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Review on: - Human Identification using GAIT Recognition Technique with PAL and PAL entropy, SVM and k-means with LDA

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Abstract: - **Gait recognition is one kind of biometric technology that can be used to monitor people without their cooperation. The controlled environments such as banks; military installations and even airports need to be able to quickly detect threats and provide differing levels of access to different user groups. The Gait shows a particular way or manner of moving on foot and gait recognition is the process of identifying an individual by the manner in which they walk. And Gait is less unobtrusive biometric; which offers the possibility to identify people at a distance; without any interaction or co-operation from the subject; this is the property which makes it so attractive [2]. This paper proposed new method for gait recognition. In this, firstly binary silhouette of a walking person is detected from each frame of an image. Then secondly, the features from each frame are extracted using the image processing operation. The step size length; centre of mass and cycle length are talking as key feature. In the end, SVM, K-means and LDA are used for training and testing purpose. Here, every experiments and tests are done on gait database. At last in this paper, the result shows that the better improvement from the previous result by using SVM, K-means and LDA.**

Keywords: - Gait Recognition, Gait Pal and Pal Entropy Image (GPPE), SVM, K-means, LDA and identification.

I. INTRODUCTION

Recognition of an individual is an important task to the identify people. The identification through biometric is a better way because it associate with individual not with information passing from one place to another. Biometrics is a physiological or behavioural characteristic; which can be used to identify and verify the identity of an individual. There are numerous biometric measures which can be used to help derive an individual identity. They are physiological; like fingerprints; face recognition; iris-scans and hand scans and behavioural; like keystroke-scan and speech recognition. The Gait recognition is relatively new biometric identification technology which aims to identify people at a distance by the way they walk. This has the advantage of being unobtrusive, difficult to conceal, non invasive and effective from a distance. The human gait recognition as a new biometric aimed to recognize person via the style of people walking, which contain the physiological or behavioural characteristics of human.

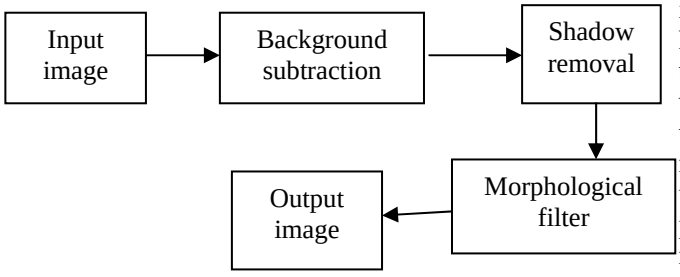

Figure 1: Silhouette extraction

Gait recognition system can be classified depending on the sensors used into three groups namely; motion vision based; wearable sensor based and floor sensor based. The motion vision can be divided into two groups namely; appearance based methods and model based methods. Then appearance based method can be also subdivided in two types; state space methods and spatial-temporal methods. Biometric gait recognition refers to verifying or identifying persons using their walking style. Human recognition based on gait is relatively recent compared to other biometric approaches such as fingerprint, iris, facial etc [5, 6]. The wearable sensors and floor sensors systems are also able to identify persons but in different conditions compared to motion vision technique. . The sensors may be set up on hip, legs, arms or other parts of the body. The floor sensors are put into the floor or on the floor which enable to detect the required measurement. The most important point is to match up testing dataset with training dataset to identify the subjects. Both systems are useful for access control such as offices, airports, malls and the other restricted places. The motion vision is used for surveillance, access control, detection and other monitoring purposes [1, 3]. The most important advantage is that person walking image can be captured from long distance and the image is then processed with low resolutions. In this paper, we focus on two different techniques Principle Component Analysis (PCA) only and PCA with radon transform (RT) on machine vision for gait recognition purposes. In gait recognition, silhouette is defined as a region of pixels of the walking person. The silhouette extraction mainly focuses on segmenting the human body. And silhouette extraction process is shown in “Figure”. Each of the frames in the image sequence is subtracted from a background model of the respective image sequence. If the pixel value of each frame is not the same with the pixel value of the background, the pixel is marked as region of silhouette. To remove shadow from the difference image; a threshold value is applied to the difference images. The difference image map is first analysed by generating the intensity histogram of the image so that the pixels distribution along the image can be represented clearly and in an effective way according to an applied threshold value. Then threshold must be suitable so that the foreground image is neither under segmented nor over-segmented. Therefore under-segmentation and over-segmentation purpose is to produce first and second reliable silhouette respectively. To remove noises produced during segmentation of silhouette; morphological filters are used. The main components of morphological filters that are used in the system are

