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Study of a Machine Learning Model for Face Detection, Age Detection, and Gender Recognition

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Abstract: ***Machine learning offers different models for age and gender recognition such as convolutional neural networks, feed forward neural network, and recurrent neural network. In our review we will be describing our system that takes input from the user and gives age and gender as output. User can provide input through browsing an image or through web camera. Our model is able to accept real time input through web camera. For the training and testing we are using structured data and we split data into testing and training date of the model. We are using train-test-split ratio as 3:7 i.e, 30% of the data will be used for training of the model and 70% of the data will be used for testing of the model . In this review we will be describing our algorithms and tools used and also methods for improving their accuracy.***

Keywords: Convolutional Neural Network(CNN), OpenCV, Face-Recognition, Rectified Linear Unit, Pooling

I. INTRODUCTION

Machine Learning is a branch of artificial intelligence that is used for analyzing data. It is based on the idea that machine can learn from data itself and recognize patterns in data. Machine leaning models uses the recognized patterns for making predictions and automating analytics. Age and gender are the two vital properties of a face and it has become very prominent area for analytic since the rise of social media platforms and other applications. Face and gender recognition plays an important role in intelligent applications such as access control, visual surveillance, and marketing intelligence, etc. Most used application of gender and age recognition system is in marketing intelligence.

Nowadays, every company wants to spread their customer reach and increase sales, this model can be useful in attracting more customers. Based on the data, model gives age and gender of the users and using this output company can create a targeted advertisement for the users. For example, if a company wants to sell women clothes then it is a wise idea to show advertisements only to female users because it is more likely that a female candidate will purchase the product then a male candidate . Similarly if a company wants to sell a baby product then it good to advertise the products only to customers who are above 25 or 26 years old because it is less likely for a teen ager to purchase a baby product. Through targeted advertising companies can save their money and also spread their potential customers reach. Other application of this model is access control, if a company wants to provide access to the application only for those users who are above a certain age then age recognition can be used to recognize age of every user and provide access only to the eligible users.

II. EXISTING SYSTEM

Holistic methods represent faces using the entire face region. Many of these methods work by projecting face images onto a low-dimensional space that discards superfluous details and variations not needed for the recognition task. One of the most popular approaches in this category is based on PCA. The idea, first proposed, is to apply PCA to a set of training face images in order to find the eigenvectors that account fo the most variance in the data distribution. In this context, the eigenvectors are typically called eigenfaces due to their resemblance to real faces.

New faces can be projected onto the subspace spanned by the eigenfaces to obtain the weights of the linear combination of eigenfaces needed to reconstruct them.

This idea was used in to identify faces by comparing the weights of new faces to the weights of faces in a gallery set. A probabilistic version of this approach based on a Bayesian analysis of image differences was proposed. In this method, two sets of eigenfaces were used to model intra-personal and interpersonal variations separately. Many other variations of the original eigenfaces method have been proposed. For example, a nonlinear extension of PCA based on kernel methods, namely kernel PCA; independent component analysis (ICA) , a generalisation of PCA that can capture high-order dependencies between pixels; and a two-dimensional PCA based on 2D image matrices instead of 1D vectors.

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III. PROPOSED SYSTEM

The model uses some python tools and machine learning techniques for the prediction of age and gender. Python is used for face detection and machine learning techniques like CNN is used for age and gender recognition.

For prediction of age and gender artificial neural network is used, namely – Convolutional neural network, Rectified linear unit layers and Pooling layers.

Output is the prediction given by the mentioned network. For accuracy improvement we are using Rectified Linear Unit(ReLU) and Pooling method in Convolutional Neural Network(CNN) for achieving better performance through activation functions. Also, in our system user can input images both via image and web camera hence interaction is easy as compared to existing systems.

Since we are using ReLU and Pooling with CNN, output of the model is supposed to be more accurate and besides better accuracy this model also provides convenient option of web camera input that makes this model more reliable and user friendly.

