

Solution Submission Template

CT/DT Number: ct20192615606

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Problem Statement: -

Face Recognition – Identify the Age, Emotion & Ethnicity of a person
(Category: -Computer Vision)

1) Background: -

The father of facial recognition was Woodrow Wilson Bledsoe. Working in the 1960s, Bledsoe developed a system that could classify photos of faces by hand using what's known as a RAND tablet, a device that people could use to input horizontal and vertical coordinates on a grid using a stylus that emitted electromagnetic pulses. Bledsoe developed the first semi-automatic face recognition system under contract to the US Government.

Facial recognition made bold head Bledsoe developed lines in early 2001 immediately after it was first used in a public space—at Super Bowl XXXV in Tampa—by the law enforcement authorities to search for criminals and terrorists among the crowd of thousands of spectators.

Facial recognition is a growing part of our everyday lives through devices and applications. Facial recognition is a biometric method of identifying a person based on a photograph of their face. Facial recognition technology falls under the category of biometrics, or the measurement of biological data.

It is a system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source

2) Your Understanding: -

Face recognition is one of the many wonders that AI research has brought forward to the world. Facial recognition technology falls under the category of biometrics, or the measurement of biological data. Facial recognition technology can be used in a number of other places, such as airports, government buildings, and ATMs (automatic teller machines), and to secure computers and mobile phones.

Facial recognition is the process of identifying or verifying the identity of a person using their face. It captures, analyse and compares patterns based on the person's facial details.

- i. The Face Recognition process is an essential step as it detects human faces and Recognize people in images and videos which is helpful in preventing crime protecting events and making air travel more convenient etc.

- ii. Design a project (program) which will accept input from user and provide Age, Gender, Ethnicity, Emotion of Faces which are present Image
- iii. Program transforms face into a set of digital information (data) based on the person's facial features.
- iv. Then on this face perform suitable algorithm (technique) for Identification of person Age, Gender and Ethnicity.

Detailed Algorithm is Explained below.

3) **Scope:** -

This project involves building project (program) implemented using Artificial Intelligence and Machine Learning for Human Face Recognition, Identifying age, Ethnicity of Person and Gender.

My project will give Information regarding Age, Gender, Emotion, Ethnicity of person using his face in the form of Image in which around his face all this detail will be mentioned and it will (project) also give output in the form of text.

My project is using use Haar Cascades (xml files) for detection of face, this Haar Cascade file is (result of) prepared using Huge dataset which consist of Positive and Negative images.

4) **Out of Scope:** -

- i. Project (code) will not detect any faces in which subject is wearing sunglasses or spectacles.
- ii. If image quality is low
- iii. If his frontal (front) face is not appearing in image. (Code will nor work on side face as haar cascade used is based on frontal face)

5) **Assumptions:** -

General Assumptions

For running this program on any machine, it is assumed that all required libraries required for this project are installed. (e.g. cv2, NumPy, argparse, keras, model)

Also, pre-processed data (models) is present in working directory. In my project it is 'haarcascade_frontalface_default.xml' and 'model_1_atul.tflern.data-00000-of-00001'

Technical Assumptions

While providing image as an input to the program it is assumed that front face of subject (user) is visible and he is not wearing sunglasses (spectacles), if this conditions (assumptions) are not fulfilled then it will affect the project's output.

It is assumed that if this program is modified for webcam then output of this program i.e. age, gender, ethnicity will be get changed if user moves his face a little bit.

