Biometric Identification Using GAIT Analysis

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Abstract:- Biometric systems are becoming increasingly important since they provide more reliable and efficient means of identity verification. Identification of a person based on gait has created a sphere of curiosity in the computer vision domain due to its high recognition capability even at a far distance with simple instrumentation. It does not require the cooperation or even awareness of the individual under observation. Gait recognition technology has many civilian and high-security applications like car parks, banks, military bases, railway stations and airports. The project aims to develop an automatic biometric system to identify a person based on his Gait cycle. We can achieve this by converting the live video into still frames and applying feature extracting techniques to get silhouettes from where we can differentiate different gait cycles. These gait cycles can then be compared to the already existing data in the database to identify the subject.

Keywords:- *Identification, Cooperation, Security, Gait Cycle, Silhouettes, Database.*

I. INTRODUCTION

The human identification and classification area have consequently gained popularity worldwide in recent times. Standard biometric identification and recognition are used commonly. Fingerprints, facial patterns, iris scans are common biometric standards.

However, biometric standards need the person to cooperate with the system as biometric identifications must be collected at a close range.

GAIT recognition analysis or the study of human motion analysis is a biometric technique that uses a person's walking pattern to identify the person. Gait recognition is to identify humans based on their gait features [1]. Compared with other biometrics such as the face, iris, palm print and fingerprint, gait features are still recognizable and can be obtained even at a low-resolution video. Gait features focus on limb movements during a walk and hence the characteristics of non-contact, long-distance, cross-view recognition and hard to disguise. All these gaps are filled and have gained immense popularity in long-distance identification in the public security industry.

II. PROPOSED WORK

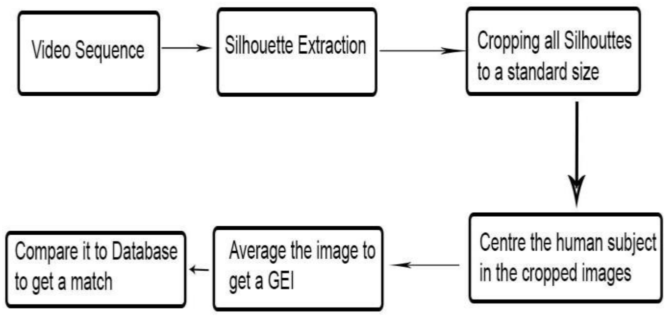

Fig. 1 Proposed methodology

Our proposed methodology is to capture walking sequences of individuals using video input. Once the walking sequence is obtained, the video input is converted into several image frames which sequence the video. Each frame is then pre-processed to get a silhouette, after which the silhouette frame is then cropped to a standard size, and the human subject is then centred. These frames are then averaged out to give a Gait entropy image(GEI) compared to the existing gait entropy images in the database to provide a match.

A. System Architecture

The system architecture is given in Fig 1. Each block is described in this Section.

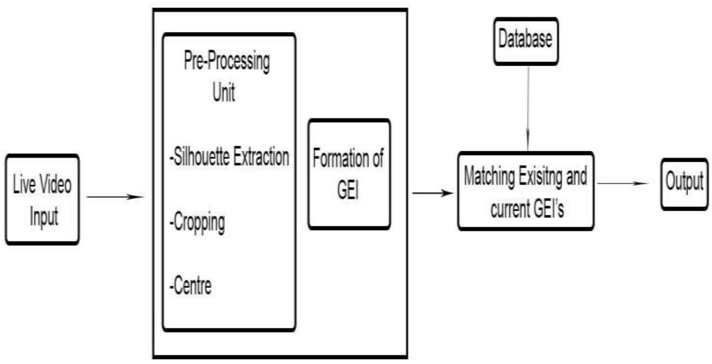

Fig. 2 Proposed system architecture

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- *Live Video Input:* The first part is to take a live video input to recognize the individual in real-time.
- *Pre Processing Unit:* The pre-processing unit will take the live video input convert it into frames. These frames are then converted into silhouettes, these silhouettes are then cropped into a standard size of 64*64 pixels, and the human subject is centred in all the frames for better matching.
- *Formation of GEI:* After the frames undergo some pre-processing, these processed silhouettes are then averaged out to give a gait entropy image to get the information about a subjects gait cycle.
- *Database:* The database stores gait entropy images of all the registered individuals of that organization. We can then compare the GEIs generated in real-time to get a biometric match.
- *Matching of GEIs:* This is the final step in recognizing the GEI generated from the real-time video input compared to GEIs stored in the database of the registered individuals. They are compared by finding the root mean square between the images and a match for identifying the individual.

