MULTIFEATURE RECOGNITION SYSTEM FOR AUTHENTICATION PROCESS

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Abstract: Palm print identification and confirming the identity of a person based on the way he walks are fairly new area in computer science compared with more traditional biometric methods and this makes it possible to authenticate the person in a kinetic fashion as he walks without requiring the attention from the person himself. The gait data is collected using a device that can be attached to a person's leg, where it detects the leg's movement in horizontal, vertical and sideway direction as the person walks. These data are used in an attempt to authenticating the walking person. For palm print recognition, a simple methodology of acquiring an image for palm using camera is done. The captured image is cropped to obtain the region of interest (ROI). The features absolute co-efficient, horizontal co-efficient, vertical co-efficient and diagonal co-efficient are extracted from the region of interest. These features are extracted using six level Haar transform.

Keywords: Region of interest (ROI), Haar transforms Energy levels, gait, data analysis and motion capturing.

I. INTRODUCTION

Biometric is the most secure and convenient authentication tool. Biometrics provide security benefits across the spectrum, from IT vendors to end users, and from security system developers to security system users Biometrics measure individual's unique physical or behavioral characteristics to recognize or authenticate their identity. In this paper, a combined work on palm print and human gait has been done for high accuracy in recognition process. Palm print recognition is a promising biometric feature for use in biometric access control and forensic applications. Palm print recognition system works much like a fingerprint recognition system except a few additional features. It is also more acceptable than face recognition system that may cause privacy issues. Palm print recognition system is a digital image processing system which can be designed using a MATLAB source code. Palm print biometric system does not require specialized acquisition devices. It is user-friendly and more acceptable by the public. In this paper no special lighting is used in this setup. The hand image is segmented and its key points are located. The hand image is aligned and cropped according to the key points. The palm print image is enhanced and resized. Sequential modified Hear transform is applied to the resized palmprint image to obtain modified haar energy (MHE) feature. The palm print point features require high resolution image. The high resolution image can be obtained through digital camera. This method can provide more detailed palm print and can be applied to the real time application.

The human gait is divided into gait cycles, which are defined as the period from an initial contact of one foot to the following initial contact on the same foot [7, 13].This period is possible to divide into three main tasks, which again is possible to divide into eight phases as illustrated in Figure1.

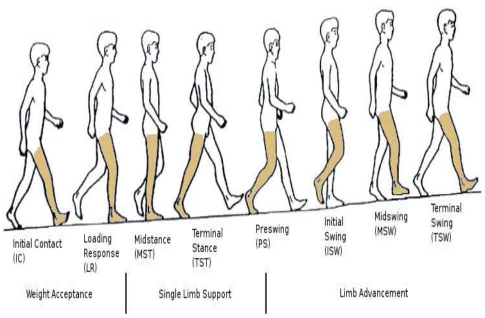


Figure 1: A complete gait cycle with its three tasks and eight phases displayed

The first task is a weight acceptance period, which involves an initial contact phase. During this task, one foot is placed at the ground and the body weight is shifted to maintain stability and absorbing shock. The second task is a single limb support task consisting of a mid distance phase, a terminal stance phase and a transition to the pre swing phase. During this task, the contra lateral foot is swung forward while the body weight is maintained on the stable foot. The last task is the limb advancement consisting of the pre swing phase, the initial swing phase, the mid swing phase and the terminal swing phase. During this task, the previously stable foot leaves the ground and shifting the body forward.

II. BIOMETRIC METHODOLOGY

A basic palm print biometric system has four stages. They are image acquisition, image preprocessing, feature extraction and feature matching. Figure. 2 shows a basic palm print biometric system.

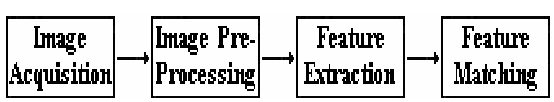


Figure.2: Basic Palm print Biometric System

Palm print can be acquired using digital camera. Digital camera can acquire high-resolution image in longer distance compared to CCD camera. It can also be connected to computer as the real time acquisition device. The hand image (palm print) is usually taken in front of a dark intensity background to ease the image segmentation process. Image pre-processing includes region-of-interest selection. Region of interest (ROI) selection is the cropping of palm print image from the hand image. The feature extraction depends on the types of feature targeted. In some cases, different features types are combined to form a new feature types.

