

# GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

## BIOMETRIC CRYPTOSYSTEM KEY GENERATION BY DIVIDE AND CONQUER METHOD

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### ABSTRACT

Traditional cryptography provides powerful mechanisms to achieve information security but suffers from the key management problems. Biometrics has been an alternative measure for user authentication and identification based on physiological and behavioral characteristics of persons but still suffers from various biometric variations (due to wear-and-tear, accidental injuries, malfunctions, and path physiological development), improper acquisition and inconsistent representation of the biometric signal. Then comes the biometric cryptosystem which blends the cryptography and biometrics to reflect the combined strength of the two fields along with wiping out some common drawbacks in them. The key is dynamically generated from the biometric data instead of storing somewhere and used for authentication or input to cryptographic algorithms. In this part we are explaining that how we can generate a cryptographic key from a finger print by simple distance base key generation method and using divide and conquer method.

**Keywords:** — Biometrics, Cryptography, Biometric Cryptosystem, Minutiae points, Image processing, , Divide and Conquer method

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### I. INTRODUCTION

#### Biometrics

The terms “Biometrics” and “Biometry” have been used since early in the 20th century to refer to the field of development of statistical and mathematical methods applicable to data analysis problems in the biological sciences. Statistical methods for the analysis of data from agricultural field experiments to compare the yields of different varieties of wheat, for the analysis of data from human clinical trials evaluating the relative effectiveness of competing therapies for disease, or for the analysis of data from environmental studies on the effects of air or water pollution on the appearance of human disease in a region or country are all examples of problems that would fall under the umbrella of “Biometrics” as the term has been historically used. The journal “Biometrics” is a scholarly publication sponsored by a non-profit professional society (the International Biometric Society) devoted to the dissemination of accounts of the development of such methods and their application in real scientific contexts.

Recently, the term “Biometrics” has also been used to refer to the emerging field of technology devoted to identification of individuals using biological traits, such as those based on retinal or iris scanning, fingerprints, or face recognition. Neither the journal “Biometrics” nor the International Biometric Society is engaged in research, marketing, or reporting related to this technology. Likewise, the editors and staff of the journal are not knowledgeable in this area.

#### Principals of finger print biometrics

A fingerprint is made of a number of ridges and valleys on the surface of the finger. Ridges are the upper skin layer segments of the finger and valleys are the lower segments. The ridges form so-called minutia points: ridge endings (where a ridge end) and ridge bifurcations (where a ridge splits in two). Many types of minutiae exist, including dots (very small ridges), islands (ridges slightly longer than dots, occupying a middle space between two temporarily divergent ridges), ponds or lakes (empty spaces between two temporarily divergent ridges), spurs (a notch protruding from a ridge), bridges (small ridges joining two longer adjacent ridges), and crossovers (two ridges which cross each other).

#### Cryptography

It is the practice and study of techniques for secure communication in the presence of third parties (called adversaries). More generally, it is about constructing and analyzing protocols that overcome the influence of adversaries and which are related to various aspects in information security such as data confidentiality, data

integrity, authentication, and non-repudiation. Modern cryptography intersects the disciplines of mathematics, computer science, and electrical engineering. Applications of cryptography include ATM cards, computer passwords, and electronic commerce.

### **Modern Cryptography**

Modern cryptography is a remarkable discipline. It is a cornerstone of computer and communications security, with end products that are imminently practical. Yet its study touches on branches of mathematics that may have been considered esoteric, and it brings together fields like number theory, computational-complexity theory, and probability theory. This course is your invitation to this fascinating field.

