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Gait Recognition Using Hough Transform and DWT

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Abstract- Identifying individuals using biometric methods has recently gained growing interest from computer vision researchers for security purposes at places like airport, banks etc. Gait recognition aims essentially to address this problem by identifying people at a distance based on the way they walk i.e., by tracking a number of feature points or gait signatures. We describe a new model-based feature extraction analysis is presented using Hough transform technique that helps to read the essential parameters used to generate gait signatures that automatically extracts and describes human gait for recognition and discrete wavelet transformation(DWT) This proposed work is present the more accuracy to identify the person or theft.

Keywords- Gait analysis, discrete wavelet transformation, Hough Transform, Canny Edge Detection.

I. Introduction

The process of verifying a person's identity, also called authentication, plays an important role in various areas of everyday life. Any situation with user interaction where the identity is required, needs a means to verify the claimed identity. One of the more obvious and commonly known application areas for identity verifying technologies, i.e. authentication, is the Logical Access Control to computer systems, where authenticity is normally established by confirming a claimed identity with a secret password or PIN code. Cash Dispensers or Computer Login Procedures are two other ubiquitous examples of this application area. On the other hand, authentication mechanisms are also applied to control Physical Access of persons to hazardous, dangerous, or high security areas. Similar or enhanced applications of this area include attendance monitoring of employees and the control of visitors in prisons. Traditional methods of confirming the identity of an unknown person rely either upon some secret knowledge (such as a PIN or password) or upon an object the person possesses (such as a key or card). But testing for secret knowledge or the possession of special objects can only confirm the knowledge or presence, and not, that the rightful owner is present. In fact, both could be stolen.

Conversely, biometric technology is capable of establishing a much closer relationship between the user's identity and a particular body, through its unique features or behaviour. All of the above mentioned application areas offer potential for biometric authentication technology, where the user's identity is verified using a physiological or behavioural characteristic such as the iris pattern, a fingerprint, or the voice. This thesis describes the development of a novel type of comfortable and easy to use biometric system. The system uses human gait as the biometric trait to authenticate people. Gait as a biometric has several important properties that make it an interesting solution to the authentication problem. First of all, people need not to interact with a sensor in an unnatural way. Second, since gait is a behavioural biometric, it performs implicitly a living person test and can thus neither be stolen nor lost. Finally, users do not need to unveil additional information about themselves other than already available.

Biometric is the study of intrinsic biological traits to uniquely identify the individuals . To automatically confirm a person's identity Biometrics has often been used. Biometrics is of two types:

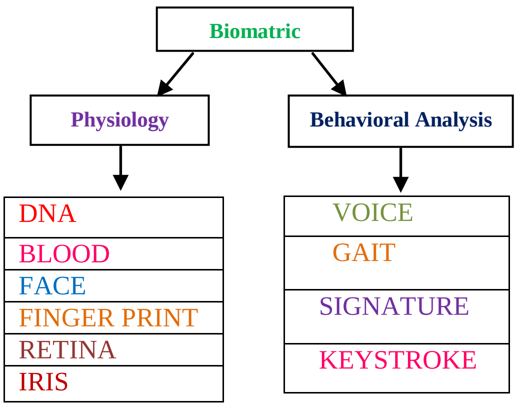


Figure 1.1: Type of Biometric

Biometric is the study of intrinsic biological traits to uniquely identify the individuals. To automatically confirm a person's identity Biometrics has often been used. Biometrics is of two types: Physiology characteristics cannot be changed easily because these are the inherent properties of the body like DNA, IRIS, Retina, Fingerprints, Face Recognition etc. and Behavioral biometrics are the learned characteristics of a person for example: Gait (human walk), signature, typing rhythm, mouse usage, sounds etc.

Gait Biometric Gait is the study of human locomotion i.e. how a person walks or runs. Or we can say that walking is a series of Gait cycles. A single Gait cycle is defined as the Period when one foot contacts the ground to when that same foot contacts the ground again. Weight acceptance is the main task of Gait cycle which involves the transfer of body weight on to a limb that has just finished swinging forward & has an unstable alignment. A Gait pattern i.e a human locomotion can be collected in three different ways and are mentioned below:

- Machine Vision Based
- Floor Sensor based
- Wearable sensor based.

