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IRIS Biometric Identification System Based on Modified Canny Edge Detection Algorithm

[1] Satvir Singh, [2] Arun Kaushik

[1] SBS State Technical Campus, Moga Road, Ferozepur-152004 (Punjab) India

[2] PTU Reginal Center, SBS STC, Moga Road, Ferozepur-152004 (Punjab) India

Abstract- Authentication is required when there is a need to know about a person who they claim to be. It is a procedure which involves a person making a claim about their identity and then providing evidence to prove it. In this paper, iris biometric identification system has been presented that uses modified Canny Edge Detection algorithm for segmentation, binarization and cropping. Feature extraction is done by normalization and feature encoding process followed by matching process based on manhattan distance. Experimental simulation results are analysed on the basis of False Acceptance Rate (FAR) and False Rejection Rate (FRR) and found better. Modified Canny Edge Detection algorithm provides accuracy up to 99.08% on the basis of FAR and FRR.

Keywords **- Canny Edge Detection Algorithm, Segmentation, Iris Pattern, Biometric Identification System.**

1. Introduction

Human identification based on iris becoming a famous tool rapidly as compared to other biometric recognition techniques. Iris recognition is an automated method of biometric identification that uses mathematical pattern recognition techniques on images obtained from camera. Several countries have been enrolled in iris recognition system. First automated iris recognition concept was given by Flom and Safir in 1987 [1]. It is Based on varying the illumination to force pupil to a predetermined size to overcome with the problem of contraction and expansion of pupil. Then the most widely used methodology was developed by Daugman. Daugman makes use of an integro-differential operator for locating the circular iris and pupil regions, and also the arcs of the upper and lower eyelids make use of active contour models for localizing the pupil in eye images. Active contours respond to pre-set internal and external forces by deforming internally or moving across an image until equilibrium is reached. It generate iris templates and compared the difference between a pair of those by computing their Manhattan Distance (MD). Another popular iris recognition system developed which also provides high accuracy [2].

A biometric identification system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric information is used in computer science to authenticate same kind of access control. Biometric systems have been developed based on fingerprints, facial features, hand geometry, handwriting, voice, retina and the one presented in this thesis the iris this biometric identification systems works in the same way as that of voice recognition system pattern. Where sample sound signal is recorded and facial colored digital image is captured for face recognition system. Many of the biometric identification systems follow two modes of operation. Firstly sample is transformed using some mathematical function into a biometric template that provides normalized and high discriminating feature representation. Secondly those features than objectively compared with other present in the database in order to determine identity. Many of the biometric systems allow two modes of operation [3]. We are living in the age in which the demand on security is increasing day by day. Consequently, biometric recognition came into existence, which is a safe, reliable and convenient technology for personal recognition. This technology makes use of physiological or behavioral characteristics to establish identify of an individual. A biometric system is a pattern recognition system that includes acquiring the biometric feature from an individual, extracting its feature vector from the raw data and comparing this feature vector with another feature vector store in the database. Face,Fingerprint, palm-prints,iris, gait, speech and signature are widely used biometric features. Biometric recognition are used in computer network login, internet access, ATM, credit card, national ID card, driver's

license and so on [4]. Nowadays, fingerprint recognition is widely and successfully used [5]. Face recognition is studied by many scholars and experts [6]. Iris recognition is a relatively new branch of biometric recognition. The human iris is the annular part between pupil and sclera. That has distinct feature such as freckles, coronas, stripes, and furrows, etc. [7].

2. Steps of Iris Recognition System

Major steps involved in iris recognition system are given following:

2.1 Segmentation

A technique is required to exclude the artifacts, shown in Fig. 1, and locating the circular iris region approximated by two circles, one for iris and another for Pupil boundary. The eyelashes and eyelids normally occlude the upper and lower parts of the iris region. The inner and the outer boundaries of the iris are determined algorithmically using Hough Transform [8] after the edge detection.

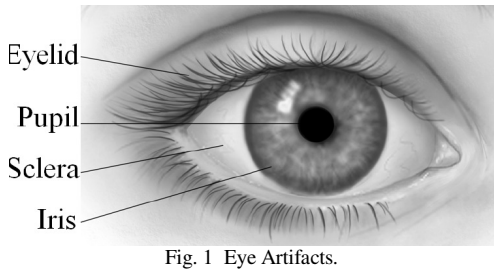

Fig. 1 Eye Artifacts.

2.2 Normalization

The Iris of different people normally captured in different sizes and size also varies for the same person due to various factors such as illumination. The normalization process produce iris regions which have the same constant dimensions so that two photographs of the same iris under different conditions have characteristic features at the same spatial location [5].

2.3 Feature Extraction

Significant features of the iris are required to be extracted so as to compare their templates images. Most iris recognition systems make use of a band pass decomposition of the iris image to create a biometric template. Iris provides texture information in the form feature vector [9] is ordered sequence of features extracted from the iris images [10].

2.4 Localization and Image Matching

The Manhattan distance function computes the distance that would be traveled to get from one data point to the other if a grid-like path is followed. The Manhattan distance between two items is the sum of the differences of their corresponding components.

