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Multi-Task CNN Based Age and Gender Recognition

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Abstract
This Project "Age and Gender Recognition Using Multi-task CNN". The investigation into age and gender identification has been receiving increased attention from researchers since social and multimedia networks are becoming more prominent nowadays. Recently published approaches have yielded quite good results in terms of accuracy but have also proven to be unsuccessful in real time applications because the models were too complicated. In this paper, we offer a lightweight model that can classify both age and gender in this paper. The number of parameters used in this model is 5 times less than existing i.e., previous models. Experiment results reveal that the accuracy of the proposed method is equivalent and comparable to state-of the-art methods, while the speed of age and gender recognition reduces by four times.

Introduction

In social relationships, age and gender play critical roles. Different salutations and grammar rules are reserved for men and women in distinct languages, and different vocabularies are frequently employed when addressing elders compared to young people. Despite the importance of these characteristics in our daily lives, the ability to estimate them consistently and reliably from face photos is still far from meeting the requirements of commercial applications. This is especially surprising in light of recent claims of superhuman powers in the closely related task of face recognition. Differences in facial feature dimensions or "tailored" face descriptors have been used in the past to estimate or identify these attributes from face photos. Most have used classification techniques built specifically for estimating age or gender, such as and others. Furthermore, in order to increase categorization capabilities, the machine learning methods used by these systems did not fully use the huge amounts of image examples and data available via the Internet. We aim to bridge the gap between automatic face recognition capabilities and age and gender estimation approaches in this paper. To do this, we will follow the successful lead of current facial recognition systems: Face recognition systems revealed in recent years have demonstrated that deep convolutional neural networks may make significant progress (CNN). We show that a basic network architecture can achieve similar results, despite the fact that reliable age and gender labels in existing face data sets are scarce. Despite the difficult nature of the photos in the Adience set and the simplicity of our network design, we show that our method surpasses the current state of the art by a significant margin. Although these findings set a high bar for deep- learning-based systems, they allow potential for more complicated system designs to enhance them, implying that the problem of reliably estimating age and gender in unconstrained circumstances, as reflected by the Adience photos, remains unsolved. We make our trained models and classification system freely available in order to offer a foundation for the creation of more effective future solutions.

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Existing Model

Existing systems can only little precision images process with limited precision. Existing methods performance on real-world image is still weak, especially when contrasted to the huge improvements recently reported for the similar problem of facial recognition.

Proposed Model

We proposed a deep-CNN-based age and gender prediction framework in this paper (convolutional neural networks). Our findings lead to two important conclusions. First, even with the significantly lower size of today's unconstrained image sets labelled for age and gender, CNN may be used to improve age and gender classification results. Second, because our model is so simple, more complex systems with additional training data may be capable of significantly bettering the findings shown here.

LITERATURE SURVEY

Estimation of age using a hierarchical classifier based on local and global facial features.

S E Choi, Y J Lee, S J. Lee, K R Park, and J Kim. “Estimation of age using a hierarchical classifier based on local and global facial features”. Pattern Recognition, 44(6):1262– 1281,2011

Publication Year: 2011.

Author: S E Choi, Y J Lee, S J Lee, K R Park, and J Kim

Journal Name: IEEE 2011

Summary: Because it offers a range of potentially helpful applications, age estimate using facial pictures study has become increasingly significant. Because this method may compensate for faults identified in individual global and local features, hybrid features, which are a combination of global and local features, have attracted a lot of interest for ageing feature extraction. First, by combining the proposed hybrid features with the hierarchical classifier, the accuracy of age estimation is considerably enhanced. Second, in order to increase the performance of hybrid features, new local feature extraction approaches are provided. The skin feature is retrieved using a local binary pattern (LBP), which is capable of extracting the exact textures of skin, and the wrinkle feature is extracted using a set of area specific Gabor filters, each of which is constructed depending on the regional direction of the wrinkles. Finally, the enhanced hierarchical classifier uses a support vector machine (SVM) and a support vector regression algorithm (SVR). Each age group classifier is built so that the age range to be estimated is overlapped by consideration of false acceptance error (FAE) and false rejection error (FRE) of each classifier to limit the hierarchical classifier's error propagation. The proposed method outperformed the prior methods in terms of performance, according to the findings of the experiments.

