Face Recognition Attendance System Using Local Binary Pattern Histogram Algorithm

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Abstract: Like other widely used biometric technologies like fingerprint, iris, and finger vein pattern recognition, face recognition is a biometric technique. The face is the most important part of the human body for recognizing each individual because it contains many important features. This study creates face classification models, employing HAAR-CASCADE OpenCV for face detection and LBPH (Local Binary Pattern Histogram) for face recognition, to identify each character's face from a collected image. The suggested facial recognition attendance system will take a picture, compare it to a database-stored picture, and then automatically register attendance.

Keywords: HAAR-CASCADE classifier, OPENCV, face recognition, face detection, LBPH, Processing, Attendance system.

INTRODUCTION -

Image processing is a method to perform some operations on an image to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which the input is an image and the output may be an image or characteristics or features associated with that image. Image retrieval: seek the image of interest. Measurement of pattern – Measures various objects in an image. Image Recognition: Distinguish the objects in an image. This is the first step, or process, of the fundamental steps of digital image processing. age. Every college and school requires an attendance system to maintain a record of each present student.

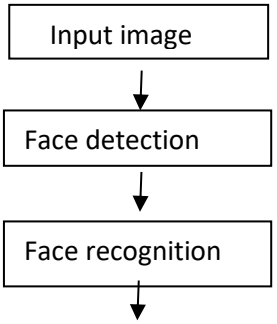
The face is an important part of human being which represents the unique identity, emotion and age. Societal intercourse and communication becomes possible through this essential part of the body. Quick and easy recognition of a person is possible through one's face. Face recognition is one of the most preferred technologies for biometric identification and verification of individuals. It is an efficient and more effective technique as compared to voice, iris, fingerprint, ear and hand gesture. Over the years after several researches, face recognition became one of the most studied research areas in the field of computer vision. It has been a fast growing and interesting area in real time application. It is a branch of pattern recognition and is an important part of the human perception system. Reliability is an important factor in face recognition algorithms or systems for the matter of security. Other methods for identification might be more accurate but face recognition has always been a major focus of research as it is the most preferred method by people for personal identification. In attendance management too face recognition is evolving as it requires bare minimum efforts. Even without any major participation or explicit action from the user side, face images can be acquired from a distance and after recognition attendance gets updated [2]

Face Recognition Attendance System is developed for the Faculty to maintain attendance records. It uses facial recognition technology to identify the person's facial features and automatically mark attendance, which is much faster than the previous method. To create an attendance system, a database is created by taking videos of different people facing in different directions. In this system, an image is captured through the camera, and then the face is detected. If the input image matches with images in the database then and then only the person gives the authentication of this system. Machine learning is the branch of computer science that designed the system by learning the different samples of the data, creating a model, and behaving like a trained model. The input data are the features of the image, which represent the image's behavior. These are some steps that the system will follow:

Steps-

1. capture a photo.
2. Then the software measures a variety of official features called landmarks or nodal points. These include the distance between eyes, the width of the nose, the depth of the eye socket, the distance from the forehead to the chin, etc., and may collect up to 15 measurements. This information is converted into a mathematical formula that represents a unique facial signature.
3. Then the unique face will be compared with the database image.
4. Mark attendance.

The above statement can be illustrated in figure 1 below.



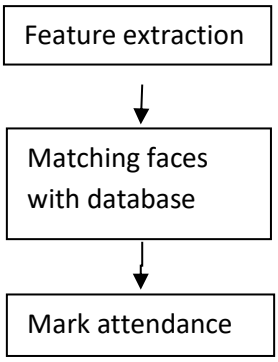


Fig 1. Process of attendance system

Literature Survey

XIAOGUANG Lu [1] proposed several algorithms that are divided into approaches based on model and appearance. Three linear subspaces Analysis are described in the methods based on appearance. Also for face recognition non-linear manifold analysis is explained.

S.T. GANDHI [2], presents the face recognition Approach to identify the person using different experimentation. This system provides authentication to the system by face as a biometric. This system suggested different applications like identification systems, access control, and document control.

Anil Kumar Sao et al.[3] proposed a template-matching algorithm for face recognition. This approach addresses the posed problem in face recognition. First, the faces are represented in an edge view. Then template matching is applied over the image. The edginess-based approach represents the image in 1 dimension. The person identification is performed based on the matching score.

