Research methods

Gender and Age Detection with Data Science

**Group 61**

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# Chapter 1: Introduction

Age and gender help to represent the facial attributes, which play a very foundational role in social interactions. Not only that, it will help to make age and gender estimation with a single face image an important task of intelligent applications to control access, human-computer interaction, law enforcement, visual surveillance, market intelligence, and more (Yu et al., 2019). In this context, the study aims to analyze gender and age detection via data science technologies. Under this, the dataset would be studied using deep learning, and one would build the gender and age detector that could approximately guess the age and gender of a person into the picture while using deep learning. The research area of age and gender detection while using deep learning-based CNN technology appears to be the active area of the study that has put a lot of effort into contributing towards the quality of analyzing the datasets. I tried to duplicate the technique using common tools. The usefulness of the method depends on a variety of variables. However, the main purpose of the investigation is to keep the algorithms as straightforward as possible while maintaining the greatest degree of reliability. Later enhancements will get rid of features from non-human things, expand the databases for individuals from other racial and ethnic backgrounds, and give machines more precise workflow management. This working example can more accurately determine a person's age and gender by analyzing a single photograph of their face using CNN data mining techniques.

# Chapter 2: Background

Gender and age represent the human identification that helps to play the main role in human communication. Further, Bisio *et al.* (2013) stated that it represents the detection system of two phases that includes gender detection as well as age. The structure is categorized into three parts, including gender estimation, face detection and age guesstimate. Face detection is used to localize the faces in the image, which represents the quite challenge due to various reasons such as environment, lightning, orientation, movement and facial expression. These lead to variations including shadow, colour, luminance and image contours. In the actual world, some male females may look the same gender and which represents the errors. At the same time, some people look youthful or more adult than their real age, leading to the differences between apparent age and real age. These attributes while identifying the colour image of the human face include hair on the face, height, weight, tattoo marks and facial attributes. Further, all the required information can be collected through this database to determine or identify. However, Shaker and Al-Khalidi (2022) identify there are some of the challenges that occur in computer-based facial gender and age estimation. People classification while depending on the persons who contain different signs and characteristics to classify those persons. The features of a facial image consisting the facial features region of nose detection, lip detection, beard, moustache, left-right eye position and skin wrinkle analysis and eyebrows that also helps with gender recognition. This is identified that the female eyebrows are thinner, longer and curly at the ends. On the other hand, male eyebrows are mismanaged as well as thicker. Age and gender detection are predicted on the basis of the facial geometric feature called attributes. Further, the FG-NET databases represent the publically accessible database that is broadly utilized for the evaluation. Figure 1 helps to describe the key points or landmarks, which include the eye, nose and mouth. Then figure 2 below contains some kinds of images from FG-NET databases.

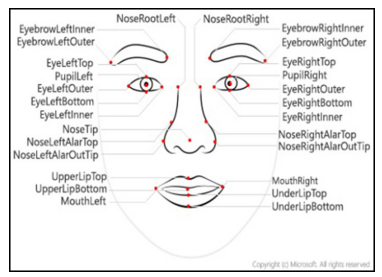
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Figure 1: Facial landmarks.

Source: (Shaker and Al-Khalidi, 2022)

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Figure 2: Some example of images from the FG-NET Aging database.

Source: (Shaker and Al-Khalidi, 2022)

Further, the goal of gender and age detection utilizing deep learning research is to precisely determine a person's gender and age with an individual facial image. It has been extensively studied how to determine age and gender from photographs. Throughout the years, various approaches have been used to solve this problem. Predictive age and gender identification through face pictures has been receiving a lot of curiosity given its broad range of potential uses in several facial analyses. With the use of the technologies listed above, experts can identify the gender and age of an individual from only one video or photograph. The use of the convolutional neural network with deep learning techniques and the way everything works collectively for gender categorization and age detection will all be discussed in this research. Thus, automatic face recognition and prediction of gender and age utilizing algorithms that learn from data have drawn a lot of attention over the past ten years and have grown in popularity as a result of the vast availability of facial photos on the globally vast Web, particularly on social media.

## 2.1 Problem domain

The predictions of age and gender for unfiltered real-world facial images classify the unconstrained real-world facial images into the predefined ages and genders due to their value in intelligent real-world applications. However, as per Sheoran *et al.* (2021), just because the traditional methods on unfiltered benchmarks provide that inefficiency in handling the large degree of variation in the unconstrained images, Also, there has been a growing interest in the automatic age and gender prediction of a person who is using facial images. Just because of the superior performance, the Convolutional Neural network-related approaches have been widely used in the current job classification and have good quality performance in the facial analysis.

