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Gender and Age Detection with Open CV

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Abstract: ***This research explores a novel approach to realtime gender and age detection using OpenCV, designed to enhance the accuracy of face recognition systems in uncontrolled environments. By incorporating advanced face alignment techniques and illumination normalization, the proposed method effectively addresses challenges associated with variations in lighting and facial expressions. The system demonstrates significant improvements in performance and is suitable for implementation in embedded vision applications, offering a robust solution for age and gender classification in realtime scenarios.***

Keywords: Gender detection, Age estimation, OpenCV, Face recognition, Computer vision

1. Introduction

The increasing number of face recognition applications in daily life has made face recognition an important research topic in recent years in recent years face recognition has received important consideration from both research groups and the market, but it remains a very interesting challenge in realworld applications. A number of distinctive algorithms are presented, being characterized based on and model - based schemes. As we are human beings there are lots of aspects which bring lots of variety on us.

This includes our facial expressions, body structure, and other physical attributes. This is the natural process and is affecting by a number of factors in our day to day life or we can say in our surroundings or our life style. So improved presentation of face recognition with age being combined. Gender recognition is the very gracefully thought among people but it is very difficult process for the computer. For social life gender plays an effective role in communication. Computer based system in which willing gender recognition method is a field of the computer vision.

Motivation and problem statement:
The number of crimes has been growing daily at a much faster rate. It has become a necessity to recognize criminals as soon as possible. The traditional way of recognition is a slow process while the proposed approach can be used to counter terrorism by identifying the features at a much faster rate. The project can also be used to reduce the frauds that can take place during voting i. e. can be used for voter identification. The older generation often finds it difficult to operate computers with ease.

Terminologies:
Terminology used in this python project of gender and age detection with open CV -

Computer Vision: This is the field of study that allow computers to see and identify digital images and videos as a human would. The objection it faces largely follow from the limited understanding of biological vision. Computer vision involves acquiring, processing, analyzing, and understanding digital images to extract data that can be used for decisionmaking. The process often contain practices like object recognition, video tracking, motion estimation, and image restoration.

Open CV: - This is short for Open Source Computer Vision. Seemingly by the name, it is an open - source Computer Vision and Machine Learning library. This library is able of processing real - time image and video while also boasting analytical capabilities. It supports the Deep Learning frameworks ***Tensor Flow***, Caffe, and Py Torch.

2. Literature Review

1) Face detection is also applied in biometrics, often as a part of (or together with) a facial recognition structure. Some present digital cameras use face detection for autofocus. Face detection is also useful for choosing areas of interest in photo. Face detection is of interest to marketers. A webcam can be connected with a television and detect any face that walks by. The system then calculate the race, gender, and age range of the face. Once the data is calm, a series of publication can be played that is specific toward the detected race/gender/age. This paper shows model or different application of this type of work. Face detection is also being studied in the field of energy conservation. Procedure for face recognition based on fact theory method of coding and decoding the face image is discussed in [Sarala A. Dabhade & Mrunal S. Bewoor, 2012. Basically uses two stages – Face detection using Haar Based Cascade classifier and recognition using Principle Component analysis. Various face detection and recognition methods compute [Faizan Ahmad et al., 2013] and also solution for image detection and recognition is proposed as an initial step for video surveillance. This Application of face recognition used most vital parts using 4 distance classifiers is target in 2011.

2) Lanitis et al. proposed the first approach applying AAM to age estimation, which extracts craniofacial growth and skip aging during childhood and adulthood.

a) age - specific estimation, which is based on the hypothesis that the aging is same for everyone; and
b) appearance - specific estimation, which follows the hypothesis that people who look similar tend to have similar aging processes. Zhang et al. formulated the inference of each person's age as a cover Gaussian process (WGP) estimation difficulty, and grown a multi - task extension of WGP to solve the problem. Since different distinctive have different aging processes, personalization is usable for age estimation. Previous researches also show that personalization can enhance the performance of age estimation.

AAM (Active Appearance Model) Approach:
Lanitis et al. bestowed the first approach applying AAM to age estimation, which obtain craniofacial growth and skin aging during childhood and adulthood.

Different classifiers (in also including shortest - distance classifier, quadratic function and neural networks) are compared when AAM is employed as the feature representation. The approach also become different between 1) age - specific estimation, which is based on the assumption that the aging process is same for everyone;
and 2) appearance - specific estimation, that follows the assumption that people who look like similar tend to have similar aging processes.