morphological opening, morphological closing and area thresholding through connected component labelling [7].
Model-based approaches employ models whose parameters are determined by processing of gait sequences (binary silhouettes). Then in these methods; parameters used as features are the height; the distance between head and pelvis; the maximum distance between pelvis and feet and the distance between feet. The silhouette of a walking person is divided in to some regions (generally seven regions). To high quality binary silhouettes; width of outer contour of the silhouette was proposed as a suitable feature. To low quality binary silhouettes, the binary silhouette may be is used as a feature [4, 11].

II. GAIT RECOGNITION

The first important step towards preventing unauthorized access is the user authentication. The user authentication is the process of verifying identity. Traditionally password were set as a string which included integer or special characters and were used for authentication and these password can easily cracked but now Biometric authentications are used. The biometric is a field of technology that uses automated methods for identifying and verifying a person. In real time applications like in banks; airports; authentications and verifications are always required. In such type of applications biometric identification methods are used.
The biometric characteristics are of two types:

A. *Physiological:*

These are biometrics which is derived from a direct measurement of a part of a human body. Then most prominent and successful of these types of measures are Face, fingerprints, iris, palm print, DNA etc. These are related to body.

B. *Behavioural:*

Voice and Gait are related to behaviour of the person. Extract characteristics based on an action performed by an individual; they are an indirect measure of the characteristic of the human form. The main feature of a behavioural biometric is the use of time as a metric. Then established measures include keystroke-scan and speech patterns. Biometric identification should be an automated process. Therefore manual feature extraction would be both undesirable and time consuming; due to the large amount of data that must be acquired and processed in order to produce a biometric signature. And inability to automatically extract the desired characteristics which would render the process infeasible on realistic size data sets in a real-world application.

C. *Gait Analysis:*

Gait analysis is the systematic study of human locomotion; augmented by instrumentation for measuring body movements; body mechanics and the activity of the muscles. Gait based recognition is more suitable in video surveillance applications because of following advantages:
1. Recognition using gait do not need any user cooperation.
2. The gait of an individual can be captured at a distance.
3. Gait recognition does not require images of very high quality and provide good results in low resolution.

Therefore Gait recognition aiming to identify the individuals by the way he walk or move.

D. Approaches for Gait Recognition:

And some basic methods or approaches for gait recognition [10]:
D.1. Moving Video based gait recognition: In this approach, gait is captured using a video-camera from a distance. Image and video processing techniques are employed to extract gait features for recognition purposes such as stride, cadence, and static body parameters extra.
D.2. Floor Sensor based gait recognition: In this approach, a set of sensors/force plates are installed on the floor and such sensors enable to measure gait related features, when a person walks on them, e.g. maximum time value of the heel strike, maximum amplitude value of the heel strike extra.
D.3. Wearable Sensor based gait recognition: In this approach, gait is collected using body worn motion recording sensors. The MR sensors can be worn at different locations on the human body. The acceleration of gait, which is recorded by the MR sensor, is utilized for authentication [7, 8].

E. Steps of Gait Recognition System:

E.1. the Background Subtraction: In this approach moving objects from background in the scene are identified first. Then some of the background subtraction techniques are applied on it .A common approach is to perform background subtraction; which identifies moving objects from the portion of video frame that differs from the background model. The background subtraction generates binary images containing black and white (moving pixels) also known as binary silhouettes. The background subtraction is a class of techniques for segmenting out objects of interest in a scene for applications such as surveillance. There are number of challenges in developing a good background subtraction algorithm. 1st; it must be robust against changes in illumination. 2nd; it should avoid detecting non-stationary background objects such as moving leaves; rain; snow and shadows cast by moving objects. And finally; its internal background model should react quickly to changes in background such as starting and stopping of vehicles.
E.2. Pre-processing: Silhouette segmentation is the first step to gait recognition. Pre-processing is done on video frames to reduce presence of noise then some filters are applied which in turns blur the frames of image, which helps in shadow removal, after pre-processing motion detection is performed. Background subtraction technique uses the difference of current image and background to detect the motion. It delineates the foreground from background in the image. Background subtraction generate binary image containing black (background) and white (moving pixel), then post processing is applied to obtain normalized silhouette images with less noise. They used morphological operators such as dilation and erosion to fill small holes inside silhouette and to filter small noise on the background. To reduce computational cost they proposed new silhouette representation method which only uses some of pixel on the contour.

