International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

Age and Gender Classification using Convolutional Neural Network

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Abstract - Due to its numerous applications in various facial analysis challenges, automatic prediction of age and gender from face images has received a lot of interest recently. The available models, however, are still below theneeded accuracy level, which is required for the usage of these models in real-world applications due to the significant intra-class variance of face images (such as difference in lighting, position, scale, and opacity). In this study, we offer a classification model that can accurately identify the gender and age range of facial images using convolutional neural networks

Key Words: Convolutional Neural Network, Machine learning, Age classification, Gender Detection.

1. INTRODUCTION

Age, gender, mood, and other characteristics can all be inferred from a person's face. Numerous dynamic aspects that alter over time, such as age, hairstyles, expressions, etc., have an impact on it. Age and gender are regarded as crucial biometric characteristics for identifying humans. For the purpose of human identification and verification, biometric recognition gathers data on a person's physiological and behavioral traits (security models). Age, gender, ethnicity, height, and face measurements are examples of soft biometrics. Hardbiometrics are measurements of the body (physical, behavioral, and biological). To speed up data traversal or to categorize unlabeled subjects for different gender and age groups, soft-biometric features can be retrieved, such as skin color, hair color, the distance between the eye and nose,facial shape, etc.

Additionally, with the ubiquitous use of computers,biometric identification is becoming more and more necessary in sectors like healthcare and home automation. Through pattern recognition, computer vision, and picture analysis, it has recently become possible to automatically determine one's physical presence and verify their identification. Age is one of the biometric characteristics taken into account. Numerous factors, including DNA alteration, metabolic changes, sun exposure, variations in face tissues, reorganization of the facial bones, and others, contribute to aging. The aging of the face has a negative impact on facial recognition systems. This concept is crucialto the new fields of computer vision research that will be investigated.

1.1 Overview with Problem Statement

With the expansion of real-world applications has expanded day-to-day living, researchers have shown more interest in the soft biometrics sector to close the communication gaps between humans and machines. Age, gender, ethnicity, height, face dimensions, and other soft biometrics are included.

Machines cannot classify patterns as effectively and powerfully as the human brain can. Therefore, our goal is touse technology to imitate the ability of the human brain to determine a person's age and gender. This problem can be solved by developing an application for age and gender detection that can accurately determine a person's age and gender. The age and gender of the person are determined by using their human face as the input. The person's age and gender are the output.

1.2 Challenges and Applications

Age estimation and facial gender classification provide numerous difficulties. Two classes that can be either male or female are subject to gender prediction. While a machine cannot easily classify gender, a human can. Numerous methods and models have been criticized for gender classification based on extra data from hairstyles, body shape, attire, and facial traits. As of now, it is not possible to determine actual age while estimating age. In order to determine age from facial photos, age grouping is still used.Additionally, there aren't enough high-quality datasets for estimating age and classifying gender to support extensive research.

Partial occlusions and poor-quality photos are the most frequent issues when it comes to face detection or age/gender classification. Due to the model's limited data set and difficulty in making predictions, these directly affect the outcome findings. When a human is making the forecast,the same rules still apply. It is more difficult for a human to comprehend what is being viewed in a low-quality image and, as a result, to predict the future.

Age recognition is important in police investigations and intelligence departments because it aids in locating the actual suspect based on his age. They may receive a filtered result of that person who has committed a criminal act or any other activity. When it comes to software, the actual and predicted ages are roughly the same, indicating its dependability, and this dependability serves as a trust factor for many other useful operations in daily life.

We propose a scheme in this paper to bridge the gap between automatic face recognition and age and gender prediction. When there is a large-scale improvement in face recognition, a link between face recognition and Convolution Neural Network (CNN) is proposed, and by studying it further, we created a system in which a limited number of face data sets are used to accurately predict ageand gender.

2. SYSTEM ANALYSIS AND DESIGN

2.1 Machine learning techniques:

The various machine learning approaches utilized for categorization and implementation in this system are covered in this section. The optimal model for the system has been determined by comparing the results of all of these models.

