FACE VISION : Real Time Age and Gender Prediction

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Abstract - *This study introduces a robust system for age and gender detection from facial images using a fine-tuned convolutional neural network (CNN). The proposed approach leverages advanced deep learning techniques to extract comprehensive features and perform precise classification tasks. The system's application extends to social media platforms, where it plays a crucial role in delivering targeted advertisements and marketing campaigns, thereby maximizing their outreach and effectiveness.*

The rapid evolution of face recognition technology necessitates continuous exploration and refinement to achieve higher accuracy and applicability across various domains. Model: 'gender_net.caffemodel'. This is the pre-trained model file for the gender classification model. By integrating cutting-edge deep learning methods with practical use cases like social media marketing, this research contributes to advancing facial recognition technologies. The findings from this study facilitate enhanced user experiences and enable more tailored content delivery strategies, thus driving innovation in digital marketing and personalized advertising.

This study introduces a robust system for age and gender detection from facial images using a fine-tuned convolutional neural network (CNN Model: 'gender_net.caffemodel'. This is the pre-trained model file for the gender classification model.

This system comprises essential stages such as face detection, alignment, and feature extraction, leading to accurate predictions of age and gender. Experimental results demonstrate consistently high accuracy rates, underscoring the effectiveness and practicality of the proposed approach for real-world applications.

Key Words: CNN(Convolution neural network), Age Prediction, Gender Prediction, Biometric System, Face Detection

1.INTRODUCTION

Human gender and age are regarded as crucial biometric characteristics for identifying individuals. The method of detecting a person's gender and age based on facial recognition in an image is known as age and gender prediction. Real-time facial characteristic recognition is a very interesting area for future research.

Gender and age are two characteristics that are essential to our social lives. According to recent study, the effectiveness of age rating based on face images has significantly improved due to the deep learning of aging characteristics from large amounts of data. With the advent of social networks and social media, automatic age and gender detection has become crucial for an increasing variety of applications[1].

In the past, many methods were proposed to begin face recognition such as the eigenface analysis, Fisher face analysis, independent component analysis (ICA), tensor face analysis, and their extensions. Furthermore, gender identification will shield users from cyberbullying and stop shady users from making fictitious social media profiles. Furthermore, social networks will be able to show content that is likely to appeal to that particular group thanks to an automated age and gender forecast [1].

Our study contributes to the ongoing efforts to refine facial recognition technologies, with a particular focus on age and gender prediction. By harnessing pretrained models and a carefully curated dataset, we aim to develop a highly accurate and efficient model that can be deployed across various domains, including security, personalized content delivery and marketing strategies.

In this paper, we attempt to propose a paper validator based on automatic age and gender distribution using CNN to identify gender and age diversity in user images and evaluate it using a dataset of real-life images.

2. RELATED WORK

Researchers have been trying to determine and estimate age and gender for a long time. They were able to do this by applying a range of deep learning strategies intended to improve the accuracy and precision of determining age and gender from human images. Many deep learning techniques were used for face identification, face recognition, age estimate, and gender detection and recognition. With the use of neural networks, these techniques examine patterns, textures, and facial traits to produce predictions that are more precise and detailed. These models have become more complex as technology develops, opening up new possibilities for applications in fields like healthcare, security systems, and targeted marketing.

2.1 Face Detection

For a long time, researchers have been attempting to identify and estimate gender and age. They achieved this by utilizing a variety of deep learning techniques designed to increase the precision and accuracy of estimating gender and age from human photos. For face identification, face recognition, age estimation, and gender detection and recognition, numerous deep learning methods were employed.

Several face detection algorithms have been proposed and widely utilized in the field of computer vision. One of the pioneering algorithms is the Viola and Jones algorithm, which utilizes rectangular boxes to detect faces.

2.2 Age and Gender Classification

Facial recognition is an early step in estimating age and gender. Extract the region of interest(ROI) on the face and use age detection algorithms. Many studies have investigated age and gender differences using deep learning algorithms and image analysis techniques. A deep learning model is used to predict age and gender prediction based on facial images[2].

