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Human Age and Gender Recognition using Convolutional Neural Networks

Prof. Abhilasha Kulkarni[1], Radhika Khiste[2], Suteja Patil[3], Shreeya Tahasildar[4], Shreeya Tambolkar[5]
[1, 2, 3, 4, 5]*Department of Computer Engineering, Marathwada Mitra Mandal's College of Engineering,Pune*

Abstract: ***This paper proposes a real-time age and gender recognition system using deep-Convolutional Neural Networks(CNN). There has been a growing demand for automatic age and gender recognition in the fields of surveillance, biometrics, recommendation systems and many more. The implementation of the proposed system includes age estimation, gender recognition and cloud storage. It is a real-time video based system developed using OpenCV. Haar cascade classifier is used for face detection which is fast and reliable. The detected face is sent for age and gender classification. The classification is done using Gil Levi and Tal Hassner CNN trained models-Caffe. Separate Caffe models are defined for age and gender recognition algorithms. Adience benchmark is used for testing of the developed model. Then the classification results are uploaded on the Amazon S3(Simple Storage Service) cloud. This paper aims at proving how CNN can be used to implement the classification model and how it outperforms the other conventional methods.***

Keywords: real-time, age and gender recognition, convolutional neural networks, Haar cascade classifier, Caffe models

I. INTRODUCTION

Face, age and gender recognition has long been recognized as an important module for many computer vision applications such as human-robot interaction, visual surveillance and passive demographic data collections. Identifying persons to allow them access to or control of facilities, tools and information are amongst the most common applications.

Age and gender recognition is one of the most difficult task as human face is complex in nature with unique characteristics. A lot of facial features like eyes, lips, eyebrows, hair, chin, beard, moustache, winkles are considered for both age and gender classification. Taking into consideration these features, developing a live-stream video model to detect the face and estimate its age and gender should be done in minimum time with maximum accuracy.

This recognition system is very useful in the field of surveillance with applications like hostels, bars, movie theatres. It can also be used in recommendation systems like games, accessories, clothes, movies, diet plans, medical treatments, lab procedures. This human-computer interaction saves a lot of money, resources and time. It helps in better analysing of users, their interests and the latest trends. Such cases can be saved and later referred whenever needed or if similar case occurs. It adds up to the technological advancements occurring in the world which helps in betterment of the country at a global level.

Applications of these techniques vary from tagging a person on social media platforms to identifying a criminal in some theft case. Consider if a person is travelling by cab.

Then using this recognition system, music can be suggested to the passenger as per his age and gender during his travel time. It is also helpful in malls to guide the customers to appropriate stores. This saves a lot of human resources as well as time. With increase in such models where there is no need of human intervention, much time and cost is saved as humans need to be trained over time. It also decreases the risk of human errors and boosts the demand of human-computer interaction systems.

In this paper we try to accomplish a responsive and faster module which captures a face from a live video stream and tries to estimate its age and gender to create logs.

Such logs are recorded and used for statistical analysis. It helps in making personalized recommendations and accomplishing faster search results. So to increase the performance and accuracy, we have used deep- Convolution Neural Networks for the same. It proves how it is better than the conventional methods. We have developed a simple architecture for the system which will work also work on relatively smaller-sized datasets.

The testing of the network is done on the Adience benchmark which have various images for age and gender classification. The images in Adience contains face photos which has variations in appearance, nose, postures and more. It contains a total of 26,580 photos of 2,284 subjects. We show that despite such variety of photos, how our simple architecture of the recognition model has a remarkable outcome and proves to be much efficient than the other substantial algorithms.

