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A FEASIBILITY STUDY ON REAL-TIME GENDER RECOGNITION

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Abstract: The human gender is recognized by an automated system with various unique features of the male and female. Real Time Gender recognition from facial features is a challenging task. In order to overcome this striving situation, the facial features measure is utilized for the gender detection. Various techniques are used for recognizing the gender from facial features. The facial parameters taken for recognition are eye, jaw, eye brows, and lips. The real time gender recognition is necessary for improving the human robot interaction (HRI). Real time gender recognition have wide variety of applications in government, forensic and commercial fields in which reliable personal identification is vital. The performance of gender recognition is also affected by non ideal images such as motion blur, poor contrast and various expressions . This paper is a study and analysis of gender recognition systems which uses various techniques based on facial features and the skeletal features of the human body.

Keywords: Feature extraction Laplace – Gaussian edge detection, Inter ocular distance, RGB-D camera, Human Robot Interaction (HRI).

I. INTRODUCTION

The gender detection is,‘ the genetic processused to specify an individual’s characteristics physically’. The need for the gender detection came in to existence with the increased requirement in the airport security. But detecting the gender of person only with facial features is a difficult task. Gender detection is a dynamic research topic in pattern recognition, which is widely used in the man-machine interface, visual communication, security, surveillance and many other aspects. Systems that perform real-time analysis are becoming desirable in many applications. The gender classification will defer for different races of people. The shape and size of the parameters of Indian and African are different. Changes in the facial features will cause a change in facial parameters which affects the gender detection. So the design should include the variation in the facial parameters for different races.

This paper is a study and analysis of various gender recognition systems which use different facial and skeletal features for recognition. In Section II, Facial features extraction for the real time human gender classification [1] discuss a processing technique using Laplacian of Gaussian filters. Facial features are determined and computed. For the determination of the gender, the Grand Theft Auto V (GTAV) database is used. Support Vector Machine (SVM) is used for the classification of gender. In Section III, Gender recognition based on the 3D human body shape for the human Robot interaction [2] uses a 3D laser scan for gender recognition. Here the system is based on the differences in the human body shape. In the 3D human body shape, it checks the shoulder width and torso length and chest statics. In Section IV, Multi-scale Independent Component Analysis (I C A) texture pattern for gender recognition [3] presents a texture feature which is adaptively learned in a frame work which is a sparse representation . A sparse classifier is used for this technique. The basis image of the facial representation is obtained by changing the size and coefficients of the mask. In Section V, an efficient and accurate real time gender recognition is proposed by Real time Gender recognition on Field Programmable Gate Array FPGA) [4].In this the facial feature extraction and the distances between the features are calculated based on the parameters like inter ocular distance, eye to nose distance, eye to mid lip distances for the gender classification. These distances for the gender recognition are measured by MAT Lab codes and then lab view convert the codes and interface with FPGA kit to make real time recognition.

II. EXTRACTION OF FACIAL FEATURES FOR THE REAL-TIME HUMAN GENDER CLASSIFICATION

Automatic real time gender detection by facial features becomes a critical component in the domain of computer human observation and computer human interaction (HCI). Gender recognition by the facial features can be done by many methods. They are Gabor wavelets, support vector machine(SVM) and artificial neural networks. Gender detection has many applications such as image and film processing, security checking system, criminal identification and many more.

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Generally for gender classification the GWT features are considered. The major features are geometric arrangement of colour, hair and mus-tache. For age classification, wrinkles and flabs of skin andtexture spots are considered. Appearance based method for facial images uses SVM nonlinear classifier and compared their results with traditional classifiers. The modern techniques such as large ensemble-RBF classifiers and Radial Basis Function (RBF) networks are used for the differentiation in classification. Principal Component Analysis (PCA) is also used to represent each image as a feature vector of low dimensional space. Genetic algorithm selects a subgroup of features from the low-dimensional feature vectors, without considering certain Eigen values, that do not seem to encode for important gender detection information.

A. **Pre Processing Technique**

The pre-processing of face image undergoes several processes to acquire the transformed face image, which will increase the quality of the image by keeping prominent features. Noise reduction, colour conversion and edge detection are some of the pre-processing methods. In this work, face images are taken from Grand Theft Auto V (GTA V) database. The overall approach for gender detection block diagram is shown in Fig.2.1.The edge detection algorithm is based on the following factors:

- Good detection - the algorithm used must point out as many real images as possible.
- Minimal response - a given edge must mark only once in a possible way; the noise,if any, in an image should not create false detection of an edge.
- Good localization - the marked edges should always be nearer to the real image

The Sobel edge detector is used for image processing, that is, at each point in an image; the resultant of this operator depends on either corresponding gradient vector, or depends on the norm of this vector. This will mainly depend on convolving the image with a separable and integer valued filter. This convolution takes place in both horizontal and vertical direction of an image. It gives better approximations of the existing derivatives.