We continue to use CNN to extract powerful features from the images, and then continuously explore age and ranking-based estimation method, and then propose divide-and-conquer facial age estimation. Abdullah M. Abu Nada used the new OpenCV library to predict user age and gender using Caffe's deep learning program.

Syed Taskeen Rahman, Asiful Arefeen developed their own database, named BUET facial database, comprises of 400 samples. It consists of 243 unique images of male and 157 unique images of female[3]. The process involved facial images of a notable range of demographic. Different lighting conditions are used for the demonstration, and MATLAB 2016a is used as the simulation tool.

By employing various strategies and procedures that are detailed in these models, all of the previously suggested models are employed to obtain an accurate age result and serve as a standard for age estimates.

Implementing such technology not only enhances user experience by providing personalized content but also offers valuable insights for targeted advertising and content delivery on social networks.

3. METHODOLOGY

With this method, we analyze the image using a dataset and preprocess it by doing things like feature extraction, image alteration using the CNN algorithm, and image pre-processing.

I. Face Detection Preprocessing:

Preprocessing steps are essential for preparing the input data for accurate face detection, age prediction, and gender prediction[4]. Proper preprocessing ensures that the input data is appropriately formatted, scaled, and normalized to meet the requirements of the underlying models, facilitating optimal performance during inference[5], [6].

II. Model Selection:

As the data is prepared by this step, we are now ready to perform the crucial step of model selection according to the requirement[7]. There are various models present which are capable of image processing like CNN which basically works on image classification, object detection, and image segmentation.

III. Feature Extraction:

The process of obtaining meaningful information or features from raw image data. Important patterns, structures, or other aspects of the image can be captured by these extracted features, and they can then be utilized for a variety of tasks like object detection, image retrieval, and image classification [8].

IV. Age and Gender Prediction:

To forecast the age and gender of the people portrayed in the facial photos, the pre-trained CNN models are fed the processed features.

V. Post processing:

Interpret the predictions obtained from the pre-trained models to extract meaningful insights and information about the age and gender distributions within the analysed dataset or images. Visualize the predicted age and gender labels on the facial images or generate summary statistics and visualizations to present the prediction results effectively.

VI. Evaluation and Validation:

Ensure the quality and consistency of the predictions across different images, datasets, and scenarios to validate the robustness and generalization capability of the pre-trained models.

We'll learn about the CNN model, as we will be using CNN model for this particular research topic.

1) Convolutional Neural Network (CNN)

CNN stands for Convolutional Neural Network, a type of deep neural network commonly used for computer tasks such as image recognition, object detection, and

image classification. The structure of an animal's visual cortex serves as an inspiration for CNNs, which extract and modify the feature learning hierarchy from input images. They have revolutionized the field of computer vision and are a fundamental technology behind many advanced AI applications. These networks excel at capturing spatial hierarchies and patterns in visual data, making them esential tools in modern machine learning.

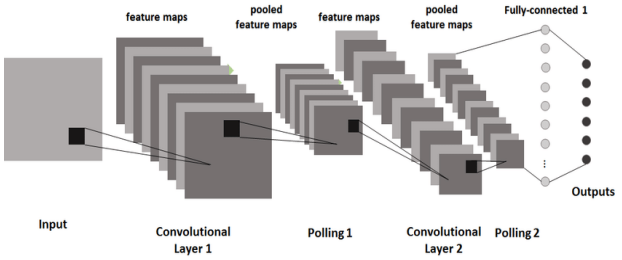

Fig -1: Convolutional neural network architecture

- **Convolutional Layers**: CNNs consist of several layers, including layers that apply convolution operations to the input image. Layers use learned filters (kernels) to extract features from the input image by sliding the filters over the image and performing summation and contrast[6], [9].

