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New approach for Attendance System using Face Detection and Recognition

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Abstract

One of the most beneficial uses of image processing is face recognition, which is essential in today's technology environment. Particularly when it comes to tracking student attendance, the identification of a human face is a popular issue in the authentication sector. A face recognition attendance system is a technique for identifying pupils based on high-definition surveillance and other computer technologies that employ face biostatistics. The purpose of creating this system is to electronically replace the conventional procedure of recording attendance by calling names and maintaining paper records. The existing procedures for taking attendance are cumbersome and time-consuming. Our goal and ambition for this article is to use the OpenCV library to develop an attendance management system that can identify faces and store them in a database so that colleges, businesses, and other institutions may use it to track attendance. This research will use a combination method of using Open CV and HOG library detecting the face in boundary box with accuracy %99.38. Adding more, it has been proposing new idea of using these techniques in all halls and labs in any educational institutes in recording the student's attendance precisely.

Keywords: Face Detection System, Face Recognition, Image Processing.

Introduction

1.1 Face Detection:

Face detection also called facial detection is an artificial intelligence (AI) based computer technology used to find and identify human faces in digital images. Everything else—including buildings, automobiles, and trees—is disregarded in favour of detecting face traits. When faced with a complicated visual landscape, humans are particularly adept at navigating faces [1]. They are able to identify a face and match it to a recognized individual in order to retrieve information about that person, including name and other details. In a fraction of a second, everything occurs easily. Because of this, the most active topic of computer science research in vision is face identification. It is more frequently used for video surveillance. To identify a human face in a bigger image and disregard other objects, face detection programs employ algorithms and machine learning. Human eyes are the simplest characteristic to identify, as was previously said, hence faces detection algorithms frequently begin by scanning for them. The system may then go on to detect the mouth, nose, and eyebrows. The algorithm does extra tests to verify that it has discovered a face if it believes it has done so. The algorithm's capacity to discern whether or not there is a face in the image and its location must be improved by training on vast data sets and including thousands of positive and negative photos and it's located in the image [2]. Face detection might be of two different forms. One method is to save a video or picture in the systems integrated device's local memory in order to statically provide the system with data for face detection. Real-time face detection, on the other hand, is the process of identifying people in real time from a live camera, such as a CCTV. Numerous fields employ face detection. This might be a program that's required for image processing—one of those programs that uses individually identifiable facial recognition within an organization to facilitate attendance. Any organization's performance analysis [1] must include keeping and keeping track of attendance statistics.

1.2 Face recognition:

People practice it on a regular basis, both consciously and unconsciously. A digitally taken image or video is compared to the subject's previously saved record as a type of biometric identification. Facial detection became more popular as a result of the development of several face recognition algorithms in the early 1990s. The automatic processing of digital photos and videos in a range of applications, including as biometric authentication, surveillance, human-computer interaction, and

multimedia management, has attracted a lot of interest since powerful and reasonably priced desktop and embedded computing systems are now widely available [3]. Face localization and normalization serve as the cornerstone for creating effective features, which in turn depend heavily on the methods used to discriminate between faces and the features extracted to describe the face pattern. The following illustration illustrates how these difficulties can be investigated from the viewpoint of face subspaces or manifolds.

