UNVERSITY TEKNIKAL MALAYSIA MELAKA

MODELING AND ANALYSIS OF SWINE SKIN BIOMETRICS FOUND ON LEATHER PRODUCTS

This report submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) (Hons.)

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ABSTRAK

Ciri-ciri fisiologi atau tingkah laku untuk mengenal pasti identiti mendakwa seseorang individu menentukan biometrik. Contoh ciri-ciri biometrik adalah muka, urat tangan, jari, tangan geometri, cetak sawit dan retina. Sistem biometrik adalah berdasarkan alat pengiraan untuk mengira rutin direkodkan dengan cara usul atau masih imej, dan alat-alat untuk merakam rutin penting fisiologi atau tingkah laku. Hasil projek ini, ia mempunyai ciri-ciri model yang berbeza terdapat pada kulit babi yang mempunyai kumpulan liang dan membangunkan teknik imej menangkap dan algoritma pengesanan matriks. Selain itu, terdapat tiga jenis sampel telah digunakan untuk analisis ini untuk memikirkan perbezaan ciri-ciri dan paten kulit. Malangnya Sistem Akses biometrik tidak boleh berfungsi seperti yang dijangkakan, terdapat masalah berlaku sepanjang projek ini. Untuk kerja-kerja masa depan adalah untuk membuat penambahbaikan ke atas Sistem Biometric Access. Satu tugas mencari algoritma pengiktirafan yang sesuai cip memori PIC dan sensor yang lebih sensitif dan sesuai untuk menjadi berkesan pada mengesan produk kulit.

ABSTRACT

Physiological or behavioral characteristics to identify the claimed identity of an individual define biometrics. Examples of biometrics characteristics are face, hand vein, fingerprint, hand geometry, palm print and retina. A biometric system is based on computational tools to compute the routines recorded by ways of motions or still images, and devices to record the indispensable physiological or behavioral routines. As a result for this project, it had model the distinct characteristics found on swine skin which had group of pores and developed the techniques of image capturing and the detection algorithms of matrixes. Besides, there were three types samples had been used for this analysis to figure out the differences of skins' characteristics and patents. Unfortunately the Biometric Access System cannot be functional as expected, there were problems occurred throughout this project. For the future work is to make improvement on the Biometric Access System. A task of finding suitable recognition algorithms of PIC memory chips and a more sensitive and suitable sensor to be effective on the detection of leather product.

DEDICATION

To my beloved family,

For my respectable lecturers

And not forgetting,

For my thoughtful and thorough supervisor and co-supervisor,

Thank you for being so supportive as well as my gratitude for the willingness to guide and to sacrifice the precious time of yours to put me through this.

May GOD bless all of you with full of happiness and the best of luck.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The usage of physiological or behavioral characteristics to identify the claimed identity of an individual defines biometrics. The examples of biometrics characteristics are face, hand vein, fingerprint, hand geometry, palm print and retina (Jain, Bolle, & Pankanti, 2005).

The thumb-print based biometric access system (BAS), shown in Figure 1, provides access to registered users. This experimental setup was created by a student for her final year project in 2011. The experiment conducted on 10 subjects consisted of 5 males and 5 females with an age spectrum of 20-year-old to 26-year-old, all of whom have had no trauma on the thumb. The subjects were needed to verify in by applying any one of the thumbs on the scanner. Once registered, the subject was assigned an identification number automatically generated by the system, denoted as an ID.

Figure 1: Hardware setup consists of an off-shelf-product (below) that was used to register a user, whose fingerprint data was saved in a PC system

1.2 PROBLEM STATEMENT

In Muslim country, swine is a non halal product theme. But nowadays, there are a lot of products such as wallet, shoes and others are made of animal skins as leathers around the world. The most common leathers are from cow, goat, snake, horse and others. With nowadays technology, swine animal also become one part of producing leather product. Besides, skin leather is difficult to identify and differentiate out which type of animal skin after the processes. Most of the users or people do not know how to figure out the differences of leather skin products and buy the leather product without noticeable and knowledgeable. In addition, there is no any equipment to identify the halal or non halal leather product. Hereby, create a system and equipment detection to prevent the non halal leather product from exporting to Muslim country.

