FACE RECOGNITION SYSTEM USING PYTHON

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***Abstract*—Face recognition is currently one of the best technologies and a very difficult task in computer vision, illumination, pose, and facial expression. Face recognition tracts target objects in live video and video camera images. It is the advancement of bio-metric applications. The rapid increase in computational resources makes rapid advancement of face recognition easier. Scientists and engineers all over the world have focused on developing increasingly robust and accurate algorithms and methods for these types of systems and their applications. The stages of development and related technologies are described in this paper. Face recognition in Python with openCV and Haar cascades is a machine learning approach in which the cascade function is trained with a set of inputs. Many pre-trained classifiers for face, eyes, smiles, etc. are already included in OpenCV. Python's face recognition algorithm can detect people's faces in images; face is a list of coordinates for rectangular regions where faces were found. It also detects faces in videos; however, we use an infinite loop to go through each frame of video and use read() to read each frame.**

***Index Terms*—Face recognition, openCV, Haar cascade classifier ,Machine Learning, neural networks, feature-based approaches, image-based approaches,SVM(support vector machine).**

I. INTRODUCTION

Human faces are always important in applications such as security systems, credit and debit card verification surveillance, and identifying criminal public places. Face detection is a major topic with a wide range of applications. Face detection software built into modern Smartphones and Laptops can authenticate the user's identity. There are numerous apps that can capture, detect, and process a face in real time, identify the user's age and gender, and apply some really cool filters [1]. Face detection, which is simple for humans, is complicated for machines to perform. The main objectives of the system are to create a facial recognition system that can be emulated and eventually overcome this capacity of human. This system focuses on the human frontal faces in particular. Face recognition algorithms have been developed in a variety of strengths. When we look at a face, we recognise it immediately if we are already familiar with it. If possible, this natural ability can be justified and used in real-world applications. There are numerous face detection algorithms available at the time. The first is a **local face recognition system**, which uses facial features to match a face with a person. The second approach, or **global face recognition system**, identifies a person by using the entire face. The above two methods have been implemented in different ways by different algorithms.

The neural network and its feasible applications in the field of research.The complications of a facial features that take place over time. Unconcern of those changes can easily identify a person. So, the idea of emulate this skill is that human beings can be very rewarding.

Face recognition is a subset of the visual pattern recognition problem. Humans constantly recognise visual patterns and obtain visual information through our eyes. The brain recognises this information as meaningful concepts. It is a matrix of many pixels for a computer, whether it is a picture or a video [2]. The machine should figure out what concept each piece of data represents in the data. In visual model recognition, this is a rough classification problem. Face recognition requires distinguishing who the face belongs to in the part of the data where all machines think of the face. This is a subdivision issue.

Face recognition in a broad sense includes related technologies for building a face recognition system. It includes face detection, face position, identity recognition, image prepossessing, etc. Face detection algorithm is to find out the coordinate system of all faces in one image. This is the process of scanning the entire image to determine whether the candidate area is a face. The output of the face coordinate system can be square, rectangular, etc. The face position is the coordinate position of the face feature in the face detection coordinate system. The deep learning framework basically implements some current good positioning technologies. Compared with face detection, the calculation time of face positioning algorithm is much shorter.

Face recognition, in its broadest sense, includes related technologies for developing a face recognition system. Face detection, face position, identity recognition, image prepossessing, and other features are included. The purpose of a face detection algorithm is to determine the coordinate system of all faces in a single image. This is the process of scanning the entire image to determine whether the candidate area is a face. The output of the face coordinate system can be square, rectangular, or other shapes. The face position is the

coordinate position of the face feature in the face detection coordinate system. The deep learning framework essentially implements some current good positioning technologies. When compared to face detection, the calculation time of the face positioning algorithm is much shorter.

