

FaceCounter: Massive Attendance Taking in Educational Institutions through Facial Recognition

Adrian Moscol
Computer Science School
Universidad Peruana de Ciencias Aplicadas
Lima, Peru
u201811410@upc.edu.pe

Willy Ugarte
Computer Science School
Universidad Peruana de Ciencias Aplicadas
Lima, Peru
willy.ugarte@upc.edu.pe

Abstract—The purpose of this project is to implement a facial recognition system that will improve efficiency when taking attendance in educational institutes, as well as reducing the possible cases of identity theft. To achieve our objective, a facial recognition system will be created that, upon receiving a photograph of the students present in the classroom, will identify them and confirm their attendance in the database. The investigation of pre-trained models using the agile benchmarking technique will be important, the analyzed and compared models will serve as a basis for the development of the facial recognition system. This program will be connected to an application that will use a simple interface so that teachers can save class time or evaluation's time by taking attendance or confirming the identity of the students present. Also, it will increase security by avoiding possible identity theft with tools such as false fingerprint molds (admission exams) or partial and/or final exams (false ID). The scope of the project has been contemplated to be developed throughout the 28 weeks and tested in the 2023-01 academic semester at Universidad Peruana de Ciencias Aplicadas in Lima.

Keywords— Massive attendance, facial recognition, face-recognition library, Educational institution, benchmarking facial algorithms

I. INTRODUCCIÓN

Attendance tracking is a common and important task for educators, but it can be time-consuming and prone to errors, which can cause delays and inaccuracies in recording attendance [6] [2]. In Peruvian universities, attendance is mandatory. During exams, it is especially important to maintain security and accuracy in identifying students and recording attendance, as the teachers in charge of supervising the classroom may not know personally most of the students. According to an article published in the newspaper Peru21, in April 2022, the prosecutor's office reported that the first place in the admission exam received help from impersonators, who charged exorbitant amounts to ensure admission [7]. On April 2019, newspaper Andina published 11 false candidates were arrested in the admission exam of the Federico Villarreal National University using fingerprint molds of real student [8].

To tackle this problem we propose an automated process for attendance tracking that will solve possible delays and human error by providing greater security during classes and exams by ensuring accurate identification of students and avoiding impersonation.

There are other works that aim to solve this problem such as Yang and Han [1] or Farhi et al. [2], but the main difference is that Yang and Han use real time video for face recognition and Farhi et al. does not present an app for the simplicity of its use. Nevertheless, our approach differs from existing solutions first of all by creating a mobile user-friendly interface app that allows teachers to easily take and upload pictures. Secondly, we have chosen to output the

attendance data as a simple txt file, for an easier implementation to school systems. Finally, we have prioritized simplicity in our system, without requiring specialized hardware or complex setup procedures. These three aspects make our system stand out in the market, providing a valuable and innovative solution for schools and universities looking to streamline their attendance tracking processes.

This paper presents our implementation of a face recognition attendance system, which uses the Python library face-recognition, a face recognition model retrained with our own data, to recognize faces of people in the classroom. The app, built with the framework React Native, allows teachers to take a picture of the classroom, which is then uploaded and processed by the system. The system will recognize the faces of students and add them to the database as either present or absent. The primary aim of this project is to reduce attendance time taken and increase security during exams identification of students so they don't do identity theft or miss out.

Some limitations of our system is that it relies on the accuracy of face recognition technology, which can be affected by factors such as lighting and occlusion.

The main contributions of our paper will be then:

- We develop an easy friendly interface app that allows users to easily manage attendance tracking.
- We develop a system capable of analysing one or multiple pictures with one or multiple faces for their recognition.
- Simple system with no need of complex hardware, common components and minimal dependencies, reducing potential compatibility issues and facilitating deployment across a range of devices.

The paper details the following: First, related works will be shown in section 2. Second, we will discuss our main contributions, talking about the theory and method used for the solution in section 3. Also, we will talk about the experimentation process of the project, with details on the analysis and selection of the algorithm library of face recognition, design of the project and development of it in section 4. We will talk about the results of this experiments in section 5. Finally, we will discuss the main conclusions of the project and possible future work that can be added in section 6.

II. RELATED WORKS

In the related works of attendance tracking systems with face recognition, several papers have explored different aspects of the technology. Some studies have investigated cheating in exams and methods to prevent it, while others have focused on the challenges of recognizing faces with masks during the COVID-19 pandemic. Real-time face recognition in video has also been explored. Additionally, some studies have aimed to reduce the complexity and expense of attendance tracking systems. These papers provide valuable insights into the development and application of facial recognition technology, as well as addressing the problem attendance tracking and exam cheating.

