

Face feature based extraction and classification for Gender Recognition and Age Estimation using Fuzzy Model

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Abstract

Facial demographic classification is an attractive topic in computer vision. Attributes such as age and gender can be used in much real life application such as face recognition and internet safety for minors. In this paper, we present a novel approach for age estimation and gender classification under uncontrolled conditions following the standard protocols for fair comparison. Our proposed approach is based on Multi Level features which are extracted from normalized face images. We proposed fuzzy model base gender prediction and mining base age estimation techniques. An approach for gender prediction fuzzy model show that gender prediction performance can be boosted by up to a great extend.

Our study is based on a dataset from natural data mining competition. We propose architecture for gender prediction, which consists of the "fuzzy learning model". The experimental results will show our proposed method significantly outperform baseline methods. A detailed analysis of features provides an entertaining insight into behavior variation on female and male users.

Furthermore, the combination of visual cues resulted almost as strong as textual analysis in predicting gender, while providing complementary information that can be employed to further boost gender prediction accuracy will be up to 96%. As a byproduct of our investigation, we were also able to extrapolate the semantic categories of posted pictures mostly correlated to males and females.

Keywords: Fuzzy Logic, Face Features Extraction (FFE), Data Mining, Gender prediction, Age Estimation, Visual analytics

1. Introduction

Face is one of the most important biometric features of human and contains lots of useful information such as gender, age, ethnicity and identity. Gender classification is to tell the gender of a person according to his / her face. It is an easy job for human beings, but a challenging one for computers. Gender classification could be of important value in human-computer interaction, such as personal identification. It is also a useful preprocessing step for face recognition. It is also used in television network system for viewer rating studies. Gender specific computer vision can have further applications in fields such as automated security / surveillance system, demographic studies (Jain and Huang 2004), safety monitoring system, etc. Earlier, the gender classification techniques were based on neural network. Gollomb et al. [1] developed a two-layer SEXNET with 30 by 30 pixel face samples. Moghaddam et al. [2] investigated to

apply the Support Vector Machine to classify gender with low-resolution 21*12 —thumbnail faces. Wu et al. [3] introduced an Automatic Real-Time Gender Classification system based on LUT-Adaboost method. The approach presented algorithm for gender recognition is based on the combination of face detector, radon and wavelet transforms and KNN classifier, which is computationally efficient and invariant to the variation. Algorithm have discussed two different feature extraction methods and compared there results.

2. LITERATURE SURVEY

Most of the Classification uses Feature Based Approach but they then differ in the way they use other different techniques and make related decisions on it. Taking this fact into account we classify different Approaches:

- **Feature Based Approach**

This approach relies on extraction of facial features to detect face.

1) Low Level Analysis: It uses the concept of pixel analysis, edge detection in image (using Sobel or Canny) and gray scale. It also uses the concept of finding local maxima (to detect nose) and local minima (to detect eyebrows pupils and lips).[2]

2) Feature Analysis: It improves the result of Low Level Analysis. It incorporates the fact that all the parts of face (eyes, nose, mouth, chin, head-top) are at somewhat at relative positions with respect to each other. Prominent features (mentioned above) are determined and they in result help in identifying potential face.[2]

- **Geometry Based Detection**

It too uses the concept of Edge Detection using the concept of Canny filter and gradient analysis. All the predominant features/specific location of image is divided into block and each block has a corresponding pixel at centre. All the central pixels of blocks are connected to nearby central pixels with an aim to span the face. [3]

- **Appearance Based Approach**

This approach relies on extraction of facial features to detect face. In this method entire image is processed in two dimensions. All the extracted characteristics are termed as features. In order to identify the face from the given image we would be required to match only those above features that correspond to the features of human face (nose, eyes, mouth etc.). To extract the feature vector, Principal Component analysis (PCA) and Independent Component Analysis (ICA) is used. We are using PCA because as the name suggest it would only compute or retain important/predominant vectors/variables and would reject the ones that don not contribute to any new information. This results in reducing computing and Time Complexity. [2]

- **Haar Like Features**

Initially to detect a face we were directly computing pixels. This features though exhaustive is also computationally not viable as in an HD image it would result in $1920 \times 1080 = 2 \times 10^6$ pixels. Thus we moved on to feature extraction from pixel computation. Entire human race possess face that has similar properties. The properties we refer to

here are the positioning of eyes, nose, mouth etc., the relative size of them and the contrast/intensity of them. This uniformity of features can be replicated using features known as Haar-like Features. A Haar-like feature consists of adjacent rectangular windows at specific location. It adds the pixel intensities in each region and then calculates the difference of both regions. The output value is categorizes this specific location. For example, Region of Eyes is darker then cheeks. Thus, the Haar feature for it would incorporate two adjacent rectangles. One on eyes and another below it, on cheeks. Then the summation of intensities is done for each rectangular and then value of summation of rectangle on cheeks is subtracted from the sum of values in rectangle on eyes. The same concept is used for identification of eyes, mouth and bridge of nose. [4]

- **Adaboost**

Features computation using the concept of Haar like features helps identify specific region. But, there are vast numbers of features for example there are about 1,80,000 features in 24×24 pixel window. [5] This would undoubtedly result in large scale computation and ultimately in high time complexity. But, of these lakhs of features there are only selected features that would help predict face with better accuracy. In general terms, there are only selected features that are necessary to build a model/algorithm that detects the face with required accuracy. Adaboost is used for this very purpose. It selects the few necessary features which when combined together/amalgamated provides a classifier that is effective for the classification of face/required object in an image. What makes Adaboost applicable in different scenarios is the fact that it is adaptive in nature. Subsequent classifiers are built so as to modify and improve on those cases that were misclassified by previous classifier. [4]

3. MOTIVATION

Over the recent years, an excellent deal of effort has been created to gender prediction from face pictures. it's been rumored that age will be accurately calculable below controlled atmosphere equivalent to frontal faces, no expression, and static lighting conditions. However, it's not easy to attain an equivalent accuracy level in real-world

atmosphere due to extensive variations privately settings, facial poses, and illumination conditions. during this paper, we tend to apply a recently-proposed machine learning technique referred to as covariate shift adaptation to assuaging lighting condition modification between laboratory and sensible atmosphere. Through real-world age estimation experiments, we tend to demonstrate the utility of our projected technique.

