

A Review on Human Identity and Gender Recognition from Gait Sequences

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Abstract: The Identification of People through gait sequences have resulted in an immense compact of curiosity in computer vision by reason of its benefit of not noticeable recognition from far distance. Biometrics recognition is a process that uniquely identifies people on the bases of natural characteristics either physical or behavioural. Identification of humans by Gait biometric is a way to recognize people by their walking manner or style of person's moving feet. Gait recognition is based on the behavioural characteristics of human that can uniquely differentiate one human from another. It receives great interest in Biometric field. In Human Gait biometric recognition there are a variety of gait recognition techniques each having its on benefits and demerits. In this paper, the different gait recognition methods are discussed.

Keywords: Gait, Biometrics, Human identity, Gender recognition, SRML, SVM

I. INTRODUCTION

The unique attribute of a human is biometrics. Recognizing a human on biometric attribute involves characteristic vectors which are derived from the physiological and/or behaviour characteristics of individual. Human identification by biometric system from distance without human participation has very much demand in different significant secure applications. In this kind of applications human identification/recognition using gait biometric become more attractive. There are two types of biometric characteristics behavioural and physiological [16]. Physiological attributes are iris, fingerprint, DNA, face, palm print etc. and behavioural attributes are gait and voice. Since a physiological characteristic need human cooperation and does not give good results in images of low resolution, so gait recognition is more attractive.

A. Human Gait Recognition

Gait is a specific way or manner of moving on foot. As human biometric gaits are commonly adopted novel field for analysis in the area of workspace vision. It receives the good attention within the workspace vision set and a variety of stride dimensions are created. In human gait recognition the increasing biometric modernization that consists of a particular person being recognized absolutely through the examinations while walking. Gait has been stretched in excitement as a method for identification over the foundations that this is not interfering and doesn't constrain the individual's partnership. Identification through gait can be employed from distance that makes it suitable for recognizing and identifying the criminals during misconduct. We make use of the term 'gait recognition' for the identity of human after

the processing the cluster of videos of the individual wandering. It doesn't imply that human gaits are constrained to strolling only; this can additionally be useful for running or any other method of development for walking. Gait recognition methods on the basis of feature extraction are categorized as model-based approach and appearance-based approach for gait identification and recognition [16].

Appearance-Based method suffers from variations in the look due to the modification of the walking direction or viewing poses.

Model-Based methods are scale and view invariants. In these methods the movements of individual body by way to apt their models for the input images or videos are extracted.

Human gait biometric recognition may be considered as advantageous over other types of biometric recognition techniques, distinctive apparent policies for associated motivations are as:

Unremarkable: Gaits of a person wandering over the scene can be collected and examined without any knowledge to a person that they are under examination and lacking any participation from the client for data collection stage and is dissimilar to retina, fingerprinting or palm printing scans.

Distance Recognition: The human gait series can be capture from a distance unlike to other biometrics recognitions like retina, palm, fingerprint, face recognitions.

Fewer details: The gait identification and recognition doesn't obligate for pictures to be captured of a great quality not like to other biometrics. As face recognition, iris recognition, palm recognition, finger print recognition which are readily effected by less quality pictures.

Complicated to conceal: Gait sequences of a human is difficult to conceal by making an attempt so the human will apparently seem more apprehensive than other biometric policies like face recognition where the person's face can be customized or covered up. Human's biometric features can be influenced through certain factors as:

- Stimulants –Alcohol, drugs and illness will change the style or way of a person's walking.
- Physical changes– Throughout the women pregnancy if a mishap happens it effecting the legs or result in extreme weight gain and influences the progress of normal growth of a person.
- Psychological change – A human temper can as well change a person's gait signature
- Clothing Style– A same person wearing different clothes may cause an automatic mark extraction system to effect on universal changing signatures for a person.

