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Detection and Rectification of Distorted Fingerprints

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ABSTRACT
One of the open come outs in fingerprint confirmation is the lack of robustness against image quality degradation. Poor-quality images result in specious and missing features, thus degrading the performance of the overall system. Therefore, it is very important for a fingerprint acknowledgement system to estimate the quality and validity of the captured fingerprint images. Also the elastic distortion of fingerprints is one of the major causes for false non-match. While this problem impacts all fingerprint acknowledged applications, it is especially unsafe in negative recognition applications, such as watch list and reduplication applications. In such applications, malicious users may purposely distort their fingerprints to elude identification. In the existing approaches by matching the different dataset by plotting Rigid Core Delta point to be specified as the finger print recognition. In this paper, we proposed novel algorithms to detect and rectify skin distortion based on a individual fingerprint image. In this process the detection is based on the patches based approaches. In these approaches the patches is defined as the rectangular position the distortion is not detected at the specified fingerprint. The patches size is varied the distortion is detection and a SVM classifier is prepared to perform the classification task. Distortion rectification (distortion field estimation) is considered as a regression problem, where the input used is a distorted fingerprint and the output is the distortion less field.

Keywords: *fingerprint, delta point, SVM, Matlab*

1. INTRODUCTION

1.1 GENERAL

The term digital image refers to processing of a two dimensional picture by a digital computer. In a broader context, it implies digital processing of any two dimensional data. A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency, slide, photograph or an X-ray is first digitized and stored as a matrix of binary digits in computer memory. This digitized image can then be processed and/or displayed on a high-resolution television monitor. For display, the image is stored in a rapid-access buffer memory, which refreshes the monitor at a rate of 25 frames per second to produce a visually continuous display.

1.1.1 THE IMAGE PROCESSING SYSTEM

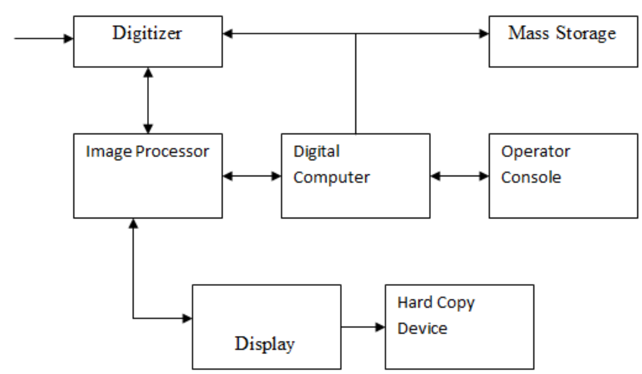


Figure 1: Block Diagram for Image Processing System

DIGITIZER

A digitizer converts an image into a numerical representation suitable for input into a digital computer. Some common digitizers are

1. Microdensitometer
2. Flying spot scanner
3. Image dissector
4. Videocon camera
5. Photosensitive solid- state arrays.

IMAGE PROCESSOR

An image processor does the functions of image acquisition, storage, preprocessing, segmentation, representation, recognition and interpretation and finally displays or records the resulting image. The following block diagram gives the fundamental sequence involved in an image processing system.

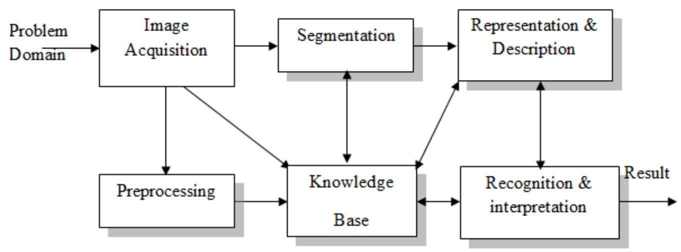


Figure 2: Block Diagram of Fundamental Sequence Involved In an Image Processing System

