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Human Identification In Video Surveillance System Using Gait

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***Abstract**:* Human identification in a video surveillance system is gaining more interest in recent days due to a security point of view because security is the most important issue in most places like jails, airports, banks, military, and research laboratories. Biometrics plays an important role in identifying or authenticating persons based on their physiological or behavioral traits. Normally people in the video surveillance system are at a distance and there is no physical contact unlike other biometrics like face, iris, and fingerprint. So, there is a need for a new biometric trait that can be used at a distance without any physical contact. In recent studies apart from traditional biometric traits like face, iris, fingerprint, gait biometric trait is gaining more impact, especially in video surveillance. Gait is a behavioral biometric trait that refers to an individual unique walking style. This biometric trait's features can be observed or captured from a distance and can be perceived unnoticeably. Due to its key characteristics, Gait is a very special and salient biometric trait concerning to surveillance point of view and it will enhance the efficiency of surveillance and reduce the burden of related people. In this paper, we have considered Gait as the biometric trait due to above said key advantages. The LBP features have been identified and extracted using the LBP technique. KNN classifier is used for training and testing the gait features. The experimental results reveal that apart from traditional biometric traits, Gait can be used as a biometric trait for human identification in video surveillance.

Keywords: Gait, video surveillance, physiological trait, Biometrics

I. Introduction

Video surveillance systems are installed in most of the areas for human tracking, but apart from just tracking and collecting footage, there is a need for the identification or authentication of humans as per the security point of view. Biometrics is the way of authenticating humans based on their physiological and behavioural traits such as the face, iris, fingerprints, and hand geometry. However, these biometrics types will fail in certain conditions. For example, the face recognition system will fail due to the low resolution of images and iris, the fingerprint will not be applicable when persons do not interact with the system. Hence there is a need for a new biometric system that works without physical intervention and also when people are at a distance. Gait is the one solution, which refers to an individual walking style. Gait-based biometric systems use a person's unique walking style as a trait in identifying people at a distance and also without the cooperation or intervention of humans. The methods used in the gait recognition system are model-based and model-free.

The Model-based approach: In this method, the gait features are extracted by constructing the mathematical model of the human body, then the gait parameters such as distance between two legs, knee angle, and thigh length can be easily measured. The drawback of this approach is, it requires more computational cost and it is more time-consuming.

Model-free approach: Most of the current work of gait recognition is based on the model-free approach. This approach extracts the gait feature based on the shape of silhouettes analysis. This approach is insensitive to the quality of silhouettes, has low computation costs, and is less time-consuming.

II. RELATED WORK

The author [14] presented work on handling invariant views in a gait recognition system and to address this he has used a 3-D convolution neural network. The experiments are carried on CASIA-B standard dataset and achieved comparable results.

The author [15] presented work on the smartphone-based Gait biometric system. The proposed system captures the gait parameters using the accelerometer and gyroscope sensors of smartphones. The experimental results show an acceptable recognition rate

The author V.G. Guru [2] presented work on recent trends Gait Recognition System which provides a study of recent works on gait recognition approach, challenges, and different datasets

The author Mohan Kumar [3] proposed a work that uses three well-known features such as step length, height, and width and applied them on the CASIA-B standard datasets and achieved an 88.6% rate. The limitation of this method is, it has addressed only the carrying bag conditions and views.

Jiwen Lu, Gang Wang[4] proposed a work on person authentication based on arbitrary walking directions. The drawback here is if the training gait series is different from the testing series then the method will fail. The work is carried on standard dataset CASIA- B and achieved a comparable recognition with the available approaches.

The author[5] proposed a fusion approach in which the structural Gait energy image is constructed by combining the two different source of images and experiments is carried out on the standard dataset by using neural network classifier for recognition and gained 89.29% but the drawback is that it has only taken views and carrying bag conditions.

The author [6] proposed a model that consists of cumulative foot pressure images as datasets and these are the record of the ground reaction force of humans during one gait cycle. The drawback of this work is it only uses cumulative foot pressure images for recognition. In the future gait, video can be combined to improve the recognition performance.

Mohan Kumar [7] proposed a technique that is based on pictorial illustration. The test sequences are characterized in brittle feature values sequences are characterized in break-valued features. The work is and training carried out on standard datasets by considering only views and carrying bag conditions with an acceptable accuracy rate of 71%.

