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Deep Learning for Age Classification using Facial Image

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Abstract

The convolutional neural network has become prominent to address several advanced issues within a real-world entity. The challenges like data accessibility on certain websites needs the user to be older than a particular age and restricting young children to access inappropriate games/websites are still demanding appropriate technological solutions. Current technology doesn't recognize the end user's age before granting access to websites and it allows access to websites based on the information given by the user. Hence to overcome these issues, the proposed system is developed for age classification using facial image.

The services provided by a number of the websites needs the end users to be older than some age however the strategies they implement don't seem to be effective enough to determine their age and gender. This work can predict the age of an individual based on facial feature extraction and analysis. The trained model is used in android application to capture the image of the user when accessing a webpage or an application and classify them as adult or child. This method provides an intermediate phase between the websites and the end users in determining whether or not the user has the right to access the service.

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1. Introduction

Age and gender play a significant role in someone's identification and are helpful to provide access to the contents on application or websites which have content not allowed for under certain Age. These services try to identify the true identity of the user by verifying age at the point of registration or providing bank account details. But, the existing methods do not achieve the purpose of the existing web services offered. In such methods, picture frame is taken as input and by processing, expected predictions will be given as output. For age and gender predictions, many algorithms use classification and machine learning concepts. Most primitive kind of algorithms are used to derive several secondary algorithms with enhancements. A couple of primitive algorithms are "Eigen Faces" and "Fisher Faces". Deep Convolutional Neural Networks (CNN) is another technique used.

Older methods of face recognition were dependent on ratios of the face. Each face image was profiled for the facial features and their ratios were calculated to find the age of the person in the image. The hypothesis like the accuracy of classification over the age gets lesser within the age group of sixteen to twenty two [16-22] years. By training a huge set of images to the models may overcome this. The input image has to have minimum noise and captured with exposure to light, the photographs without brightness cannot be classified at higher accuracy.

We used IMDB and WIKI datasets which have more than 5 lakhface images. The date of birth of those people in the image and the date the image captured are mentioned as the name of the image. Using this the age of

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the person in the image is calculated. First, we divide the data set into training and testing sets. In the training set, we crop the face in the image using Matlab and train the model using deep neural networks for 30 epochs. This yields a machine learning model which takes a new image as the input and produces the age of the person in the output. This model is then converted into a TensorFlowlite model which is used in our android application. This application is used to restrict children from viewing the content on the internet that are not intended to them.

The main aim is to restrict children from mature and unintended content on the internet and providing a means of authentication of age in online platforms. If the user is found to be a child from the model then the website or the content can be hidden or restricted to the user and asked for parental assistance. Since there is no effective method to do so currently, our work can provide a means by which age restrictions can be made possible.

2. Literature survey

The oldest study on facial recognition is based on EigenFaces by M. Turk and A. Pentland published in Journal of Cognitive Neuroscience, 1991 [1]. Which recognizes the person based on multiple facial image of their own. This method involved face recognition based on the Eigen vectors calculated from the individual's multiple face images. In this way, the known individual could be recognized. A lot of age classifiers were then made and many of them were based on facial image. These classifiers classified the person based on their facial image. And in 2004 A Lanitis, C. Draganova [3] published a paper which compare the effectiveness of different classifiers available which showed us how good each classifiers are.

A. Anand, A. Genovese published a paper where they classified the age based on the facial image using convolutional neural networks. This method is similar to the method we used. It consists of multi-layer neural network that trained the dataset which contains a huge number of facial images and the age of the person in them. This method yields a machine learning model that can later be used to classify the age of a new person.

Other methods of age classification used different methods other than facial images like biometric [20] and skin texture and MRI data [14]. These methods could generate a lot of information on a person using very small amount of data. This classification of age based on facial image can have many uses. The children are free to access the internet at their will and this could be restricted to a certain extent by classifying the age of the user while accessing the internet. There are other papers where they follow other methods to find the age as well, but to classify the age of an unknown person with just a single image has a wider usage than the biometric and MRI age classifications.

The other methods which involve Fingerprint and MRI information also do not offer complete or hundred percent accuracy. The Facial image based classification can achieve an accuracy above 85% which is very high and acceptable.

The IMDB and WIKI dataset provides a huge number of facial images with the age. This is a widely used dataset, papers [7] on age classification using facial image are likely to use this dataset as this contains clear facial images of celebrities and their age.

The identification of the age to restrict access to the service are compromised by cyber security. And as the technological growth on deep neuron network and image processing bring a great deal to implement such platforms which makes a level of security towards the under aged people.

Detecting and extracting the facial properties from the face image, which can be used for recommending and suggestion on certain products are services to provide to the user, And the machine learning models can have a high end classification on more complicated details which may feature to provide more suggestion.

