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Hybrid Classifier for gait recognition

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Abstract: *Gait recognition is one form of biometric technology that can be used to monitor people exclusive of their cooperation. Controlled environments such as banks, military installations and even airports require being able to quickly spot threats and providing differing levels of access to different user groups. Gait shows a particular way or manner of moving on foot and gait recognition is the process of identifying person by the style in which they move.. Gait is less unobtrusive biometric, which offers the possibility to identify people at a distance, without any dealings or help from the subject; this is the property which makes it so attractive. This paper proposed new method for gait recognition. In this method, firstly binary silhouette of a moving person is spotted from all frame. Secondly, feature from each frame is extracted using image processing operation. Here center of mass, step size length, and cycle length are taking as key feature. At last neural network is used for training and testing purpose. We have created different model of neural network based on hidden layer, selection of training algorithm and setting the different parameter for training. Here all research is done on gait database. Different groups of training and testing dataset give different results.*

Keywords: *Gait, SURF, SVM, K-NN.*

I. INTRODUCTION

We use the term gait recognition to signify the identification of an individual from a video series of the subject walking. This does not mean that gait is limited to moving, it can also be applied to running or any means of movement on foot. It has attracted interest as a method of identification because it is non-invasive and does not require the subject's cooperation. Gait recognition i.e., to identify person by the way of walking style. Gait recognition has overcome faults of other recognition technique and is more advantageous over other forms of recognition techniques like face, finger, speech, iris or palm. It can be used to recognize or identify a person from far distance without knowledge of that person. This paper proposed new technique for gait recognition. In this method, frames are created from video and stored. Secondly, feature from each frame is extracted using Hanavan's model. Here height of person, distance between two hands and distance between two legs are taken as key feature. At last K-NN with SURF and SVM are used for training and testing purpose. Here all the research work is done on gait database created using mat file. Different groups of training and testing dataset give different results.

We utilize the term Gait recognition to imply the ID of a single person from a feature succession of the subject strolling.

1.2 Gait Recognition system

The Gait Recognition System is which that identify the gait of the authorized individual by comparing it with the stored sequence in the database.

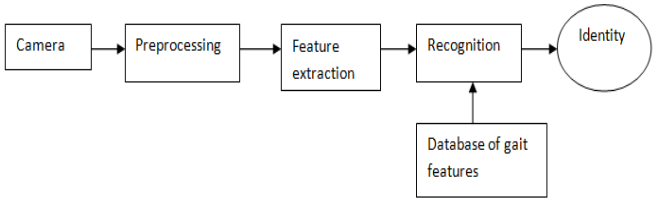

Figure 1.1: Gait Recognition system

Video capture: Method of accurate tracking person y sein indoor surveillance video stream obtained from static camera. Example a video camera on front door or anywhere in multi-complex can save gait sequences of a moving person, so that video can be used for additional processing.

Background subtraction: Background subtraction is a computational vision process of extracting foreground

objects in a specific scene. A foreground entity can be described as an object of attention which helps in reducing the amount of data to be processed as well as provide important information to the task under thought. Frequently, the foreground object can be thought of as a coherently moving object in a scene. Background subtraction generates binary images containing black and white (moving pixels) also identified as binary silhouettes. Background subtraction is a class of techniques for segmenting out objects of interest in a scene for applications such as surveillance. There are many challenges in developing a good background subtraction algorithm. First, it must be robust against changes in illumination. Second, it should avoid detecting moving background objects such as moving leaves, rain, snow, and shadows cast by moving objects. Finally, its internal background model should react quickly to changes in background such as starting and stopping of vehicles.

Feature Extraction: It is the extraction of appropriate feature that will effectively capture the gait characteristics. Feature extraction can be done by two ways:

- Model based approach
- Model free approach

Model Based Approach: It is the approach which models the human body with the appropriate geometric curves. Parameters used in model based approaches:

1. Distance used as parameters
2. Ellipse fitting in silhouette regions
3. Hip rotation model
4. Model using a combination of shapes

