Machine Learning (UML501)

Project-: Age and Gender Classification

BE 3rd Year

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Introduction

Age and gender play fundamental roles in social interactions. Languages reserve different salutations and grammar rules for men or women; very often, different vocabularies are used when addressing elders compared to young people. Despite the essential roles these attributes play in our day-to-day lives, the ability to automatically estimate them accurately and reliably from face images is still far from meeting the needs of commercial applications. This is particularly perplexing when considering recent claims of super-human capabilities in face recognition.

Past approaches to estimating or classifying these attributes from face images have been based upon differences in facial feature dimensions or “tailored” face descriptors. Most have employed classification schemes designed particularly for age or gender estimation tasks, including others. Few of these past methods were designed to handle the many challenges of union-strained imaging conditions. Moreover, the machine learning methods employed by these systems did not fully exploit the massive numbers of image examples and data available through the Internet to improve classification capabilities.

In this project, we attempt to close the gap between automatic face recognition capabilities and those of age and gender estimation methods. To this end, we follow the successful example laid down by current face recognition systems: Face recognition techniques made in the last few years have shown that they can make tremendous progress in deep convolutional neural networks (CNN). We demonstrate similar gains with a simple network architecture designed by considering the limited availability of accurate age and gender labels in existing face data sets.

Age and gender are essential parts of facial attributes; identifying them based on facial data analysis and a required step for such tasks. Many MNCs are using these kinds of tools for a better customer fitting, making it easier for them to work with customers and their particular needs, cater to their needs better, and create an excellent customized experience for them. It is easier to identify and predict the needs of different individuals based on their gender and age.

The process of guessing the age and gender of an individual is a difficult task not only for computers but also us, as in today's world, people have different kinds of structural genetic problems, and some even apply makeup and use prosthetics to hide their actual age. Even though the class gender has grown, people recognize themselves with different genders today. Due to these difficulties, our model has some limitations but works well under normal circumstances.

Not everyone ages the same, depending on genetics and how well they take care for their skin and body. We also often associate white hairs and baldness with a person in his old age but in this we ignore some problems people faces due to som illness . Still, it is very different for different people. Similarly, we associate long hair and body ornaments or jewelry with women, but it is not limited to a woman. Only males, too, sometimes wear it. So it is not such an easy task when we have so many similarities and dissimilarities among gender. This task, especially age and gender detection, is a subjective matter solely based on looks and facial appearances and can vary widely.

Technology Used For Age and Gender Estimation

Convolutional Neural Networks (CNNs)
We have used CNN for image processing and extracting features form images and creating array sets or raw data by feature encoding for input data processing and extracting facial features from the image to detect age and gender.

CNNs are a class of Neural Network which work incredibly well on image data. They work similarly to how we humans recognize objects. As mentioned previously, the network first looks at the pixels of an image, then it gradually extracts the important features of the images using convolutions.

Pytorch

PyTorch is a deep learning tensor library based on Python and Torch, primarily used for applications that use GPUs and CPUs. PyTorch is preferred over other deep learning frameworks such as TensorFlow and Keras because it uses a dynamic computational graph and is completely Pythonic. We used it to process the data and train our model while utilizing both CPU and GPU power for faster epochs

TorchVision

We have used Torchvision library for Computer Vision that goes hand in hand with PyTorch. It has utilities for efficient Image and Video transformations, some commonly used pre-trained models, and some datasets

OpenCV

We are going to use the OpenCV library for all the image pre-processing tasks. OpenCV reads data from a contiguous memory location. We will use OpenCV library for resizing the images and creating feature vectors out of it, that can be achieved by converting the image data to numpy arrays for use by CNN for training purposes.OpenCV is a pre-built, open-source CPU-only library (package) that is widely used for computer vision, machine learning, and image processing applications. It supports a good variety of programming languages including Python.

CAFFE Model

CAFFE model uses classification using a machine learning algorithm has 2 phases-:

Training phase: In this phase, we train a machine learning algorithm using a dataset comprised of the images and their corresponding labels.

Prediction phase: In this phase, we utilize the trained model to predict labels of unseen images.

