Age and Gender Detection Using Deep Learning

A

MINI PROJECT REPORT

SUBMITTED

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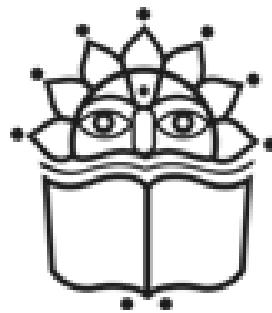IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF FOURTH YEAR, DEEP LEARNING

OF

Bachelor of Computer Engineering

Under the guidance of

Prof. Sushma Nandgaonkar
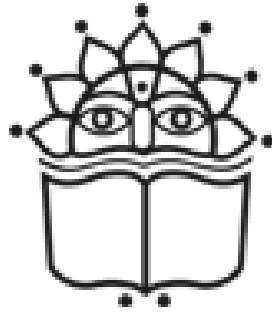
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THIS IS TO CERTIFY THAT FOLLOWING STUDENTS

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HAVE SUCCESSFULLY COMPLETED THEIR MINI PROJECT WORK ON

AGE AND GENDER DETECTION USING DEEP LEARNING

DURING THE ACADEMIC YEAR **2022-23** IN THE PARTIAL FULFILLMENT TOWARDS THE COMPLETION OF **DEEP LEARNING** IN **COMPUTER ENGINEERING.**

Mini Project Guide   HoD Deptt. of Comp. Engg.
(Prof. Sushma Nandgaonkar)   **(Dr. C. S. Kulkarni)**

Principal
(Dr. R. S. Bichkar)

Acknowledgments

Abstract

Mankind has advanced technology to the extent that the 21st century is the crack of the dawn for unimaginable achievements. The aforementioned technology can be used for our benefit in identifying one's age and even their gender just based on their glimpse from a camera, image and even a video. This research paper will methodically chalk out the whole procedure, multiple methodologies and algorithms that can be used, which one is the most accurate and how it all comes together. It will also stress on its importance and how it can be implemented to benefit our day to day life. The paramount objective of the paper is to build a gender and age detector that can approximately guess the gender and age of the face of an individual in a picture using Deep Learning on the audience dataset. Moreover, to get the most effective predictions and result by overcoming the problem of accuracy and time. Moreover, the map for the ways this technology can be used to our benefit and look at the huge spectrum where it can be implemented: ranging from security services, CCTV surveillance and policing to dating applications, matrimonial sites

The deep learning network is used to train and learn these images, Which can effectively identify age and gender. The CNN model is used as the primary network. The results show that techniques of data augmentation and preprocessing have delivered promising insights to estimate age and genders of data present in dataset.

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Introduction

Human face may be a storehouse of various information about personal characteristics, including identity, emotional expression, gender, age, etc. the looks of face is affected considerably by aging. This plays a significant role in nonverbal communication between humans. Age and gender, two key facial attributes, play a really foundational role in social interactions, making age and gender estimation from one face image a very important task in machine learning applications, like access control, human-computer interaction, law enforcement, marketing intelligence and visual surveillance. Automatic gender classification and age detection may be a fundamental task in computer vision, which has recently attracted immense attention. It plays a very important role in an exceedingly wide selection of the real-world applications like targeted advertisement, forensic science, visual surveillance, content-based searching, humancomputer interaction systems, etc. for instance we are able to use this method to display advertisement supported different gender and different age bracket. This method may be employed in different mobile applications where there's some age restricted content in order that only appropriate user can see this content. However, gender lassification and age approximation is still a difficult task.

We propose a model which can first perform feature extraction on the input image which can classify eyes, lips, beard, hair, etc. Supported these features the model will classify the gender as male or female. We've used Haar Cascade for feature extraction purpose. Age is estimated with the assistance of Caffe Model. The age classifier takes an image of an individual's face of size 256x256 as an input to the algorithm that's then cropped to 227x227. The age classifier returns a integer representing the age range of the individual. There are 8 possible age ranges , that the age classifier returns an integer between 0 and seven. The gender classifier returns a binary result where 1 indicates female and 0 represents male

1.1 Overview

Deep Learning is an Sub part of Artificial Intelligence which deals which multiple computer operated applications in which a machine works with a Multiple Neurons and Hidden layers which helps us in better Classifications and Predictions. It is used to reduce the Errors using Weight Biases.

