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Face-based Gender recognition Analysis for Nigerians Using CNN

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Abstract-
Estimating human gender from faces in images is an important area of research as many applications rely on it. Facial recognition is a branch of biometrics that uses the face which is a physical trait to uniquely identify individuals. Gender recognition using face analysis is also an important task in computer vision as it helps in visual surveillance, intelligent user interfaces, demographic studies etc**.** The fundamental of gender recognition and other similar classification problem is broken into four stages i.e. the image to be examined to the pre – processing of the image, feature extraction and lastly classification. Several approaches including the deep learning approach which is a representation of the learning procedure that discover multiple levels of representations using neural network has been explored for gender recognition. This work is essential in creating a face-based recognition for gender analysis for Nigerians. The face database consists of over 6000 images of Nigerians with different variations. The created database was used to analyze gender by pre-processing the images, extracting necessary features and classification using the Convolutional Neural Network (CNN). An overall recognition accuracy of 98.72% was achieved demonstrating the feasibility and research potential in such direction.

Key words: ANN, CNN, Gender Recognition, Nigerians, MLP

1. Introduction

Gender classification serves as a groundwork for several applications. Analyzing genders automatically from database helps in various applications such as; biometrics, visual surveillance, electronic customer, human-computer interaction, commercial applications etc. [1], [2]. Automatic gender classification also has it relevance in aiding the growth of online social networking websites and social media [3]. Gender recognition can also be used in the evaluation of students' academic performance [4]. Humans can easily recognize genders from faces but a computer or machine needs to train on database to be able to predict gender accurately. Gender classification serves as a major challenge in speech processing. It is required to identify the speaker's gender in order to obtain robust features that will help to design the in-depth of the required classifier [5]. Most places nowadays requires authentication and face recognition is a major verification method. Authentication mainly depends on the recognition accuracy. It was discovered that females have a lower recognition rate compared to that of males [6]. Distinguishing human's gender based on faces is a difficult task. One of the state-of-art systems that has been used for features extraction and classification is Convolutional neural Network and has been shown to give good performance with difficult feature space [7]. The robustness of CNN over traditional methods was also demonstrated in the work of [8]. Convolutional Neural Network (CNN)

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has helped to improve the recognition accuracy of unconstrained images in a dataset used for gender classification [9]. In demographic estimations, CNN has also been employed and has been found suitable. In order to train CNN for gender recognition, four factors are important. These are: (i) the training strategy, (ii) the target gender, (iii) pre-training of the network, (iv) the CNN depth. To use CNN in multitask training mode, it needs to be built from scratch [10]. Another area where CNN has been used to optimize segmentation is in the use of Iris localization because it performs better that other traditional methods [11]. Apart from face images, other biometric traits has also been used for gender classification, these includes handwriting and voice. The ability to perform gender classification based on handwriting is useful in the development of intelligent systems which can be used by forensic experts, neurologists and psychologists by exploiting texture as the discriminative features between females and males [12]. Most gender analysis work were trained with general database like the labeled faces in the wild (LFW), GoogleNet, VGGNet and so on. Most of the images in the database mentioned, were taken in a controlled environment which could stand as a factor for good accuracy(s) gotten when used to train. Getting primary data in a controlled and uncontrolled environment, helps the machine or computer to analyze genders from faces more effectively. The database used in this paper consists of only Nigerians faces cutting across the various tribes we have in Nigeria. Training a computer with world faces can be inadequate when needed to analyze genders for only Nigerians as the physical trait differs from faces to faces and from tribe to tribe. The database used exhibits "natural" variability in pose, lighting, focus, resolution, facial expression, age, gender, race, accessories, make-up, occlusions, background, and photographic quality which helps in training and learning of the algorithm used for the classification process. Images in the database are expressed in a simple and consistent pattern to make it easy for the CNN network to analyze.

Convolutional Neural Network (CNN or ConvNet) is a learning-based feature extraction and classification method. It is a deep feed-forward Artificial Neural Network (ANN) since it does not give room for feedbacks to previous layers in the system, it runs information in the direction from input towards output just like the multilayer perception (MLP) although CNN performs better due to its ability to reduce the nearest minimum classification error. CNN is a state-of-the-art feature extraction and classification tool especially suited for databases with large sample sizes and has proven over the years to be a good solution to image/faces identification and classification problems. Inconsistencies between male and female faces can be of help in biometrics [3].