- Symmetric-key cryptography
- Public-key cryptography

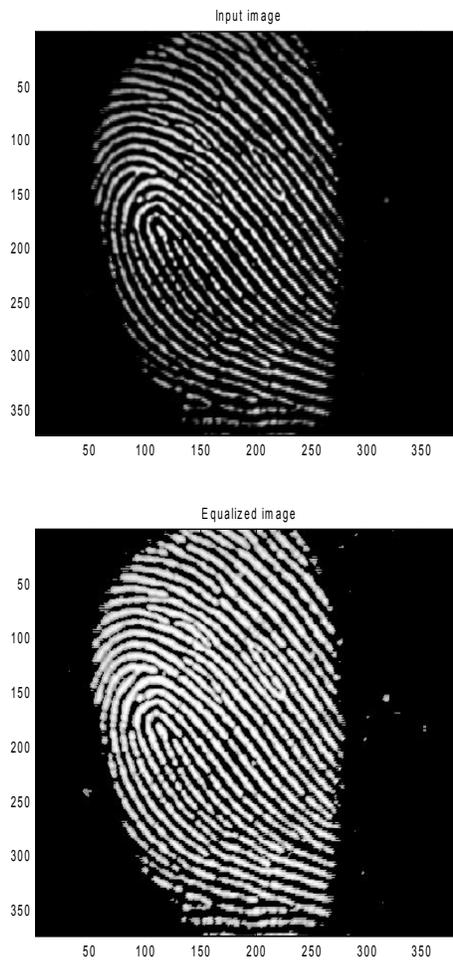
## **II. BIOMETRIC CRYPTOSYSTEM**

Despite of so many advantages, the Biometric systems also suffer from many drawbacks. Password-based authentication systems do not involve any complex pattern recognition techniques (passwords have to match exactly) and, hence, they almost always perform accurately as intended by their system designers. On the other hand, biometric signals and their representations (e.g., facial image and Eigen coefficients of facial image) of a person vary dramatically depending on the acquisition method, acquisition environment, user's interaction with the acquisition device, and (in some cases) variation in the traits due to various path physiological phenomena. Some of the common reasons for biometric signal/representation variations are- Inconsistent Presentation, Irreproducible Presentation and Imperfect Signal/Representational Acquisition. Biometric cryptosystem removes some common problems in the above two fundamental mechanisms and ensures the combined strength of the cryptography and biometrics. In such systems, while cryptography provides high and adjustable security levels, biometrics brings in no repudiation and eliminates the need to remember passwords or to carry tokens etc. There are different ways to achieve the bio crypto system:- Biometric based

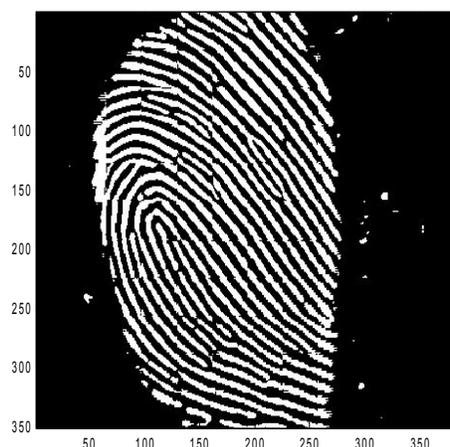
- Key release mode : In this mode the biometric template and the keys are stored as separate entities and the key is released only if the biometric matching is successful.
- Key binding mode: In this mode the key and the template are monolithically bound within a cryptographic frame work.
- Key generation : In this mode the key is derived directly from the biometric data and is not stored in the database.

## **III. MINUTIAE EXTRACTION**

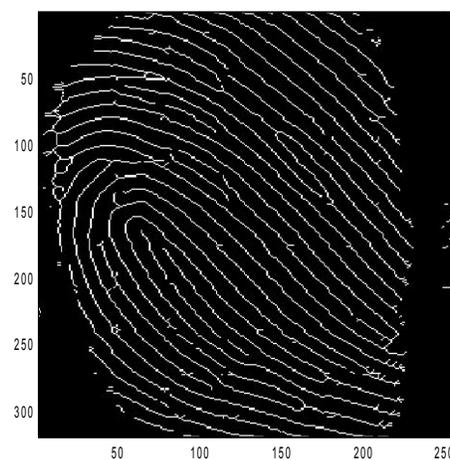
The minutiae points are extracted from the acquired fingerprint image through various image processing techniques. There are few steps to finding the exact number of minutiae from an image. First is to check that the image is RGB or not if it is RGB then we will have to convert it into gray. RGB to gray converts the RGB image to gray scale intensity image. It can be done by eliminating hue and the saturation information while retaining the luminance. To make the image more clear the image can be inverse. Then Histogram Equalization and Filters are used to enhance the contrast of an image. The Histogram Equalization block enhances the contrast of images by transforming the values in an intensity image so we will get the histogram of the output image which is approximately matches a specified histogram. Here shows you how to modify the contrast in intensity images using the Contrast Adjustment and Histogram Equalization.