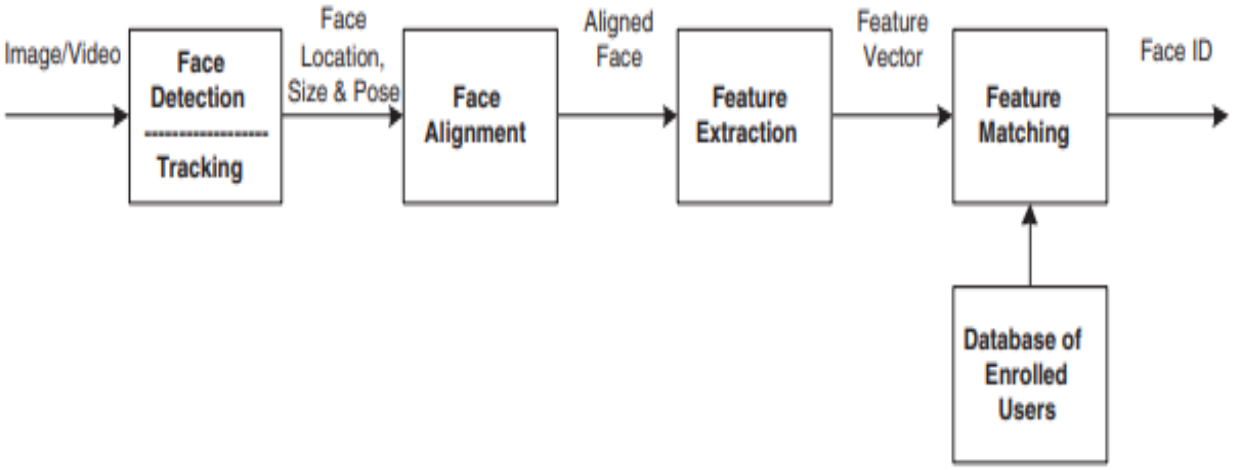

Figure 1 Face Recognition Model Process [3]

There are several face recognition applications such as:

1. Automated surveillance with the intention of identifying and following people [26].
2. Closed-circuit television (CCTV) networks now in use might be enhanced with facial recognition technology to look for lost children or other missing individuals as well as find known offenders [27].
3. Multimedia-friendly user interfaces for computers (part of ubiquitous or context-aware systems, behaviour monitoring at childcare or centres for old people, recognizing customers and assessing their needs like Amazon go and Amazon fresh) [28].
4. The time it takes to take attendance may be significantly decreased in (high schools, colleges, hospitals, etc....) using an attendance management system.
5. Health monitoring using face detections [29].

The paper has bees comparing five techniques for face detection and recognition Truein, Jibble, factoTime and AttendLab. It shows advantages and disadvantages for each algorithm regarding operating system and performance and convenience. We have been a best algorithm for designing and implementing the attendance system.

2.Related Work

There are several algorithms for face detections such as:

2.1 *Haar Cascade*

It is an object detection system that can recognize faces in still photos or moving videos. In order to recognize a face, Haar cascade classifiers are trained on a large number of pictures, both with and without faces. This means that instead of choosing non-facial areas, Haar classifiers scan the window for faces. According to research [2], image processing and pattern recognition experts have found it difficult to reliably identify human faces. An object detection system called the Haar Cascade Algorithm may be used to find faces, pedestrians, objects, and facial emotions [3].

Haar Cascade Classifier is one of the best detectors for face detection from a picture in terms of speed and accuracy [4]. The most important component of the face detection Haar Cascade Classifier is the Haar characteristics. While the Haar Cascade Classifier features can detect any item [3], these features are utilized to determine if a feature is present in a particular picture. The work [5] and [6] focuses on precise eye-central localisation using a webcam. Five distinct procedures were employed in the investigation.

The study of Viola and Jones [3] is depicted in Fig. 3. A cascade function is developed using the various quantities of pictures, both positive and negative, in this machine learning-based technique. It is then utilized to find things in other images in that situation. To increase classification performance in this study, the system requires a large number of positive pictures (photos with faces) and negative images (photos without faces). Then I have to take the features out of it. According to Soo [7], "A Haar-like feature checks nearby rectangular areas at a certain location in a detection window, adds the pixel intensities in each region, and computes the difference between these sums."

