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Determine the Emotional States of People by Taking a Picture of Their Faces Using Artificial Intelligence

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Abstract: ***There are some limitations to consider when using AI to identify emotional states. One limitation is that people can sometimes be difficult to read, and their emotional states may not always be evident from their facial expressions or language. Additionally, people can sometimes be intentionally misleading or difficult to read, which can make it challenging for AI algorithms to accurately identify their emotional states. Finally, AI algorithms may not always be able to accurately identify subtle or complex emotions, as these can be difficult for even humans to accurately interpret. In this article, we will address an important topic, which is determining the emotional state of people using artificial intelligence, the different applications in which artificial intelligence was used to determine the emotional state, we will also learn about the different ways to determine the face and some algorithms that help in that.***

Keywords: ***Face Detection, Artificial Intelligence, People's Emotion, Emotion Analysis, Python Language.***

1. INTRODUCTION

Recognition of facial expressions of emotion has recently become a significant problem in many applications. The study of facial expression recognition has grown significantly in recent years. The goal of facial emotion identification is to identify various human emotional states based on face photographs, including neutral, happy, sad, surprised, afraid, angry, disgusted, and disdain. The difficulty with face emotion detection is getting it to identify an emotion state accurately and automatically. As a result, it can be difficult to determine whether two people who are experiencing the same feeling are comparable because they may be expressing it in different

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ways. For instance, the expression may change depending on the person's mood, their skin tone, their age, and their surroundings. Generally, FER is divided into three major stages

1. Face Detection,
2. Feature Extraction,
3. Emotion Classification.

In the first stage of processing, an image of a face is found. This is a preprocessing step, and facial elements can be found in the area. The nose, lips, brows, and eyes are examples of facial features that can be found in this first stage. Facial Emotion Recognition, or FER, is an important topic in both the brain and intelligence spaces. People use FER as one of the main channels of information when communicating with other people. It's also a very important topic when it comes to intelligence since it helps retrieve useful characteristics from various regions on the face. In the second stage of this process, a classifier needs to be trained in order to be used to generate labels for the Emotions. This is necessary because labeling emotions is an important part of FER that can't be skipped. The last stage of this process involves using this trained classifier to generate labels for Emotions.
Human expression recognition plays an important role in interpersonal relationships. Expression is reflected in speech, hand and body posture, and facial expressions. Therefore, the extraction and understanding of expressions is of great significance for the interaction of human-computer communication.

Figure 1 emotion detection

Application of Facial Expression Detection

1. The task of facial emotion recognition in computer vision is interesting. It can be applied to a wide range of fields,
2. Healthcare: These cameras can give hospitals vital input, such as tracking how a patient reacts facially to medical devices or treatments. This technology can assist in monitoring all patients simultaneously, evaluating patient conditions, and enhancing medical care.

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3. Improve Businesses must employ facial emotion detection technology to track what viewers are watching and how they are reacting to it to make sure their videos are as effective as possible.
4. Automotive: Automakers from all around the world are concentrating on developing cars that are safe to drive and offer customers a customized experience. Furthermore, facial detection systems can comprehend human emotions thanks to the usage of AI,

Face Detection

Due to the vast amount of data that is currently available, face recognition is one of the extremely essential applications used frequently in the field of deep learning. It has a variety of uses, some of which we will examine in this article. Face detection is frequently the first step in apps that involve face monitoring, analysis, and identification, and it significantly affects how subsequent processes function within an app. By pointing out the areas of the video or image that should be the focus for assessing gender, age, and emotions, face detection aids in the analysis of the face. (BLOG, 2021)

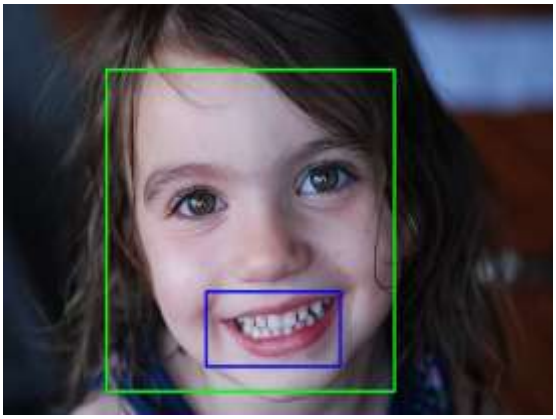

Figure 2:face detection

What is The Process of Face Detection?

