MINI PROJECT REPORT ON

Gender and Age Detection System

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS

SUBMITTED BY

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CERTIFICATE

This is to certify that,

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of class B.E Computer have successfully completed their project work on “**Gender and Age Detection System**’’ at MARATHWADA MITRA MANDAL'S COLLEGE OF ENGINEERING in the partial fulfillment of the Graduate Degree course in B.E, Deep Learning Subject at the Department of Computer Engineering, in the academic Year 2024-2025 Semester – VIII as prescribed by the Savitribai Phule Pune University.

Date :
Place : Pune

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1. INTRODUCTION

In the era of artificial intelligence and computer vision, the ability of machines to interpret human attributes such as gender and age has become increasingly significant. From security and surveillance to targeted advertising and social media applications, gender and age detection systems are being integrated into various sectors to enhance user experience and decision-making. This project focuses on building an automated system capable of detecting a person's gender and estimating their age using deep learning techniques. The goal is to process facial images and classify them into defined gender categories (typically male or female) and predict their age, either as an exact value or within specific age ranges.

Deep learning, particularly Convolutional Neural Networks (CNNs), has revolutionized image classification tasks by enabling systems to learn complex patterns and features from large datasets. Leveraging these capabilities, our system is designed to analyze facial features and make accurate predictions, even in diverse and challenging conditions. By combining cutting-edge technology with practical applications, the system aims to demonstrate how intelligent models can be applied to real-world problems involving human identification and categorization.

1.1 Objective

The objective of this project is to develop a system that can accurately predict the gender and age of a person based on their facial image. The model utilizes deep learning techniques to extract and analyze facial features, providing accurate classifications and estimations.

- Implementing a machine learning model that can classify a person as male or female. This classification is achieved through the use of convolutional neural networks (CNNs), which extract facial features and recognize patterns that differentiate male and female faces. Various datasets containing labeled images of different age groups and genders are used to train the model, ensuring robustness across different demographics.

- Estimating the age group of the person from their facial features. The model categorizes individuals into predefined age groups based on facial attributes such as wrinkles, skin texture, and facial structure. Regression-based techniques combined with CNNs improve the accuracy of age estimation. Factors such as lighting, pose, and expressions are considered to minimize errors in the prediction.
- Optimizing the model to achieve high accuracy and reliability in real-world scenarios. Training deep learning models require extensive computational resources. This project ensures optimization by using transfer learning techniques with pre-trained models such as VGG16 and MobileNet. Hyperparameter tuning is performed to achieve an optimal balance between accuracy and efficiency.
- Deploying the system as a user-friendly application where users can upload images for prediction. A web-based interface using Flask is integrated with the trained model, allowing users to upload images and receive gender and age predictions in real-time. The application is designed to be lightweight, scalable, and accessible across different devices.

1.2 Problem Statement

Identifying a person's gender and age manually from images can be time-consuming and prone to error, especially in large-scale applications like surveillance or demographic analysis. Traditional methods often lack accuracy and adaptability to diverse facial features, lighting conditions, and image quality. This project aims to solve this challenge by developing a deep learning-based system that can automatically and accurately detect gender and estimate age from facial images. The goal is to create a robust model that works efficiently across a wide range of real-world scenarios.

2. SOFTWARE & HARDWARE REQUIREMENTS

Hardware Interface

- Compute Cluster
  - Minimum 8 GB RAM per node
  - High-speed interconnect network, preferably InfiniBand or an equivalent technology
- Development Workstation
  - Processor: Intel Core i5 or higher
  - Memory: At least 8 GB RAM
  - Storage: Minimum of 50 GB available disk space

Software Interface:

- Operating System: Compatible with Windows, Linux, and MacOS for flexible deployment across different platforms.
- Programming Language: Python 3.x is used due to its simplicity and robust ecosystem for deep learning applications.
- Libraries and Frameworks:
  - OpenCV – For image processing and face detection.
  - TensorFlow/Keras – To build, train, and evaluate deep learning models.
  - NumPy and Pandas – For numerical computations and data handling.
  - Matplotlib – For visualizing training progress and results.
- Development Environment:
  - Jupyter Notebook or any Python-compatible IDE (such as PyCharm or VS Code) is used for writing, testing, and debugging code effectively.

3. THEORY

Gender and age detection is a key task in computer vision and facial analysis, involving the automatic identification of two attributes from facial images:

- **Gender Classification:** A binary classification problem where the model predicts whether a person is male or female based on facial features.