Subsequently, a personalized age approximation used in the specialty of aging processes is then presented to cluster identical faces before classification. In addition, Geng et al. modeled the aging process with AAM depend on a sequence of age - ascending face images for the same personal. Hence, various aging models can be learnt for different persons. More specifically, Geng et al. introduced a personalized age estimation method that explain the long - term aging subspace of a person, called Aging pattern Subspace (AGES). AGES approximation his/her age by projecting the question face into the aging subspace that best reconstruct the face image.

3. Methodology

Generally, the face classification methods are sensitive to face localization errors and variations in illumination. Therefore, the face image should be normalized prior to feature extraction. On the other hand, in our application the limitations of entrenched systems in terms of memory and computational requirement must be taken into consideration. In here, we examine these problem and present strong solutions for them.

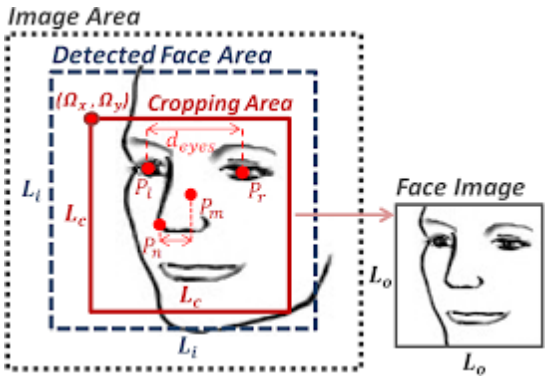

Figure: Face alignment using nose and eyes

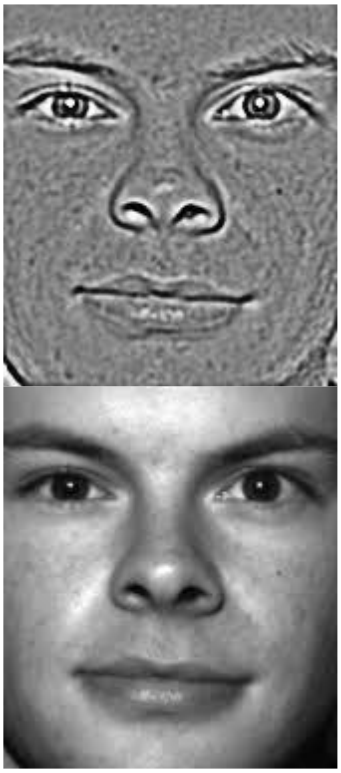

Figure: (a) **PS on Masculine Face (5◦, 10◦)**

Face alignment-
A common approach in face alignment is the positioning of frontal face images into an upright canonical pose based on the position of eyes. To locate the eyes, we use the open - source f land mark library which is a memory efficient, real - time, and fairly accurate facial landmark detector. Figure 1 illustrates some detected facial features points on the eyes and nose. The eyes can be aligned parallel by an in - plane rotation of the face image into an up right pose using the angle θ = arc tan (Pr, y − Pl, y/ Pr, x − Pl, x) where the points (Pl, x, Pl, y) and (Pr, x, Pr, y) denote the center positions of the left and right eye. Typically, the distance between the eyes deyes is used to compute the dimensions of the cropping area where Deyes = root of (Pr, x −Pl, x) ^2 + (Pr, y −Pl, y) ^2. But, in uncontrolled environments as the head's yaw angle increases, the eyes distance shortens. As a outcome, the dimensions of the picking area become smaller, causing an over - scaling error proportional to the yaw angle and, consequently, the loss of information from the upper and lower parts of the face. On the other side, as shown in Figure 1, the parallel distance between the points Pn and Pm on the nose increases when the eyes distance deyes shortens. Therefore, we propose to use the horizontal positions of the upper nose Pm, x and the lower nose Pn, x to compensate for the over - scaling in face alignment.

Effect of illumination
As a matter of information, in unconstrained environments the facial texture is liable to uneven illumination which may impact the demographics perception. Russell demonstrated the Illusion of Sex on an androgynous face by only increasing the facial contrast, resulting in a feminine look on a male subject. Likely, in our experiments we have noticed the same effect on various lighting conditions.