II. RELATED WORK

[**Gurmeet Kaur Baljinder Kaur Munish Kumar[1]]**Biometrics identification methods have been in use for a very long time. The reason being the biometrics recognition is very secure. Also every person has unique biometric characteristics. The term Biometric is derived from a greek word. Bio means life , and metric means to measure. This paper presents a new method for verifying a person's identity. Here one of the behavioral biometrics i.e. the Gait pattern of Human Being is used. A wearable device mounted with Accelerometer is used to collect data for Gait analysis. This Accelerometer will detect leg's movement in horizontal, vertical and sideway direction. After detecting the movement in all the axes the data is fed to the microcontroller's A/D pins and then with the help of LabVIEW a person's Gait pattern is acquired.

[Alexandre Gadiou [2]] Human recognition at a distance is important in security systems. In this document, is described an efficient identification method which is directly inspired from. The problems with the existing algorithms are the accuracy of motion extraction and computation time. The solution proposed here is to identify people by measuring the closest similarity between 2 distance signals. The results obtained with this method are very encouraging. The accuracy of this algorithm is 95% in outdoor conditions with a database containing 20 people and has a low computational cost**.**

[Imed Bouchrika, Michaela Goffredo [3]] Given the continuing advances in gait biometrics, it appears prudent to investigate the translation of these techniques for forensic use. We address the question as to the confidence that might be given between any two such measurements. We use the locations of ankle, knee, and hip to derive a measure of the match between walking subjects in image sequences. The Instantaneous Posture Match algorithm, using Harr templates, kinematics, and anthropomorphic knowledge is used to determine their location. This is demonstrated using real CCTV recorded at Gatwick International Airport, laboratory images from the multiview CASIA-B data set, and an example of real scene of crime video. To access the measurement confidence, we study the mean intra- and inter-match scores as a function of database size. These measures converge to constant and separate values, indicating that the match measure derived from individual comparisons is considerably smaller than the average match measure from a population.

[Ahmed Mostayed, Mohammad Mynuddin Gani Mazumder [5]] Detection of gait characteristics has found considerable interest in field of biomechanics and rehabilitation sciences. In this paper an approach for abnormal gait detection employing Discrete Fourier Transform (DFT) analysis has been presented. The joint angle characteristics in frequency domain have been analyzed and using the harmonic coefficient recognition for abnormal gait has been performed. The experimental results and analysis represent that the proposed algorithm based on DFT can not only reduce the gait data dimensionality effectively, but also lighten the computation cost, with a satisfactory distinction. In order to make the algorithm more generic, a Mean Square Error (MSE) analysis is also presented. Future work will be the expansion of the detection introduced in this system to include abnormality detection instead of just an abnormal or normal detection that would prove to be a valuable addition for use in a variety of applications, including unobtrusive clinical gait analysis, automated surveillance in addition to a variety of others.

[**Murat EK˙INC[6]**] Gait refers to the style of walking of an individual. This paper presents a view-invariant approach for human identification at a distance, using gait recognition. Recognition of a person from their gait is a biometric of increasing interest. Based on principal component analysis (PCA), this paper describes a simple, but efficient approach to gait recognition. Binarized silhouettes of a motion object are represented by 1-D signals, which are the basic image features called distance vectors. The distance vectors are differences between the bounding box and silhouette, and are extracted using 4 projections of the silhouette. Based on normalized correlation of the distance vectors, gait cycle estimation is first performed to extract the gait cycle. Second, eigen space transformation, based on PCA, is applied to time-varying distance vectors and Mahalanobis distances-based supervised pattern classification are then performed in the lower dimensional eigenspace for human identification. A fusion strategy is finally executed to produce a final decision. Experimental results on 3 main databases demonstrate that the right person in the top 2 matches 100% of the time for the cases where training and testing sets corresponds to the same walking styles, and in the top 3-4 matches 100% of the time when training and testing sets do not correspond to the same walking styles.

