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Facial Emotion Detection System Using Image Processing in Python

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Abstract: The number of devices in a person's home exceeds the number of people themselves. It is now time we can no longer ignore the existence of such gadgets since they hold tremendous computational capacity. When we examine the last 10 years from a technological perspective, one thing becomes very clear: technology has infiltrated all aspects of human lives in each possible way to us. The automatic detection of human emotions is a subject that is frequently discussed, and that is what this research aims to do. The project is being created as an Android app. The suggested system is being created using cutting-edge technology, and the project's goal is to identify facial emotions effectively, swiftly, and with the fewest possible steps. The project can identify a variety of emotions, but its distinguishing characteristic is that it can identify the intensity and proportion of each emotion that an individual is experiencing.

Introduction

The ability to communicate precisely using complex and strong spoken (and later in history, written) languages is one of humanity's singularities that has contributed immensely to the development and growth of humanity. Having said that, a large portion of what is transmitted is done so through nonverbal cues (gesture and facial expression) rather than through those languages. It is not unexpected that facial expressions have been studied for millennia given how important they have been to human interactions. Charles Darwin developed one of the significant studies on facial expression analysis in the 19th century, which is more beneficial for the science of automated recognition carried out by machines. He organizes many expressions into groups based on their shared characteristics, as well as the facial deformities connected to each of these groupings. [1]. Human emotion detection is used in various situations when more security or personal data about the person is needed. We could need to set up a second layer of protection where, in addition to the face, the emotion is also detected. This can be considered the second stage after face detection. This can be helpful to confirm that the subject in front of the camera is more than just a two-dimensional image. There are eight categories of human emotions: fear, disgust, contempt, anger, surprise, sadness, happiness, and neutral. These feelings are quite subdued. Due to the limited amount of facial muscle contortions, it can be difficult to distinguish between them because even a slight variation can cause a change in expression. Additionally, as emotions are highly context-dependent, various people's displays of the same emotion may differ, even across the same person. Even if we could confine our attention to just the parts of the face that exhibit the most emotions, such as the area surrounding the mouth and eyes, how we extract these gestures and classify them is still a crucial issue. For these tasks, neural networks and machine learning have been applied with positive results. Pattern recognition and classification have been shown to benefit greatly from machine learning techniques. The features are the most crucial components of any machine learning system. In this study, we examine the extraction and modification of features for algorithms like Support Vector Machines. Algorithms and feature extraction methods from several articles will be compared. The human emotion dataset can be used as a highly useful example to explore the nature, resilience, and efficiency of classification methods for various dataset types [2,3]. To examine facial expressions, we have used the image processing technique. Image processing is a technique that may be used to improve an image and extract some usable data from it. It is a very effective technique for converting an image to its digital form so that you can later execute numerous operations on it. This method resembles signal processing in that the input is a 2D image composed of a range of numbers (from 0 to 255), each of which represents a pixel value [4,5]. In this study, we characterize an individual's external appearance into their core emotions, which include anger, hatred, fear, happiness, grief, surprise, and neutrality. The major goal of this technology is to make machine-human interaction more effective by allowing the computer to recognize the user's mood. Identification and the arrangement of external appearances can be used in this case as a distinctive pathway for communication between humans and machines. Additionally, the framework power varies from person to person and additionally alters with age, sexual orientation, size, and state of the face. Even the appearance of an identical person changes with time [6,7,8].

Literature Review

Preliminary Research into Control System using Quantified Human Emotions [9]. To increase the entertainment value of machines and robots, a preliminary study was done on how measurable human emotions may be read by a camera and integrated into their systems. Typically, this level of value and the performance of the events that employ these devices are measured by attendance, customer retention rate, survey results, etc. Computer Vision for the detection of

body expressions of children with cerebral palsy [10]. The major purpose is to improve patient communication so that they receive better care. This article describes an experiment using computer vision to enhance computer communication with people who have cerebral palsy. Children who have cerebral palsy are disabled because it impedes their ability to develop healthy posture and mobility. The development of a procedure that supports people with special needs in improving their quality of life is made possible by technology. Overview of Emotion Recognition System [11]. Recognizing human emotions is crucial to interpersonal relationships. Since the beginning of time, researchers have been interested in the automatic recognition of emotions. Consequently, there have been numerous advancements in this area. Speech, hand, and body gestures, as well as facial expressions, all represent emotions. Therefore, the connection between human and machine communication places great value on extracting and comprehending emotion. The developments in this area as well as the numerous techniques for emotion recognition are discussed in this essay. The primary goal of the study is to suggest a method for real-time emotion identification.