Extracting faces from large photographs, which often contain many non-face elements such as buildings, landscapes, and other body parts, is achieved through face recognition technology using machine learning and algorithms. Human eyes are one of the easiest facial features to detect and are usually the first thing facial recognition algorithms look for. The algorithm then tries to locate the mouth, nose, eyebrows, and iris. After identifying these facial features and drawing conclusions, the program performs additional tests to ensure that the extracted facial features are indeed faces. Facial recognition applications use algorithms and ML to find faces in large photographs, which often contain non-facial elements such as buildings, landscapes, and other body parts such as feet and hands. One of the most recognizable aspects of a face is the eyes, and facial recognition algorithms typically start looking there. The computer then tries to identify your iris, mouth, nose and nostrils. Once the algorithm determines that a face region has

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been found, it performs additional tests to confirm that the face has been detected. For the algorithm to be as accurate as possible, it must be trained on huge datasets containing hundreds of thousands of images. These images may or may not contain human faces. The training process helps the algorithm determine if an image contains faces and where those face regions are located. It's also a good time to define major algorithm types, such as machine learning, artificial intelligence, and deep learning.

New services are constantly being developed thanks to modern machine learning algorithms. These algorithms can process huge amounts of data and find patterns in it. This data can be anything from images to text to numbers and more; it can also be the number of clicks or arguments a particular image receives. Google, Baidu and Apple's voice assistants Siri and Alexa are all powered by modern machine learning algorithms. Additionally, many popular recommendation systems are powered by machine learning, including Netflix and Spotify.

In order for an ML program to be considered artificial intelligence, it must be able to learn how to perform tasks beyond simple performance. AI systems include reasoning, problem solving, planning, learning, perception, manipulation and human intelligence. (Face Detection, n.d.)

Figure 3 emotions

Technologies Used To Develop Face Detection
TensorFlow, OpenCV, MATLAB, and neural networks are among examples.

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Face Detection Methods

Background removal is one of the most accurate facial recognition techniques. Background removal helps reveal the edges of faces, such as when an image has a simple, solid-colored background or a predefined, fixed background.

• Skin tone can occasionally be used to identify faces in colour photographs, but this may not be accurate for all skin tones.

• Another way to find faces is through movement. Users of this technology will need to figure out the range of motion as there is almost always a face moving