6) Solution Approach

High Level Solution Approach

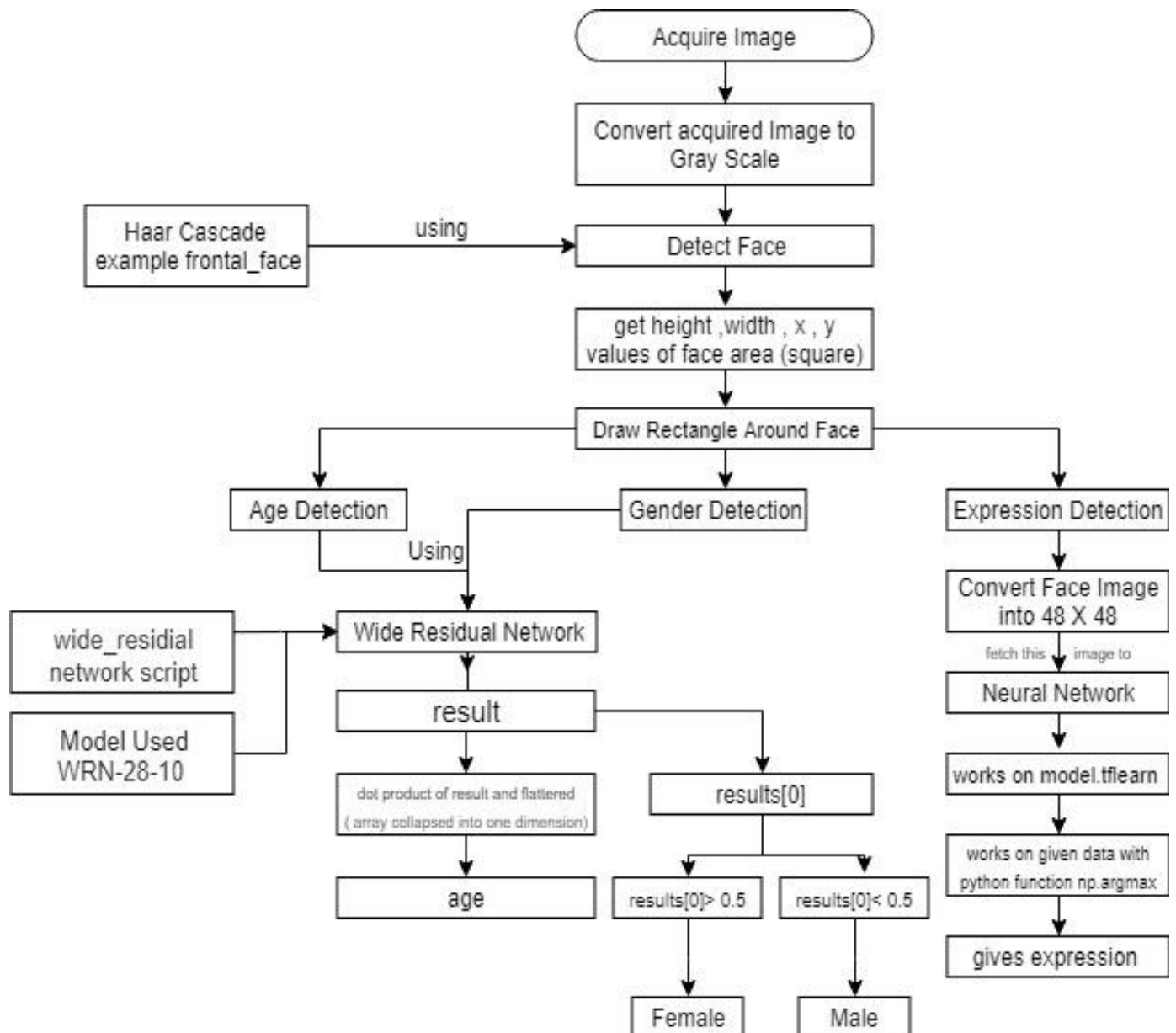
For High level approach I have come across two different libraries. While studying these module (libraries) I have come across Pros and Cons of these libraries and I have found that OpenCV is more preferable because of below comparison.

MATLAB (Matrix laboratory)	OpenCV (Open-source Computer Vision)
<p>Pros</p> <ul style="list-style-type: none"> ◦ <i>Easy-to-perform linear algebra</i> - Incredibly simple & capable of computing large matrices - inverses, multiplication, rank etc. ◦ <i>Simpler language</i> - Much easier to write lines of code. Similar functionality might be just 1–2 lines of code compared to OpenCV. ◦ <i>Picture worth a 1000 words</i> - Visualizing in MATLAB is 	<p>Pros</p> <ul style="list-style-type: none"> ◦ <i>Faster & Free</i> - With BSD license for OpenCV, you get all the features for free. Also, optimized code runs faster than MATLAB! ◦ <i>Richer & bigger community</i> - With regular improvements and over 40,000 developers, it's one huge family. Your back is taken care of. ◦ <i>Portability</i> - Due to its source-code in C/C++, any machine