1.2 Motivation

The motivation behind age and gender detection is to provide an automated and accurate method for face recognition and analysis, which can be useful in various fields and industries. The primary motivation for this technology can be attributed to several factors,including:

i) Efficiency: Age and gender detection can provide a fast and efficient method for identifying and analyzing individuals based on their age and gender. This can save time and resources in various applications, such as security systems and healthcare.

ii)Accuracy: Age and gender detection using deep learning techniques has shown high accuracy rates, which can be useful in applications where accuracy is crucial, such as healthcare and security

iii) Personalization: Age and gender detection can provide a personalized experience for users in various applications, such as entertainment and social media. For example, it can be used to recommend movies or music based on a person's age and gender.

iv)Data analysis: Age and gender detection can be used to analyze customer demographics and behavior, which can be useful for businesses in marketing and retail.

v)Research: Age and gender detection can be used for research purposes, such as studying age and gender-related health issues or understanding consumer behavior.

Overall, the motivation behind age and gender detection is to provide a useful and efficient method for identifying and analyzing individuals based on their age and gender, which can be applied in various fields and industries

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Proposed Work

2.1 Problem Definition

Age and gender detection is a computer vision task that involves predicting the age and gender of a person from a given image or video. The problem is to develop an algorithm or model that can accurately predict the age and gender of a person from their facial features such as wrinkles, facial hair, and other attributes. The input to the model is an image or video frame that contains a human face, and the output is the predicted age and gender of the person in the image.

2.2 Scope of Mini Project

- Security: Age and gender detection can be used in security systems to identify unauthorized individuals based on their age and gender. For example, it can be used to identify underage individuals attempting to enter a restricted area.

- Marketing: Age and gender detection can be used in marketing to analyze customer demographics and tailor marketing strategies accordingly. This can help businesses better understand their customers and improve their marketing efforts.

- Healthcare: Age and gender detection can be used in healthcare to assist with the diagnosis and treatment of certain medical conditions that are more prevalent in certain age and gender groups.

- Entertainment: Age and gender detection can be used in entertainment to provide personalized experiences, such as recommending movies or music based on a person's age and gender.

- Social media: Age and gender detection can be used in social media to provide personalized content, such as targeted ads and news articles.

2.3   Objective of the Mini Project

- The objective of age and gender detection is to automatically identify and classify the age and gender of a person based on their facial features. The primary goal of this technology is to provide an automated and accurate method for face recognition and analysis, which can be used in various applications, such as security systems, marketing, healthcare, and entertainment.

- In security systems, age and gender detection can be used to identify individuals who are not authorized to enter certain areas based on their age, such as underage individuals. In marketing, age and gender detection can be used to analyze customer demographics and tailor marketing strategies accordingly. In healthcare, age and gender detection can be used to assist with the diagnosis and treatment of certain medical conditions that are more prevalent in certain age and gender groups.

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System Architecture
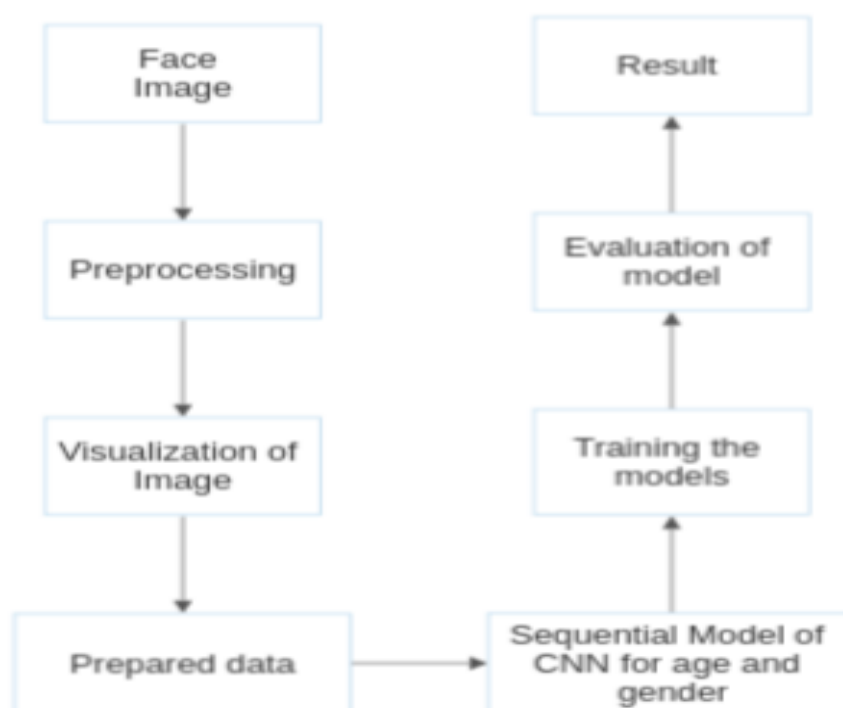
Figure 3.1: System Architecture