In the existing work, a palm print based biometric system that can be work in peg less environment. The key point in the hand image is determined before the palm print image is selected and extracted. The palm print image is normalized and its features are extracted. Three different feature extraction methods, namely, Discrete Cosine Transform (DCT) energy feature, Wavelet Transform (WT) energy feature and SobelCode, which can be used to represent the palm print effectively is investigated. The palm print feature is stored as feature vectors and matched using similarity measurement and neural network to identify the identity of the individuals.

The Figure 3 uses a novel orientation estimation algorithm for palm prints. A new Initial estimation method is developed to reliably estimate the orientation field even in regions having many creases. It is used in ridge enhancement and minutiae validation, making it very important in minutiae extraction. Various orientation estimation algorithms have been proposed for fingerprints these algorithms consist of two main steps: initial estimation and post smoothing. Lots of post smoothing methods has been designed, including the hierarchical gradient method, the model-based method, the region growing algorithm, etc. But no matter how powerful these smoothing algorithms are, they all rely on the results provided by the initial estimation. If there are overwhelming errors in the initial estimation results, no smoothing algorithms can generate reliable results magically

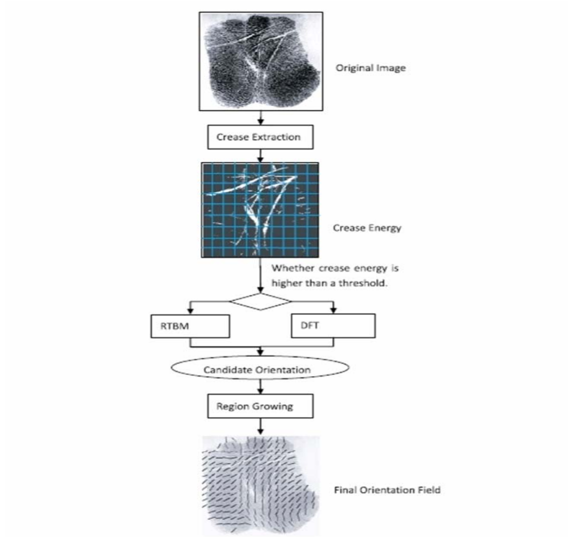


Figure 3: Flowchart of composite algorithm

The complete overview of the proposed palm print biometric system is shown in Figure 4.The following sections explains the condition during hand image acquisition, determination of the key points in the hand image, Palm print image selection ,extraction and matching are explained in Section gives the overview of feature extraction and representation. The results and discussion among different type of methods have also been done .The final section summarizes the conclusion obtained from this work.

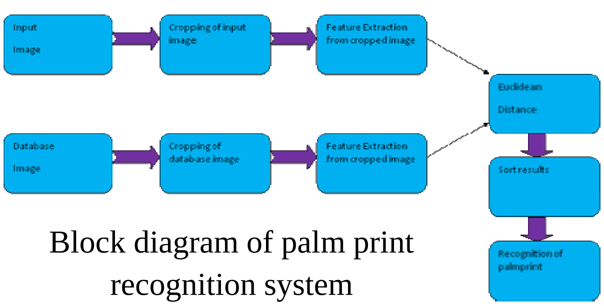


Figure 4: Block diagram of palm print recognition system

This paper deals with the device used for collecting a person's walking features is referred to as the Gait Collector. This is a device that was created for this research that is basically consisting of the following two components:

AVR Butterfly: AVR is a family of fairly cheap and feature-rich micro controllers from Atmel Corporation1. Their micro controllers are designed as Reduced Instruction Set Computers (RISC). For this paper, the AVR Butterfly has been used, which is an evaluation board equipped with a ATmega169 micro controller and a whole series of other useful features, such as a 100 segment LCD display, a 4Mbit data flash memory, a Real Time Clock 32,768 Hz oscillator, a 4-way joystick with center pushdown button, a RS-2322 level converter, a boot loader for programming and a built-in safety pin so it can be hanged on your shirt.

ADXL202: The ADXL202 is a low cost dual-axis accelerometer from Analog Devices3 capable of detecting acceleration up to ±2g, which should be sufficient for detecting normal walking. The use of accelerometers for motion capturing is possible due to the recent advances in this technology, which makes it more and more popular in technologies measuring tilt, shock and vibration. The output from the ADXL202 is a digital signal whose duty cycles (another name for the signal's pulse width) are proportional with the acceleration. The outputs from the accelerometers are measured in microseconds using the Gait Collector, and are referred to as the "acceleration data. These accelerometers where chosen primary due to their low cost. These recommendations are however for attaching accelerometers to a shoe and not to the leg. Data obtained using the Gait Collector shows that during normal walking, most of the registered values are in the range of ±2g. A range of ±10g would in this situation most likely introduce inaccuracy.