3. Methodology

Our method of implementation takes in one face image and uses pre-trained model to classify the age dynamically and in real-time, as shown in Fig. 2 our method can be divided into 3 main steps:

i) Dataset selection and pre-processing
ii) Training the machine learning model
iii) Age-gender estimation using pre-trained model

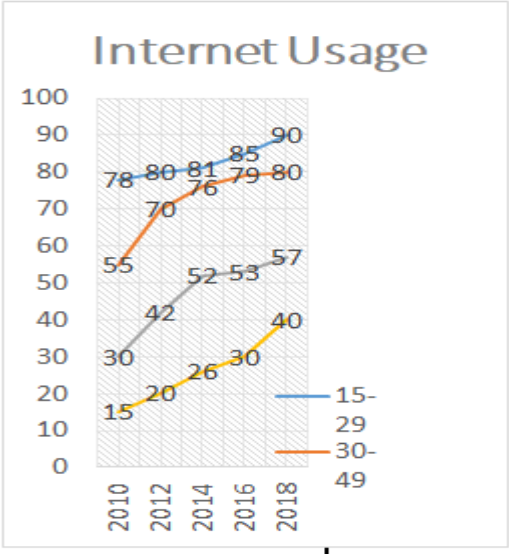

Figure 1: Graphical Representation of age group and their usage of internet over time [2010 - 2019]

A. Dataset selection and pre-processing

There are many datasets of facial images like the colour FERET dataset, SCface dataset, IMDB-WIKI dataset and

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the Multi-PIE dataset are the prominent ones. We used IMDB-WIKI dataset as they contain more than five lakh facial images of celebrities and their age, Since Age classification requires age as an attribute while training, IMDB names the images as the date of the image captured and date of birth of the person in the image. By these two dates, we calculate the age of the person in the image. Hence IMDB-WIKI dataset is the most effective dataset for age classification.

These images contain a lot of unwanted pixels which can affect the performance and accuracy of the model. Hence cropping of just the face is done so that all the unnecessary data in the image like the hairs, background are removed. All the images are not taken in similar lighting, and with similar quality, Hence the images are subjected to filtering which remove any visible noise in the image which can then be used for training.

B. Training the machine learning model

Once the pre-processing is done, the images are trained along with the age of the person in the image.

The age of the person in the image is derived from the name of the image. The name of the image is given in such a way that the year in which the person was born and the year in which the image was taken is written in the name of the image. By subtracting the year of image taken with the year of birth of the person in the image, we get the age of the person in the image.

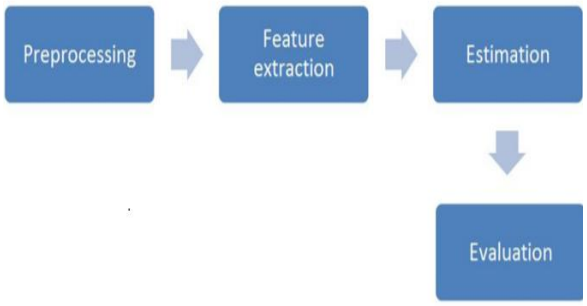

Figure 2: Shema on flow of age gender estimation

This age and name of the image is stored in a Database".mat" file which is used for training. With the help of Keras Application Neural network such as "ResNet-50" and "InceptionResNetV2" with image size of 224x224 or 299x299 respectively. We are using "Adam" optimizer. The categorical value labelled for age ranges from 1 to 101(years) and gender as 1 and 2(1-Female and 2-Male) the labels age and gender are provided to the neural network as a list of those to generator set. During training, the goal is to minimize the loss and avoid overfitting. We stop the training at 30 epochs because, that is the time when the loss is minimum and overfitting does not occur. The neural network architecture is shown in figure 4.

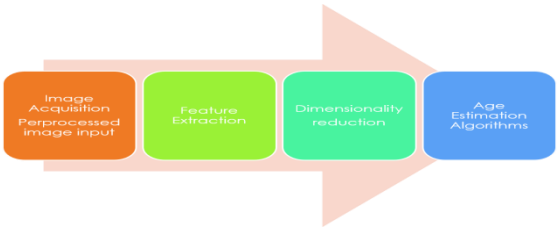

Figure 3: High end Application Overview of model

C. Age estimation using pre-trained model

For the prediction of class age on the input image we use "Dense" layer for return the categorical values unit of 1–101 for age and 1 or 2 for gender. The activation is "softmax".The trained weights for the model is stored as checkpoints after each epoch as an ".hdf5" file. After training the model, the weights file contains the updated weights for the neural network that can accurately classify the age of the person in the image.