Figure 2 shows an androgynous male subject, illuminated from two different light source positions. In Figure 2 (b), the light source is 35◦ below the horizon inducing non - monotonic gray value change by which the examiner operceives a feminine look from the male subject. In order to normalize the photometry and less the effects of local shadows and highlights, we bestowed to apply the Preprocessing Sequence (PS) approach on the aligned face image. The results of applying the PS are shown in Figures 2 (a) and2 (b). Never the less, a large amount of textural noise is still present.

4. Project Prerequisites

Python
You need python installed on your system. It is the language in which all the code of project is written. Python is a general purpose language that can be used for a broad variety of application. It contains high level data structure dynamic typing, dynamic binding, and many more types that make it as useful for complex application development.

Some of the fields in which python play a crucial role:
- **Data Science:** This field makes up of substantial user base of python for both its computing and compiling of data libraries.
- **Machine Learning:** Python's code can implement machine learning, which helps improve algorithm - based tech from voice recognition to content recommendation.
- **Data Mining:** Python's sprightliness and scalability also makes it an attractive program to process and mine big data, which has seen a lot of mileage in the finance sector.

Here are some advantages of using python:
- **Popularity and Access:** Python has a huge communal to support it, which helps maintain its convenience to any skill level - it's also free and open - source software.
- **Simple Syntax:** The Python coding language has an simple - to - learn syntax and uses English words.
- **Readability:** Lines of code written in Python are also simple to read. For instance, Python uses a pleasant, clean break in the form of a new line of code to complete a command, rather than semicolons or parentheses.
- **Scalability:** You can start a program in Python without having to worry about the difficult task of rewriting or adapting code for other platforms as you scale up.

OpenCV
OpenCV is a cross - platform library using which we can expand real - time **computer vision applications**. It mainly attentions on image processing, video capture and analysis containing character like face detection and object detection.
Using OpenCV liberary you can -
- Read and Write images
- Capture and Save videos
- Process Images like filter, transform
- Detect specific objects such as faces, eyes, cars in the videos and images.
- Analysis the video, i. e. estimate the motion in it and subtract the background and track object in it.

OpenCV was originally developed in C++. In extra to it, Python and Java bindings were delivered. It goes on some Operating Systems such as windows, Linux, OSx, FreeBSD, Net BSD, Open BSD, etc.

Following are the main liberary module of the OpenCV liberary:

Core Functionality
This module defenses the basic data structures such as Scalar, Point, Range, etc., that are used to build OpenCV applications. In addition to these, it also holds the multidimensional array **Mat**, which is used to store the images. In the Java library of OpenCV, this module is difficult as a package with the name **org. opencv. core**.

Image Processing
This module protections several image processing operations such as image filtering, geometrical image transformations, color space conversion, histograms, etc. In the Java library of OpenCV, this module is integral as a package with the name **org. opencv. imgproc**.

This module covers the video examine concepts such as motion estimation, background subtraction, and object tracking. OpenCv has java library, and this openCV module is implicated as a package with the name **org. opencv. video.**

Video I/O:
This openCV module justify the video capturing and video codecs using OpenCV library. OpenCv has java library, and this module is involved as a package with the name **org. opencv. videoio**.

calib3d
This module holds algorithms concerning basic multiple - view geometry algorithms, single and stereo camera standardization, object pose estimation, stereo correspondence and elements of 3D reconstruction. OpenCv has java library and this module is added as a package with the name **org. opencv. calib3d**.

features2d
This module holds the concepts of feature detection and description. OpenCV has java library and this module is involved as a package with the name **org. opencv. features2d**.

Objdetect
This openCV module has the detection of objects and example of the predefined classes such as faces, eyes, mugs, people, cars, etc. OoenCV has java library, and this module is elaborate as a package with the name **org. opencv. objdetect**.

Highgui
This is an easy - to - use interface with simple UI abilities. In the Java library of OpenCV, the characterstics of this module is involved in two different packages namely, **org. opencv. imgcodecs** and **org. opencv. videoio**.

Model Training and Testing
In Deep learning algorithm Convolution neural network in which can get in an input image, allot significance (learnable weights and biases) to various aspects/objects in the image and be capable to differentiate one from the other.

