HUMAN AGE ESTIMATION USING MACHINE LEARNING TECHNIQUES

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ABSTRACT

With the advent of Artificial Intelligence and different Machine learning techniques now it become easy to identify different features of an Image. This paper composes the idea of a solution based on Machine learning techniques for the estimation of age from a single face image without using any facial landmark. Based on the present available IMDB Wiki datasets of facial images we can easily extract the features like the no of objects, static and dynamic objects etc. The most recent endeavor composed the estimation of real age research that has been going since decades, humans want to study the apparent age estimation utilizing face image with other humans too. We intend to tackle both of the tasks with a simple as well as convolutional approach determined in the pre-trained image classification on Image net using the neural networks (CNNs). The core of our solution is based Machine learning techniques on large data set, strong face alignment as well as an expectation in the value formulation for general age regression. We intend to verify our methods based on certain standard benchmarks.

Keywords- Machine Learning, Datasets, Artificial Intelligence, CNN

I. INTRODUCTION

Now days, Machine learning (ML) has become one of the core area in all fields, however, discipline of Machine Learning is as a subset of Artificial Intelligence which is concerned with the capability to the computer systems or any electronics equipment or electrical machines in order to improve the performance automatically throughout its experience [5]. Along with the addition of excessive data, Machine Learning refines the automotive learning process through training and lead towards adaptation of its algorithm.

Machine Learning algorithms are used to implement the different models. Machine learning can be categorized as: Supervised, Unsupervised, Semi-Supervised and reinforcement learning and teaching techniques.

A. Supervised Learning Techniques: When learning or teaching is applied on marked or labeled data or the desired outcomes is known called as guided learning. For example, Amazon’s Recommendation System, voice assistant, Weather Apps, Gmail Spam Filtration etc. It also helps in prediction of future results for unseen data.
B. Unsupervised Learning: If the learning is applied on unmarked or unlabeled datasets or the data is not known in advance then this type of learning is known as unguided learning [5]. For example, NASA uses this learning approach to create the different clusters of heavenly bodies each of which consists of similar nature objects.

C. Semi-Supervised learning approach is a hybrid approach as a combination of supervised and unsupervised learning with few marked or labeled and unmarked or unlabeled data [5]. For example, automatically detection of Facebook photos for the multiple photos of a same person from a family function photo cluster (clustering-unguided learning) by naming that person once (guided learning) and afterwards it’ll automatically attached the name tag to that person in all photos.

D. Reinforcement Learning is a machine learning technique which allows the efficient observation of surroundings and consistent learning behavior to a learning system in order to enhance the frequency of cumulative incentives or rewards [5]. It is also known as reward-based learning system. For example, Robot in a manufacturing unit.

Deep Learning (DL) is another subset of Artificial Intelligence and also subset of Machine Learning, in other words we can say it is deeper study or learning of ML. Deep Learning that makes the computational multi-layer Neural Network feasible. Typical DL architectures are deep neural networks (DNNs), convolutional neural networks (CNNs), recurrent neural networks (RNNs), generative adversarial networks (GAN), and many more. Neural Networks (NNs) are a subset of ML techniques. These networks are not intended to be realistic models of the brain, but rather robust algorithms and data structures able to model difficult problems.

Web-based learning environments such as massive open online courses (MOOC), digital electronics education and design suite (DEEDS) and learning management systems (LMSs) allow teachers to study student performances using logged student data, but teachers may have difficulty analyzing the student logs. MOOCs and LMSs are popular types of web-based learning platforms; they provide free higher education to the entire world and offer courses from different universities.

2. RELATED WORK

Machine Learning is a new area of Artificial Intelligence, many researchers are using this for their own domain of research. The proposed research also based on the Machine learning.

Lei Zhang and et al. (2012) proposed an application for tracking the location i.e. SensTrack which is used with smart phones embedded with Wi-Fi facility in order to reduce the usage of GPS due to its availability at high cost with negative impacts on battery in very short period. SensTrack operated the GPS sample by using stored information and can switch the location and to re-build the track route from recorded location Gaussian Process Regression approach is followed.