As detailed in the diagram, the first step in the process is image acquisition by an imaging sensor in conjunction with a digitizer to digitize the image. The next step is the preprocessing step where the image is improved being fed as an input to the other processes. Preprocessing typically deals with enhancing, removing noise, isolating regions, etc. Segmentation partitions an image into its constituent parts or objects. The output of segmentation is usually raw pixel data, which consists of either the boundary of the region or the pixels in the region themselves. Representation is the process of transforming the raw pixel data into a form useful for subsequent processing by the computer. Description deals with extracting features that are basic in differentiating one class of objects from another. Recognition assigns a label to an object based on the information provided by its descriptors. Interpretation involves assigning meaning to an ensemble of recognized objects. The knowledge about a problem domain is incorporated into the knowledge base. The knowledge base guides the operation of each processing module and also controls the interaction between the modules. Not all modules need be necessarily present for a specific function. The composition of the image processing system depends on its application. The frame rate of the image processor is normally around 25 frames per second.

- **DIGITAL COMPUTER**
  Mathematical processing of the digitized image such as convolution, averaging, addition, subtraction, etc. are done by the computer.
- **MASS STORAGE**
  The secondary storage devices normally used are floppy disks, CD ROMs etc.
- **HARD COPY DEVICE**
  The hard copy device is used to produce a permanent copy of the image and for the storage of the software involved.
- **OPERATOR CONSOLE**
  The operator console consists of equipment and arrangements for verification of intermediate results and for alterations in the software as and when require. The operator is also capable of checking for any resulting errors and for the entry of requisite data.

1.1.2 IMAGE PROCESSING FUNDAMENTAL

Digital image processing refers processing of the image in digital form. Modern cameras may directly take the image in digital form but generally images are originated in optical form. They are captured by video cameras and digitalized. The digitalization process includes sampling, quantization. Then these images are processed by the five fundamental processes, at least any one of them, not necessarily all of them.

IMAGE PROCESSING TECHNIQUES

This section gives various image processing techniques

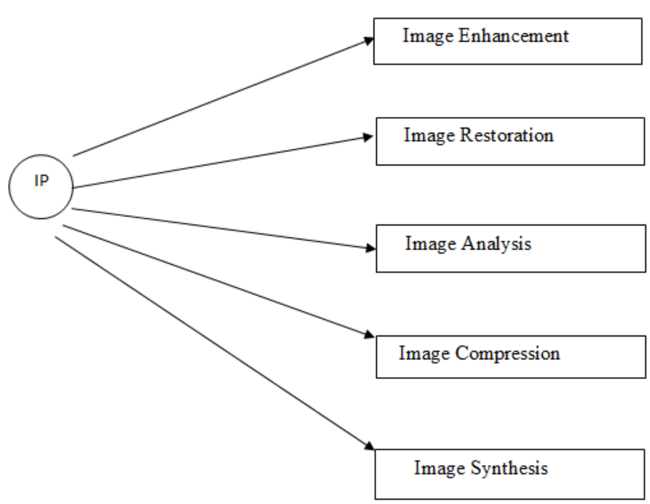


Figure 3 : Image Processing Techniques

IMAGE ENHANCEMENT

Image enhancement operations improve the qualities of an image like improving the image's contrast and brightness characteristics, reducing its noise content, or sharpen the details. This just enhances the image and reveals the same information in more understandable image. It does not add any information to it.

IMAGE RESTORATION

Image restoration like enhancement improves the qualities of image but all the operations are mainly based on known, measured, or degradations of the original image. Image restorations are used to restore images with problems such as geometric distortion, improper focus, repetitive noise, and camera motion. It is used to correct images for known degradations.

IMAGE ANALYSIS

Image analysis operations produce numerical or graphical information based on characteristics of the original image. They break into objects and then classify them. They depend on the image statistics. Common operations are extraction and description of scene and image features, automated measurements, and object classification. Image analyze are mainly used in machine vision applications.