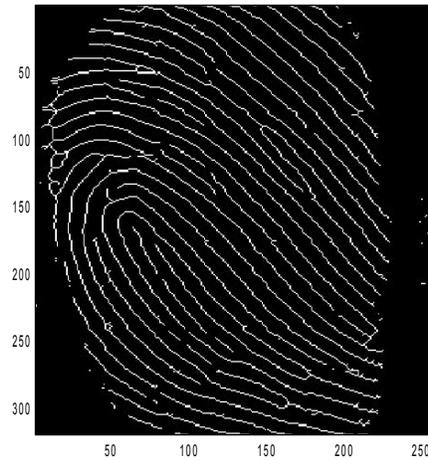
Here the above figure 1 is the input image and figure2 is the image after equalization. Both the images shows the changes in the input image and the equalized image as the figure 2 is more clear than the input image. Binarization is the process which has been performed after histogram equalization. This process is done to convert the grey level image into a binary image it enhance the contrast between the ridges and valleys in a fingerprint image. It Convert the image to binary image, based on threshold. Here we are taking two values as 1 is for the white and 0 for the black Therefore, a level value of 0.5 is between black and white, regardless of class. in this we will have to define the class or level If we do not specify level, it uses the value 0.5. Here the figure shows the process of binarization.



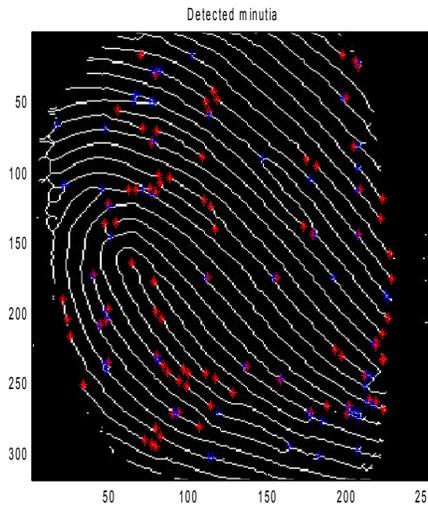
Morphological operation is used to find the region of interest. In region of interest (ROI) we are taking a portion of an image that we want to filter or perform some other operationon. We can define ROI by creating a binary mask. A binary mask is a binary image that is the same size as the image we want to process with pixels that define the ROI set to 1 and all other pixels set to 0. After the morphological operation process of ridge thinning can be done.



It is performed to eliminate the redundant pixels of ridges and eliminate it till the ridges are just one pixel wide, in each scan of full fingerprint image. After fingerprint ridge thinning minutiae points are more cleared and can be marked easily as shown in the figure. Thinning is the process to eliminate the redundant pixel but after this, still there is some noise is present in the image. To remove this noise and make the view of an image clearer we are performing the process of denoising. It is the process of removing noise and converting the image into double precision. It converts the intensity image into double precision so if the input image is of class double, the output image is identical. After removing the noise we get the clearer image of a finger print or we can say that to remove the false minutiae and make it more effective denoising is must. Here the image we get after denoising, in this all the minutiae's are shown clearly



After the process of denoising it is easy to detect the real minutiae's from the image. As all the minutiae's are now clearly shown so we can identify or detect the real minutiae's. These detected minutiae's are the actual number of minutiae which are present in a given image of fingerprint.

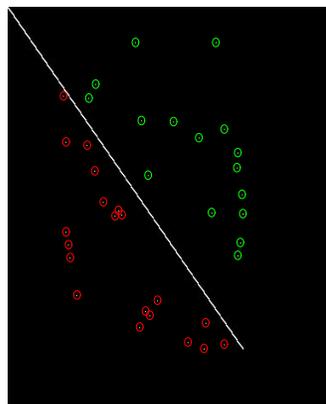


#### IV. PREVIOUS METHOD

After finding the number of minutiae in the image we have to divide the whole image in row and coluinatmns. To mark the minutiaes taking two coordinates called "x" and "y". Now finding the long distance minutiae or we can say that the farthest point from both the coordinates. Mark this point and draw the reference line as shown in the fig.



