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Evolution of Gait Biometric System and Algorithms- A Review

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ABSTRACT

In the modern world scrutinizing the image holds its important for recognition of a person. Digital Image processing for quite a long time has been used for these purposes. As days rolled on a new branch evolved called as computer vision which contains computer based algorithm for analyzing the images. Computer vision duplicates the visual property of a human and do the same electronically by use of improved algorithms. It is an artificial system that extracts information from the images. The image data can be a video sequence or a multidimensional data obtained from cameras or image scanners. Many recognition systems exit and one such is Gait recognition. Gait recognition is based on obtaining the information of a person using walking gesture. The gait images are obtained and segmented as gait energy images. The accuracy is improved by using modified Gabor PDF and LGSR (Locality Constrained Group Sparse Representation) algorithm.

Key words: Gait Analysis, Matching Accuracy, Timing, Energy Images, segmentation.

INTRODUCTION

Authenticating in security point of view is identifying a human being. In biometric identification, many forms of recognition systems are used. In face recognition, the facial features are used for identifying a person. In fingerprint recognition, the finger print of the induvial is used which is compared with another individual for identifying the person. In DNA analysis, every cell is identified as digital image. As many forms of recognition systems exist in real time implementation Gait analysis is future recognition system for authenticating a person. Gait analysis is done by taking the walking style of an individual by considering the gait cycle. The gait recognition system has a greatest advantage then other recognition systems because its being unobtrusive and distance recognition. For gait analysis, various algorithms are used which are discussed in this paper.

Baseline algorithm

The baseline algorithm uses a set of 12 experiments with a large database by estimating silhouettes by separating the background from the image. The recognition is performed by temporal correlation of the silhouettes. The covariance taken into consideration are viewing angle, type of shoe, walking surface and time. The problem in this algorithm is some parameters like shadow, moving background like videos, clothing, accessories carried by the person are not well recognized. They are not removed by the baseline algorithm.

Static body and stride parameter

The static body parameter approach of gait recognition uses static constraint such as stride length, speed, size ratio of the body. It is a model based approach[2].In contradiction if the recognition is based on any model it is called as model free approach of gait recognition.

Neighboring algorithm

The neighboring algorithm is a unique example of activity specific biometric schema which is opposite to the above algorithms. This is done when an individual is in a state of motion performing a specific action. It is the procedural way proposed for obtaining joint trajectory on time[3]. This is based on dynamic parameter of an individual. This algorithm focus mainly on the lower portion of the body for identification by taking the values of the joint angles in walking plane.in real time this algorithm is worked out by placing 3D markers into the sagittal plane and obtaining the planar offset value which is measured between markers and underling skeleton structure along with the joints. This three gives the value of joint trajectory.

Temporal alignment technique

This method was proposed by Collins et al in the year 1977. This method uses 2D silhouettes for extracting human gait features. In this method clothing, color and texture problems reduced. In this paper the analysis is done by two methods. First method includes the determination of frequency and phase of each gait sequence. This allows us to perform the dynamic time warping and aligning of gait sequence before matching process.

The second method includes data reduction and summarizing the sequence with prototypical key features[4]. Some of the technique are simple temporal correlation, Fourier dynamic time wrapping, Hidden Markov Models. Even though it reduces many redundancies the only problem was it is sensitive to view points.

Statistical approach

In all the above methods, the main problem is lacking training templates. To avoid this problem a novel method was introduced called as statistical method. This method combines statistical gait structures from the real templates and the synthetic templates. The real templates are computed directly from the training silhouettes. Whereas the synthetic templates are obtained from the simulating silhouette distortion[16]. The only drawback was it cannot identify between male and female individuals.

Appearance based approaches

The appearance based approach is based in a new spatio temporal method of gait identification. In this method, a new representation was obtained called as gait energy images. These images are obtained by using principal compound analysis. This method reduces the dimension of the image[5]. This approach takes different types of characteristic into account which gives better result than the model based approaches.

Some stages include pattern matching activity of shape and dynamic movement, whereas other stage may include only shape similarities of the person. In final individual gait energy images of gray value are averaged.

Relavant componend analysis (RCA)

This method uses maximum likelihood calculation for analysis. Here radon transform is applied to get gait templates. RCA is applied on these templates and maximum likelihood is calculated within the class covariance matrix. The nearest neighbor classifier is employed to verify the person is male or female [14]. This method is mainly used gender recognition.