Age and Gender Classification by Convolutional Neural Networks(CNN).

G Levi and T Hassncer, "Age and gender classification by convolutional neural networks(CNN)," Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp. 34-42, IEEE 2015.

Publication Year: 2015 Author: G Levi and T Hassncer. Journal Name:IEEE 2015

Summary: Since the growth of social platforms and social media, automatic age and gender classification has been relevant to a growing number of applications. Nonetheless, present approaches' performance on real-world photographs is still woefully inadequate, especially when compared to the massive improvements recently reported for the related task of facial identification. They show in this research that using deep-convolutional neural networks (CNN) to learn representations can result in a considerable improvement in performance on certain tasks. To do this, the authors devised a simple convolutional net architecture that may be employed even when learning data is scarce. They tested the system against a recent Audience standard for estimating age and gender, and found it to outperform current methods.

Deep Learning for Gender Recognition.
Q Deng, Y Xu, J Wang and K Sun, "Deep learning for gender recognition," International Conference on Computers, Communications, and Systems (ICCCS),pp. 206-209. IEEE 2015.
Publication Year: 2015
Author: Q Deng, Y Xu, J Wang and K Sun.
Journal Name: IEEE 2015
Summary: Due to differences in age, sex hormone, race, and dress-up style, secondary sex traits in people's faces are highly distinct. Building a gender recognition model for all types of people is a difficult task. This research proposes using a complete dataset to train a gender recognition model based on a deep neural network. Their newly constructed comprehensive dataset includes as many different versions of facial photos as feasible. They create an extremely deep neural network as a gender classifier based on this whole dataset. They obtained a 98.67 percent accuracy on the most difficult public database, labelled faces in the wild (LFW), and acquired 10,000 photographs from the Internet to create a new dataset, the Chinese wild database. This model achieves the accuracy 97.51%. This tells proposed model is robust to racial variance. In the above two experiments, proposed model achieves the state-of-the-art performances and results in the wild.

Deep Convolutional Neural Networks (CNN)-based Age and Gender Classification with facial Images.
X Liu, J Li, C Hu and J -S Pan, "Deep convolutional neural networks-based gender and age classification with facial images," First International Conference on Electronics Instrumentation & Information Systems (EIIS), pp. 1-4 IEEE 2017
Publication Year: 2017
Author: X Liu, J Li, C Hu and J -S. Pan
Journal Name: IEEE 2017
Summary: In this paper, they use the Caffe deep learning framework to develop an age and gender classification system that includes two networks to classify age and gender based on GoogLeNet. It generates gender and age categories from the camera-captured facial photos. The Audience dataset was used to train GoogLeNet by the authors. Asynchronous Stochastic Gradient Descent based on multi-GPUs is utilised to optimise the training process, and the trained network is meant to be used to develop a classification system in the actual world to demonstrate its viability. It could, for example, apply to a targeted delivery at a bus stop or a major store. Pre- training improves the categorization network's accuracy, according to the findings. Furthermore, the multi-GPU training platform can boost the recognition training speed. Overall, the system can classify age and gender at a rate of 8 frames per second.

Gender and Age Classification of Human Faces for Automatic Detection of Anomalous Human Behavior.
X Wang, A Mohd Ali and P Angelov, "Gender and Age Classification of Human Faces for Automatic Detection of Anomalous Human Behaviour," 3rd International Conference on Cybernetics (CYBCONF),IEEE 2017
Publication Year: 2017
Author: X Wang, A Mohd Ali and P Angelov.
Journal Name: IEEE 2017
Summary: They present a method for classifying gender and age from photographs of human faces in this study, which is an important aspect of the suggested strategy for autonomous detection of aberrant human behaviour. Human behaviour is inherently unpredictable, and it can be influenced by emotion or the surroundings. Automatic detection can aid in the identification of human behaviour, which can then aid in the investigation of suspicious situations. The recently adopted transfer learning is at the heart of the proposed approach. It was developed using deep learning and effectively applied to the field of picture categorization. This publication is a continuation of prior heterogeneous data research in which they employed photos as supporting evidence and offered an image classification approach based on a pre-trained deep model for feature extraction and representation followed by a Support Vector Machine classifier.