IMAGE COMPRESSION

Image compression and decompression reduce the data content necessary to describe the image. Most of the images contain lot of redundant information, compression removes all the redundancies. Because of the compression the size is reduced, so efficiently stored or transported. The compressed image is decompressed when displayed. Lossless compression preserves the exact data in the original image, but Lossy compression does not represent the original image but provide excellent compression.

IMAGE SYNTHESIS

Image synthesis operations create images from other images or non-image data. Image synthesis operations generally create images that are either physically impossible or impractical to acquire.

APPLICATIONS OF DIGITAL IMAGE PROCESSING

Digital image processing has a broad spectrum of applications, such as remote sensing via satellites and other spacecrafts, image transmission and storage for business applications, medical processing, radar, sonar and acoustic image processing, robotics and automated inspection of industrial parts.

MEDICAL APPLICATIONS

In medical applications, one is concerned with processing of chest X-rays, cineangiograms, projection images of transaxial tomography and other medical images that occur in radiology, nuclear magnetic resonance (NMR) and ultrasonic scanning. These images may be used for patient screening and monitoring or for detection of tumors' or other disease in patients.

SATELLITE IMAGING

Images acquired by satellites are useful in tracking of earth resources; geographical mapping; prediction of agricultural crops, urban growth and weather; flood and fire control; and many other environmental applications. Space image applications include recognition and analysis of objects contained in image obtained from deep space-probe missions.

COMMUNICATION

Image transmission and storage applications occur in broadcast television, teleconferencing, and transmission of facsimile images for office automation, communication of computer networks, closed-circuit television based security monitoring systems and in military communications.

RADAR IMAGING SYSTEMS

Radar and sonar images are used for detection and recognition of various types of targets or in guidance and maneuvering of aircraft or missile systems.

DOCUMENT PROCESSING

It is used in scanning, and transmission for converting paper documents to a digital image form, compressing the image, and storing it on magnetic tape. It is also used in document reading for automatically detecting and recognizing printed characteristics.

DEFENSE/INTELLIGENCE

It is used in reconnaissance photo-interpretation for automatic interpretation of earth satellite imagery to look for sensitive targets or military threats and target acquisition and guidance for recognizing and tracking targets in real-time smart-bomb and missile-guidance systems.

PROJECT DESCRIPTIONS:

The Goal of the Project a distorted fingerprint can be thought of being generated by applying an unknown distortion field d to the normal fingerprint, which is also unknown. If we can estimate the distortion field d from the given distorted fingerprint, we can easily rectify it into the normal fingerprint by applying the inverse of d. So we need to address a regression problem, which is quite difficult because of the high dimensionality of the distortion field (even if we use a block-wise distortion field). In this paper, a nearest neighbor regression approach is used for this task. The proposed distorted fingerprint rectification algorithm consists of an offline stage and an online stage. In the offline stage, a database of distorted reference fingerprints is generated by transforming several normal reference fingerprints with various distortion fields sampled from the statistical model of distortion fields. In the online stage, given a distorted input fingerprint, we retrieve its nearest neighbor in the distorted reference fingerprint database and then use the inverse of the corresponding distortion field to rectify the distorted input fingerprint.

2. SYSTEM ANALYSIS

In Existing System, Distortion detection is believed as a two class classification problem, where the registered ridge orientation map and period map of a particular fingerprint are utilized as the feature vector and a classifier is trained to execute the classification task. Distortion correction (or equivalently distortion field estimation) is considered as a regression problem, the input is a distorted fingerprint and the output is the distortion field. To solve this problem, a database of several distorted reference fingerprints and accompanying distortion fields is made in the offline stage, and then in the online stage, the closest neighbor of the input fingerprint is found in the database of distorted reference fingerprints and the corresponding distortion field is used to correct the input fingerprint. They require special force sensors or fingerprint sensors with video capturing capability. They cannot detect distorted fingerprint images in existing fingerprint databases. They cannot detect fingerprints distorted before pressing on the sensor. However, allowing larger distortion in matching will inevitably result in higher false match rate. For example, if we increased the bounding zone around a minutia, many non-mated minutiae will have a chance to get paired. In addition, allowing larger distortion in matching will also slow down the matching speed.