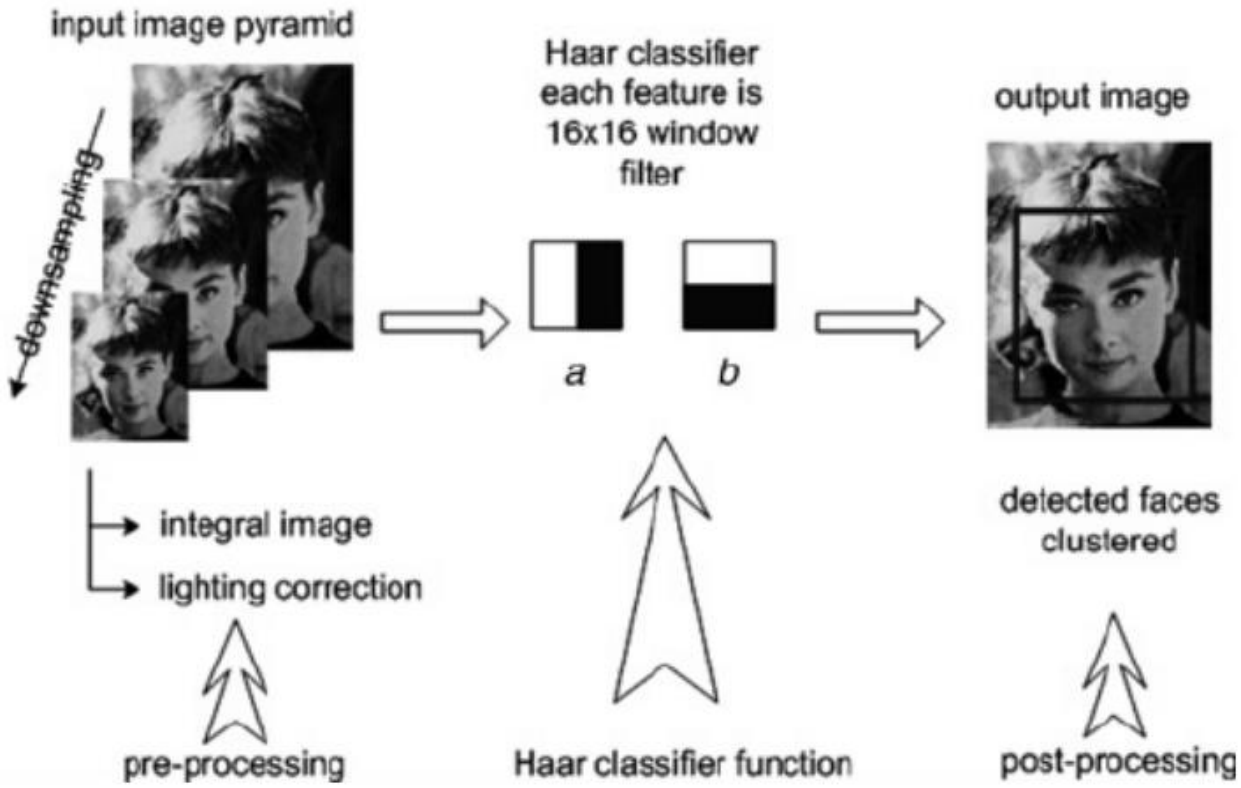

Figure 2 Haar Cascade Model [30]

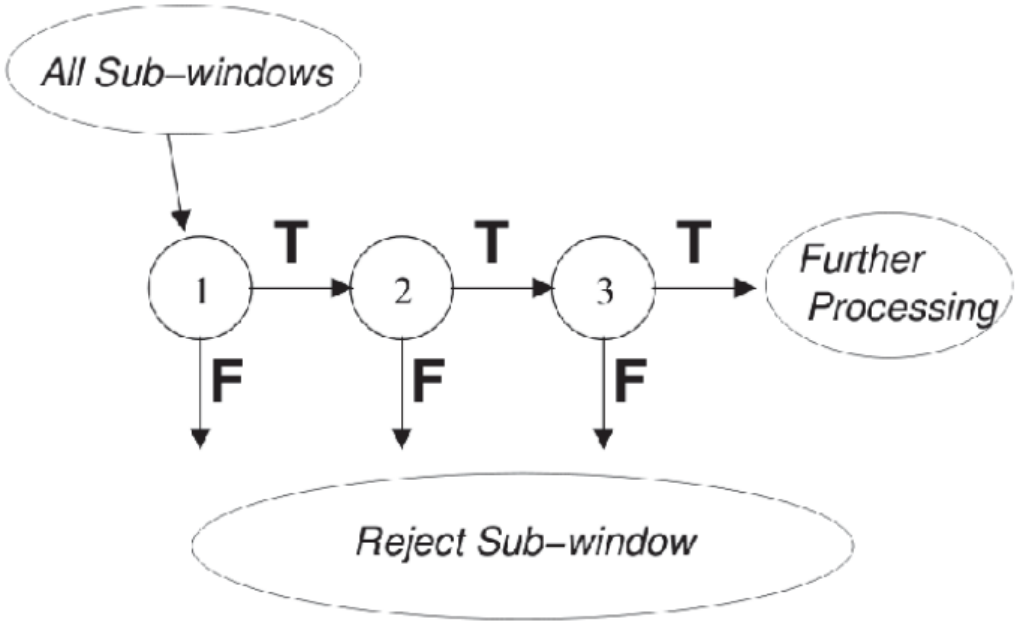

Figure 3 Detection cascade in the Viola-Jones algorithm [3]

2.2 *Hog (Histogram of Oriented Gradients) in Dlib library*

Is an item detected using a feature descriptor in computer vision and image processing?