Firstly system will take input images of faces which contains labels of age and gender weather they are male or female along with their ages. After that it will be given to the next step and data is downloaded from the keras. After that data is splitted into training data, testing data and validated data is preprocessed i.e. resized and rescaled.Also data is augmented. Input layers are defined and hidden also defined. As output needed for data is data classified into two different classes.So, two neurons are passed at the output layer. Here, CNN is used which contains five convolutional with simultaneous max-pooling layers. Model is build with the data as well as performance also evaluated. Different images were tested with random data of citrus plant and output is checked. Lastly face is classified as male or female and detect the age.

The architecture of age and gender detection using Convolutional Neural Networks (CNN) typically involves several key components, including:

i)Convolutional Layers: These layers perform the feature extraction from input images using a series of convolutional filters. The output of the convolutional layers is a set of feature maps, each of which represents a particular feature extracted from the input image.

ii)Pooling Layers: These layers reduce the dimensionality of the feature maps by performing down-sampling operations. Common types of pooling layers include max-pooling and average-pooling.

iii)Fully Connected Layers: These layers take the flattened output from the convolutional and pooling layers and perform the classification task. In age and gender detection, the fully connected layers typically consist of two or more neurons representing the predicted age and gender classes.
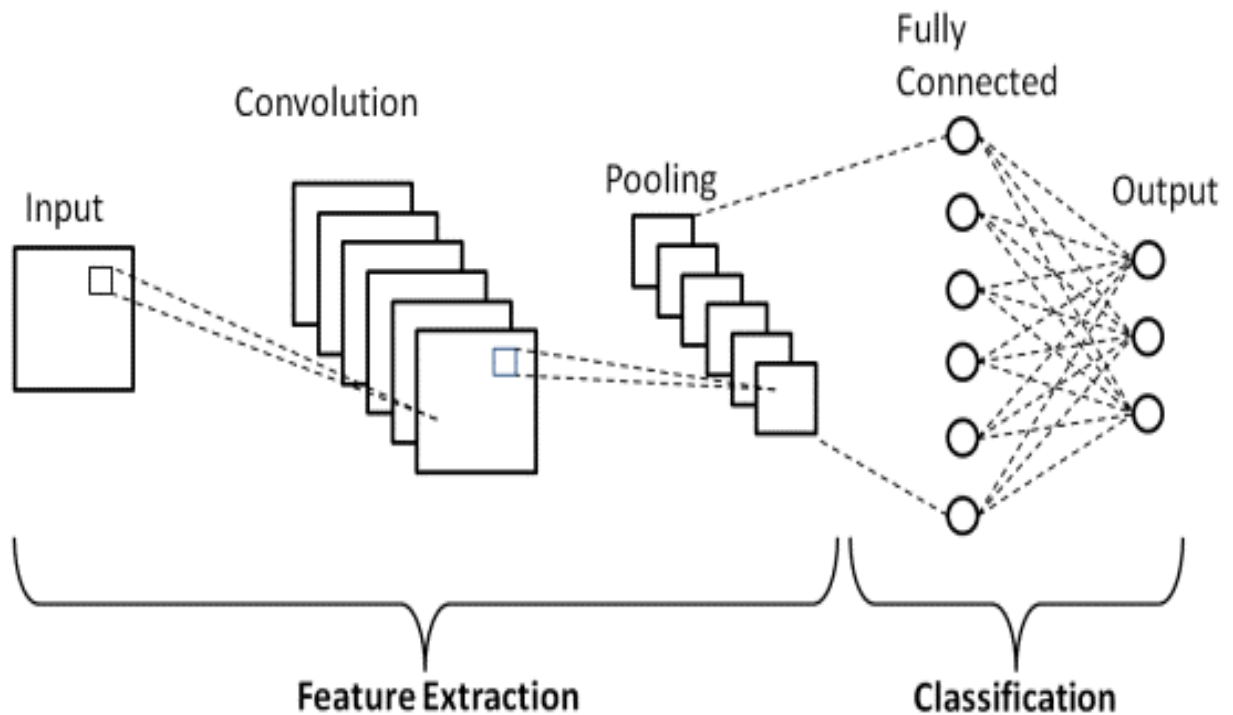
Figure 3.2: CNN Architecture [1]

iv)Dropout: This regularization technique is used to prevent overfitting by randomly dropping out some of the neurons during training.

v)Activation Functions: These functions are used to introduce non-linearity in the model

and make the output of each neuron bounded. Common activation functions include ReLU, sigmoid, and tanh.