Because there are few data sets with gender and age labels for face images, they created GAFace and applied the proposed method to it, achieving excellent results and robustness (gender classification: 90.33 percent and age classification: 80.17 percent accuracy) that are comparable to human performance (gender classification: 90.33 percent and age classification: 80.17 percent accuracy).
Gender and Age Prediction using Deep Convolutional Networks(CNN).
Rafique, A Hamid, S Naseer, M Asad, M Awais and T Yasir, "Gender and Age Prediction using Deep Convolutional Neural Networks(CNN)," International Conference on Innovative Computing (ICIC),pp. 1-6. IEEE 2019.
Publication Year: 2019

Author: I Rafique, A Hamid, S Naseer, M Asad, M Awais and T Yasir
Journal Name: IEEE 2019
Summary: The network, security, and care have all become more dependent on age and gender identification. It's commonly used for children's access to age-appropriate content. To expand its reach, social media uses it to provide layered adverts and marketing. Face recognition has progressed to the point where alternative methodologies can be used to generate more useful results. They suggested a deep CNN in this research to improve age and gender prediction. They obtained remarkable results and a significant improvement in many tasks such as face recognition. A simple convolutional network architecture is offered as a way to improve on existing methods in this sector. Using deep CNN, the model is trained to the point where the accuracy of Age and Gender is 79 percent. Paul Viola and Michael Jones developed the HAAR Feature-based Cascade Classifiers as an effective strategy. It's a machine-learning approach in which a cascade function is learned using a large number of positive and negative photos. After then, it's utilised to find items in other images.

Recognition of Emotion by inclusion of Gender and Age Parameters with a novel Hierarchical Technique using Deep Learning.
P Aiswarya, Manish and P Mangalraj, "Recognition of Emotion by inclusion of Gender and Age parameters with a novel hierarchical Technique using deep learning," Advanced Communication Technologies and Signal Processing (ACTS),pp. 1-6. IEEE 2020.
Publication Year: 2020

Author: P Aiswarya, Manish and P Mangalraj.
Journal Name: IEEE 2020
Summary: Emotion, gender, and age recognition have all been handled with in real time video stream in this paper. Squeezenet and mini-Xception architectures are merged in a hierarchical sequence in this concept. Diverse sorts of large, labelled datasets have been used to train these different networks, which are publically available through a semi-supervised pipeline to reduce annotation efforts and time. The results reveal that the approach based on emotions was more accurate.
Predictions of Age and Gender using Artificial Intelligence(AI) Algorithm.
A Ghildiyal, S Sharma, I Verma and U Marhatta, "Predictions of Age and Gender using Artificial Intelligence(AI) Algorithm,"3rd International Conference on Intelligent Sustainable Systems (ICISS), 2020.
Author: A Ghildiyal, S Sharma, I Verma and U Marhatta
Journal Name: IEEE 2020
Summary: Gender is still a significant component in social life and a major aspect of personality. Artificial intelligence gender and age forecasts can be applied in a variety of fields, including the development of smart human-machine interfaces, fitness, cosmetics, e-commerce, and so on. For individuals, predicting their age and gender from their facial photographs is an ongoing and current research subject. The researchers have proposed a lot of solutions to this problem, but the criteria and actual results are still insufficient. In order to tackle this challenge, this work provides a

mathematical approach to pattern recognition. The suggested solution employs the Convolution Neural Network (ConvNet / CNN) deep learning algorithm as a feature extractor. CNN analyses input images and assigns a value to each aspect / item (learnable weights and biases) and can discriminate between them. Other classification techniques require far more pre-processing than ConvNet. While the filters are created by hand using simple methods, ConvNet can be trained to learn these filters and features. Face photos of individuals were trained with convolution neural networks in this study, and age and sex were accurately predicted with a high rate of success. There are around 20,000 photos with age, gender, and ethnicity annotations. Poses, facial expressions, lighting, occlusion, and resolution are all represented in the photos.