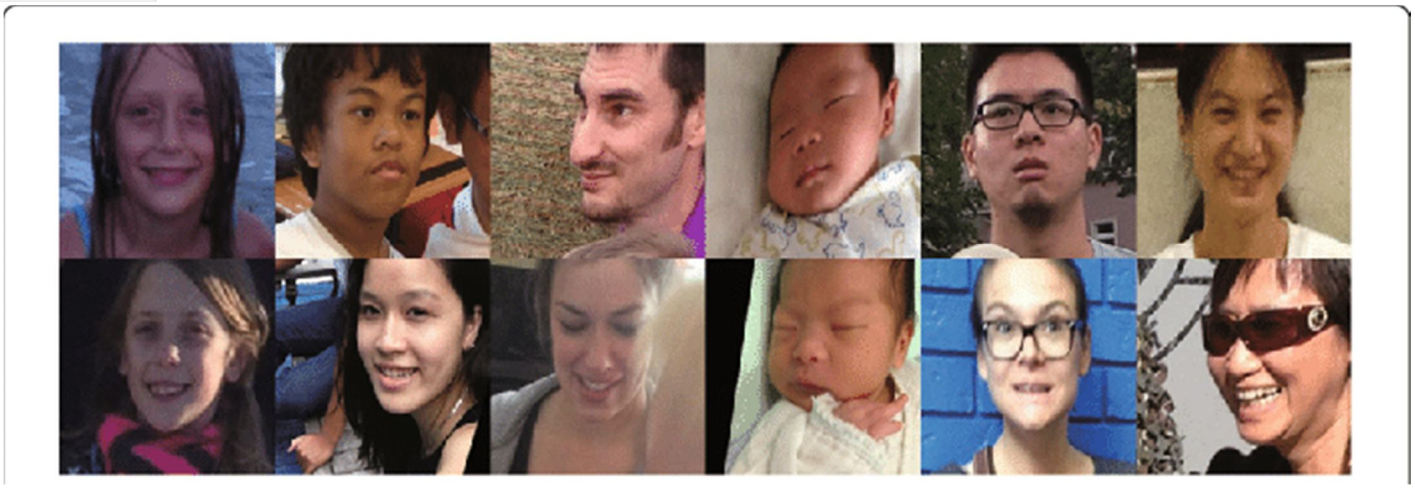

Fig.1 Faces from Adience benchmark for age and gender classification

II. PROPOSED METHODOLOGY

As the system proposes a live-stream age and gender recognition module, a CCTV camera is used to capture the video frames. These frames are sent via the edge device into the system. The captured frames are further sent for classification if any face has been detected. The detected results is then classified into age and one of the gender groups. The age of the detected face is classified into one of the groups- “0–2”, “4–6”, “8–13”, “15–20”, “25–32”, “38–43”, “48–53” and “60-100”; while the gender is classified as "male" and "female". The classified results are then stored on the cloud for future reference.