Convolution Layer - The kernal
I, d=5 (H) x 5 (B) x 1 (Number of channels, eg. RGB)

In the above demo, the green section look like our **5x5x1 input image, I**. The CNN element is used for complex in carrying out the complication operation in the first part of a Convolutional Layer is called the **Kernel/Filter, K**, represented in the color yellow. We have certain **K as a 3x3x1 matrix.**

5. Model Architecture

The model we used is made with Keras using **Convolutional Neural Networks (CNN).** A convolutional neural network is a specific type of deep neural network which executes very well for image classification purposes. A CNN mostly contains of an input layer, an output layer and a hidden layer which can have multiple layers. A convolution operation is executed on these layers using a filter that performs 2D matrix multiplication on the layer and filter.
The CNN model architecture contains of the following layers:

- Convolutional layer; 32 nodes, kernel size 3
- Convolutional layer; 32 nodes, kernel size 3
- Convolutional layer; 64 nodes, kernel size 3
- Fully connected layer; 128 nodes

The final layer is also a completely connected layer with 2 nodes. A Relu activation function is used in all the layers excluding the output layer in which we used Softmax.

6. System Implementation

Step implementation

Step 1 – Select Image as Input from a Camera
Through a webcam, we will take images as input. connect the webcam, we made an infinite loop that will seizure each frame. We use the method provided by
OpenCV, **cv2. VideoCapture (0)** to contact the camera and set the capture object (cap). **cap. read ()** will read each frame and we stock the image in a frame variable.

Step 2 – Select the image from folder
With a webcam, we will click a picture and that picture save in that folder where code is saved.

Step 3 - Detect Face in the Image
In third step detect the face from selected image and a green colour rectangle has drawn on the face of image.
cv2. rectangle (frameOpencvDnn, (x1, y1), (x2, y2), (0, 255, 0), int (round (frameHeight/150)), 8)
Through cv2. rectangle function a rectangle is drawn where co - ordinates is x1, y1, and x2, y2. And rectangle color will be green because the color code is (0, 255, 0). We can choose any colour for rectangle boundary but I have chosen green color and the code I mentioned above color and create frame.

Step 4 – Detect the gender
In this step choose the gender from the selected image. That have two option male and female so choose between these options.
genderList= ['Male', 'Female']
from the genderList will be choosen is that the given image is males's or female's image.

Step 5 – Detect age from image
From selected image we have calculated the age. Not calculate the accurate age I mentioned already the calculation of accurate age is some time difficult so I have tae some ranges of ages and she/he belong to between range of ages.
ageList= [' (0 - 2) ', ' (4 - 6) ', ' (8 - 12) ', ' (15 - 20) ', ' (21 - 24) ', ' (25 - 32) ', ' (38 - 43) ', ' (48 - 53) ', ' (60 - 100) ']
ageNet. setInput (blob)
agePreds=ageNet. forward ()
age=ageList [agePreds [0]. argmax ()]
print (f'Age: {age [1: - 1]} years')
Take an image as a input through ageNet. setInput (blob) function and through the other function that I mentioned above calculate the age. and give the output between the age ranges that I have mentioned already.

Step 6 – Result
The output or result of the code that I mentioned in the module above. I selected the image first than I give the input to the source code and the output given by source code that I have mentioned in step 6.

We can see gender & age mentioned on the top of the image.

This is the main working of my major project that I have mentioned above in some steps.

Basically, we click the image from webcam and select the image as a input for our source code. Source code will draw rectangle on face of image and calculate the gender and image through some function given in the source code. And after execution of the source code we have get an same image with that I have given in source code as a input but this time some that image will get with some changes is that this time gender and age mentioned on the top of the image. This is working of "**gender and age detection with open cv**".

7. Conclusions & Recommendations

6.1 Conclusions

This study presents a comprehensive framework for realtime gender and age detection using OpenCV, addressing the challenges posed by uncontrolled environments. The proposed system demonstrates significant improvements in accuracy and efficiency, making it a viable solution for embedded vision applications. Future work could extend this approach to include additional demographic factors such as emotion and ethnicity, further enhancing the systems utility in diverse realworld scenarios.

6.2 Future Work & Recommendations

The Project "Gender and Age detection system" detect the gender and age from the image. Upon altering the dataset, the same model can be skilled to predict emotion, age, ethnicity, etc. The gender and age classification can be used to predict gender in uncontrolled real time scenarios such as railway stations, banks, bus stops, airports, and also The old - style way of identification is a unhurried procedure while the planned approach can be used to counter terrorism by identifying the structures at a much faster rate. The project can also be used to incredulous the rackets that can take place during voting i. e. can be used for voter identification.

For example, depending upon the number of male and female passengers on the railway station, restrooms can be built to ease the travelling.

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