B. Requirement Analysis

The experiment setup is carried out on a computer system that has the different hardware and software specifications as given below;

- *Software:* We used python primarily for this project, a high-level language that we can use for numerical computation, visualization, and programming.
- *Hardware:* Hardware is the central part of the gait recognition system. The hardware required for this task is a desktop and a video source with a high-resolution sensor that will capture the video. Frames will be extracted from this video input. For this project, we will not use any camera as we will be using an already created database.
- *Dataset and Parameters:* The Institute of Automation, Chinese Academy of Sciences (CASIA) provide the CASIA Gait Database to gait recognition and related researchers to promote the research.
- Dataset B is an extensive Multiview gait database, there are 124 subjects, and the gait data is captured from 11 different views capturing the view angle, clothing and carrying condition.

C. Implementation

To identify and classify the human subject based on the gait cycle, we compare a gait entropy image we obtained from the live feed to the gei, which is already stored in the database to get a match. We use the following algorithm to perform the classification:

Algorithm:

- Acquisition of the data, we read the dataset of all 124 subjects
- Pretreatment- All the silhouette images undergo pre-processing in which we crop the images into 64*64 pixels, centre the human subject and adjust the heights of the frame.
- The frames are then averaged to give out a Gait entropy image(GEI)
- The GEI is then compared to already formed GEI templates of different subjects by finding the root mean square.
- When compared using root mean square value, any two images are said to be similar if the value falls under the given threshold. The lesser the value, the more similar is the images. Some research paper suggests that 0.6 is a safe threshold for recognition

D. Pre Processing

We extract silhouettes from each frame using background subtraction techniques.

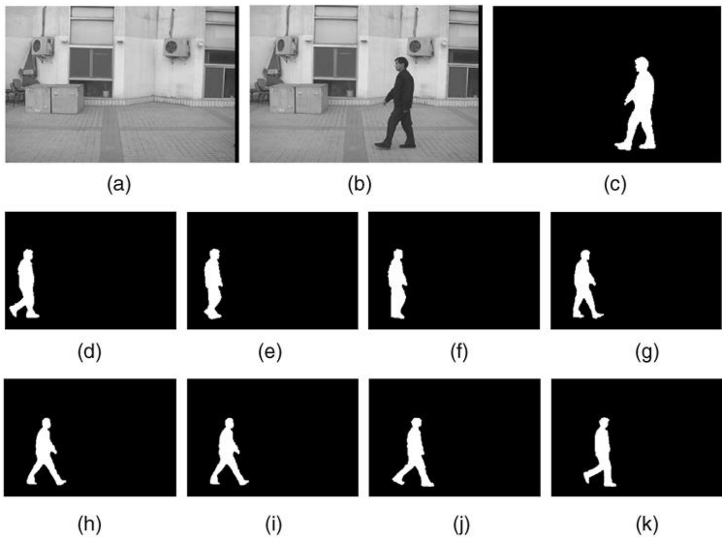

Figure 3: Extraction of Silhouettes

These silhouette frames are then cropped into a standard size of 64*64 pixels, and the human subject is centred in all the cropped frames.

Before Pre-treatment

After Pre-treatment

E. Gait Entropy Image

Size-normalized and centre-aligned silhouettes, a GEI is computed by calculating Shannon entropy for each pixel in the silhouette images. Considering the intensity value of the silhouettes at a fixed pixel location as a discrete random variable, the entropy of this variable over a complete gait cycle is computed.

Figure 5: Gait Entropy Image

F. Mathematical Formula

The formula used for similarity comparisons is:

$$D = \sqrt{\frac{\sum[I_2(x,y) - I_1(x,y)]^2}{\sum[I_1(x,y)]^2}}$$

When compared using root mean square value, any two images are said to be similar if the value falls under the given threshold.

G. Sample Dataset Used

The Institute of Automation, Chinese Academy of Sciences (CASIA) provides the CASIA Gait Database to gait recognition and related researchers to promote the research.

Table 3.1 Sample Dataset Used

Dataset	**Subjects**	**Variation**
Dataset A	20	-Each person has 12 image sequences -4 sequences for parallel,45 degrees and 90-degree directions
Dataset B	124	View angle, clothing and carrying condition
Dataset C	153	It considers four walking conditions: normal walking, slow walking, fast walking, and normal walking with a bag.

Dataset B was used for this project, an extensive Multiview gait database, there are 124 subjects, and the gait and the gait data is captured from 11 different views capturing the view angle, clothing and carrying condition.

Figure 3.6: Gait Dataset

III. CONCLUSION

This project will build a model to identify an individual using their unique gait pattern successfully. This is more convenient than other biometric systems because it classifies an individual based on actions and minimizes the cooperation required to identify a person based on biometrics. Research is still going on, and it is not practically implemented; researchers still have to touch and study different domains. We can also try to increase the efficiency of present algorithms; at last, we can say that to make it stronger, faster and more precise, a lot of work is still to be done.

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