SUJATA G. BHELE [4] presents face detection systems reviews. This paper is mostly focused on soft computing methods like SVM, ANN, etc. to detect the face. These approaches may give better results. This paper discussed the different feature extraction algorithms like PCA, LDA, and ICA. In this paper, some problems are also mentioned each reducing accuracy like image quality, pose variations, and illumination changes.

3. Proposed System

To overcome the problem in the existing attendance system we shall develop a biometric-based attendance system over a simple attendance system. There are many solutions to automate the attendance management system like thumb-based simple computerized attendance system, and iris scanner but all these systems have limitations overcome and security point of view. our proposed system shall be a "Face Recognition Attendance System" Which uses the basic idea of image processing which is used in many security applications like banks, airports, intelligence agencies, etc.

A. Architecture

The proposed system is very simple, effortless, and manageable with lucid operations. It embraces a database of students' faces and their details like name, enrolment number, and Course. Two or more cameras depending on the need and size of the classroom are to be accommodated on the ceiling of the classroom covering the entire area. These cameras will capture images several times during a lecture. This will increase the efficiency of the system because if the camera will not cover some students then other cameras will capture their faces. There are numerous expressions and poses possible that a student can perform. if at a particular instance system fails to detect faces due to unfavorable poses then the system can detect those faces at another instance of image acquisition. Once the image acquisition is done when the teacher triggers the system by making a click on the start button thereafter system will undergo face detection. After the faces are detected in an image taken by all cameras at all given instances the detected faces will be compared with stored images of the students in the database. Once the face is matched the present is marked in front of its corresponding enrolment number and name in excel format. Though there are multiple cameras and multiple instances, there is a possibility of redundant faces. Collaborated –results will be generated by excluding redundant faces of the same student so that single attendance is given to that student during a lecture.

B. methodology

In developing an intelligent attendance management system, some steps need to be followed to achieve this Successful task. The steps are definable as follows:

- Database creation
- Image amelioration detection
- Feature extraction
- Face recognition
- Redundancy removal
- Report generation

System Analysis and Design –

Requirement Specifications –

This is the most important section of the project. This section describes the detailed workflow of the project and the necessary theoretical background.

Tools and Technologies – Tools and Technologies Tools and techniques used in the project are described in this section of the thesis. This project focused was mainly focused on Python Programming and its libraries.

Python –

Python is a high-level object-oriented programming language. Python is a multi-purpose programming language that works on different platforms like Windows, Linux, Mac, Raspberry Pie, etc. Python is more popular than other programming languages because it has simple syntax than other programming languages

OPENCV

OpenCV is an open-source machine learning and computer vision library. It provides bindings for Java and Python programming languages. It focuses mainly on video capturing, image processing, and analysis. It has face detection 15 and object detection features. OpenCV can be used to read and write images and capture and save videos. It can perform feature detection like faces, cars, images, etc. Many established companies like Yahoo, Google, Microsoft, Intel, and many others use the library.

Python libraries –

TKINTER –

TKINTER is the standard GUI library for Python. Python when combined with TKINTER provides a fast and easy way to create GUI applications. TKINTER provides a powerful object-oriented interface to the Tk GUI toolkit.

MATPLOTLIB –

A plotting library used for the python programming language and its numerical mathematics extension NumPy.

ALGORITHMS –

Local Binary Pattern Histogram Algorithm (LBPH) –

The Local Binary Pattern Histogram (LBPH) algorithm is a face recognition algorithm based on a local binary operator, designed to recognize both the side and front faces of a human. However, the recognition rate of the LBPH algorithm is limited, if the conditions, such as in the expression diversification, disorientation, and a change in the lighting performance manifest. It is widely used in facial recognition due to its computational simplicity and discriminative power.

The steps involved to achieve this are:

- creating dataset
- face acquisition
- feature extraction
- classification

The LBPH algorithm is a part of opencv.

OPENCV HAAR CASCADES –

Object Detection using HAAR feature-based cascade classifiers is an effective method proposed by Paul Viola and Michael Jones in the 2001 paper, "Rapid Object Detection using a Boosted Cascade of Simple Features". It is a machine learning-based approach in which a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, HAAR features shown in the below image are used. They are just like our conventional kernel. Each feature is a single value obtained by subtracting the sum of pixels under the white rectangle from the sum of pixels under the black rectangle.