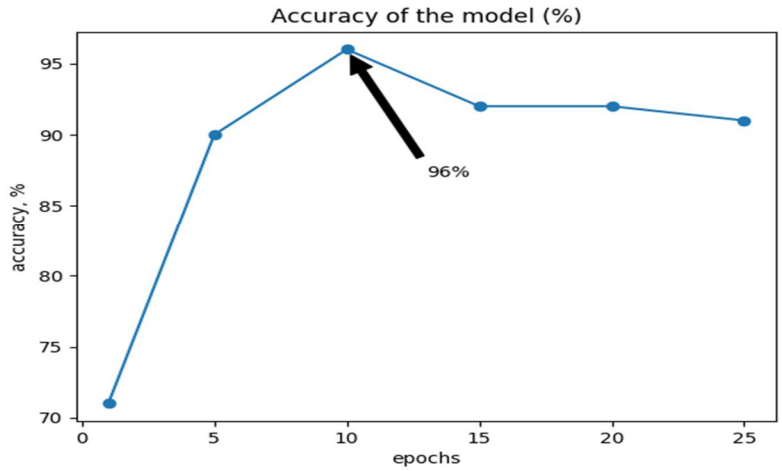

Fig1: shows that accuracy of the model decreasing after 10 epochs

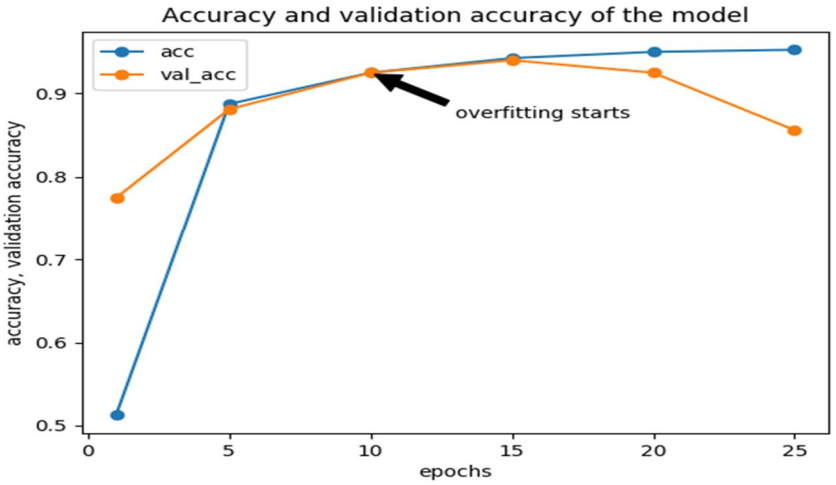

Fig2: shows interaction accuracy and validation accuracy

From the fig1 we can observe that after 10 epochs we reach the maximum accuracy of 96% and after that is starts decreasing from 10^{th} epoch to 25^{th} epoch.

Fig2 shows the intersection of accuracy and validation accuracy. Validation accuracy shows how the model respond to new data. Validation dataset contains data that model new sees and so the model cannot memorize it. If accuracy keeps improving and validation keeps decreasing, then the model is likely to be in a over-fitting situation. From the graph we can see that intersection point of accuracy and validation accuracy is 10^{th} epoch, so the model is good to be trained on 10 epochs.

Tools and methods used in the model are stated below

A. Convolutional Neural Network(CNN)

A convolutional neural network is a deep learning algorithm which can take in an an input image, assign importance(weights) to various objects in the image and be able to differentiate one from the other. The pre-processing required in a convolutional network is much lower as compared to other classification algorithms. While in primitive method filters are hand-engineered, with enough training, CNN have the ability to learn these filters.

The Convolutional layer is first layer in the network it takes image as an input. The transformed into matrix of pixel values. Reading of the image starts from top left corner of the matrix, then a filter is selected. Filter is a smaller matrix which is also called core or neuron. Then the filter moves along the input image, the filter's multiply its value with the pixel value. All these multiplications are summed up and one number is obtained at the end. This process is followed for rest blocks of the matrix and results in a matrix which is smaller than input matrix.

