An Innovative Normalization Process by Phase Correlation Method of Iris Images For the block size of 32 ∗ 32

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ABSTRACT: *Biometric technology deals with recognizing the uniqueness of individuals based on their exclusive Physical or behavioral characteristics. The developments in science and technology have made it possible to use biometrics in application when it is required to establish (or) confirm the identity of persons. Amongst a range of method, Iris recognition is a hastily intensifying technique of biometric technology. A large range of identification methods is used either verify or decide the identity of person request their processes, This paper provides the inspiration for image acquisition, segmentation, normalization standed on the human being Iris imaging. A combination method is used to fragment the eye's digital image. The mined Iris region was then standardized by using Image registration method. A phase correlation method is installed for this Iris image registration principle. Investigational consequences demonstrate that our system is reasonably efficient and gives hopeful performance.*

Keywords : Image Registration, Segmentation, Normalization, Phase Correlation, Iris Recognization

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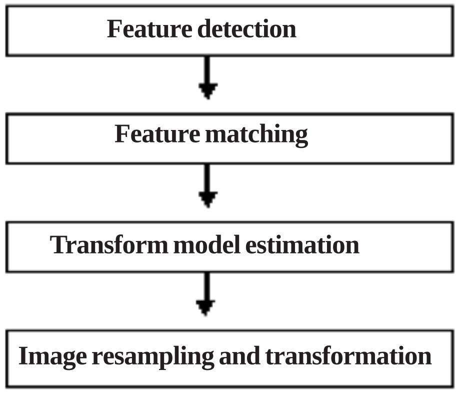
1. Introduction

Information security is concerned with the assurance of confidentiality, integrity and availability of information in all forms. Biometric technologies are the foundations of personal identification systems. It provides an identification based on a unique feature or characteristic possessed by the individual. Enrolment and identification are the two modes of operations. Among various techniques, iris recognition is a rapidly expanding method of biometric technology.

It has emerged as one of the most powerful and accurate identification techniques in the modern world. This work provides a walkthrough for image acquisition, image segmentation, image normalization, feature extraction and matching based on the Human Iris imaging. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. Segmentation of the iris texture from an acquired digital image is not always accurate, the image contains noise elements such as skin, reflection and eyelashes that must be located and removed.

2. Image Registration Techniques

Image registration is important in remote sensing, medical imaging, and other applications where images must be aligned to enable quantitative analysis or qualitative comparison. Using Image Processing Toolbox, the user can interactively select



points in a pair of images and align the two images by performing a spatial transformation, such as linear conformal, affine, projective, polynomial, piecewise linear, or local weighted mean.

Steps involved in Image Registration

• **Feature detection:** Salient and distinctive objects (closedboundary regions, edges, contours, line intersections, corners, etc) in both reference and sensed images are detected.

• **Feature matching:** The correspondence between the features in the reference and sensed image established.

• **Transform model estimation:** The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated.

• **Image resampling and transformation:** The sensed image is transformed by means of the mapping functions.

3. Iris Normalization

Registration is a fundamental task in image processing. It is used to align two or more pictures taken. In general, registration is done at different times, from different sensors, or from different viewpoints. Virtually all large systems, which evaluate images, require the registration of images or a closely related operation as an intermediate step. Specific examples of systems where image registration is a significant component include matching a target with a real-time image of a scene, for target recognition.

3.1 Registration Has Three Advantages

• It accounts for variations in pupil size due to changes in external illumination that might influence iris size.

• It ensures that the irises of different individuals are mapped onto a common image domain in spite of the variations in pupil size across subjects.

• It enables iris registration during the matching stage through a simple translation operation that can account for in-plane eye and head rotations.

4. Previous Methods of Normalization

In this section, we give some of the methods of normalization which were used in the previous literature.

4.1 Daugman's Rubber Sheet Model

An iris is localized by an integro-differential operator and unwrapped into a rectangular image; then a set of 2D Gabor filters were applied to the unwrapped image and the quantized local phase angles were used for iris encoding. The homogenous rubber sheet model (Daugman, 2007) remaps each point within the iris region to a pair of polar co ordinates (r, θ) where r is on the interval [0,1] and θ is angle in [0, 2 π]. The rubber sheet model takes into account pupil dilation and size inconsistencies in order to produce a normalized representation with constant dimensions.