# Chapter 3: Research Question

In individuals of various age groups, how are the age and gender estimated using data science techniques in deep learning-based CNN technique and compared to the traditional methods for age and gender estimation using automatic face recognition?

## 3.1 Search string

The search string is a group of exact words or phrases used to focus a search in a database or search engine to find relevant articles for a certain research topic. In this case, the search string for the article titled "Gender and Age Detection with Data Science" would look like this:

"IEEEXplore" OR "IEEE digital library" AND "Age Estimation" AND (published within "2013-2023") OR "CNN", "gender detection", "gender classification", "deep learning", "Face Detection", "Face Recognition" OR "Machine Learning".

Due to the particular requirements and conditions of the search string, only relevant papers from the IEEEXplore digital collection, published during the last ten years, and written in English are taken into account. Additionally, the search gives high priority to material that primarily corresponds to the keywords related to age estimation, CNN, deep learning, gender detection, gender classification, face detection, face recognition, and machine learning. Using this targeted search phrase, the publications that fulfil the study's inclusion and exclusion criteria, as well as its research topics of interest, are located.

## 3.2 Inclusion/exclusion criteria

The inclusion and exclusion criteria help identify the study population in a consistent, reliable, objective, or uniform manner. The exclusion criteria, while including the factors or characteristics that help to make the study's recruited population intangible, Further, in accordance with this study, only relevant articles on IEEEXplore digital library-based topics are heavily focused. Only English-language-based papers were selected during this research, and no other language-based papers were included in this study. Only those papers were selected that were published in the last 10 years. Those papers that are majorly focused on the keywords of Age Estimation, CNN, deep learning, gender detection, gender classification, Face Detection, Face Recognition, or ML/machine learning were selected for this research.

# Chapter 4: Literature Review

Gender, age, and emotion recognition from speech are crucial for both human-machine and human-human interactions. In order to determine age, gender, and emotion from audio snippets for research purposes, among other things, Zaman *et al.* (2021) claim that categorizing audio based on age and gender is vital. Telecommunications companies typically use audio call analysis to predict client demographics and offer personalized recommendations. Although researchers have looked into detecting these traits from various sources, few studies employ a single source to determine gender, age, and emotion. Much attention has been given to computer vision, particularly in face identification, detection, and localization of facial landmarks, as noted by Al-Shannaq and Elrefaei (2019). Age, gender, and ethnicity are significant characteristics quickly discernible from a person's face. Classifying the image into a particular age range is necessary for age estimate (A.E.) using face images. This job continues to be difficult because of internal characteristics, such as gender and race, and external characteristics, like settings and lifestyle. Various facial patterning patterns have been considered to create a reliable age assessment system. The steps in ageing a photograph using facial features are face identification and location, extracting pertinent characteristics, feature vector development, and image classification. This technique is required since age estimation is one of the auxiliary soft biometrics that enhances our understanding of users' identities. These details can be used in addition to basic biometric traits like the face, fingerprint, and iris. Raw/aligned face pictures taken after face detection are commonly used in gender classification methods. These methods function well in constrained settings with consistent lighting and locations. However, they struggle when applied to real-world data with a wide range of positions and occlusion, reducing classification accuracy. Cheng *et al.* (2019) recommend Convolutional Neural Networks (CNNs) trained on particular preset patches with varied resolutions and partial cropping as a solution to this issue. The decisions of the CNNs are then pooled by a majority vote to classify gender appropriately. However, because landmark points are displayed wrongly, this system continues to be less accurate. Identifying gender, age, and emotion from speech and face imagery is crucial for many applications. Despite major advancements, problems still exist, particularly when processing diverse and real-world data. Further developments could improve the accuracy and resilience of tasks involving gender classification and age prediction in machine learning techniques, notably CNNs.

# Chapter 5: Conclusion

Gender and Age Detection with Data Science refers to applying data science techniques, particularly machine learning and deep learning algorithms, to identify and determine the gender and age of individuals from a range of data sources, most typically facial pictures or voice recordings. In addition, it examines the value of gender and age detection from speech and facial images in various applications, such as market intelligence and human-machine interaction. The research aimed to look at gender and age detection using deep learning technologies, especially Convolutional Neural Networks (CNNs). The study discusses the challenges of accurately estimating an individual's age owing to internal and external factors, including gender, race, environment, and lifestyle. The research has developed algorithms for determining gender and age from facial images, but accuracy has to be increased by accounting for variations in real-world data. The study highlights the potential for automatic facial identification using data-driven algorithms, gender and age prediction, and so on.

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