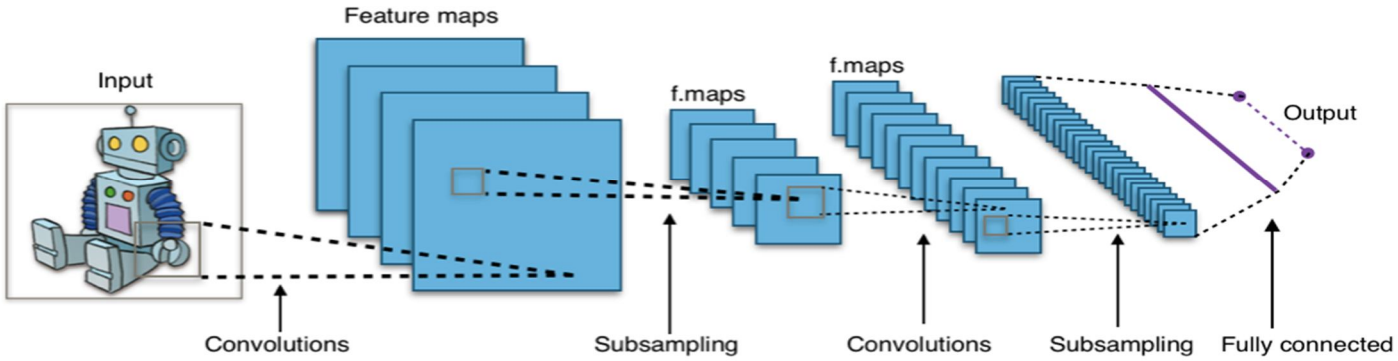

Fig3: Architecture of convolutional layers with feature maps

B. Rectified Linear Unit(ReLU)

The rectified linear activation function is a function that output same value as input if the input value is greater than or equal to 0 and output 0 if input value is less than 0. It has been used as default activation function for many neural networks because it is easier to use. The models which uses this function can be trained easily and also gives better performance. A node or unit that implements this activation function is mentioned as a rectified linear activation unit or ReLU for brief. Often, network that use the rectifier function for the hidden layers are mentioned as rectified network. The non-linear layer is added after each convolution operation. it's an activation function, which brings nonlinear property. Without this property a network wouldn't be sufficiently intense and can not be ready to model the response variable (as a category label). In our model ReLU is main component which is used to improve accuracy of the model and it also makes it easier for training of the model

C. Pooling

Pooling is a layer which is added after non-linearity(ReLU) has been applied to the feature maps which output by a convolutional layer. The ordering of layers are as follows.

1) Input Layer
2) Convolutional layer
3) No-linearity Layer(ReLU)
4) Pooling

The pooling layer follows the nonlinear layer. It manipulates width and height of the image and performs a down-sampling operation on them. As a result the image volume is reduced. this suggests that if some features (as for instance boundaries) have already been identified within the previous convolution operation, than an in depth image is not any longer needed for further processing, and it's compressed to less detailed pictures.

D. Fully Connected Layer

After completion of above mentioned procedure, the last step is to connect totally connected layer. This layer takes output from convolutional network. Placing a totally connected layer to the top of the network leads to an N dimensional vector, where N is the amount of classes from which the model selects the specified class

E. OpenCv

OpenCV stands for open source computer vision and it is used in computer vision real time processing. In our system openCv is used for capturing face in a image. After capturing face, face is converted into a set of numerals which is used for further processing as specified above.