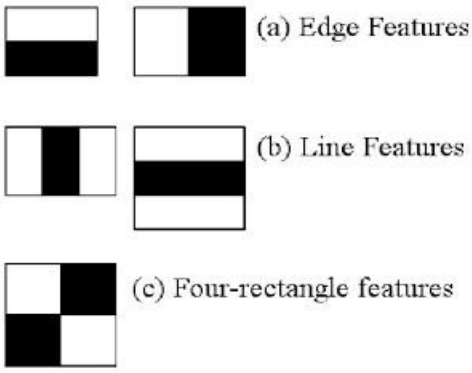


Fig. 2

Now all possible sizes and locations of each kernel are used to calculate plenty of features. For each feature calculation, we need to find the sum of the pixels under the white and black rectangles. To solve this, they introduced integral images. It simplifies the calculation of the sum of the pixels, how large may be the number of pixels, to an operation involving just four pixels.

But among all these features we calculated, most of them are irrelevant. For example, consider the image below. The top row shows two good features. The first feature selected seems to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is irrelevant. So how do we select the best features out of 160000+ features it is achieved by

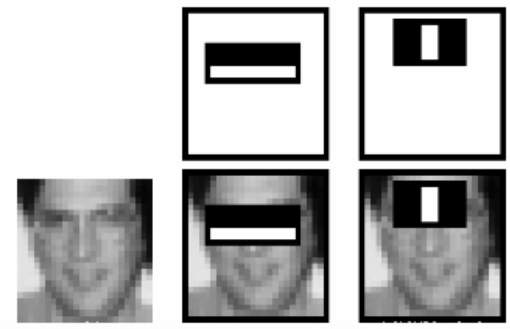


Fig.3

For this, we apply every feature on all the training images. For each feature, it finds the best threshold which will classify the faces as positive and negative. But obviously, there will be errors or misclassifications. We select the features with a minimum error rate, which means they are the features that best classify the face and non-face images. (The process is not as simple as this. Each image is given equal weight in the beginning. After each classification, the weights of misclassified images are increased. Then the again same process is done. New error rates are calculated also new weights. The process is continued until the required accuracy or error rate is achieved or the required number of features are found).

The final classifier is a weighted sum of these weak classifiers. It is called weak because it alone can't classify the image, but together with others forms a strong classifier. The paper says even 200 features provide detection with 95% accuracy. Their final setup had around 6000 features. (Imagine a reduction from 160000+ features to 6000 features. That is a big gain).

So now you take an image. Take each 24x24 window. Apply 6000 features to it. Check if it is a face or not. Isn't it a little inefficient and time-consuming? Yes, it is. The authors have a good solution for that.

In an image, most of the image region is a non-face region. so it is a better idea to have a simple method to check if a window is not a face region. If it is not, discard it in a single shot. Don't process it again. Instead, focus on regions where there can be a face. This way, we can find more time to check a possible face region.

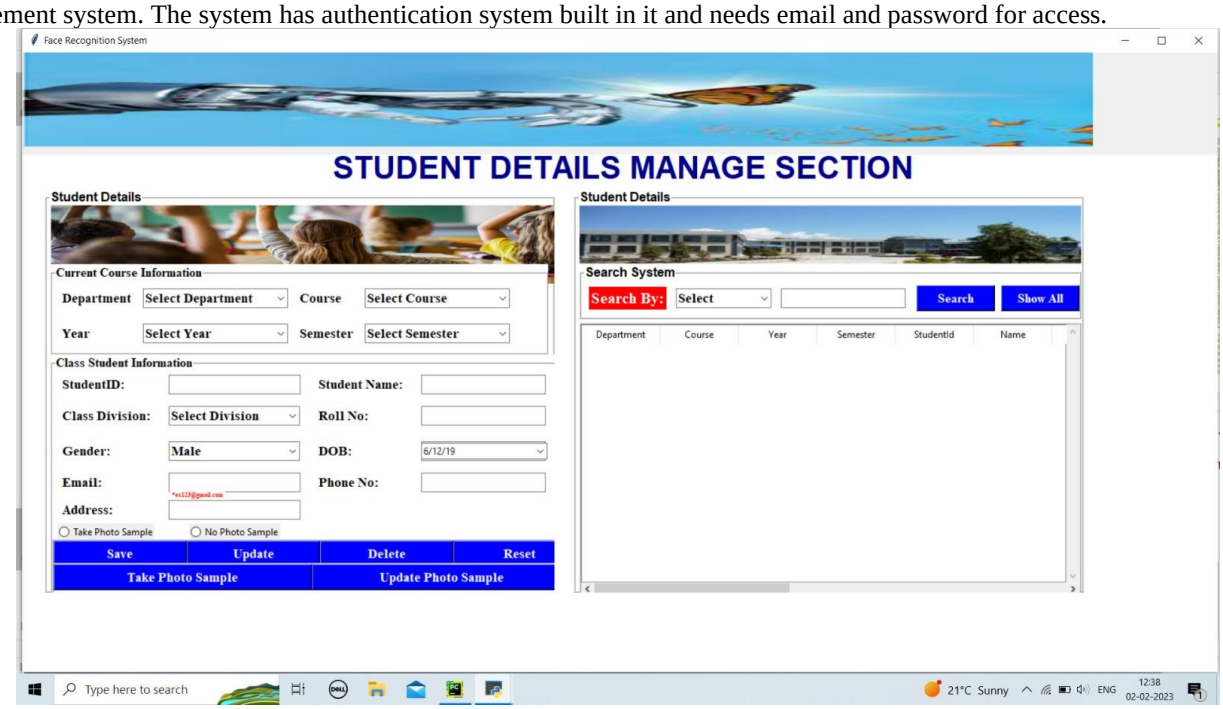
For this, they introduced the concept of the **Cascade of Classifiers**. Instead of applying all the 6000 features on a window, group the features into different stages of classifiers and apply one-by-one. (Normally first few stages will contain a very less number of features). If a window fails the first stage, discard it. We don't consider the remaining features on it. If it passes, apply the second stage of features and continue the process. The window which passes all stages is a face region. How is the plan!!!

