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Performance Analysis of Edge Detectors for Palmprint Matching

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Abstract— **The palmprint has been used for future prediction of human being. In the recent years the palmprint has been used for biometric applications as human verification. The palmprint has many lines of different sizes and directions. The lines are detected as edges using popular edge detecting algorithms such as Sobel, Prewitt, Roberts, Log, Zero-cross, and Canny. Thus, an analysis work has been performed on these popular edge detection algorithms to identify suitable edge detection algorithm which improves the palmprint matching process. The experiment results reveal that the canny edge detection algorithm identifies complete set of edges of various sizes compared with other popular edge detection algorithms. Moreover, the Sobel edge detection algorithm identifies the medium and as well as longer lines. Further, the Prewitt, Roberts, Log, and Zero-cross edge detection algorithms ignore the small lines and identifies only the main longer lines. Thus, the analysis work confirms the Canny and Sobel edge detection algorithms are preferable for edge detection algorithms.**

Keywords— Palmprint, Edge Detection, Biometrics.

I. Introduction

Authenticating human beings at various places such as Airport, Office, Internet payment, etc. is an essential task. There are several techniques used such as punch card system, magnetic swipe card system with pin number, fingerprint verification system, palmprint verification system, face recognition, etc. The failure rate of these systems are varies from 1% to 5%. The system may have false acceptance or false rejection or both. The failure of the verification system may lead to security threat to the Airport or Office, etc.

The punch card system is outdated and in few places the magnetic swipe card system is utilized. Some places the fingerprint verification systems are implemented. Few places the palmprint systems, face recognition systems are in use. The palmprint is unique in features for a person. The palmprint verification system is highly preferred due to the simplicity of the system and speed. Since, the area of the palmprint is higher than the fingerprint and lesser than the face, is highly preferred for feature extraction. The palmprint verification system has been implemented with the help of touch less system using android base mobile phone [11].

II. Related Works

There are many researchers working palmprint verification system. Few works are reported here.

L.J. Spreeuwers and F. Van Der Heijden proposed a new method for evaluation of edge detectors based on the average risk of a decision [1]. The average risk is a performance measure well-known in Bayesian decision theory. They described a method to estimate the probabilities on a number of different types of errors. A weighted sum of these estimated probabilities represented the average risk. The weight coefficients defined the cost function. The method was suitable, not only for the comparison of edge operators, but also for the determining of the weaknesses and strengths of a certain edge operator. They considered Sobel algorithm, the Marr-Hildreth operator, and the Canny operator for experiment. The experiment results that the Canny operator performs best.

D. Ziou and R. Mohr summarised a SED (Selection of Edge Detectors) system. This automatically selects edge detectors and their scales to extract a given edge [2]. The system inputs are location of an edge, the image, and set of constraints related to the delocalization error and the computation time for the desired quality. The results of the system are characteristics of the given edge, the detectors, and their scales. They used edge analysis, detector choice, and result analysis for selecting edge detectors. D. Ziou and A. Koukam summarised a SED system [3]. They used image structure analysis involved segmentation of edge into a set of edgels, detector choice, and result analysis.

Mike Heath et al. described a new experimental framework for making quantitative comparisons using subjective ratings made by people [4]. This approach is complement to signal-based quantitative measures. They selected four edge detectors Canny, Sobel, Nalwa-Binford, and Sarkar-Boyer for comparison. They set three conditions edge detector, parameter set, and image. They used ANOVA analysis.

Qiang Ji and Robert M. Haralick introduced a new criteria for analytically evaluating different edge detectors without the ground-truth information [5]. They adopted kernel-variance criteria for comparing different edge detectors than the regular convolution based. They studied performance of four edge

detectors using synthetic test image. The experiment results shows integrated edge detector outperforms the canny edge detector at noise level 5. Further, they studied, performance difference between the LOG zero-crossing perator and Haralick's facet zero-crossing operator. They confirmed that both the techniques generate comparable results for kernel sizes larger than 25 pixels. They also recommended not to use kernel sizes less than 11 for LOG operators.