B. GTA V Data Base

For gender determination, images are needed in a specific database. The purpose of this database is to check the robustness in gender recognition. GTAV provides an extension to the old-style approaches of a 2D space in addition to the depth information. An image taken from the GTAV database is applied with laplacian edge detection technique to find the important features present in the image.
The block diagram is shown in Fig.2.2.

C. Facial Features Determination

For feature extraction, mainly we consider two types of features. The global features which includes the distance between two eyes, then the distance between lips to the nose, and the distance between nose to the line joining of two eyes, the distance between the line joining two eyes and lips . Another one is grid features which is based on fore head, eyelid and skin colour etc.

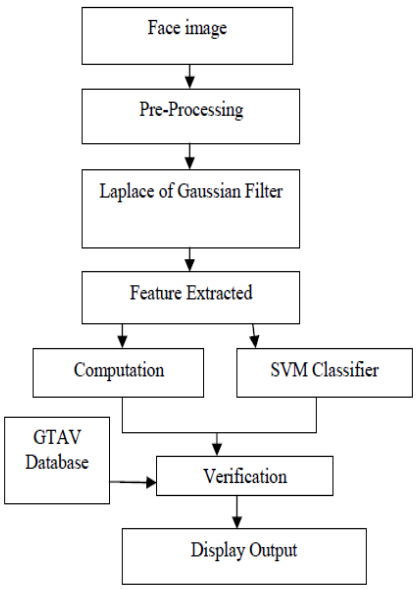

Figure 2.1: Block Diagram of Gender Detection

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Figure 2.2: (a) Original Input Image from GTAV database (b) After Laplacian of Gaussian edge detection.

Initially, the facial features are identified for the computation of ratios of distances between the features, which decide the gender of an individual. The ratioswill be calculated depending on 4 key parameters of the face by the classifier. They are,

1) **Inter-Ocular distance:** The distance between the midpoints of right eye-ball to the left eye-ball.
2) **Eye to Nose:** The distance between the midpoint of joining of two eyes pixel of the image and
3) Nose tip in the image.
4) **Lips to Nose**: The distance between nose tips to the midpoint of lips pixel in the image.
5) **Lips to Eyes**: The distance between midpoints of the lips pixel to the line joining of two eyes pixel in an image.

Figure 2.3: After feature extraction of the input image

The ratios calculated are:-
Ratio 1 = distance between the eyes to eye to nose distance
Ratio2 = Right eye to left eye distance and the distance between the eye to lip distance
Ratio 3 = eye to nose distance to eye to chin distance
Ratio 4 = eye to nose distance to eye to lip distance

These global features are extracted with a rectangular box which is drawn from the starting point of the feature to a certain area. This is done with all the features of the face image as shown in figure 2.3,and the distance between these features are calculated. As the result has only two classes of data, researchers use SVM for recognition. To improve the performance of SVM the nearest neighbour classification is used.

III. REAL- TIME GENDER RECOGNITION BASED ON 3D HUMAN BODY SHAPE FOR HUMAN ROBOT INTERACTION

Considering the HRI scenario in gender recognition and the differences in human body shape, this work provides a real-time gender recognition system for HRI scenario. It includes the depth image processing of an RGB-D image taken by a camera (Kinect). Gender recognition methods can be divided into face-based methods using 2D images, ie, gait-based methods using 2D video sequences and human-body-shape-based methods using 3D laser scans.

A. Gender recognition System

For the gender recognition process, the depth images from Kinect are used. The extraction of 3D skeletal joint positions are identified from the depth image by shotton et.al. method. Machine learning methods based on a SVM were then applied and utilized the 3D skeletal information for the gender recognition.

B. 3D Human Body Shape

The gender of a person can be distinguished by analysing the chest region as well as the body size information. The short distance interactions of robots make it hard for them to obtain the upper body information of a human, like shoulder width and torso length .so the

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chest region is considered as a 3D information about the body. The upper body joint positions are shoulder Left (S L) shoulder right (S R), Head to chest (HC,)Head to spine (SP) and shoulder centre (S C) as shown in Fig.3.1

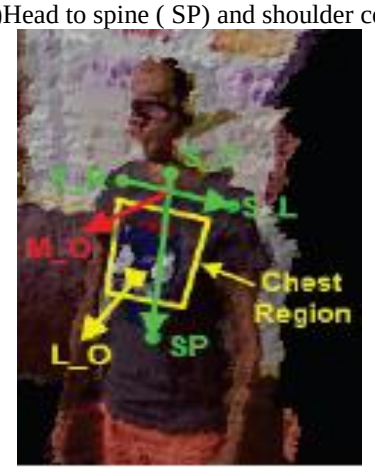

Figure3 .1 3D analysis

C. **Shoulder Width And Torso Length**

Normally the Males have larger body size than females. According to the position of the joints, we can obtain:
Shoulder Width = Dist(S L, S C) + Dist(S C, S R) (1)
Torso Length = Dist(S C, SP) + Dist (SP,H C)(2)

