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Intelligent Human Age Estimation System Based on Hybrid Techniques

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Chapter One

General Introduction

1.1 Introduction

In the past few years, with the increased focus on video-based security systems and social robotics, researches about the numerical analysis of faces (which includes face detection and identification, face expression recognition, and gender classification) drew the attention in computer vision and pattern identification communities [1]. About those researches, the estimation of a person's age by numerically analyzing their facial image is quite a new subject. The estimation of age by using numerical facial image analysis may be implemented in a wide range of potential implementations, for example, developing intelligent human-machine interfaces and improving the protection and safety of young people in a variety of certain sectors (such as medicine, transport, business, banks, and so on) [2]. It may be highly beneficial for developed video monitoring, business intelligence, demographic statistics gathering, enhancement of search in large data-bases, and patron profiling. The attribute of the age may be utilized in verifying faces and enriching tools which are utilized in the investigations of the police. Generally, automatic age estimate by the machine is beneficial in applications in which the goal is determining a person's are without recognizing him [3].

1.2 Age Estimation

The estimator of age could be utilize a method based on machine learning (ML) for training a framework. It use to obtain features and making predictions of

age for query faces with trained model. In general, estimation of the age may be taken under consideration as an issue of multi-class classification, an issue of regression or both combined [4].

The estimate of age from face images needs a considerable amount of information from input image. Extracting those characteristics is highly important due to the fact that the efficiency of a system of age estimation will be highly dependent on the obtained features quality. A considerable amount of studying the estimation of age was proceeding in the direction of extracting aging features [5]. Methods of classification appear to consider optimal performances in demographic classifications such as gender, age, and ethnicity. Nonetheless, this supposition can't constantly be true. However, this classification could give some sufficient results in a single database [6].

1.2.1 Feature Extraction

The aim of determining face detection is given a spot image. Thus, if there are faces in the image, in which case, return the location of the image and every face's extent. Some of face detection issues are the following:

• **Pose**: A person is not looking directly at the camera every time a picture is taken of him/her. Therefore, more often than not, a human's face will be at an angle with the camera and thus the ratios of the face will be altered.

• **Face expression**: The look of a face is influenced by the face expression of an individual.

• **Occlusions**: Occlusion could be the most complicated issue in facial detection and identification. It indicates the fact that some human face parts be partly occluded by other facial images [7].

• **Presence or absence of features**: Face features like mustaches, spectacles, and beards, may be present or otherwise, and there's large variability of those features in bulk, format, and color.

• **Orientation of the image**: images of faces are different for various rotations around the optical axis of the camera.

• **Image condition**: Image conditions such: distribution of lighting, background, the distance between camera and person, and resolution of the image are important factors. Characteristics of image capturing devices effect images and the appearance of faces [8].

There are numerous matters that are closely related with the detection of faces. A face localization has the aim of determining image index of a single face. This is a simplified issue of detection assuming that an image includes a single face only. The target of feature detection of faces is the detection of the existence and position of some face characteristics such as: nose, eyes, lips, eyebrows, mouth, etc. Also, the proposing of there is merely a single face present in an image. Face recognition performs a comparison of an input image i.e. a probe versus a database i.e. a gallery and returns a match if found. In addition, facial expression recognition, face tracking, and face authentication are worth invoking as common problems. Detection of faces is an initial step in automated systems that is capable of solving the abovementioned issues [9].

1.2.2 Classification

Classification is one of the Data Mining techniques that is using to analyze a specific dataset and takes each instance of it and assigns this instance to a certain class. The classification is using to extract models that accurately define important data classes within the specific dataset. So classification is the process to assign a

class label from dataset whose class label is unknown. There are two classification kinds, which are supervised and the unsupervised [10].

1.2.2.1 Supervised Classification

Supervised classification utilizes spectral signatures that have been extracted from the training samples for classifying the image. Utilizing the toolbar of Image Classification becomes easily creating training samples for the representation of classes that we need to be extracted. This system is also capable of easily creating a file of signatures with the use of the training samples that is afterwards utilized by tools of multi-variate classification for the classification of images [11].

1.2.2.2 Unsupervised Classification

Unsupervised classification finds spectral classes i.e. clusters in multi-band images with no interference from an analyst. This classification type is accomplished via granting access to the tools for the sake of creating clusters, the capability of cluster quality analysis, and access to tools of classification [12].

