DEEP LEARNING BASED GENDER AND AGE PREDICTION FROM FACIAL IMAGES

[1]B Anil, [2] Lambu Alekhya, [3] Sreekanth Mare, [4] Yelagandhula Venkatesh
[1]AssistantProfessor, [234]Students
Department of Computer Science & Engineering
Siddhartha Institute of Technology & Sciences, Narapally
badaralaanil_cse@siddhartha.co.in, 23TQ1A0504@siddhartha.co.in, 23TQ1A0505@siddhartha.co.in, 23TQ5A0513@siddhartha.co.in,

Abstract

Age and gender prediction from facial images has emerged as a significant application in the field of computer vision and deep learning. This project proposes an automated system that detects human faces in images and accurately predicts both age and gender using advanced deep learning techniques. The system is built using a Convolutional Neural Network (CNN), which is highly effective in extracting meaningful features from facial images.

Initially, the input images undergo preprocessing steps such as resizing, normalization, and face detection to ensure consistency and improve model performance. The processed images are then passed through multiple convolutional and pooling layers to capture essential patterns related to facial structure, texture, and appearance. These extracted features are further processed through fully connected layers, where gender classification is performed as a binary classification task and age prediction is treated as a regression problem.

The model is trained on a labeled dataset of facial images and evaluated using validation data to assess its accuracy and generalization capability. Experimental results demonstrate that the proposed deep learning model can effectively analyze facial characteristics and produce reliable predictions for both age and gender.

I. Introduction

Automatic analysis of human facial images has become a prominent research area in the fields of Computer Vision and Deep Learning. With the rapid advancement of artificial intelligence technologies, modern systems are now capable of extracting meaningful information from images, including facial expressions, identity, age, and gender. Among these applications, age and gender prediction from facial images plays a crucial role in various real-world domains such as security surveillance, demographic analysis, human–computer interaction, targeted advertising, and access control systems.

Traditionally, age and gender estimation relied on manual feature extraction techniques, including facial landmarks, texture patterns, and geometric measurements. However, these conventional methods often required extensive preprocessing and were highly sensitive to variations in lighting conditions, head pose, and facial expressions. As a result, their performance was limited and less reliable in real-world scenarios.

The emergence of deep learning, particularly Convolutional Neural Networks (CNNs), has significantly improved the performance of facial analysis systems. Unlike traditional approaches, CNN-based models automatically learn hierarchical features directly from raw images. They can capture both low-level features such as edges and textures, as well as high-level semantic features like facial structure and age-related patterns. This capability enables more accurate and robust prediction of age and gender from facial images.

II. Literature Survey

Recent advancements in deep learning have significantly improved the performance of age and gender prediction systems using facial images. Several researchers have explored different architectures and techniques to enhance prediction accuracy and robustness.

Divyanshu Singh (2023) proposed a CNN-based model for age and gender detection that includes preprocessing steps such as face detection, alignment, and background removal. The model achieved good accuracy on the Audience dataset, demonstrating the effectiveness of convolutional neural networks in facial demographic analysis.

Lixiong Qin (2023) introduced a transformer-based architecture called *SwinFace*, which performs multiple tasks including age estimation and gender prediction. By using attention mechanisms and a shared backbone, the model achieved high accuracy on datasets like RAF-DB and CLAP2015.

Nathanael L. Baisa et al. (2023) proposed a multi-task learning framework that simultaneously predicts identity, age, and gender. The study showed that shared feature learning improves overall prediction performance compared to single-task models.

Bhavana Bhaurao Helwate (2024) developed a machine learning system using CNNs for demographic prediction. The study highlighted that combining feature extraction with classification techniques improves reliability and accuracy.

Shailesh Arya (2024) compared multiple deep learning architectures such as MobileNet, UNet, and EfficientNet. The results indicated that MobileNet provides efficient age estimation, while UNet performs better in gender classification tasks.

Ankita Mondal (2024) proposed a CNN-based approach with preprocessing, augmentation, and batch normalization. The model achieved high accuracy on the UTKFace dataset and showed robustness under varying environmental conditions.

Abhinav Singh (2024) integrated object detection with facial analysis to improve real-time performance. The system first detects faces and then predicts age and gender using CNN models, making it suitable for real-world applications.

Lixiong Qin et al. (2024) developed a hybrid transformer-sequencer model that combines attention mechanisms with sequential neural networks. This approach improved feature extraction and generalization performance.

Rajat Deswal (2025) proposed a CNN-based system trained on the UTKFace dataset, achieving improved accuracy over traditional methods and demonstrating the effectiveness of deep feature extraction.