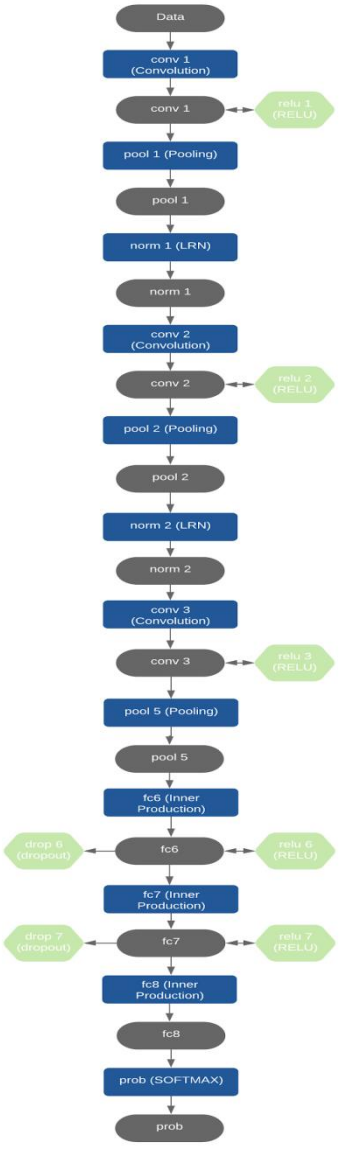

Figure 4: Full schematic diagram of network architecture

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Implementation of CNN Model:

Using our neural network model, we build an android application ACUN (Age Classification using Neural network for Children Cyber Security). Main objective of our application are:

1. The application has to be running in the background to monitor other applications starting and stopping.
2. The API of our model and application should be running completely offline throughout the service.
3. The application should be completely untraceable and should not be killed when clearing the RAM or force stop.

To achieve those objectives initially the Keras model which was overweight to directly load the model to mobile application and is not an effective approach so we converted the model (keras) to tflite model using Tensorflowtflite converter. Then the application runs in the background which has been set with every 0.5 sec checks any applications is triggered in foreground and running foreground which capture the application-id if it is new this feature is achievable by rvaleriolibrary.

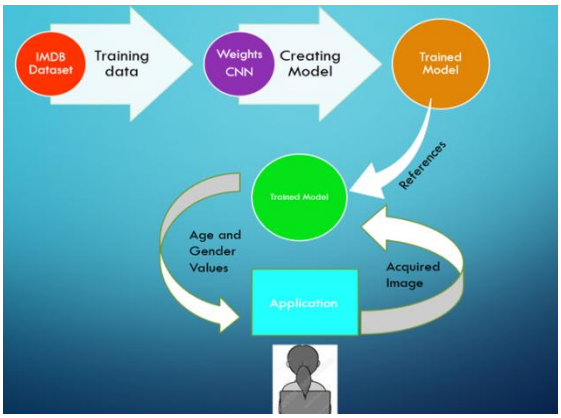

Figure 5: ACUN Application Service Architecture

The application is newly triggered before the application opens our application triggers the front camera and captures images without any surface view or any indication of image capturing using library kevalpatel2016:hiddencamera. The raw image is pre-processed and sent to our neural network model as an input image. The model then returns the age and gender estimated. Having the application id by the help of android play store API we can get the age limit to use the application and be verified with the estimated age we obtained by the model. If the case in which the age is below the accepted value then our application interprets the application in the foreground and displays the appropriate window showing alert. And if the user tends to close and reopen the application this process again starts again and continues the cycle the details are shown in figure 5.

4. Applications

1. ACUN(Age Classifier using CNN) app: Android application:

This application deals with providing security to children (aged under 18) to not get affected by contents over some application which needs age verification before use.

2. Gaming applications like PUBG, Fortnite, GTA and many games have their own age restrictions and in this case our application comes in handy.
3. Places that allow only adults like bars and pubs can use this to classify adults.
4. Many webpages grant access based on the person's age, this method can be used to verify their age
5. Streaming applications like Twitch need to have the age verified from the user before access.

5. Conclusion and Future Work:

To provide a method to check whether the person using the service is old enough to do so. Restrict access to the people who do not belong to a specific age group.Detecting and extracting the facial properties feature of the face which can be used for recommending and suggestion.

The input image has to have minimum noise and captured with exposure to light. The photographs without brightness cannot be classified at higher accuracy. The age group between 16-21 has lower accuracy than that of other age group so more dataset which is specific to this age category can improve the accuracy and can have other neural model to only represent this age group which further can be provided as a input to much more deeper neural model. Using this model we can achieve implementation on web services as in extension to any web browser or a new third party web browser, by the help of tracking the domain name or having track on keywords or content of the http requesting the server. Firewall API helps to check the webpage contents as sensitive instead of blocking the response to the request. Our micro service can be called by providing the live image captured and can get the response as the age and then proceed with the further action.

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