In order to detect whether or not a face (or any other item you train it to identify) is present in a Region, HOG extracts characteristics into a vector that is then fed into a classification method, such as a Support Vector Machine. In the HOG feature descriptor, the distribution of gradient Direction histograms (oriented gradients) are employed as a feature. Because edges and corners (Regions of abrupt intensity changes) contain a lot more information about object shape than flat Regions do, gradients (the x and y derivatives of a picture) are advantageous because of how Great their magnitude is in these areas [8] [9]. In Dlib, there is already a trained model for identifying faces. Creating an object based on that model is all that is left to accomplish. The method of predicting faces using HOG and Dlib is now over [10].

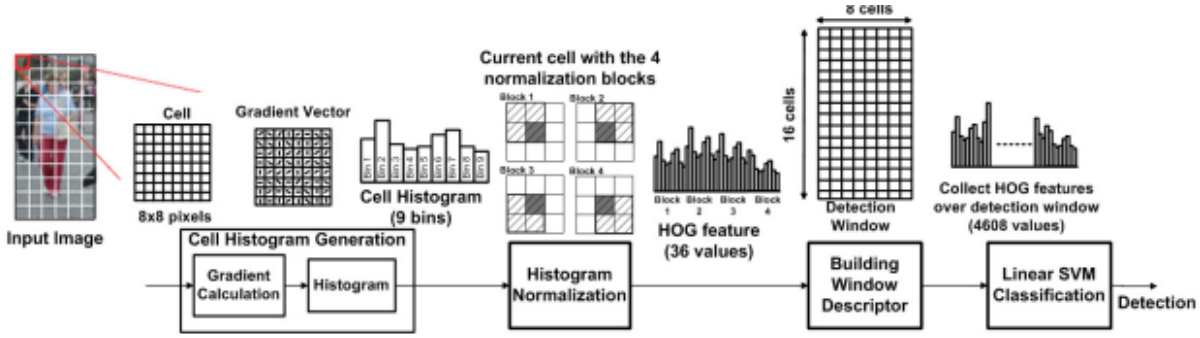

Figure 4 Hog Features [11]

A 16x16 block may be utilized to normalize the image and make it illumination invariant. By decreasing every pixel values by two while working with a 16x16 block, we may reduce the gradient's intensity and, as a result, the histogram values. In a perfect world, variations in illumination wouldn't influence our perception [11]. Feeding the vector into the SVM a 36 x 1 element vector that can be produced from the four histograms in a 1616 block is possible. In order to train a soft SVM to identify the face in a picture, all 36x1 vectors are combined into a single, substantial vector. The system already has a trained facial detection model.

2.3 YOLO

The most advanced deep learning-based real-time object identification system is called You Only Look Once. It applies a single neural network to an image, separates it into regions, and calculates

the probabilities of the weight bounding boxes and the probabilities for each area. These bounding boxes, base YOLO model processes pictures in real-time at 45 FPS (frames per second); it is a smaller form of the network; and there is Fast YOLO, which processes an incredible 155 FPS while still reaching double the map of other real-time detectors. Though YOLO has a lower propensity to forecast false positives in the background than cutting-edge detection algorithms, it generates more localization mistakes [14].

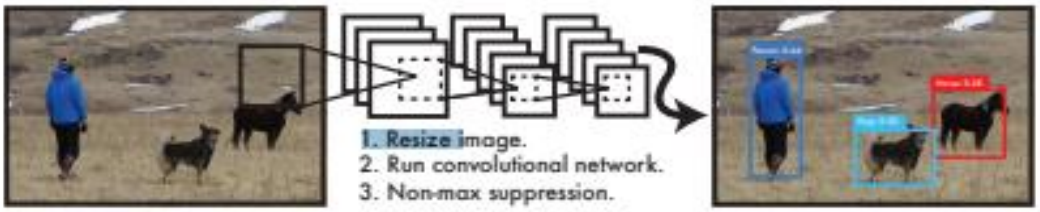

Figure 5 YOLO Detection System

Processing images with YOLO is simple and straightforward. The system (1) resizes the input image to 448 × 448, (2) runs a single convolution network on the image, and (3) thresholds the resulting detections by the model's confidence [14].

