Innovative Appliance of Identification of facial features with Image Processing Techniques and Deep Learning Convolutional Neural Networks

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Abstract

The main objective of this paper is to classify the gender based on different facial features such as eyes, nose, mouth, overall features such as face contour, head shape, hair line etc. The gender classification algorithm uses machine learning technique (supervised learning). In this case the algorithm is trained on a set of male and female faces and then used to classify new data. In this paper, face detection and gender classification methods are combined. The face detection acts as a pre- processing operation to the gender classifier that determines the gender. There are multiple methods in which facial recognition systems work, but in general, they work by comparing selected facial features from a given image with faces within a database. It is also described as a Biometric Artificial Intelligence based application that can uniquely identify a person by analyzing patterns based on the person's facial textures and shape. Automated gender recognition plays an important role in many application areas such as human computer interaction, biometric, surveillance, demographic statistics etc. Existing systems has a disadvantage in accuracy. Though there are many algorithms in Present system are being developed and implemented to achieve accuracy in identifying gender the results arestill unsatisfactory. Proposed system has an advantage of accuracy. The accuracy achieved in this system is impressive compared to the existing system. CNN algorithm gives better accuracy compared to other algorithms.

Keywords: *Machine Learning, Deep Learning, Image Processing, Convolutional Neural Networks.*

1. Introduction

Gender is one of the main factors in the interaction between individuals. Recently, with the development of social media environments and smartphones, gender recognition applications have both begun to grow and become important. In many fields such as face recognition, facial expression analysis, tracking and surveillance, human-computer interaction, biometry, gender recognition applications can be seen. In this paper, gender recognition was carried out from face images with deep learning [1].

Face is one of the most important biometric traits. Face recognition is one of the most flourishing applications of image analysis and has gained popularity in the past several decades. There are many existing methods for face recognition. The main motive of this paper is to classify the gender based on different facial features such as eyes, nose, mouth, overall features such as face contour, head shape, hair line etc. The gender classification algorithm uses machine learning techniques (supervised learning) and CNN which makes gender recognition more efficient when compared to other methods [2].

Gender recognition using OpenCV's fisherfaces implementation is quite popular and some of you may have tried or read about it also. But, in this example, different approach to recognize gender was used. This method was introduced by two Israel researchers, Gil Levi and Tal Hassner in 2015. CNN models are used in this example. OpenCV's DNN package which stands for "Deep Neural Networks" is used [3].

Human face contains important visual information for gender perception. It is challenging for a machine to identify this visual information which separates male faces from female faces. Research is going on so that a machine can achieve human level accuracy. Various methods have been proposed for classifying gender from several controlled and uncontrolled dataset. It is more challenging in uncontrolled situations. Beside these some face images are so confusing, in mostof the time a human also fails to detect the gender from the image. So, the problemis to recognize the gender of a person efficiently [4].

2. Related Work

The general system in gender identification method uses preprocessing, face detection, Feature Extraction and then classification. The classification involves taking the feature vectors extracted from the image and using them to automatically classify an images gender[1][2]. This is done by using different algorithms [5]. As the subject is to be classified as either male or female, a binary classifier is used like K-Nearest Neighbors (KNN), support vector machine (SVM), Adobos, neural networks and Bayesian classifier. There is a probability of giving wrong results in a few cases because there are some situations in which a female face can contain some male features like extra facial hair resembling men. Programs may result also result in wrong answers in the presence of makeup[6].

3. Methodology

It is challenging for a machine to identify this visual information which separates male faces from female faces. Research is going on so that a machine can achieve Human face contains important visual information for gender perception human level accuracy[7]. Various methods proposed for classifying gender from several controlled and uncontrolled dataset. It is more challenging in uncontrolled situations. Beside these some face images are so confusing, in most of the time a human also fails to detect the gender from the image. The role of ConvNet is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction. The predicted gender may be one of “Male” and “Female” them automatically classify an images gender [8].