In Proposed System was evaluated based on finger level. At the finger level, we estimate the performance of differentiating between natural and changed fingerprints. It is based on the patches based classifications. When the patches length is varied on the threshold value is to be defined as a distorted fingerprint. When the patches length is based on the threshold value is to be defined as the distortion less fingerprint. This is based on the characteristics extracted from the orientation field and minutiae perform. SVM classifier is prepared to perform the classification task. Distortion rectification (distortion field estimation) is considered as a regression problem, where the input used is a distorted fingerprint and the output is the distortion less field. The proposed algorithm is based on the characteristics extracted from the orientation field and minutiae perform or satisfy the three required requirements for alteration detection algorithm: 1) speedy operational time, 2) Huge true positive rate at small false positive rate, and 3) Ease of integration into AFIS.

Fingerprint rectification algorithm consists of an offline stage and an online stage. In the offline stage, a database of distorted reference fingerprints is generated by transforming several normal reference fingerprints with various distortion fields sampled from the statistical model of distortion fields.

The proposed distortion rectification algorithm by performs well by performing matching experiments on various databases.

The proposed algorithm can improve recognition rate of distorted fingerprints evidently.

3. SYSTEM IMPLEMENTATION MODULES

- Detect distorted fingerprints
- Extracted Distorted Fingerprint
- fingerprint Verification algorithm
- distorted fingerprint rectification algorithm

3.1 Detect distorted fingerprints

Fingerprint distortion detection can be considered as a two class classification problem. We have used the registered ridge orientation map and period map as the feature vector, which is further classified by SVM classifier. An input fingerprint image which is provided is normalized by cropping or cutting a rectangular region of the input image fingerprint, which is located at the center of the fingerprint and aligned along with the longitudinal direction of the fingerprints, using the NIST Biometric Image Software (NBIS). This step insures that the features extracted in the subsequent steps are invariant with respect to translation and rotation of finger. The orientation field of the fingerprint is estimated using the gradient-based method. The starting orientation field is smoothed moderating filter, followed by moderating the orientations in pixel blocks. A foreground mask is earn by measuring the dynamic range of gray values of the fingerprint image in local blocks and morphological process for filling holes and removing isolated blocks is performed. The orientation field is near by a polynomial model to obtain. The error map is counted as the absolute difference in-between and used to construct the feature vector.

3.2 Extracted Distorted Fingerprint:

To extract Distorted based on the Patches Conversion. The fingerprint images is Converted into the block based representation. Each and every block is Varied depends upon the threshold values is based on the distorted fingerprint. The block is not varied upon the threshold values it is defined as the distortion less fingerprint. And the based on the each block to extraction distortion part.

3.3 Fingerprint Verification algorithm

The most widely used minutiae-based fingerprint matching method, In this methodology, a minutia in the fingerprint implies the ridge characteristics such as ridge ending or ridge bifurcation. Almost all the fingerprint recognition systems usage minutiae for matching. The abnormality observed in orientation field also noted that minutiae distribution of altered fingerprints often differs from that of natural fingerprints. On the basis of minutiae extracted from a fingerprint by the open source minutiae extractor in NBIS, a minutiae density map is composed by using the Parzen window method containing uniform kernel function.

3.4 Distorted fingerprint rectification algorithm

A distorted fingerprint can be thought of being generated by applying a strange distortion field to the normal fingerprint, which is also strange. If we can calculate the distortion field from the given distorted fingerprint, we can easily correct it into the normal fingerprint by applying the inverse of d. So we need to turn to a regression problem, which is quite hard because of the high dimensionality of the distortion field (although if we use a block-wise distortion field). We use nearest neighbor regression approach for this project.

