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Smart Attendance System Using OpenCV

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Abstract -The essential part of the human body that distinguishes an individual is their face. The primary objective of this project is to develop an attendance monitoring system based on facial recognition for academic system in order to upgrade and improve the current attendance management system and increase its effectiveness and efficient than it existed previously. With an OpenCV Real-time Face Recognition based attendance system, you may not only capture attendances but also provide security when the system needs to identify a specific student's identity and the moment of their admission. Since it is entirely automated and much simpler, it is simple to handle the records that will be transformed into an excel file and to keep track of the students or visitors who are present. The goal of this study was to use OpenCV to create a Real-time face recognition system for school attendance that would gather information about students who were present before or after class. The system will need student registration and a password, automatically record each student's attendance using face recognition, and transform that data into an excel or text file.

***Key Words*:** OpenCV, Real-time face recognition

1. INTRODUCTION

Maintaining attendance is a crucial task in all schools to track students' academic progress. Each institution handles this in a different way. Some of these institutes still rely on outdated paper- or file-based systems, while others have implemented ways for automatic attendance using biometrics. A facial recognition system is a type of computerized biometric software that can identify a person by comparing patterns based on their facial features. All organizations require employees to record their attendance in order to evaluate their performance. Each institute has a distinctive method in this sense. While some people manually record attendance using antiquated paper- or file based systems, others automatically take attendance utilizing biometric technologies. With these methods, however, people have to wait a very long time to enter in a line. There are numerous biometric authentication techniques available; however they all use the same key authentications. Each biometric system starts with an enrollment phase where a person's distinctive traits are entered into a database, followed by identification and verification processes. Both of these procedures compare a subject's biometric characteristics to a template that was initially saved at the time of enrollment. Examples of biometric templates include fingerprints, eye iris, face, hand geometry, signature, stride, and voice. In order to ensure that employees can automatically record their attendance for their participation, our system uses a facial recognition approach. Face recognition is a two-step process that starts with identifying faces in the image and ends with these faces being validated against a database. Face recognition refers to the process of detecting a known face that has already been trained to the system, whereas face detection refers to the process by which the system recognizes human faces in the photos and video streams. As everyone is aware, keeping track of attendance is crucial in all kinds of organizations. The demand for lecturers to manage class attendance rises along with the number of educational institute pupils or employees at a firm. The solution to these kinds of issues may be provided by this initiative. An observer counts the number of pupils in a lecture hall, each one is identified, and the total number of students present is then kept on file. There are various components that must be handled in order to construct a real-time face recognition system that is practical and usable. Only the faces that have been registered in the system will be recognized by the system. The main objective of this project is to improve the effectiveness, timeliness, simplicity, and clarity of the system for tracking and managing attendance. Here, faces will be recognized using facial recognition methods. Following a comparison between the processed image and the already-stored record, the database will record attendance as appropriate. Compared to the existing system's conventional attendance marking system, this method lessens the strain on people. Four steps will be taken to implement this suggested system: image capture, group image segmentation and face identification, face comparison and recognition, and attendance updating in an excel sheet. As a biometric technique, face recognition involves determining if a specific person's face image matches any of the face images that are kept in a database. Because of the alterations that various elements, like facial expression, ageing, and even lighting, might affect the image, this problem is difficult to automatically fix. Although it may not be the most accurate biometric method, facial recognition has a number of advantages over the others. Face recognition is easy, practical, and self-sufficient. The anticipated system uses face recognition technology to automatically track students' or employees' attendance without their participation. Images of pupils or employees are taken using a webcam. The faces in the photos taken are recognized, matched to the photos in the database, and the attendance is recorded. [1]

2. METHODOLOGY

Real-time face recognition used to accomplish the study's goals, developed a prototype system model using the descriptive research methodology. The System Development Method uses the prototype model to implement the steps of gathering requirements, creating a quick design, creating a prototype that is tested by users through user evaluation, and then iterating and refining the prototype as necessary until it is an acceptable prototype that will be implemented and maintained from which the entire system can now be used. [2]

2.1 Visual Studio Code

Visual Studio Code is a desktop source code editor that runs on Windows, macOS, and Linux. It is compact but effective. The dynamic application was created using this open-source framework.

2.2. Python

Python is an interpreted, object- acquainted and semantic programming language. It's particularly appealing for Rapid Application Development as well as for operation as a scripting or cement language to connect being factors due to its high- position erected- in data structures, dynamic typing, and dynamic list. Python's straightforward syntax places a strong stress on readability, which lowers the charge of programme sustentation. Python's support for modules and packages promotes the modularity and exercise of law in programmes. For all popular platforms, the Python practitioner and the comprehensive standard library are freely distributable and available in source or double form.