Laura Liu and David Zhang proposed a palm-line detection approach to simultaneously extract structure and strength features of palm lines by minimizing a local image area of similar brightness to each individual pixel [6]. They tested the proposed palm-line detection approach with canny edge detector and susan edge finder on the public palmprint database built by the Biometric Research Centre at the Hong Kong Polytechnic University. The EER of the palm-line detector is 1.0% which is the lowest one compared with the Susan edge finder 2.3% and the canny edge detector 5.4%.

Pablo Hennings et al., designed multiple correlation filters in sub regions of the palmprint [7]. They proposed a segmentation stage that selects palmprint sub regions to train the filters in a class-by-class basis using different edge-detection operators. They used phase symmetry approach to extract amplitude and phase measures of the signal at particular scale and space locations. They computed difference of the absolute values of the even and odd filter sequences at each scale. Then, they computed a weighted average of the difference images at each scale. They used PolyU database for experiments. The experiment results were shown in figure 4 and 5. By mistake they mentioned figure 5 based on edginess. The average EER was 0.0012% for using edginess and 0.0003% for using phase-symmetry edge detector, which was claimed as better.

Rodrigo Moreno et al., defined a methodology for evaluating edge detectors through measurements on edginess maps instead of on binary edge maps [8]. These measurements avoided possible bias introduced by the application dependent process of generating binary edge maps from edginess maps. The features of completeness, discriminability, precision and robustness, were introduced. The *R*, *DS*, *P* and *FAR*-measurements in addition to *PSNR* applied to the edginess maps were defined to assess the performance of edge detection. Well-known and state-of-the-art edge detectors had been compared by means of the new proposed metrics. Results had shown that it is difficult for an edge detector to comply with all the proposed features.

Weiqi Yuan et al. proposed a palmprint principal lines detection method [9]. This method employed priori knowledge of statistical properties about palm lines. They considered particular direction of principal lines based on the feature of their valley type edges and minimum gray value. Further they devised linking algorithm for broken lines. This scheme avoided blind searching and enhanced the robustness. An extraction rate (ER) index was defined to evaluate the effect of the approach. They achieved 86.67% extraction rate.

C. Saravanan proposed an enhancement scheme for palmprint using median filters for biometric applications [12]. The experiment results shows that the enhanced palmprint has bright ridges compared to normal ridges identified palmprint.

The edge detection of palmprint is the most important phase in the palmprint matching. Thus, a performance analysis of edge detectors is performed and the results are discussed in the following section.

III. Experimental Results

The palmprint line identification is an important phase in the palm print matching. It is proposed to analyse the six well known filters Sobel, Prewitt, Roberts, Log, Zero Cross and Canny for identifying the palmprint lines. The figure 1 shows one of the experiment image used for this experiment. The figure 2 shows the experiment results of various filters and its line detection.

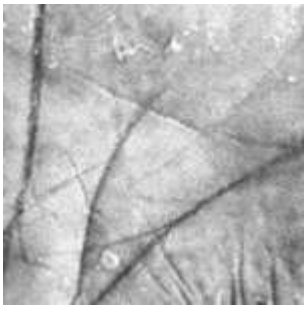
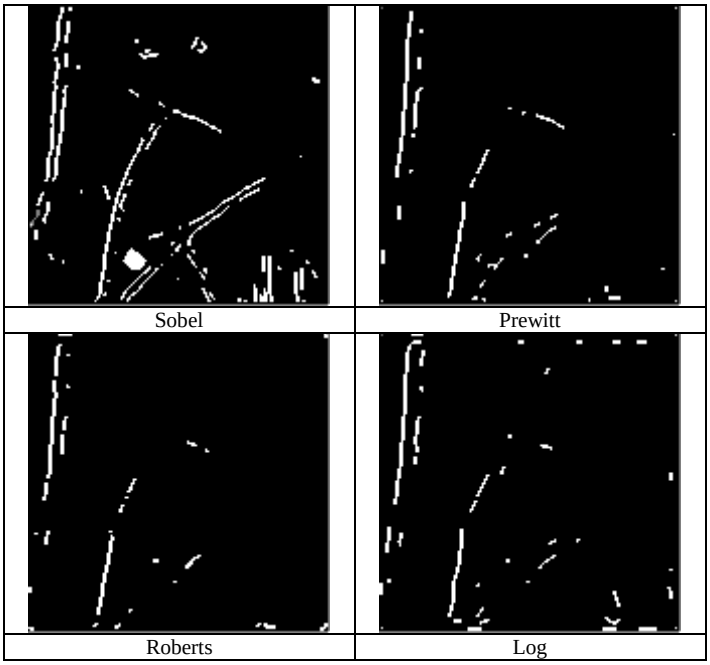