Jyoti Bharti in [8] proposed a technique that considers four-point features and constructs a graph with all pairs shortest distance. The features here considered are knee, toe, ankle, and palm. The Euclidian distance is also measured between all points and the recognition is achieved by the similarity index of all air shortest distance. The experiment results are obtained by a neural network classifier on standard datasets and achieved a 95% accuracy level. The drawback of this work is only the side views of the subjects are considered and which is not acceptable in real-time.

The author [9] presented a model-free approach based on shape features of gait images. Later three of the classifiers are used such as neural network, nearest neighbor, and support vector machine are implemented for identification. The experimentation is carried out on 100 gait subjects with the above classifiers generates a result of 97.67%, 94.33%, and 94.67%, respectively. The drawback of this work is it considers fewer subjects with fewer variations.

The author[11] presented work in Proceedings of the IEEE, 06 20, pp. 2013. The proposed systems automatically authenticate the person based on his gait features. The system achieves 90% of the accuracy rate. The drawback of this work is the results change with the change of shoes, cloth and illumination of light and also performances also decreases.

The author [12] presented work on a Gait recognition system Using Multi polarized silhouettes. The prosed system uses new features called multi Bipolar silhouette vectors which helps in identifying the people more uniquely compare to the other shape features

The author [13] presented a work on, "Wavelet analysis of cyclic human gait for recognition," The proposed work extracts new features based on the wavelet analysis of the gait cycle. The limitation of this work is, the results are depended on the quality of the silhouettes. If there is noise in the silhouettes then the results will degrade.

III. METHODOLOGY

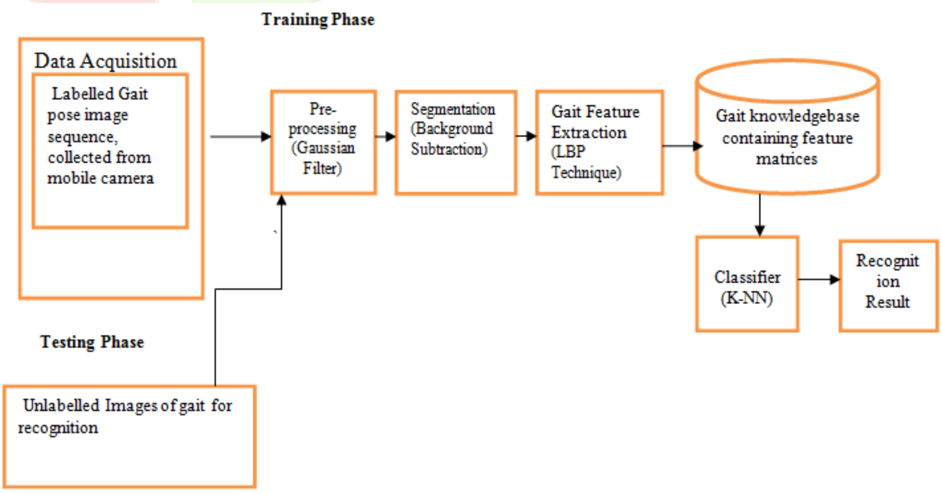


FIG:1 PROPOSED HUMAN IDENTIFICATION SYSTEM USING GAIT

1. Data Acquisition:

Local Dataset:

All videos are captured by a digital camera. The video format is changed into .avi format or any other formats supported by Matlab. The input videos have been captured with different individuals in different illusions, different positions, different situations, and different conditions.

2.Pre-processing: Image Pre-processing techniques are necessary to remove the noise and to enhance the quality of Gait-pose images. Pre-processing phase is needed to improve the image quality and make the segmentation results more accurate.

3.Segmentation: In computer vision, image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something more meaningful and easier to analyze. Segmentation is done on the captured images to extract foreground from background. Efficient Segmentation techniques like Edge detection, background subtraction, histogram-based, parametric-based techniques can be used.

DCT frame conversion :

A Discrete Cosine Transform (DCT) is used to separate the background and foreground regions. DCT is better than other methods where texture analysis is performed in the spatial domain. DCT converts images from the spatial domain to frequency domains that makes texture analysis easier. Here the binary images are converted to DCT frames which generate rough binary segmentation maps which are later helpful in extracting or detecting foreground objects like human motion from the background. Discrete cosine transform is a Fourier-related transform similar to the discrete Fourier transform (DFT), but using only real numbers. The Discrete cosine transforms are generally related to Fourier Series coefficients of a periodically and symmetrically extended sequence and the equation is as follows

$$y(k,l)=\frac{2}{\sqrt{N\cdot M}}c(k)\cdot c(l)\cdot\left[\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}x(i,j)\cdot\cos\frac{(2\cdot i+1)\cdot k\cdot\pi}{2\cdot M}\cos\frac{(2\cdot j+1)\cdot l\cdot\pi}{2\cdot N}\right]$$