2. Related Works

The authors in [13], used a combination of local features and contextual features (the foggy face) that was extracted from images for gender classification. The experiment was done using 4 CNN to extract the required features and Ada-boost based for the classification. They experimented with five (5) widely used datasets i.e. LFW, FERET, Adience benchmark and image of Groups dataset for training while Specs on Faces (SoF) was used to evaluate the network. Their work was to check the improvement in generalized and unrestricted datasets, they also argued that basic facial features are sufficient for gender classification. Facial features like the two eyes, nose and mouth was used this was inspired

by the behavior of humans in gender recognition. Their approach produced a great validation accuracy.

Authors in [14], proposed a dictionary learning approach for gender classification. They used three different dictionaries, a male dictionary, female dictionary and features dictionary. The three dictionaries were learnt using two dictionary learning method i.e. a Dictionary learning gender classification (DL-GC) and a Separate Dictionary Learning gender classification (SDL-GC). They also used three (3) publicly available datasets, the FERET, LFW and the Groups Dataset. An automatic features extraction was used to extract necessary features (only 2 features were used) and the Sparce Representation Classification was used as the classifier. They obtained an improvement on previous accuracies on gender classification.

Another gender classification work was done using a Deep Convolutional Neural Network (D-CNN) [3].(Amit Dhomme 2018), D-CNN was used on VGGNet architecture in attempt to obtain a better accuracy for gender recognition as against accuracies gotten from previously used method. The D-CNN has the ability to automatically extract features from images other than methods that requires a separate feature descriptor. D-CNN was used for both the features extraction and the classification of gender. D-CNN also has its distinct from other methods because of its ability to assists the network layers in learning parameters and reducing weight loss. Less parameters are also required when using D-CNN. The accuracy gotten was an improvement on previous works.

Authors in [15], presented an effective technique to predict gender from offline handwriting samples. The method uses textual features for prediction. They applied a generic and script independent approach to English and Arabic handwritings. The proposed technique required the use of multiple features descriptors like the Local Binary Pattern (LBP), Histogram of Oriented Gradients (HOG), Statistics Computed from gray-level Co-occurrence Matrics (GLCM) and the Segmentation-based fractal texture analysis (SFTA). Artificial Neural Network (ANN), Support Vector Machine (SVM), Nearest Neighbor Classifier (NN), Decision trees (DT) and random Forests (RF) were used as classifiers. The multiple classifiers were combined using bagging, voting and stacking methods in order to optimize the system performance. They used the QUWI dataset.

Authors in [16], studied the effect of word representation in gender classification using deep learning. They used a dataset that has 18000 names from India, Japan and Sri Lanka for gender classification. They also proposed a new technique for word embedding called the Enhanced Integer representation to combine with the existing techniques like the One-Hot representation and Integer Representation. They combined CNN together with word embedding techniques and also combined LSTM with word embedding. LSTM combination gave a better performance. The system performance was evaluated based on the accuracy, training time and the input layer size.

From the literatures reviewed, it was discovered that gender classification was done using publicly available dataset and general classification which may be limited in some areas. Also different methods were used for features extraction and classification but in this paper, CNN was used for both features extraction and Classification. Moreover the CNN used is a standard CNN i.e. not a Deep CNN.

3. Methodology

The dataset consists of over 6000 images of both male and female with different variations, 3063 face images of male and 3063 for females. The database was split into training data and test data. There were two (2) classifications for the images labeled as M_faces for male and F_faces for female.

3.1 Image Pre-processing

This entailed resizing all the images into a standard dimension to create uniformity. The dimension used was 50 x 50. The images were subsequently converted to grayscale for image enhancement in order to optimize the performance of the network, to reduce processing time and make analysis easier as opposed to using multiple channel images.

3.2 The CNN Architecture

After thorough evaluation of the layers available in a CNN architecture, the architecture in Figure 1 was designed and adopted. This architecture yielded a good accuracy.

