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A Real-Time Palm Print Implementation on VLSI System of Identification

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Abstract:- Palm print is a modern physiological biometric that is gaining popularity due to its consistent and special characteristics. It looks into the feasibility of identifying people using ridge features derived from palm print photographs. The ridge-based palm print matching algorithms have been used for large-scale individual recognition applications. Skin distortion and the varying discrimination power of various palm print regions are dealt with using the segment-based matching and fusion algorithm. Until matching, the palm prints are registered into the same coordinate scheme using the orientation field-based registration algorithm. The cascade filter is designed to reject gallery palm prints that aren't matched. The entire palm print recognition algorithm is implemented in FPGA to achieve substantial time and memory savings. In MATLAB, the palm print matching scheme is introduced. Since MATLAB is not well suited for high-performance real-time applications, a hardware implementation of FPGA was created to resolve this problem.

Keywords – Palm print; cascade filtering; FPGA implementation.

INTRODUCTION

Biometrics is a branch of science that deals with automated methods for recognizing (verifying or identifying) individuals based on their physical and/or behavioral characteristics. Law enforcement authorities have been gradually using palm prints to locate suspects in recent years. Efficiency is a critical factor in law enforcement palm print recognition systems, but it is a difficult problem to solve due to the huge database size and poor image quality. Since the pattern of ridges is distinctive and their information is stable, palm print can be used as an accurate human identifier. Palm print biometrics has many advantages over other physical biometric characteristics, including low intrusiveness and stable line features. Friction ridges and flexion creases are the two main characteristics of the human palm.

The folding of the palm creates flexion creases. The palm is divided into three regions by the three most prominent flexion creases, known as main creases: thenar, hypothenar, and interdigital. A biometric system is designed with five goals in mind: cost, user acceptance, environmental constraints, accuracy, computation speed, and security. There are several small creases on the palm that are not as permanent as the main creases. The buckling instability in the basal cell layer of the fetal epidermis causes friction ridges to form. To see the ridge element, you'll need a resolution of about 500 pixels per inch. Friction ridge patterns on the palm are both distinctive and permanent, making them useful as a biometric feature for identifying people. The majority of existing palm print recognition research focuses on low-resolution palm print images that can be captured with low-cost cameras. Ridges can't be seen at this low resolution, so matching is more dependent on major and minor creases. [David Zhang et al 2003] proposed the Gabor filter to remove texture features at various scales and orientations with less coefficients to achieve a high recognition rate.

[A.K.Jain et al 2009] proposed a minutiae-based palm print recognition device that was accurate enough. To obtain the ridge orientation, the region-growing algorithm was proposed.[J.Dai et al 2011] proposed a multi-feature based palm print recognition system that extracts and equates multiple features such as minutia points, orientation area, and major creases to achieve higher accuracy. The main biometric modalities, which must be both identifiable and insensitive to changes in age and skin tone, are used in large-scale identity recognition systems such as forensic and border control systems.

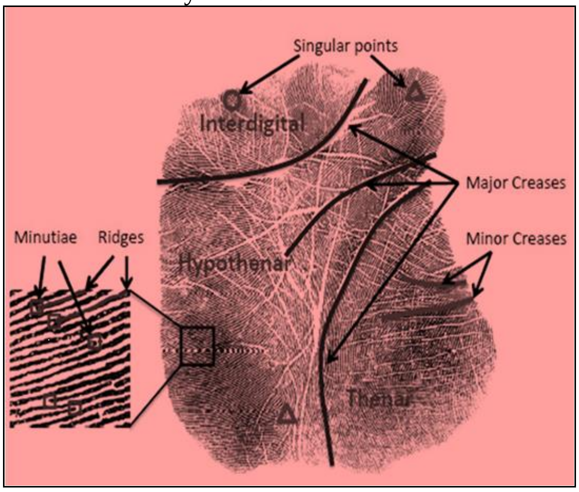

Figure 1: Crease and ridge characteristics of a palm print

Palm print recognition systems for these applications must be based on ridge features, with creases serving as supplementary features. In fact, the standard resolution for capturing palm prints in forensic applications is about 500ppi, and courts of law accept person identification based solely on ridge features (such as minutiae).

It contains the following items:

1) A detailed statistical analysis of various palm print characteristics is conducted to guide the design and parameter selection of the matching device.

2) In the direction of arrangement with the distortion and unstable discrimination power of different palm print areas,

the segment-based palm print matching and fusion algorithm is used. To correct for distortion, the entire palm print image is divided into small fragments, which are then individually matched.

3) An orientation field based registration algorithm is designed for registering palm prints of different positions and rotations into the same coordinate system before matching to minimize computational complexity. The cascade filter is designed to reject gallery palm prints that aren't mated. Because of additional limitations on memory and other peripheral equipment, implementing palm print on a general purpose computer can be faster, but it is not very time efficient.