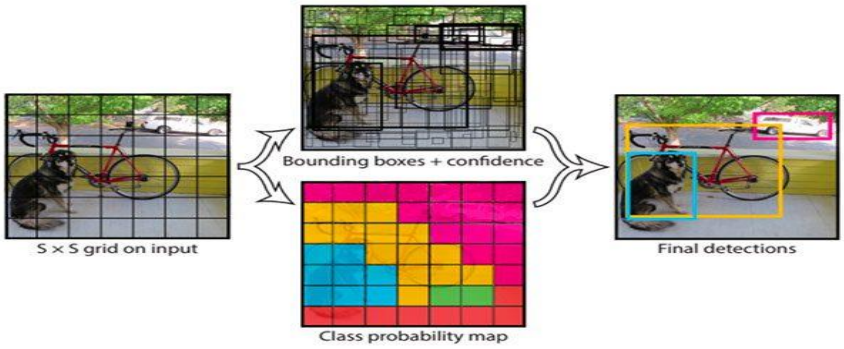

Figure 6 YOLO Model.

The YOLO system conceptualizes detection as a regression issue. It splits the picture into an S grid and forecasts B bounding boxes, confidence in those boxes, and probability for the C class for each grid cell. These predictions are represented by an S (B 5 + C) tensor [30]. There are 24 convolution layers in the YOLO detection network, followed by two fully linked layers. The features space from earlier layers is decreased by alternately adding one and one convolution layer. On the

Image Net classification challenge, YOLO pre-trains the convolution layers at half resolution (224 224 input picture), and then doubles the resolution for detection [13].

2.4 SSD (Single Shot Multibox Detector)

Let's begin by discussing how the name of the architecture came to be in order to better grasp SSD. Object localization and classification tasks are finished by the network in a single forward pass, which is referred to as one-shot. The bounding box regression method created by Szegedy et al. is called MultiBox. Detector the network is an object detector that classifies the items it discovers [13].

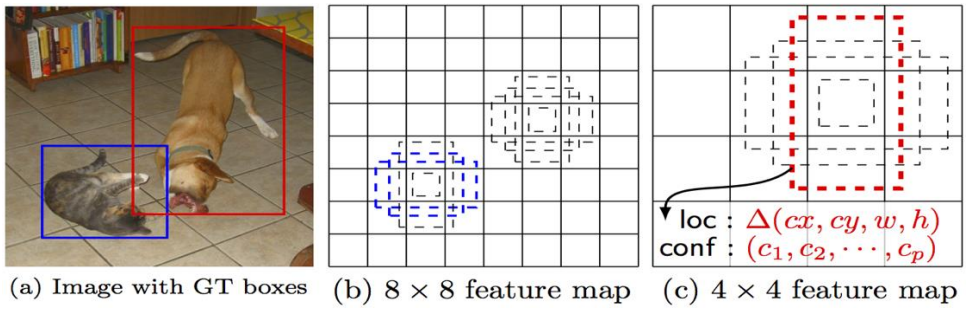

Figure 7 SSD default boxes at 8x8 and 4x4 feature maps

SSD's design, as seen in the above figure, is based on the legendary VGG-16 architecture but does not include the completely linked layers. The basis network, VGG-16, was chosen owing to its excellent performance in jobs requiring the categorization of high-quality images and its vast application to issues where transfer learning might assist provide better results. Instead of using the original VGG fully connected layers, several auxiliary convolution layers (starting with conv6) were added, allowing for the extraction of features at various scales while gradually reducing the size of the input to each succeeding layer [13].

According to [14], the authors of this paper explain how they built an attendance system that uses photos or videos taken by a security camera to detect and distinguish human faces quickly and correctly. To make it simple for their system to find a particular image in the attendance database, it will transform the video's frames into images.

In relation to [14], Using a component-based, trainable system, they demonstrate how to find frontal and near-frontal viewpoints of faces in still gray pictures. In the system, a two-level hierarchy of Support Vector Machine (SVM) classifiers is utilized. This article provides a face detection and identification technology-based indexing technique for photos and videos. Images are

scanned using a face detector using neural networks. A picture from a database or a frame from a video series is scanned for faces by a neural network-based face detector [15].