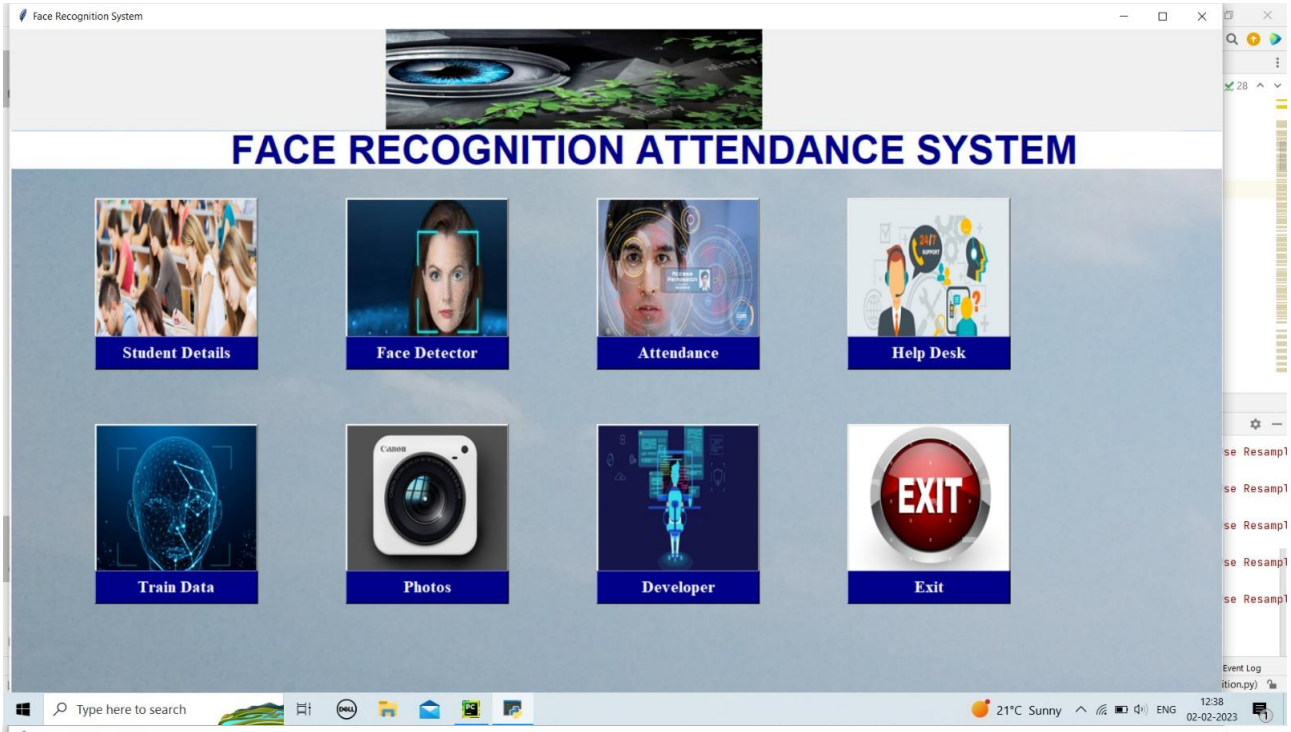
The authors' detector had 6000+ features with 38 stages with 1, 10, 25, 25, and 50 features in the first five stages. (Two features in the above images are obtained as the best two features from a data boost). According to the authors, on average, 10 features out of 6000+ are evaluated per sub-window.