B. Basic functioning of Gait Recognition System

The basic configuration and the dealing of human gait recognition are presented as:

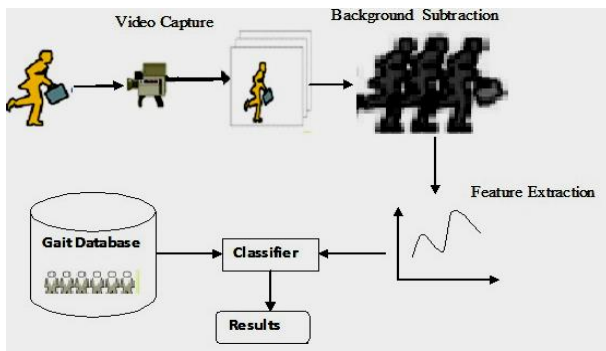


Fig. 1: Block drawing for human gait recognition scheme

Video capturing: It is a technique of exactly tracking a human in indoor observation where video streams are attained through different static cameras. This can be like a video camera installed over front gate or all over the critical positions of the building which helps in accumulating the gait series of a human in motion so that the captured video may be utilised for further course of action.

Subtracting background: Subtraction of background is a computational visualization method for extracting prominence effects from a specific view. A forefront thing can be expressed as a thing of attention that help in minimizing the amount of data for processing and give significant information for assigned analysis. Usually, the prominence thing can be considered as a reasonably moving entity in a view. Background subtraction creates two pictures comprising white and black also recognized like binary silhouettes. It is a kind of methods for separating out items of concern in a view for purposes as supervision. There are numerous obstacles in growing a better algorithm for subtraction of background. First, it needs to be strong across variations in terms of brightness. 2nd, it should not include static background items such as leaves, shadows, exciting snow, and rain spread by exciting things. At last, changes to variations in background like starting and finishing of automobiles very quickly should be reflected with the help of internal background model.

Extraction of Features: Feature extraction is considered to be prime and important step in gait identification and recognition. The aspect needs to be resilient to working conditions and should produce better discriminability beyond single persons. Every gait series is divided into parts called gait cycles. Initially, gait cycle for an individual starts with rest, then left foot is moved forward, rest, forward moment of right foot, and finally the rest position of human body. The sum of prominent pixels to the subject helps in obtaining the gait cycle. At the areas of comfort, this amount needs to be less. Gait cycle for the scene is calculated by taking all the frames among two static positions.

Matching and Recognition: Matching and Recognition is considered the final step of human recognition on the basis of gait. Here, test video sequences taken as input from human are matched with the trained sequences for the database. Usually, least length recognizer can be utilized for gait identification or recognition. In training process, two equivalent and parallel training processes such as spatial and physical arrangements are mined together. Pre-processing is done with the help of

template projection and extraction. Projected vectors of both spatial as well as temporal templates are joined together to expand vectors before recognition. The final step includes comprehensive vectors being synchronized to the trained database sets with the use of multi linear discriminated analysis, linear discriminant analysis, Neural Network and Back propagation neural network (BPNN).

C. Applications of Gait

Gait recognition area has got wide variety of applications besides security in various fields of engineering. The various applications include the ability as well as the analysis.

Medical diagnostics: The anxious stride might show some compensation for fundamental pathologies or be in blame of causation of signs in itself. Normally the cases like cerebrally paralyzed and patients suffering with strokes that are widely observed in stride laboratory. The examination of step allows analysing, intercession methodologies to be completed for the further advancements in recovery designing. Apart from medical applications, stride dissection is used as a part of skilled games preparing to update and enhance physical implementation. In the examinations of electronic stride, patient usually strolls or run with the sensors in their feet with the target of sending a few purpose of insight regarding the weight of foot, reach of movement, timing to reach workstation and to plots a graph. Specialist usually surveys them and after surveying they invent medication plan [18].

