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A Survey on Real-Time Age and Gender Prediction using Python & ML

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ABSTRACT: This survey paper investigates the field of age and gender prediction, specifically emphasizing non-voice analysis methods. The study focuses on the utilization of Python programming language and Convolutional Neural Network (CNN) algorithms in this context. With a growing emphasis on privacy concerns and diverse applications, voice-independent approaches are gaining prominence. The paper provides a thorough review and comparison of various techniques, methodologies, and datasets employed in age and gender prediction tasks.

A significant portion of the survey is dedicated to unraveling the underlying principles of CNN algorithms and their adaptation to image-based data. The discussion highlights the effectiveness of these algorithms in extracting discriminative features, which contribute to more accurate predictions. The examination of challenges, trends, and potential future directions in this domain offers valuable insights into the dynamic landscape of age and gender prediction without voice analysis using machine learning techniques.

Overall, the survey aims to provide a comprehensive overview of the current state of the field, offering researchers and practitioners a nuanced understanding of the methodologies and advancements in age and gender prediction, while also identifying potential avenues for further exploration and improvement.

KEYWORDS: Age prediction, Gender prediction, Survey, Python programming, Machine learning, Convolutional Neural Network (CNN), Image-based data Facial features, Preprocessing, Feature extraction.

I. INTRODUCTION

In the ever-evolving landscape of artificial intelligence and machine learning, the intersection with demographic prediction, specifically age and gender estimation, has garnered significant attention. Notably, the imperative to address privacy concerns has led to a paradigm shift in methodologies, prompting a departure from traditional voice-based analyses. This survey paper embarks on an exploration of age and gender prediction, focusing explicitly on methodologies that exclude voice analysis, while harnessing the capabilities of Python programming in tandem with Convolutional Neural Network (CNN) algorithms.

The driving force behind this investigation lies in the contemporary emphasis on safeguarding individual privacy, necessitating innovative and non-intrusive approaches in demographic prediction. By deliberately excluding voice analysis, the study seeks to meet the demands of diverse applications that require accurate predictions without compromising privacy. Central to this inquiry is the introduction of CNN algorithms, known for their proficiency in processing image-based data, as a viable solution for robust and reliable demographic predictions.

This introduction sets the tone for a comprehensive survey that not only reviews existing methodologies but also delves into the foundational aspects of CNN algorithms within the context of age and gender prediction. The motivation behind steering away from voice-dependent approaches is underlined, emphasizing the need for solutions that strike a balance between predictive accuracy and privacy preservation. Through an in-depth examination of various techniques, datasets, and emerging trends, the paper aims to equip researchers and practitioners with a nuanced understanding of the current state-of-the-art in demographic prediction. Ultimately, the survey contributes to the ongoing discourse surrounding ethical and privacy-centric applications of machine learning in the realm of demographic analysis.

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Facial age and gender prediction has gained significant attention in recent years due to its wide range of applications in various fields, including marketing, security, and healthcare. This project aims to develop a real-time facial age and gender prediction application using Python and Tkinter, which will leverage a pre-trained model to accurately estimate the age and gender of individuals based on input from a live camera feed.

II. METHODOLOGY

Phase 1: Real Time Dataset
Capture with Webcam:
•The webcam is triggered by a capture function in Python to capture images in real-time.
•When a face is detected by the webcam, it initiates the capture process.

Phase 2: Pre-processing:
Image Detection:
•The captured face image is processed further.
•Conversion to Gray Scale:
•The color image is converted into a grayscale image.
•This is typically done using MATLAB code, representing the image in binary digits (0 and 1).
Noise Reduction:
•Gaussian filtering method is used to reduce noise in the grayscale image.

Phase 3: Normalization:
Face Area Cropping:
•The system crops the detected rectangular face area using MATLAB's built-in object functions.
Feature Detection:
•It detects specific facial features like eye pair, mouth, nose, and chin.
•This provides separate images of left eye, right eye, left eyebrow, right eyebrow, mouth (image of lips), and nose.

Phase 4: Feature Extraction:
Global and Grid Features:
•A combination of global and grid features is extracted from the face images.
•Global features include distances between key facial landmarks such as eye distance, eyeto-nose tip, eye-to-chin, and eye-to-lip.
•These distances are calculated to form four key features.

Phase 5: Gender Detection:
CNN-Based Gender Detection:
•Convolutional Neural Networks (CNN) are used for gender detection.
•Features such as hair length, beard, moustache, and skin texture are extracted.
•Comparison is performed using CNN to determine the gender (male or female).

Phase 6: Age Prediction
Age Classification:
•Age prediction involves eight age categories, such as (0-2), (4-6), (8-12), (15-20), (2532), (38-43), (48-53), and (60-100).
•Skin texture is a key feature for age prediction, as it varies across different age groups.
•CNN algorithms are used for age prediction based on extracted skin texture features.