II. Related Work

1) Haar Cascade Classifier Feature

Haar Cascade is an Object Detection Algorithm that can be used to recognise faces in images or real-time videos. Viola and Jones provided edge or line detection features, which are used in the approach. The Haar Feature-based Cascade Classifier is used to teach the fundamentals of face and eye detection. It's a machine-learning approach in which a cascade function is learned using a large number of positive and negative photos. After then, it's utilised to find items in other photos. To train the classifier, the method requires a large number of positive images (images of faces) and negative images (images without faces). After that, we must extract features from it. Haar characteristics, as illustrated in the graphic below, are employed for this. They're really similar to our convolution kernel.

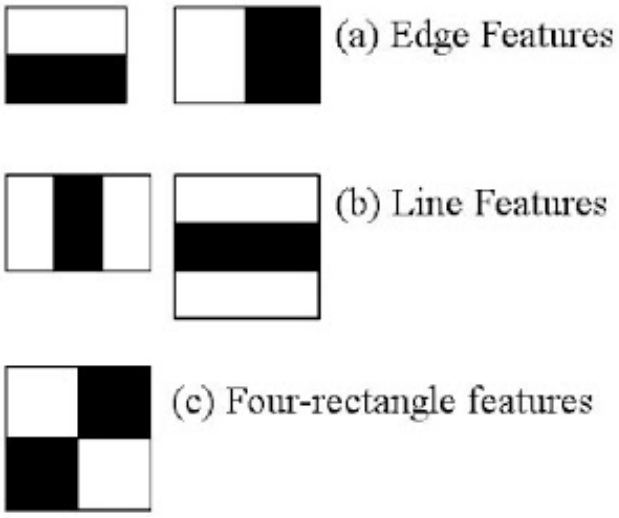

Fig. 1. **Haar Features**

Fig. 1. depicts the Haar features, which are a single value derived by subtracting the sum of pixels beneath the white rectangle from the total of pixels beneath the black rectangle.

We computed that the first feature chosen appears to focus on the fact that the area around the eyes is frequently darker than the area around the nose and cheekbones. The second feature chosen is darker features than the bridge of the nose, which is based on the eye. You do not, however, require the same window that applies to your cheekbones and other areas. Face recognition system that captures images of facial features, extracts them, stores them, and matches them. However, laying transmission lines in areas with poor topography is a challenge. The authors proposed a system based on real-time facial recognition that is reliable, secure, and quick, but that has to be improved under varied lighting circumstances [3].

2) Face Tracking

This algorithm's goal is to detect a facial item in real time and maintain tracking of that object. The training samples photos of other items of your choice are used to detect and track by the training classifier in this case. Face tracking is one of the features of a facial recognition system. We can utilise some system algorithms to pick out specific, distinguishing features of a human's face in this case.

3) Face Detection

This [4] face detection method determines whether or not the image is a face image. Haar Cascade classifier is used in the detection procedure. Paul Viola and Michael Jones devised an effective object detection method using Haar feature-based classifiers. A cascade function is trained from photos using a machine learning approach. It's used to find items in other pictures.

4) Face recognition

Face recognition is a step beyond face detection. Face detection only detects the location of a human face in an image, whereas face recognition creates a system that can identify humans. Face recognition is a broad challenge of verifying or identifying people in photographs or videos. Big tech companies are still working to develop a faster and more accurate face recognition model. Face recognition is a technique for identifying or verifying an individual's identity by using their face. Face recognition algorithms vary in accuracy.

5) openCV

OpenCV (Open Source Computer Vision Library) is a programming function library primarily aimed at real-time computer vision. OpenCV is compatible with a wide range of programming languages, including Python, C++, and Java. It can analyse images and videos to recognise objects, faces, and even human handwriting. When it is integrated with various libraries, [5] such as Numpy, a highly optimised library for numerical operations, the number of weapons in your arsenal increases, i.e. any operations that can be done in Numpy can be combined with OpenCV.

6) NUMPY

NumPy is a fundamental Python package for scientific computing that provides a multidimensional array object. Other mathematical operations can be performed with this, but in overall, we hardly need it to convert our images into some form of array so that we can store the trained model.

NumPy, which stands for Numerical Python, is a library that includes multidimensional array objects along with routines for processing those arrays. NumPy can perform mathematical and logical operations on arrays.NumPy is a Python library. It is an abbreviation for 'Numerical Python.' It is a library that contains multidimensional array objects as well as a collection of array processing routines.