The aspiration is to recognize the unlawful animal skin that is found on leather products. This is to answer the requirement of religion beliefs. For example, Islam prohibits a Muslim to use swine skin for any applications.

Using the BAS and additional tools, this project will propose characterization techniques that will define swine skin. Therefore, the niche of project will fall under the non Halal product theme.

1.3 OBJECTIVE

The objective of this project is to characterize swine skin presence on leather products.

1.4 SCOPE

This project will model the distinct characteristics found on swine skin and will propose generalized recognition algorithms. Therefore, the scopes of the project are:

i) Identification of the typical leather products made of swine skin;
ii) Design of image capturing techniques and detection algorithms;
iii) Development of the image capturing techniques and the detection algorithms;
iv) Assessment the efficiency of the image capturing technique and the detection algorithms.

CHAPTER 2

LITERATURE REVIEWS

2.1 INTRODUCTION

From the Greek words biometrics can be defined as *bios* means life hence *metron* means measure. Biometrics system works by recognising user based on their physical and behavioural characteristics. In general term, biometrics used alternatively to describe a characteristic or a process. As a characteristic definition, biometrics is a measurable biological including of anatomical and physiological, and also behavioural characteristics that can be used for automated recognition. As a process definition, biometrics is an automated method of recognising and individual based on measurable biological including anatomical and physiological, and also behavioural characteristics.

2.2 FINGERPRINT LIVENESS DETECTION BASED ON QUALITY MEASURES

A new fingerprint parameterization for liveness detection based on quality choices is presented as to comprehend that different sensors have different level of acquisition phases. Within the analysis and learnt vulnerabilities of finger print appreciation systems have led to an enhancement of the safety level offered by biometric systems (Galbally, Fierrez, Rodrigues-Gonzales, & Alonso-Fernandez, 2006). The liveness detection formulas are use to distinguish between real and false traits. It can broadly be divided into software-based methods and hardware-based methods. The software-based methods will be research to calculate the static and ever changing features for vitality detection by a new parameterization based on quality measurement in finger print liveness detection. Galbally, Fierrez, Rodrigues-Gonzales, & Alonso-Fernandez (2006) resolve the meaningful of parameterization will be properly reached to classified fingerprint real or false. Before than the category step, elect the absolute sensor that used in the acquisition and the final feature use as training data of the classifier the dataset. The finger print picture quality will be analyzed and assess by instrumented several choices which are ridge-strength choices which choices the energy concentration along the prevalent direction of ridges utilizing the intensity gradient, ridge-continuity choices which is computed as the average best difference of direction angle with the surrounding picture block and ridge-clarity choices which computed from the segmented foreground of gray level picture. The results consists of the category performance of each of the optimal subsets is computed on each of the datasets in terms of the Average category.

The Average Classification Error is the classification performance of each of the optimal subsets that computed on each of the datasets defined as ACE = (FAR + FRR) ÷ 2, defines the error, where the FAR (False Acceptance Rate) represents the percentage of false fingerprints misclassified as real, and the FRR (False Rejection Rate) computes the percentage of real fingerprints assigned to the false class (Lim, Jiang, & Yau, 2002). The acceptable sensor is importantly selected properly for the absolute feature subsets as the performance of parameters and abilities for a sensor to resolve the pictures perfectly been clarified. So the ridge strength, ridge continuity and ridge explain of a sensor is necessary to be tested out so that result absolute performance. Besides, the optimal feature subsets are additionally been experimental to show that the new parameterization is relationship to the static and everchanging features. The new parameterization of finger print for liveness detection based on quality decisions has been proposed. According to Galbally, Fierrez, Rodrigues-Gonzales, & Alonso-Fernandez (2006), this is to certify that the database of pictures to be robust to the multi-sensor scenario, properly classifying through 93% of fingerprint pictures and to show the acquisition process is quicker and more convenient.