- **Pooling Layers**: Pooling layers are usually placed in convolutional layers. They aggregate data within small regions to sample the feature maps derived from convolutional layers. Common pooling operations include max pooling and average pooling, which stores the maximum or average value in each pooled field.

- **Activation Functions**: For the output of the convolutional and pooling processes, an activation function called ReLU (Rectified Linear Unit) is employed to add nonlinearity into the network, enabling the relationship between components to be investigated.

- **Fully Connected Layers:** CNNs often have one or more layers after the convolutional and pooling layers. By establishing connections between each neuron in one layer and every other layer's neuron, these layers facilitate high-level representation and categorization.

- **Training**: CNNs are typically trained using supervised learning, where the network learns to map input images to corresponding labels or categories. Stochastic gradient descent (SGD) and its variants are optimization methods that are used to obtain training through backpropagation., which adjust the network's parameters (weights and biases) to minimize a loss function that measures the difference between predicted and true labels[10].

3. LITERATURE REVIEW

In recent years, age and gender estimation from facial images has attracted great attention due to its widespread use in various fields such as security, business and communication of personal information. Many studies have investigated various methods and techniques to achieve accuracy and reliability[11]. An important method is to use Convolutional Neural Networks (CNNs) to perform age and gender estimation tasks. CNN has shown excellent performance in image analysis tasks by leveraging its ability to automatically extract hierarchical features from facial data[12]. Liu et al. (2015) demonstrated the effectiveness of CNN in age estimation, achieving accuracy across various age groups. Additionally, the combination of facial features shapes improves the age and gender prediction model[13]. Researchers such as Liang et al. (2017) and Zhang et al. (2019) used a geographic approach combined with machine learning algorithms to achieve accurate age and gender classification.

TABLE 1. Literature summary

SR NO.	NAME OF THE PAPER	AUTHOR	SUMMARY
1.	Human age and gender classification using convolutional neural network	Mohammed Kamel Benkaddour , Sara Lahlali, Maroua Trabelsi	CNN system that predicts gender and estimates age from face images and videos, showing better results than previous methods on datasets like IMDB and WIKI.
2.	Age and Gender Prediction and Validation Through Single User Images Using CNN	Abdullah M. Abu Nada, Eman Alajrami, Ahemd A. Al-Saqqa, Samy S. Abu-Naser	The need for accurate age and gender data in form validation, proposing a Deep Learning and CNN-based method.
3.	Facial Image Classification Based on Age and Gender	Thakshila R. Kalansuriya, Anuja T. Dharmaratne	Addressing lighting and wrinkle variations for robust classification.
4.	Age Estimation from Facial Images based on Hierarchical	Imed Bouchrika, Nouzha Harrati,	Uses local binary patterns to estimate age

	Feature Selection	Ammar Ladjailia and Sofiane Khedairia	ranges from facial features.
5.	A Study on Face Recognition Techniques with Age and Gender Classification	Sandeep Kumar, Sukhwinder Singh, Jagdish Kumar	Face recognition techniques for age and gender prediction, evaluating performance, suggesting future research directions in biometrics.

4. IMPLEMENTATION

In this section, the actual implementations which we carried out in this research is described.

4.1 Libraries Used

The following are the libraries used:

Sklearn – for creating CNN model.

NumPy, Pandas, Matplotlib –for mathematical operation.

TensorFlow – for machine learning models.

OpenCV – Object detection and image processing.

Keras – for implementation of neural networks.

Tkinter–for constructing basic graphical user interface (GUI) applications.

Tkvideo – for playing videos in GUIs created with tkinter.

4.2 Model Selection

1. Face Detection Model :
   a. Model Name: OpenCV Face Detector
   b. Files:
      i. Prototxt:'opencv_face_detector.pbtxt'. This is the prototxt file for a face detection model using the OpenCV Deep learning module.
      ii. Model:'opencv_face_detector_uint8.pb'. This is the pre-trained model for the face detection model.
2. Age Estimation Model :
   a. Model Name: AgeNet
   b. Files
      i. Prototxt: 'age_deploy.prototxt'. This is the prototxt file for an age estimation model.
      ii. Model: 'age_net.caffemodel'. This is the pre-trained model file for the age estimation model.
3. Gender Classification Model :
   a. Model Name: GenderNet
   b. Files:
      i. This is the prototxt file for a gender classification model.
      ii. Model: 'gender_net.caffemodel'. This is the pre-trained model file for the gender classification model.