In [3], the authors provide an article provides a detailed analysis of the policies and strategies for academic integrity used by different educational institutions in Spain to prevent evaluative fraud. The results show that only 27.5% of institutions use an identification device for online evaluation. Private universities are the ones that use identity verification software the most (75%) compared to those that do not use it (9.5%).

There are other example of face recognition application in other problems that are interesting to take a look like in [4], the authors developed a system to distinguish between masked, unmasked, and incorrectly masked individuals using a mobile application called MadFaRe (Masked Face Recognition application), this because of the COVID-19 pandemic we had during this last years. The developed a deep learning and CNN-based facial recognition algorithm [4]. The author achieved a validation assertiveness of 80.88% for partial facial recognition. For the results of facial recognition applying CNN, an increase in validation was obtained from 78.41% to 90.40%.

We now can take a look to papers that used the face recognition as a way to solve the attendance tracking. Starting in [1], the authors propose a complete assistance system that combines multiple modules to reduce the complexity of the program and make the code reusable. The system consists of a video terminal module, a cable transmission module, data storage, a facial recognition module, and a computer terminal module. Tests were conducted in two universities, where 200 students who must register with ID cards were selected. The facial recognition rate was high (around 82%). The system aims to reduce absenteeism, and the results showed that the rate of students skipping classes decreased by 13% compared to the control group.

Then we can analyze the creation of a facial recognition system for attendance taking that aims to reduce time and maintenance costs. In [2], the authors have measured the accuracy of their proposal using two tables that focused on scenarios such as distance, angles, and lighting. The results showed high accuracy, with recognition rates of 97.1% to 98.8% for face positions in the range of -15° to $+15^\circ$, and an average accuracy of 96.47% under low-light conditions. This system can recognize faces with an accuracy of 99% to 98% when the face is 4 to 5 meters away from the camera under normal lighting conditions.

Finally, in [5] the authors conducted 6 tests where the number of recognized individuals increased per test. In all tests, the program was able to detect the number of people in the photo and achieved a 0% false recognition rate. It achieved 100% accuracy in each of the tests, with the most notable being case 6, which involved 12 people.

We can then say our proposed multi-facial recognition attendance tracking system for teachers offers several advantages compared to previous approaches. While [1] and [2] have demonstrated the potential of facial recognition for attendance tracking, our system offers a more user-friendly interface for teachers to take a picture of the classroom, which is then uploaded and processed to recognize all students in the image. Our system also extends previous work by allowing for recognition of multiple faces in a single image and automatically marking students as present or absent in a database. Additionally, our approach offers the potential for improved accuracy and convenience over traditional attendance taking methods.

III. MAIN CONTRIBUTION

The paper aims to present the contributions of a new attendance tracking system. The system is designed to provide an easy-to-use app for users to manage attendance tracking, with a simple interface that eliminates the need for complex hardware and reduces potential compatibility issues. The attendance data is stored in both txt and csv files, which can be easily imported into other software systems for further processing or analysis. The system also includes a face recognition model, created using the python library face-recognition, which is integrated into an android app that teachers can use to take a picture of the classroom. However, the project has several restrictions, such as the requirement for a private connection to the database,

a minimum camera resolution of 2 megapixels, and a minimum Android version of 10. The exclusions of the project are that it will not be compatible with IOS operating systems and that it will only use images, not videos or real-time imaging.

A. Context

Base de datos: Una base de datos es un conjunto organizado de información que se almacena y se puede acceder electrónicamente desde una computadora. Los datos son generalmente estructurados en tablas y campos para facilitar la búsqueda, clasificación y recuperación de información específica. La base de datos se puede utilizar para una variedad de propósitos, como la gestión de inventarios, la facturación, el seguimiento de clientes, la gestión de proyectos y mucho más [9].

Firebase: Firebase es una plataforma en la nube que permite desarrollar aplicaciones móviles y web sin necesidad de crear y gestionar una infraestructura propia de servidores. Ofrece soluciones para el almacenamiento de datos en tiempo real, autenticación de usuarios, notificaciones push, entre otros servicios. Según Firebase, su plataforma se integra con múltiples lenguajes y frameworks [10].

React Native: React Native es un marco de desarrollo de aplicaciones móviles que utiliza JavaScript y React para crear aplicaciones nativas para iOS y Android. Fue desarrollado por Facebook y su comunidad de desarrolladores [11].

Massive attendance: Massive attendance is the process of taking attendance for a large group of people, such as in a conference, lecture, or other event. It often involves the use of technology to collect and analyze data quickly and efficiently.