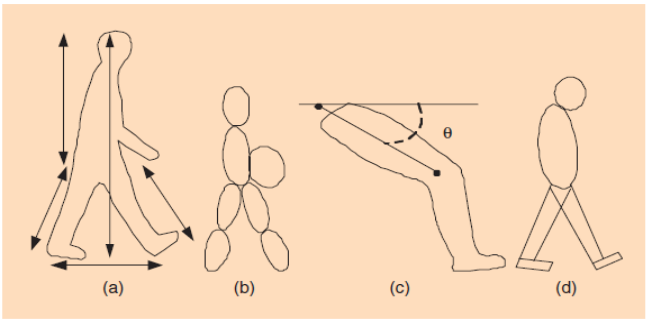

Figure 1.2: Model Based Approach

Model Free Approach: In this the variations in shape, distance vectors in the sequence of images of moving human silhouette to characterize the gait features and also known as holistic methods. Features are extracted from the silhouettes for gait recognition.

1. Width of Silhouette
2. Vertical and Horizontal Projections

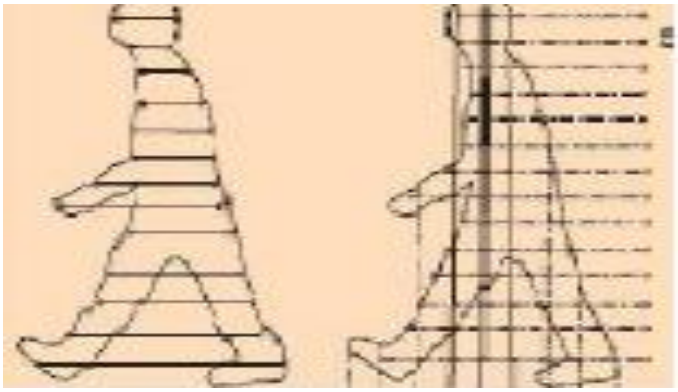

Figure 1.3: Model Free Approach

For the features extraction, the **Hanavan's model** is used. In this system, the important attributes which wasn't used earlier, are extracted.

Features extracted in the model are listed below:

1. Length of one hand
2. Length of leg
3. Distance between both hands
4. Distance between right hand and left leg
5. Distance between left hand and right leg
6. Distance between head and feet

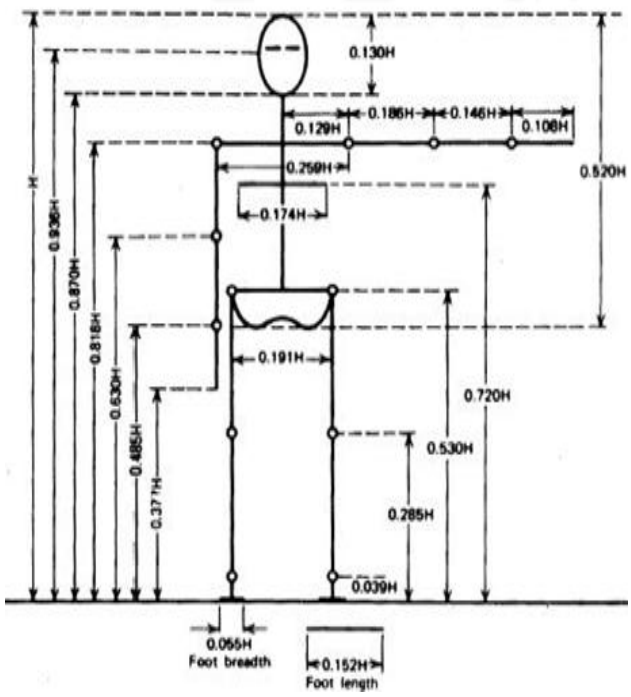

Figure 1.4: Hanavan's model

Matching and Recognition: Matching and Recognition is the final step of gait-based person identification. Here, input test video sequences are compared with the trained sequence in the database. In general, minimum distance classifier may be used for gait recognition.

Matching: Moving target characterization calculation is utilized separate person (i.e., passerby) from other

nearer view objects (viz., vehicles). Surf characteristic is used in this system for matching .which has not been used till date in the gait recognition systems, these concentrated quirk vectors are common to seeing single individual. Surf Feature is utilized for perceiving persons on the premise of stride.

SURF (Speeded UP Robust Features)

Surf feature is used for matching in this system it is a robust local feature detector that can be used in computer vision tasks like object recognition or 3D reconstruction. Interest points are selected at distinctive locations in the image, such as corners, blobs, and T-junctions. The most important property of an interest point detector is its repeatability. The repeatability expresses the reliability of a detector. Surf characteristic is used for matching in their system here we use surf feature to find out the critical points which help us to matching the images more accurately. Surf feature has been used first time in gait recognition system.