Figure 1. Segmented Palmprint



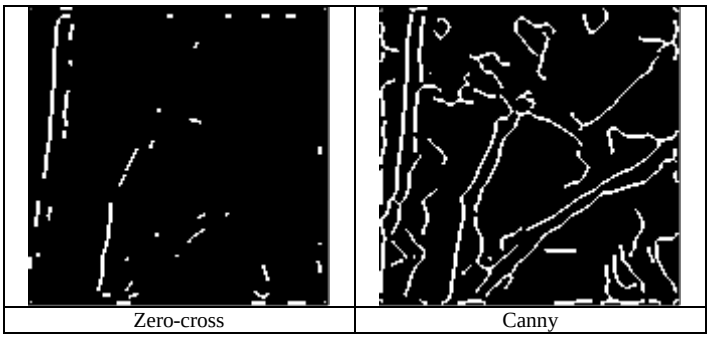


Figure 2. Result image of various edge detection algorithms

IV. Conclusion

From the experiment results shown in the figure 2, the order of edge detectors are listed in terms of performance, 1) Canny, 2) Sobel, 3) Prewitt, 4) Roberts, 5) Log and 6) Zero-cross. The Canny and Sobel edge detectors are highly recommended for palm print matching applications.

References

[1] L.J. Spreeuwers and F. van der Heijden, Evaluation of Edge Detectors Using Average Risk, IEEE, 1992, pp. 771-774.

[2] D. Ziou and R. Mohr, An Experience on Automatic Selection of the Edge Detectors, IEEE, 1992, pp. 586-589.

[3] D. Ziou and A. Koukam, The Selection of Edge Detectors Using Local Image Structure, IEEE, pp. 366-370, 1995.

[4] Mike Heath, Sudeep Sarkar, Thomas Sanocki, and Kevin Bowyer, Comparison of Edge Detectors: A Methodology and Initial Study, IEEE, 1996, pp. 143-148.

[5] Qiang Ji and Robert M. Haralick, Quantitative Evaluation of Edge Detectors Using the Minimum Kernel Variance Criterion, IEEE, 1999, pp. 705-709.

[6] Laura Liu and David Zhang, Palm-Line Detection, IEEE, 2005.

[7] Pablo Hennings, Marios Savvides, and B.V.K. Vijaya Kumar, Palmprint Recognition with Multiple Correlation Filters Using Edge Detection, for Class-Specific Segmentation, IEEE, 2007, pp. 214-219.

[8] Rodrigo Moreno, Domenec Puig, Carme Juli`a, and Miguel Angel Garcia, A New Methodology for Evaluation of Edge Detectors, ICIP 2009, pp. 2157-2160.

[9] Weiqi Yuan, Sen Lin, Haibin Tong, Shudong Liu, and Sen Lin, A Detection Method of Palmprint Principal Lines Based on Local Minimum Gray Value and Line Following, IEEE, 2011.

[10] G. Padmavathi, P. Subashini, and P. K. Lavanya, Performance evaluation of the various edge detectors and filters for the noisy IR images, Sensors, Signals, Visualization, Imaging, Simulation and Materials, pp. 199-203.

[11] Haruki Ota, Ryu Watanabe, Koichi Ito, Toshiaki Tanaka, and Takafumi Aoki, Implementation of Remote System Using Touchless Palmprint Recognition Algorithm, MoMM2010 Proceedings, ACM, 2010.

[12] Chandran Saravanan, Enhancement of Palmprint using Median Filter for Biometrics Application, International Conference on Advances in Science and Technology, (ICAST2014), Science Publications, pp. 16-18, 2014.

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