Biometric recognitions and forensics: Different individuals can be recognized by using biometric identifier by making minute changes in step style. Taking a case after figure, it expresses that the step recognition in security access the applications territory. Multiple domains in human information preparations where cognitive psychology is practised are brought together by various applied areas of research. It includes recognising a pattern, decision making, representing mental, expertise, visual cognition, and knowledge acquisition. All these areas are very helpful in field of illegal justice system and biometrics. The widely used field for forensic and biometric applications uses the technologies like integration, selection testing and training of examiners.

D. Gait Basic Terminologies

Gait recognition system uses some crucial terminologies which are mentioned as:-

- **Gait cycle:** It is described as time difference between the two occasions of walking that begins with contact to land for one foot and ends with same foot making again the contact to the land.
- **Gait events:** The walk cycle is separated into seven different occasions or periods first four take place during stance stage, when the foot is on the land and other three takes place during swing stage, when the foot is moving ahead through the air.
- **Gait Phases:** Gait cycle involves different phases as:
- **Stance phase:** In this phase foot of a person lies above ground level.
- **Swing phase:** In this phase the foot of human remains not in touch with the land level and the human leg swings in researching for consequent foot strike.

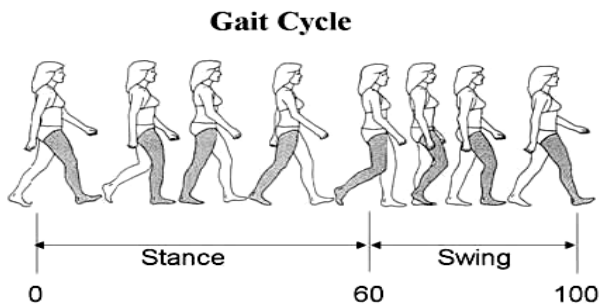


Fig. 2: Gait Cycle [6]

All these stages generally join starting contact and the loading response. The starting touch is constantly implied when the heel strike. The joint improvement throughout this stage permits the deal of weight onto the recent stance stage leg while minimising paralyze, sparing stroll speed and also maintaining robustness [19].

II. GAIT RECOGNITION METHODS

The main gait recognition methods used in various phases of the system are given below:

1) Background subtraction techniques: They can be categorized into two distinct types:

- Non Recursive technique: A non-recursive method applies a sliding window advance for the background judgment. It evaluates the base image focused around the sophisticated variety of each pixel inside the structure. Main drawback of this method is memory stockpiling requirement. The part of the usually used non-recursive techniques are depicted beneath:
- Median filter: These are particularly applied in digital image processing by taking into consideration certain conditions, it removes noise while edges are preserved. Thus, Keeping away from removing out the boundaries, by either cropping the signal or cropping the image boundary afterwards.

2) Model Based Method:

This approach utilizes models whose parameters are often controlled by the handling of stride groupings which are in paired shapes. These systems have great quality feature arrangements like scale, view invariant and oblige. In this technique human outline is divided into neighbourhood areas related to different human body components and ovals are fixed to all area to speak to the human configuration.

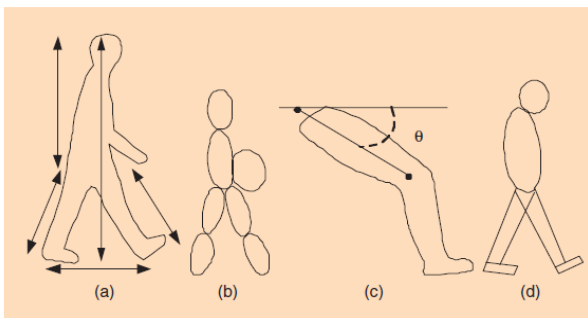


Fig. 3 Model based approach for feature extraction [13]

This method applies midpoints of the centroid and the angle quantity. Ghastly tricks and Spatial are calculated from these close locales for recognition and categories. In these model-based procedures, the accuracy of human model remaking unambiguously depends upon the nature of the calculated human profile [7] although, since model-built procedures depend in light of the unique proof of particular walking parameters in the stride category, these procedures generally make efficient step arrangements to be valuable. Additionally various obstructions, e.g. obstruction toward oneself for strolling subjects may significantly effect the calculation of model parameters unbelievable. Thus, a multi Polaroid stride securing structure would be more suitable for such type of strategies.