easy. With its integrated IDE, you can edit code, display output, plot figures, manipulate data etc.	capable of running C/C++ (Linux), can have OpenCV running as well.
Cons <ul style="list-style-type: none"> ◦ <i>Costly</i> - Unless you are provided with a license or your bank balance <i>has more than 5 digits to the left of the decimal</i>, the budget is not for the faint of the heart. ◦ <i>Slower</i> - Comparatively slower especially for real-time processing of videos on incrementally lower-level machines. 	Cons <ul style="list-style-type: none"> ◦ <i>Challenging for beginners</i> - More so on C++ than Python definitely. Python's syntax helps but MATLAB is hard to beat when dealing with large matrices. ◦ <i>Weak documentation</i> - Again, more challenging for beginners. Lesser tutorials and documentation. This is slowly changing

Models/ Algorithms proposed

While implementing this project for detection of face the 'haarcascade_frontalcatface.xml' file is used for detection of face and for detecting emotions of person 'model_1_atul.tflern.data-00000-of-00001' model is used. For detection of Age, Gender, Emotion of person from front face following algorithm (approach) is used



7) Implementation Framework

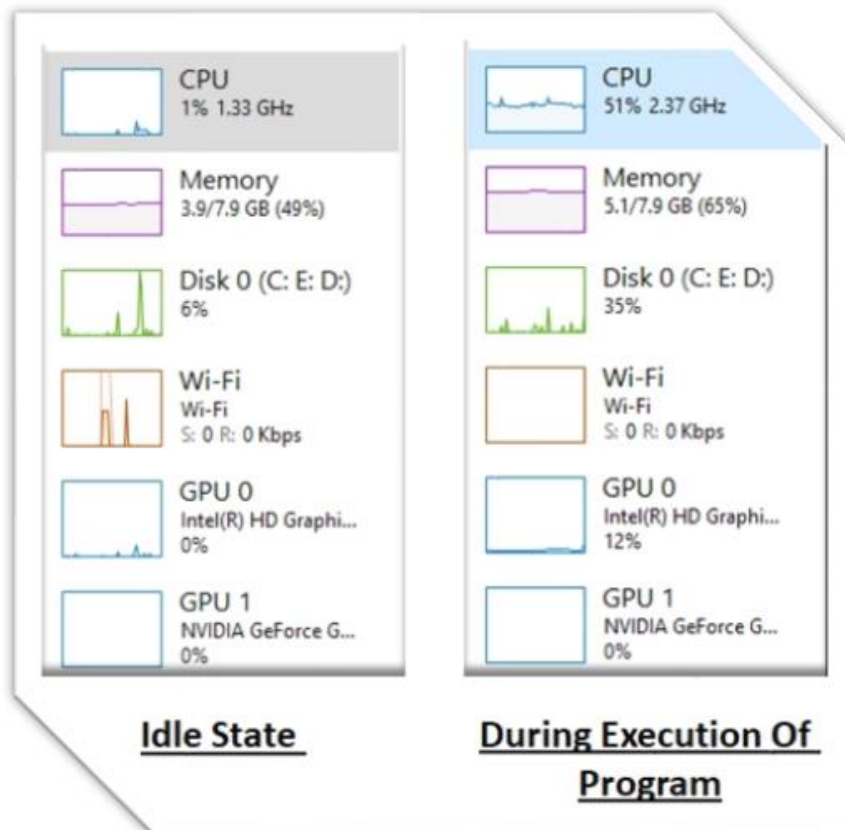
General Implementation Approach

Software

- Python Interpreter
- Python IDE (PyCharm ,Jupiter ,Spider etc)
- Required Libraries
- OS (Windows 7 or 10 , Fedora , Linux)