4.2 Bole's Method

In the (Boles et al, 1998) system, iris images are first scaled to have constant diameter so that when comparing two images, one is considered as the reference image. Once the two irises have the same dimensions, features are extracted from the iris region by storing the intensity values along virtual concentric circles, with origin at the centre of the pupil. A normalized resolution is selected, so that the number of data points extracted from each iris is same.

This technique is essentially similar to Daugman's rubber sheet model but for minor differences. In this method, scaling is done during matching stage, and it is carried out relative to the comparing iris region, rather than scaling to some constant dimensions (Libor Masek, 2003).

4.3 Mapping Functions

The system proposed by Wildes et al (1994) employs an image registration technique, which geometrically warps a newly acquired image, $I_a(x, y)$ into alignment with a selected database image $I_d(x, y)$. When choosing a mapping function ($u(x, y)$,$v(x, y)$) to transform the original coordinates, the image intensity values of the new image are made to be close to those of corresponding points in the reference image. The mapping function must be chosen so as to minimize,

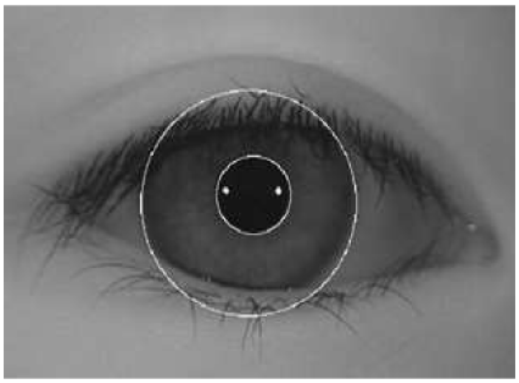


Figure 1.1 (a)

Figure 1.1 (b)

Figure 1.1 (c)

Figure 1.1 (d)

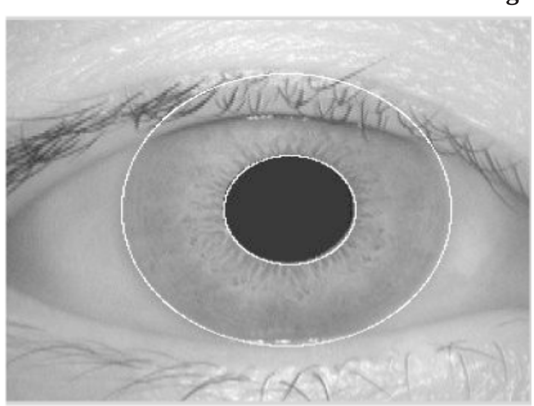


Figure 1.1 (e)

$$\iint (Id\,(x, y) I\ \ (x-u, y-v))^2\, dxdy$$

While being constrained to capture a similarity transformation of image coordinates (x, y) to (x', y') as follows,

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} x\,\iota \\ y\,\iota \end{bmatrix} - sR\ (\phi) \begin{bmatrix} x \\ y \end{bmatrix}$$

Where s is a scaling factor and R (Φ) is a matrix representing rotation by Φ. In implementation, given a pair of iris images Ia and Id, the warping parameters s and Φ are recovered via an iterative minimization procedure.

5. Motivation for Our Approach

The methods for Normalization mentioned in the previous sub section have some limitations along with some advantages.

Even though the homogenous rubber sheet model accounts for pupil dilation, imaging distance and non-concentric pupil displacement, it does not compensate for rotational inconsistencies. In the Daugman system, rotation is accounted for, during matching by shifting the iris templates in the θ direction until two iris templates are aligned, which has average efficiency in removing the noises (Libor Masek, 2003).

The method proposed in Boles et al, (1998) was based on calculating the zero crossings of the wavelet transform. These representations are stored as templates and are used for the matching algorithm. Though the wavelet transform has ability to eliminate the effect of glares due to reflection of the light source on the surface of the iris, the recognition results obtained were based on a very small number of images and testing was not as exhaustive and thorough (Miltiades Leonidou, 2002).

Wildes et al adopted the affine motion model to represent the motion between iris images. This registration method is time consuming and difficult to implement in practical systems (Miltiades Leonidou, 2002).