[Mohamed Rafi, Md. Ekramul Hamid[7]] This paper describe a new model-based feature extraction analysis is presented using Hough transform technique that helps to read the essential parameters used to generate gait signatures that automatically extracts and describes human gait for recognition. In the pre processing steps, the picture frames taken from video sequences are given as input to Canny edge detection algorithm which helps to detect edges of the image by extracting foreground from background also it reduces the noise using Gaussian filter. The output from edge detection is given as input to the Hough transform. Using the Hough transform image, a clear line based model is designed to extract gait signatures. A major difficulty of the existing gait signature extraction methods are the good tracking the requisite feature points. In the proposed work, we have used five parameters to successfully extract the gait signatures. It is observed that when the camera is placed at 90 and 270 degrees, all the parameters used in the proposed work are clearly visible. The efficiency of the model is tested on a variety of body position and stride parameters recovered in different viewing conditions on a database consisting of 20 subjects walking at both an angled and frontal-parallel view with respect to the camera, both indoors and outdoors and find the method to be highly successful. The test results show good clarity rates, with a high level of confidence and it is suggested that the algorithm reported here could form the basis of a robust system for monitoring of gait.

[Nyo Nyo Htwe, Nu War[4]] Human identification using gait is a new biometric intended to classify individuals by the way they walk have come to play an increasingly important role in visual surveillance applications. In gait biometric research, various gait classification approaches are available. This paper presents human identification system using the view-invariant approach. The framework of proposed system consists of the subject detection, silhouette extraction, feature extraction, and classification. Firstly, moving subjects are detected from the video sequences. And extractions of human silhouette are done by using background subtraction method. In feature extraction step, motion parameters such as joint angles, angular velocity and gait velocity are calculated using speeded up robust features (SURF) descriptors. This descriptor helps to read the essential points used to generate gait signatures and extracts motion parameters for classification. In the final stage, Meta-sample based sparse representation method '(MSRC) is used in classification of the extracted motion parameters and features. Experiments are conducted on the own dataset which obtain overall classification rate of 94.6782%.

III. PROPOSE WORK

In the research paper, the gait feature like knee angle of left and right knee is used. The foot distance is another feature as whether the human is injured at feet, drunk or in other circumstances in which his/her normal walking is changed; the foot distance between toe of one leg to other leg's ankle will remain same in major cases. One more important feature that is left untouched even in literature as per my knowledge is palm angle. The hand movement is also unique body gesture of every human. The angle made by elbow is different for everyone conditionally in normal walking case as if person is carrying anything then that angle is altered.

For this purpose extracted silhouettes of walking movement of an object is taken from the database uploaded at the home page of Shuai Zheng, a DPhil student at University of Oxford.Various steps are described step by step in detail below:

Step 1: Features from silhouettes are to be calculated. But before that pre processing on the loaded data need to be done. In pre processing edge detection is done and for this purpose canny edge detector is used in my case as the Canny method finds edges by looking for local maxima of the gradient of image. The gradient is calculated using the derivative of a Gaussian filter. The method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges. The edge detection procedure starts from weak edges and then move to strong edges. This helps fill in gaps in the detected edges.

A comparison of different edge detection techniques on a sample frame is shown in figure 2.1 and 2.2. figure 2.1 show the original frame used for edge detection.

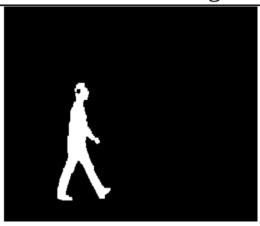


Figure 2.1: Original frame

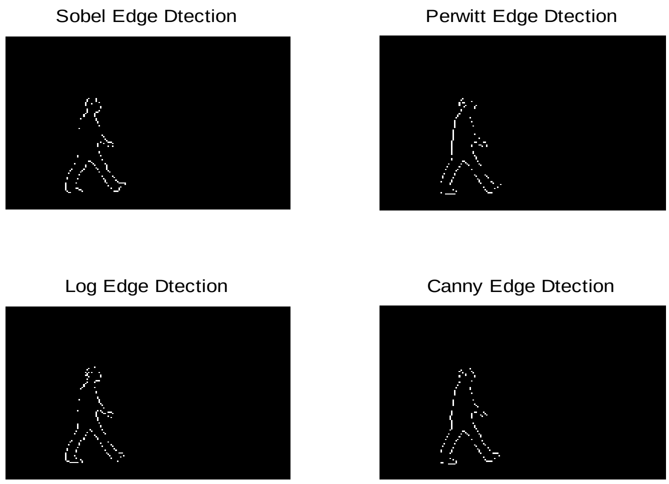


Figure 2.2: edge detected frame with various edge detection algorithms

Figure 2.2 clearly shows that canny edge detection algorithm gives real edges of frame. So in our proposed work it is used for pre processing of frames. Even after detecting edges form canny edge, discontinuities can be observed in edges in above figure. These discontinuities give rise to false feature extractions. So to avoid this discrete wavelet transform is applied on frame first and then edges are detected from the transformed image.