Acharya and Sinha (2014) forecast students’ performances using machine learning techniques (e.g., C4.5, sequential minimal optimization (SMO), Naive bayes, 1-NN (1-Nearest Neighborhood), and MLP (multi-layer perceptron) with input features (e.g., gender, income, board marks and attendance). They applied correlation-based feature selection (CBFS) techniques to improve the model performances and determined that SMO achieves a higher effective average testing accuracy (66%) than do other methods.
De Albuquerque et al. (2015) employed artificial neural networks (ANNs) to predict student’s performance. These models achieved high accuracy (85%) using input features such as grades, periods of study and school scores. Huang and Fang (2013) performed a study that used machine learning techniques to predict student academic performance in engineering courses. In this study, the input features included course grades from all semesters and the output variable was exam scores. The researchers observed that SVMs are suitable for predicting an individual student’s performance and that multilinear regression is suitable for forecasting the performance of all students in a course. Alberto M. C. Soza and Jose´ R. Amazonas (2015) has been implemented as Principal Component Analysis (PCA) based clustering algorithm for fault detection that use Hadoop Framework and Mahout implementation. This algorithm integrated with IOT architecture implemented by the LinkSmart middleware. Proposed implementation and architecture increased the potential and functionality of IOT LinkSmart middleware [12]. Hardi Desai and et al. (2017) has proposed a vision to implement an affordable and compatible IOT based wireless sensor network in order to monitoring and analyzing the grocery levels at supermarkets as well as at homes. This system also provides an immense to use as future scope in the kitchens and to monitor the different storage places to manage the commodities in smooth manner [14]. Vahdat et al. (2015) used process mining (PM) and complexity matrix (CM) methods to analyze the relationship between grades and students’ learning processes using DEEDS data. They concluded that the average student grades are positively correlated with the CM and that difficulty is negatively correlated with the CM. In addition, they determined that process discovery using PM and CM models provides valuable information regarding student learning processes. Recently, an early predictive model was developed using student demographic, LMS data, and aptitude-related features. The authors developed a learning analytic system with an applied LR model that sent emails to high-risk students (Jayaprakash et al. 2014). The LAP 2015 challenge mainly focuses on the original age estimation from the image of the face. It also provides a study on demographic estimation with human perception and machine performance.

1. **Real age estimation:**
   The earlier literature assumes the reconcile sight of the face in the input image or employ a face pre-treating step such that the face is localized and an adjustment of the face is determined for the few processing steps.

2. **Apparent age estimation:**
   Our Dex method was introduced at the ChaLearn LAP 2015 challenge for the apparent age estimation. This was an extension of the IMDB-WIKI age estimation datasets with the in-depth inspection. This paper showed the model presentation on real age estimation. The qualitative and quantitative evaluation of this paper also confirmed the good performance and robustness of this model. Some runners up methods are illustrated as LAP is one of the largest data set on apparent age estimation. LAP challenge suggested the following approach based on general to specific deep transfer learning:
   - Pre- train CNN- This approach is for multi-class face classification using the CASIA- We face database.
• Fine-tune CNN- This approach is for age estimation on the very large extra age datasets.
• Fine-tune CNN on the LAP apparent age data.
• Ensemble Learning and fusion of 10 CNN’s.

3. PROPOSED WORK

Age estimation is a process of determining a person’s age based on biometric features. This article is focused on age estimation from a single face image. One of the important tasks of human and computer vision is age estimation from a single face image it has many applications including social media and forensics. It also includes the bunch of other facial elements and biometric tasks like hair color, gender, race, expression, etc.

There is an inflated demand for the instinctive extraction of the biometric details from the images of the faces or videos with the modern publication of the intelligent application. Some of the applications where age estimations play a significant role are given below:

1. Supervision
   Ex. Automatic identification of untended children at an unexpected time and places.

2. Human-computer interaction (HCI)
   Ex. Estimating the age of nearby people by the smart agents.

3. Law enforcement
   Ex, By default scanning of the records for the suspects with age estimations, will help in the investigation.

4. Perceived age
   Ex, Assessing the development of the beauty products, plastic surgery, role casting of movies, helped by the human resource for providing the employment of the specific role for the public age group.

5. Access control
   Ex, Restriction on the access of the minor products to sensible products such as alcohol by the vending machine.

One should pen down that all the intelligent applications need to gear up the age estimations under the dissipated settings that means, the face must not be aligned or under known, unaffected, light, and background condition. So, the face should be detected first, then aligned, and then in the last, it should be used as an input for age estimation.

4. OUR IDEA

Our proposed approach is known as deep Expectation (DEX) for the estimation of age and it came from the recent changes in the fields of image classification or object detection working on the principle of deep learning. Basically, there are four ideas that we have taken from the deep learning literature for the application in our solution. It is as follows:

1. The deeper neural networks (involves sheer parameter increment or model complexity) are better to model highly nonlinear kind of transformation with the standard web on the current architecture.
2. The wide diversity and larger amount of data in the data set will result in overfitting of better network learning methods to generalize while making the learning robust.
3. The overall performance is dependent upon the input image’s object alignment.
4. When we take the small training data, eventually it becomes easy to fine-tune a network that is already trained for comparable inputs and objectives henceforth gives benefit from the transfer of knowledge.

