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Intelligent Algorithms for Personal Authentication using Palm Vein

A Thesis submitted to the Department of Computer Science,
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Abstract

In the ubiquitous network society, individuals can easily oncoming their information anytime and anywhere. With the increase in technology threat to personal data and national security had also increased .Because of this risk, personal identification technology is used which includes Passwords, personal identification numbers and identification cards. However, cards can be stolen and passwords and numbers can be guessed or forgotten. To solve these problems we used biometric authentication technologies. Biometrics is automated methods of recognizing a person based on a physiological or behavioral characteristic. An example of characteristic is face recognition, fingerprints, hand geometry, signature verification, iris, retinal, finger/hand/palm vein recognition, ear recognition, and voice recognition.

Academic and industry tried to develop a device that can catch the vascular patterns under the skin .Fujitsu has developed a palm vein pattern authentication technology that uses vascular patterns as personal identification data .Vein recognition technology is secure because the authentication data exists inside the body and so it is very difficult to forge. It is highly accurate. This technology has many applications like in banking, hospitals, government offices, in passport issuing, libraries, personal computer, etc. Business growth will be achieved with these solutions by reducing the size of the palm vein sensor and shortening the authentication time.

Palm vein authentication has a high level of authentication accuracy due to the uniqueness and complexity of vein patterns of the palm. Because the palm vein patterns are internal to the body, this is can be a difficult

method to forge. Also, the system is contactless and hygienic for use in public areas. The contactless palm vein authentication technology consists of image sensing and software technology. The palm vein sensor captures an infrared ray image of the user's palm. The lighting of the infrared ray is controlled depending on the illumination around the sensor, and the sensor is able to capture the palm image regardless of the position and movement of the palm. The software then matches the translated vein pattern with the registered pattern, while measuring the position and orientation of the palm by a pattern matching method.

This study illustrates an image analysis method to extract the region of interest (ROI) from palm vein image. After extracting ROI, I design a sequence of preprocessing steps to remove the translation and rotation of palm vein images introduced in the data collection process and reduce a lot of data amount without losing much useful information. Then design a sequence of preprocessing steps that enhance the contrast between palm vein patterns and background using Homomorphic filter and Canny filter. After extract palm vein pattern it used to extract the features to use output features in matching step. This study use three different algorithms to extract features from pattern these algorithms are Principal Component analysis (PCA), Scale Invariant Feature Transform (SIFT) and Local Binary Patterns (LBPs) algorithms. In vein pattern matching a one-to-one match is done use the K-nearest neighbor (KNN) classifier with the Euclidian distance as a similarity measure using CASIA Multi-Spectral Palmprint Image Database V1.0 (CASIA database). It compared the three feature extraction algorithms, and the results showed that the SIFT algorithm outperforms the remaining algorithms with correct recognition rate (CRR) 96.13% and it is also the speediest algorithm with 0.045 second.

List of Publication

[1]. Mona A. Ahmed, Hala M. Ebied, El-Sayed M. El-Horbaty, Abdel-Badeeh M. Salem, "Analysis of Palm Vein Pattern Recognition Algorithms and Systems", International Journal of Bio-Medical Informatics and e-Health, Volume 1, No.1, pp. 10-14, June – July 2013.

[2]. Mona A.Ahmed, Hala M.Ebied, El-Sayed M.El-Horbaty, Abdel-Badeeh M. Salem, "Palm Vein Preprocessing Image based on Homomorphic Filtering", International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 3, Issue 5, pp. 200-204, September-October 2014.

[3]. Mona A. Ahmed, El-Sayed M. El-Horbaty, Abdel-Badeeh M. Salem, "Intelligent Techniques for Matching Palm Vein Images", Egyptian Computer Science (ECS), Volume 39, No.1, pp. 1-14, January 2015.