3) Model Free Method: In this method a binary silhouette is achieved initially by back ground subtraction method. Certain features like static and dynamic information of moving objects are then extracted. A first approach was performed by Johnson. Silhouettes of the walking person are operated directly by this approach.

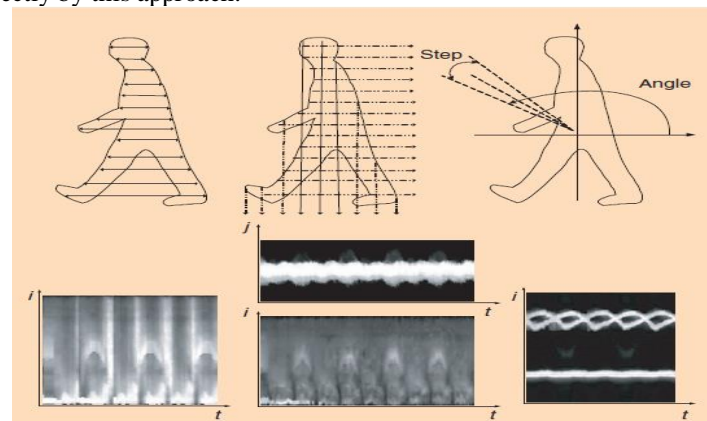


Fig. 4 Model free method of feature withdrawal

A. Gait metric Learning Algorithms

Sparse Reconstruction Based Metric Learning (SRML): Sparse reconstruction based metric learning is considered to be a metric learning technique for studying distance metric to reduce the intra-class sparse reconstruction inaccuracies as well as to increase inter-class sparse reconstruction inaccuracies concurrently, as a result discriminative information should be utilized for gait identification and recognition. For every gait series, various C-AGI features are obtained by means of the above pre-processing and the measures of feature extraction, these C-AGIs are used to explain individual gait from diverse poses and views. In training process, intra class re-construction inaccuracies for the entire training sets are made as little as achievable and the inter class re-construction inaccuracies for the entire training sets are made as massive as achievable concurrently, through studying the distance metric, as to utilize additional discriminative information for gait recognition. Experimental result showed that this method produces effectively good recognition rate then other metric learning algorithms used for gait recognition [1]. It uses point-to-set distance for studying distance metric which efficiently model huge intra-class viewing variation, particularly for limited number of training samples.

B. Other Metric Learning Algorithms

Neighbourhood Components Analysis (NCA) [21]: A narrative nonparametric learning technique that handle the responsibilities of distance learning and dimensionality decline in a combined manner. Though many recent effort has paying attention on nonlinear techniques, we sense that linear embed has still not fully satisfied its prospective for either learning or visualization. NCA is a supervised distance learning technique used for classification of multivariate data into different classes.

- Disadvantages: poor recognition rate.

- Large Margin Nearest Neighbor (LMNN) [22]: Mahalanobis distance metric for k-nearest neighbor (kNN) categorization is learned with semi definite programming. Metric is skilled for the objective that the k-nearest neighbors constantly associates to the similar class whereas samples from dissimilar classes are divided with a large margin. On data sets of unstable size and complexity, metrics trained using this leads to significant progresses in k-nearest neighbor (kNN) classification. As in SVMs, the learning problem shrinks as a convex optimization on the basis of pivot loss. Compared to SVMs, this framework does not require modification or addition for multi way classification problems. It makes no assumptions regarding the structure or distribution of data and scales for large number of classes. It focuses mainly in three directions. Firstly, LMNN classification is applied for problems with large number of classes, where its benefits are mostly apparent. Secondly, kernel trick are investigated to carry out LMNN classification in non-linear feature spaces. As LMMN yields extremely non-linear decision restrictions in the unique input, however it is confusing that “kernelizing” will go ahead to any further enhancement. At last, this framework is extended to learn locally adaptive distance metrics that changes across the input space.