4. PROBLEM DEFINITION

Gender identity is one's personal experience of one's own gender. All societies have a set of gender categories that can serve as the basis of the formation of a person's social identity in relation to other members of society. In most societies, there is a basic division between gender attributes assigned to males and females,¹ a gender binary to which most people adhere and which enforces conformance to ideals of masculinity and femininity in all aspects of sex and gender: biological sex, gender identity, and gender expression. In all societies, some individuals do not identify with some (or all) of the aspects of gender that are assigned to their biological sex;¹ some of those individuals are transgender or gender queer. Some societies have third gender categories. The approach presented algorithm for gender recognition is based on the combination of face detector KNN classifier, which is computationally efficient and invariant to the variation. Algorithm have discussed two different feature extraction methods and compared there results.

5. DESCRIPTION OF THE PROPOSED WORK

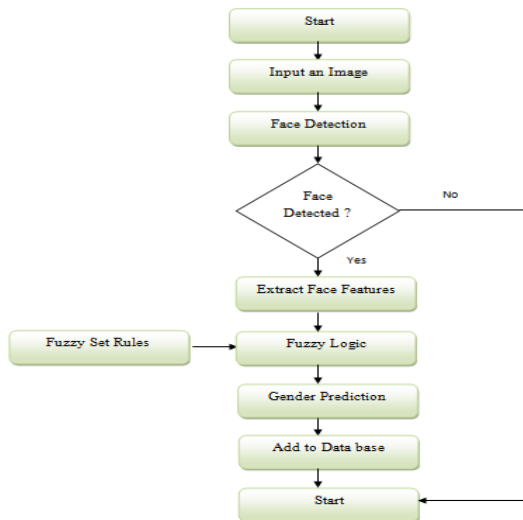


Figure 3.1 Data flow diagram (Gender Prediction)

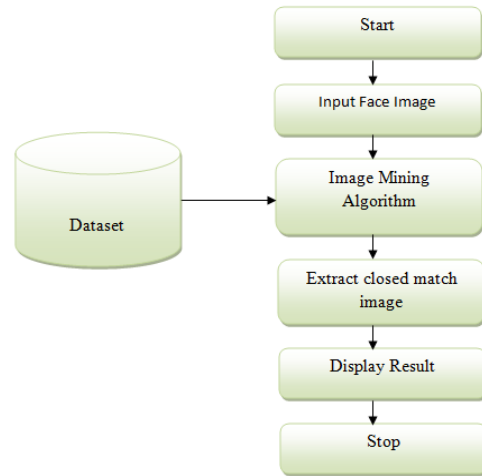


Figure 6.1: Data flow diagram(Age Estimation)

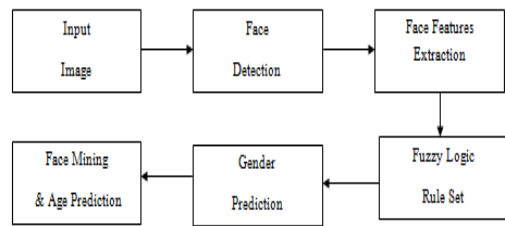


Figure 6.2 System Architecture Diagram

- **Gender Recognition Algorithm**

1. Start
2. Input an Image (I)
3. Skin Color Segmentation of an Image I
4. Detect Face Features
5. Extract Face Features from an image I
6. Apply Fuzzy set rules
7. Display gender
8. Stop

- **Age Estimation**

1. Input an Image
2. Detect Face
3. if Face present go to step 4 else go to stop
4. for k=0 to count(Database faces)
 - dev=math.abs(I-database(k))
 - add list(k)=dev
- end
5. Sort list in descending order
6. display age of image list(0).
7. Stop

- **Description of an Algorithm**

1. Algorithm first accepts an Image as input.
2. A Skin Color Segmentation will have done to predict whether an input image have a face or not.

3. Face detection will be based on face features detection.
4. If Face Present in an Image, an Algorithm will go to step 5 else discard process.
5. Face Features are extracted from face Image like eyes, nose, mouth, eyebrows etc.
6. Fuzzy Set rules are based on height and width of face features .It consist of statements like if ...else ...then.
7. Based on fuzzy rules gender will be predicted. Detected face will be mined with similar face from database and its respective age will be displayed as a predicted age

6. RESULT ANALYSIS

SN	Total Testing Images	Accuracy	
		Gender Prediction (%)	Age Estimation (%)
1	10	90	95
2	50	97	98
3	100	97.67	98.99
4	150	98.43	99.35
5	200	99.43	99.66

CONCLUSION

Algorithm presents an approach to age and gender classification from still image. The proposed methodology system will performs on average comparably to Human listeners, although the performance of our classifiers is worse on short utterances. A simple “majority voting” combination study did not improve classification accuracy, presumably due to the systematic nature of confusions.

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