So this is a simple intuitive explanation of how Viola-Jones face detection works. Read the paper for more details.

RESULTS AND DISCUSSION

Face Recognition Attendance System is simple and works efficiently. The project is based on web and needs browser to access the management system. The system has authentication system built in it and needs email and password for access.




Face Recognition System
FACE RECOGNITION ATTENDANCE SYSTEM
Student Details
Face Detector
Attendance
Help Desk
Train Data
Photos
Developer
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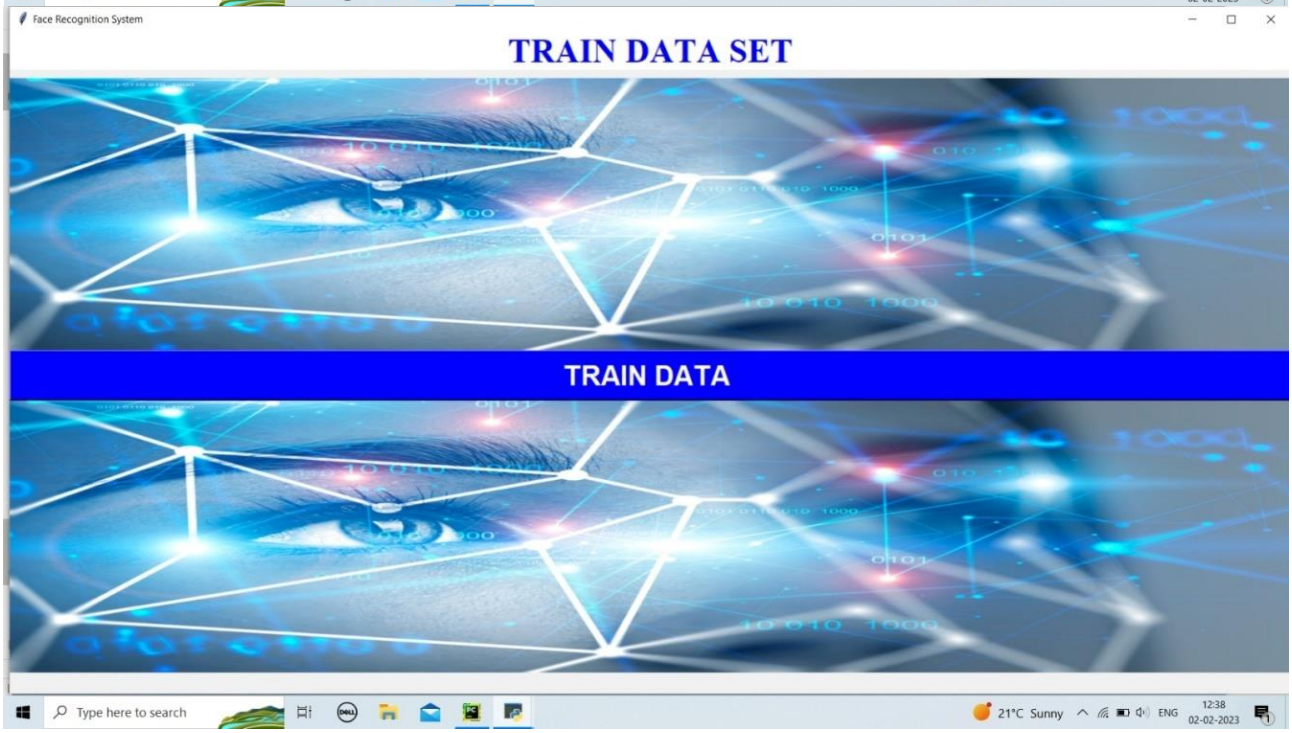
Exit
Type here to search
21°C Sunny
ENG
12:38
02-02-2023