E.3. Feature Extraction: Feature extraction is a special form of dimensionality reduction. And when the input data is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet) then the input data will be transformed into a reduced representation set of features (also named features vector). Then transforming the input data into the set of features is called feature extraction.

E.4. Recognition: This is the final step of human identification using gait. In this step input videos are compared with sequences stored in database. Different types of classifiers are used for the recognition. Such as: MDA (Multi-linear discriminant analysis), LDA (Linear Discriminant Analysis).They use MDA approach to optimize the separability of gait features.

F. Gait Recognition System:

System will identify unauthorized individual and compare his gait with stored sequences and recognize him. The background subtraction is the common approach of gait recognition. Then Background subtraction method is used to subtract moving objects and to obtain binary. Using background subtraction, pre-processing is done to reduce noise. The background subtraction techniques are also classified into two types: non- recursive methods and recursive methods. Non recursive techniques use sliding window approach for background subtraction. The recursive methods use single Gaussian method and Gaussian mixture model. The Gait recognition method contains two parts

1. Training part
2. Testing part

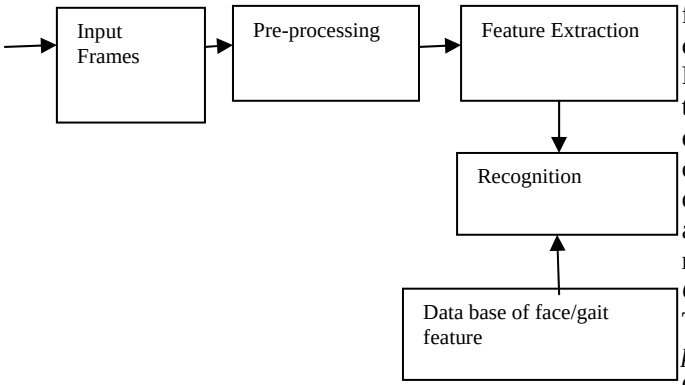

Figure 2: Block diagram of Gait Recognition System.

Gait analysis laboratory has several cameras (video or infrared) placed around treadmill, which are directly linked to a computer. Then person has markers located at various points of body (e.g. spines of the pelvis, ankle malleolus) [10]. When person walks down the treadmill and the computer calculates the trajectory of each marker in three dimensions. And model is applied to calculate the movement of bones.

III. NEURAL AND FUZZY LOGIC

Neural network is set of interconnected neurons. This is used for universal approximation. The artificial neural networks are composed of interconnecting artificial neurons (programming constructs that mimic the properties of biological neurons). The Artificial neural networks may either be used to gain an understanding of biological neural networks; or for solving artificial intelligence problems without necessarily creating a model of a real biological system. Then real; biological nervous system is highly complex: artificial neural network algorithms attempt to abstract this complexity and focus on what may hypothetically matter most from an information processing point of view. Good performance (e.g. as measured by good predictive ability; low generalization error) or performance mimicking animal or human error patterns; can then be used as one source of evidence towards supporting the hypothesis that the abstraction really captured something important from the point of view of information processing in the brain. The other incentive for these abstractions is to reduce the amount of computation required to simulate artificial neural networks.

A. Architecture of artificial neural network:

The basic architecture consists of three types of neuron layers: input; hidden; and output. At last in feed-forward networks; the signal flow is from input to output units; strictly in a feed-forward direction. Then data processing can extend over multiple layers of units; but no feedback connections are present. The recurrent networks contain feedback connections. Then Contrary to feed-forward networks; the dynamical properties of the network are important. And in some cases; the activation values of the units undergo a relaxation process such that the network will evolve to a stable state in which these activations do not change anymore [12].