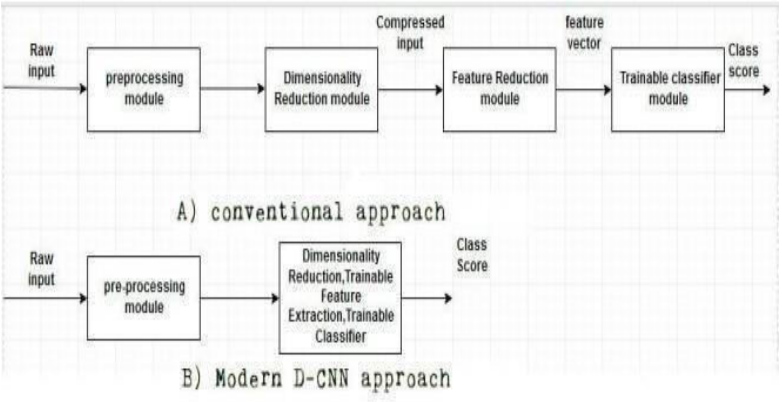

Figure 1: CNN Approach

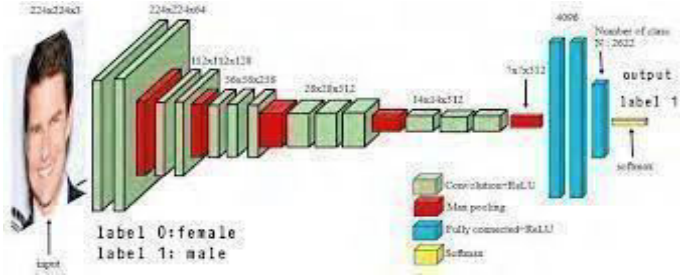

Figure 2: Gender Recognition

4. Experiments and Results

In this step some measures are used to assess the performance of the gender classification system. Basically, the system is tested in terms of accuracy, trustworthiness. Audience dataset is used which is available in public domain. This dataset serves as a benchmark for face photos. It also includes various real-world imaging conditions like noise, lighting, pose and appearance. Images have been collected from "Flickr" albums. It has total of 26, 580 photos of 2, 284 subjects and is about1GB in size. Themodel has been trained on this dataset.

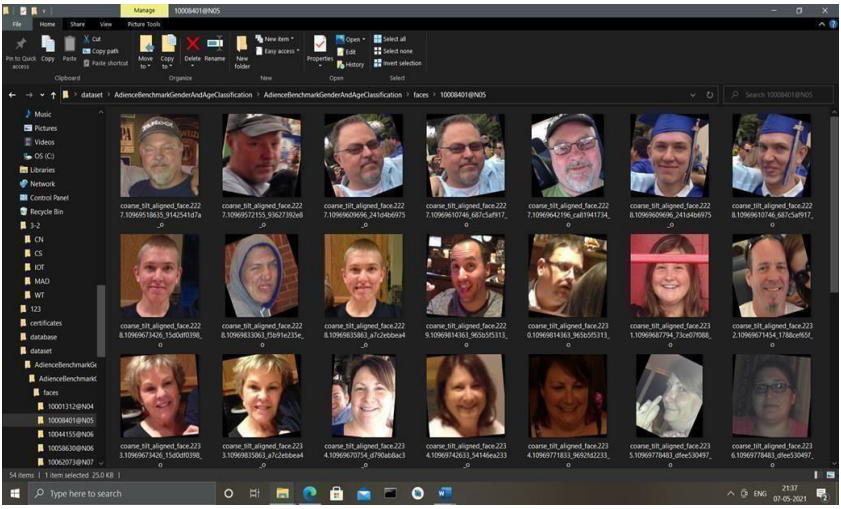

Figure 3: DATASET

To start with the paper, the first step that needs to be done is data collection. Datasets play an important in deep learning as it is used to

train the system to get the required output. Some datasets are available publicly while some are not. This dataset has images of people of different age, gender and ethnicity. In the paper, the dataset images are input into the algorithm to identify the gender. The dataset is used to train the model to perform gender classification.