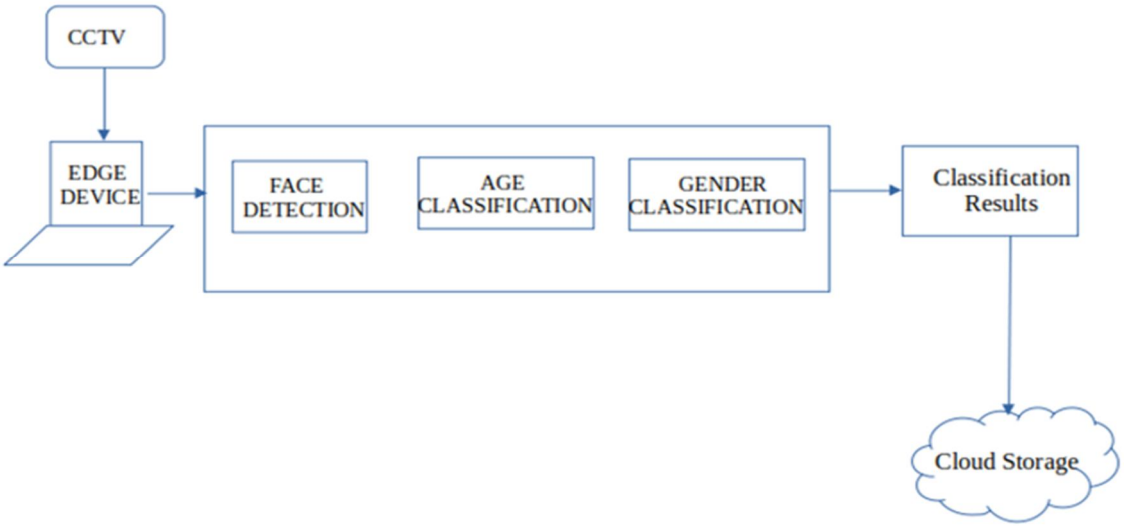

Fig.2 System Architecture

This system can be categorized into 3 steps-

1) *Face Detection:* Face detection is the ability of a computer to detect a person's face using digital images. The process of detecting is quite complex and often begins tracking from human eyes as they are the most easiest feature to detect on a human face. After the eyes, the algorithm tries to detect eyebrows, the mouth, nose, nostrils and the iris. Once the algorithm has surmised that it has detected a facial region, it validates the same and sends it for further classification. We have used the haar cascade classifier algorithm for detecting the face. First the captured image frames are loaded using OpenCV which by default loads the image into BGR colour space. The image is then converted to gray scale as OpenCV face detector expects gray images hen we load the haar classifiers(downloaded XML files) which considers the image as the input. OpenCV’s Cascaded Classifier detects the face using detect Multi Scale function. If a face is not detected, the image is discarded else is sent for further classification. The face detection results are stored in a json file.

2) *Age and Gender recognition using CNN:* We are using the Gil Levi and Tal Hassner trained CNN models which were published as Caffe models for age and gender recognition. We are going to use OpenCV's Deep Neural Networks i.e. dnn package which supports the Caffe models. There are two files each for age and gender recognition. One of the file is ".prototxt" which contains the definition of CNN. It contains definition of the layers in the neural network, each layer's inputs, outputs and functionality. Other file is ".caffemodel" which contains the information of the trained neural network (trained model). The input image is first pre-processed before sending into deep neural networks for classification .The pre-processing first includes scaling where the image is scaled using a scale factor. Then the image is transformed into a spatial size as expected by the Convolutional Neural Networks. For most current state-of-the-art neural networks size is either 224×224, 227×227 or 299×299.Then a 3-tuple of the RGB means or a single value is subtracted from every channel of the image. OpenCV assumes images are in BGR channel order; however, the mean value assumes that it is RGB order. To resolve this discrepancy the R and B channels in the image are swapped. This is the whole pre-processing of the image before sending it for classification. Then the gender of the person in the image is estimated. For this , the image is passed through the Caffe model files defined for gender. Similarly age is classified into one of the predefined age groups- "0–2", "4–6", "8–13", "15–20", "25–32", "38–43", "48–53" and "60-100" using the Caffe model files defined for age classification.
3) *Step 3- Cloud Connectivity:* Amazon S3 or Amazon Simple Storage Service is a service offered by Amazon Web Services that provides object storage through a web service interface. It is highly scalable, reliable, fast and inexpensive data storage infrastructure. So we create a bucket which is mainly the container of Amazon S3 used to store data. The face detection json file and a video file containing the classification results are uploaded to the bucket onto the cloud.

III. RESULTS

Thus age and gender classification system has been successfully implemented using Haar cascade classifier and Deep-Convolutional Neural Networks(CNN).CNN gives an accuracy of almost 75% using the small sized Adience dataset. CNN outperforms the other machine learning traditional algorithms used in such prediction systems. The accuracy of the system can be increased using large datasets and by increasing the CNN layers.

IV. CONCLUSION

We were able to detect age and gender of a human using facial images. The CCTV captured frames from the live-video stream. If faces were detected, they were sent for classification. Age and gender of the detected face was estimated and displayed. The algorithms used are one of the most accurate methods for age and gender classification. This system works in all working conditions and has been successfully implemented.

V. FUTURE SCOPE

Applying pose estimation to the detected faces would give us a good sense of how each face elements corresponds to the overall face positioning. These information can help us to better represent the face image as a whole. Another potential future direction is to improve the accuracy of the current age classification. Building a database from images of people captured in real-world scenarios (e.g., images from people watching a public TV display) would be a good idea to generalize the age and gender model for real-world applications.