Principal component analysis(PCA) and linear discriminant analysis (LCA)

This gives the discriminant approach for distant recognition by taking several views into account. In this view each gait image has unequal insight power. The data are taken from MOBO database. Several gait cycles are combines at last for accurate image. Finally, a close of high dimensional images are transformed to low dimensional image having specific eigen value and rerepresentes to get cleat and improved result. For obtaining a clear and efficient representation a classical dimensionality reduction technique is introduced called as PCA and LCA. These methods are formally employed before classification to get a clear gait image from each set[5,6].

General tensor discriminant analysis

In this approach the averaged gait images that are obtained are subjected to Gabor filtration. This decomposes the images for even more suitable way for recognizing the set of gaits. This give a whole new representation for the gait images. The reason for taking averaged gait images are given as follows. The human brain is having special

function for processing the multi resolution images in controlled scale parameters. This is done by Gabor filters. The second reason being the Gabor filters can identify similar profiled mammalian cortical cell and the final reason for using this approach is that it is simple and easily implemented in computer vision analysis at a successful rate[6].

Image to class distance

This utilizes each gait energy images a set of local Gabor function and calculates the distance between one energy image to all the remaining gait energy images in the gallery which belong to the same class[7].

Sparse representation (SR) and group sparse representation (GSR)

The main aim of the researches is to obtain a nonlinear feature to the liner feature classification. This gives improved scalability and accuracy. The sparse representation is very effective in controlling the high dimensionality images. In this method, even audio and video signals are also made to fixed rate by using wavelet transform[8]. This approach gets the liner relationship of the query images to the reference images. This is represented as L_1 (norm regularization reconstruction error)

In SR, the samples are independent. If there is a situation of being both the query and reference samples are mixed together then GSR is used by organizing to correct values. The main disadvantage of these methods is these are computationally expensive[8].

Local coordinate coding (LCC)

This is an improved version sparse in which they include an argument saying that locality is more important than sparsity for getting successful liner function. Here codes are obtained for each function. This employs bag of words model which uses the same l1 normalization for local smooth sparsity codes. By getting the similar patches SIFT vector quantization is applied to transform into visual words[9].

Coefficient of correlation

In present days, the information from the images are also obtained from content rather than context. The main problem faced by the recognition system in this situation is that how to measure the similarity in content. whether to take global properties or to take object semantics.

When global properties are considered color, histograms are used. While on the other hand object semantics is considered the inter dependency between the extraction is considered. The correlation reduces the retrieval time. This method is tested both on multi component image and on color or isolated texture[10]. The main drawback being there is big gap between the feature being extracted and human perceive scenes[13]. This creates accuracy problems in pixel levels.

Histogram

Histogram is the simplest method for image feature representation[16]. The only drawback is its lacking spatial information. This is overcome by introducing color covariance vectors which consider spatial information as histogram refinement. Each pixel contains coherent bucket proportion to the pixel value. During the searching process the person can give propionate color value or can give its equality histogram.

Texture retrieval

This method is used for outdoor environment for recognizing environmental situation such as sky, sea etc. it utilizes second order statistics calculation which is implement on texture similarities of the images. This is done based on the brightness level obtained from each pixel of both query and original image. It also takes contrast, periodicity of repetition, direction, coarse randomness into consideration. A separate database collection is maintained for this approach.

Shape retrieval

This method implements identification based on the shape feature. This method is very efficient then texture retrieval since it is defined. During retrieval query set is compared with the database with certain shape features stored in it. Queries are then answered with nearest matching result. This is done by two methods. certain global feature such as aspect ratio moment can be taken. Alternatively, for second method elastic template,

histogram, edge detection, skeletal structure, can be used. These methods are in 2-D structural manner. When clear solution is not available certain view point details can be considered. Recent years identification by shape is done using three dimensional.

Retrieval by other types of primitive features

This is one of the oldest method. This uses the spatial aspect for identification. This establishes pictorial date reliving by position in the query image.

This gives the spatial geographical location and information. This technique is also seen in image searching. Many improved algorithm is used for spatial relationship. This gives raise to spatial indexing by combining cues like color and shape of the image.

Color feature extraction

Color feature extraction of conservative color histogram Called as CCH. This extracts the color feature of the image. Fuzzy color correlation can also be used. The extraction is based on four steps. The first being selecting color space, second being quantizing the color space third being Etraction of the feature from the quantized color space, and finally deriving appropriate distance[16].

Color coherence vector(CCV)

In this method, the spatial information is incorporated into color histogram. Here every histogram bin is divided into two coherent and vector. The bin is taken as coherent if the pixels belong to same color region if that is not the it is taken as incoherent. Whether it is coherent or incoherent the CCV vector is generated in form of color histogram. This gives additional spatial information for retrieval purpose. This results in better accuracy.

