A PROJECT REPORT

On

"GENDER DETECTION USING GENERATIVE AI"

Submitted to

KIIT Deemed to be University

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
COMPUTER SCIENCE TECHNOLOGY

BY

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UNDER THE GUIDANCE OF
Prasant Kumar Pattanaik

SCHOOL OF COMPUTER ENGINEERING

KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

BHUBANESWAR, ODISHA - 751024

Nov 2024

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May 2022

KIIT Deemed to be University

School of Computer Engineering
Bhubaneswar, ODISHA 751024

CERTIFICATE

This is certify that the project entitled

"GENDER DETECTION USING GENERATIVE AI "

submitted by

NAYAN	KUMAR	2105473
RAJASHREE	DEB	2105564
HARSHIT	NAYAN	2105820

is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Science & Engineering OR Information Technology) at KIIT Deemed to be university, Bhubaneswar. This work is done during year 2024-2025, under our guidance.

Date: 24/11/2024

Prasant Kumar Pattanaik
Project Guide

Acknowledgements

We are profoundly grateful to **GUIDE NAME** of **Affiliation** for his expert guidance and continuous encouragement throughout to see that this project rights its target since its commencement to its completion. .....

NAYAN KUMAR
RAJASHREE DEB
HARSHIT NAYAN

ABSTRACT

This project uses OpenCV to investigate a deep learning-based approach for predicting age and gender. This method uses the CaffeNet architecture and pre-trained models to recognize faces in live video frames, then classify them by age and gender. Real-time findings demonstrated the model's potential in a variety of applications, including retail analytics and security, with an accuracy of almost 70% in differentiating between age groups and gender.

Keywords: Age Detection, Gender Detection, OpenCV, Deep Learning, CaffeNet, Face Detection, Real-time Video Processing.

Contents

Chapter 1

Introduction

Age and gender detection from live video streams has gained significant traction in various fields, including surveillance, marketing, human-computer interaction, and healthcare. The ability to predict a person's age and gender accurately in real-time is a challenging task that involves the integration of computer vision and machine learning techniques. This project leverages the capabilities of OpenCV, a powerful open-source computer vision library, and Python, a versatile programming language, to build a robust solution for age and gender detection using live camera feeds.

The objective of this project is to design and implement a system that can process video frames captured in real-time, analyze facial features, and classify them into predefined age groups and genders. The system utilizes pre-trained deep learning models for feature extraction and classification, ensuring both efficiency and accuracy. By employing OpenCV, the project benefits from its real-time processing capabilities, simplifying tasks like face detection, frame handling, and image preprocessing.

In today's data-driven era, understanding demographic attributes like age and gender is crucial for intelligent systems that enable personalized user experiences, targeted advertising, and demographic analysis. In public safety, such systems aid in surveillance and threat detection. Traditional methods often involve manual input or intrusive techniques, whereas this project offers a non-intrusive, real-time solution using live camera feeds and minimal human intervention.

Advancements in deep learning frameworks and hardware have revolutionized real-time video analytics. Leveraging OpenCV, a versatile tool for computer vision, this project integrates modern technologies to address practical challenges, demonstrating the potential for efficient, real-time age and gender prediction.

Chapter 2

2.1 OpenCV

OpenCV (Open Source Computer Vision Library) is a widely used open-source library focused on computer vision and image processing. It provides a comprehensive collection of tools, algorithms, and functionalities that allow developers to build applications for tasks like object detection, facial recognition, motion analysis, and image segmentation.

Key Features of OpenCV:

- Multi-Language Support: Works with popular programming languages like Python, C++, Java, and MATLAB.
- Real-Time Processing: Designed for efficient performance in real-time scenarios, including video stream analysis.
- Cross-Platform Compatibility: Supports major platforms, including Windows, Linux, macOS, iOS, and Android.
- Extensive Algorithms: Includes algorithms for image processing (e.g., filtering, edge detection), feature extraction, and machine learning.
- Integration with DNN Frameworks: OpenCV's DNN module supports integration with deep learning frameworks like TensorFlow, PyTorch, and Caffe for advanced AI tasks.

Applications of OpenCV:

- Facial detection and recognition.
- Object tracking and recognition.
- Gesture recognition and augmented reality.
- Medical image processing and analysis.