In comparison to software implementation, application-specific hardware implementation is significantly faster. Hardware deployment has become a more appealing choice as VLSI (Very Large Scale Integrated) technology progresses. The use of parallelism and pipelining in algorithms, as well as the implementation of complex computation tasks on hardware, result in substantial reductions in execution times. Application Specific Integrated Circuits (ASICs), Digital Signal Processors (DSPs), and Field Programmable Gate Arrays are some of the other technologies available for hardware design (FPGA).

The design of Field Programmable Gate Arrays (FPGAs) provides the best performance, but the complexity and cost associated with the design are extremely high. On an FPGA, hardware design strategies such as parallelism and pipelining are feasible, which are not possible in dedicated DSP designs. For real-time palm print recognition algorithms, FPGAs are an excellent alternative.

II. MATCHING SYSTEM FOR PALM PRINTS

A. Overview of the System

A new palm print matching scheme is used for 1: N matching. Since different palm print share several of the same ridge flow patterns, the orientation field is used for palm print registration, transforming palm print of various rotations and displacements into the same coordinate organization. As a result, a tight location constraint can be enforced in the matching algorithm, resulting in a significant increase in matching speed. Palm print that have been recorded are divided into small fragments.

All of the corresponding segments are finely matched and compared during palm print matching. The basic operations of the palm print matching method are shown in Figure 3.

This is how it works:

The cascade filter is based on the assumption that certain segments in palm print are very distinctive, and that by contrasting these distinctive segments, many non-mated gallery palm print can be discarded.

1) The palm print image is captured using a palm print scanner, and then the AC signal is acquired. The analogue signal is converted to a digital signal, which is then sent to a computer for processing.

2) The gallery palm print are done in the palm print registration stage during the enrollment stage. The question palm print is performed separately during the identification stage. The question palm print are complete palm print that have been live-scanned from unknown aspects, while the gallery palm print are full palm print in general. The palm print in the gallery is automatically recorded.

3) The cascade filter compares the segments between the question and gallery palm print in order. Palm prints from the gallery that are very different from the question palm print are immediately denied. After comparing only a few segments, a significant portion of the gallery palm print was rejected.

4) The query palm print is paired with the remaining gallery palm print after cascade filtering, and the query palm print's true mate is calculated using segment based matching and fusion algorithm.

B. Image capturing.

A commercial palm print scanner was used to capture the image. A palm print image is collected by a palm print scanner, which then converts the AC signal into a digital signal that is sent to a device for further processing. Windows XP/Vista compatibility, a 3GHz CPU, and 512 MB of RAM are among the system specifications. LSCAN 500P was used to capture the image. With a resolution of 500ppi, the LSCAN 500P captures forensic-quality images. The LSCAN 500P has a one-of-a-kind interactive LCD monitor that makes using the scanner a breeze. The LCD monitor speeds up and simplifies the capture process. This device employs safe auto capture technology, allowing users to acquire high-resolution palm images in less than a second.

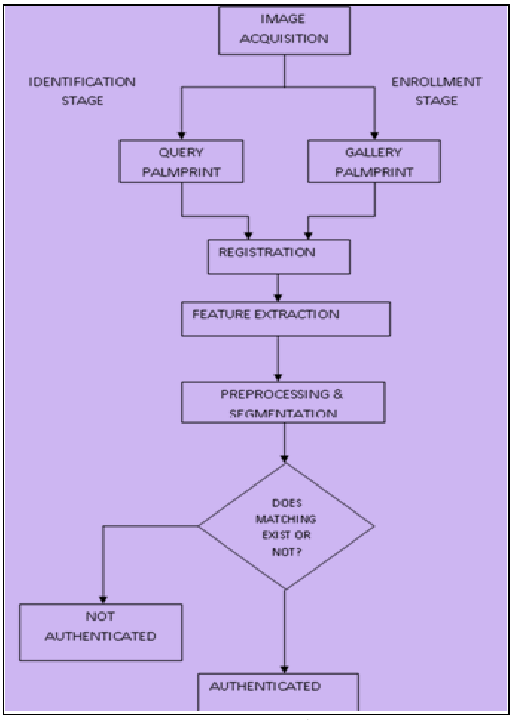

Figure 2(a).Print the basic operations of the palm matching method

C.Registration is the third phase.

To aid matching, registration is required to put different palm prints into the same coordinate system. Most biometric identification methods, such as iris and face recognition, require registration. The outer and inner contours of the iris are used to identify it, while the

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position of the eyes is used to identify the face. The enrollment stage of palm print registration includes the gallery palm prints, while the identification stage includes the query palm prints. The question palm prints are absolute palm prints scanned live from unknown suspects. The palm prints in the gallery are typically absolute palm prints. The palm prints in the gallery are automatically recorded. Methods for registering palm prints include finger intervals, hand size, and hand size.

Contactless low-resolution palm print verification is organised using contour; principal lines. Contactless systems capture low-resolution palm prints (see fig.2 (a)), which show the entire palmer region as well as the finger roots. The registration of palm prints captured using contact-based techniques such as inking and FTIR sensors (see fig.2 (b)), in which fingers are not accessible and hand contours and principles are either incomplete or not authentic, is a difficult job. The recorded image is collected at a resolution of 500ppi in this method. The orientation field dependent registration algorithm is used to perform the registration.