B. Feed Forward Neural Networks:

Feed-forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. The Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs. And they are extensively used in pattern recognition. It is type of organisation which also referred to as bottom-up or top-down. And Single-layer perceptron; multilayer perceptron and radial basis function are types of feed forward neural networks.

C. Single layer Perceptron:

The simplest kind of neural network is a *single-layer perceptron* network; which consists of a single layer of output nodes; the inputs are fed directly to the outputs via a series of weights. And in this way it can be considered the simplest kind of feed-forward network. Then sum of the products of the weights and the inputs is calculated in each node; and if the value is above some threshold (typically 0) the neuron fires and takes the activated value (typically 1); otherwise it takes the deactivated value (typically -1). Neurons with this kind of activation function are also called artificial neurons or linear threshold units. At last in the literature the term perceptron often refers to networks consisting of just one of these units. And similar neuron was described by Warren McCulloch and Walter Pitts in the 1940s.A perceptron can be created using any values for the activated and deactivated states as long as the threshold value lies between the two. Most perceptron have outputs of

1 or -1 with a threshold of 0 and there is some evidence that such networks can be trained more quickly than networks created from nodes with different activation and deactivation values. Perceptron can be trained by a simple learning algorithm that is usually called the delta rule. This calculates the errors between calculated output and sample output data; and uses this to create an adjustment to the weights; thus implementing a form of gradient descent. Single-unit perceptron are only capable of learning linearly separable patterns.

D. Multilayer Neural networks:

This class of networks consists of multiple layers of computational units; usually interconnected in a feed-forward way. Therefore each neuron in one layer has directed connections to the neurons of the subsequent layer. Many applications the units of these networks apply a sigmoid function as an activation function. Then universal approximation theorem for neural networks states that every continuous function that maps intervals of real numbers to some output interval of real numbers can be approximated arbitrarily closely by a multi-layer perceptron with just one hidden layer. The result holds only for restricted classes of activation functions, e.g. for the sinusoidal functions. Multi-layer networks use a variety of learning techniques; the most popular being back-propagation [13].

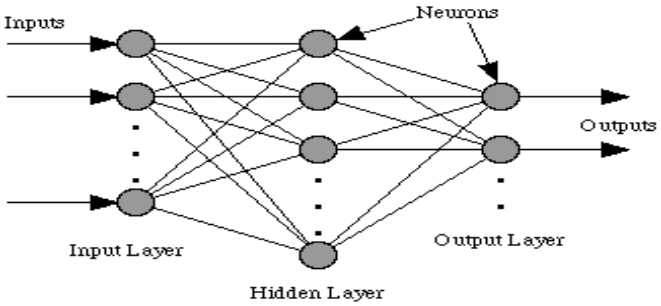

Figure 3: Multiple NN

Here, the output values are compared with the correct answer to compute the value of some predefined error-function. The various techniques; the error is then fed back through the network. By using this information; the algorithm adjusts the weights of each connection in order to reduce the value of the error function. And in this case; one would say that the network has *learned* a certain target function [5]. To adjust weights properly, one applies a general method for non-linear optimization that is called gradient descent. To this method the derivative of the error function with respect to the network weights is calculated; and the weights are then changed such that the error decreases (thus going downhill on the surface of the error function). To this reason; back-propagation can only be applied on networks with differentiable activation functions.

IV. Linear Discriminant Analysis

Linear Discriminant Analysis (LDA) is a techniques used for data classification and dimensionality reduction. In PCA, the shape and the location of the original data sets changes when transformed to a different spaces whereas LDA doesn't change the location but only tries to provide more class reparability and draw decision between the given classes.

In discriminate analysis, the two scatter matrices, called *within-class* (*Sw)* and *between-class* (Sb) matrices are defined to quantify the quality.

$$S_w = \sum_{i=1}^{k} \sum_{x \in \Pi_i} (x - m_i)(x - m_i)^T \text{ and } S_b = \sum_{i=1}^{k} n_i (m_i - m)(m_i - m)^T, \text{ where}$$

$$m_i = \frac{1}{n_i} \sum_{x \in \Pi_i} x \text{ is the } \textit{mean} \text{ of the ith class, and } m = \frac{1}{n} \sum_{i=1}^{k} \sum_{x \in \Pi_i} x \text{ is the } \textit{global mean}.$$