- Information-Theoretic Metric Learning (ITML) [23]: This approach is utilized to study a Mahalanobis distance function. The problem is devised to minimize the differential comparative entropy between two multi-variate Gaussians in restraints to distance function.

C. Recognition

Human Recognition is performed by support vector machine as discussed below:

- Support Vector Machines (SVMs):

Utilizing SVM effectively compels one for thorough understanding of its functionality. At certain conditions when organizing a SVM the expert desires to resolve on different choices as how to pre-process the data or information, what bits to operates, finally setting and initializing the parameters for Support Vector Machines (SVMs). Clueless judgments may carry regarding exceptionally lessened implementation. As in this we plan to build the user with a normal understanding of whole judgments and grant general rules and regulations. Each samples established were formed by applying the PYML machine learning, which concentrated on portion techniques of SVMs.

- The SVM Classifier:

Categorization complication may be finite to attention of the two class concern lacking misfortune of extensive statement. In this concern, the aim is to partition the two classes for a

capability which is encouraged from reachable cases. There are number of imaginable straight characterizers which can distinguish the information, but there is only one characterizer that magnifies the border. Here we assume that this bound will sum-up well rather than the other imaginable.

The classifier is an isolating hyper plane.

Normal cases the main “important” teaching points are support vectors and they explain the hyper planes.

Rectangular development algorithms can analyze that training point's x_i are the support vectors by positive Lagrangian multiplier α_i .

Both in double formulation of the trouble and in explanation, teaching point emerge only within inner goods.

- Other Basic Classifiers:

Nearest Neighbour(NN) and Nearest Feature Line(NFL): The results showed that NFL achieves minimum classification error compared to NN classifier thus NFL performed superior than NN [24].

Nearest Feature Plane (NFP) and Nearest Feature Space (NFS): All aspect planes span by three autonomous features are created. The class tags are retrieved by penetrating the nearest feature plane. The minimum number of prototypes in NFS classifier can be one. In order to have classifiers work exactly as NFS then classifiers NN, NFL, and NFP should respectively used for one, two, and three models for each class. Not including the class partition, the human identity retrieved by NFP is extra accurate than NN and NFL. NFS posses the benefit to recognize the human by the nearest feature distance between inquiry and sample space. In order to categorize non parametrically the input enquiry through the nearest feature distance in point, line, plane, and space respectively [24] then all NN, NFL, NFP and NFS are considered as nearest feature classifiers.

1) Properties of SVM.

Some of the main properties of Support Vector Machine are given below

- Elasticity in selecting a correspond method or function.
- Insufficiency of resolution when handling with huge datasets.
- Exclusively support vectors are utilized for indicating the dividing hyper planes.
- Capability of dealing with huge aspect areas. Complication does not rely upon the dimension of the attribute space.

2) Applications of SVM

Support Vector Machine has been utilized profitably in various real-world complications as:

- Gait recognition and identification.
- Text and hypertext classification.
- Digital Image categorization.
- Bioinformatics such as Cancer classification, Protein classification.
- Hand written character that is writing recognition.

III. RELATED WORK:

Jiwan Lu et al. in [1] thoroughly underwent the issues raised to identity a human and gender recognition from gait series with arbitrary walking notifications. The majority of datasets considers that human walk or move along a permanent route or a pre-defined pathway although this is impractical because human beings wander openly and the

strolling notification might be time changeable. To learn this novel complication a new gait dataset known as ADSC-AWD (Advanced Digital Sciences Center-Arbitrary Walking Directions) is created where human walks openly in the sight and the strolling instructions are irrational and time-changing. Human silhouettes are obtained by subtracting background in every gait series and then cluster them into some clusters. As the character for every cluster, Cluster-based averaged gait image(C-AGI) is calculated. A technique is planned, SRML (Sparse Reconstruction Based Metric Learning) is used for discriminating gait character abstraction. The planned SRML technique is used to reduce the intra-class sparse reconstruction mistakes and increasing the inter-class sparse reconstruction inaccuracies, as to exploit additional discriminative information for human identification and gender recognition. They achieved comparable rate with existing gait-based gender recognition.