4.3 Datasets

The research leverages the IMDB-WIKI dataset, a comprehensive collection of over 500,000 facial images sourced from IMDb and Wikipedia, encompassing a diverse range of ages and including both age and gender annotations. The age annotations are provided as birth and photo taken years, enabling accurate age estimation, while the gender labels are binary, specifying whether the individual in the image is male or female. The age and gender classification models utilized in this research, namely 'age_net.caffemodel' and 'gender_net.caffemodel' are trained on this dataset, serving as the foundation for the age and gender classification tasks.

4.4 Data Preparation

In this stage, we leverage intuitive functionalities to prepare the facial images for age and gender detection. This includes image preprocessing techniques such as resizing, normalization, and alignment to enhance the accuracy of our predictions[14]. These operations are seamlessly performed using OpenCV and other libraries, providing us with essential tools for tasks like image resizing, pixel normalization, and facial feature extraction[12]. These libraries offer built-in functions that streamline the process of preparing facial data for age and gender estimation, ensuring robust and reliable results.

4.5 Feature Extraction

In this age and gender detection model focused on facial images, we used advance techniques such as OpenCV and deep learning to extract essential facial features crucial for accurate classification[8]. This process involves identifying key facial landmarks, analyzing texture variations, and capturing color distributions within facial regions. By leveraging these diverse features, this system can categorize individuals into specific age groups and accurately classify gender attributes. The broad availability of this screening method increases the accuracy and reliability of our predictions, making it ideal for many

applications that require public and technical analysis validation.

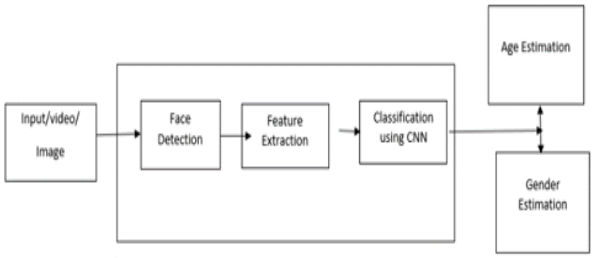

Fig -2: Age and Gender Prediction Model

5. RESULT

Our project focuses on a desktop application designed specifically for detecting age and gender from facial images. We've used advanced deep learning techniques to create a tool that's both accurate and easy to use. Through testing, we've proven its reliability, showing that it can quickly and accurately estimate age and classify gender in real-time. Our user-friendly interface makes it accessible to people with varying levels of technical expertise. This project highlights the practical applications of artificial intelligence, showing how it can benefit industries like security, marketing, and more. Moving forward, our application reflects our dedication to innovation and excellence in deep learning. The output of Face vision application is shown below.

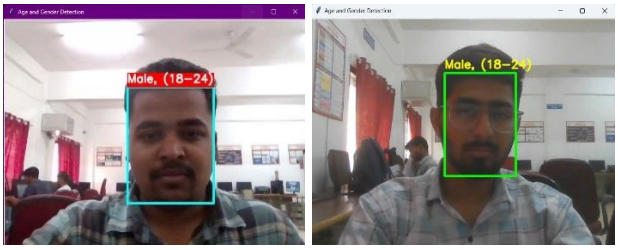

Fig -3: Result of Face Vision Application

6. CONCLUSION

Our study contributes to the ongoing efforts to refine facial recognition technologies, with a particular focus on age and gender prediction. By harnessing pretrained models and a carefully curated dataset, we aim to develop a highly accurate and efficient model that can be deployed across various domains, including security, personalized content delivery, and marketing strategies.

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