2.3 DATA ACQUISITION AND QUALITY ANALYSIS OF 3-DIMEMSIONAL FINGERPRINTS

There is a new technology of noncontact 3D fingerprint capture and processing for higher quality fingerprint data acquisition. Nowadays, fingerprint recognition is wisely applying in both forensic law enforcement and security applications involving personal identification. Traditional fingerprint acquisition is performed in 2D using contact methods which based on devices detect the geometric difference between contact and noncontact parts of the finger on the device. AFIS is automatic fingerprint identification system consist of four modules: image acquisition, pre-processing, feature extraction, and feature matching. The system is based on the performance of module and higher matching will be achieved if fingerprint quality is sufficiently high. A noncontact 3D scanning system will be developed to employ structured light illumination (SLI), the processing of these scans is then performed to virtually extract the finger and palm surfaces, and create 2D flat equivalent images. Flashscan3D LLC sensor will be used for this study. The algorithm for fingerprint scanning is phase measuring profilometry (PMP) which originally from the classical optical interferometry techniques. The PMP technique uses fewer frames for a given precision. PMP projects shifted sine wave patterns and captures a deformed fringe pattern for each shift. There are two ways to develop an AFIS system using 3D fingerprints which are 3D image based and 2D flat equivalent image based. The 3D process as the acquired print is dependent on the fingerprint ridge depth variation. The original 3D data is then unraveled by flattening the tube. The ridge information of the fingerprint is extracted from the unraveled 3D surface. Ridge depth is converted to gray level which contains the similar ridge information as in 2D inked fingerprint as well as other information like pores on the finger and height of ridges.

The NIST Fingerprint Image Software (NFIS) is a public domain source code distribution including several packages for fingerprint quality purpose system which are pattern classification system (PCASYS), minutiae detection system (MINDTCT) and fingerprint image quality system (NFIQ). Some quantitative measures will be developing for evaluating the performance of the presented 3D fingerprint scanning and processing. Statistical metrics including overall image quality, local image quality, minutiae quality, and classification confidence number and conventional 2D plain fingerprints with a Cogent CSD450 2D fingerprint scanner will be used to perform scanner evaluation. Both sets of data will compare by using NIST software. The 2D and 3D plain fingerprints will be processed and analysis with the three NIST components: PCASYS, MINDTCT and NFIQ. The results show that all the statistical metrics can be generated by the NIST software, for traditional 2D fingerprint quality evaluation and evaluate the quality of unraveled fingerprints obtained from the 3D scans. The scanner performance can be quantified by the scanned image quality. Higher quality of scans will lead to a superior performance of fingerprint recognition systems. 3D and 2D fingerprints almost have the same confidence number for best quality images. In conclusion, using the NIST software, new non-contact 3D approach provides the superior performance in terms of the number of high quality features. The future work will be proceed base on registration fingerprints with 2D and 3D images and improve the ridge depth precision of cameras and lens distortion correction (Wang, Hao, Fatehpuria, Hassebrook, & Lau, 2009).

2.4 BIOMETRIC SYSTEMS

A sample acquired from sensor is a biometric measure presented by a user and captured by the data collection subsystem as an image or signal. The sample will be stored in storage unit and transmitted. This is important as the accuracy of the sensor used to pick up the sample of biometric data need to be evaluated. During the sample pick up phase, the inherent biometric characteristics are displayed to the sensor. The signal processing module represents the core of the system is composed by sub modules implementing pre-processing functions (image filtering and enhancement), the feature extraction, and the matching between two features. The biometric systems used to store only a mathematical representation of the information extracted from the presented sample by the signal processing module that use to construct or compare against enrolment templates samples of the biometric feature. Then a transmission process is implemented to transmit the collected data to the signal processing section. During this transmission, some non desired effects are presented and would be taken into consideration. In particular, the channel effect is defined as the changes imposed upon the presented signal in the transduction and transmission process due to the sampling, noise, and frequency response characteristics of the sensor and transmission channel.