4. SYSTEM DESIGN

4.1 SYSYTEM ARCHITECTURE DIAGRAM

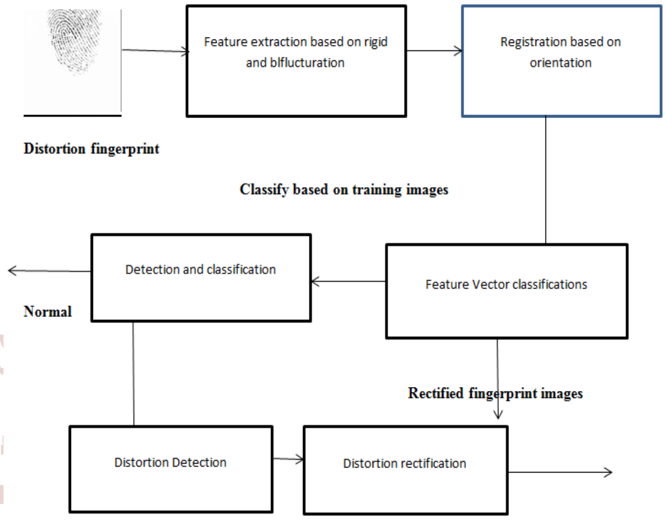


Figure 4: System Architecture Design

5. SYSTEM STUDY

5.1 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

5.1.1 ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

5.1.2 TECHNICAL FEASIBILITY

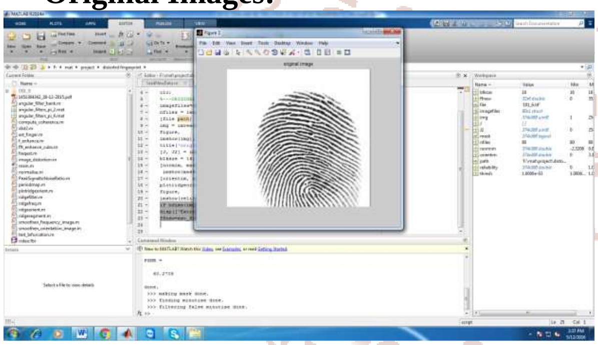
This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

5.1.3 SOCIAL FEASIBILITY

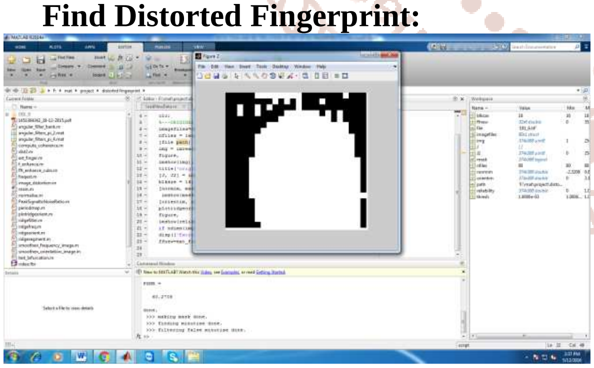
The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

6. SCREENSHOT

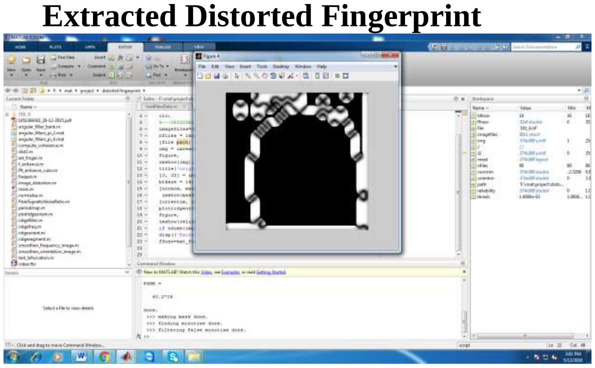
6.1 Original Images:



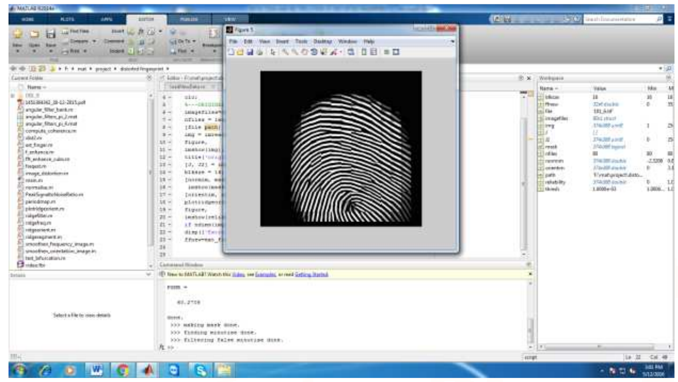
6.2 Find Distorted Fingerprint:



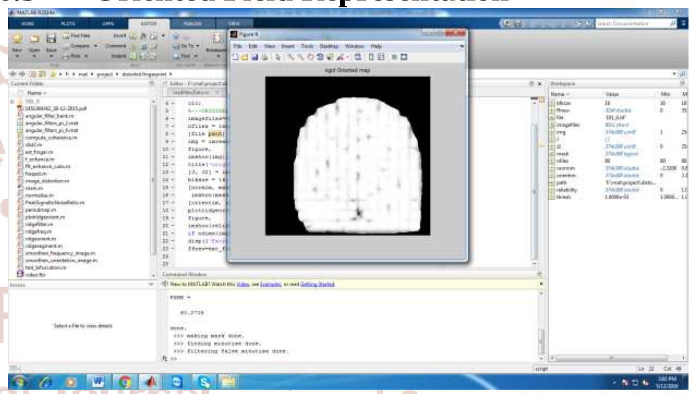
6.3 Extracted Distorted Fingerprint



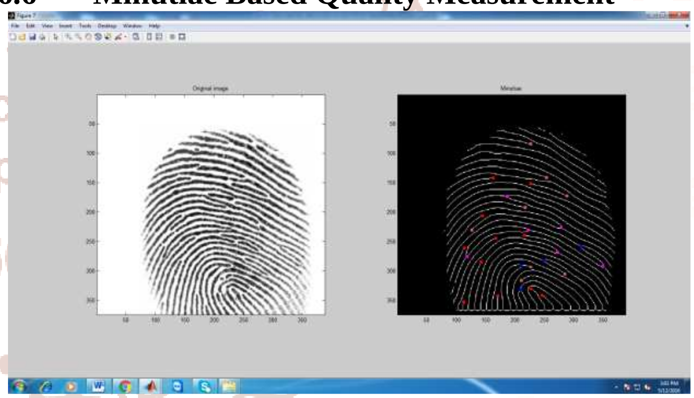
6.4 Rectify Distorted Fingerprint Based on the Patches



6.5 Oriented Field Representation



6.6 Minutiae Based Quality Measurement



7. CONCLUSION

False non-match frequency of fingerprint matchers is relatively high in severely distorted fingerprints. It creates a security hole in automatic fingerprint detection systems that could be used by criminals and terrorists. So, building up of fingerprint distortion scrutiny and reformation algorithms to fill the hole is a must. The paper illustrates a new distorted fingerprint detection and rectification algorithm. Distortion detection is done by the use of registered ridge orientation map and period map of a fingerprint as the feature vector, a SVM classifier is made to classify the input fingerprint as distorted or normal. In distortion rectification (or distortion field estimation), a nearest neighbor regression method is employed to anticipate the distortion field from the input distorted fingerprint , later the inverse of the distortion field is used to change the distorted fingerprint into a normal one. The experimental results on FVC2004 DB1, Tsinghua DF database, and NIST SD27 database show that the proposed algorithm can enhance rate of identification of distorted fingerprints unmistakably.

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