In all the methods proposed in (Ma L, et al, 2002 and Zhu.Y, et al, 2002), the global movements between iris images are represented using a simplified affine motion model. Thus, it only compensates linear iris deformation and registers iris images with pixel accuracy. In reality, it is not suited for iris recognition systems with high recognition rate. They consist of several steps namely, global correction of shift and rotation, location of landmark, their correspondences and image registration using second-order polynomial model and linear set of equations.

These disadvantages motivated as to look for a different method for normalization. We have employed phase correlation method along with mapping function, which is relatively new in this arena with a hope to overcome these limitations.

6. Approaches of Image Registration

Image registration essentially consists of the following steps Zitova et al, (2003).

• **Feature detection:** Salient and distinctive objects (closedboundary regions, edges, contours, line intersections, corners, etc) in both reference and sensed images are detected.

• **Feature matching:** The correspondence between the features in the reference and sensed image is established.

• **Transform model estimation:** The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated.

• **Image resampling and transformation:** The sensed image is transformed by means of the mapping functions.

After locating the iris using segmentation, we cannot encode the image directly as there will be noise present in the image. So, we should first carry out the calibration, i.e. each primitive image should be adjusted to the same size and corresponding position through normalization using image registration techniques.

Registration of an image can be carried out using different approaches (Wikipedia, Image Registration) such as

- Intensity-based vs feature-based
- Linear vs. nonrigid transformation models

- Spatial vs. frequency domain methods
- Single- vs. multi-modality methods
- Automatic vs. interactive methods

By considering the properties of the above classifications, we have implemented the normalization process which is feature based, linear and uses multi-modality and frequency domain methods. Our algorithm can be implemented in both automatic and interactive ways.

7. Phase Correlation Method- Our Approach

In image processing, phase correlation is a method of image registration and uses a fast frequency-domain approach to estimate the reliable translate offset between two similar images

7.1 Why Phase Correlation?

Unlike many spatial-domain algorithms, the phase correlation method is resilient to noise, occlusions, and other defects in images. This method can be extended to determine rotation and scaling differences between two images by first converting the images to log-polar coordinates. Due to properties of the Fourier transform, the rotation and scaling parameters can be determined in a manner invariant to translation

7.2 Principle of Phase Correlation

The mathematical principles of the phase correlation alignment method for measuring translation, rotation, and scaling were described by Jun-Zhou Huang et al, (2005). Let *Sk* (*n*1, *n*2) and *Sk* + 1 (*n*1, *n*2) be two images (represented by their pixel matrices) with a shift (*d*1, *d*2) between them. Then

$$Sk\ (n_1, n_2') = Sk + (n_1 + d_1, n_2 + d_2) \qquad (1)$$

The shift in the spatial domain is thus reflected as a space change in the frequency domain. We can obtain the complex valued cross-power spectrum expression,