Why Use NumPy? Lists in Python serve the same purpose as arrays, but they are slow to process. NumPy aims to provide an array object that is up to 50 times faster than traditional Python lists. The array object in NumPy is called n-darray, it provides a lot of supporting functions that make working with ndarray very easy. Arrays are frequently used in data science, where speed and resources are critical.

III. EXISTING WORK

P Y Kumbhar [6] intends to implement a real-time Face detection and tracking the head poses position from high definition video using Haar Classifier via Raspberry Pi BCM2835 CPU processor, which is a combination of SoC with GPU based Architecture, in this paper. The experimental results were computed using computer vision SimpleCV and OpenCV framework libraries, as well as the above-mentioned hardware results, at 30 frames per second at 1080p resolutions for greater accuracy and speed in face detection and tracking the head poses position. This work can be improved further by integrating stereo depth analysis of face detection using two sensor technology linked to a high-speed processor.

Sohan Garg [7] proposes a simpler human-machine interaction routine for face detection and recognition technology. A machine can detect a person's face from a previously stored database of faces using a standard web camera. So, if you want better results, you should experiment a lot, and if you still can't get good results after experimenting a lot, you might need a more complicated face recognition algorithm than PC(Eigenfaces), such as 3D Face Recognition or Active Appearance Models, which are discussed below..

Jeevan Singh [8], Given how humans perceive faces and how they differ from verification machines, it should be fascinating to see how machines favour different facial expressions rather than presenting face recognition challenges. As a result, this paper investigates the question of face recognition using incomplete facial information. The experiment is based on the use of (OOP) with OPENCV (Open Computer Vision) for accurate face classification and identification. Throughout this paper, we will implement a Haar-Classifier for Face Detection and Tracking using Haar features.

Md. Shamim Ahsan [9], Aims to provide four different discussions on face detection algorithms. First, we investigate a wide range of available face detection algorithms in five steps, including history, working procedure, advantages, limitations, and usage in other fields in addition to face detection. Second, in each method, we include a comparative evaluation of different algorithms. Third, to provide an all-inclusive viewpoint, we provide detailed comparisons among the algorithms exemplified. Finally,[9] we conclude this study by proposing several promising areas of research to pursue.

S. Graceline Jasmine[10] proposed a face recognition system that is automated. This application is based on face detection, feature extraction, and recognition algorithms, and it detects the human face automatically when the person in front of the camera recognises him. We used the KLT Algorithm, Viola-Jones Algorithm, and Haar cascade classifier to detect human faces.

IV. IMPLEMENTATION

OpenCV (Open Source Computer Vision Library)[11] is a programming library that focuses on real-time computer vision. An image may include a lot of information, which we can interpret in a variety of ways and perspectives. So, what exactly is an image, and how do you interact with one? In simple terms, an image is a visual representation of something that can be easily deal with using computer vision (from a machine learning perspective). Computer Vision, abbreviated as 'CV,' is a branch of Artificial Intelligence that extracts valuable information from digital photos, videos, and other media. 'CV' has a lot of real-world experience.
Reading an Image: Color photos, grey-scale images, binary images, and multi spectral images are all types of digital images. Each pixel in a colour image has its own colour information. Grayscale images have only shades of grey as their only colour, whereas binary images have only two colours, generally black and white pixels. Image data spanning the electromagnetic spectrum within a specific wavelength is captured in multi spectral photographs. This section shows the reading the image from my local directory.