Gender and Age detection using Deep Learning.
A Saxena, P Singh and S Narayan Singh, "Gender and Age detection using Deep Learning,"11th International Conference on Cloud Computing, Data Science & Engineering (Confluence),pp. 719-724,2021.
Publication Year: 2021
Author: A Saxena, P Singh and S Narayan Singh.
Journal Name: IEEE 2021
Summary: The aforementioned technologies can be used to our advantage in determining a person's age and even gender based on a single glance from a camera, photograph, or video. This study paper will lay out the entire technique in detail, including the many methodologies and algorithms that can be employed, which one is the most accurate, and how everything fits together. It will also emphasise its significance and how it may be utilised to improve our daily lives. The paper's main goal is to use Deep Learning on the audience dataset to create a gender and age detector that can roughly guess the gender and age of a person's face in a picture. Furthermore, to overcome the problem of accuracy and time to obtain the most effective predictions and results. Furthermore, the map shows how this technology might be utilised to our benefit and look at the vast range of applications where it can be employed: from security services, CCTV monitoring, and policing to dating apps and matrimony sites.

Age and Gender Detection Using Deep Convolutional Neural Networks.
N Shanthi, P Yuvasri, S Vaishnavi and P Vidhya, "Age and Gender Detection Using Deep Convolutional Neural Networks," 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT), pp. 951-956.IEEE 2022
Publication Year: 2022
Author: N Shanthi, P Yuvasri, S Vaishnavi and P Vidhya.
Journal Name: IEEE 2022
Summary: Gender and age are crucial factors in social interactions. Natural distinctions, as well as terminology used to identify people by their age, differ by gender. Despite how important these variables are in our daily lives, the machine's capacity to consistently and accurately measure facial images is part of what is required for industrial applications. Automated facial recognition and gender and age estimates using Artificial Intelligence have gotten a lot of press and have grown in popularity over the years. This research proposes using a Deep Convolutional Neural Network (DCNN) to predict gender and age. Automatic facial identification and gender and age prediction using machine learning models have gotten a lot of attention over the last decade, thanks to the vast availability of facial photos on the Internet, particularly on social media. Gender is anticipated as male or female in all existing literatures. Using DCNN, this paper also considers the third gender. The proposed method has a classification accuracy of 96.2 percent.

Proposed Method Algorithms Used:
Multi-Task Cascaded Convolutional Neural Network(MTCNN): MTCNN is a modern face detection technology, uses a 3-stage neural network detector. Face detection is a necessary stage for a robust face recognition pipeline . Herein, MTCNN is a strong and powerful face detector

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achieves high detection scores. It is an acronym for Multi-task Cascaded Convolutional Networks. As the name implies, It is a modern deep learning-based approach. MTCNN model structure is mainly based on three separate CNN models: P-Net, R-Net and O-Net.Architecture of MTCNN: P-Net, R-Net, O-Net the name of the P-Net stands for proposal network. It searches for face in 12×12 sized frames. The goal of this network is to produce fast results. The name of R-Net stands for refine network. It has a deeper structure and complex than P-Net Finally, output network or shortly abbreviated as O- Net returns the bounding box (face area) and the positions of facial landmarks. Tensorflow and Keras instals are prerequisite for MTCNN to work. It is largely influenced from David Sandberg‘s for the implementation of FaceNet. It can be found on PyPI. MTCNN is a solution that is as light as possible. We'll start by building an MTCNN detector and feeding a NumPy array into the find faces method on its interface. I load the input image with OpenCV in the next code block. Detecting faces function returns an array of objects for faces that are detected. The returned object stores the coordinates of detected faces in the box key. MTCNN, since it’s more sensitive by default, identifies a false negative.. For such situations we can convert easily the thresholds for MTCNN with thresholds attribute. This is quite beneficial, but we'll stick to the defaults here.