$$C\,k, k+1(f_1, f_2) = Sk+1\,(f_1, f_2)\,Sk * (f_1, f_2) \qquad (2)$$

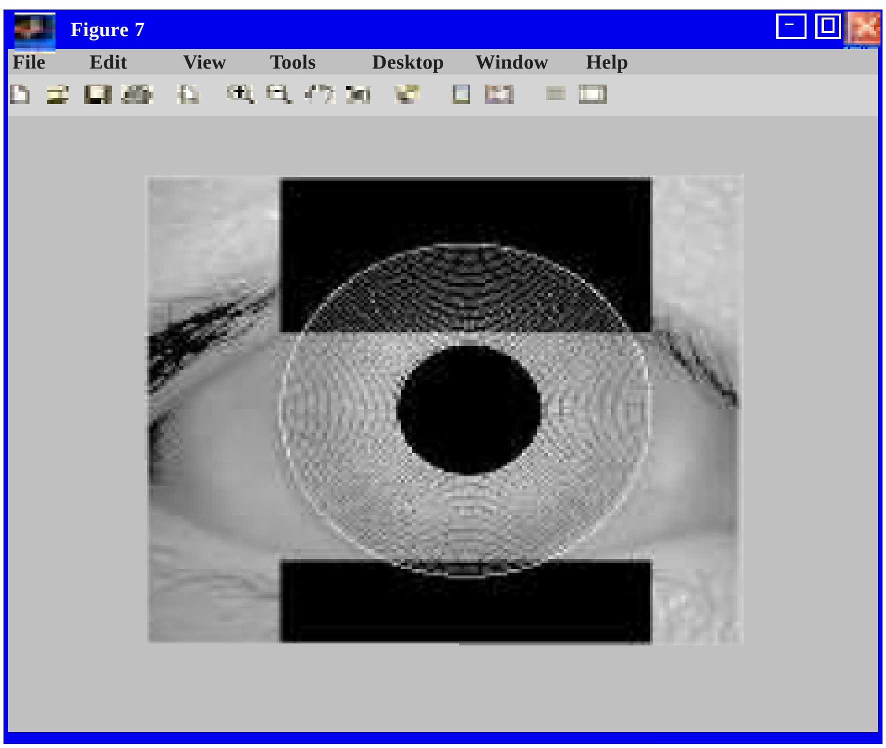


Figure 2.1 (a)

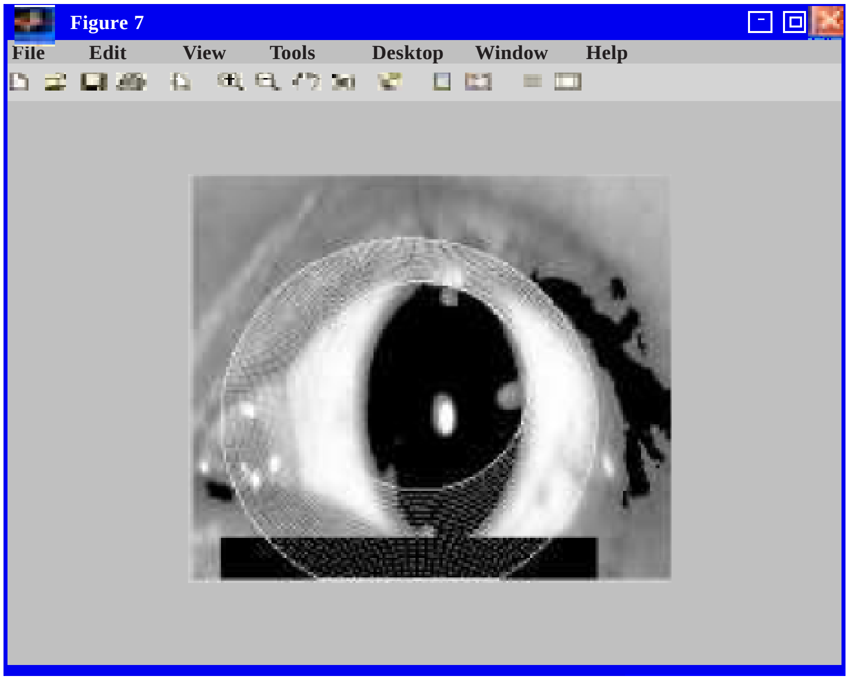


Figure 2.1 (b)

Figure 2.1 (c)

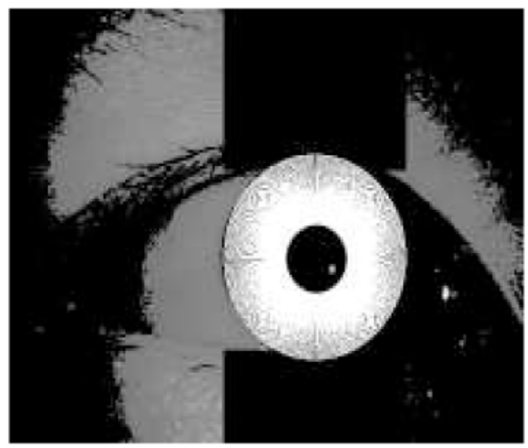


Figure 2.1 (d)

Where, $*$ denotes the complex conjugate. To reduce the influence of luminance variation, the right side of (2) is normalized as follows,

$$\phi C k, k+1 \,(f_1, f_2) = \frac{Sk+1(f_1, f_2)\, Sk * (f_1, f_2)}{|\, Sk+1(f_1, f_2)\, Sk * (f_1, f_2)\,|} \qquad (3)$$

From (1, 3) we can obtain the following equation,

$$C k, k+1(n_1, n_2) = \delta(n_1 + d_1, n_2 + d_2) \qquad (4)$$

Where, δ denotes the pulse function. The above equation indicates that if we confine the location pulse in the cross correlation map of two images, we could obtain the spatial displacement between them. One example of the cross correlation map is shown in Figure 3.1

Already phase correlation methods are used for the retinal images and finger print matching techniques. While considering retinal images, it is focused mainly on registration of images which suffers from diabetic retinopathy, where much pathology can disturb the registration process.