Phase 7: Classification
Age and Gender Classification:
•Age ranges and gender are dynamically classified based on the extracted features.
•Softmax classifier is used to transform feature vectors into probability distributions.
•This allows for the interpretation of age and gender as probabilities, ensuring they sum to 1 and fall between 0 and 1.

III. PROPOSED ALGORITHM

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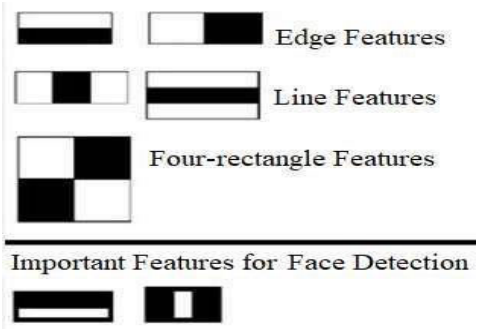
HAAR-LIKE FEATURES:

Haar-like features are named after Alfred Haar, a Hungarian mathematician in the 19th century who developed the concept of Haar wavelets (kind of like the ancestor of haar-like features). The features below show a box with a light side and a dark side, which is how the machine determines what the feature is. Sometimes one side will be lighter than the other, as in an edge of an eyebrow. Sometimes the middle portion may be shinier than the surrounding boxes, which can be interpreted as a nose.

- There are 3 types of Haar-like features that Viola and Jones identified in their research:
- Edge features
- Line-features
- Four-sided features



These features help the machine understand what the image is. Imagine what the edge of a table would look like on a b&w image. One side will be lighter than the other, creating that edge like b&w feature as you can see in the picture above. In the two important features for Face Detection, the horizontal and the vertical features describe what eyebrows and the nose, respectively, look like to the machine. Additionally, when the images are inspected, each feature has a value of its own. It's quite easy to calculate: Subtract White area from the Black area.

CNN Algorithm:
A convolutional neural network consists of an input layer, hidden layers and an output layer. In any feed-forward neural network, any middle layers are called hidden because their inputs and outputs are masked by the activation function and final convolution. In a convolutional neural network, the hidden layers include layers that perform convolutions.
Defining the CNN Model

- Input layer
- Convo layer (Convo + ReLU)
- Pooling layer
- Fully connected(FC) layer
- Softmax/Logistic layer
- Output layer

IV. LITERATURE SURVEY

1.Paper Name: A Lightweight Deep Convolutional Neural Network Model for
Author: Md. Nahidul Islam Opu, Tanha Kabir Koly, Annesha Das and Ashim Dey
Abstract: Recognition of age and gender has become a significant part of the biometric system, protection, and treatment. It is widely used for people to access age-related content. It is used by social media in the distribution of

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layered advertising and promotions to expand its scope. Application of face detection has grown to a great extent that we should upgrade it using various methods to achieve more accurate results. In this paper, we have developed a lightweight deep Convolution neural network model for real-time age and gender prediction. For making the training dataset more diverse, Wiki, UTKFace, and Adience datasets have been merged into one containing 18728 images. Using this vast mixed dataset, we have achieved accuracy of 48.5980.76tested in real-time. Different experimental investigations on the prepared dataset show that with most recent approaches, our model provides competitive prediction accuracy

2.Paper Name: Gender, Makeup, Age and Illumination Prediction from Faces using Ensemble Modeling.
Author: Kundan Nigam, Sahil Sharma
Abstract: Gender, makeup, age and illumination classification has become one of the major task and these tasks has become more powerful in real time applications. Still, the performance of existing method is lacking when compared in optimization. In this research paper we have been applied various machine learning models to get the results more optimized. We try to developed ensemble techniques for sturdy age classification ranges and these ranges are classified into four categories that are child, young, middle and old. Similarly Gender classification ranges are divided into male and female and Makeup classification ranges are divided into partial makeup and over makeup and also illumination classification ranges are divided into bad, medium and high categories.

3. Paper Name: Gender and Age based Census System for Metropolitan Cities
Author: Shiva Mittal, Vikram Singh Rajput
Abstract: This paper presents a smart computer-vision based system which helps ensure disciplined entry of people in places by ascertaining the allowable age and gender of the person, as well as storing the data for census use. The system involves deep learning based facial image classifiers, which predict the gender and age from the image of face captured by the camera in real-time. The actuating response is generated according to the prediction of the computer vision algorithm, which further keeps the record of encountered faces with the respective counts of persons with corresponding facial traits. The log of the entire surveillance process can be monitored online through the integrated IOT capability, thereby can be used as primary data source. The successful experimental runs demonstrate the system's usability in the real world applications.

V. FUTURE WORK

When changing a dataset, the same model can be trained to predict the feelings of race etc. Age and gender classifications can be used to predict age and gender in uncontrolled real-time situations such as train stations, banks, buses, airports, etc. For example, depending on the number of male and female passengers by the age on the train station, toilets and restrooms can be built to facilitate transportation.

For future works, we will consider a deeper CNN architecture and a more robust image processing algorithm for exact age estimation. Also, the apparent age estimation of human's face will be interesting research to investigate in the future.

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