Wabor filter bank

This uses Wabor transformation to obtain Wabor functions. The orientation and S scales are used for getting the parameter which dilates the Wabor parameter for giving Wabor functions. This method is well suited for texture identification. This gives the highest and best texture recognizing result[15].

Edge detection, contour detection and region formation

This technique is done for low level images for extracting information from the cue. This mainly based on bottom up approach. During automatic prediction of mages accuracy is very important and it is very crucial to carry out in which the overall result is based on the segmented image[13]. This mainly takes the matrix form for segmentation. Here a 3X3 matrix is used which contains the operator of a Sobel matrix. Kernels are forms in which one kernel is rotated by other at 90 degree angle.

-1	0	+1
-2	0	+2
-1	0	+1

G_x

+1	+2	+1
0	0	0
-1	-2	-1

G_y

The values inside the mask represent the kernel values. These are taken for edge detection. The values flow both in vertical and horizontal direction relative to the pixel grid of the given image. In each orientation, separate gradient component is produced called as G_x and G_y. the absolute magnitude is found by combining both these gradient components at each point and orientation. Thus, the magnitude is given by

$$|G| = \sqrt{Gx^2 + Gy^2}$$

This is one of the fastest way of approach. The orientation angle of the edge gives the spatial gradient. The other simple and quick method for computation is the Roberts cross. This gives the 2-D spatial gradient of the image. Pixel value

measured at each point gives the output gradient of the image. This is 2X2 matrix.

+1	0
0	-1

0	+1
-1	0

In this method, the mask is deigned to run at a maximal angle of 45 degree. The spatial gradient and angle of orientation is done in same method. Prewitt method is also identical to Sobel operator for vertical and horizontal detection. Threshold adjustment are made to avoid difficulties of segmentation subjected to Over and under segmentation of images[13].

Active contour model

For shape and object boundary detection various transformation such as Hough transformation and Fourier descriptors are used. This method is also called as snake for interactive clarification. Here the imposter is forced to guide the snake of feature interest. Here seed points are used where a point is taken as seed and prediction is carried out grouping similar seed characteristic together for segmentation[13].

Relevance feedback technique

This method is mainly used for bridging the sematic gap existing between positive and negative results from the user. Here the human vision inaccurately matched to computer vision by improves algorithms contain sematic codes which produces better results[13].

Fuzzy approach

The fuzzy approach is used for handling the nebulousness in the query image by uncertain representation of image. This is mainly instigated in retrieval process. The feedback is incorporated with the fuzzy characteristic for analogous image credentials[13].

Marginal fisher analysis (MFA)

In image segmentation selecting small set of features for analysis is of greater importance. This is accomplished by dimensionality reduction procedures. This is getting a wide range of attention in gait acknowledgement. In this method, an advance matrix is developed along with tensor based dimensional reduction algorithm. This can be directly implemented in 2-D input image when the image is in form of grey level having averaged values. This also maintains seed points for within class classification of images[11].

Locality constrained group sparse representation (LGSR)

This is a patch distributed algorithm giving patch distributed features (PDF). This relay on the Gabor features. In this the gait energy images are taken as a set of local augmented Gabor features from which the features are extracted giving the concatenated result taken from different scales and orientations along the horizontal and vertical axis. In face recognition, discrete cosine transform is used which lacks certain real time issues. For better results Gabor PDF is preferred. In this method, a global Gaussian mixture model is implemented for getting the local features from the gait energy image. The probe and query images are compared with each other and the set contains the nearest local patch value is given as identified output. This method is also used for videos in which the video is normalized using the constrains of grey mages bit by bit[1].

In this method, a minimum weighted mixed norm value is taken $1_{1,2}$ which is a reconstruction error parameter. Two criteria are used as minimum reconstruction error and maximum weighted inverse reconstruction error. Once the error coefficient is calculated the video gallery is reconstructed for error detection.

DISCUSSION

By comparing and analyzing the simulated results it is noted the edge detection and contour detection is applied based upon the type of video image chosen. The LGSR classifier is best opted for all type of identification and images whether it is grey or energy images. The classifier generated a local feature which suites for identification with accurate results. By comparing with different sort of recognition systems the gait is unobstructed and even a small reduced detail is enough for identifying

the person. The algorithm using Gabor feature requires smaller featuring detail which is added advantage. This algorithm can be developed into a powerful biometric system which serves best in controlled as well as un controlled environments this can be applied even for animals and extended to many medical diagnoses. The algorithm is made faster in simulation base having different database stacked in computer giving detailed information of a person.

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