V. Support Vector Machine (SUM)

The Support Vector Machine (SVM) is a state-of-the-art classification method introduced in 1992 by Boser, Guyon, and Vapnik. The SVM classifier is widely used in bioinformatics (and other disciplines) due to its highly accuracy, process the high-dimensional data and able to calculate such as gene expression and exibility in modelling diverse sources of data .SVMs belong to the general category of kernel methods. The kernel method is an algorithm that depends on the data only through dot-products. When the case, the dot product can be replaced by a kernel function which computes a dot product in some possibly high dimensional feature space. There have two advantages: One is ability to generate non-linear decision boundaries using methods designed for linear classifiers. And the Second one is use of kernel functions allows the user to apply a classifier to the data that have no obvious fixed-dimensional vector space representation. The Some prime examples of the data in bioinformatics are sequence, either protein or DNA and protein structure. Using SVMs effectively requires an understanding of how they work. When training an SVM the practitioner needs to make a number of decisions: how to pre-process the data, what the kernel is to use, and finally, setting the parameters to the SVM and the kernel [1]. Uninformed choices may result in severely reduced performance. Our aim is to provide the user with an intuitive understanding of these choices and provide general usage guidelines. All of the examples shows were generated using the PyML machine learning environment, which focuses on kernel methods and SVMs.

A. PRELIMINARIES: LINEAR CLASSIFIERS

Support vector machines are an example of a linear two-class classifier. This section or part explains what that means. The data of a two classes learning problem consists of objects labelled with one of two labels corresponding to the two classes; for convenience we assume the labels are +1 or -1. In what follows boldface x denotes a vector with components xi. The notation of xi will be denote the ith vector in a dataset, f(xi; yi)gni =1, where yi is the label associated with xi. The objects xi are called patterns or examples. We are assume some examples belong to some set X. Initially we assume the examples are vectors, but once we introduce kernels this assumption will be relaxed, at which point they could be any continuous/discrete object

(e.g. protein/DNA sequence or protein structure).A key concept required for defining a linear classifier is the dot product between two vectors, also defined as an inner product or scalar product. The vector w is known as the weight vector, and the b is known called the bias. Consider the case b = 0first. The set of points x such that wTx = 0 are all points that are perpendicular to w and go through the origin | a line in two dimensions, a plane in three dimensions, and more generally, a hyper plane [2]. The bias b translates the hyper plane away from the origin. The hyper plane fx: f(x) = wTx + b = 0divides the space into two: the sign of the discriminant function f(x) denotes the side of the hyper plane a point is on. The boundary between regions classified as positive and negative is called the decision boundary of the classifier.

B. KERNELS: FROM LINEAR TO NON-LINEAR CLASSIFIERS

In many applications a non-linear classifier provides more accuracy. The linear classifiers have advantages, one of them being that have simple training algorithms that scale well with the number of examples [9, 10]. This begs the question: Can the machinery of linear classifiers be extended to generate non-linear decision boundaries? Furthermore, can we handle domains such as protein sequences or structures where a representation in a fixed dimensional vector space is not available? The naive way of making a non-linear classifier out of a linear classifier is to map our data from the input space X to a feature space F using a non-linear function.

The approach of explicitly computing non-linear features does not scale well with the number of input features: when applying the mapping from the above example the dimensionality of the feature space F is quadratic in the dimensionality of the original space. This result in a quadratic increase in memory usage for storing the features and a quadratic increase in the time required to compute the discriminant function of the classifier. That kind of quadratic complexity is feasible for low dimensional data; but when handling gene expression data that can have thousands of dimensions, in the quadratic complexity number of dimensions is not acceptable. Kernel methods solve this issue by avoiding the step of explicitly mapping the data to a high dimensional feature-space [8].

Gaussian kernel is defined by:

$$K(\mathbf{x_i}, \mathbf{x_j}) = \exp\left(-\frac{\left\|\mathbf{x_i} - \mathbf{x_j}\right\|^2}{2\sigma^2}\right) \quad (1)$$

Where k > 0 is a parameter that controls the width of Gaussian. It plays a similar role as the degree of the polynomial kernel in controlling the exibility of the resulting classifier. We saw that a linear decision boundary can be kernelized i.e. its dependence on the data is only through dot products. In order for this to be useful, the training algorithms need to be kernel able as well [6]. It turns out that the large numbers of machine learning algorithms can be expressed using kernels including the perceptron algorithm, and ridge regression and SVM.

