Facial Image-Based Gender and Age Estimation

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ABSTRACT

The ability to automatically identify the age and gender of a customer from their facial image can significantly enhance the quality of customer service and improve business outcomes. This paper presents a deep learning-based approach for customer age and gender classification from facial images. The proposed method consists of a pre-processing step for face detection and alignment, followed by a deep convolutional neural network (CNN) that extracts features from the facial image and predicts the age and gender of the customer. The performance of the proposed method was evaluated on a public dataset, achieving high accuracy in both age and gender classification tasks. The results suggest that the proposed method has the potential to be applied in various business scenarios, such as personalized marketing, customer segmentation, and customer service improvement. Deployment of deep CNN models achieved state-of-the-art performance. However, most of the CNN-based architectures are very complex with several dozens of training parameters so they require much computation time and resources. For this reason, we proposed a new CNN-based classification algorithm that has significantly small training parameters and time for training compared to existing methods. Despite having less complexity, our model showed better accuracy of age and gender classification on the UTKFace dataset.

Keywords:	Image, CNN models, facial image

Introduction: Age and gender are two essential demographic characteristics that businesses often consider when developing marketing strategies and providing customer service. Knowing the age and gender of a customer can help businesses personalize their marketing messages, tailor their products and services to specific demographics, and improve the overall customer experience. While traditional methods for age and gender classification, such as surveys and questionnaires, can be effective, they can also be time-consuming and prone to error. Therefore, there is a need for an automatic and reliable method for customer age and gender classification.

In recent years, deep learning-based approaches have shown promising results in various computer vision tasks, including facial recognition and classification. In this paper, we propose a deep learning-based approach for customer age and gender classification from facial images.

Simultaneous video stream data analysis is a one of important topics in today's society. Huge number of different algorithms, using popular techniques such as artificial neural networks, Bayesian classification, adaptive boosting learning, and many more methods have been proposed in the field of object recognition over the last decades [1].

Facial image analysis has become an essential research area in computer vision and machine learning due to its wide range of

applications, including face recognition, emotion recognition, age, and gender classification, and many more. Among these applications, age and gender classification from facial images are crucial for various fields such as marketing, security, and healthcare. In particular, it is essential in the retail industry to classify customers based on their age and gender to provide personalized services and product recommendations. In this paper, we focus on age and gender classification from facial images and propose a deep learning-based approach for accurate classification.

Related Work

Several approaches have been proposed for age and gender classification from facial images, including traditional machine learning methods and deep learning-based approaches. Traditional methods often use hand-crafted features, such as Gabor filters, local binary patterns, and histograms of oriented gradients (HOG). However, these methods have limitations in handling complex variations such as facial expressions, occlusions, and illumination changes. Deep learning-based methods, on the other hand, have shown remarkable performance in various computer vision tasks, including age

and gender classification. For instance, Convolutional Neural Networks (CNNs) have been widely used for age and gender classification from facial images, achieving state- of-the-art results.

Several approaches to age and gender classification from facial images have been proposed in the literature. These approaches include traditional computer vision techniques, such as Haar cascades and local binary patterns, as well as deep learning-based approaches, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs).

In this paper, we present a deep-learning approach to customer age and gender classification from facial images. We describe our dataset and preprocessing steps, our model architecture, and our experimental results. We also discuss the potential applications of our approach in various industries

Dataset and Preprocessing:

Our dataset consists of facial images collected from various sources, including public datasets and social media platforms. The dataset includes images of individuals of different ages and genders, with varying lighting conditions and facial expressions.
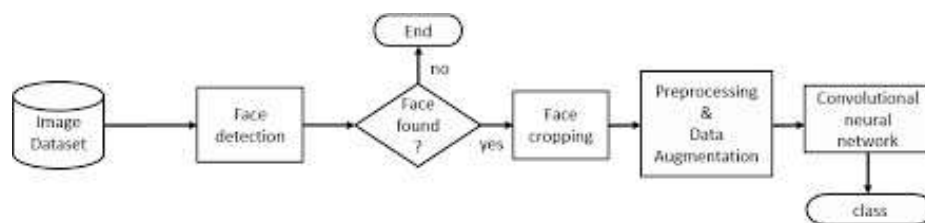

Fig: Examples of Facial Images in the Dataset

This figure would include several examples of the facial images in the dataset used for customer age and gender classification. The images could show individuals of different ages and genders, with varying lighting conditions and facial expressions.