Background subtraction: It is one of the most common segmentation techniques in a video surveillance system for extracting the moving objects from the foreground. It is performed by subtracting the current frame from a reference frame. The reference frame is a DCT frame that consists of a separate background model and the difference with the current frame leads to foreground extraction. This method will work only when the foreground image consists of moving objects like here the moving person and the static background. The difference of the image leads to some change in the intensity of the pixel values and later this is compared with some fixed threshold value to differentiate between the background pixel intensity values with the foreground values. Mathematically the same can be denoted with the following equation as shown below

P[F(t)]=P[I(t)]-P[B]

P[F(t)]-P[F(t+1)]>Threshold, where P refers to the pixel value at interval t of the current frame.

4. Feature Identification and Feature Extraction

Feature extraction consists of transforming arbitrary data, such as text or images into numerical features usable for Machine learning. Then machine learning technique is applied to these features. Here LBP technique has been used for extracting gait features

Local Binary Patterns Technique(LBP)

- In LBP every pixel of the frame is assigned with a decimal number called LBP codes
- Each code is generated by the binary pattern of an image
- Each value of the binary patterns are created by subtracting 3x3 neighboring pixel values with its center pixel value and then compare with a threshold value
- If the difference value is positive then it is assigned with 1or else 0
- Finally by concatenating each binary value in a clockwise direction from the topmost left corner to the end of the neighboring value generate the binary number, which is later assigned to a decimal number to get LBP code

Mathematically the difference of center pixel value with neighboring value to generate the LBP codes is as shown below

$$\boldsymbol{P-1}$$

$$\boldsymbol{LBPR,P = sgp - gC}\ .\ \boldsymbol{2p}$$

where $\boldsymbol{p}$=**0** neighborhood pixels gp in each block is the threshold by its center pixel value gc sampling points

5. Knowledgebase: This database consists of features matrices of all the subjects

6. Classification:

KNN classifier is used for training and testing the gait features. The k-nearest neighbor algorithm is amongst the simplest of all machine learning algorithms. An object is classified by a majority vote of its neighbors, with the object beingassigned the class most common amongst its k nearest neighbors. k is a positive integer, typically small. If k = 1, then the object is simply assigned the class of its nearest neighbor.
The same method can be used for regression, by simply assigning the property value for the object to be the average of the values of its k nearest neighbors. It can be useful to weigh the the contributions of the the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones.
The neighbors are taken from a set of objects for which the correct classification (or, in the case of regression, the value of the property) is known. This can be thought of as the training set for the algorithm, though no explicit training step is required. In order to identify neighbors, the objects are represented by position vectors in a multidimensional feature space. It is usual to use the Euclidean distance, though other distance measures, such as the Manhattan distance can be used instead.

IV. RESULTS AND DISCUSSION

1.Data Acquisition:

Local Dataset

For the experimentation, a walking video of 100 persons has been considered,70% of them have been considered for training and 30% of them have been used for testing. All videos are captured using a digital camera. The video format is changed into .avi format or any other formats supported by Matlab. The input videos have been captured with different individuals in different illusions, different positions, different situations, and different conditions.

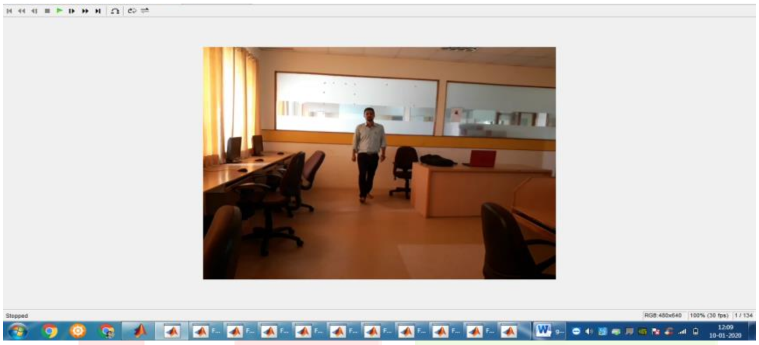


Fig:2 Input The Video In. Avi Format

2.Frame Conversion:
The selected input video will be converted into several frames based on the length of the video and stored in a separate folder named Frames for future use. For the code to get run only the required number of frames are considered.