A model for implementing an automated attendance management system for students in a class is put forth in the article by the researcher whose name appears there. It uses facial recognition methods, Eigenface values, Principle Component Analysis (PCA), and Convolution Neural Networks (CNN). Then, by comparing them to a database of student faces, a relationship between recognized faces ought to be conceivable. This strategy will work well for keeping track of students' attendance and records [16]. while This work focuses on a facial recognition-based attendance system that has a decreased false-positive rate by employing a threshold of confidence, or Euclidean distance value, when identifying unfamiliar people and storing their photographs [17].

Additional writers are added in [18]. Their research aims to give an analysis of various face detection techniques and algorithms. Finally, three distinct algorithms Haar cascade, AdaBoost, and template matching were described for several face identification applications.

This work presents a software system for automating the attendance-taking technique, as shown by the addition of the author in paper [18][19]. In this program, face detection, image processing, and face recognition techniques are used to produce a consolidated attendance system that addresses the shortcomings of manual attendance.

2.5 *Similar projects*

There are services that function similarly to ours, but we want to utilize the finest aspects of all of them in ours. In the part below, we will contrast them and all of their positive and bad characteristics.

2.5 .1 *Truein*

Touchless attendance is taken using Truein Face Attendance, which is cloud-based. Truein is the best attendance solution for use cases including office attendance, contract employee attendance, and remote/roaming staff attendance in a number of sectors. In terms of facial recognition-based attendance software, Truein is a pioneer. More than 200 companies rely on it [20].

2.5 .2 *Jibble*

You can monitor the time and attendance of your employees with Jibble, a cloud-based tool. To clock in, punch in, or jibble in and out, employees can utilize a web browser, Slack, or a mobile device (iOS & Android). Timesheets that are automatically generated, activity and project monitoring, client billing, and robust reporting will all be advantageous to your team [21].

2.5.3 factoTime

FactoTime makes it possible to collect employee attendance directly from a mobile device, doing away with the necessity for a biometric attendance equipment. A selfie and their present location might be used by employees to conduct the punch. In order to track attendance, they can also employ QR codes [22].

2.5.5 AttendLab

For new enterprises and smaller organizations, AttendLab is a fully functioning face recognition attendance system. Web app development services are offered in full by AttendLab. This online face recognition attendance system includes fast face processing, live face detection; a compact face features template, and a face picture quality evaluation function [23].

Here are a few of their benefits and drawbacks in comparison to our project.

Table 1 Advantages and disadvantages of similar project

Service	Advantage	Disadvantage
Truein	API and support are available and it is customizable. Detects faces even with masks.	Does not support Mac OS.
Jibble	It was created by a company familiar with the industry, making it more complex and has many more features.	True, Jibble is simple and straightforward to use, but if you want to give new employees a better understanding, you should schedule a brief training session.
factoTime	By scanning the QR code, the user can do their attendance.	UI/UX of the factoTime needs to improve for a better user experience.
AttendLab	Have support, updates and IP restrictions.	It’s online only and not available on any other platform.

3.Methods and Materials

We need face detection and identification technology, especially in Iraq and Kurdistan where we still rely on antiquated methods for daily tasks. Every student's name is still spoken aloud in class for attendance purposes in universities and secondary schools. The schools and institutions may

become high-tech and smart if we develop an attendance system utilizing machine learning and recognition. Numerous investigations and experiments have been conducted in recent years on attendance systems that use facial detection and identification technology. These papers were most relevant to our research and were utilized as inspiration by us. There are additional ways from which we may evaluate and choose the best for our project, but we will focus on the four that we have selected to explain and compare. Research methodology is the procedures or strategies used to locate, select, process, and analyze information about a topic. It is particularly about how a researcher methodically develops a study to assure accurate and trustworthy results that answer the research aims and objectives.