There are attributes of a biometric system that can be identify as uniqueness, universality, permanence, measurability, user friendliness, acceptability, and circumvention. Uniqueness refers to an identical feature should not appear in two different people, Universality means that the feature type is present/occurs in as many people as possible. The Permanence property is the requirement that the feature not change over time. Measurability concerns the possibility to measure the feature with technical instruments. User friendliness requires the measure is easy and comfortable to be done. Acceptability refers to the people's acceptance of the measure in daily lives. Circumvention concerns the toughness to deceive the system by fraudulent methods. There are two configurations in biometric system which is identification and verification. Identification is the acquired and processed biometric feature that compared to all biometric templates stored in a system. Verification means that the user enters her/his identity into the system and a biometric feature is scanned.

2.5 QUALITY ASSESSMENT OF BIOMETRIC SYSTEMS: COMPREHENSIVE PERSPECTIVE BASED ON ACCURACY AND PERFORMANCE MEASUREMENT

Accuracy of measurements evaluates the result of a measurement that applied the system on a standardized database. The accuracy is given by indexes evaluated using the concept of error. The second source of uncertainty need to be considers which may affect the overall accuracy. Here are the steps to compute the accuracy performance of the systems defining the proper indexes.

A. Step 1: Enrollment

The templates are computed and stored on disk. The presence of errors is monitored by using an index named REJ_{ENROLL}, this phase is the rejection ratio due to fail, timeout and algorithm crash processing situations.

B. Step 2: A General Matching Score Computation

For symmetric and asymmetric matching functions, each biometric template is matched against the biometric sample will stored in a matrix called genuine matching scores (GMS) and imposter matching scores (IMS). GMS refers to the matching that computed between samples of the same identity certified individually. IMS is the matching values of samples of different individuals. The result of GMS and IMS matrix values are compared and evaluated.

C. Step 3: Accuracy Indexes

The errors of the matching algorithms that consider single comparisons of a submitted sample against a single enrolled template may be found. The rates are false match rate, FMR (t) and false nonmatch rate, FNMR (t). They are functions of the threshold value **t** used to compare the matching value to make the decision. The probability of FMR for a sample will be falsely declared to match a single randomly selected template (false positive). The probability of FNMR for a sample will be falsely declared not to match a template of the same measure from the same user supplying the sample (false negative). The evaluation of the overall accuracy level of a biometric system is evaluated by considering two error plots; the first is the receiving operating curve (ROC). The ROC is a graphical plot of the fraction of true positives versus the fraction of false positives for a binary classifier system as its discrimination threshold is varied. The second is the plot of FNMR versus FMR in a logarithmic chart, called the detection error trade off (DET) plot. The DET plot can be used to directly compare biometric systems. The purpose of these two plots is needed in order to directly compare biometric systems, the FNMR and FMR errors of the systems plotted in the DET plot must be evaluated on the same dataset. The equal error rate (EER) is need to be considered as it is computed as the point where FMR (t) = FNMR (t) and the score distributions often interpolated by the quantized data. (M. Gamassi, 2005)

2.6 MULTIMODAL BIOMETRIC PERSON RECOGNITION SYSTEM BASE ON FINGERPRINT & FINGER KNUCKLE PRINT USING CORRELATION FILTER CLASSIFIER

Biometric system is essentially an automatic pattern recognition system that recognizes a person by determining the authenticity of their specific characteristics possessed by that person. There are problems like noise in the sensed biometric data, non-universality and lack of distinctiveness of the chosen biometric trait lead to unacceptable error rates in recognizing a person. A robust multi-biometric identification system integrates two biometric modalities: *FKP* (Finger Knuckle Print) and *FP* (Fingerprint) features of an individual for identification purposes. A fingerprint refers to the flow of ridge patterns in the tip of the finger. The ridge flow exhibits anomalies in local regions of the fingertip, and it is the position and orientation of these anomalies that are used to represent and match fingerprints. The image-pattern formation of a *FKP* trait recognizes a person based on the knuckle lines and the textures in the outer finger surface. The line structures and finger textures are stable and remain unchanged throughout the life of an individual. Uni-modal biometric identification system based on *FKP* modalities using correlation filter classifier and consists of preprocessing, matching, normalization and decision process showed at figure 2.1. Modality (*FKP* and *FP*) identification with correlation filters is performed by correlating a test image (transformed into the frequency domain via a discrete Fast Fourier Transform (*FFT*)) with the designed filter (enrollment) and the output correlation is subjected to an Inverse Fast Fourier transform (*IFFT*).