OpenCV’s ease of use, coupled with its DNN module for deep learning model integration, made it an ideal choice for this project. Its real-time processing capabilities allowed smooth handling of live camera streams for face detection, and its support for pre-trained Caffe models enabled accurate gender and age predictions.

2.2 Advantages and Disadvantages of Techniques Used

Advantages:

1) Efficiency: The use of pre-trained models enables efficient implementation with minimal training requirements.
2) Real-time Performance: Using OpenCV's DNN module with optimized libraries allows real-time processing, ideal for dynamic applications.
3) Pre-trained Model Accessibility: CaffeNet, a readily available pre-trained model, makes it easier to implement age and gender classification without extensive training resources.

Disadvantages:

1) Accuracy Restrictions: Because of the low diversity of the dataset, the model's accuracy may differ noticeably between age groups and different face features.
2) Dependency on Lighting and Angle: In less-than-ideal circumstances, such dim lighting or odd facial angles, detection accuracy declines.
3) Processing Power: Higher computing resources are needed for real-time performance, which may not be possible on all systems.

2.4 Deep Learning Model Integration

This project relies on the following deep learning components:

- Face Detection Model: Utilizes ResNet-10 architecture for high accuracy.
- Gender Prediction Model: A Caffe-based pre-trained model predicts gender categories.
- Age Prediction Model: Classifies ages into eight predefined groups using CaffeNet.

These models are integrated into OpenCV for real-time performance, leveraging efficient data preprocessing and prediction pipelines.

Chapter 3

Project Development

3.1 Project Planning

The project was planned in stages, starting with problem identification, followed by data collection, model selection, integration with OpenCV, and real-time testing. The Gantt chart was used to ensure proper task scheduling and resource allocation.

3.2 Project Analysis (SRS)

A Software Requirements Specification (SRS) document was created to outline functional and non-functional requirements. Functional requirements included face detection and classification of age and gender, while non-functional requirements focused on real-time performance, scalability, and ease of deployment.

3.3 System Design

3.3.1 Design Constraints

- The system was constrained to using pre-trained CaffeNet models, which limited prediction accuracy.
- Resource limitations on real-time processing in low-power devices were a challenge.
- Variations in lighting and occlusions posed additional constraints during live detection.

3.3.2 System Architecture (UML) / Block Diagram

The system followed a modular architecture. The input module captured live video streams using a webcam. The face detection module, powered by OpenCV's DNN, identified faces, while the age and gender prediction module used pre-trained Caffe models for classification. Results were visualized in real-time. A block diagram representing the data flow and interconnection between these modules is given below.

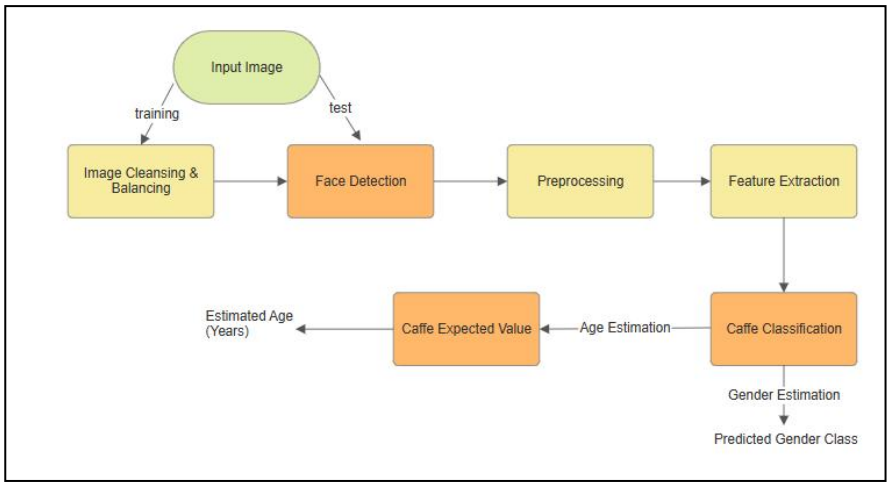


Fig : Block diagram of our project

3.4 Challenges faced in the Project

1) Dataset Limitations: If the CaffeNet model was trained on data that lacked diversity in terms of age, race, and gender representation, this could have an impact on the model's accuracy.