The training phase for an image classification problem has 2 main steps-:

Feature Extraction: In this phase, we utilize domain knowledge to extract new features that will be used by the machine learning algorithm. HoG and SIFT are examples of features used in image classification.

Model Training: In this phase, we utilize a clean dataset composed of the images' features and the corresponding labels to train the machine learning model.

In the predicition phase, we apply the same feature extraction process to the new images and we pass the features to the trained machine learning algorithm to predict the label.

HDF5

The HDF5 format can be thought of as a file system contained and described within one single file.We have used it to read and write image data with ease. Think about the files and folders stored on your computer. However in an HDF5 file, what we call "directories" or " folders" on our computers, is called groups and what we call files on our computer are called datasets.

Information About Dataset

Description

In order to facilitate the study of age and gender recognition, we have used a data set and benchmark of face photos made by Open University Of Israel. The data included in this collection is intended to be as true as possible to the challenges of real-world imaging conditions. In particular, it attempts to capture all the variations in appearance, noise, pose, lighting and more, that can be expected of images taken without careful preparation or posing.

This data set was used in the paper *Age and Gender Estimation of Unfiltered Faces* (See publications page for more information). The paper describes the process of collecting the data set and provides additional information on the test protocols used with it.

Statistics and info-:

Total number of photos: 26,580
Total number of subjects: 2,284
Number of age groups / labels: 8 (0-2, 4-6, 8-13, 15-20, 25-32, 38-43, 48-53, 60-)
Gender labels: Yes
In the wild: Yes
Subject labels: Yes

	0-2	4-6	8-13	15-20	25-32	38-43	48-53	60+	Total
Male	745	928	934	734	2308	1294	392	442	8192
Female	682	1234	1360	919	2589	1056	433	427	9411
Both	1427	2162	2294	1653	4897	2350	825	869	19487

Table 1. **Adience image dataset distribution**. Number of images for each gender and age range.

The directory contains the following files:

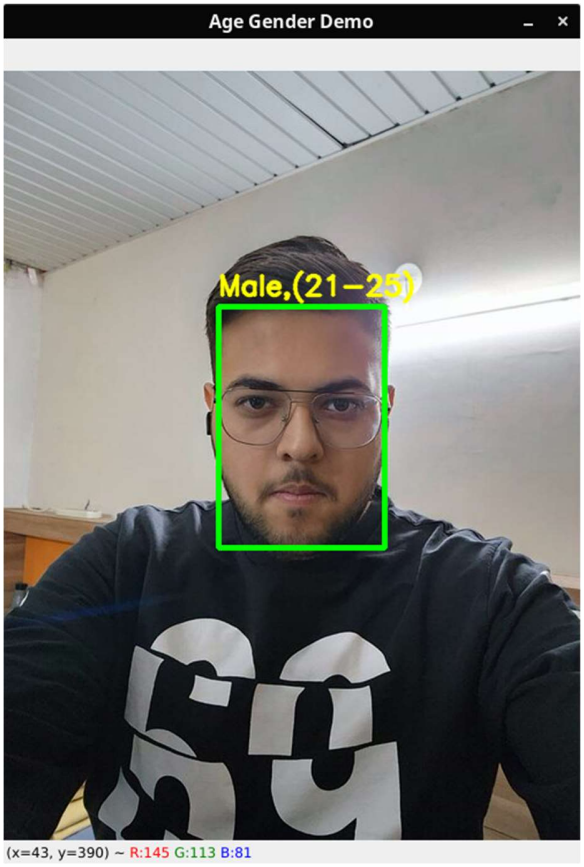
- faces.tar.gz (936M) - Face images, cropped
- aligned.tar.gz (1.9G) - Face images, cropped and aligned using our 2D, in-plain alignment tool
- fold_0_data.txt - fold_4_data.txt - text files with indices to the five-fold cross validation tests using all faces
- fold_frontal_0_data.txt - fold_frontal_4_data.txt - same as above, but using only faces in approximately frontal pose