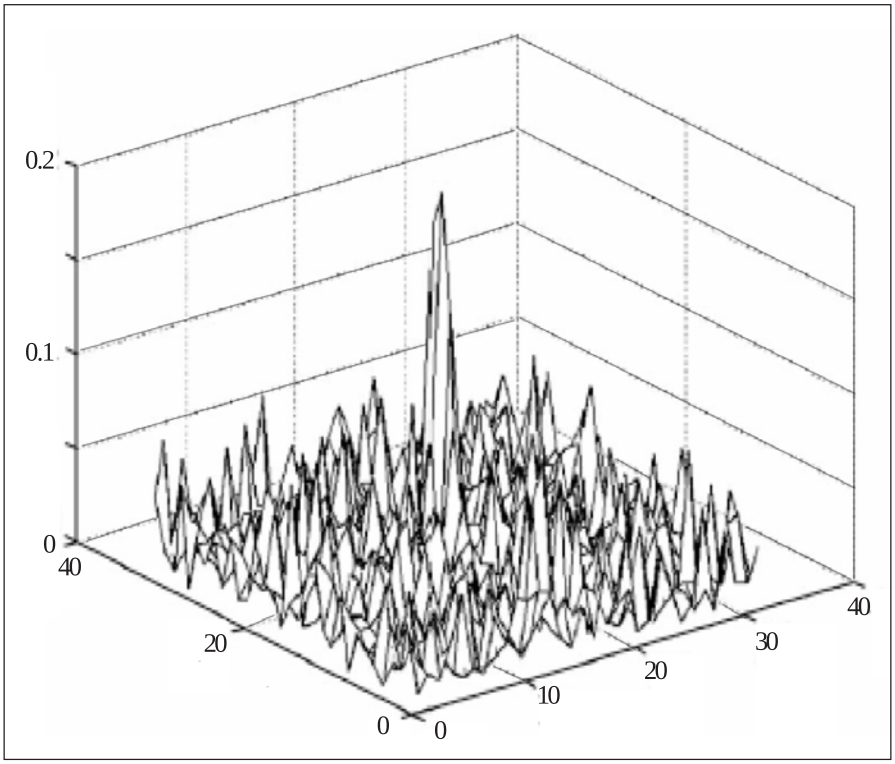


Figure 3.1

In (Jun-Zhou Huang et al, 2005) phase correlation is used for iris recognition. We have implemented this approach with some changes in the procedure.

Our Algorithm

For the most general case when images are of different scale, the algorithm for registration using phase correlation consists of the following steps (Druckmuller. M, 2009).

1) Computing the Fourier transform amplitudes of images $Sk\ (n_1, n_2)$ and $Sk + 1\ (n_1, n_2)$

2) Transforming the Fourier transform amplitudes to the polar coordinate system with a shift(d1,d2) between two images *Sk* and $Sk + 1$,

3) Measuring C and δ by means of phase correlation.

4) Applying the scaling factor $C - 1$ and rotation $- \delta$ on image $Sk\ (n_1, n_2)$, resulting in $S1\ (n_1, n_2)$.

5) By shifting the spatial domain, obtain the complexvalued cross-power spectrum expression. Where, $f1$ and $f2$ are frequencies.

6) The expression is normalized as $Ck, k + 1\ (n_1, n_2)$ and δ is obtained.

While using this algorithm for estimating the local motion between the two iris images Jun-Zhou Huang et al, (2005) divided the iris images in to a number of 16×16 blocks. Then they expanded each 16×16 block to a 32×32 block to perform phase correlation. But some computations are involved in this method to identify correct phase correlation peak because of this expansion.