Discrete Wavelet transform detects the exact instant when signal changes. The DWT of images is a transform based on the tree structure with D levels that can be implemented by using an appropriate bank of filters.

Step 2: After preprocessing step feature extraction will be done by Hough Transform. The **Hough transform** is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform. The classical Hough transform was concerned with the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses.

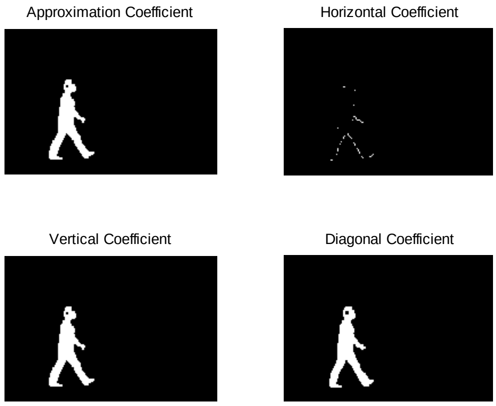


Figure 3.1: Different wavelet transformed Image

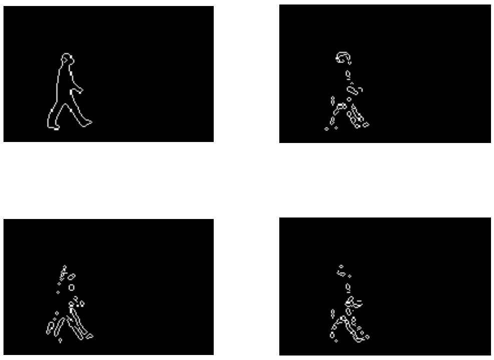


Figure 3.2: Canny edge detected wavelet coefficients

The final result of the linear Hough transform is a two-dimensional array (matrix) similar to the accumulator -- one dimension of this matrix is the quantized angle θ and the other dimension is the quantized distance r. Each element of the matrix has a value equal to the number of points or pixels that are positioned on the line represented by quantized parameters (r, θ). So the element with the highest value indicates the straight line that is most represented in the input image.

Step3: In feature extraction step Knee angles of front leg and other leg, palm angle and foot to foot distance will be taken out to match it with the database.

IV. RESULT AND DISCUSSION

We have selected frames captured of a man moving from left to right and from right to left and gait features as explained above will be compared with each other. Database thus obtained consist silhouettes of frames only. It saves our work to convert frames into silhouettes as capturing video in a suitable environment was unavailable with us. To capture frames, camera is placed at different angles generally at 90^o,120^o, 180^o, but we have selected only frames for which camera angle to object was 90^o as it is easy to find out gait parameters from this angle.

Figure 4.1: Interactive selection of desired frame by user

Frame at any position have been selected and convert into canny edge detection image. canny edge detector is the best method to detect edges but still discontinuities in edges is also visible. With these discontinuities gait parameters may be calculated wrong. To correct it first wavelet transform is applied over selected frame and the approximation coefficient of wavelet transform, having highest energy is selected for canny edge detection algorithm. The result of this process is visible after pressing the button named 'Wavelet Transform' as shown in figure 5.5.

To apply hough transform only area of object skeleton will be considered.

In MATLAB working of hough transform is in three steps:

1. A hough transform matrix is formed by applying transform on image
2. Peaks in transform matrix are detected. Number of peaks is user defined.
3. Extract line segment based on hough transform. Two parameters 'Fillgap' and 'Minlength' specified the minimum distance between two lines and minimum length of line to be ignored respectively.