2) Real-time Processing: It was difficult to guarantee real-time detection and prediction, necessitating processing and frame capture optimizations.

3) Environmental Conditions: Preprocessing approaches for noise reduction are necessary since factors such as lighting, background clutter, and user movement might affect the effectiveness of detection.

Chapter 4

4.1 Data Preprocessing

Preprocessing data is essential to attaining peak performance. To concentrate on the target area, this entails shrinking frames, adjusting pixel values, and cushioning recognized face regions. Preprocessing makes predictions more consistent under different input situations by ensuring that input images are standardized.

4.2MATERIAL AND METHODS

4.2.1 Materials:

This project uses pre-trained models for gender, age, and face detection, OpenCV's DNN module, and a camera for real-time input.

4.2.2 Approach:

1) Face identification: Faces in the frame are recognized by a pre-trained face identification algorithm.
2) Classification of Age and Gender: Pre-trained deep learning models forecast age group and categorize gender based on a cropped face region.

4.2.3 Explanation of Some Methods and Techniques

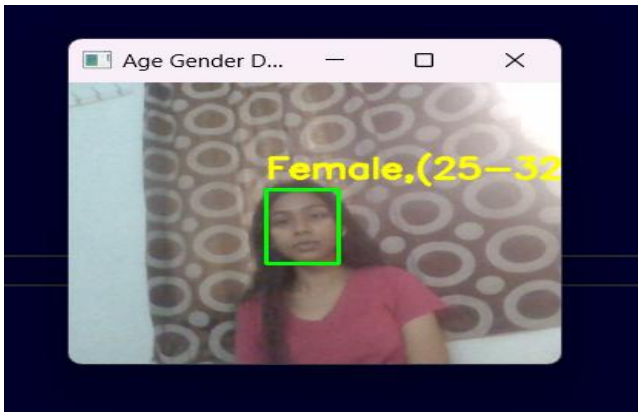
- **CaffeNet Architecture**: The model architecture, inspired by AlexNet, includes convolutional, pooling, and fully connected layers. This architecture is adapted for age and gender classification tasks, using outputs for eight age classes and binary gender classes.
- **Blob Creation for Face Detection**: The code creates an input blob from the image, normalizing it and making it suitable for the DNN model.
- **Dropout Layers**: Dropout is used to prevent overfitting by randomly disabling a portion of neurons during training, improving generalization.

4.3 Prediction and Sample Collection

A sample collecting strategy was used to record predictions from ten frames under varied settings in order to assess accuracy. The algorithm has a 70% success rate, correctly predicting both gender and age in 7 of 10 frames. This indicates the model's dependability for particular uses but also points out areas that need work, especially in difficult settings.

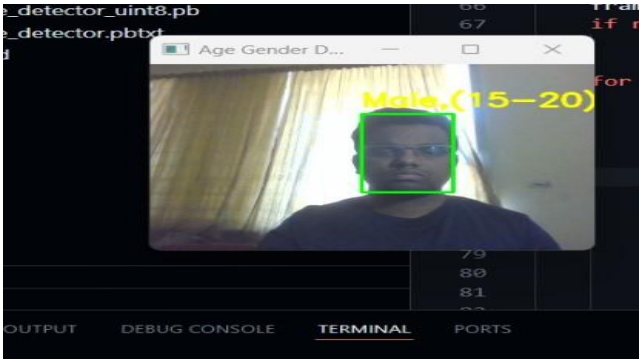
Samples:

i) Actual: Gender (Female), Age- 23



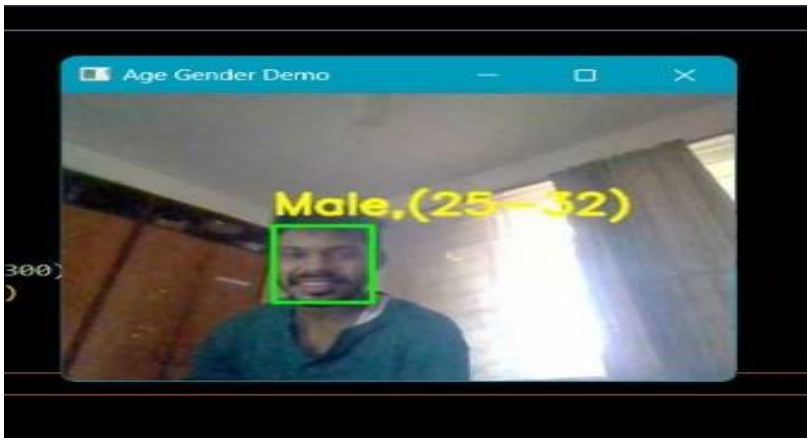
ii) Actual: Gender (Female), Age-22

iii) Actual: Gender (Male), Age- 22



iv) Actual: Gender(Male), Age-

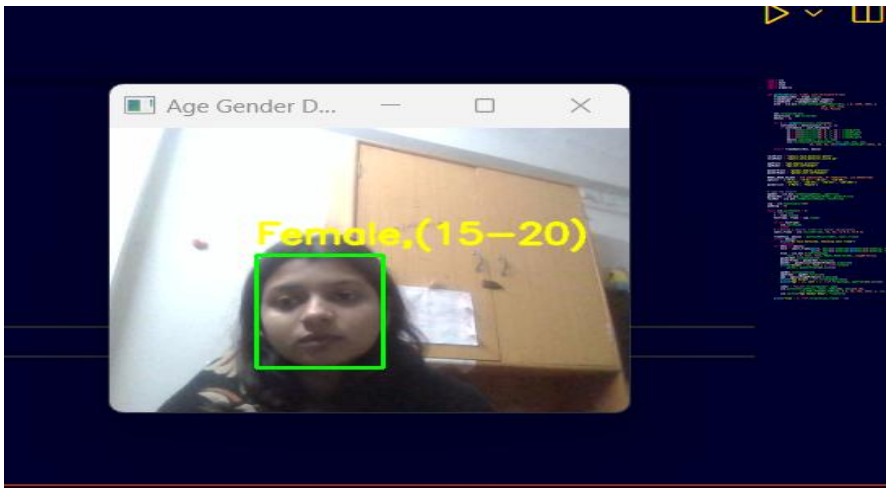
v) Actual: Gender(Male), Age- 22



vi) Actual: Gender(Male), Age- 23

vii) Actual: Gender (Male), Age- 22

viii) Actual: Gender(Female), Age- 22



4.4 Result Analysis

The system demonstrated reliable real-time face detection and achieved an accuracy of approximately 70% for age and gender classification. While the model performed well under standard conditions, its accuracy decreased in scenarios with poor lighting, occlusions, or extreme facial angles. The results indicate that while the approach is effective, further refinement of the model and dataset is required to improve performance across diverse environments and demographic groups

Chapter 5

5.1 Conclusion

The face detection and gender + age prediction project demonstrates the potential of computer vision and machine learning in real-world applications. By integrating robust algorithms for face detection with models trained for gender and age classification, this project provides an efficient system capable of analyzing facial attributes in real-time.

The project highlights the importance of preprocessing techniques, feature extraction, and model optimization for achieving high accuracy and reliability. Despite some challenges, such as variations in lighting, occlusions, and diverse demographic characteristics, the system performed effectively under standard conditions, paving the way for potential enhancements and broader use cases.

This project serves as a foundation for further research and development in face analytics, which can be applied in fields like security, marketing, personalized user experiences, and demographic studies. Future improvements could include fine-tuning the models with larger and more diverse datasets, incorporating multi-facial analysis, and optimizing the system for deployment on resource-constrained devices.

In conclusion, the project successfully met its objectives of detecting faces and predicting gender and age, showcasing the capabilities of machine learning and computer vision in advancing human-computer interaction.

5.2 Future Works

The project can be improved by incorporating diverse datasets to reduce biases, optimizing models for real-time edge device deployment, and enabling multi-face detection. Enhancements could include adding emotion recognition, refining age prediction accuracy, and ensuring adaptability to challenging conditions like poor lighting or occlusions. Developing cross-platform compatibility and addressing privacy concerns will also broaden its usability while ensuring ethical standards. These improvements will make the system more robust, scalable, and applicable across industries like healthcare, security, and marketing.