1) Properties of an Image

Shape: There is a shape to every image. The shape of the picture's boundaries, i.e. the height and width, might be referred to as the length of the boundaries.
print(img.shape) is the most simple method for printing the image's shape, but we can also extract the shape using:
h, w, c = img.shape
the int ("Dimensions of the image is:nnHeight:", h, "pixelsnWidth:", w, "pixelsnNumber of Channels:", c)

Type: The "type" method can be used to determine the image's type. This method allows us to understand how image data is represented.
The "type" method provides information on how picture data

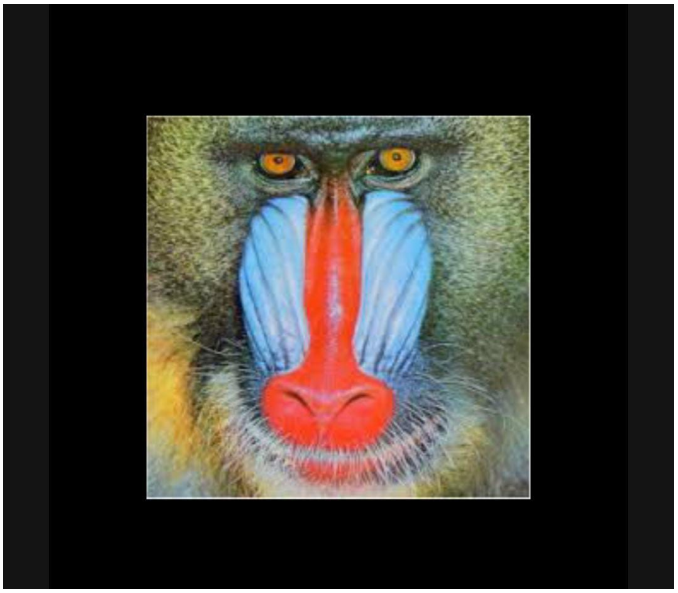

Fig. 2. This is an image of a mandrill.reading the image from my local directory.

is represented. Carry out the following steps:
print(type(img))

The data type of the image you have just read: We can validate the data type of the image because it is an N-dimensional array.
We can examine the image's data type to see if it's an N-dimensional array:
print(img.dtype)

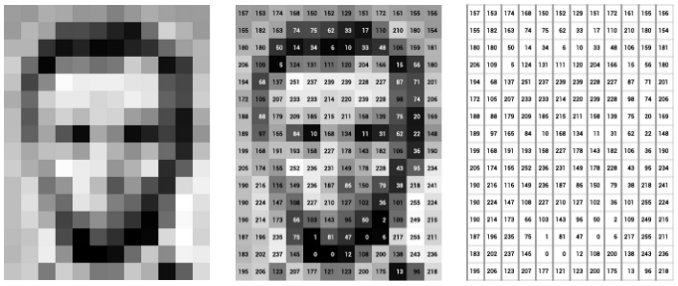

Fig. 3. **matrix representation of an image**

Image pixel values: An picture can be thought of as a collection of little samples. Pixels are the name for these examples. Try zooming in on an image as much as possible for a better comprehension. The same can be seen divided into many squares. These are pixels, and when they're all put together, they make up an image. A matrix is one of the most straightforward ways to represent an image. We can even use a matrix to build and save an image.
print(img)

Image Resolution: The number of pixels in an image can be characterised as image resolution. The visual quality improves as the number of pixels increases. The number of rows and columns is determined by the image's form, as we saw earlier. This could be referred to as the image's resolution. 320 x 240 pixels (mostly suitable for small screen devices), 1024 x 768 pixels (appropriate for viewing on standard computer monitors), 720 x 576 pixels (good for viewing on standard definition TV sets with 4:3 aspect ratio), 1280 x 720 pixels (for viewing on widescreen monitors), 1280 x 1024 pixels (good for viewing on full-screen size on LCD monitors with 5:4 aspect ratio), 1280 x 720 pixels (for viewing on widescreen).

Viewing the Image: Let's look at how to put the image in a window. To do so, we'll need to develop a graphical user interface (GUI) window that will display the image on the screen. The first parameter must be the GUI window screen's title, which must be given in string format. Using the cv2.imshow() method, we can display the image in a pop-up window. However, you may find yourself stuck with its window if you try to close it. To counteract this, we can utilise the "waitKey" function.
cv2.imshow('Mandrill', img) k = cv2.waitKey(0) if k == 27 or k == ord('q'): cv2.destroyAllWindows()

Saving the Image: Before saving the image, how about converting the image to grayscale and then save it? Convert the image to gray-scale using.
$gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)$
Now we can save the image:
$cv2.imwrite('Mandrill_grey.jpg', gray)$

V. RESULT AND ANALYSIS

The computers are taught to detect the visual features within using this strategy, which relies on massive databases and noticing emerging patterns to make sense of images. You can also return 'not matched' if the similarity is below a certain level.
Get the detections and predictions by passing the blob through the neural network. After looping over the detections, draw boxes around the detected faces. Show the image that results. The recognition technique is straightforward and effective.