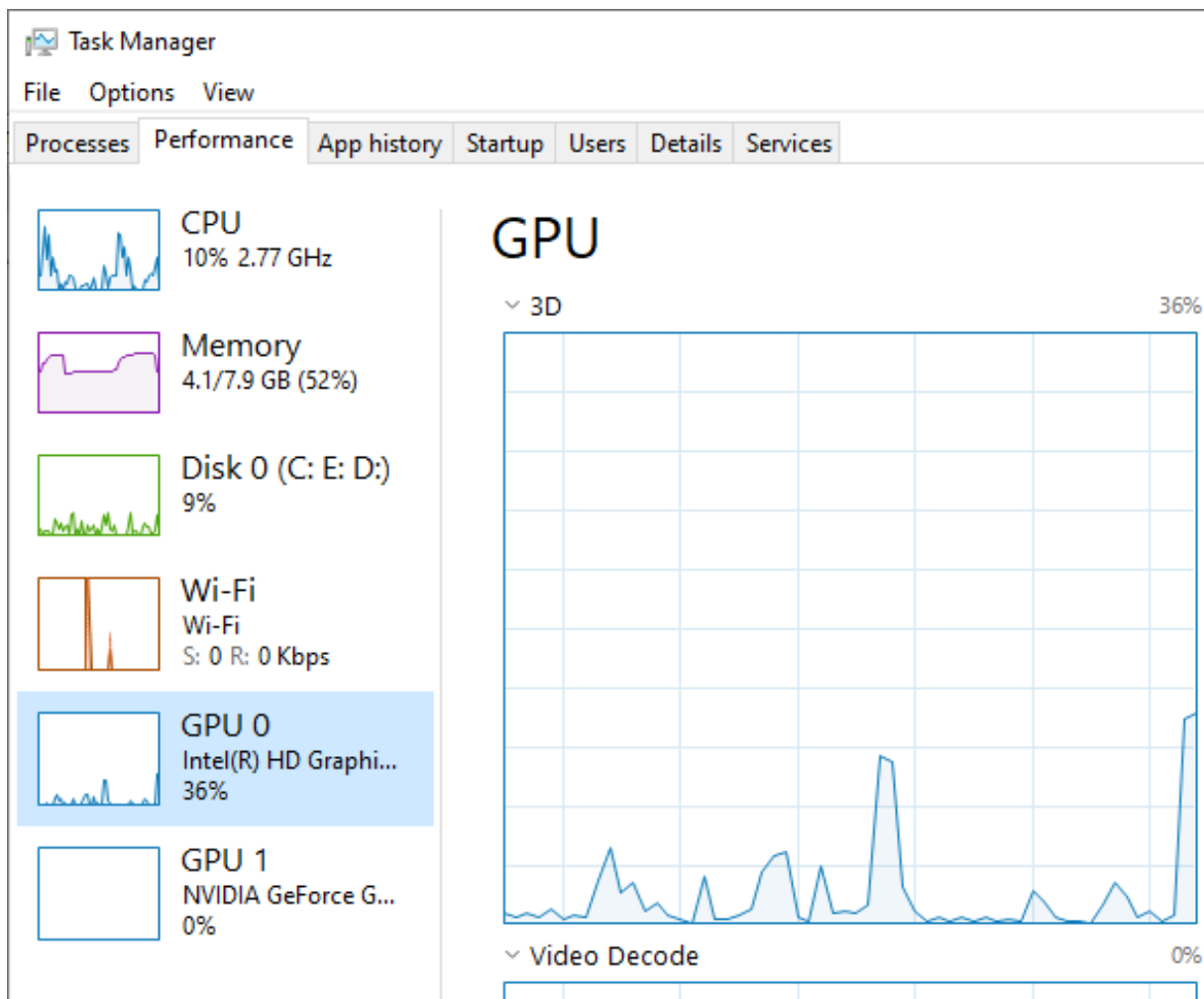
Hardware

- Camera (Webcam) or Images
- i5 Processor (i3 will be fine , but PC may lag)



Above Performance Details are of Laptop having
Configuration Intel® Core™ i7-7700HQ CPU @ 2.80 GHz

During Execution of program Above results are recorded. Load on CPU , GPU and Memory may vary with different PC's (machines)



Load On GPU During Program Execution

8) **Solution Submission:** -

<https://github.com/sanket9006/FACE-DETECTION-AND-AGE-GENDER-EMOTION>

In the problem statement it is mentioned that program should detect Face, Age, Gender, Emotion. Ethnicity from given input but I was able to complete only 4 requirements (Face, Age, Gender, Ethnicity) out of it, I tried my best but I was unable to detect ethnicity of person.