2.3. Numpy

A general-purpose package for handling arrays. It has outstanding speed. It offers a multidimensional array object. It is the cornerstone Python module for scientific computing and capabilities to handle the array. Simply define, because numpy's optimized and pre-compiled C code handles all the heavy lifting, making it faster than standard Python arrays. Numpy arrays and actions are vector zed, so there is no explicit looping or indexing in the code because of this. This improves the code's readability while also bringing it closer to accepted mathematical notation. Numerous commercial systems now use NumPy, which is rising in popularity. Understanding what this library is likely to give is crucial as a result. Because of its syntax, which is yet small, powerful, and expressive, NumPy is one of the most powerful Python libraries. [3]

2.4. Computer Vision

Computer vision is a method that enables us to comprehend how images and videos are stored, how to change them, and how to extract data from them. The foundation or primary tool utilized in artificial intelligence is computer vision. Self driving cars photo-editing apps and robotics are heavily relying on computer vision.

2.5. OpenCV

OpenCV is a major open-source library for image processing, machine learning, and computer vision. It now plays a significant part in real-time operation, which is crucial in modern systems. Using it, one may assay filmland and pictures to find faces, objects, and indeed mortal handwriting. Python is able to handle the OpenCV array structure for analysis when it is integrated with different libraries, such as NumPy. We use vector space and apply fine operations to these features to distinguish visual figures and their colorful features.

2.6. YoloV5

The object discovery system YOLO, which stands for "You Only Look Once", separates images into a grid structure. In the grid, each cell is in charge of finding objects within of it. Due to its accuracy and speed, YOLO is one of the most well known object detection algorithms. The COCO dataset was used to train the YOLOv5 family of compound-scaled object identification models, which also has basic capabilities for Test Time Augmentation (TTA), model ensembling, hyperparameter evolution, and export to ONNX, CoreML, and TFLite. The four models of YOLOv5 are the YOLOv5s, YOLOv5m, YOLOv5l, and YOLOv5x. YOLOv5 often makes use of the following architecture:

- **Backbone:** The main use of Model Backbone is to extract important features from an input image. In YOLO v5, CSP (Cross Stage Partial Networks) are utilized as the framework to extract highly beneficial properties from an input image.

- **Neck:** Feature pyramids are often created using the Model Neck. When it comes to object scaling, feature pyramids help models generalize to the target situation successfully. It makes it easier to recognize the same thing in a range of scales and sizes. The feature pyramids helps models operate efficiently on previously unexplored data. Other models employ a variety of feature pyramid strategies, including FPN, BiFPN, and PANet. In YOLO v5, to obtain feature pyramids, PANet is applied as a neck. Feature pyramids are quite beneficial in facilitating models to perform effectively on previously unseen data. Other models, such as FPN, BiFPN, and PANet, use various sorts of feature pyramid approaches.

- **Head:** The last detecting stage is primarily the respon- sible of the model Head. It builds final output vectors with bounding boxes, objectness scores, and class probabilities using anchor boxes. [4] G. Image Processing Image processing is a technique for applying various operations to an image in order to improve it or to draw out some relevant information from it. According to the simplest definition, It is the study and modification of a digital image, particularly to increase its quality. Basically, image processing involves the following three steps: 1. Import of the picture. 2. Examining and modifying the picture. 3. A report or altered image that was the outcome of the output from an image analysis.[5]

3. MODELS AND DATASET

A face recognition model consists of the following steps:

• Face Detection: Find faces, construct bounding boxes around them, and record the coordinates of the bounding boxes.

• Face Alignments: Make the faces uniform with the training database by normalizing them.

• Face feature extraction: Take face features that will be used for training and recognition tasks and extract them.

• Face recognition: It is the process of comparing a face to one or more known faces in a database that has been created.