For orientation assignment, SURF uses wavelet responses in horizontal and vertical direction for a neighborhood of size 6s. Adequate Gaussian weights are also applied to it. The dominant orientation is estimated by calculating the sum of all responses within a sliding orientation window of angle 60 degrees. Exciting thing is that, wavelet response can be found out using integral images very easily at any scale. For many applications, rotation invariance is not required, so no need of finding this point of reference, which speeds up the process. SURF provides such a functionality called Upright-SURF or U-SURF. It improves speed and is robust up to +15 Open CV supports both, depending upon the flag,. If it is 0, orientation is calculated. If it is 1, orientation is not calculated and it is faster.

Recognition: Some of the generally used recognition techniques are described below. In the training, after parallel processing of two training processes, SVM and KNN are used techniques.

KNN (K-nearest-neighbour)

K-Nearest Neighbours (KNN) classifier instantly finds the data set on the basis of Euclidian distance. In case of K-NN first the data is trained and stored in memory. Recognition is performed on a tested sample by calculating the Euclidian distance between the sample and every sample present in training set. K indicates the number of nearest neighbour which is considered while determining the result. The tested sample is checked to lie inside the majority of samples. Then it considers matched otherwise not matched. Euclidian distance can be calculated as:-

$$d(p,q) = \sqrt{(q_1 - p_1)^2 + \cdots (q_n - p_n)^2} \quad \text{-------- (3)}$$

Where p, q represents the features set for the two different samples.

SVM (Support vector machines)

SVM is highly advanced and accurate technique used for classification and recognition in today's world.SVM as the name denotes support vector machine consists of support vectors which help in identification on the basis of features.After training data set it finds a hyper plane to separate different classes by solving the quadratic optimization equation :-

Minimize: $\frac{1}{2}\|W\|^2 + C\sum_{i=1}^{N}\varepsilon_i$ ------- (6)

Subject to $y_i(w*x_i)+b \geq 1 - \varepsilon_i, \varepsilon_i \geq 0$.

Where w, b and ε_i denote weight vector for learned decision hyperplane, model bias and slack variable. C is the penalty factor which keeps the balance of classification accuracy.

SVM classifies the test instance based on the following decision function:

$$f(x) = sign(\sum_{x_i \in sv} \alpha_i y_i K(x_i, x) + b \quad \text{--- (7)}$$

Where sv , α_i, and $K(x_i, x)$ represent support vectors ,Lagrange multiplier and kernel function.f(x) denotes the distance of the test instance from separating hyperplane and the sign indicates the class label. In this paper linear SVM is used.

1.3 Gait Applications

SECURITY: Military, Airport Terrorism/Domestic Crime

In recent years, automated visual surveillance has been under a big interest. This is mainly due to the vital purpose to provide a safe environment. As a result, there is a rapid increase in synchronized closed-circuit television (CCTV) cameras, which require an intelligent approach. Thus, these ideal systems should be able to recognize the identity of the subject if they detect a suspicious behavior. Basically, such systems, having monitored the process, should be able to give a warning before the actual event happens, and be able to identify the subject from the crowd immediately. The gait recognition is the most suitable biometric measure for these reasons. Also its unobtrusiveness feature that does not require observed subjects' cooperation makes gait recognition more attractive to study for security reasons. Thus, the gait recognition will be a very useful and powerful tool to recognize perpetrators.

Gait Analysis in remedy

A gait recognition technique is not limited to security applications, a lot of medical applications are based on

this technique. For example, the main purpose in medicine linked with gate is to identify walking conditions to treat pathologically abnormal patience, to identify different neuromuscular disorders, such as multiple sclerosis and Parkinson's disease, in their early stage.

Gait Analysis in Sport

Gait analysis is in wide use in sports biomechanics applications. It helps people involved in sports to improve performance and lower injury risks by tracking the walking and running process and identifying posture or movement-related problems that might occur.

Live application: An Innovative Gait Tunnel by Southampton University shows how we can implement Gait Recognition Technique effectively.