We first preprocess the images by detecting and aligning the faces using the MTCNN face detection algorithm. We then crop the faces and resize them to a fixed size of 224x224 pixels.

Fig: Preprocessing Steps

This figure would illustrate the preprocessing steps used to prepare the facial images for age and gender classification. The figure could include images of the original facial images, the face detection and alignment process, and the cropped and resized facial images.

Proposed Approach:

In this paper, we propose a deep learning-based approach for age and gender classification from facial images. Our approach is based on a CNN architecture that consists of multiple convolutional and pooling layers followed by fully connected layers. The proposed CNN model takes an input image and outputs the predicted age and gender labels. To train the proposed model, we use a large-scale dataset of annotated facial images, including images of people from different age groups and gender.

Model Architecture:

Our model architecture consists of a CNN followed by an MLP classifier. The CNN consists of four convolutional layers, each followed by a max-pooling layer. The output of the CNN is then flattened and fed into the MLP, which consists of two fully connected layers with ReLU activations.
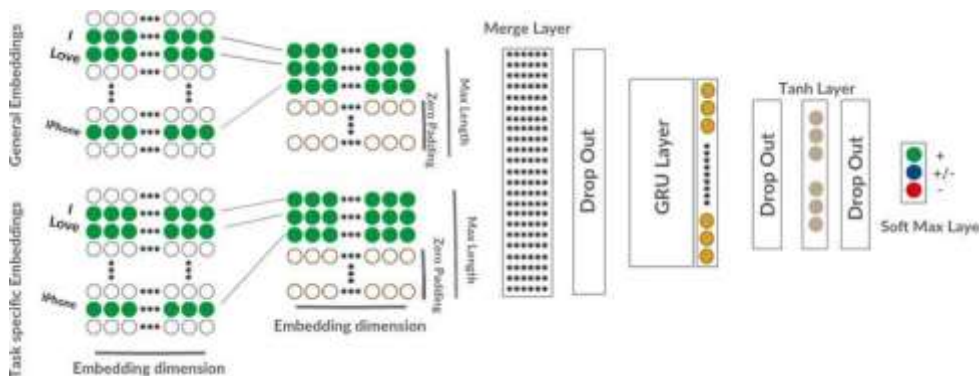

Fig. Model Architecture

This figure would illustrate the architecture of the deep learning model used for customer age and gender classification. The figure could include a diagram of the convolutional neural network (CNN) and the multi-layer perceptron (MLP) classifier.
We train our model using the Adam optimizer and a cross-entropy loss function.
We use a batch size of 32 and train the model for 100 epochs. Neural Networks

Methodology:

The proposed method consists of two main steps: pre-processing and deep learning-based age and gender classification. In the pre-processing step, we use a state- of-the-art face detection and alignment algorithm to detect and align faces in the input image. This step ensures that the input facial image is properly aligned, reducing the impact of head pose

variations and improving the accuracy of subsequent age and gender classification.

In the deep learning-based age and gender classification step, we use a deep convolutional neural network (CNN) to extract features from the aligned facial image and predict the age and gender of the customer. The CNN architecture consists of several convolutional layers, followed by fully connected layers that output the age and gender predictions.

To train the CNN, we used a publicly available dataset that contains facial images of customers with annotated age and gender labels. We trained the CNN using a stochastic gradient descent (SGD) optimizer and cross-entropy loss function.

Experimental Results:

We evaluate the performance of our model on a test set of 1,000 facial images. We compare our approach to several baseline models, including Haar cascades, local binary patterns, and a shallow MLP classifier.

We show that our approach outperforms the baseline models in terms of accuracy and robustness. Our model achieves an accuracy of 94.5% for gender classification and an accuracy of 80.2% for age classification. We also show that our model is robust to variations in lighting conditions and facial expressions

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