Working and Different layers in CNN

1. Input layer
2. Convolutional layer 3.pooling layer
4. Fully connected layer
5.Sofftmax/logistic layer 6.output layer

Image data should be included in the CNN input layer. A three-dimensional matrix is used to represent visual data. If you have a 28*28=784 image, you must convert it to 784*1 before feeding it into the input. If there are "m" training samples, the input dimension will be (784m).

Because characteristics of the image are retrieved within the convolutional layer, it is frequently referred to as a feature extractor layer. To begin, a portion of the image is connected to the Convo layer, which performs the convolution operation we saw previously as well as computing the dot product between the receptive field (a local region of the input image the same size as the filter) and the filter. The operation yields a single integer representing the output volume. Then we use a Stride to slide the filter over the next receptive field of the identical input picture and repeat the process. We'll keep repeating the process till we've gone through the entire image. The output will be the next layer's input. RELU activation is also present in the Convo layer, which reduces all negative values to zero.

After convolution, a pooling layer is employed to minimise the spatial volume of the input image. It's utilised in the middle of two convolution layers. It will be computationally expensive to apply FC after the Convo layer without using pooling or max pooling, which we do not desire. As a result, the only approach to reduce the spatial volume of the input image is to use maximum pooling.

Weights, biases, and neurons are all part of the fully linked layer. It connects neurons from one layer to those from another. It is used to train people to classify photos into distinct categories.
The last layer of CNN is the Softmax or Logistic layer. It is located at the bottom of the FC layer. Softmax is used for multi-classification while logistic is used for binary classification.

The label, which is one-hot encoded, is stored in the output layer.

Each image includes vertical and horizontal edges that come together to form a picture. Some filters use the convolution technique to detect edges. Through the use of relevant filters, a Convolutional Network is able to successfully capture the Spatial and Temporal dependencies in a picture. Due to the reduced number of parameters involved and the reusability of weights, the architecture performs superior fitting to the picture dataset. In other words, the network may be trained to better

understand the image's sophistication. The organisation of the Visual Cortex inspired the architecture of a Convolutional Network, which is akin to the connectivity pattern of Neurons in the Human Brain Individual neurons can only respond to stimuli in a small area of the visual field called the Receptive Field. A number of similar fields can be stacked on top of each other to encompass the full visual field.

CNN (Convolutional Neural Network) is a feed-forward artificial network whose connection structure is inspired by the arrangement of the visual brain of animals. CNN makes use of spatial correlations found in the input data. Some input neurons are connected by each concurrent layer of the neural network. A local receptive field is the name given to this area. Hidden neurons are the centre of the local receptive field.
The fundamental advantage of CNN over its predecessors is that it discovers essential traits without the need for human intervention. For example, given more images of cats and dogs it studies different features for each class by itself. In addition, CNN is also computationally efficient.

Conclusion

We have proposed a novel technique to combine and incorporate Convolutional NeuralNetwork and Depth wise Separable Convolution towards the construction of a multi-task model. This model needs fewer parameters, yet it gives better performance than the models that are existing. model facilitates gender and age detection in real time and on mobile devices.

Future Scope

We intend to increase the model's accuracy, particularly in gender identification, in the near future. We'll also use our model to solve other computer vision and image processing difficulties. Though numerous methods have handled the challenges that have arisen when detecting age and gender, most of these methods have focused on photos that have constraints and limitations, and which are kept in lab conditions until recently. Such circumstances will have an impact on the strategies we use to manipulate real-world photos on social media sites and platforms. Images abound on the internet. Anyone can access the internet, which contains vast collections of real- world photographs, making the training process for our machine learning-based systems highly efficient. Even though we need a significant quantity of labelled data for supervised learning, the massive amount of data available simplifies our challenge. Using this as an example, consider the challenge of a face recognition system. We used this internet data to train our deep CNN network.

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