1. Results and Discussions

The project has been developed with these technologies:

- As real-time operation becomes increasingly important in today's systems, OpenCV, a sizable open-source library for computer vision, machine learning, and image processing, is used [24]. It may be used to photographs and movies to find objects, individuals, and even human handwriting. To recognize visual patterns and their many qualities, we use vector space and apply mathematical operations to these properties.
- Face recognition the easiest face recognition library in the world lets you recognize and work with faces from Python or the command line. Developed using the cutting-edge deep learning facial recognition technology from dlib. Using HOG in the background, the model achieves a 99.38% accuracy rate on the Labelled Faces in the Wild benchmark. This further offers a straightforward face recognition command line program that enables face recognition on a folder of photographs from the command line [29].
- Face recognition the easiest face recognition library in the world lets you recognize and work with faces from Python or the command line. Developed with the cutting-edge deep learning facial recognition technology from dlib. The model utilizes HOG in the background and achieves a precision of 99.38% on the Labelled Faces in the Wild benchmark. Additionally, a straightforward face recognition command line utility is available [25] that enables you to perform face recognition on a folder of pictures from the command line.

Functional requirements are elements that the system will need to accomplish or function. In the case of this project, it was crucial to collect certain requirements that would be necessary to fulfil

the earlier mentioned objectives. The following functional and non-functional needs were identified through a use case analysis utilizing the client (user) story. The user story, which was created using the notes taken during client meetings, contained the functional requirements, which are now being presented.

- Take pictures of faces using a webcam or an external camera.
- A dedicated HD camera.
- Registration page
- Check the attendance list.
- Locate an unknown individual.
- Faces on a photograph must always be recognized.
- Bounding boxes for the face photos must be identified.
- Based on identified faces, determine the overall number of attendees.
- Reducing the overall number of faces found.
- Resize the facial photos that were cropped to make them consistent with the scale needed for identification.
- The database should be updated with faces.
- Be able to identify faces that have been preserved in the database.
- Perform recognition one at a time for each face that Face Detector has cropped out.
- In the plot area, the output picture's name ought to be visible above the image.

  The interface of the system as shown in Figure 8 below

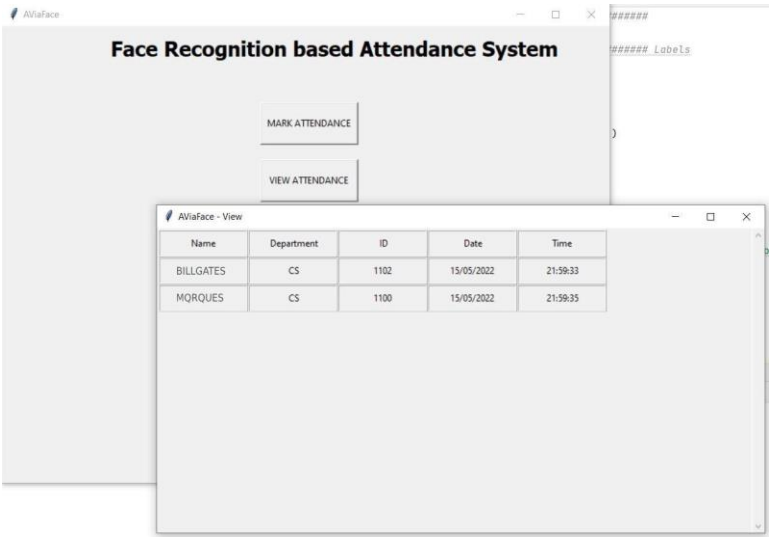

Figure 8 Application for Attendance System

- **System workflow:**
    - Capture face images using an external Drive camera or a web camera: Because our system uses the OpenCV library, it is able to connect to external cameras as well as webcams from any other device.
    - A specialized HD camera: It is best to utilize a high-end camera to record faces precisely.
    - Registration page: We designed a page for registering users that is accessible to the administrator.

    - Faces on a photograph must always be detected: this is an essential component of every attendance system, and you can solve this by employing sophisticated algorithms. The library we use for detection and recognition employs HOG in the background, one of the greatest algorithms for detection.
    - - The facial photos must be recognized in bounding boxes. This technique is employed so that the user can understand how the system operates as it is shown in Figure 9.