In general, the RBF kernel is a reasonable first choice. The kernel is nonlinearly maps samples into a higher dimensional space so it, unlike the linear kernel, can be handle the case when the relation between class labels and attributes is nonlinear. Moreover, the linear kernel is a special case of RBF since the linear kernel with a penalty parameter ~ C has the same performance as the RBF kernel with some parameters (C;). In addition, the sigmoid kernel behaves like RBF for certain parameters. The second reason is the number of hyper parameters which influences the complexity of model selection. The polynomial kernel has number of hyper parameters than the RBF kernel. There are some situations where the RBF kernel is not suitable. In particular, when the multiple features is very large, one of the feature may just use the linear kernel.

C. SVM FOR UNBALANCED DATA

Many datasets encountered in bioinformatics and other areas of application are unbalanced, i.e. one class consist of a lot more examples than the other. The Unbalanced datasets can present a challenge when training a classifier and SVMs are no exception see [13] for a general overview of the issue. The good strategies to producing a high-accuracy classifier on imbalanced data is to classify any example as belonging to the majority class; this is called the majority-class classifier. While highly accurate under the standard measure of accuracy such a classifier is not very useful [10]. When presented with an unbalanced dataset that is not linearly separable, an SVM that follows the formulation will often produce a classifier that behaves similarly to the majority-class classifier. The crux of the problem is that the standard notion of accuracy (fraction of correctly classified examples , or the success rate,) is not a good way to measure the success of a classifier applied to unbalanced data, as is the evident by the fact that the majority-class classifier performs well under it.

The problem with the success rate is that it assigns equal importance to errors made on examples belonging the majority class and errors made on examples belonging to the minority class. To correct or correction for the imbalance in the data we need to assign different costs for misclassification to each class.

K-Means:

KMeans is an iterative refinement heuristic algorithm that works faster. This common technique is to run the algorithm several times regain the best clustering found. K-means clustering procedures which can be applied for scalable image retrieval from large databases. K-means clustering algorithms to group the images into clusters based on the color content. Clustering is a mutually exclusive partitioning process of the feature space of feature vectors in a meaningful way for the application domain context. Within the clusters, we may perform or defined nearest neighbour search efficiently. Unique aspect of that system is the utilization of hierarchical and k-means clustering techniques. Now we are going to filter most of the images in the hierarchical clustering and after then apply the clustered images from the hierarchical clustering to K-Means, so we will get better and favoured image results. After the selecting cluster centres and the clustering, the given querying image is first compared with all over

cluster centres. The ranked of clusters are according to their similarity with the query. After Then the query image is compare with directly to the images in these clusters. Thus, numbers of multiple comparisons is decreased considerably from comparing the query with all the images in the database. Thus the numbers of similarity comparisons required depends on the sizes of the clusters and the number of clusters being examined .A user instead of searching through a large database is concerned in only clustered image results. Then, we are applied clustered images from the hierarchical clustering to the k-means algorithm which takes the input parameter, k, and set of partitions of an object into k clusters so that the resulting intra-cluster similarity is high. The object is assign to the cluster to which it is the most similar one. The distance of the object between centre is nearest and closest to it. then computes and perform the new centroid and in this way each center finds the centroid of its own points. This process iterates until the function of criterion is converges. Thus, the accuracy of retrieval will be better with the hierarchical and The K-Means clustering. It reffered to the better result and performance than by using individual algorithmic methods.

V. CONCLUSION

Human Identification Using Gait Recognition has been proposed previously but there have been always need for better Gait Recognition Technique. The existing Human Identification Using Gait Recognition doesn't consider some important parameters like distance between right hand and right leg and thus it is poor in quality. The existing Human Identification Using Gait Recognition algorithm is less accurate. Therefore, propose an enhanced Human Identification Using Gait Recognition algorithm which is based on PAL and PAL entropy and SVM (SUPPORT VECTOR MACHINE), LDA and k-means. Our enhanced Human Identification Using Gait Recognition algorithm is more accurate. Our enhanced Human Identification Using Gait Recognition algorithm is fast and thus saves time.

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