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A comparative study of finger vein recognition by using Learning Vector Quantization

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Abstract- This paper compares the accuracy of finger vein recognition using various features with Learning Vector Quantization method. For this purpose, two main features are employed: Scale Invariant Feature Transform (SIFT) and Local Extensive Binary Pattern (LEBP). The other features that formed LEBP features: Local Multilayer Binary Pattern (LmBP) and Local Directional Binary Pattern (LdBP) are also employed. The accuracy that use SIFT feature from binary images give a slightly better result than LmBP, LdBP, and LEBP.

Index Terms - finger vein recognition, SIFT, LEBP, LVQ

INTRODUCTION

The finger-vein pattern is one of biometric areas that can be used for personal identification. In general, finger-vein recognition consists four stages: image capturing, preprocessing, feature extraction and recognition. A feature extraction stage gains a lot of attention from many researchers. The examples of feature extraction methods which already used for finger-vein recognition are line tracking, maximum curvature, and mean curvature. However, those methods that already mentioned have not yet been focused on extracting fitur from degraded images.

Image degradation can be caused by scaling, rotation effect, translation effect, and varying illumination conditions. Those conditions may affect the accuracy of recognition stage and reduce the performance of system. One of the features which has been widely used for finger-vein recognition with degraded images is *Scale Invariant Feature Transform* (SIFT). As a mentioned in [1], SIFT has a capability to extract feature from images that degraded by scaling, rotation effect, and translation effect. SIFT feature can be extracted from grayscale iamges or binary images. LEBP which introduced by Liu (2014) is the other feature that affords to extract feature from degraded images [2]. Both features have potential to be used in recognition stage.

In recognition stage, there are two types of methods that can be used. The first one is using threshold distance [2] and the other one is using classification methods such as SVM [3] and LVQ [4]. There is currently no implementation of LVQ in finger-vein recognition using the potential feature that has been mentioned above.

In this paper, we will perform a detailed comparative study for finger-vein recognition using SIFT feature and LEBP feature with LVQ method as classifier. In a systematic manner, we will compare and evaluate the results obtained based on each technique and present the benefits associated with each paradigm.

METHOD

Finger-vein recognition which explained in this paper consists of four main stages: prerocessing, feature extraction, recognition, and comparative study. SIFT and LEBP are features that extracted from images and will be analysed. LVQ method wil be used in recognition stage. A flowchart of finger-vein recognition system is provided in Figure 1.

I.Preprocessing

The preprocessing steps that aplly for degraded images are selecting ROI, size normalization, and image enhancement. The methods that used for image enhancement are median filter, frangi filter, CLAHE, and morphology operation.

II.Feature Extraction

There are two features that will be obtained from images which produced from preprocessing stage. There are SIFT feature and LEBP feature. SIFT feature is obtained from grayscale images and binary images. The steps to get this feature follow the steps that explained

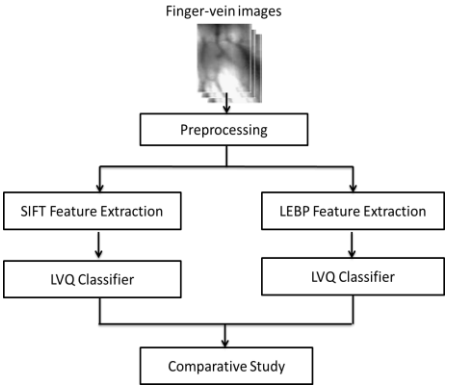

FIGURE 1.FLOWCHART OF FINGER-VEIN RECOGNITION SYSTEM

in [1]. The results of SIFT feature extraction are list of keypoints with value descriptors. Then, SIFT descriptors transform into histogram representation using Bag Of Visual Words (BVW) [5].

LEBP features are obtained from grayscale images using vein pattern as mask. LEBP features are the result of combination process between LmBP feature and LdBP feature which represented in 72 binaries vector [2]. Every eight bits of LEBP vector converts into decimal values with a range between 0 to 255. The decimal values that obtained map into histogram representation.

III.LVQ Classifier

LVQ is supevised learning that closely related with *Vector Quantization* (VQ) dan *Self Organizing Map* (SOM) [6]. There are two layers that build LVQ. They are competitive layer and output layer. In every competitive layer, there is initialization process of a weighting vector that has similarity to the input vector. Each neuron in the competitive layer will be found the best matches to winning neuron. Then the class in the output layer neuron is associated with winning neuron set into a high value.

IV. Comparative Study

The results from feature extraction will be the input for LVQ classifier. SIFT feature and LEBP feature, both will be represented as histogram vector. The accuracy of LVQ classifier will be the materials that analyzed.

RESULT AND DISCUSSION

The comparative experiments between SIFT and LEBP using LVQ classifier were conducted on the *finger-vein* dataset from *Hong Kong Polytechnic University* [7] that use finger vein images from 50 persons.Parameter in LVQ classifier which are learning rate, number of hidden layers, and number of epochs set into the same conditions. Table 1 shows the accuracy result of SIFT and LEBP. The average accuracy that can be achieved is 97%. From the

TABLE 1. TABLE OF ACCURACY RESULTS.

Accuracy of Finger Vein Recognition (%)				
SIFT (binary)	**SIFT (grayscale)**	**LmBP**	**LdBP**	**LEBP**
97,45	97,34	97,24	96,38	97,32

results, it can be said that SIFT feature from binary images give a slightly better result than LmBP,LdBP, and LEBP feature with a different of 0,1%. It also reveals that the other features: LmBP, LdBP, and LEBP are effective to implement on degraded images.

CONCLUSION

This paper compares the accuracy of finger vein recognition using SIFT and LEBP features with LVQ method. To compare both features, SIFT feature and LEBP feature are modified into the same representation that is histogram vector. The conditions of LVQ classifier are also set to the same. So that, the fair comaprisons can be achieved. From the results, SIFT feature from binary images give a slightly better result than LmBP, LdBP, and LEBP but not really significant.

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