IV. SYSTEM ARCHITECTURE

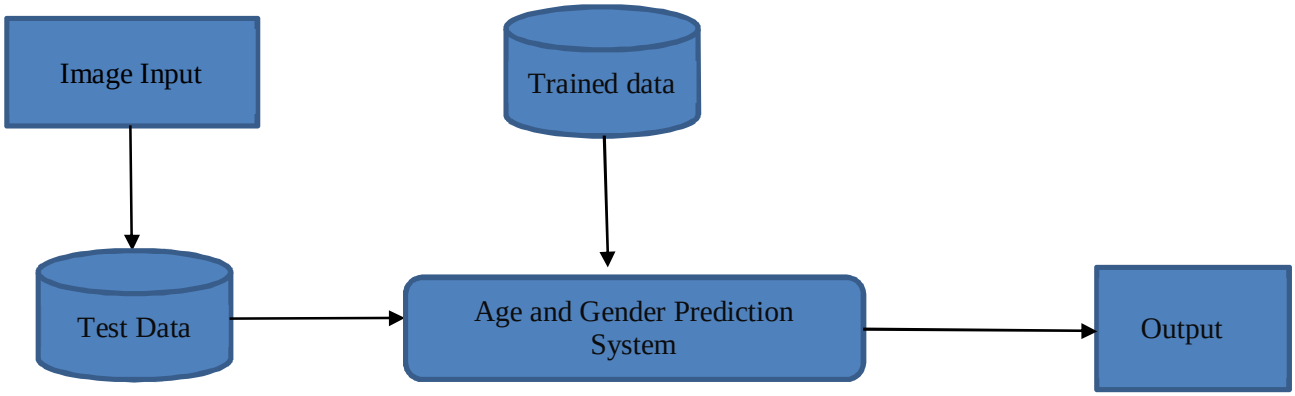

Fig4: Working of the model

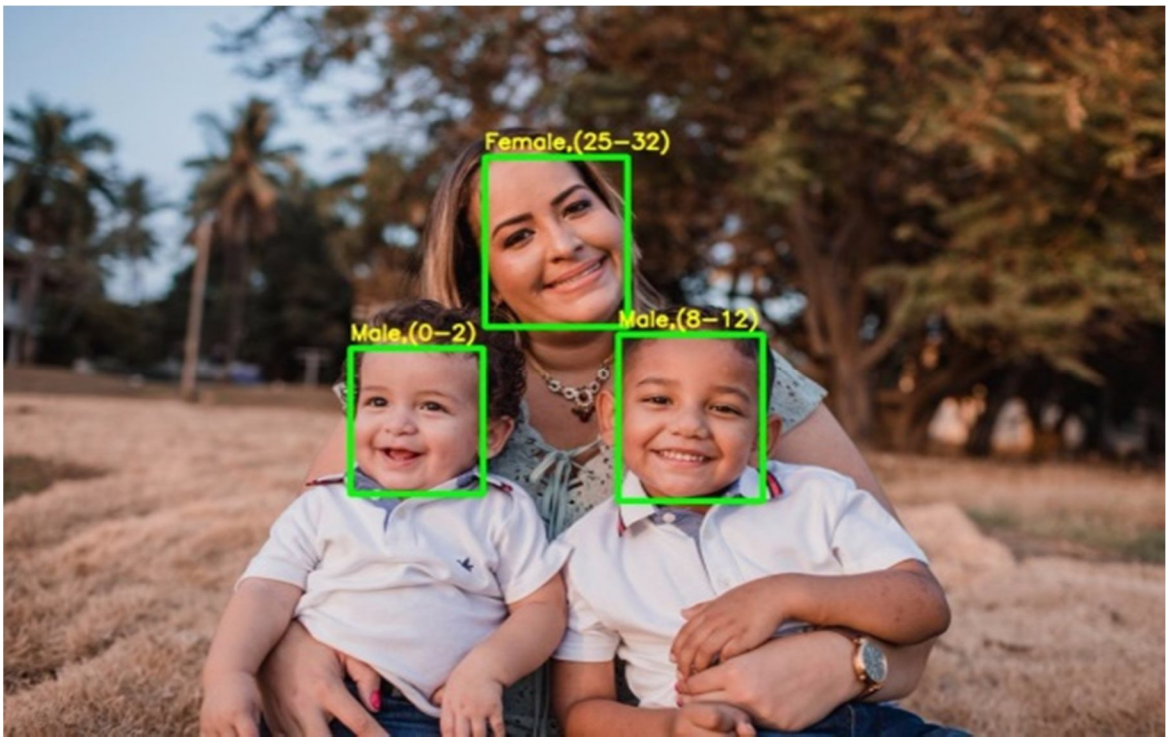

Figure5: Sample output

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V. CONCLUSION

Traditional methods based on hand-engineered features that provided state-of-the-art accuracy only a few years ago have been replaced by deep learning methods based on CNNs. Indeed, face recognition systems based on CNNs have become the standard due to the significant accuracy improvement achieved over other types of methods. Moreover, it is straightforward to scale-up these systems to achieve even higher accuracy by increasing the size of the training sets and/or the capacity of the networks. However, collecting large amounts of labelled face images is expensive, and very deep CNN architectures are slow to train and deploy. Generative adversarial networks (GANs) are a promising solution to the first issue. Recent works on GANs with face images include facial attributes manipulation facial expression editing generation of novel identities , face frontalisation and face ageing. It is expected that these advancements will be used to generate additional training images without requiring millions of face images to be labelled. To address the second issue, more efficient architectures such as MobileNets are being developed and used for real-time face recognition on devices with limited computational resources .