EMOSIC- An Emotion-Based Music Player for Android [12]. In this study, the researcher explores creating an advanced technology that was user-friendly. adjusting the music being played based on the user's actions or current mood. 50 speech samples made up the dataset used to assess the user's feelings, emotions, and mood. This was the best method, but it was also the slowest and least accurate due to the large computing costs. Feature extraction, regression, valence arousal plane, and tempo analysis are the techniques used. The issue is that music has been designed, classified, and implemented because it is so crucial to a person's life. As a result, this program includes suggested songs that are played to the user's satisfaction in accordance with their mood.

Emotional States Recognition by Interpreting Facial Features [13]. In this constantly evolving world of computers, people are discovering new ways to engage with them and vice versa. This must be a neutral emotion that interprets the user's emotional situation and adapts to the behavior properly to accomplish human-computer intelligent interaction. To identify and recognize facial expressions, this study attempts to give a software application that sets the contour of the face, mouth, nose, and face line. We use the free source computer program OpenCV and a lab for machine learning [14, 15].

Methodology and Results

STEPS INVOLVED IN INSTALLING PYTHON 2.7 AND THE NECESSARY PACKAGES

Firstly, took a sample image in either the.jpg or.png format and use image processing to determine the subject's emotional state. Any living being from which emotions can be collected is referred to as a "subject" (in this sentence).

A. Importing Libraries

The Python 2.7.x, NumPy, Glob, and Random packages of Python 2.7 must be downloaded and installed for this project to be implemented successfully. Python will be set up by default on the C disc in this instance. Start working by opening Python IDLE and importing all the packages [16].

B. NumPy

One of the Python packages used for complicated technical evaluation is NumPy. It is used to implement multidimensional arrays, which are made up of different mathematical formulas to process.

The axis dimension of an array that has been declared in a program; the rank of an array refers to how many axes are present e.g. A= [1,2,3,4,5], B= [[1,2,3,4], [5,6,7,8]]. Due to the one-dimension feature, there are 5 members with rank 1 in the given array A. Given that the array is 2-dimensional in this instance, the rank is 2. The first dimension has two elements, whereas the second contains four.

C. Glob: The Glob module recognises the pattern and creates a file in relation to it based on the rules laid out by Unix Shell. The whole route name is generated [17, 18, 19, 20].

Wildcards: Various operations can be carried out on individual files or sections of directories using these wildcards. There are several functional wildcards, but only two of them are helpful:

TABLE 1: Various files created in a Directory.

List of all files/working material saved inside a directory named “direc” direc/filename1List of all files/working material saved inside a directory named “direc” direc/filename5 direc/filename6 direc/filename7 direc/filename8 direc/filename9 direc/files

a) Asterisk (*): It represents any number of characters with any combination.

For eg. import glob
for name in glob.glob (‘direc/file*’)
print name

Result=>
direc/filename5
direc/filename6
direc/filename7
direc/filename8
direc/filename9
direc/files

b) Question Mark(?): It represents or finds a single missing character.

For e.g.
import glob
for name in glob.glob(‘direc/filename?’)
print name

Result=>
direc/filename5
direc/filename6
direc/filename7
direc/filename8
direc/filename9

This wildcard does not expand itself and is restricted to a single directory. That is, it fails to locate a file in a subdirectory.

D. Random

A random number or element is selected by the Random Module from a specified list of elements. This module supports the operations that grant access to them [21,22,23]. Classification of Random Module: -

1) randint(p,q)
It returns a value of x such that- p<=x<=q
2) randrange (cow, goat, bull, deer, mouse)
It returns any random variable or element from the given range.