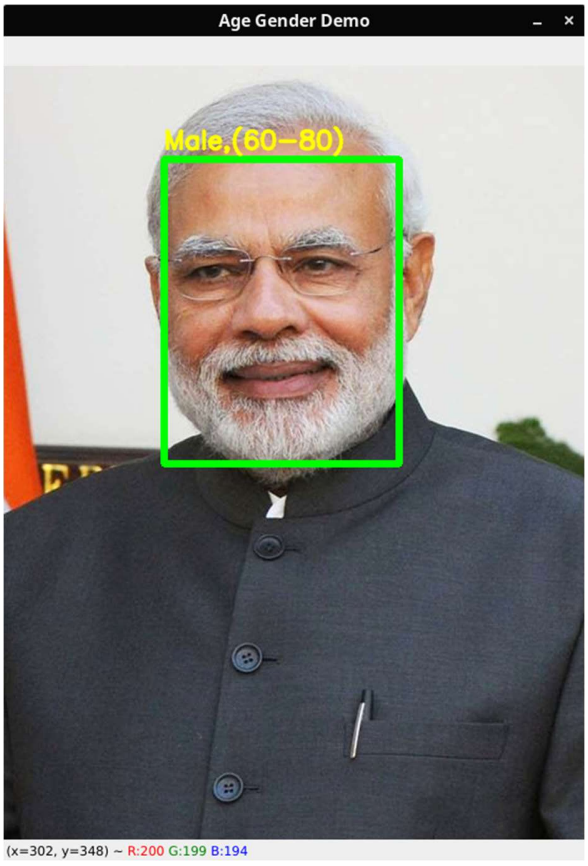
Download -: The data is stored on FTP server: *agas.openu.ac.il*
Alternatively, direct access to the download directory is available through:

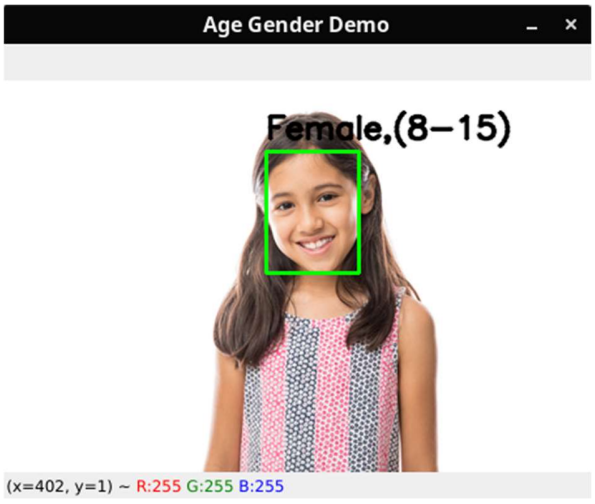
Username-:adiencedb Password-:adience
http://www.cslab.openu.ac.il/download/