1.3 Related Works

In the past few years, there are many works have been in the human age estimation area this thesis presents some of them:

- Jhony K. Pontes, Alceu S. Britto, and et al (2015) [13]: They proposed an innovative model for integrating Local Binary Patterns (LBP), Active Appearance Models (AAM), Local Phase Quantization (LPQ), and Gabor wavelets (GW) for the sake of obtaining a feature representation which is highly discriminative and is capable of modeling appearance, shape, skin spots, and wrinkles. Moreover, they have proposed an innovative flexible

method for hierarchical estimation of age, which consists of multi-class Support Vector Machines (SVMs) for the classification of subjects to age groups followed by an Support Vector Regression (SVR) for the estimation of a particular age.

Errors which could occur in the step of classification, as a result of hard borders amongst the classes of ages, have been compensated in estimating particular age via a flexible age ranges overlapping. The efficiency of the suggested method has been measured on FG-NET Aging database and a value of mean absolute error (MAE) = 4.50 was achieved.

- Pablo Pardo García, and Sergio Escalera Guerrero, et al (2015) [14]: A new age estimation facial image database is presented, a study comparing the estimation to both kinds of ages was done by suggesting two age estimation methods use the state of art approaches, one depended on Biologically Inspired Features (BIF) and the second based on Convolutional NN (CNN). The results of the two methods executed are show the superiority of the CNN over the BIF and they too show the hard of the age estimation problem with face images captured in an uncontrolled environment. The method achieves MAE of 7.99.
- Wei Zhao, and Han Wang (2016) [15]: They proposed an Strategic Decision Making Label Distribution Learning algorithm (SDM-LDL) with a set of methods that are specified for various age label distribution types. The experimental results which have been performed on the most common data-base of aging faces, FG NET, showed that it was superior to and more valid compared to all suggested SDM learning algorithms over existing label distribution learning and other single-label learning algorithms for the

estimation of face age. The inner characteristics of SDM-LDL have been additionally investigated with more benefits, the MAE its value was 5.07.

- Xiaolong Wang, Robert Li, and et al (2017) [16]: The authors have adopted a model of convolution map, and proposed a new method for feature learning which has been based on Convolutional Sparse Coding (CSC) that is capable of automatically learning the characterization of aging signatures. In comparison with other common methods of feature learning such as deep convolutional NNs (CNNs), they have verified that the learning method is capable of extracting localized subtle features of aging such as the CNNs, and in addition to that, considerably decrease the size of the model. In addition to that, they have employed the pooling of standard deviation (STD) for summarizing the feature of aging. Ultimately, the obtained features have been fed to a discriminative manifold framework of learning for obtaining low-dimensional representations which are more discriminative and additionally enhance computational efficiency. The method uses FG-NET database and the MAE value was 4.01.
- Soumaya Zaghbani, and et al (2018) [17]: They have presented a new age estimation approach from face images according to auto-encoders. An auto-encoder can be defined as an Artificial neural networks (ANN) which is utilized in unsupervised learning of sufficient coding. It has the aim of learning the representation for a dataset. The aim of their study was exploiting the efficiency of auto-encoders in learning features using a supervised way for the estimation of the age of a user. They have utilized FG-NET database for testing the efficiency of their presented approach. The results of experimentations have shown that the presented approach is robust

Abstract

In the past few decades, the age estimation of humans from visible data like video data and still images is one of interesting research because of many prospective applications like the development of intelligent human-machine interfaces and refinement of safety and protection in various sections as convey, security, and medicine. On the other hand, age estimation is still very challenging matter because of aging is influenced by several factors like accidents, facial hair, wrinkle, and skin condition. Lately, many machine learning techniques are used to estimate ages.

In this thesis, a new intelligent system for human age estimation from facial images by using machine learning techniques and two swarm intelligence based algorithms was proposed. The typical structure for the proposed system consists of several phases: pre-processing phase, face detection phase, feature extraction phase, feature selection phase for eliminating redundant features, and classification phase. The proposed system experimented using the aging FG-NET database. The database divided into seven classes which have been turning out that some classes have the same number of features. Therefore, these seven classes combined into three classes based on the number of features it contains to minimize the mean absolute error and increase precision. The face detection phase is performed using the viola – jones algorithm. Feature extraction is utilized using linear discriminate analysis LDA, and feature selection is implemented by using two swarm intelligence based algorithms, firefly and bat algorithms. Finally, two machine learning based algorithms, J48 classifier and decision table are utilized for age estimation.

The obtained results showed that the proposed system has given the precision of 88.77% when using Firefly with the J48 classifier, while achieved a precision of 86.79% when using Firefly with a decision table classifier. Furthermore, a hybrid approach of Firefly and Bat algorithms with a J48 classifier was applied and has given the precision of 90.45%, while the same hybrid approach achieved a precision of 87.05% when use a decision table classifier. Finally, a best result of mean absolute error of 1.14, was obtained by the hybrid approach of Firefly and Bat algorithm with the J48 classifier.