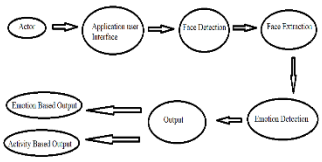

Fig. 1 Block Diagram for emotion detection

DIFFERENT EMOTIONS THAT CAN BE DETECTED OUT OF AN IMAGE:
1. Anger
2. Disgust
3. Fear
4. Happy
5. Neutral
6. Sad
7. Surprise

STEPS INVOLVED TO PERFORM EMOTION DETECTION USING OPENCV-PYTHON:
1) We must first create a Dataset after the required software has been successfully installed. Here, we can analyze a collection of photographs to construct our own dataset, ensuring that the information we extract is reliable and sufficient. Alternatively, we may use an existing database [24, 25, 26].
2)After that, the dataset is separated into two folders. The photographs will all be in the first directory, and the information about the various emotions will all be in the second directory.
3)The output photos from running the test photographs through the Python code will all be saved into a different directory, arranged according to the emotions they represent and then encoded.
4) OpenCV has a variety of classes that can be used for emotion recognition, but we'll mostly be using the Fisher Face class.
5) Extracting Faces: To extract as many faces as possible, we employ a series of the four preconfigured classifiers provided by OpenCV.
6) Training set and Classification set have been created from the dataset. Extracting data from a variety of photographs and the training set is used to teach the many types of emotions. To gauge the effectiveness of the classifier, a classification set is employed [27, 28].
7) The images should have the exact same size and other attributes for the best results.
8) Each image's subject is examined, turned grayscale, cropped, and saved to a directory.
9) Using 80% of the test data, we then create a training set, and the remaining 20% are classified using the classification set. Repetition will increase effectiveness [29, 30, 31, 32].

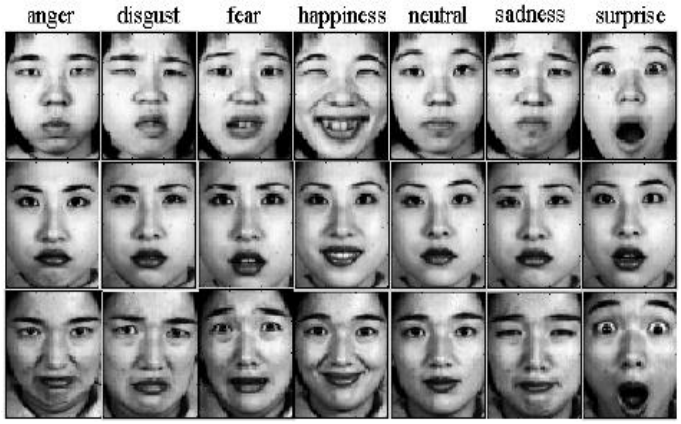

Fig.2 Output of a sample image

Cohn-Kanade AU-CODED EXPRESSION DATABASE
This is one of the Databases that can be used for emotion detection. There are many different types of emotions in this database. While a third category is still in the construction stage, this database is currently accessible in two different categories. The first version is designated "CK," whereas the second is designated "CK+." The neutral emotion is first picked up by the CK version before moving on to the next higher emotions. The frequency of processes increased by around 75% and the frequency of topics by about 80% with the publication of the second type of this database. The third release is almost ready and will include both CK and CK+ Database features, such as the integration of integrated 30^0 rotation from the front.

Future work

Future studies can explore a more reliable face detection algorithm along with other beneficial aspects to enhance the outcomes. We just concentrated on a few locations and distances, but a face can have a great deal more interesting features that can be statistically analyzed and utilized to develop the algorithm. Additionally, not all characteristics aid in incredible precision; some may not be useful in conjunction with other features. To enhance the precision of the dataset, feature selection, and reduction techniques can be applied to the newly produced feature. Applications for sleepiness recognition in drivers [1] can be created by selecting features and combining several algorithms.
It is possible to fine-tune algorithms like logistic regression, linear discriminant analysis, and random forest classifiers to get better accuracy and outcomes. A model's accuracy can also be determined using metrics like cross-validation score, recall, and f1 score, and the model can be refined based on the outcomes of these metrics.

Conclusion

In this study, we recommended a methodology for accurately classifying human emotions. The technique builds a representation of the six fundamental human emotions using image processing and convolutional neural networks. There are seven universal emotions- Anger, Disgust, Fear, Happy, Neutral, Sad, and Surprise.
Most of the time, the proposed approach appropriately categorizes emotions. The main objective is to create a framework for programming feeling identification. The suggested framework performed as expected on the webcam video feed.

Table 2: Comparisons with other paper

Algorithm and Features	Number of Emotions	Accuracy
Open CV Python	7 Anger, Disgust, Fear, Happy, Neutral, Sad, Surprise	Open CV 80%
CNN	7	95
SVM (Multiclass +binary)	7	89.78
SVM (ORB Features)	7	69.9 / 79.1
M-CRT	7	90.72

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