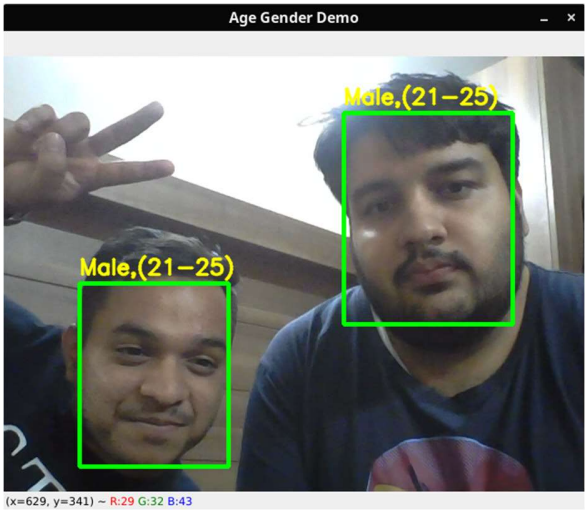
Result

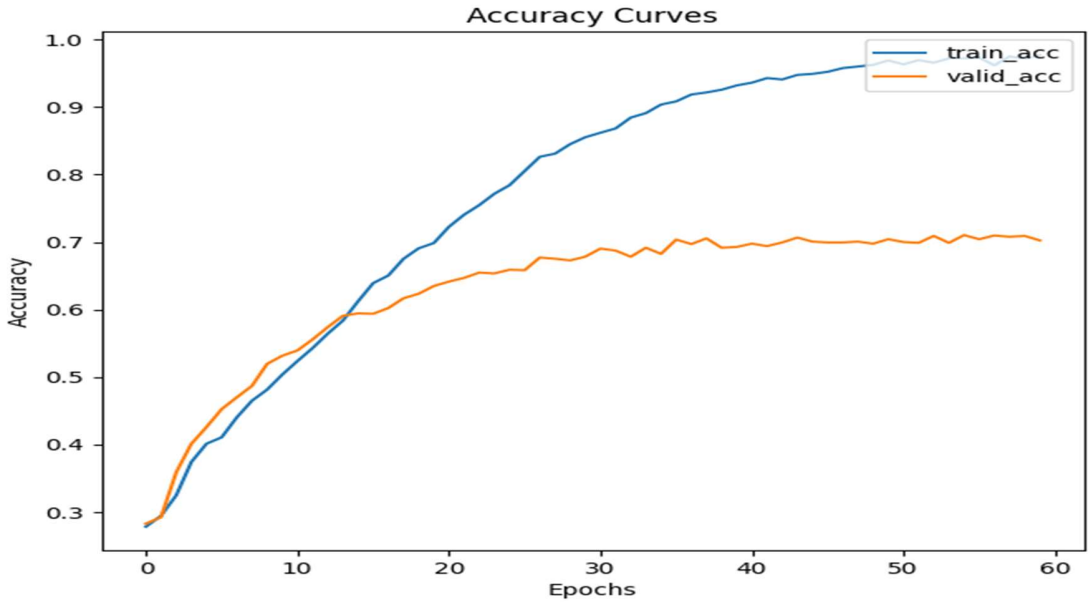
The Dataset and model has an accuracy of about 92% with 60 epochs and is able to detect faces properly and could tell your age with +- 3years . Here are some sample shots-:



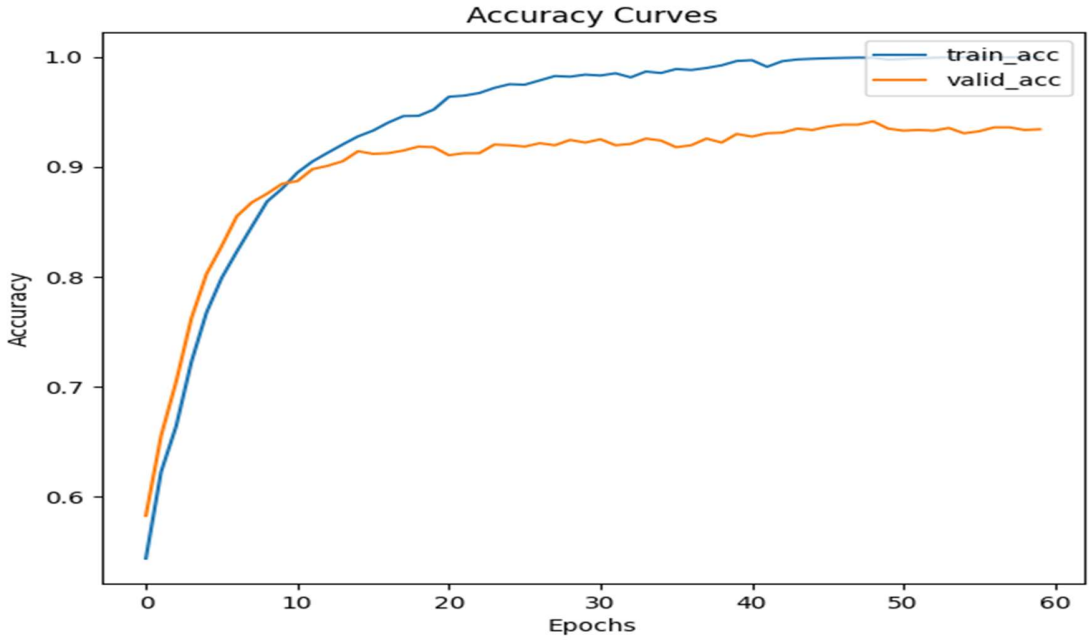








Age train & valid Accuracy



Gender train & valid Accuracy

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