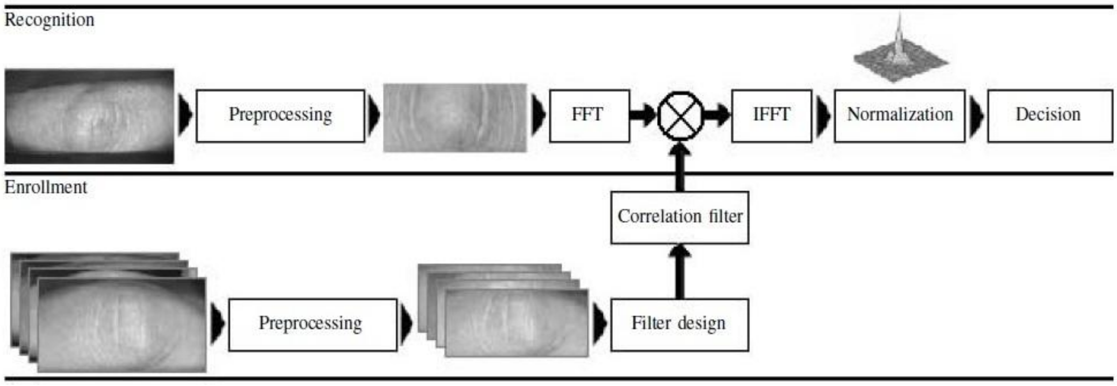

Figure 2.1: The block-diagram of the proposed uni-biometric identification system based on minimum average correlation energy. (Abdallah Meraoumia, 2012)

Matching Module (Correlation filtering)

a) MACE filter formulation ($H = D^{-1}X(X^{+}D^{-1}X)^{-1}u$)

To increase produces sharp peaks at the origin of the correlation plane. *D* is a diagonal matrix of size $d \times d$, (d=no of pixels), X is matrix size, N is number of training images and + is complex conjugate (X = N x d). *u* is column vector of size N.

b) UMACE Filter Formulation ($H = D^{-1}X$)

Minimizes the average correlation energy over a set of training images and maximizes the peak height at the origin of the correlation plane.

c) Matching process

For each class a single MACE (UMACE) filter is synthesized. Once the MACE (UMACE) filter $H(u, v)$ has been determined, the input test image $f(x, y)$ is cross correlated with it in the following manner:

$$c(x, y) = IFFT\{FFT(f(x, y)) * H^{+}(u, v)\}$$

d) Similarity Measurement

Maximum peak size used to measure the similarity for image matching; the peak-to-sidelobe ratio (*PSR*) of parameter is used as a performance measure for the sharpness of the correlation peak.

In conclusion, *FP* and *FKP* are integrated in order to construct an efficient multi-biometric recognition system based on matching score level and image level fusion by minimize average correlation energy (*MACE*) and Unconstrained *MACE* (*UMACE*) filters in conjunction with two correlation plane performance measures, max peak value and peak-to-sidelobe ratio, to determine the effectiveness of this method. Final experimental results showed that the designed system achieves an excellent recognition rate and high resolution fingerprint database.

2.7 SEQUENTIAL FUSION OF DECISIONS FROM ADAPTIVE AND RANDOM SAMPLES FOR CONTROLLED VERIFICATION ERRORS

This is about the reliability performance of biometric identity verification systems from intra-class variability and inter-class similarity. Intra-class variability is caused when individual samples of the same person are not identical for each presentation and interclass similarity arises from high degree of identicalness of the same biometric trait between different persons. These limitations bring the misclassification of the verification claims resulting in false alarms and false rejects