In Sweden, bankruptcy police was not able to make out actual suspect by other techniques of recognition but due to Gait Recognition technique they finally were able to apprehend the perpetrator.

Figure 1.6: Innovative Gait Tunnel

1.4 Advantages

Gait as a biometric can be seen as advantageous over other forms of biometric identification techniques for the following reasons:

- Unobtrusive
- Distance Recognition (Effective from a distance)
- Reduced detail
- Difficult to conceal

II. LITERATURE SURVEY

Jiwen Lu, Gang Wang and Pierre Moulin. Most datasets like USF, CASIA assume that people walk along a fixed direction or a pre-defined path and this is unrealistic. Human Identification and gender recognition from gait sequences with arbitrary walking directions are not easy as human gait is sensitive to varying poses. To study this problem, a new gait database named ADSC-AWD is constructed in which people walk freely in the scene, and the walking directions are arbitrary and time-varying.

The proposed SRML method for gait feature extraction which can minimize the intra-class sparse reconstruction errors so that more discriminative information can be exploited for human identification and gender recognition. They achieved comparable rate with existing gait-based human identity and gender recognition.

Maodi Hu, Yunhong Wang, Zhaoxiang Zhang and De Zhang. A modeling approach is proposed for gait-based gender classification which includes shape features extraction. Shape appearance of both genders is integrated into a model. Assessing walking patterns can provide valuable information regarding physical conditions of individuals. They use both CASIA dataset B and IRIP gait databases. The result shows the superior performance over model free approach.

M. Jeevan et al. Existing Gait representations are sensitive to changes in various conditions such as carrying bag and clothing. To overcome this, Pal and Pal Entropy were proposed. CASIA datasets A, B, C have been carried out to demonstrate the effectiveness of the proposed representation of Gait. They achieved reasonable results on a large database like CASIA dataset B and C, vindicate the suitability of this method for large datasets.

Qiong Cheng, Bo Fu and Hui Chen. Gait recognition based on PCA (Principal Component Analysis and Linear Discriminate Analysis (LDA) is proposed. PCA is used to reduce dimension of the images without much loss of information and LDA is performed to optimize the pattern class. For the experiment, they used their own database and they achieved better recognition rate from PCA compared to LDA

S. Yu, T. Tan, K. Huang, K. Jia, and X. Wu. X. Li, S. Maybank, S. Yan, D. Tao, and D. Xu. [5] Each gait image is partitioned into several different parts such as head, chest, and legs, and performs classification on each part with SVM. The outputs of different parts were then combined and fused. Gait analysis is difficult because of the wide variety of movements of the different parts of the body. AGI has shown to be effective for both human Identification and gender recognition.

X. Huang and N. V. Boulgouris. Most gait recognition methods assume that the walking path is pre-defined but this assumption is unrealistic because people walk freely and walking direction may be time-varying. A gait recognition system is proposed where the walking

direction changes during the walking period. They proposed a gait recognition system that uses multiple views.

III.PROBLEM FORMULATION

❑ Gait recognition aims to identify people by the manner they walk. Several Parameters has been proposed for Gait Recognition previously but there have been always need for better parameters to improve recognition. The objectives are based on the problems which the gait recognition system is facing these days.

❑ The existing Human Identification Using Gait Recognition doesn't consider some important parameters like distance between hands, distance between left hand and right leg, distance between right hand and left leg.

The previous approach will fail if the walking style in the testing sequence is significantly different from that in the training sequences. This is because there will be large differences of features of the same subject like they're walking speeds and directions.

IV. OBJECTIVES

- To make an improved gait recognition system by using parameters (like length of head, length of right hand, length of neck, length of right leg etc) in Hanavan's model.
- The proposed human identification using gait recognition algorithm which is based on SVM, KNN and SURF.
- System of human identification using gait recognition algorithm is distributed and range independent for different videos images.
- To use surf feature for matching in gait recognition system.

V. METHODOLOGY

Phase 1: Select a Live Video for database. I develop a code so that live video is automatically converted into video frames and mat file as database. We are going to work on frames for which the inputted video or testing video will transformed into the frames so that we can match them.

Phase 2: We will implement the concept of background subtraction so that unneeded part will be deleted and then we can concentrate on related part because if the threat is moving on a particular place but we need to concentrate only on object rather than complete frame.