Hence, we tried this same algorithm by taking blocks of size 32×32 instead of 16×16 for finding overlapping areas between two iris images taken at a time, to estimate iris local motion. This can accommodate larger rotational angles between iris images, i.e. and also reduces the computations mentioned above though the rate of acceptance may be affected to a small extent

8. Advantages of Proposed Method

Write the body of the paper here. Write the body of the paper The most remarkable property of the phase correlation method compared to the classical cross correlation method is the accuracy with which the correlation function can be detected. The phase correlation method provides a distinct sharp point of registration whereas the standard cross correlation yields several broad points and a main point whose maximum is not always exactly centered at the right point.

A second important property is due to whitening of the signals by normalization, which makes the phase correlation notably robust to those types of noise that are correlated to the image function, e.g., uniform variations of illumination, offsets in average intensity, and fixed gain errors due to calibration. This property also makes phase correlation suitable for registration across different spectral bands.

Using the convolution theorem, it can be shown that the method can also handle blurred images, provided that the blurring kernel is relatively invariant from one frame to another. One may, for instance, use this property to register images contaminated with wide-band additive noise, by taking the phase correlation in the low-frequency portion of the spectrum. In the discrete case, however, it is valid only if the shift vector is of integer values. Therefore, when applied to discrete images, the method would fail to detect non integer subpixel shifts.

Also, the phase correlation always contains a single coherent peak at the point of registration corresponding to signal power, and some incoherent peaks which can be assumed to be distributed normally over a mean value of zero. The amplitude of the coherent peak is a direct measure of the degree of congruence between the two images. More precisely, the power in the coherent peak corresponds to the percentage of overlapping areas, while the power in incoherent peaks corresponds to the percentage of non overlapping areas.

9. Implementation

In this paper, digital images of iris are taken and localized by using a combination of Canny Edge detection and Circular Hough Transform. Then, image registration is carried out to remove noises by our approach which is a variation of phase correlation method. Feature extraction is carried out using 2D Gabor filter.

As a next step, the iris code has to be stored as a template in the database. To provide template security, an algorithm which is a combination of Reed Solomon and Hadamard techniques is proposed as our contribution. Then matching is done for identifying and verifying the iris. Figure 4.1 gives an overall view of our paper.

We selected images from bench marked CASIA database for segmentation process. In segmentation process, Canny Edge detection is used to identify the rectangular of eyes. The database combined iris image groups from 200 different eyes and each iris image is acquired at different time with the interval of 6 months. We choose five iris images from each iris group and experimental work is done under Matlab 7.0

Here, the input iris images are transformed, with the Fourier transform amplitudes, to the polar coordinate system with a shift (d_1, d_2) between two images *Sk* and *Sk*+1. Then C and δ are measured by phase correlation. After that, the scaling factor *C*–1 and rotation – δ on image *Sk* (n_1, n_2) are applied, resulting in *S*1 (n_1, n_2). By shifting the spatial domain, the complex-valued cross-power spectrum expression for iris is obtained, which is normalized.

10. Conclusion

We have implemented phase correlation method on iris images of CASIA and UBRIS.V1 benchmarked databases. We have also tried to implement this algorithm for the images taken in our labs. Overall performance of our technique in detecting noises is observed to be on par with the other techniques.

We present detailed discussions on the overall experimental results. Since image registration is only one of the important parts of an iris recognition method, the proposed method is evaluated by analyzing the identification and verification performance of previous recognition algorithms with different registration methods.

11. Future Scope

Phase Correlation method is used for Image Registration for removal of noises in gray scale images. This paper can be exten-