Now give the positions to the minutiae's above and below of this reference line. As the no. of minutiae's above or on the line is taken as "1" and the no. of minutiae's below this reference line is taken as "0". Count all the minutiae's and give the position according this reference line. For making it more clear mark the minutiae's with different color. As here all the minutiae's above the line are marked with green and all the no. of minutiae's below the line is marked as red as shown in the fig. Checking all the rows and columns and then appending all the "0" and "1" and find the key.



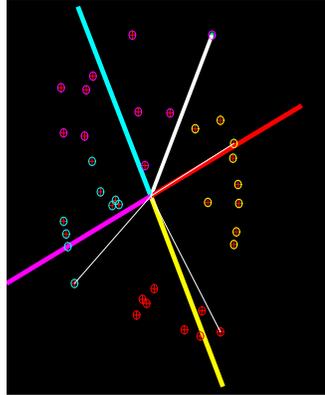
Drawback of this method is that it cannot work when the orientation of the image gets changed. Also it cannot give the results when the image gets displaced or we face the problem of scaling. In scaling the image either gets large or gets small, then its actual size. The problem of zoom in and zoom out come under this. At the time of authentication it creates problem as it cannot authenticate the same person if the image gets displaced and oriented. In bank each person has its own desktop to use. They use their fingerprint as login password at that time if there is any changes in the orientation of their fingerprint the system does not authenticate the same person as the key changes due to change in image(its orientation and position). This problem occurs because it generates different keys for the same person. If any changes found in the orientation, position or the size of the image, it will take it as new image and generate the key accordingly. The key stored in data base does not match and system does not authenticate the same person. So to remove this problem we are using method called divide and conquer.

## V. USING DIVIDE AND CONQUER METHOD

To remove the drawbacks of the previous method we are trying divide and conquer method. It includes the following steps:

1. Find out the number of minutiae's by minutiae extraction.
2. Find the furthest point from centroid Calculate distance with all points.
3. Find maximum, get the points and draw the line and then calculate angle.
4. Create 4 lines in four direction Define radius and coordinate of four points.

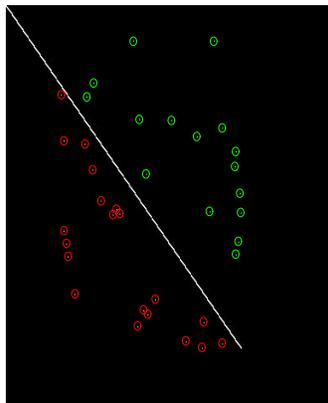
5. Divide points in for quadrant, calculate angle with centroid.
6. Find out maximum distance from centroid in every quadrant, for all quadrants.
7. Sort the points according to the distance from centroid. Sort the value.
8. Get the key in decimal.



## VI. RESULT

Key generation has been done from both the above mentioned methods and we get the keys in the decimal form. The previous method is about the reference and distance based and generates the different keys for the same image if its gets oriented, displaced. While the divide and conquer method is about dividing the whole image into coordinates and able to generate the key even if the image gets oriented and displaced from its original place. We are here using the 6 images of a fingerprint of a same person. Previous method gives the different keys for different images as the image changes the orientation get changed and it will generate a new key for every image, of the same person's finger print. To eliminate this drawback divide and conquer technique is used and will generate the same key for the same person even if the image changes its orientation.

Key generated by the previous method



Columns 1 through 12

0 0 0 0 0 0 0 1 0 1 0 0

Columns 13 through 24

0 0 1 0 1 0 1 0 0 1 0 1

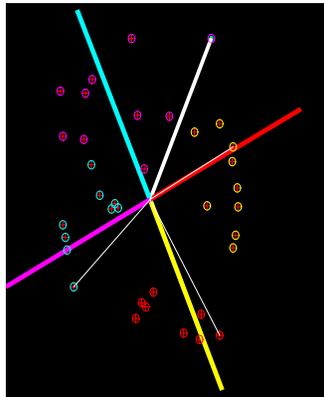
Columns 25 through 36

0 0 1 1 1 0 1 1 1 1 1 1

Decimal key

Ans = 6.8126e+10

Key generated by Divide and Conquer for the same image



Columns 1 through 12

1 0 0 0 0 0 0 1 1 0 1 1

Columns 13 through 24

1 1 0 0 0 0 0 0 0 0 0 0

Columns 25 through 36

1 1 0 1 1 1 1 1 1 1 1 1

Decimal key

Ans = 6.8636e+10

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