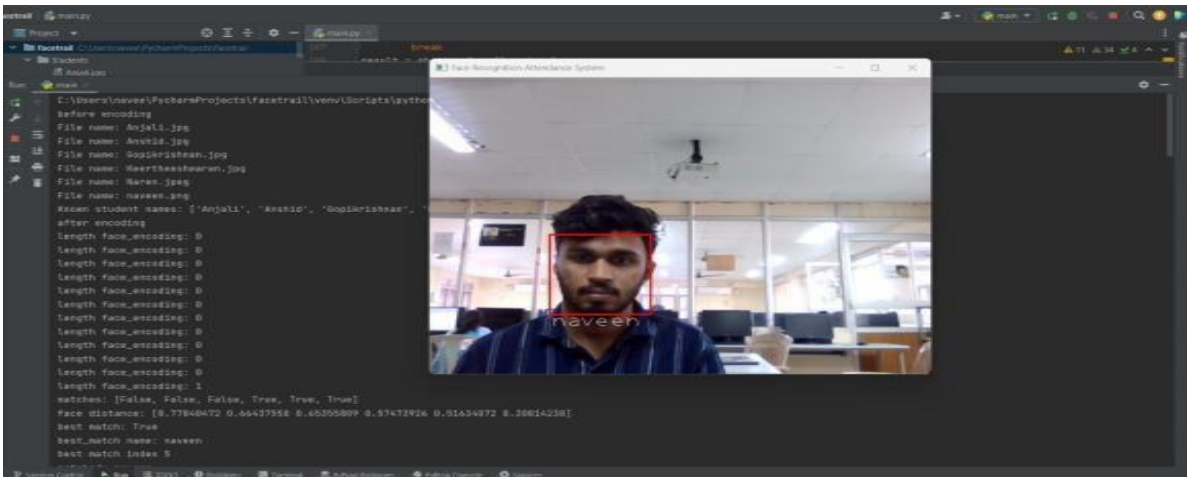

Figure 5 Identifying the person and making attendance in local CSV file

4. Conclusion

The project aims to improve the existing face attendance system by incorporating the Google API as a unique feature. This enhances the overall functionality and accuracy of the system. The development work for this project has been done using Python packages which are known for their efficiency and ease of use.

One of the key advantages of using Python-based packages is that they can significantly simplify the development process. This allows developers to focus on the core functionalities of the project rather than spending time on low-level implementation details. As a result, the project can be completed in a shorter period of time and with fewer resources.

Another important aspect of this project is its cost-effectiveness. The use of Google Sheets instead of cloud storage reduces the cost of storing attendance data. Google Sheets is a cloud-based spreadsheet application that allows for real-time collaboration and data sharing. This eliminates the need for expensive cloud storage solutions and makes the system more accessible to smaller businesses and organizations.

Overall, the combination of the Google API and Python-based packages has resulted in a highly efficient and cost-effective face attendance system. This system can be easily integrated into existing workflows and provides accurate attendance data in real-time.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

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