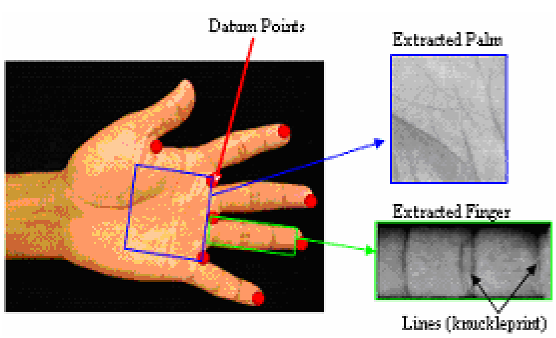
Two ADXL202 accelerometers have been attached to the AVR Butterfly's ATmega169 micro controller. These two accelerometers are mounted at a right angle of each other such that they are capable of collecting acceleration data along three orthogonal axes; the vertical acceleration, which is referred to as the X axis in this report, the forward movement, referred to as the Y axis and the sideway movement, referred to as the Z axis.

The Gait Collector has been encapsulated in a plastic box measuring 5.4cm×8.2cm×3cm. Some straps have also been provided to be able to attach the Gait Collector firmly to a person's leg. When attached, it appears as shown in Figure 5.

Figure 5: The Gait Collector attached to a person's leg in its ideal position just above the right foot's ankle

III. PALMPRINT RECOGNITION PROCESS

The right hand images of different users are taken in front of a uniform dark intensity background using high resolution digital camera. In the palm print acquisition device, a digital cameral is used to capture high resolution palm print images. In our experiment, a DIMAGE Xt camera is used, and the collected palm prints are 2048×1536, 24bit RGB images. To obtain high verification accuracy, it is important to construct an objective verification database. Therefore, we collected palm print images at different times and different position, and built the palm print database. In the collection, 10 individuals provided their palm prints, mainly consisted of volunteers from the students and staff at our college.



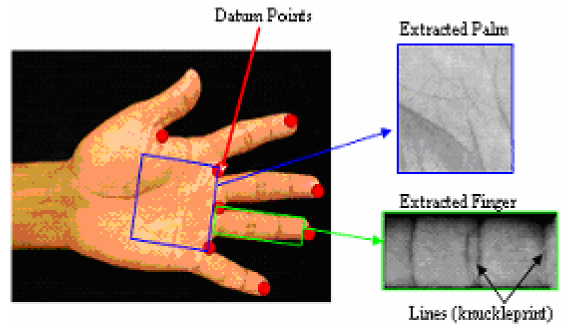


Figure 6: Extracted features

Feature extraction is a step to extract the meaningful features from the segmented ROI for the later modeling or verification process. In extracting the features, we use the operator-based approach to extract the line-like features of palm print in the ROI of palm table. A six level Haar transform is being used for feature extraction in order to obtain both high and low frequency coefficients. The following steps are involved.

A. ALGORITHM STEPS:

Step 1: Image is converted to binary image.

Step 2: Boundary tracing 8-connected pixels algorithm is applied on the binary image to find the boundary of palm print image .The starting point is the bottom left point "P" and the tracing direction is counter clockwise. The end point is also "P". And these boundary pixels are collected in Boundary pixel vector (BPV). It calculates the energy level

Step 3: Euclidean distance is calculated between database image and input image.

$$E\ Dist = [(X-X1)\ ^\wedge 2 + (Y-Y1)\ ^\wedge 2]\ ^\wedge (1/2) \quad \text{---- (1)}$$

Where X, Y in equation (1) represents pixel points of database image and X1, Y1 represents pixel points of input image. The proposed palm print identification system line segments. It makes uses of the added attributes of comprises three modules, i.e., palm print acquisition, line orientation and line point association to measure palm print representation, and palm print identification. The novel technique of Modified Line segment has been adopted in a number of applications, such as Euclidean Distance (ED), which is given by equation 1.

E Dist is one of the most commonly used methods Palm print Matching image processing and matching applications. It measures two images' dissimilarity without explicit Dissimilarity point correspondence. Cropped image from database image is shown in figure 7 and cropped region of an input image is shown in figure 8.