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List of Abbreviations

Adaptive Resonance Theory	ART
Adaptive sequential floating forward search	ASFFS
Automatic Teller Machine	ATM
Central Asia Student International Academic	CASIA
Correct Recognition Rate	CRR
Data Encryption Standard	DES
Deoxyribonucleic Acid	DNA
Difference of Gaussian	DOG
Equal Error Rate	EER
Genuine Acceptance Rate	GAR
Identification	ID
Information System	IS
K-nearest neighbor	KNN
Light-Emitting Diodes	LEDs
Linear Vector Quantization	LVQ
Local Binary Patterns	LBPs
Local Derivative Patterns	LDPs
Localized Radon Transforms	LRT
Near-infrared	NIR
Personal Computer	PC
Principal Component Analysis	PCA
Region of Interest	ROI
Scale Invariant Feature Transform	SIFT
Vascular Pattern Extractor Algorithm	VPEA
Vascular Pattern Marker Algorithm	VPMA
Vascular Pattern Thinning Algorithm	VPTA
Visible Wavelength	VW

Chapter 1

Introduction

1.1 Problem Definition

The problem of truly identifying individuals in our society has become bigger in recent years, due to our complex, mobile and vastly interconnected information society. The most secure way of identifying people is said to be the verification/identificatoin of a concrete entity, inherently belonging to this person: something that he is or that he does. This is what biometrics is: the automated use of physiological or behavioral characteristics to determine or verify identity. The security of biometric identification has however been questioned, especially for established techniques like fingerprint verification. A relatively new biometric feature is the palm vein pattern. Many researchers are interested in biometric identification/verification methods and evaluate new biometric developments with regard to the technical and legal aspects of the method.

The palm vein is one of the most reliable physiological characteristics and relatively new physiological biometrics due to its uniqueness, permanence of the vascular pattern, stability and strong immunity to forge of vein pattern characteristics so that it can be used to distinguish between individuals.

The contactless palm vein authentication technology consists of image sensing and software technology. The palm vein sensor captures an infrared ray image of the user's palm. The lighting of the infrared ray is controlled depending on the illumination around the sensor, and the sensor is able to capture the palm image regardless of the position and movement of the palm.

The software then matches the translated vein pattern with the registered pattern, while measuring the position and orientation of the palm by a pattern matching method.

Palm vein recognition system consists of four key steps: Infrared palm images capture, Detection of Region of Interest (ROI) and pre-processing, palm vein pattern extraction, feature extraction and feature matching.

The thesis presents a study that based on achieving the last three steps of palm vein recognition system .This thesis introduce a new preprocessing algorithm for the enhancement of extract palm vein pattern. In addition, it conduct a comprehensive study that focuses on exploring and analyzing the efficiency of applying PCA, SIFT and LBPs algorithms to extract features from palm vein patterns and using K-nearest neighbor (KNN) classifier to compare their results.

1.2 Thesis Objectives

The goal of this thesis is present a new preprocessing algorithm to extract the region of interest (ROI) and enhancement the quilty of image to extract palm vein pattern and making comparison between most features extraction algorithms used in palm vein authentication system using K-Nearest Neighbor or K-NN classifier to decide the best one of them in recognition and the time takes to recognitions the person .

Palm vein recognition involves a training stage and a recognition stage. In training stage, features of the training samples are calculated and stored in a template database. In the recognition stage, features of the input vein are computed and then by using K-NN (Euclidean distance) matching classifier,

these features are compared with the stored template to obtain the recognition result.

1.3 Contribution

The thesis presents a study that based on making a preprocessing to palm vein images and used the preprocessing palm vein images to extract the features from it to achieving accurate classification for palm vein images enrolled on database.

The thesis presents a study that based on feature extraction and achieving accurate classification for palm vein. The thesis conducts a comprehensive study that focuses on exploring and analyzing the efficiency of applying PCA, LBP and SIFT algorithms with K-NN classifier.

1.4 Methodology

To achieve the goal of study first, it made a study on the palm vein database and select the database that is available and used before in the literature review this database is CASIA multi-spectral palmprint image database V1.0 (CASIA database).

Second, it made a brief study on the preprocessing , features extraction algorithms and the classification technique and choose the most used from it and the best one that outcome the best classification accuracy.

Third, it designed an algorithms used them in extract (ROI), preprocessing step and extraction of palm vein pattern using Dilation filter, Erosion filter, Homomorphic filter and canny edge detector.

Then it used the most three features extraction algorithms principal component analysis (PCA), scale invariant feature transform (SIFT) and