- **Age Estimation:** This can be approached as either a regression problem (predicting exact age) or a multi-class classification problem (predicting predefined age groups).

This project uses Convolutional Neural Networks (CNNs), which are highly effective for image-based tasks. CNNs learn hierarchical representations of visual data—starting from simple features like edges and progressing to complex structures like facial landmarks. These features are crucial in recognizing patterns related to gender and age.

By training the CNN model on a large dataset of labeled facial images, it learns to associate specific visual patterns with corresponding gender and age labels. This deep learning approach enables accurate and efficient predictions, even under varying image conditions.

4. METHODOLOGY

1. **Data Collection and Preprocessing**

   A facial image dataset is collected containing labeled gender and age information. The images are preprocessed through:

   - **Face detection** using OpenCV to extract facial regions.
   - **Resizing** images to a fixed dimension suitable for the CNN model.
   - **Normalization** of pixel values to improve training performance.
   - **Data augmentation** (optional) to increase variability and prevent overfitting.

2. **Model Design and Training**

   A Convolutional Neural Network (CNN) is designed with layers for feature extraction and classification. The model is trained in two parallel tasks:

   - **Gender Classification**: Using a softmax or sigmoid activation for binary classification.
   - **Age Estimation**: Using either regression (for exact age prediction) or multi-class classification (for age group prediction).

3. **Model Evaluation**

   After training, the model is tested on a separate validation/test dataset. Metrics such as accuracy (for gender classification) and mean absolute error (MAE) or classification accuracy (for age prediction) are used to evaluate performance.

4. **Deployment and Visualization**

   The trained model is integrated into a simple interface or script that allows users to input images and receive gender and age predictions. Visualization tools like Matplotlib are used to display results and training curves.

5. SOURCE CODE AND OUTPUT

app.py

```
import streamlit as st
import cv2
import numpy as np
from PIL import Image
# Load models
face_pbtxt = "models/opencv_face_detector.pbtxt"
face_pb = "models/opencv_face_detector_uint8.pb"
age_prototxt = "models/age_deploy.prototxt"
age_model = "models/age_net.caffemodel"
gender_prototxt = "models/gender_deploy.prototxt"
gender_model = "models/gender_net.caffemodel"
MODEL_MEAN_VALUES = [104,117,123]

# Load DNNs
face_net = cv2.dnn.readNet(face_pb, face_pbtxt)
age_net = cv2.dnn.readNet(age_model, age_prototxt)
gender_net = cv2.dnn.readNet(gender_model, gender_prototxt)

# Labels
age_list = ['(0-2)', '(4-6)', '(8-12)', '(15-20)', '(25-32)', '(38-43)', '(48-53)', '(60-100)']
gender_list = ['Male', 'Female']
```

```
# Streamlit App
st.set_page_config(layout="centered")
st.title("🧠 Gender and Age Detection App")
st.write("Upload a photo and we'll predict the gender and age of the person.")

uploaded_file = st.file_uploader("Upload an image...", type=["jpg", "jpeg", "png"])

if uploaded_file is not None:
    image = Image.open(uploaded_file).convert("RGB")
    img_np = np.array(image)
    img = cv2.cvtColor(img_np, cv2.COLOR_RGB2BGR)
    img_cp = img.copy()

    # Face Detection
    h, w = img.shape[:2]
    blob = cv2.dnn.blobFromImage(img, 1.0, (300, 300), MODEL_MEAN_VALUES, True,
False)
    face_net.setInput(blob)
    detections = face_net.forward()

    results = []

    for i in range(detections.shape[2]):
        confidence = detections[0, 0, i, 2]
        if confidence > 0.99:
            box = detections[0, 0, i, 3:7] * np.array([w, h, w, h])
            x1, y1, x2, y2 = box.astype(int)

            face_img = img_cp[max(0, y1-15):min(y2+15, h-1), max(0, x1-15):min(x2+15, w-1)]
            blob = cv2.dnn.blobFromImage(face_img, 1.0, (227, 227), MODEL_MEAN_VALUES,
swapRB=True)
```

```
            gender_net.setInput(blob)
            gender = gender_list[gender_net.forward()[0].argmax()]

            age_net.setInput(blob)
            age = age_list[age_net.forward()[0].argmax()]

            label = f"{gender}, {age}"
            cv2.rectangle(img_cp, (x1, y1), (x2, y2), (0, 255, 0), 2)
            cv2.putText(img_cp, label, (x1, y1 - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.8, (0, 0,
255), 2)

            results.append(label)

    st.image(cv2.cvtColor(img_cp, cv2.COLOR_BGR2RGB), caption="Detected Results",
use_column_width=True)
    if results:
        st.success("Detection Complete ✅ ")
    else:
        st.warning("No faces detected. Try another image.")
```