Ai-Hua et al. in [8] displayed on the gait recognition subject that differentiate persons through the assessment of walking example. Here they used a basic and proficient walking recognition method that focused around situating body joints and was displayed. The outset key edge was concentrated focused around cyclic step investigation. For every one key casing picture, foundation subtraction was executed to focus strolling body outlines from the foundation. At this position the directions of joints are practiced as per the geometrical attributes showed during wandering. Finally the closest neighbour classifier was utilized to arrange subjects.

Ahmad Puad Ismail et al. in [9] presented grouping of sex that was still adolescent by human walk knowledge which is based on the model-based approach. First of all, there are six features which were placed at lower part of the human stride especially from beneath the waist and then they have been acclaimed and dignified as the enormous focuses are skeleton zed, which is focused around the accomplished form of human walk. The next 32 picture sequences are concentrated as distinctive vectors imitated by determination of characteristic. The proposed technique affirmed that it is appropriate to be used for sexual recognition focused around human walk if the analysis with accuracy is of 90% or more.

C. Y. Yam et al. in [10] discussed the ability to perceive persons by their walk. Here they portrayed another framework which stretches the methodology, to perceive persons by their walking style and idea behind this was a two-sided symmetric and coupled oscillator, which assimilates both the upper and the lower leg. This technique has proved to be appropriate for perceiving persons when rambling or running.

J. Han and B. Bhanu in [12] proposed a novel approach. GEI is an efficient and effective gait version which achieves extremely competitive performance than other gait recognition techniques. This is an organized and broad gait recognition technique.

Arun Joshi et al. in [16] described an effective and simple means for automatic human recognition from body silhouette and gait using SVM and back Propagation neural network. In this only two types of features are extracted the width and the height of the silhouette. The combination of a simple correspondence method and a background subtraction procedure is used to track and segment silhouette of a walking person.

Pratap C et al. in [25] the methods implemented for Gait identification are often responsive to reduced resolution, drastic illumination conditions, frame rate, varying weather conditions and occlusions amongst other common problems in the Gait detection systems. Most of the researchers prefer Gait Recognition using silhouette images of videos. Here skeleton information of individual obtained by using the Microsoft Kinect depth sensor was used for gait analysis, which is insensible to type of clothing, items carrying by individuals, lighting changes and gives a superior recognition rate.

A.Usha and P.A Mathina in [26] presented a method in which affinity propagation (AP) clustering for feature extraction and SRML technique for classification is applied. First of all video is changed into frames then AP clustering is used for feature extraction. Sparse classifier is used to classify the input videos and to discover the gender as well as to identify the human.

Xiaohui Zhao et al. in [27] presented technique for humans walking in arbitrary directions using gait recognition. With the help of angle estimation scheme, generally, monitor equipment's view angle in conditions of the probe subject is projected. Using the ACM, the gallery gait appearance is changed to the expected view, and at the end, similarity measurement are examined. This scheme is used on the CASIA-B multi-view gait datasets and gives better recognition results than other schemes due to pixel's correlation extraction method that is consistent in the ACM creation process, training process, and the testing process. The disadvantage of the ACM is that high-quality exchange outcomes are only attained for like poses as like poses share more related information for emergence conversion. To overcome this advantage, better recognition result are produced by extended ACM for remote views by considering the advantage of the fact that two views can give more connected information for emergence conversion.