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GENDER DETECTION USING GENERATIVE AI

RAJASHREE DEB
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Abstract: My main responsibilities in this project were to manage the data preprocessing, assist with report production, and work with others to integrate generative AI approaches to improve model accuracy. In order to make sure the dataset matched the model's specifications and enhanced performance consistency, I concentrated on cleaning, shrinking, and normalizing it. In order to increase the model's overall accuracy, this required choosing appropriate image size, modifying pixel intensities, and standardizing face alignments throughout the dataset.

Individual contribution and findings: This position taught me how crucial consistent data preparation is to increasing model correctness, particularly in deep learning applications where results can be greatly impacted by input variability. I became aware of generative AI's potential to enhance categorization in situations with varying illumination and facial angles, where conventional models frequently falter. By creating new examples artificially to increase model variety, generative AI integration also offered insights into managing unbalanced collections.

Individual contribution to project report preparation: By writing sections on data preprocessing and providing technical explanations of the preprocessing methods and generative AI approaches, I helped prepare the report as a whole. In order to set the scene for the objectives and approaches of our project, I briefly described the introduction and background parts.

Individual contribution for project presentation and demonstration: As part of the project presentation, I had to discuss the data preprocessing procedures and how they affected the accuracy of the model during the demonstration. In order to demonstrate the importance of preprocessing in enhancing the model's performance, I also gave real-time samples of how preprocessed and enhanced photos looked when input into the model.

Full Signature of Supervisor: ……

Full signature of the student: ……..

GENDER DETECTION USING GENERATIVE AI

NAYAN KUMAR
2105473

Abstract: My primary role in this project was to implement and fine-tune the generative AI models used for enhancing gender detection accuracy. I contributed to developing and training models that utilized synthetic data generated by GANs (Generative Adversarial Networks) to address imbalances in the dataset. My focus was on leveraging generative AI to improve model performance in challenging scenarios such as varying lighting conditions and facial orientations.

Individual contribution and findings: Through my work on generative AI, I learned how artificial data augmentation could significantly reduce biases and improve model robustness. I realized the importance of generating diverse, high-quality synthetic samples to handle real-world variations. Additionally, I identified that generative AI could effectively complement traditional machine learning techniques to enhance classification accuracy. My contributions provided the model with an enriched dataset, leading to improved accuracy metrics

Individual contribution to project report preparation: I contributed by detailing the generative AI techniques and models used in the project. This included explanations of the GANs architecture, training process, and its role in creating a balanced and robust dataset. I also assisted in drafting the evaluation and results sections, emphasizing how generative AI impacted the model's performance and accuracy.

Individual contribution for project presentation and demonstration: For the project presentation, I explained the integration of generative AI in gender detection and showcased its impact through before-and-after accuracy metrics. During the demonstration, I highlighted examples of synthetic data generated and how it improved the model's performance in handling edge cases, such as occlusions and varying facial angles.

Full Signature of Supervisor: ……

Full signature of the student: ……..

GENDER DETECTION USING GENERATIVE AI

Harshit Nayan
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Abstract:

This project uses OpenCV to investigate a deep learning-based approach for predicting age and gender. This method uses the CaffeNet architecture and pre-trained models to recognize faces in live video frames, then classify them by age and gender. Real-time findings demonstrated the model's potential in a variety of applications, including retail analytics and security, with an accuracy of almost 70% in differentiating between age groups and gender.

Individual contribution and findings:

Through my work on OpenCV, I learned how we can use it for various applications in real life. One of such use is our face detection along with gender and age prediction in realtime camera feed. Additionally, I helped in solving errors that came in between successful completion of the programs.

Individual contribution to project report preparation:

I contributed by preparing the chapter 3 of the report that was the Project Description and Challenges faced during the project a needed for the data set before it can be feeded to the model for training. I also assisted in drafting the evaluation and results sections, emphasizing how generative AI impacted the model's performance and accuracy by getting different real time users to test our model. Also gave the Conclusion and Future works.

Individual contribution for project presentation and demonstration:

For the project presentation, I was tasked to get information from my other team members, understand the flow of our working in our project and compile them in a well prepared presentation. Explained the various application of Gender, Age and Face detection in time of GEN AI.

Full Signature of Supervisor: ……

Full signature of the student: ……..