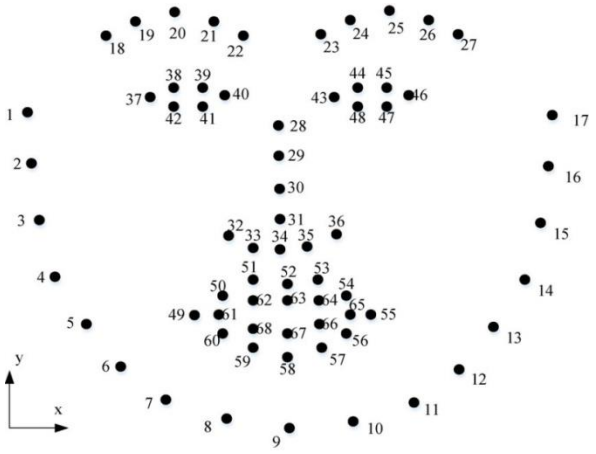

Fig -1: Landmarks on a human face

DATASET

A data set is a set of associated, discrete pieces of connected data that can be viewed independently, simultaneously, or maintained as a separate unit. A data structure of a certain type is used to structure a data set.

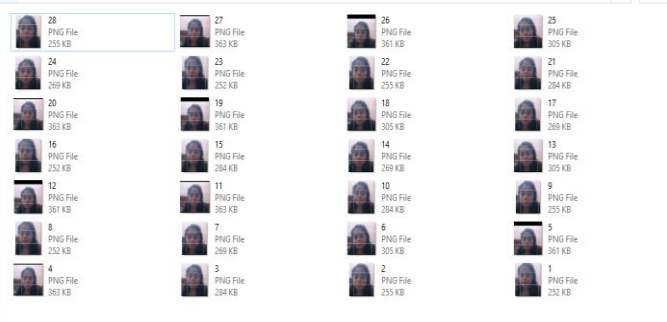

Fig -2: Dataset of a student

For example, a data set in a database can include a collection of company information (names, salaries, contact information, and so forth). Numerous pictures are needed for this project's data set. We need to train our classifier in order to recognize individual faces. Our classifier needs a tremendous amount of data to be trained. Data Set refers to the collection of information. We must make each person's identity distinct in order to store their data from the data set individually. As a result, I requested input from the user or administrator before gathering user data to identify faces.

4. IMPLEMENTATION AND TESTING

Image Capture: In order to acquire good results, we need an HD camera. We can manually capture each and every image from the webcam or we can manually take the images from the video stream. While performing frame capture from the video stream would produce results faster, we won't be able to correctly record the face in the event that light is lost or if the face is not properly captured. [6]

Image processing: Using a digital computer to run an algorithm on digital images is known as digital image processing. The advantages of digital picture processing are substantial over analogue image processing as a subfield or area of digital signal processing. It permits the application of a considerably wider variety of algorithms to the input data and can prevent issues like the accumulating noise and distortion during processing. Digital image processing can be described as a multidimensional system because images can exist in at least two dimensions and possibly more. Three factors, particularly the establishment and advancement of discrete mathematics theory, the growth of computers, and the generation and development of digital image processing, are the key influences on these three areas. Last, there is a growing need for a variety of applications in the fields of environment, agriculture, industry, military, and medical science.[7]

Table -1: Testing

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	New window on screen	Passed
2. Detect face	Take real time video from camera	Detect a human face	Detected	Passed
3. Detect different part of a face	Take real time video from camera	Detect nose, eyes, mouth	Detected	Passed
4.Creating dataset	Take input from camera	Creating a dataset for model	Dataset successfully created.	Passed
5. Training	Train model from dataset	Saved trained model	Training successful.	Passed
6. Recognition	Trained model	Recognize the trained model	Recognize model successfully	Passed

5. CONCLUSIONS

Face detection and identification algorithms can be used to capture images from a camera or CC camera, reduce manual labor required of humans, improve security, and make decisions based on the results of the recognition. Face detection and recognition systems can be used to create a wide range of applications, including face recognition-based automatic attendance systems, worker attendance tracking systems, security and safety applications, and police tools for locating thieves in images and apprehending them. In this system, a lecturer or teaching assistant will keep track of each student's attendance for a lecture, section, or laboratory. It saves time and trouble, especially if there are a lot of pupils in the lecture. This attendance system demonstrates the application of facial recognition technology for the purpose of tracking student attendance, and this student record may also be used in exam-related situations in the future. According to preliminary testing of the prototype system, the Face detection OpenCV Python library is a huge help to developers because it eliminates the need for them to manually write the function of detecting photos. The technology has performed as predicted during testing, and employing Face detection to take attendance is going according to plan. As a tester's recommendation, the system feature can further improve the design. Since it automatically records the names that are registered in the image and can be converted into an excel file for documentation, the OpenCV Real-Time Face Recognition Attendance System is useful for saving time for a teacher or user when taking attendance. Its usability is effective for individuals who operate remotely or in any location or circumstance that prevents us from travelling because it is an online platform, and its applicability may be a solution to a problem during a pandemic.

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