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Artificial Neural Networks and Gene Expression Programing based age estimation using facial features

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Abstract This work is about estimating human age automatically through analysis of facial images. It has got a lot of real-world applications. Due to prompt advances in the fields of machine vision, facial image processing, and computer graphics, automatic age estimation via faces in computer is one of the dominant topics these days. This is due to widespread real-world applications, in areas of biometrics, security, surveillance, control, forensic art, entertainment, online customer management and support, along with cosmetology. As it is difficult to estimate the exact age, this system is to estimate a certain range of ages. Four sets of classifications have been used to differentiate a person's data into one of the different age groups. The uniqueness about this study is the usage of two technologies i.e., Artificial Neural Networks (ANN) and Gene Expression Programing (GEP) to estimate the age and then compare the results. New methodologies like Gene Expression Programing (GEP) have been explored here and significant results were found. The dataset has been developed to provide more efficient results by superior preprocessing methods. This proposed approach has been developed, tested and trained using both the methods. A public data set was used to test the system, FG-NET. The quality of the proposed system for age estimation using facial features is shown by broad experiments on the available database of FG-NET.

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1. Introduction

An individual's face image carries an important amount of information comprising information about the identity, emotional state, ethnic origin, gender, age and head orientation of that person. Also the human face bears important noticeable evidence associated to individual traits. In this study, we try to prove that the computer can classify human age according to features extracted from human facial image. Here both Artificial Neural Network (ANN) web.iitd.ac.in/~sumeet/Jain.pdf, http://www.learnartificialneuralnetworks.com as well as Gene Expression Programing (GEP) (Ferreira, 2001) based classification of human age using facial features has been studied and proposed. The problem of having a suitable approach for age estimation for getting more specific categories of age ranges is still a challenging problem.

1.1. Age estimation

The purpose of age estimation is to determine an individual's age based on biometric features. Estimation of the age of a person from a digital photo is an interesting task which includes the study of human aging procedure. Human being cannot resist the variations that take place with aging; it is extremely difficult to collect sufficient data for age estimation. Thus, most researchers working in this domain try to obtain the results in certain age groups. The experimented age ranges till date are still too wide as they normally are up to 15 or 20 years. The main difficulty that occurs while shrinking the size of the age ranges is the question of accurateness of the extracted features from the face. First we have classified the ages into two groups i.e., (0–34) and (35–69). And then both these groups have been subdivided into two groups each making the four categories i.e. (0–17), (18–34), (34–50) and (51–69). As our main goal is age estimation and not facial recognition, we use only front images, with face free of Glasses or beard. To make our system more efficient and accurate, we selected only those images which were clicked in good lighting conditions and were free from unnecessary blurring or wrong orientation.

The major hurdle of shrinking the size of the age ranges is the correctness of the extracted features. Accuracy of the results fluctuates depending on the extracted features and the way they are used for age estimation i.e., some researchers use 20, 22, 35, or 68 features. Some of the open databases like FG-NET http://www.fgnet.rsunit.com, 2015 and Morph have been used for testing age estimation systems. These datasets contain photos and ages of the people and there are usually ages from 0 to 70 years. We have used FG-NET database which contains 68 feature points.

1.2. Previous related work

Different researchers have used different approaches to estimate the human ages. Some have even tried to estimate the aging effect (Ramanathan et al., 2009) which is the counter process of age estimation. Fukai et al. (2008) proposed an age estimation system on the AIBO. AIBO is an autonomic entertainment robot produced by SONY, AIBO has many sensors to get information around itself and moves according to its instinct. AIBO takes the face images and then age feature is extracted from the Images by the fast Fourier transform (FFT), and it is selected by the GA. Then Age is estimated by the 1-dimensional Self organizing Map. An error of 7.46% in age estimation was attained. A three phase age estimation approach was used by Horng et al. (2001). The three phases of this method were Location, feature extraction and age classification. They constructed two back propagation models. The verification percentage for first model was 99.1% and for second model, it was 78.49%. A subspace method known as AGES (Aging pattern Subspace) was used by Geng et al. (2007). The basic idea of AGES is to model the aging pattern, which is demarcated as an order of a specific individual's face images organized in time order, by building a typical linear subspace. The Main Absolute Error of this approach is 6.77% which is enhanced than method of the AIBO and the ages in AIBO scheme are between 15 and 64, while in AGES they are between 0 and 69. This work was further improved by Geng et al. (2008). In order to match the nonlinear nature of the human aging progress, a new algorithm named KAGES is proposed based on a nonlinear subspace trained on the aging patterns, which are defined as sequences of individual face images sorted in time order. The Main Absolute Error for this approach is 6.18% which is better than other approaches. Hewahi et al. (2010) used BPANN (Back Propagation ANN) based EasyNN Tool for their training and testing to compare their results with human observations. Our proposed methods are totally unique in nature, the way we classify the age ranges here, are not similar to