Image given below shows combined result for different images (test cases) on my machine.

Result



Note: -

In order to identify Age, Gender and detect Age I have to use two models
 1) model_1_atul.tflern.data-00000-of-00001

Of File Size (186 MB (19,58,10,464 bytes))

2) weights.18-4.06.hdf5

Of File Size (433 MB (45,50,64,145 bytes))

Because of their large size I was not able to upload them on GitHub (GitHub don't allow to push files larger than 100 MB.) In order to run my provided code this file must be present working directory.

9) **Appendix: -**

Writing code for face detection in order to detect Emotions ,Age and Gender involves various stages the first stage involves detection of face in image which is done using OpenCV and frontal face Haar Cascade after that for detection of Age , Gender and Emotion I have used two data model, links to these data models are mentioned in references. For testing whether my code is working properly or not I have test it on different images which I have downloaded from the web, links to these images are explained in references.

10) **References: -**

Blog Links: -

- [1] <https://www.learnopencv.com/tag/age-prediction/>
- [2] <https://www.learnopencv.com/age-gender-classification-using-opencv-deep-learning-c-python/>
- [3] <https://www.dlology.com/blog/easy-real-time-gender-age-prediction-from-webcam-video-with-keras/>

YouTube Videos:

- [1] <https://www.youtube.com/watch?v=PmZ29Vta7Vc&t=2827s>
- [2] <https://www.youtube.com/watch?v=atJmJ8tNc3U&t=188s>
- [3] <https://www.youtube.com/watch?v=F0njE7D22SI&t=340s>

Images Used In Project for Testing: -

- [1] https://www.google.com/search?safe=strict&tbm=isch&q=group+photo+black+background&spell=1&sa=X&ved=0ahUKEwj63NHizqLkAhUyILcAHZCLC6cQBQg6KAA&biw=1920&bih=937&dpr=1#imgrc=vPPm5BWOsbf_LM:

- [2] https://www.google.com/search?safe=strict&tbm=isch&q=group+photo+black+background&spell=1&sa=X&ved=0ahUKEwj63NHizqLkAhUyILcAHZCLC6cQBQg6KAA&biw=1920&bih=937&dpr=1#imgsrc=DN98EtS_zYFo8M:
- [3] https://www.google.com/search?q=womens+cricket+team+india&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjb7tPOz6LkAhUQSo8KHSsSBfkQ_AUIEyD&biw=1920&bih=937#imgsrc=YRmylN0v15iYOM:
- [4] <https://www.google.com/search?safe=strict&tbm=isch&q=group+photo+black+background&spell=1&sa=X&ved=0ahUKEwj63NHizqLkAhUyILcAHZCLC6cQBQg6KAA&biw=1920&bih=937&dpr=1#imgsrc=oooFWT-Q19B0kM:>
- [5] <https://www.spettacolo.eu/priyanka-chopra-jonas-nel-cast-we-can-be-heroes-robert-rodriguez/>
- [6] https://www.google.com/search?q=black+background+group+photo&safe=strict&hl=en-IN&tbm=isch&source=iu&ictx=1&fir=YiEjEuYcr_YJ2M%253A%252C6eFcI03bKx3SBM%252C_&vet=1&usg=AI4_-kQ7I7dIKH59fiafxap2iwXVDpaTMQ&sa=X&ved=2ahUKEwjpu6nI0aLkAhUK8HMBHeBHBKAQ9QEwAXoECAkQCQ#imgsrc=YiEjEuYcr_YJ2M:

Reference Papers: -

- [1] Sergey Zagoruyko and Nikos Kodiaxs. Wide Residual Networks. SERGEY ZAGORUYKO AND NIKOS KOMODAKIS: WIDE RESIDUAL NETWORKS 1

Data Models Used for Age, Gender, Emotion Detection: -

- [1] <https://www.dropbox.com/s/rf8hgoev8uqjv3z/weights.18-4.06.hdf5>
- [2] <https://drive.google.com/uc?id=1rdgSdMcXIvfoPmf702UCtH6RNcvkKFu7&export=download>