Face Recognition System
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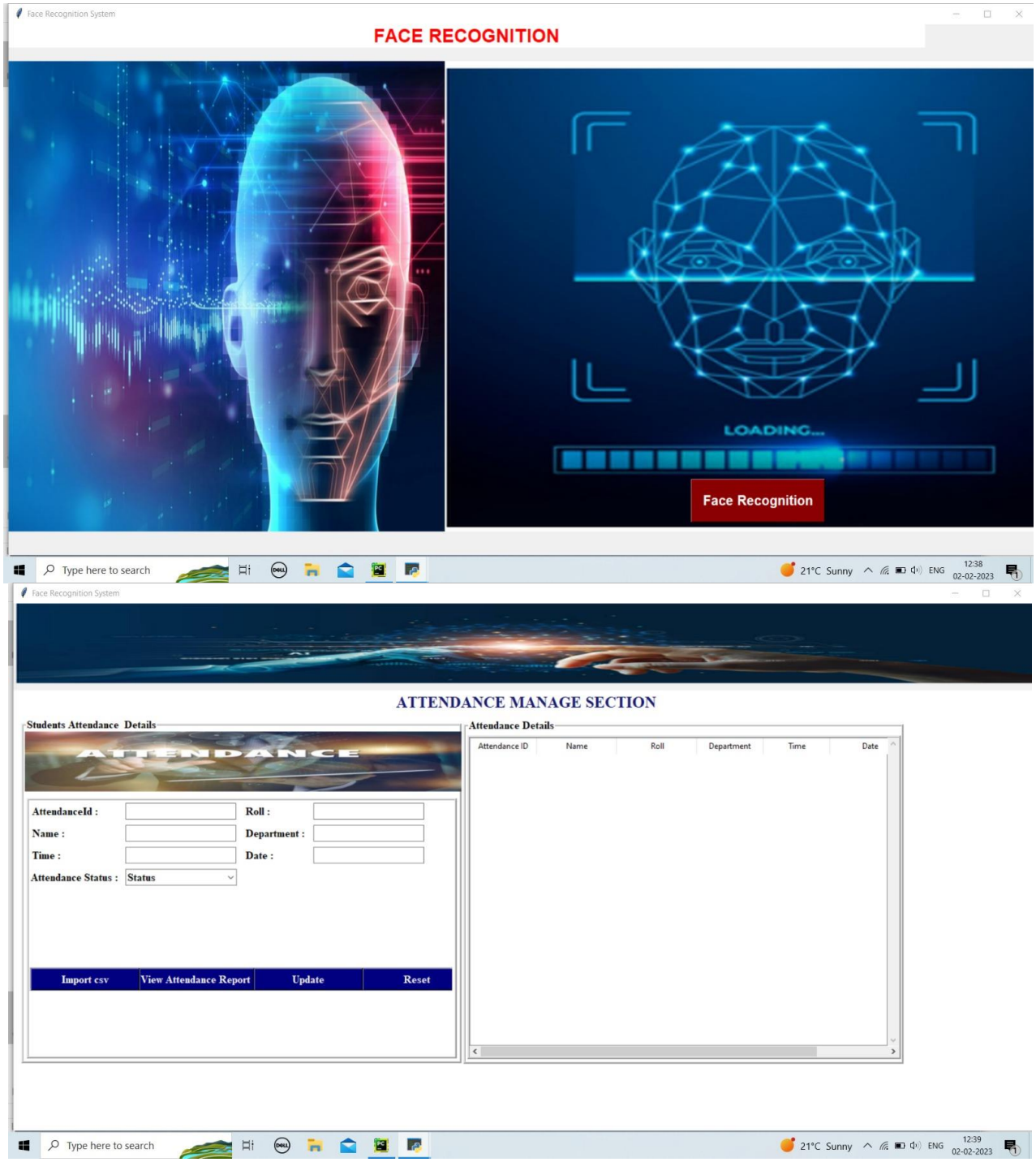

CONCLUSION

Face Recognition Attendance System based on face recognition techniques have thus proved to be time-saving and secure. This system can also be used to identify an unknown person. In real-time scenarios, the LBPH algorithm outperforms other algorithms with a better recognition rate and a lower false-positive rate. The future work is to improve the recognition rate of algorithms when there are unintentional changes in a person, like a tonsure, the use of a scarf, or a beard. The system developed only recognizes faces with up to 30-degree angle variations, which has to be improved further. Gait recognition can be fused with face recognition systems in order to improve the performance of the system. Poor lighting conditions may affect image quality, which indirectly degrades system performance. Our system will perform well, but it is not a perfect solution.

Before the development of this project, there were many loopholes in the previous method of taking attendance using the old method, which caused many troubles for most of the institutions. Therefore, the facial recognition feature method is secure enough, reliable, and available for use. It saves time and a lot of effort, especially if it is a lecture with a huge number of students.

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