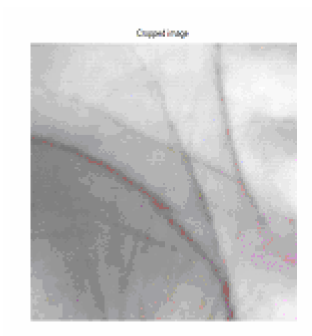


Figure 7: Cropped image from database image

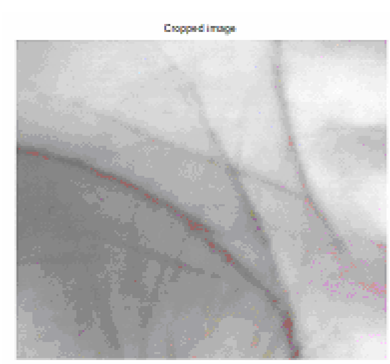


Figure 8: Cropped image of input image

IV. GAIT RECOGNITION PROCESS

The raw data from the Gait Collector are in the form of duty cycles. Every measure in microseconds proportional with the acceleration. When these values are to be analyzed, they are transferred to a computer and stored in a file. After the data has been stored to file, the headers and other unnecessary information must be removed from the file to make it readable in Mat lab. The complete gait recognition process is shown in figure 9.

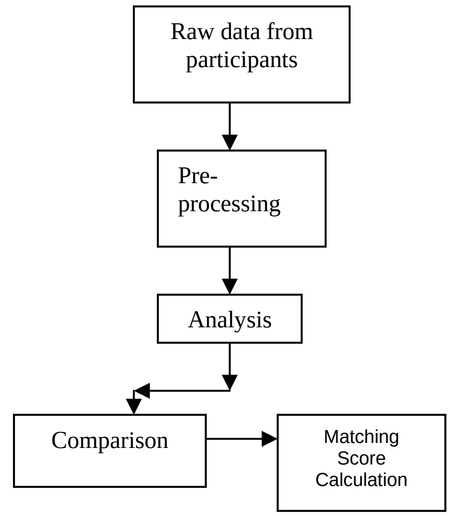


Figure 9: Gait Recognition Process

To ease the analysis process, the acceleration data collected were the persons did not actually perform walking was manually deleted from the file. The gait data collected from a person is stored in three files; one file with the plain raw data from the Gait Collector, one file with the headers removed to make it readable in Mat lab and one file where data, which is not collected during walking, had been removed manually. Data collected using the Gait Collector results in acceleration data in the three axes X, Y and Z as shown in Figure 8. To gain a better understanding of what to look for in these data, more details regarding the information provided by the raw data itself is necessary. The acceleration data in the X-axis will reflect the acceleration provided by the rising and lowering of the foot. It will show a downward spike as the foot leaves the ground, as well as an upward spike direction as the foot reaches its highest point as it is moved forward.

Assuming the person walks with constant speed, the acceleration in Y-axis will not be affected by the speed of the person. This acceleration will merely be a reflection of the foot moving forward during the single limb support phase, resulting in a small spike when the foot touches the ground. It will also to some extent reflect the acceleration of the foot moving forward.

The acceleration in Z-axis will reflect the sideways motion of the foot during movement. This will not reflect any large accelerations, but since this movement is not a strictly necessary movement in the same extent as the movements in X and Y axes, the Z axis movement might have a larger level of individual characteristics. As data is collected using the Gait Collector, the various characteristics of a person's movement can be made visible by displaying them in graphs.

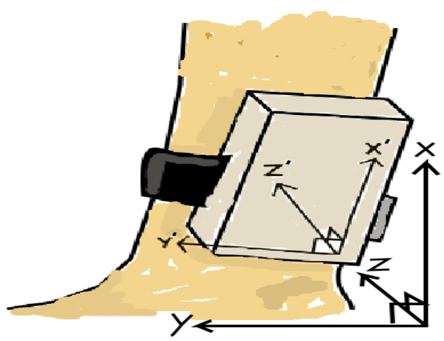


Figure 10: The Gait Collector attached to a leg with the three acceleration axes displayed

Also note how these axes are oriented compared with the physical axes. A typical dataset's resultant vectors and their orientations are shown in Figure 8. As shown, the data is fairly repeatable over several periods. A more detailed image of how the foot itself moves during one of the gait cycles is shown in Figure 11. This illustration is an attempt of mapping the foot's movement with the various fluctuations in the X and Y axes acceleration data. As this mapping was not a major part of this project, it has not been validated. However, it gives an indication of which motions are associated with which parts of the obtained data.