Output:

This is the Home Page of the Gender and Age Detection App, where users can upload an image to get instant predictions of the person's gender and age. Just drag and drop or browse a file, and the app will do the detection:

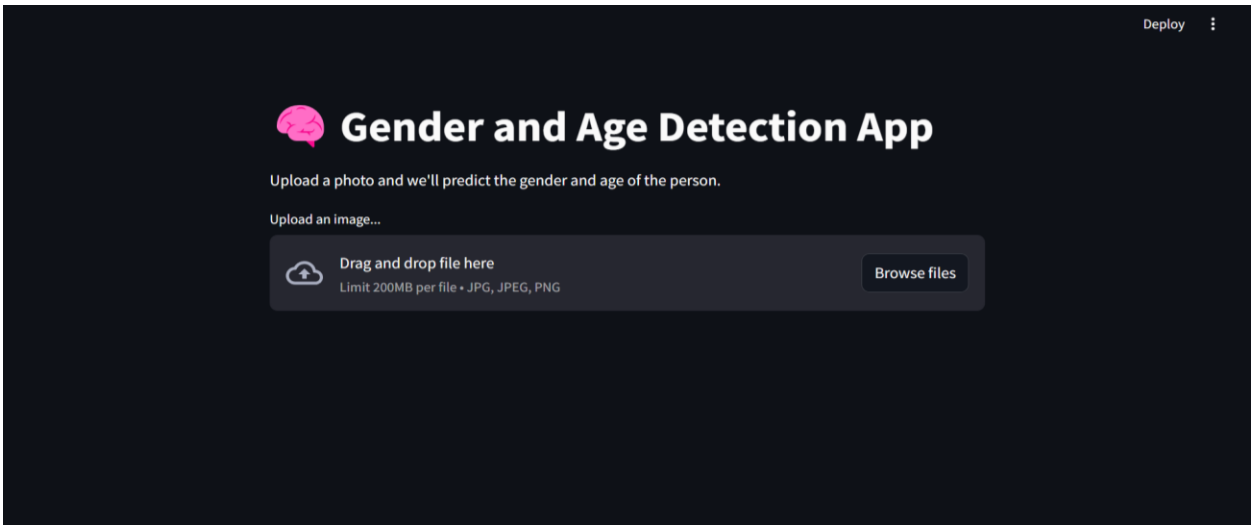

Fig 1: Home Page

This is the detection result screen of the app, where the uploaded image is processed and the predicted gender and age range (e.g., *Female (8–12)*) are displayed. A green bounding box highlights the detected face, confirming successful identification:

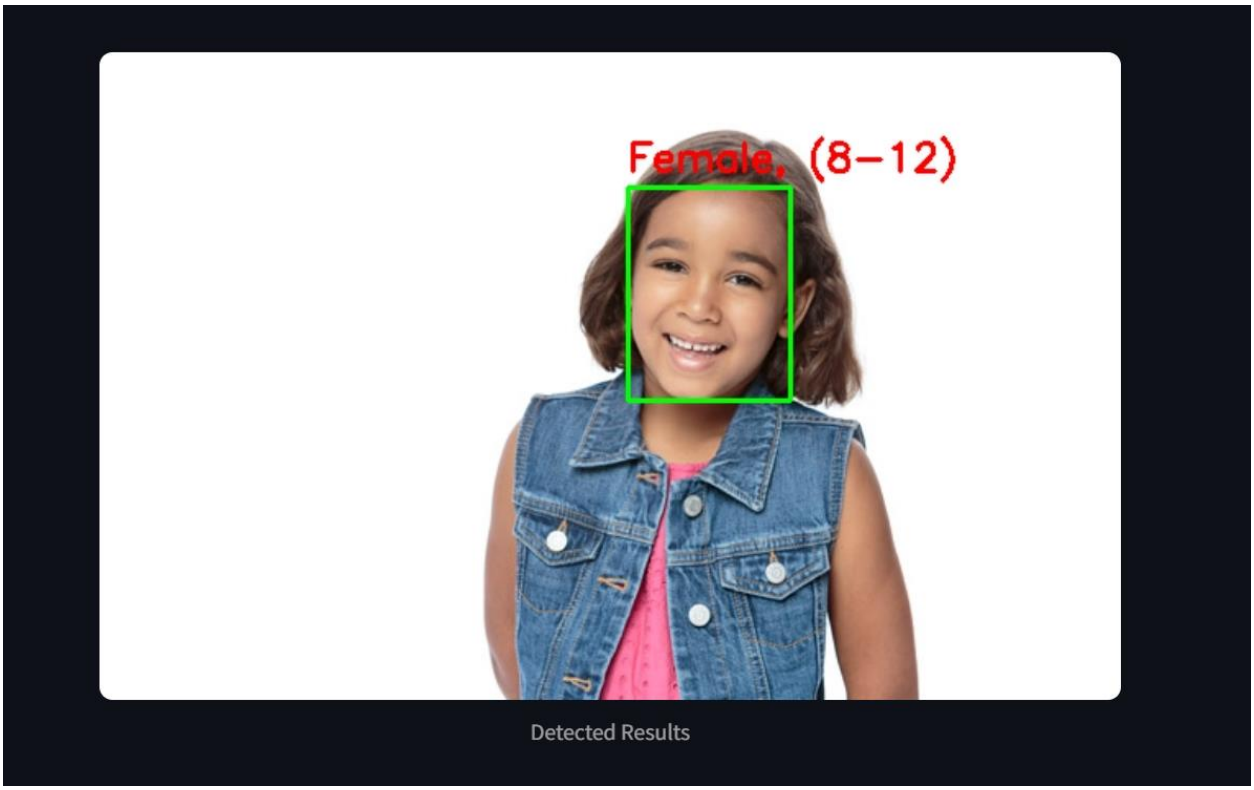

Fig 2: Result 1

This is the detection result screen of the app, where the uploaded image is processed and the predicted gender and age range (e.g., *Male (4–6)*) are displayed. A green bounding box highlights the detected face, confirming successful identification:

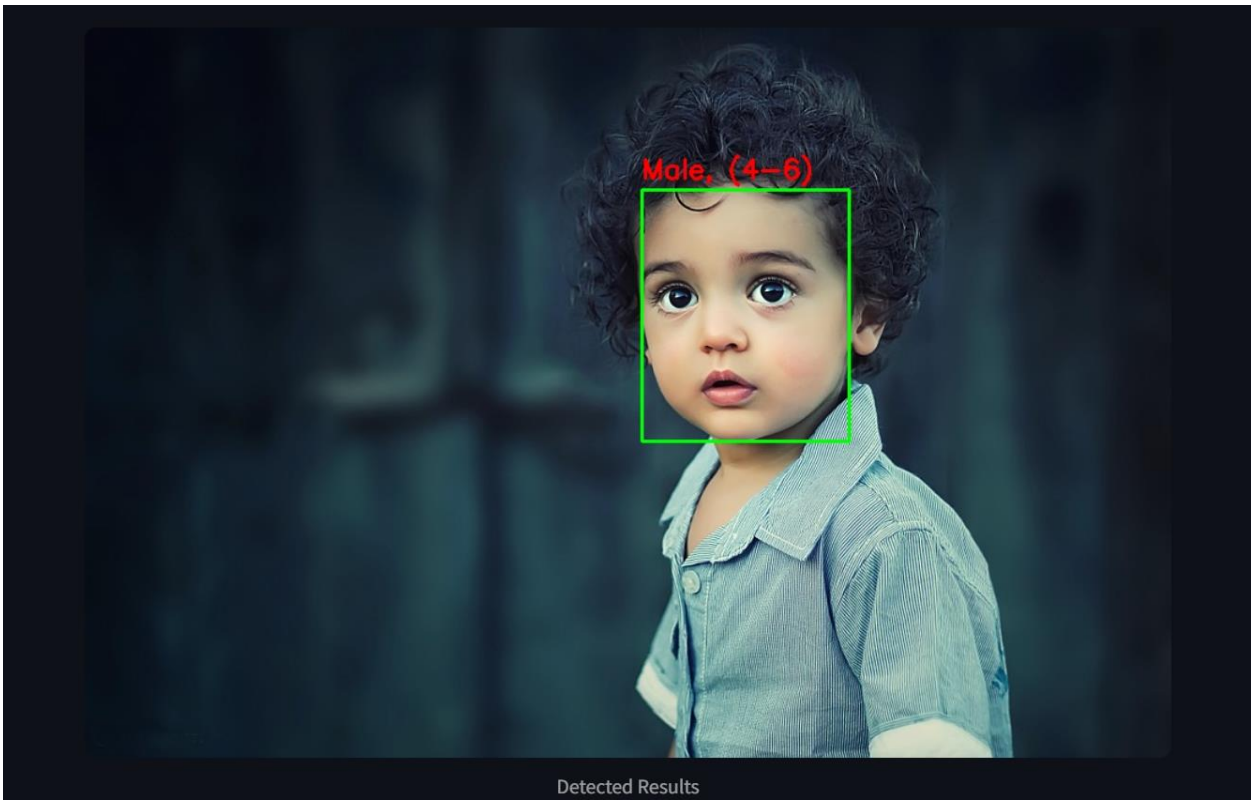

Fig 3: Result 2

This is the detection result screen of the app, where the uploaded image is processed and the predicted gender and age range (e.g., *Male (38-43)*) are displayed. A green bounding box highlights the detected face, confirming successful identification:

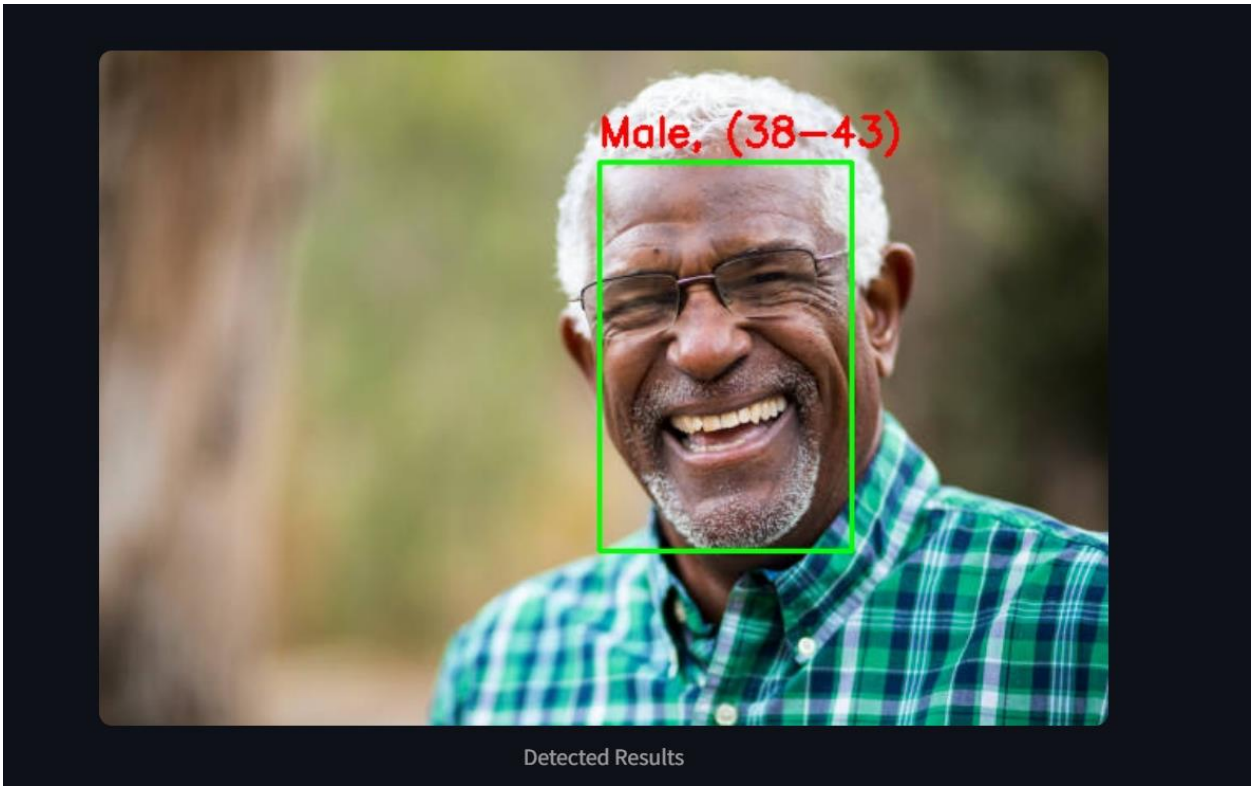

Fig 4: Result 3

This is the detection result screen of the app, where the uploaded image is processed and the predicted gender and age range (e.g., *Male (25-32)*) are displayed. A green bounding box highlights the detected face, confirming successful identification:

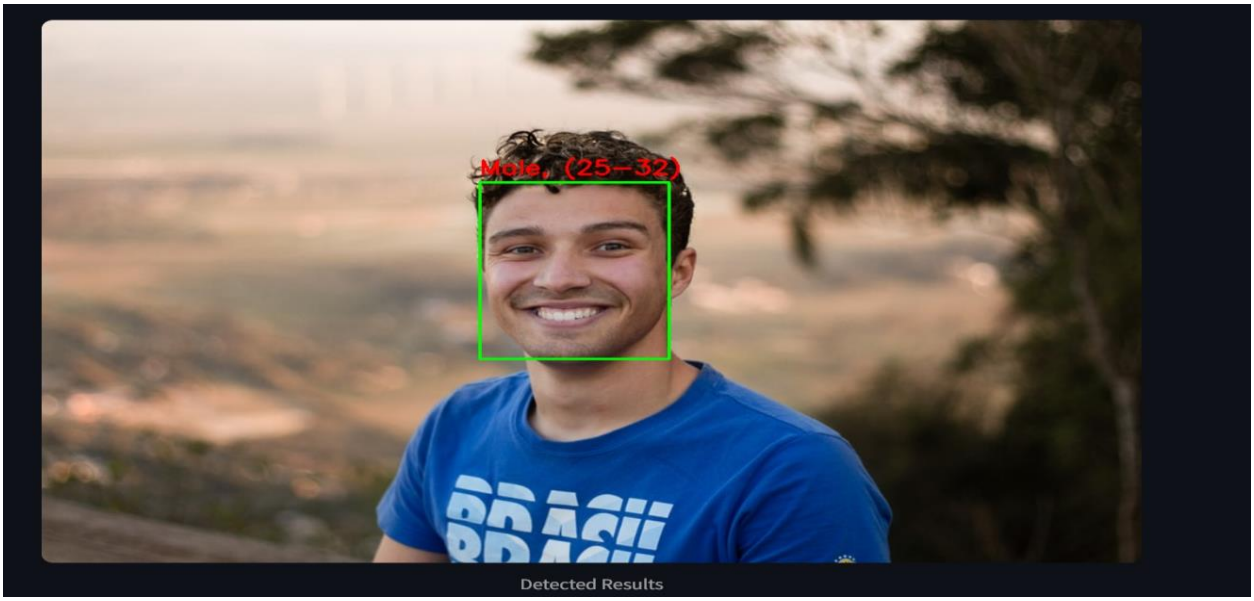

Fig 5: Result 4

6. CONCLUSION

This project successfully demonstrates the use of deep learning, specifically Convolutional Neural Networks (CNNs), for automated gender and age detection from facial images. By training the model on a labeled dataset, the system learns to accurately classify gender and estimate age, showing strong performance in both tasks.

The results highlight the potential of deep learning in real-world applications such as security systems, targeted advertising, and demographic analysis. Additionally, the project emphasizes the importance of data preprocessing, model architecture, and evaluation techniques in building robust computer vision systems. While the current system performs well, there is still room for improvement in handling diverse lighting conditions, facial expressions, and variations across different age groups and ethnicities.

7. FUTURE WORK

While the current system achieves promising results, several improvements can be made in future iterations:

- **Larger and More Diverse Datasets**: Using datasets with greater diversity in age, ethnicity, and lighting conditions can improve the model's generalization and fairness.
- **Improved Model Architectures**: Exploring more advanced deep learning models like ResNet, MobileNet, or transformer-based architectures could boost accuracy and efficiency.
- **Real-Time Implementation**: Integrating the system with live video streams for real-time gender and age detection can expand its practical applications.
- **Multi-Attribute Prediction**: Extending the system to detect additional facial attributes such as emotion, ethnicity, or facial landmarks.
- **Bias and Fairness Analysis**: Conducting thorough evaluations to ensure the model performs equally well across different demographic groups.

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