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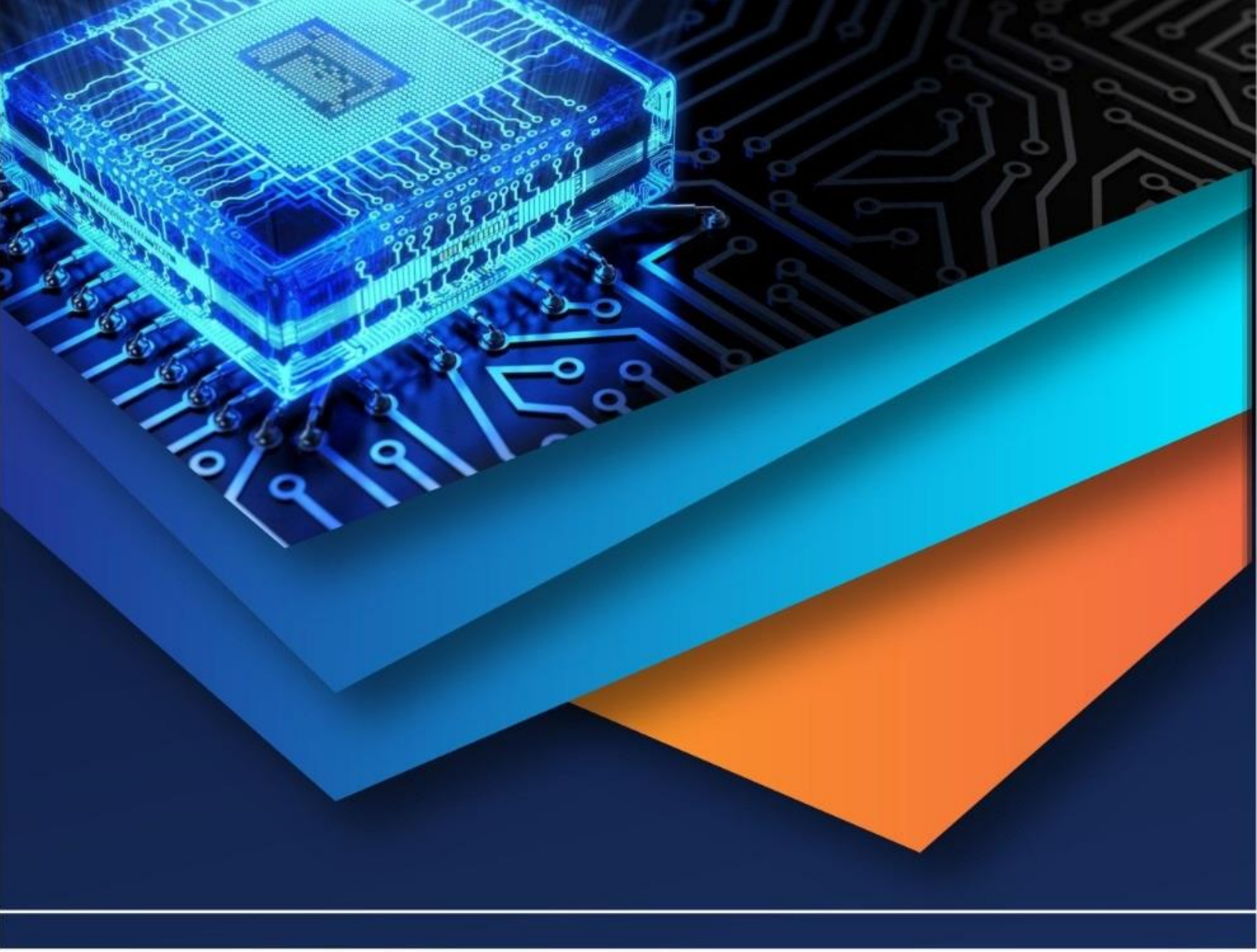

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