Table 1: Comparison Results for Palm print Recognition

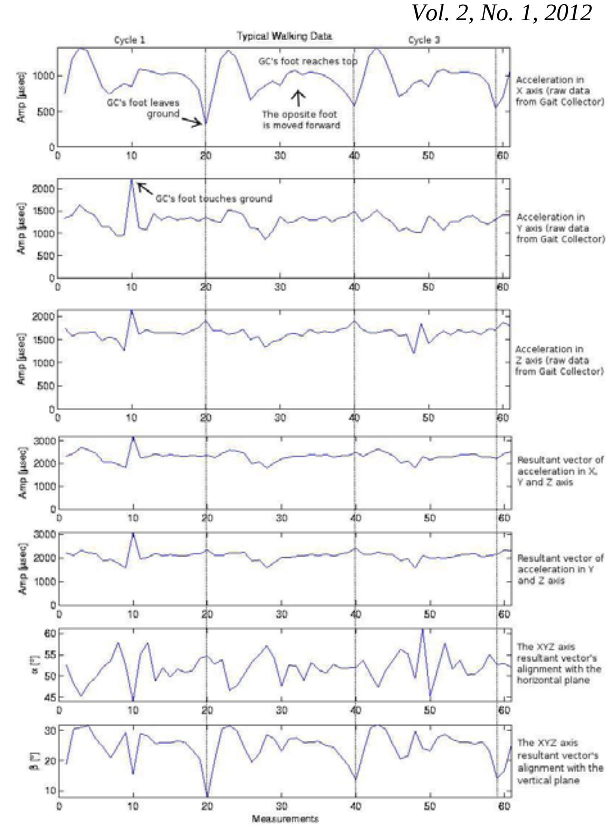


Figure 11: Shows the data gathered from the Gait Collector over three gait cycles.

V. EXPERIMENTSAND RESULTS

In this paper, Palm print and Gait are considered to calculate FAR and FRR. False Acceptance Rate (FAR) is the percentage of wrongly accepted individuals over the total number of wrong matching. False Rejection Rate (FRR) is the percentage for number of wrongly rejected individuals over the total number of correct matching. In similarity measurement (Euclidean Distance and Hamming Distance), the accuracy is calculated using equation (2).

$$\text{Accuracy} = (1 - (\text{FAR} + \text{FRR}/2)) * 100 \quad \text{----------} \ (2)$$

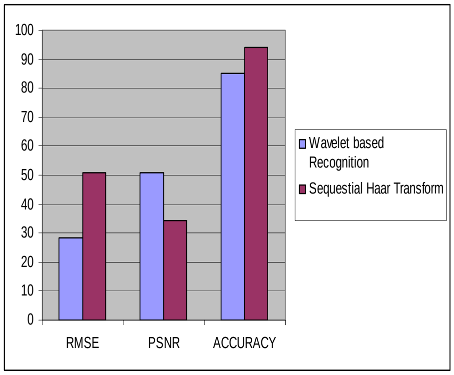


Figure 12: Graph representing comparison between Wavelet based Recognition and Sequential Haar Transform.

Table 2: Comparison Results for Gait Recognition

METHOD	RMSE (dB)	PSNR	ACCURACY (%)
Wavelet Based Recognition	28.20	50.87	85
Sequential Haar Transform	50.87	34.23	94

Method	**Threshold**	**FAR**	**FRR**
Comparing FFT of X axis data	> 308 < 57	44.7%	21.1%
Comparing FFT of Y axis data	> 1527 < 123	61.6%	19.5%
Comparing FFT of Z axis data	> 887 < 51	77.4%	21.1%
Comparing FFT of the XYZ Resultant Vector	> 2000 < 99	68.4%	19.5%
Comparing FFT of YZ Resultant Vector	> 1878< 60	65.8%	21.1%
Local Minima Detection on the FFT of XYZ Resultant Vector	> 357 < 62	70.5%	20.0%
Local Minima Detection on the FFT of YZ Resultant Vector	> 236 < 55	61.1%	21.1%
Comparing the FFT of the Horizontal Orientation of the XYZ Resultant Vector	> 12.8 < 2	40.0%	21.1%
Comparing FFT of the Vertical Orientation of the XYZ Resultant Vector	> 12.6 < 1.7	61.1%	21.1%

VI. CONCLUSION

In this paper we have presented a palm print with gait recognition system for security purposes. The process of cropping and feature extraction was carried out for the database images. After calculating the energy levels the person was identified as authenticated or unauthenticated. This paper shows that it is possible to collect reliable and valid movement data from a person using accelerometers. The results also show that it is possible to detect relations between a person and his gait using kinetic acceleration data. Through fairly simple analysis methods is it possible to distinguish him from other persons. However, for gait authentication to achieve acceptable security performance, more work is needed and better methods for analysis must be developed and assessed.

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