VI. ACKNOWLEDGEMENT

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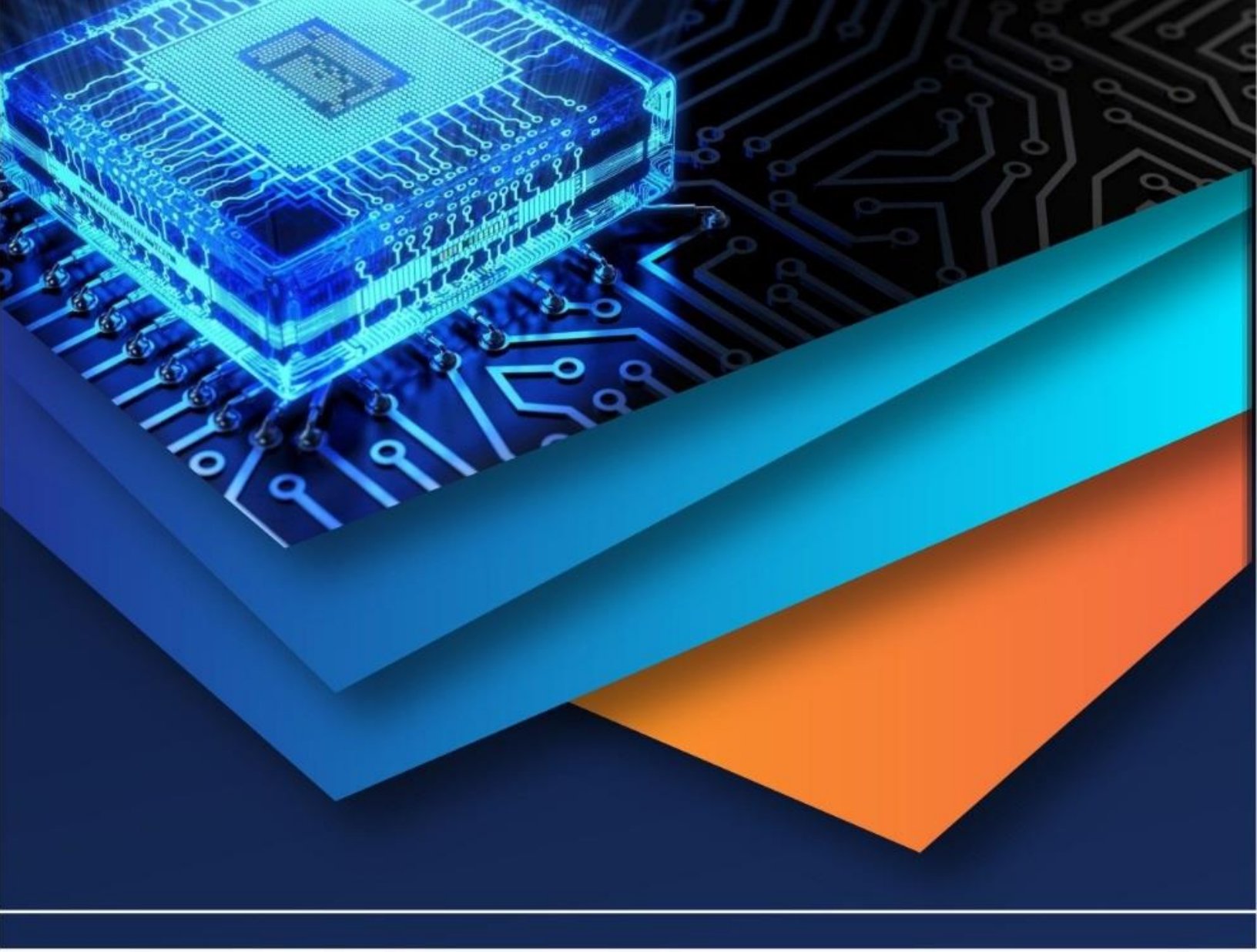

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