Phase 3: We are going to implement the concept of feature extraction which means on the basis of what different parameters we are going to match the database image with the man who is walking.

Phase 4: Lastly I develop a code to test recognition performance of our proposed method using Support Vector Machine (SVM) and KNN and for matching testing and training data we are going to use SURF which will show better results than previously obtained using other different methods.

Recognition which is basically consists of two different parts:-

1. Matching the database with the inputted data.
2. Testing the result.

VI. RESULTS

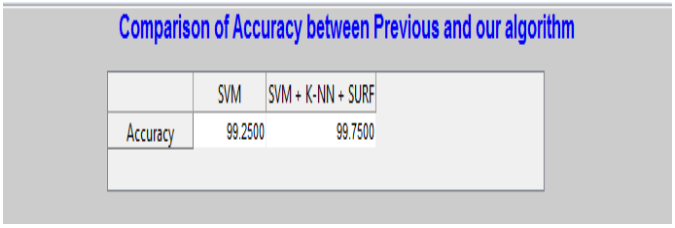

Fig 6.1: Comparison of CCR between previous and proposed algorithm.

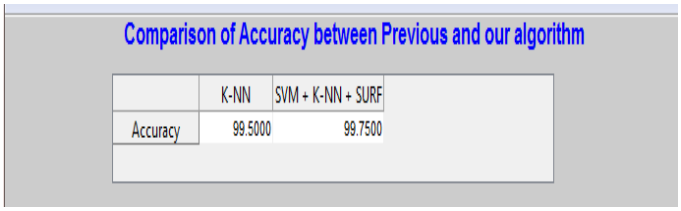

Fig 6.2: Comparison of CCR between previous and proposed algorithm.

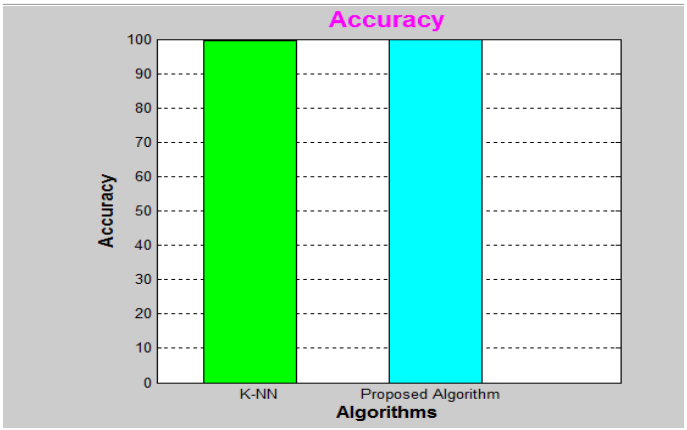

Fig.6.3: Graph of comparison of pervious work and proposed work.

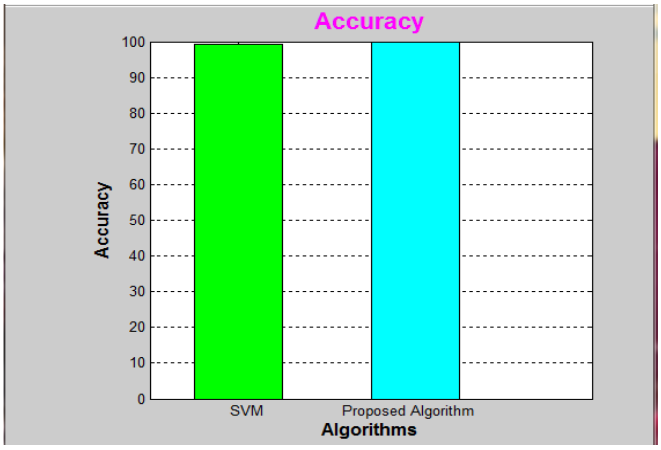

Fig.6.4: Graph of comparison of pervious work and proposed work.

VII. CONCLUSION

- In this research different classifier like SVM, and K-NN have been used for gait recognition.
- Pre-processing and then background subtraction enhances feature extraction and recognition process.
- The results are analyzed and found that accuracy is enhanced when combined classifier SVM, and K-NN are used.
- Experimental Results show improved accuracy with combined classifiers SVM, and K-NN.

FUTURE WORK

Try to reduce the time complexity, improve compression rate and ratio.

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