Facial recognition: Facial recognition refers to the technology of identifying or verifying the identity of a person based on their facial features. It uses algorithms to analyze and compare the unique characteristics of a person's face [12].

face-recognition library: The face-recognition library is a Python package that provides face detection, face recognition, and facial landmark detection capabilities. It uses deep learning algorithms to analyze images and identify faces in them. It can be train with your data for your usage [13].

Educational institution: An educational institution refers to an organization that provides formal education and is recognized by the educational authorities of a particular country or region. This can include schools, colleges, universities, and other institutions that offer educational programs [14].

benchmarking facial algorithms: Benchmarking is the process of evaluating the performance of a system or component by measuring its capabilities and comparing them against established standards or other systems. In facial recognition algorithms, benchmarking is used to assess the accuracy and efficiency of different algorithms. A benchmarking of facial algorithms was done to determine which one would be more suitable for our project [15].

B. Method

In order to select the best algorithm for this project, a thorough benchmarking was conducted to compare various algorithms and libraries. After a comprehensive analysis of factors such as price, simplicity, information about the algorithms and effectiveness, the team decided to use the Face-Recognition library in Python. The pre-trained algorithm was then trained with pictures of the users that were going to be tested, which involved taking a video of twenty to thirty seconds and using a small program that extracted every frame of the video and saved it in a folder. The algorithm was then trained with these folders, saving the list of images with the name or code of the user. This training process allowed the algorithm to accurately recognize the faces of the users. The algorithm's recognition capabilities were not limited to single faces, as it was also able to identify multiple faces in a single picture. This approach proved to be highly effective in achieving the project's goals and

could be further optimized to enhance the precision and speed of the recognition process.

To ensure that the recognition has been properly registered, the team has developed a database that simulates teachers, assigned classrooms, and their students. Firebase has been chosen as the platform for storing not only the videos but also the database that will be connected to the app. Firebase is a comprehensive platform that provides tools and services for mobile and web development, including app building, authentication, real-time databases, storage, and hosting. As shown in Figure 1, the data is stored in Firebase and connected to the app. When a picture is taken and sent, the face recognition system runs and recognizes the students from the folder with images. Every time a student is identified, the program checks whether the student belongs to the classroom the picture was taken for. If the student is present in the classroom, he or she is marked as present in the database. Otherwise, the student is marked as absent. Additionally, each picture analyzed is saved in another folder in Firebase storage to provide a record of the time and date. Finally, the database is updated with the information of the present and absent students, and a txt and csv file are created for easy implementation in institutions.

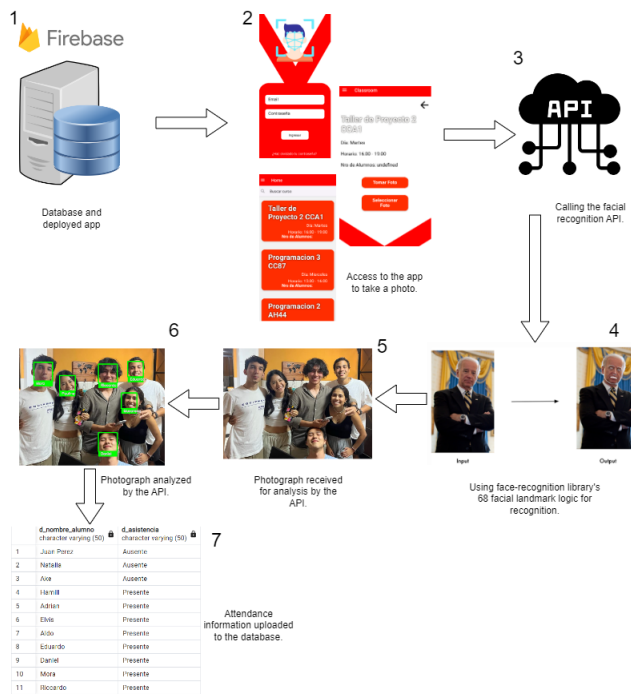


Fig. 1. App Architecture

To seamlessly integrate the process of face recognition into the mobile app, the team needs to develop an API that connects the app and the recognition program. The API will enable the user to simply take a picture, which will then be automatically uploaded to the system's database. Subsequently, the recognition algorithm will be triggered and will determine if the student is present or absent. One of the main advantages of this approach is that it eliminates the need for teachers to wait for the app to respond, as the recognition process will be handled automatically in the background. This will save time and reduce the burden on teachers, allowing them to focus on other important tasks. Additionally, this seamless integration will help ensure that attendance data is collected accurately and in real-time, providing teachers with up-to-date information on their students.

IV. EXPERIMENTS

A. Benchmarking

B. Design

C. Develop of the app

V. RESULTS

VI. CONCLUSIONS AND PERSPECTIVES

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