The input to the CNN is typically an image of a face, and the output is the predicted age and gender of the person in the image. The CNN model is trained on large datasets of labeled images, and the weights of the model are adjusted during training to minimize the prediction error.

Overall, the architecture of age and gender detection using CNN involves a series of convolutional, pooling, and fully connected layers, along with dropout regularization and activation functions, to extract relevant features from the input image and predict the age and gender of the person in the image.

Project Requirements Specification

4.1   Performance Requirements

For the Best Performance of the Software, user must follow the sequence of the activities to achieve the required results. Do not proceed to recognise text before the picture is captured. While using the software, users action must be consistent and unique. Input to the software must be in Proper Format.

4.2   Software Quality / Attribute Requirements

Some of the quality of attributes identified include:

- **Portability :** In API portability can be defined as compatibility of application with platform upgraded or downloaded versions.

- **Flexibility :** The architecture of the application will be flexible enough for some later requirements change or application enhancement.

- **Maintainability :** Whenever there is a change in requirement or bug found the application will be easily maintainable.

4.3   Hardware Requirements

- **System Processor :** Core i5 processor 10th generation 8 GB RAM

- **SSD :** 512 GB

4.4   Software Requirements

- **Operating system :** Windows 10 (Intel/AMD 64-bit)

- **Coding Language :** Python (version 3.7.0)

- **Libraries :** Keras, Tensorflow, Matplotlib, Seaborn, Numpy, Pandas

- **IDE :** Jupyter Notebook, Anaconda, Google Colab

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Tools Used

5.1 Overleaf

Overleaf is free to use. You Can Create, Edit and Share your projects with a sign up method. Overleaf is a real time editor for used to reasearch paper and projects. Oveleaf is a cloud based LaTeX editor used for writing, editing and publishing scientific documents. Overleaf can be a access multiple user at a time.

5.2 Anaconda Navigator

Anaconda is an open source tool. Anaconda Navigator also includes a graphical user interface. It can be used for python and R programming language for Data Science that aims to simplify package management and deployment. Anaconda Navigator can launch any applications and manage Anaconda package without using command line interface.

5.3 Jupyter Notebook

Jupyter Notebook is a widely based application for a creating and sharing any documents. Jupyter notebook is mostly used in Python Programming language related project. Jupyter Notebook can be support programming language such as R and python.

5.4 Diagrams.Net

Diagrams net is free online diagram software. It can be used for making flowchart, process diagram, DFD diagram, UML diagram and network diagram.

5.5 Libraries Used

- **Tensorflow:**

TensorFlow is an open-source library for numerical computation and machine learning, developed by Google Brain Team. It allows developers to build and deploy machine learning models and other mathematical computations, especially those that involve large-scale data processing, with high performance and scalability.

TensorFlow is designed to be a flexible and efficient platform for building and training machine learning models across a range of applications, including image and speech recognition, natural language processing, and robotics. It uses a computational graph model to represent mathematical operations, allowing developers to define complex mathematical computations as a series of interconnected nodes in a graph.

The library also provides a wide range of tools and APIs to support the development and deployment of machine learning models, including support for distributed computing, GPU acceleration, and integration with other popular machine learning frameworks like Keras and Scikit-learn.

- **Keras :** Keras is an open-source neural network library that is written in Python. It provides a high-level interface for building and training neural networks, making it easier for developers to create and experiment with deep learning models.Keras was originally developed as a user-friendly interface for building neural networks on top of Theano and TensorFlow. However, since version 2.4.0, Keras has been integrated as a part of TensorFlow itself, making it the default high-level API for building and training deep learning models with TensorFlow.One of the key features of Keras is its simplicity and ease of use. It allows developers to define neural network architectures using just a few lines of code, making it easy to experiment with different models and parameters.

  Keras also provides a wide range of pre-built layers and models that can be used to build more complex architectures.Keras supports both CPU and GPU acceleration, allowing developers to leverage the power of GPUs for faster training of neural networks. It also supports distributed training, making it easier to scale training across multiple machines.

- **Matplotlib :** Matplotlib is a widely-used open-source library for creating visualizations and plots in Python. It provides a range of functions for creating a variety of plots, including line plots, scatter plots, bar plots, histograms, and more.