Facial recognition using Haar cascade and LBP classifiers Methodology

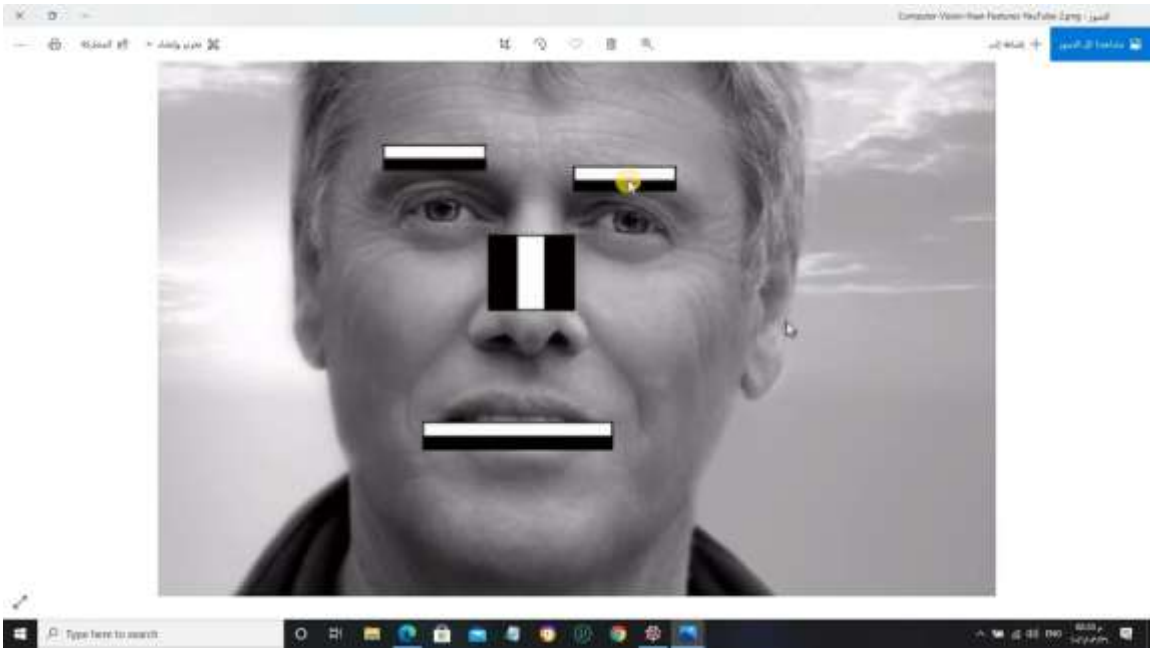

Figure 4 haar cascade algorithm

(The hair cascade algorithm uses specific filters to extract features from the delivered image. These filters each only look at a single region of the image. The pixel intensities of the white and black parts are then combined. The extracted feature value is obtained by subtracting these two are summed. Edge features, line features, and midline features are three types of hair-like features that can be derived using the hair cascade technique. We load the pre-trained XML classifier file to use it to detect faces in images. Next, flip we call the DetectMultiscale function to find the faces in the image. The DetectMultiscale function returns the positions of the detected faces. Then a region of interest is created around all the faces found in the image. In the output of the Detect Multiscale method, there are rectangles around the face he drawn..) (Introduction to OpenCV haar Cascade)

• Load input image.

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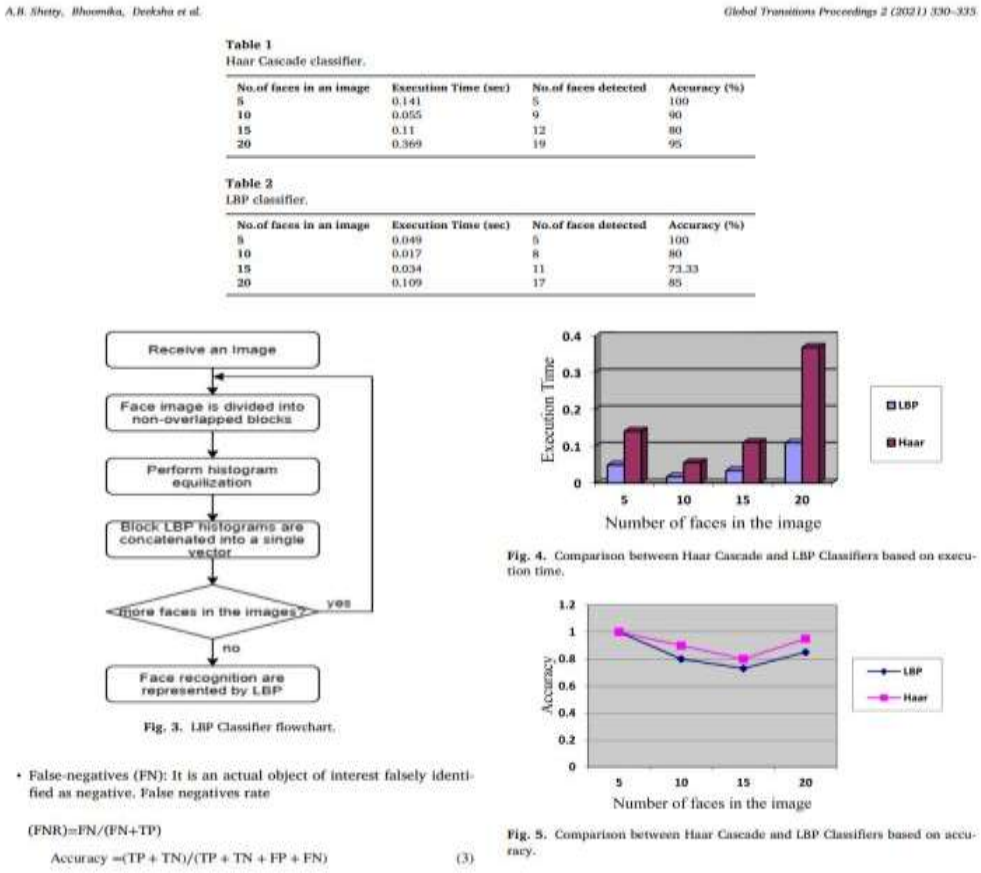
• Convert the input image to a grayscale image.
• Application of Haar cascade and LBP classifiers.
• Comparison of two classifiers based on accuracy and time.
• Import required libraries
• Capture the image captured by the camera.
• To process an image through a classifier, convert it to a grayscale image.
• Images are loaded using OpenCV
• By default, images are loaded in BGR color space