D. **Chest Statistics**

The chest region of a female is different from a male. The gender can be determined by analysing the chest parameters like chest altitude, the chest surface distribution. The depth 3D images give this statistics. These statistics are calculated (yellow rectangle in Fig. 3.1) based on the positions of S L, S R, S C and SP. Chest altitude means the height of the chest region projected on the men's heading orientation. The chest altitude CR means the vector from the origin of the camera to the chest region point. The surface normal distribution can represent by calculating the mean and variance of the angle between the local surface normal (L O) and the man's orientation. So that the flat chest tends to have a small mean and variance.

IV. MULTI–SCALE INDEPENDENTCOMPONENT ANALYSIS (I C A)TEXTURE PATTERN FOR GENDER RECOGNITION

To eliminate the scenarios in the methods of gender recognition, a sparse representation of feature, like adaptively learned texture can be used. The ICA filters of multi scales are obtained using face patches collected from the training models. As the variation in the gender appearance is significant, a group of learned filters (basis images) for facial representation are obtained by varying the size and coefficient of the mask. For obtaining intrinsic variations, the filters are learned from textured patches which are sampled from the training images. For modelling this patches distribution, Principal component analysis (PCA) regarded as Gaussian distribution random variables are used. They minimise the second-order statistics.ICA tries to estimate the statistically independent components estimated by ICA. The size of the sampled patches controls the basis images numbers.

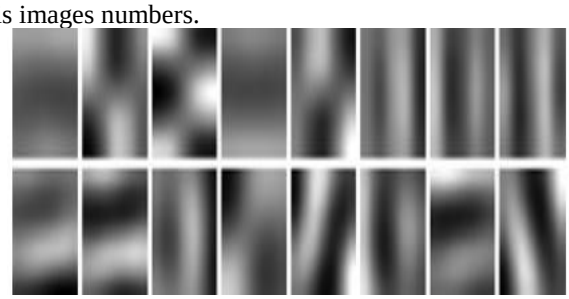

Fig. 4.1 Multi-scale ICA basis images of sizes 5 × 5 (top row) and 7 × 7. (bottom row) learned from Feret database.

An encoded image can be obtained by a group of certain scaled filters.To obtain richer information, ICA filters of multi scales are used to generate a coded image. The fig.4.1 shows the encoded images, divided in to sub regions which are non-overlapping. The histograms of the sub regions are then concatenated in to a compact feature. The histograms at various sizes are then concatenated to obtain the proposed feature. This is the extraction process of MITP shown in Fig.4.2.

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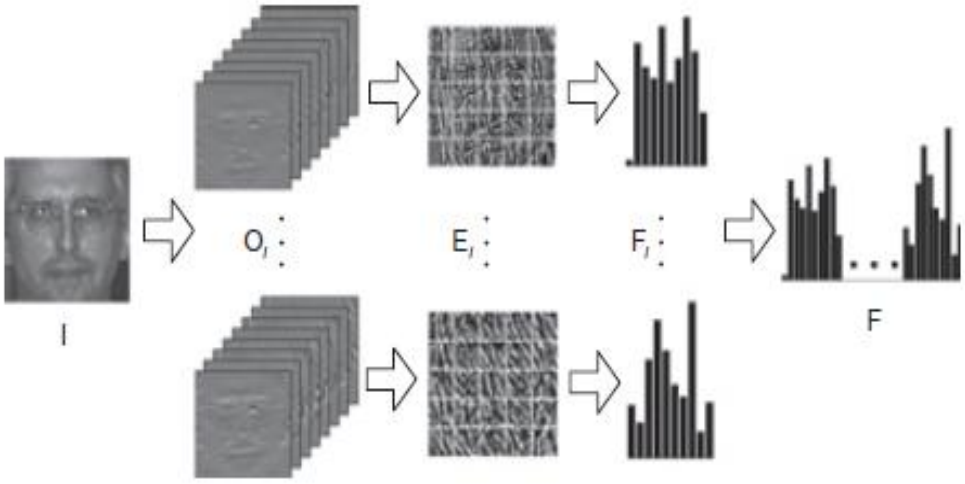

Fig. 4.2 Whole process of proposed multi-scale ICA texture pattern(MITP) feature extraction.