Deep learning techniques for computer vision:

In recent times, deep learning techniques proved to be a big success in the Computer Vision discipline. Deep learning enables multi-layered computing models to determine and interpret data with multiple abstraction levels and imitates how the information is perceived and translated by the brain. So, it implicitly captures large-scale data structures. Deep learning has outperformed many of the previously existing techniques. Deep learning has enabled various techniques in computer vision to increase accuracy and efficiency, which includes object detection, action recognition, human emotion recognition, and others. Further, types of deep learning techniques will be discussed with their comprehensive details.

Convolutional Neural Networks(CNN):

Convolutional Network Network (CNN) was first proposed in 1962, and it consists of the following layers.

- Convolutional Layer: As it is known that CNN utilizes various kernels, so the convolutional operation of the layer increased the learning time of the developed model.
- Pooling Layers: It reduces the spatial dimensions of the input volume for the next convolutional layer. It only affects the length and height, and not the depth.
- Fully connected Layers: Several connected neural network layers have been used to perform any high-level reasoning.

There are some difficulties that might also arise with CNN, such as overfitting, which is due to the CNN training of a large number of parameters. The solution to it is the pretraining of parameters, which accelerates the learning process of the model as well as improves the generalising capability of the model. In short, CNN has outperformed the usual and traditional machine learning algorithms.

3. IMPLEMENTATION

Python programming language, as well as numerous computer vision and machine learning packages and libraries, will be used throughout the research implementation. The primary goal of the project will be to create a Python-based, Tensorflow-compatible high-level convolutional neural network API. Python, in and of itself, is a high-level programming language. Python is open-source, object-oriented, and has simple readability and coding. Because it contains so many packages, it is widely used in Big Data, Machine Learning, and Computer Vision. Furthermore, Python was chosen for this experiment because it is free to use, compatible with the Windows operating system, and contains all of the necessary librariesfor face recognition, emotion detection, and gender classification.

Face identification consists of three steps. Detect which part of an image is the face, then train our classifier for that dataset of images, and finally, predict the face. OpenCV, a Python open-source library for computer vision, will be used for this. A Haar cascade frontal face default classifier will be used for face detection, which is a pretrained model that is freely available online. A default Haar classifier will be used for gender and age prediction. The first step will be to detect the face in the image using some test images. All of the images used in the training are freely available online and open-source.The entire experiment will be implemented in Keras with Tensorflow as the backend. The entire Convolutional Neural Network will be built on these, as well as the OpenCV computer vision library. Keras can determine whether the model's current epoch outperformed the previously saved epoch. In this case, the best model weights will be saved in a file that will allow the weights to be loaded directly without retraining if the model needs to be used in another

situation. Keras has modularity, extensibility, and Python nativeness when compared to other similar libraries.

Gender identification is the process of determining whether a person is male or female. It is a binary model because there are only two options: male or female. The primary libraries for Gender Classification are OpenCV and Keras.

4. RESULTS

By analyzing human facial features in real-time, this model can predict ages ranging from 0 to 80 and classify genders as Male or Female. Because the model predicts age in real-time, it is subject to change with each webcam frame.