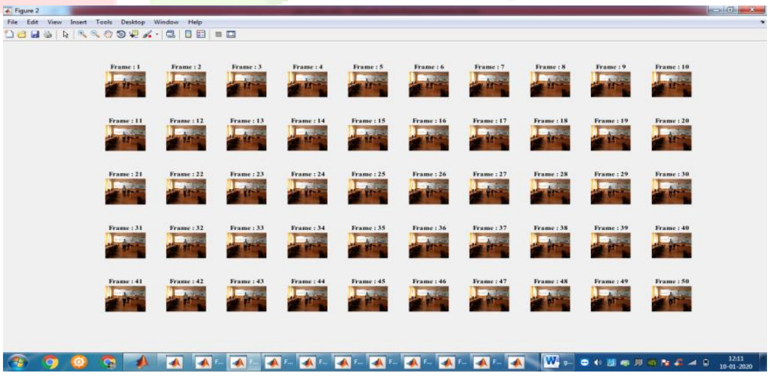


Fig 3: Frame Conversion

3. Resizing Frames:
Every converted frame in the folder will be of different sizes, which makes image processing difficult. Hence all the frames will be resized into default size to make the operations such as multiplying, comparison, etc.

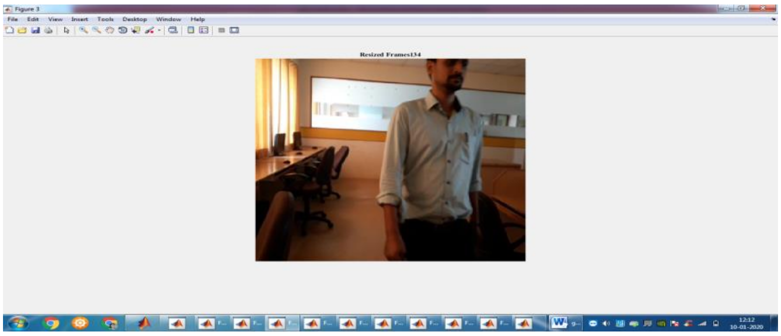


Fig 4: Resized Frames.

4.Frame Filtrations:

The image or frames in the folder might contain noise. That noise might create disturbance in the process. So, that noise should be removed from the converted frames. Matlab supports different types of filters like median, salt & pepper, Gaussian filter, and others. Gaussian filter was found to be best suited for reducing noise from frames or images.

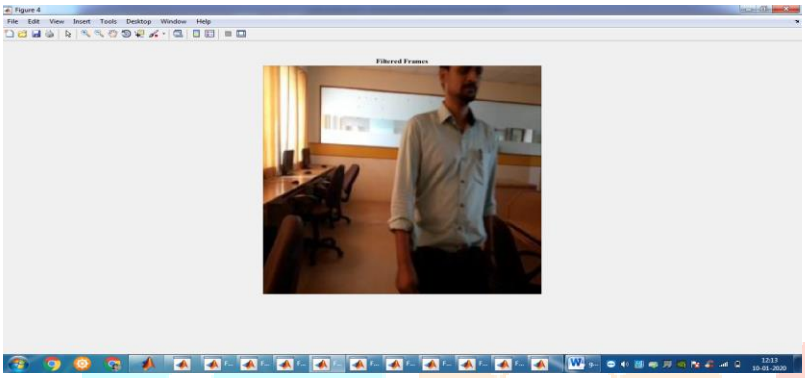


Fig 5: Filtered Frame

5 Binary Conversion:

The filtered frames will be then converted into binary images. The entire images will be converted in form of 0's and 1's. All the binary images will be stored in a separate folder named Binary where the main running code is present. Once the entire code is executed the binary images get stored and then get refreshed.

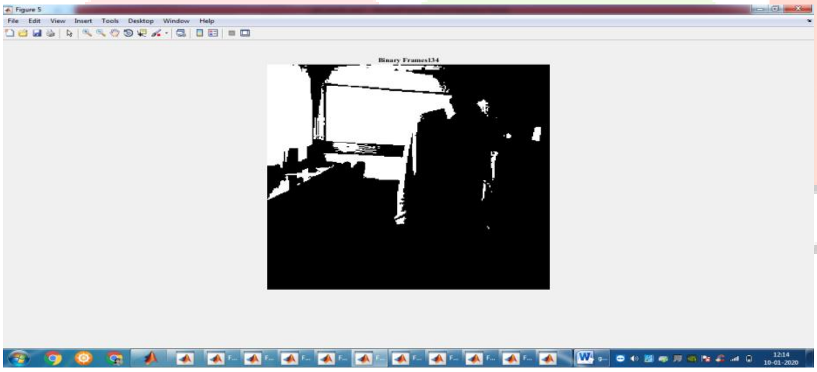


Fig 6: Binary Frames

6. DCT Frames Conversion:

The images are converted into Discrete cosine transform frames and stored in a separate folder. A discrete cosine transform (DCT) is used to separate the background and foreground regions