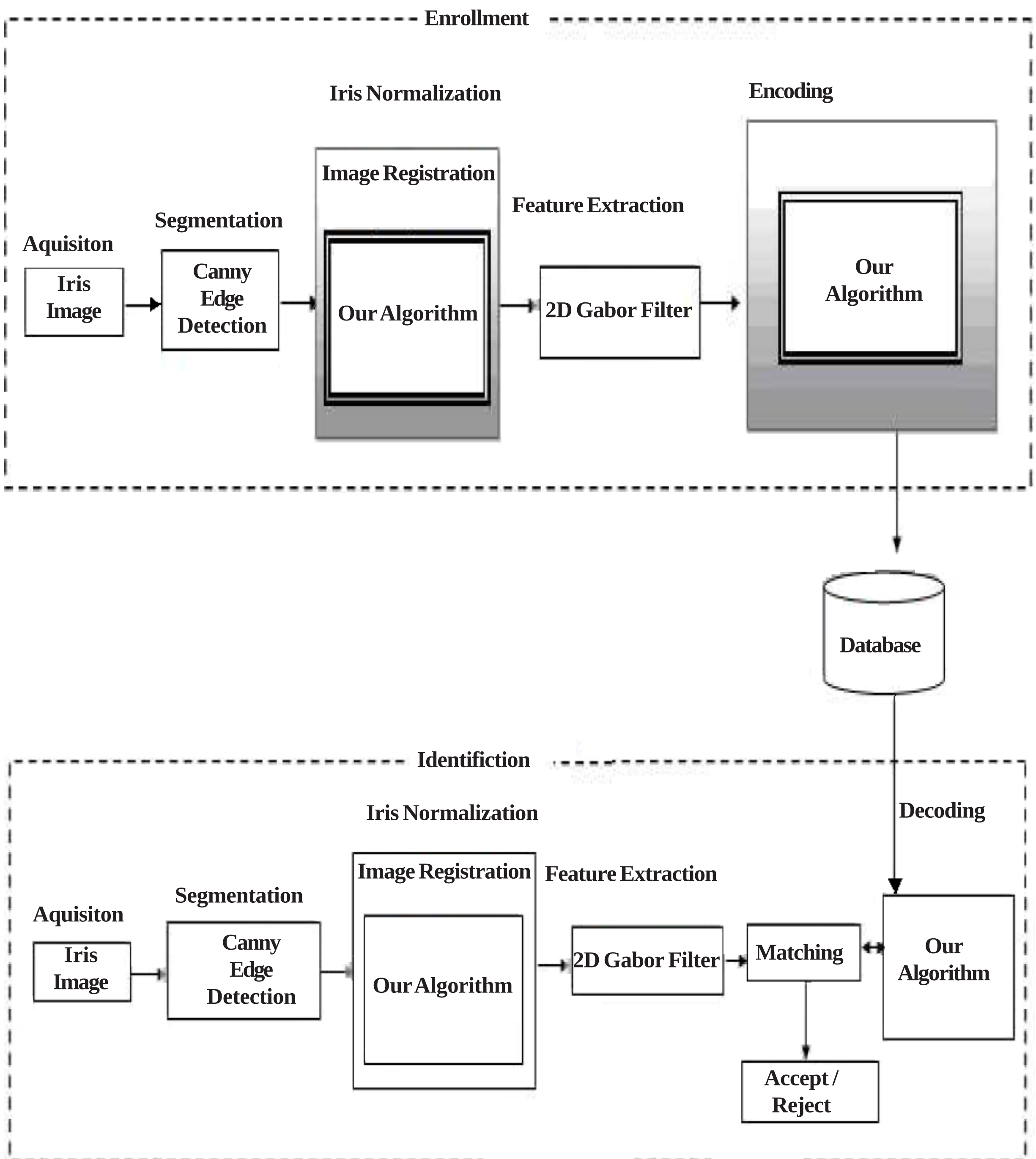


Figure.4.1

ded to develop algorithms to find out the noises for the color images.

This provides platform for registration of multi model images in various disciplines. Methodologies like system and quantity required to form computer aided design system as a whole.

Image registration can also be employed in medical applications in which segmentation is needed to determine area of interest in an image and in many cases accurate demarcation of objects, leads valuable information. Quantification is often the ultimate goal especially in medical application. Hence, our approach can be tested for medical applications.

A study can be made on the utilization of these techniques in medical diagnosis as in (Ridza Azri Ramlee, et al, 2011), it is mentioned that iris recognition can be used for the presence of cholesterol in a person.

The proposed algorithm for template security can be applied to the other biometric identification systems as these systems have sensitive information.

In our research paper, benchmarked database images, real time iris images have been used for experimental results. The paper can be refined to increase the processing speed.

Also system should be planned to test on a larger database to validate the robustness of the system. These techniques can also be independently studied for several different applications, resulting in a large body of research

12. Acknowledgment

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