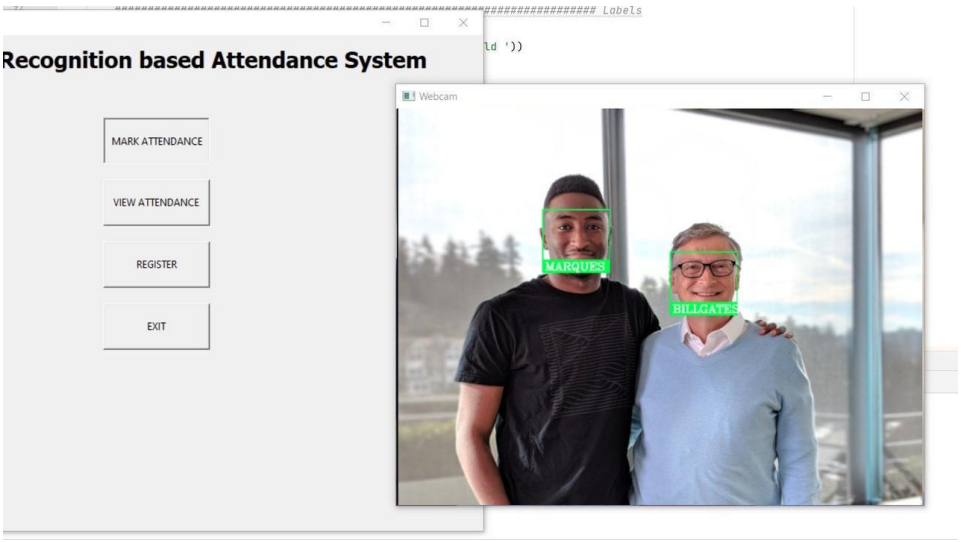

Figure 9 Detection more than one register students

- Calculate the total attendance based on detected faces: 100% done in our system it can be seen in the above pictures.
- Resize the cropped face images to match faces the size required for recognizing: This is done to speed up the process and to lock the bounding box on the face correctly.
- Faces should be loaded into the database: We use csv file to store the data.
- - Identify faces that have been saved in the database: This basically entails identifying the encoded face in the list, which can then be used to add additional features.
- Since the system can only identify two faces at once on the screen, it is necessary to perform facial recognition for each face that the Face Detector has cut out one at a time. This prevents errors from occurring when detecting faces that may somewhat resemble one another.
- The name of the output image should be displayed above the image in the plot area: 100% done it can be seen in the above picture as it's shown in Figure 10.

Figure 10 Final output detection and recognition

2. Conclusion

This study describes a facial recognition-based automated student attendance system. By comparing the input photographs that were derived from the attendance images registered with, the suggested solution offers a way to identify the individuals. With the use of an input facial picture that

was taken from a frame of the recorded video, the suggested method may identify and locate faces. Additionally, it offers a way to see the attendance information.

The existing procedures for taking attendance are cumbersome and time-consuming. Our goal and ambition for this article is to use the OpenCV library to develop an attendance management system a combination method of using Open CV and HOG library detecting the face in boundary box with accuracy %99.38. adding more it has been proposing new idea of using these techniques in all halls and labs in any educational institutes in recording the student's attendance precisely. That can identify faces and store them in a database so that colleges, businesses, and other institutions may use it to track attendance.

In general, the project was effective in demonstrating the use of state-of-the-art facial recognition from dlib. Once in place, it might be used to record the students' attendance history and take their attendance. The project has the ability to grow in the future with the addition of new features for instructors and students. There is room for adding more elements, such assignments, outcomes, and test scores. A mechanism to determine whether a user is unknown is also included in the system.
Our research enables automated attendance monitoring in the classroom. This module may also be utilized in various circumstances, such as verifying employee attendance or using it at meetings, conferences, etc.

The paper has bees comparing five techniques for face detection and recognition Truein, Jibble, factoTime and AttendLab. It shows advantages and disadvantages for each algorithm regarding operating system and performance and convenience. We have been a best algorithm for designing and implementing the attendance system. There are a few constraints in the suggested method. First, the input image has to be frontal and a single, upright facial image. Second, in cases of severe lighting issues, accuracy may suffer. Thirdly, erroneous recognition may take place if they obtained picture is fuzzy. In addition, for a high degree of accuracy, the test picture and train image must be of same quality and be taken with the same apparatus. Therefore, if someone is wearing makeup when their face is being recognized in a picture, the key characteristics will be hidden.

In reality, a better camera with a better light source is able to lessen the illumination issue and also be able to prevent the acquisition of blurry photographs. In order to get better results, future work

might benefit from using a better camera and lighting source. In particular, the locations where test and training photographs are taken, this might lessen the reliance on the brightness of the surroundings. There is also a possibility of developing a facial recognition system using several face images. The effectiveness of the system may rise as a result.

Author's contribution

We have been contributed to this research as group work in development and writing the article.

Conflict of interests

No

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