We initiate the process by first rotation of input image at different angles and then picking up the face detection based on the highest score. We intend to align the face using different corners of the angle by cropping it for sub-steps. Being one of the simple as well as a strong procedure that eventually doesn't involve any kind of facial landmark detection. As far as our convolutional neural network (CNN) is concerned, we utilize the Deep V-16 architecture.

We intend to start from pre-trained CNNs on a large Image Net dataset for further processing such that:
1. To be benefited from the representation of the learning in discrimination 1000 object categories in images.
2. To pursue an important representation with a great start for further processing of retraining or fine-tuning on smaller data sets.

For superior performance in this whole process, the age annotations on the face images by fine-tuning using CNN become essentially important. CNN has the nature to adapt the best fit in the particular distribution of data to target age estimation. We have explored the advantages of fine-tuning by crawling on the internet face images with available is data due to the scarcity of facial images along with (apparent) age annotations.

We have come about more than 523 3051 facial images from the IMDB and Wikipedia websites to form a new data set that is publicly available and essentially called IMDB-WIKI. This data set has become the largest publicly available data set composing gender and real age annotation. Do we all know that age estimation is a regression problem we have decided to move further and reduced the age estimation as a part of the multi-classes classification of age twins by the continuation of softmax expected value refinement?

Our specific contribution is below mentioned:

1. Creation of the largest IMDB-WIKI dataset including real age with gender annotations;
2. Formulation of a novel regression using the classification in continuation by expected value refinement;
3. A DEX System, which has won the LAP 2015 challenge on estimated apparent age.

This piece of work is the extension as well as a detailed model of our previous LAP challenge report paper. Officially we are now going to introduce one of the largest data sets named IMBD-WIKI for the apparent age estimation by providing deep analysis of the proposed DEX system while applying the methodologies and results of a report on the standard real age estimation data set.

The pipeline of DEX method for the estimation of age:
1. Input Image
2. Face detection
3. Cropped face
4. Feature extraction
5. Prediction

5 EXPERIMENTS

In this section, we will present the experimental result. In which we will talk about the datasets which are being used.

Datasets

In this paper, we will have five datasets for real and apparent age. These five data sets are:

A. IMDB-WIKI: This new data set is introduced for the age estimation. It is one of the largest publically available datasets for the estimation of the age. Most of the data set of the face which are used in today’s world are either very small, contains only the frontal face or age levels are missing. As the amount of the data that is being used for training, strongly affects the accuracy of the model, especially those which are using deep learning, there is a need for large data sets.

B. FG-NET: It stands for “The Face and Gesture Recognition Research Network”. It is the aging database which consists of 1002 color and greyscale images that are taken in an uncontrollable environment.

C. MORPH: It stands for “Morphological Face Database”. It is one of the largest globally available longitudinal face databases, which contains more than 5000 mugs shot.

D. CACD: It stands for “Cross-Age Celebrity Datasets”. This database contains almost 163,466 images of 2000 celebrities that have been collected from the internet.
Table 1 List of attributes (features) used in this study

<table>
<thead>
<tr>
<th>F1</th>
<th>Number of Curve on the face</th>
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</thead>
<tbody>
<tr>
<td>F2</td>
<td>Number of wrinkles Present in Face</td>
</tr>
<tr>
<td>F3</td>
<td>Distribution of colour Patches Present</td>
</tr>
<tr>
<td>F4</td>
<td>Different size of Folds present in Face</td>
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<tr>
<td>F5</td>
<td>Face Darkness</td>
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</tbody>
</table>

Human age estimation using Machine Learning Techniques
6. CONCLUSION

In this, we discussed the solution for the real age and apparent age estimation. DEX (Deep Expectation) formulation builds a flavourful face alignment. The VGC-16 is the deep architecture and classification followed by the expected value formulation of the age estimation problem.
REFERENCES

Biographical notes:

Rajesh Kumar Tiwari completed M. Tech (IT) and PhD in the field of data security form Birla Institute of Technology, Ranchi in the year 2010. Currently, he is working as Professor and Dean of Academic Affairs at RVS College of Engineering and Technology, Jamshedpur, Jharkhand, India. His research is focused on data security, cloud computing, database management system, and Machine Learning and Artificial Intelligence. He has published more than Fifty research papers in SCI/Scopus/UGC Approved Journals.

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