  One of the key features of Matplotlib is its flexibility and customizability. Matplotlib allows users to customize nearly every aspect of a plot, including the plot type, color scheme, axis labels, and font size. This makes it a powerful tool for creating professional-looking visualizations and data presentations.

  Matplotlib also has a wide range of built-in features for handling common data visualization tasks, such as handling dates and times, creating subplots, and adding annotations to plots. Additionally, Matplotlib is designed to work seamlessly with

other Python libraries for scientific computing, such as NumPy and Pandas.

One of the downsides of Matplotlib is that it can be complex to use, particularly for beginners. However, there are many resources available online, including tutorials and documentation, that can help users get started with the library.

Overall, Matplotlib is a powerful and flexible library for creating data visualizations and plots in Python, making it a popular choice for data analysts and scientists.

- **Sklearn:**Scikit-learn (also known as sklearn) is a widely-used open-source machine learning library for Python. It provides a range of tools and algorithms for building and training machine learning models, including classification, regression, clustering, and dimensionality reduction.

  Scikit-learn provides a simple and consistent API for working with machine learning models, making it easy to experiment with different algorithms and hyperparameters. It also includes a range of utility functions for data preprocessing, feature selection, and model evaluation.

  One of the key advantages of Scikit-learn is its ease of use and accessibility. The library includes a range of pre-built machine learning models and datasets, making it easy for beginners to get started with machine learning. Additionally, Scikit-learn integrates well with other scientific computing libraries in Python, such as NumPy and Pandas.

  Scikit-learn also includes a range of advanced machine learning algorithms and techniques, including ensemble methods, kernel methods, and deep learning. The library is actively maintained and updated, with new algorithms and features being added regularly.

  Overall, Scikit-learn is a powerful and user-friendly library for building and training machine learning models in Python, making it a popular choice for data analysts and scientists.

- **Seaborn:** Seaborn is a Python data visualization library based on Matplotlib. It provides a high-level interface for creating more visually appealing and informative statistical graphics than Matplotlib, while also being easy to use and customize.

  Seaborn provides a range of functions for creating various types of plots, including scatter plots, line plots, bar plots, and histograms. Additionally, Seaborn includes specialized plots for statistical analysis, such as distribution plots, regression plots, and factor plots.

  One of the key features of Seaborn is its ability to easily create complex and informative visualizations with just a few lines of code. Seaborn's default color palettes and plot styles are designed to be visually appealing, and the library also includes options for customizing colors, fonts, and other design elements.

Another advantage of Seaborn is its integration with Pandas data structures. Seaborn can directly plot data stored in Pandas DataFrames, making it easy to create visualizations directly from data without the need for additional data preparation.

Overall, Seaborn is a powerful and user-friendly data visualization library that is especially useful for exploring and visualizing complex datasets. Its high-level interface and built-in statistical functionality make it a popular choice for data analysts and scientists.

- **PIL:** PIL (Python Imaging Library) is a third-party library for Python that adds support for opening, manipulating, and saving many different image file formats. PIL provides a range of image processing capabilities, including resizing, cropping, rotating, and transforming images. It can also apply various filters to images, such as blurring, sharpening, and enhancing contrast.

  The original PIL library has not been updated since 2011, but a fork of the library called Pillow has been developed, which is actively maintained and updated. Pillow is compatible with Python 2 and 3, and it can be installed using pip.

  One of the advantages of using PIL/Pillow is its ease of use. The library provides a simple and consistent interface for working with images, making it easy to perform common image processing tasks. PIL/Pillow can be used for a range of applications, such as resizing images for web pages, creating thumbnails, and processing images for machine learning applications.

  PIL/Pillow also provides support for working with more complex image formats, such as animated GIFs and multi-page TIFFs. Additionally, the library can be extended through plugins to support additional image file formats and image processing capabilities.

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Conclusion

Age and gender detection using Convolutional Neural Networks (CNN) has been a successful approach for automated face recognition and analysis. CNN models are trained on large datasets of labeled images, and they learn to extract relevant features from faces, which are then used to predict the age and gender of a person.Age and gender detection using CNNs has several applications, including security systems, marketing, and healthcare. For example, it can be used to identify underage individuals in restricted areas or to analyze customer demographics in retail environments.

Bibliography

[1] CNN architecture from GeeksforGeeks

A

Glossary

A.1   List of Notations Used

- **CNN :** Convolutional Neural Network

- **DFD :** Data Flow Diagram

- **UML :** Unified Modelling Language

- **GUI :** Graphical User Interface

- **SSD :** Solid State Drive

- **HDD :** Hard Disk Drive

- **API :** Application Programming Interface