The classifier used is sparse classification (SC) which is based on the idea that a test sample from any class can be a linear combination of the training samples in the same class.

V. REAL – TIME GENDER RECOGNITION ON FPGA

Various techniques can be used for classifying the gender, based on facial information. For feature extraction, we consider two kinds of features. The global features which are based on the distance between two eyes, lips to the nose, jaws to the line joining two eyes, eye brows to the line joining two eyes. Second one is grid features based on skin colour, hair colour etc. Laplace-Gaussianedge Detection is applied to the image taken by the web cam or selected from the Model face database. The centroid of the eyes are found by using inbuilt Mat lab function. The midpoint of two eyes are found to perform further exploration on gender recognition. A rectangular frame is drawn from that point to identify the position of eyes and then the iteration continues to all features of the face. The distances are calculated from these features. The feature measured are Inter-ocular distance, Eyes to Nose distance, Eyes to Jaw distance, and Eyes to Lips distance. Based on these features the gender classification is done. The geometry of the face, the pixel values of the images are also measured to classify the gender of the person.. Each facial feature parametergives particular value in percentage and then the threshold is decided. If the values of the parameters exceed the threshold value, then the gender of the person is detected.

A. Computation Of facial Features

First the facial features are identified for performing the computation. The distance between features and the area in which features lie, and the ratio between them are calculated depending onthe key parameters of the facewhich decides the gender of an individual. The parameters are,

a) Distance between centre point of the eyes are calculated by keeping the centre of the eye balls as centroid.
b) Position of the eye to carry out the further analysis
c) Distance from centroid of the eyes to two points above the eyes by considering the area of eye brows.
d) The distance below the eyes to ear to determine the presence of hair around the ear.
e) Distance from centroid of the eye to the nose point, and centroid to the jaw for determining the shape of the jaw.
f) Distance from centroid to the lower mid lip for detecting the facial hair.

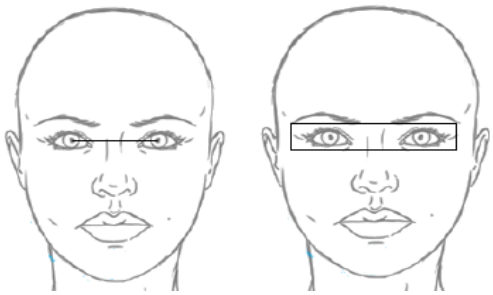

Figure 3.1Detection of Eyes and distance between the iris.

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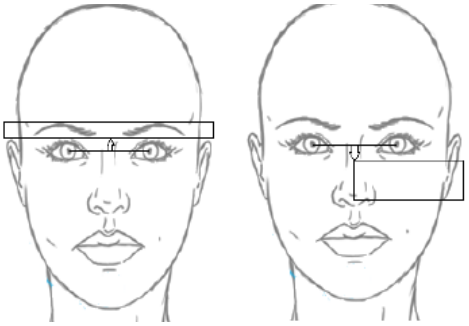

Figure 3.2Detection of eyebrows and nose .Measurement of distance from eye line to nose.

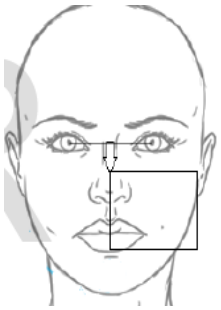

Figure 3.3Detection of mouth and measurement of distance between eye line and lower lip

B. **Vision development Module**

The Vision Development Module is used to advance and organise a machine vision applications. This unit has many functions like getting images from a host of cameras and processing images, locating features, identifying objects, checking for presence, and measuring parts. It is used to process the image entering the math script module. A textual math is added by this Module to the Lab View environment, which will act as a compiler for the Mat lab files. No need of extra code generation for processing Mat lab file in Lab View. This module is designed to process the 2D array code from Mat lab file.

C. **FPGA Module**

The My Rio kit is used for the real time operation. It is Xilinx FPGA customizable I/O Lab View programmable, dual-core ARM Cortex A9 processor with non volatile memory, this device is designed to operate in standalone mode. USB 2.0 is used for connecting web cam to the FPGA ,Push button and 16x2 LCD to the FPGA Device are connected to Expansion Port (MXP)

VI. CONCLUSION AND FUTURE SCOPE

On detailed study of all the above papers, it is observed that the techniques have the following draw backs.

a) The classification of any person may differ due to the race. The persons coming from dissimilar part of the globe will have different features, size, colour, and shape. So different techniques are needed for different races,
b) The accuracy rate will be decreasing, when the person is not in the premises of camera than the predefined distance.
c) Delay in response will increase if the database size increase to incorporate the gender recognition of different races.
d) A frontal image is necessary for the processing of the gender recognition. So angle in which the image obtained will affect the result.

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