VI. CONCLUSION

Face detection is used in a variety of areas, including security and human tracking. It is dependent on improving identity performance; there are numerous areas where improvements can be made, some of which are simple to implement. Color processing, edge detection, and other features can be added, for example. A specific camera for face identification may be developed in the future, which will increase image quality and

Fig. 4. read,resize,displaying the image

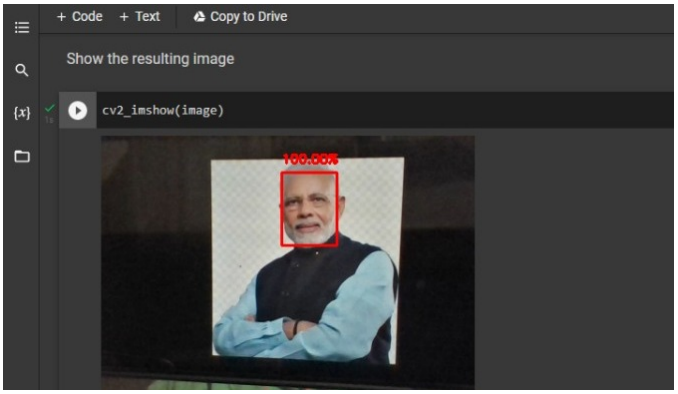

Fig. 5. read,resize,displaying the image

tackle challenges such as image filtering, image reconstruction, and denoising. You can make better decisions on datasets and enhance facial recognition accuracy by taking more and more images of each person, especially in varied angles and lighting situations, by taking more and more photos of each person.
In the future, a specific camera for face recognition may be developed, which will increase image quality and tackle challenges such as image filtering, image reconstruction, and denoising.

REFERENCES

[1] Shivam Singh Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India ,Prof. S. Graceline Jasmine Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India,"Face Recognition System".

[2] Al-"A Review of Face Recognition Technology" L. Li and X. Mu wrote the paper. S. Li and H. Peng Allaf,O.N. "Review of face detection systems based artificial neural networks algorithms". arXiv 2014, arXiv:1404.1292.

[3] https://towardsdatascience.com/face-detection-with-haar-cascade-727f68dafd08

[4] Shivam Singh Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India ,Prof. S. Graceline Jasmine Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India, "Face Recognition System"

[5] https://www.geeksforgeeks.org/face-alignment-with-opencv-and-python/

[6] "Real Time Face Detection and Tracking Using OpenCV", Prof. P Y Kumbhar, April 2017. , Mohammad Attaullah, Shubham Dhere, Shivkumar Hipparagi

[7] "Facial Detection Recognition Using Open CV library",Manav Bansal, Sohan Garg ,Sir Chhotu Ram Institute of Engg. and Tech., CCS University, Meerut, Uttar Pradesh, India, march 2016.

[8] "Face Detection and Tracking Using OpenCV " A Survey",Jeevan Singh, Vishal Kumar,B.Tech(CSE),B.Tech(CSE),School of Computing Science and Engineering , ,Galgotias University, Greater Noida,UP ,India

[9] "Human Face Detection Techniques", A Comprehensive Review and Future Research Directions Md Khaled Hasan , Md. Shamim Ahsan , Abdullah-Al-Mamun , S. H. Shah Newaz ,and Gyu Myoung Lee,Sept 2021.

[10] "Face Recognition System", Shivam Singh Department of SCSE Vellore Institute of Technology,Prof. S. Graceline Jasmine, Chennai Tamil Nadu, India, may 2019. Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India

[11] https://www.analyticsvidhya.com/blog/2021/09/a-beginners-guide-to-image-processing-with-opencv-and-python/: :text=OpenCV