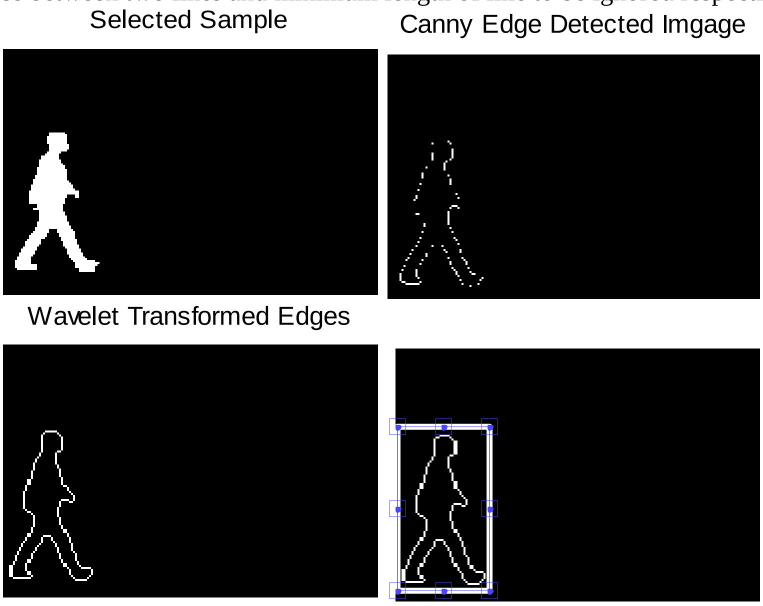
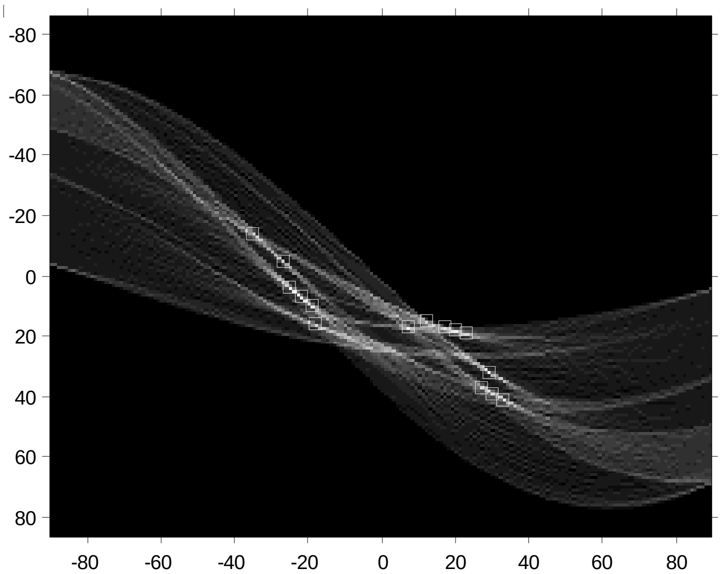


Figure4.2: Skeleton part selected for Hough Transform



Hough Transform matrix with 15 peaks detected

Figure4.3: Hough Transform matrix with 15 peaks detected

Table: Knee angle in different frames

Frame No.	Front Knee Angle	Frame No.	Back Knee Angle
4	89.8629	9	56.9761
5	103.6658	10	45.3031
6	116.4625	11	38.3867
7	123.0667	12	30.5826

knee angle is increasing while back knee angle is decreasing with frames. This is because front knee angle is measured form front side of foot and back knee angle as name indicates is measured from back knee of other foot.

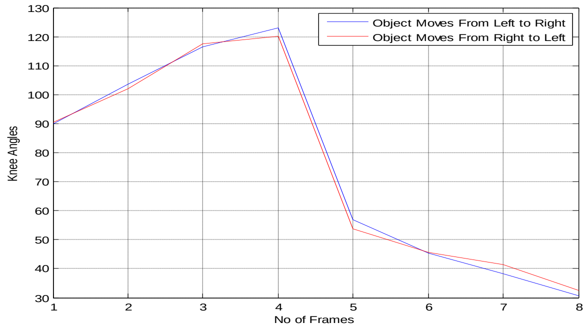


Figure 4.4: Graph showing comparison of knee angles in case of two moving directions of a same object

IV. CONCLUSION

It was found that knee angle, palm angle and foot to foot distance are such features which are unique to every human and very difficult to copy. In literature canny edge detection was used for image pre processing but it was giving errorneous edges as proved in chapter 4. To extract features correctly errorneous results are very dangerous. So before that wavelet transform is applied on captured frame and then canny edge detection is applied as wavelet transform detects the exact instant when the signal changes and categorise that into different energy coefficients. The limitations of canny edge detection were removed by this step. Hough transform successfully extracted features form the edges. I previous work till now no one has given freedom to user to select the joint angles which are to be extracted. But here in my work it is made customised. User can select the which knee angle is to be measured and by drawing a reference line along the hough line, that can be measured. Frame data of a same person is captured when he moves form right to left and vice versa

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