Haar cascade classifier

1. Use the built-in function cv2.imread(image path) to load the input image, where the image path is passed as an input parameter
2. Switch to grayscale mode and display again
3. Load the hair cascade classifier (Facial recognition using Haar cascade, 2021)



A.B. Shetty, Bhoomika, Deeksha et al. Global Transitions Proceedings 2 (2021) 330–335

Table 1
Haar Cascade classifier.

No.of faces in an image	Execution Time (sec)	No.of faces detected	Accuracy (%)
5	0.141	5	100
10	0.055	9	90
15	0.11	12	80
20	0.369	19	95

Table 2
LBP classifier.

No.of faces in an image	Execution Time (sec)	No.of faces detected	Accuracy (%)
5	0.049	5	100
10	0.017	8	80
15	0.034	11	73.33
20	0.109	17	85

Fig. 3. LBP Classifier flowchart.

Fig. 4. Comparison between Haar Cascade and LBP Classifiers based on execution time.

Fig. 5. Comparison between Haar Cascade and LBP Classifiers based on accuracy.

• False-negatives (FN): It is an actual object of interest falsely identified as negative. False negatives rate

(FNR)=FN/(FN+TP)

$$\text{Accuracy} = (TP + TN)/(TP + TN + FP + FN) \quad (3)$$

Figure 5 results Deep face model

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A traditional face recognition pipeline includes four steps. The first three are alignment, rendering and classification, which are all repeated using explicit 3D face modeling to apply piecewise affine transformations. Next, a nine-layer deep neural network is used to derive facial representations. In order to achieve wider coverage, this deep network uses many locally connected layers without weighting. It contains over 120 million parameters, and the training dataset is an identity-labeled dataset of 4 million face photos that represent over 4,000 identities. The largest face dataset to date is used in training. Utilizing large face databases paired with accurate model-based alignment yields impressive performance for our method. This gives our approach a competitive edge when pitted against other classifiers on the LFW dataset. Our method performs at 97.35% accuracy, beating the state-of-the-art by more than 27%. (deep Face, n.d.)

Model	LFW Score	YTF Score
Facenet512	99.65%	-
SFace	99.60%	-
ArcFace	99.41%	-
Dlib	99.38 %	-
Facenet	99.20%	-
VGG-Face	98.78%	97.40%
Human-beings	*97.53%*	-
OpenFace	93.80%	-
DeepID	-	97.05%

2. RESULTS

1.The emotional state of the person is stored in an Excel file
2.Face detection is a hot topic with many practical applications. Modern smartphones and laptops have face detection software built in that can verify the user's identification. Numerous apps have the ability to capture, detect, and process faces in real time while also determining the user's age and gender and applying some really amazing filters. The list is not just restricted to these mobile applications because face detection has numerous uses in surveillance, security, and

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biometrics. The original Object Detection Framework for Real Time Face Detection in Video Footage was proposed by Viola and Jones in 2001, however, and that is where its Success stories have their roots.

3.Affective computing, often known as emotion AI, is a rapidly expanding subfield of artificial intelligence that enables computers to interpret and analyse nonverbal cues from people, such as their body language, gestures, and voice tones, in order to determine how they are feeling.

Therefore, to assess a person's emotional state, visual Emotion AI uses computer vision technology to analyse facial appearances in photos and videos.

Figure 6 emotions

Summary

Facial expression recognition has become an interesting research area in computer vision and one of the most successful applications in image analysis and understanding. Some examples of applications that use these processes today are Apple's Face ID, medical imaging including eye dilation tests, patient monitoring, and more. Advances in computer vision research will provide neuroscientists and psychologists useful insights into how the human brain works, and vice versa. The accuracy we obtained when applying the aforementioned model was 97%

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