Muqing Deng et al. in [28] presented technique for multiple views fusion and deterministic machine learning, a multiple-views fusion approach is used, where gait sequences from diverse angles are processed as a type of manufactured silhouette images. Then, the manufactured silhouettes are categorized with four different types of time-varying gait image features, consisting three width features of the silhouette and one silhouette area feature. Finally, gait inconsistency underlying various individuals, time-varying gait features is efficiently modelled by deterministic learning algorithm. In order to get gait information in diverse views, the direct multiple view images fusion can be used which overcome the drawback of recognition by single camera. On the basis of established technique, various gait patterns are recognized by the negligible error principle. The technique shows the possible outcomes, particularly for the cases of carrying conditions, different styles of clothing and walking speeds.

D. Lopez Fernandez et al. in [29] presented a new technique for the purpose of multi-view gait recognition, the main aim is to recognise human walking on unrestrained paths. Taking the movement of the subject into concern, on the basis of angular analysis of 3D objects, a new moving invariant gait descriptor is used. The gait sequence need not be

divided into gait cycles and provides reaction prior to the processing of whole sequence. Majority vote policy is used to strengthen the classification results. Support Vector Machine is used in order to classify the sliding temporal window. On unrestrained paths the effectiveness of the technique is demonstrated experimentally for gait recognition.

Daigo Muramatsu et al. in [30] discussed a gait recognition algorithm which results in better accuracy for the cases where views that are observed are dissimilar. In order to generate multiple joint gait features, View transformation technique by varying the source gait features is used. An assumption is made, the existing and multiple transformed features be supposed to be similar in case the target subjects are identical. In order to measure the consistency of the feature and a likelihood ratio from the scores, multiple scores are calculated. The output depicts that this method good results better in terms of calibration and discrimination. But this method focuses more on view issues of gait recognition, other variants like clothes, belongings and walking speed may affect recognition accuracy.

Sruti Das Choudhury and Tardi Tjahjadi in [31] described a gait recognition technique which is not altered with various challenging factors of gait identification generally irregular variations in carrying and clothing conditions. Averaged gait key-phase image (AGKI) is used which is created by averaging all of the five key-phases of the gait stages of a gait series. The AGKIs are analyzed with the help of Gaussian low-pass and high-pass filters, each one at three different cut-off frequencies to obtain strength against irregular changes in carrying conditions and clothing in addition to other factors, e.g. segmentation noise, walking speed, change in hair style, shadows under feet and change in ground surface. The optimal cut-off frequencies of the Gaussian filters are attained on the basis of analysis of the focus values of human subject's silhouettes that are filtered. Rotation forest collection learning recognition is subjected to improve both individual correctness, diversity within the ensemble for better comparative recognition rate.

Xin Chen et al. in [32] describes that human's gait is effected while walking with different kinds of person it means that walking with different kinds of partner will produce multi-gait patterns. Various attributes produced with the help of a model known as latent conditional random field and the model is trained by support vector machine framework. The outcomes showed that this technique gives better performance for gait recognition, when walking together with multiple people.

Derlatka Marcin in [33] presented a technique to improve the quality of gait recognition for women walking in different footwear that is high heels and sports shoes on the bases of ground reaction forces (GRF). The outcome performance is highly effected by the experience for high heels walking.

CONCLUSION

Now the demands of the biometric visual examination scheme are increased, people identification and recognition from distance, in recent times has achieved more importance. Human gait series is an impending behavioural quality and several associated learning techniques have confirmed that it has very good potential for biometric identification and recognition. This paper demonstrated easy but efficient

techniques for gender recognition and detection of person from gait series and body silhouettes. Easy feature selection Hanavan's human body model will decrease the computation cost considerably during the gait training and identification. These techniques are exercised on various frames of human videos, which are live videos and several are from ADSC-AWD dataset. In visual examination models, individual ID at a separation has chosen up for more ventures. The improvement of workstation vision schemes has additionally guaranteed for vision based programmed gait examination that might be always achieved for human gait training and testing reason. The gait techniques can give better and improved performance when the number of features are increased and changed.

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