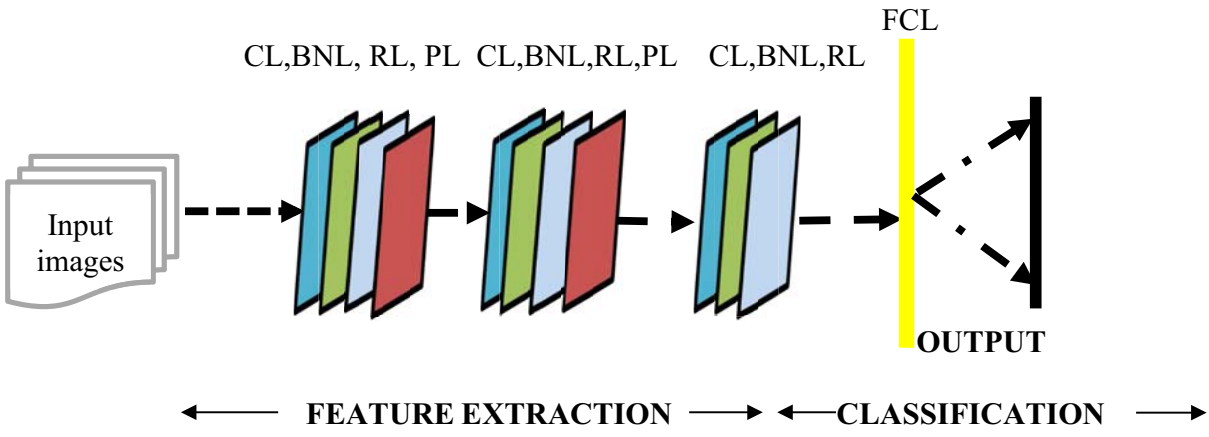

Figure 1: The CNN architecture used

CL – Convolutional layer
BNL – batchnormalization layer
RL – relu layer
PL – pooling layer

FCL – fully connected layer

4. Result and discussions

The CNN architecture was trained with 2900 random images from the male faces and 2900 random images of the female faces. Different learning parameters were used to obtain a good validation accuracy. Fig. 2 shows the accuracy obtained from the network.