III. System Analysis

The system focuses on automatically predicting age and gender from facial images using deep learning techniques. It analyzes input images, detects faces, and extracts meaningful features for classification and regression tasks. The system requires a labeled dataset for training and validation to ensure accurate predictions. It involves preprocessing steps such as resizing, normalization, and face alignment to improve model performance. The core component is a Convolutional Neural Network (CNN) that learns facial patterns and representations. The system must handle variations in lighting, pose, and facial expressions. It should provide reliable predictions in real-time or near real-time scenarios. Performance evaluation is done using metrics like accuracy and loss. The system is designed to be scalable and adaptable to different datasets. Overall, it aims to automate demographic analysis efficiently.

Existing System

Traditional systems for age and gender prediction relied on manual feature extraction techniques such as facial landmarks, geometric measurements, and texture analysis. These systems used machine learning algorithms like Support Vector Machines (SVM) and decision trees for classification. The preprocessing steps were complex and required domain expertise. These models were sensitive to variations in lighting, pose, and image quality. They struggled to generalize well across diverse datasets. Feature extraction was time-consuming and often incomplete. Some early deep learning models were also limited due to smaller datasets and less optimized architectures. Real-time performance was difficult to achieve. The accuracy of predictions was relatively lower compared to modern systems. Overall, existing systems lacked robustness and scalability.

Disadvantages of Existing System

- Requires manual feature extraction, which is time-consuming
- Low accuracy compared to modern deep learning models
- Highly sensitive to lighting, pose, and facial expressions
- Poor generalization across different datasets
- Complex preprocessing steps
- Limited ability to handle real-world scenarios

Proposed System

The proposed system uses a deep learning-based approach to automatically predict age and gender from facial images. It employs a Convolutional Neural Network (CNN) to extract features directly from raw images without manual intervention. The system includes preprocessing steps such as face detection, resizing, and normalization to enhance performance. Multiple convolutional and pooling layers are used to capture important facial patterns. Fully connected layers are used for gender classification and age estimation. The model is trained on a large labeled dataset to

improve accuracy and generalization. It can handle variations in lighting, pose, and facial expressions more effectively. The system is designed for real-time or near real-time predictions. It is scalable and can be extended with advanced architectures. Overall, it provides a more efficient and accurate solution.

Advantages of Proposed System

- Automatic feature extraction using deep learning
- Higher accuracy and reliability
- Robust to variations in lighting, pose, and expressions
- Better generalization across datasets
- Reduced need for manual preprocessing
- Suitable for real-time applications
- Scalable and adaptable to new data