The contour; principal lines are used to organize contactless low-resolution palm print verification. Low-resolution palm prints (see fig.2 (a)) are captured by contactless systems and reveal the entire palmer area as well as the finger roots. Registration of palm prints captured with contact-based techniques like inking and FTIR sensors (see fig.2 (b)), where fingers are not available and hand contours and concepts are either incomplete or not authentic, is a challenging task. In this process, the captured image is collected at a resolution of 500ppi. The registration is done using the orientation field based registration algorithm.

D. Extraction of Characteristics

Feature extraction is the process of reducing the number of resources needed to accurately represent a wide collection of data. The captured image's ridge features are extracted and fed into the preprocessing phase.

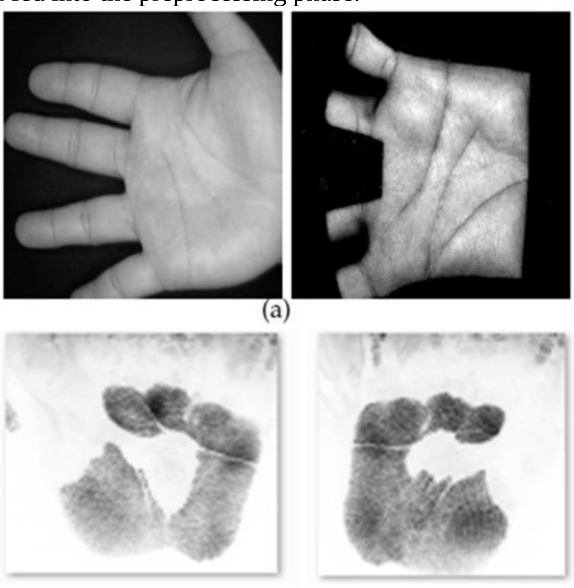

Figure 2 (b). (a) In a laboratory environment, contactless techniques were used to capture palm print photographs (a).

The left palm print in (a) comes from the CASIA palm print database, while the right palm print comes from the Poly U palm print database. In an operational setting, contact-based techniques are used. figure 2 (b)

E. Segmentation and preprocessing

Preprocessing the image to create a suitable sub-area for feature extraction and matching is a critical problem that must be addressed first. Distortions such as rotation, shift, and translation are present in the palm images as a result of the images obtained by a digital scanner without any pegs, making it difficult to locate at the correct location in the same direction. To align different palm prints and crop the region of interest for feature extraction, preprocessing is used. A segment-based palm print matching and fusion algorithm is proposed to cope with the distortion of different palm print regions. To deal with distortion, the entire palm print image is divided into small segments after preprocessing. The palm print image is segmented into 64*64 pixel blocks during the segmentation process. Segment the palm print picture (64*64 pixels) in Figure 2(c).

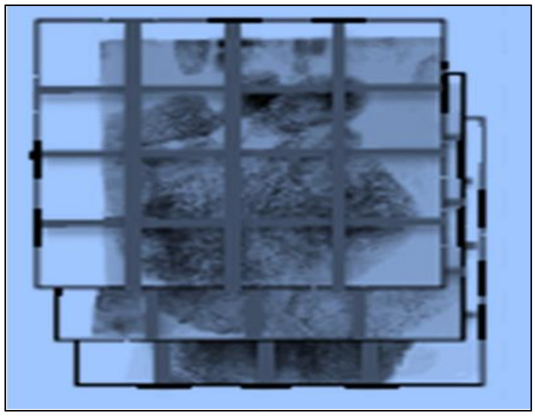

Figure 3.b Gives an example of a person's right palm with eight impressions.

EXPERIMENTS III

Palm print Database (A)

To test the algorithm, 80 subjects provided 1,280 palm print images (two palms per person, eight impressions per palm).Hisign's commercial palm print scanner was used to capture the palm print photographs. Both of these palm prints have a resolution of 500ppi and a size of 2040*2040 pixels. Figure 3.a gives an illustration of a person's left palm with eight impressions.

FPGA Implementation (B)

The entire palm print recognition algorithm was built in VHDL and implemented in an FPGA. When compared to programme implementation, the execution time was greatly reduced. The execution time of hardware modules is calculated using the VHDL description's synthesis and simulation performance. To evaluate the synthesis and simulation, the Modelsim tool is used. It will produce a signal if the question palm print and gallery palm print match and recognise each other.

FINAL REMARKS

Palm print matching algorithms based on ridges have been used for large-scale individual recognition applications. The computational complexity is minimized by using an orientation field-based registration algorithm. To handle skin distortion and the varying discrimination power of different palm print areas, a segment-based matching and fusion algorithm is proposed. To compensate for distortion, the entire palm print image is divided into small segments and then individually matched. Since previous MATLAB work was unsuitable for high-performance real-time applications, a hardware implementation of FPGA was created to fix this problem. The developed palm print recognition system can be implemented in VLSI and used as a stand-alone system for high-security applications, reducing execution time. The implementation of a palm print recognition device on ASIC will be the focus of future work.

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