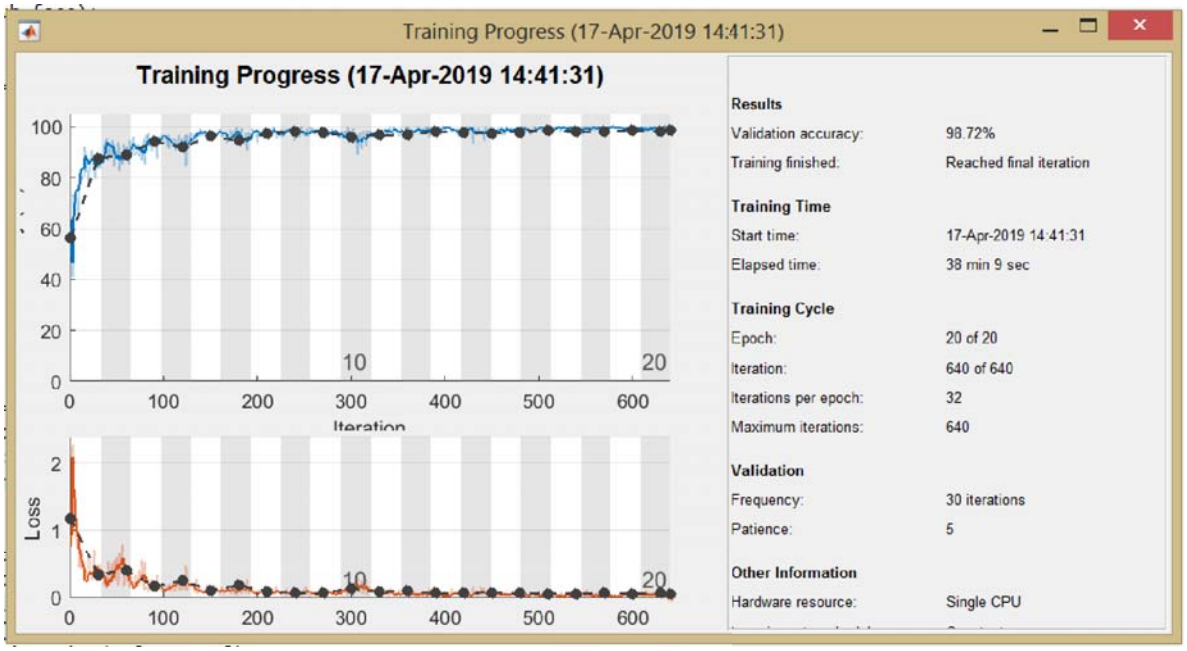

Figure 2. Validation accuracy of 98.72%

5. Conclusion

Although gender analysis through facial recognition is not a new thing, in this paper, we have worked with only Nigerian faces using the state of the art algorithm i.e. CNN. The CNN architecture adopted consists of only 3 Convolutional layer hence not a deep CNN. No past work, to the best of our knowledge, used a CNN architecture for both extraction and classification with only Nigerian faces for gender classification. MATLAB software was used to implement the code.

6. Recommendation

The database used can be expanded to cover more than half of the population of Nigeria in order to get a more robust system.

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Reference

[1] Duan, M., et al. (2018). "A hybrid deep learning CNN–ELM for age and gender classification." Neurocomputing **275**: 448-461.
[2] Mingxing Duan, K. L., Canqun Yang, Keqin Li (2018). "A hybrid deep learnin CNN–ELM for age and gender classification." Elsevier **275**: 448-461.
[3] Amit Dhomne, R. K., Vijay Bhan (2018). "Gender Recognition Through Face Using Deep Learning." International Conference on Computational Intelligence and Data Science (ICCIDS 2018) **132**: 2-10.
[4] Temitope M. John, J. A. B., Segun I. Popoola, David O. Omole, Jonathan A. Odukoya, Priscilla O. Ajayi, Mary Aboyade, Aderemi A. Atayero (2018). "The role of gender on academic performance in STEM-related disciplines: Data from a tertiary institution." Data in Brief **18**: 360-374.
[5] Zakariya Qawaqneh, A. A. M., Buket D. Barkana (2017). "Deep neural network framework and transformed MFCCs for speaker's age and gender classification." Knowledge-Based Systems **115**: 5-14.
[6] Shifeng wu, D. w. (2019). "Effect of subject's age and gender on face recognition results." J. Vis. Commun. Image R(60): 116-122.

[7] Zakariyah Qawaqneh, A. A. M., Buket D. Barkana (2017). "Age and gender classification from speech and face images by jointly fine-tuned deep neural networks." Expert Systems With Applications(85): 76-86.
[8] Joke A. Badejo, E. A., Adekunle Akinrinmade, Matthew B. Akande (2018). Medical Image Classification with Hand-Designed or Machine-Designed Texture Descriptors: A Performance Evaluation. International Conference on Bioinformatics and Biomedical Engineering.
[9] Grigory Antipov, S.-A. B., Jean-Luc Dugelay (2016). "Minimalistic CNN-based ensemble model for gender predictionfrom face images." Pattern Recognition Letters(70): 59-65.

[10] Grigory Antipov, S.-A. B., Jean -Luc Dugelay, Moez Baccouchi (2017). "Effective training of convolutional neural networks for face-based gender and age prediction." Pattern Recognition(72): 15-26.
[11] Heinz Hofbauer, E. J., Andreas Uhl (2019). "Exploiting superior CNN-based iris segmentation for better recognition accuracy." Pattern Recognition Letters(120): 17-23.
[12] Abdeljalil Gattal, C. D., Imran Siddiqi, Youcef Chibani (2018). "Gender classification from offline multi-script handwriting images using oriented Basic Image Features(oBIFs)." Expert Systems With Applications(99): 155-167
[13] Mahmoud Afifi, A. A. (2019). "Deep gender classification based on AdaBoost-based fusion of isolated facial features and foggy faces." Journal of Visual Communication and Image representation **62**: 77-86.
[14] Hossein Moeini, S. M. (2017). "Gender dictionary learning for gender classification." Journal of Visual Communication and Image Representation **42**: 1-13.

[15] Mahreen Ahmed, A. G. R., Hammed Afzal, Imran Siddifi (2017). "Improving handwriting based gender classification using ensemble classifiers." Expert Systems with Applications **85**: 158-168.
[16] Ritesh, C., Bhagvati (2018). Word Representations For Gender Classification Using Deep. International Conference on Computational Intelligence and Data Science (ICCIDS 2018), India.