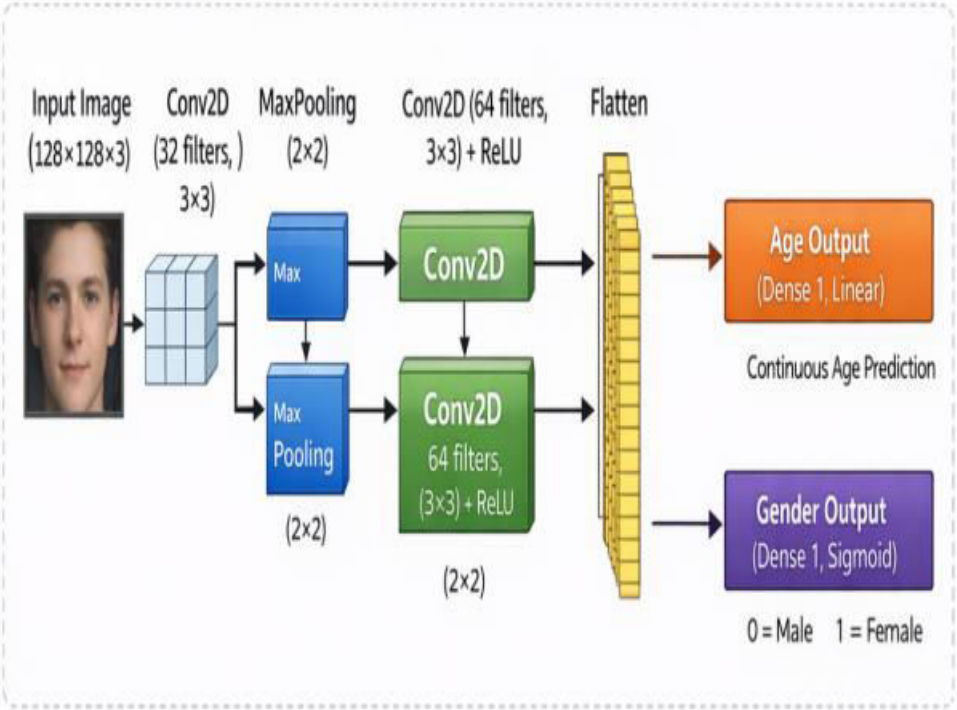
IV. Methodology

The proposed system follows a deep learning-based methodology for predicting age and gender from facial images. Initially, the input images are collected from a labeled dataset and undergo preprocessing steps such as face detection, resizing, normalization, and noise removal to ensure consistency and improve model performance. The preprocessed images are then fed into a Convolutional Neural Network (CNN), which consists of multiple convolutional layers to extract low-level and high-level facial features, followed by pooling layers to reduce dimensionality and computational complexity. The extracted feature maps are flattened and passed through fully connected layers for classification and regression tasks. Gender prediction is treated as a binary classification problem, while age estimation is handled as a regression problem. The model is trained using backpropagation and optimization techniques such as Adam optimizer to minimize loss. Finally, the trained model is evaluated using validation data and deployed to predict age and gender from new input images in real-time.

To improve model generalization and prevent overfitting, data augmentation techniques such as rotation, flipping, zooming, and brightness adjustment are applied. The preprocessed images are then fed into a Convolutional Neural Network (CNN), which consists of multiple convolutional layers for feature extraction. These layers identify low-level features like edges and textures, as well as high-level features such as wrinkles, facial structure, and skin patterns.

System Architecture

The architecture of the proposed system is designed as a sequential pipeline that processes facial images step by step. It begins with the input image, which is passed through a face detection module to identify and extract the facial region. The detected face is then preprocessed to standardize size and quality. The processed image is fed into the CNN model, where convolutional and pooling layers extract important facial features. These features are then passed to fully connected layers that perform gender classification and age prediction. The final output of the system consists of the predicted gender (male/female) and estimated age. This architecture ensures efficient feature extraction, accurate prediction, and scalability for real-world applications.



V. Result and Output

Random Image Selected: 23_1_3_20170119164534718.jpg.chip.jpg
1/1 ——— 0s 54ms/step
Actual Age: 23
Actual Gender: Female
Predicted Age: 22
Predicted Gender: Female
Prediction Confidence: 98.99 %
Gender Accuracy: 100 %

Random Image Selected: 25_0_3_20170119171146199.jpg.chip.jpg
1/1 ——— 0s 39ms/step
Actual Age: 25
Actual Gender: Male
Predicted Age: 25
Predicted Gender: Male
Prediction Confidence: 100 %
Gender Accuracy: 100 %

Random Image Selected: 31_0_1_20170116220207245.jpg.chip.jpg
1/1 ——————————————————— 0s 34ms/step
Actual Age: 31
Actual Gender: Male
Predicted Age: 30
Predicted Gender: Male
Prediction Confidence: 99.34 %
Gender Accuracy: 100 %

Random Image Selected: 54_0_3_20170119210114392.jpg.chip.jpg
1/1 ——————————————————— 0s 32ms/step
Actual Age: 54
Actual Gender: Male
Predicted Age: 54
Predicted Gender: Male
Prediction Confidence: 100 %
Gender Accuracy: 100 %

Random Image Selected: 7_1_3_20161220221712842.jpg.chip.jpg
1/1 ——————————————————— 0s 33ms/step
Actual Age: 7
Actual Gender: Female
Predicted Age: 5
Predicted Gender: Male
Prediction Confidence: 90.78 %
Gender Accuracy: 92%

VI. Conclusion

The age and gender prediction system based on facial images using deep learning has been successfully developed to automatically analyze facial features and estimate demographic attributes. The system utilizes advanced deep learning techniques, particularly Convolutional Neural Networks (CNNs), to extract meaningful features from facial images and perform accurate predictions.

By training the model on a labeled facial image dataset, the system effectively learns patterns related to facial structure, skin texture, and age-related characteristics. Compared to traditional machine learning approaches, the use of deep learning significantly improves prediction accuracy, robustness, and automation by eliminating the need for manual feature extraction.

The proposed system demonstrates practical applicability in various domains such as security and surveillance, targeted marketing, demographic analysis, and human–computer interaction. Despite certain limitations, including sensitivity to image quality, lighting conditions, and dataset diversity, the system provides reliable and efficient results.

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[4] Dr.G.Vishnu Murthy, BhargaviNalacheruve 1Professor, Department of computer Science & engineering, Anurag University, TS, India. 2Student, Department of computer Science & engineering, Anurag University, TS, India.

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