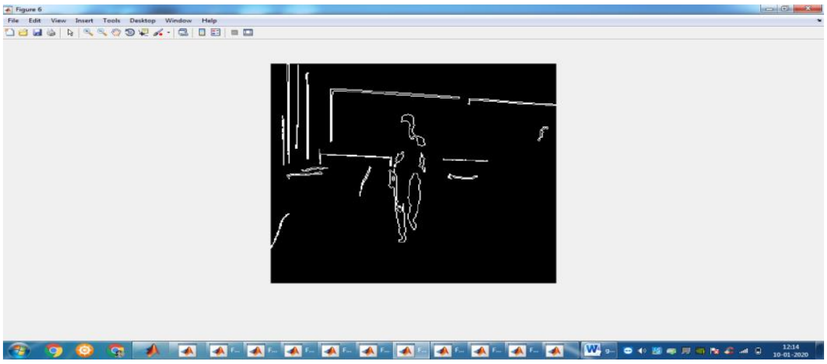


Fig 7: DCT Frames

7 Feature Identification and Feature Extraction

Human gait contains many features like walking speed, the distance between two legs, etc. The LBP features are identified, extracted, and stored in Matlab file format. For extracting the human gait features we use LBP(Local Binary

Patterns) technique.

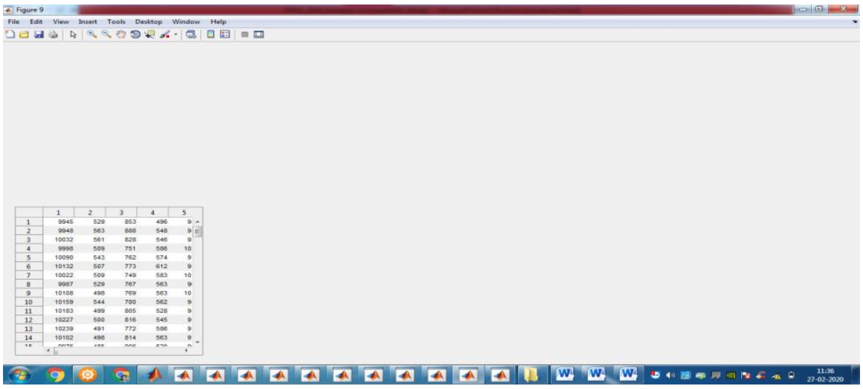
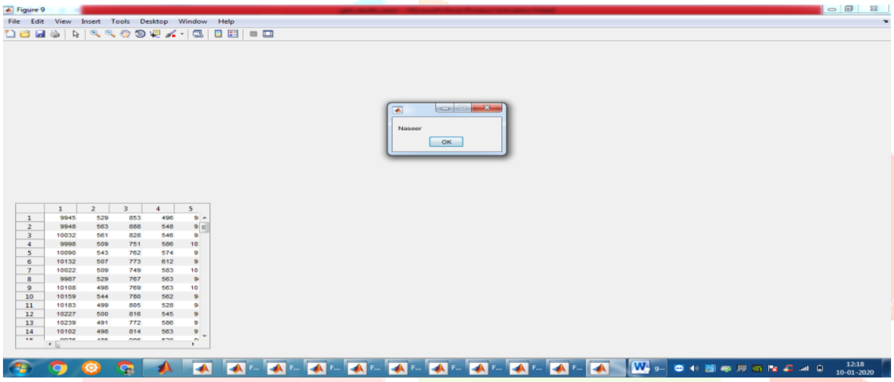


Fig 8: LBP Feature Values.

8 Human Identification with Gait features

In the end, by collecting all the gait features, and considering the classification technique that will provide the identity of a particular individual. The message box or the dialogue box pops up and displays the label of that individual.



9: Pop Up Message Showing Human Identification

V. CONCLUSION AND FUTURE SCOPE

In this paper, we have considered a sample size of 100 subjects walking videos. We can identify the person with 93% accuracy. The main advantage of this biometric trait is that a human can be identified from distance without their physical intervention. Results reveal that the KNN classifier yields 93% accuracy. Still, the accuracy can be improved by considering different advanced classifiers like deep learning algorithms. Also, more videos can be acquired of different aged groups under different conditions.

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