The input given is in the form of a face image and the image features are analyzed based on the algorithm. An unknown image is then inputted to predict the gender of the same. An output will be generated which will contain the gender prediction of the unknown face image. The dataset is categorized into 'Train' and 'Validation', each of which contains 'Male' and 'Female'. The paper is trained using 8, 000 images in each class and validated using 1, 000 images in each class. The model is trained using ConvNet (Convolutional Neural Network) consisting of 5 layers. The CNN consists of many hidden layers such as Convolutional layer, ReLu layer, MaxPooling layer, Fully Connected layer, etc. Using these layers, the input face image is converted into weights and saved in '. h5' format. The average accuracy achieved in the paper is 90%.

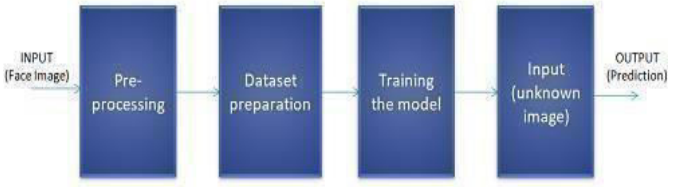

Figure 4: Implementation

The training program includes data augmentation. Data augmentation means increasing the number of images in the dataset because plentiful high- quality information is the key to significant machine learning models. Foremost, training examples needs to be augmented via a variety of random transformations, so that the model would never see twice the exact same picture and this helps prevention of overfitting thereby generalizing model in a better way.

The setup for the paper is as follows:

•16000 training examples (8000 per class)

•2000 validation examples (1000 per class)

Training Dataset:

The training dataset is a set of examples employed to train the model i. e. , to fit the parameters. Most of the approaches used for training the samples tend to over fit if the dataset is not increased and used in variety.

Validation Dataset:

A validation dataset is also called the ‘development dataset’ or ’dev set’ and is used to fit the hyper parameters of the classifier. It is necessary to have a validation dataset along with training and test dataset because it helps avoid over fitting. The ultimate goal is to choose a network performing the best on unseen data hence we use validation dataset which is independent of the training dataset.

Test Dataset:

The test dataset is not dependent on the training or validation dataset. If a model is fitting both the training dataset as well as test dataset then it can be said that minimum overfitting has taken place. The test dataset is the dataset which is only used to test the performance of the classifier or model. The test dataset is employed to check the performance characteristics like the accuracy, loss, sensitivity, etc.

The dataset images are input into the algorithm to identify the gender. The input given is in the form of a face image and the image features are analyzed based on the algorithm. An output will be generated which will contain the gender prediction of the unknown face image.

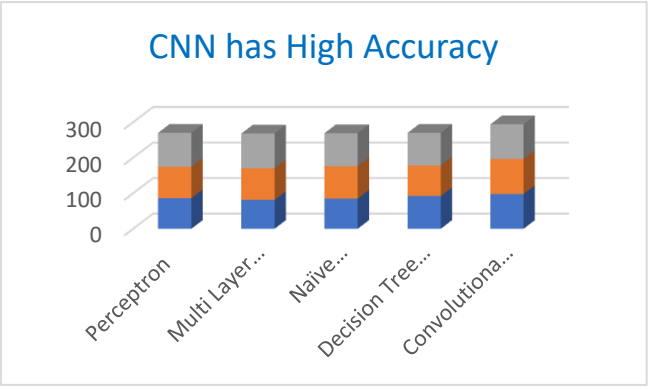

Figure5: Comparison graph showing high Accuracy for CNN

5. Conclusions and Future Scope of Work

Convolutional Neural Network, a supervised machine learning algorithm gives accurate and better results as compared to other algorithms. For gender classification, the model is trained on the pre-processed data and hence is able to determine the gender of the face image. The categories used for gender classification are: male and female. This approach gives an average validation accuracy of 90% after10 epochs for gender. The variance of validation accuracy is not that high because only less validation samples are used. More the number of samples more will be the accuracy of the model.

Upon changing the dataset, the same model can be trained to predict emotion, age, ethnicity, etc. The gender classification can be used to predict gender in uncontrolled real time scenarios such as railway stations, banks, bus stops, airports, etc. For example, depending upon the number of male and female passengers on the railway station, restrooms can be constructed to ease the travelling. However, it gives an insight into what the future may hold in computer vision. This can be used in many applications, such as face recognition, gender recognition and age estimation. The value of these applications depends in several areas, such as security applications, law enforcement applications, and attendance systems.

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