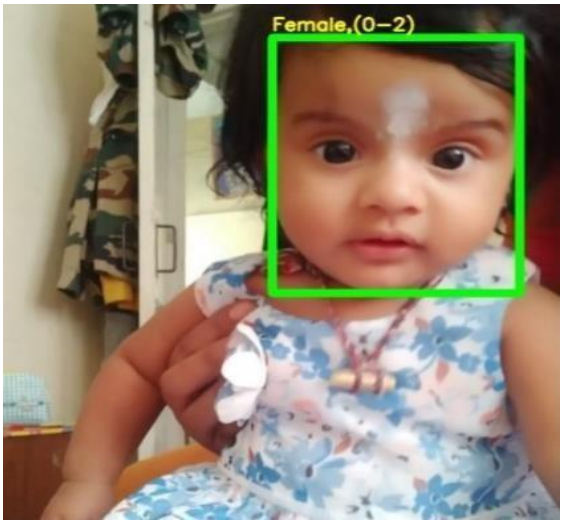

Figure 1: Age and Gender prediction of age range 0-2

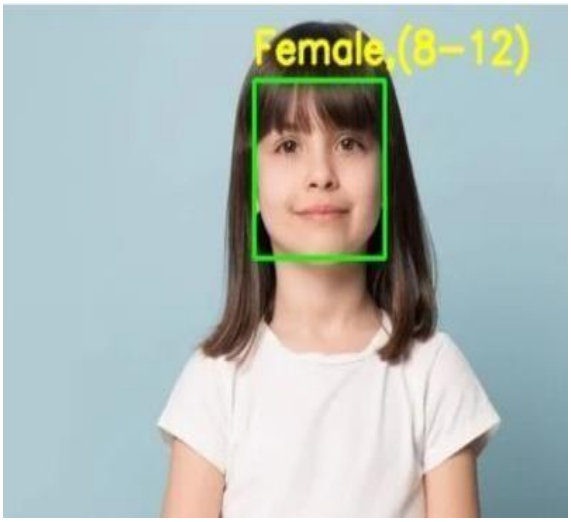

Figure 1: Age and Gender prediction of age range 8-12

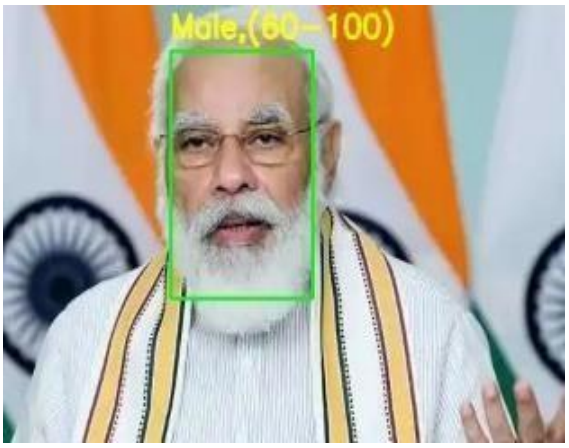

Figure 1: Age and Gender prediction of age range 60-100

Figure 1,2 and 3 shows the prediction results of the developed model.

5. CONCLUSIONS

A thorough literature review of various Machine Learning and Deep Learning techniques is used to discuss all of the techniques and methods that have already been implemented in this field. Facial images have become increasingly important in recent decades, owing primarily to their promising real-world applications in a variety of emerging fields. The proposed system is capable of classifying gender as either male or female and predicting age from 0 to 80.

The model's accuracy is calculated separately to provide a more accurate comparison and interpretation of the study. The proposed architecture was built methodically to improve accuracy and reduce the number of parameters. Gender classification and age prediction have been manually tested, and the results have been astounding. Because gender classification is considered a binary problem in this study, it has proven to be very efficient with the use of Keras and achieves an overall accuracy of about 90%. Age prediction is affected by a variety of external factors, including lighting effects, facial expressions, and skin tones, but it also produces impressive results.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to Prof. Suhasini, who served as our project advisor. Prof. Suhasini directed us through this project, offered us important advice, and helped us develop it beyond our expectations. Second, we would like to express our gratitude to Dr. Ranjith K N, our project coordinator, for her ongoing support and assistance in helping us for

completing this project within the allotted time. Additionally, we would like to extend our sincere gratitude to our department's head, Dr. Ranjith K N, for giving us access to a platform where we can attempt to work on project development and illustrate the real-world applications of our academic curriculum. We would like to thank Dr. Y T Krishne Gowda,our principal, for giving us the chance to complete this wonderful project on the topic of "Age and Gender Classification Using Convolutional Neural Network." This project has also assisted us in conducting extensive research and learning how to implement it.

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