The formula for this distance between a point $X = (x_1, x_2, \ldots)$ and a point $Y = (y_1, y_2, \ldots)$

$$d = \sum_{i=1}^{n} | x_i | - | y_i |$$

3. Proposed Work

Pattern recognition algorithms generally provide a reasonable answers for all possible inputs and to perform matching of the inputs, taking into account their statistical variation. This is opposite to pattern matching algorithm that provides the interclass and intra class variability. Iris recognition technique is based on biometric information of the subject and used to authenticate the access control. Iris is located between the cornea and lens of eye. It provides personal identification of an individual based on a unique features possessed by human iris. Iris recognition systems involve image acquisition localization and pattern Matching. Image acquisition is the process which deals with the capturing of a high quality image of the iris with the help of a digital camera. Iris localizations is the process which delimits the iris from rest of acquired image. Whereas in pattern matching involves segmentation and feature extraction and determination and manhattan distance from the previously stored information in the database. In this work, we use Improved edge detections and compared with that of Canny Edge Detector performing the segmentation. This is a new technique in iris recognition field that helped novel approach applied recognition performance. We use MATLAB® tool to implement our work with samples of iris image collected samples from 5 people are used for training and testing purposes [9], [11].

3.1 Basic Design of Work

The efficiency of the recognition system depends on four sub systems extraction which include feature segmentation, normalization and feature encoding and matching. Segmentation is done in this work by using both Improved Canny edge Detection and Canny so as to compare their performance in the form of flow graph and explained in brief as follows. The basic design of our proposed work is as shown in Fig. 2

Data Acquisition: This involves the acquisition of eye images from a group of live person, in this paper. In the work a database is created by collecting left eye image and saved as .jpg files.

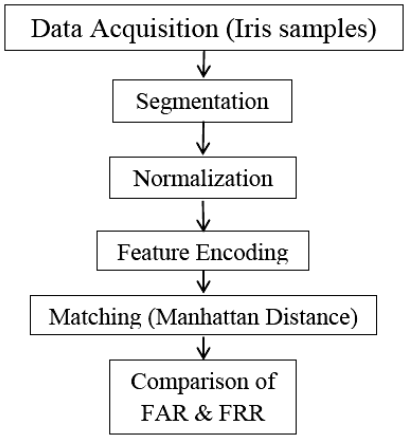

Fig. 2 This Recognition System Flow Graph.

Segmentation: This step involves determination of circle coordinates and line coordinates followed by Binarization, edge detection and cropping as shown in Fig. 3 The process of edge detection is experimented using Improved Canny edge detection algorithm.

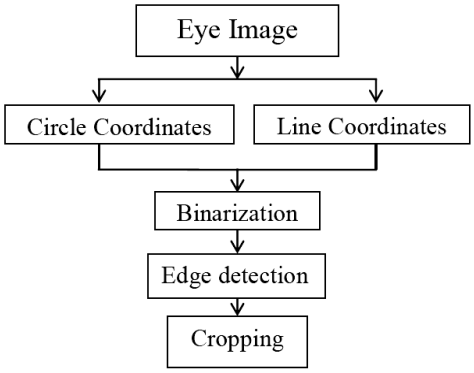

Fig. 3 Segmentation Process.

Feature Extraction: This step performs feature extraction process by using normalization encoding and then save all the features in the database. It is also known to as a training phase [12].

Binarization: In current techniques the binarization is usually performed either globally or locally. Some hybrid methods have also been proposed. The global methods use one calculated threshold value to divide image pixels into object or background classes. Whereas the local schemes can use many different adapted values selected according to the local area information. Hybrid methods use both global and local information to decide the pixel label.

Algorithm 1 Feature Extraction

Start
Add images after segmentation to
Extract Features.
For (int i = 0; i < image; count++)
Prop [k] =image [i].features [i]
Recall Normalization & encoding
Save to DB
Stop

In binarization each pixel is converted into one bit. Assign 1 or 0 depending upon the mean value of all the pixels. If the value is greater then mean value then its 1 otherwise 0. The binarization is done by sigma and scaling center co-ordinates of each image [13].

Algorithm 2 improved canny edge detection

Step1: Select the input **(i)**
I:-input iris image sample
Step 2: Apply the segmentation on **(i)** and find the
Circles **(c_n).**
Step 3: Apply binarization on c_n.
Step 4: For all the row & columns in matrix **(i)**
Convert into corresponding bit patteren **(0 &1)**
Apply Normalization on **R.**
Step 5: Apply gradient formula on **R.**
Which will give **[g_x, g_y].**
Step 6: g_x, g_y are taken into Gaussian formula.
Step 7: if result is apply convertion to fast fourier Transform.
Else
Normal canny will be executed.
Step 8: FFT create the waves of sine & cosine.
Step 9: Apply Manhathen distance by converting the
Waves into grid of **x** & **y**.
Step 10: **if** d == 0 **image matched**
d ≠ 0 **image not matched.**
Stop.

Improved canny edge detection: Improved canny's edge detection algorithm is well known as the optimal edge detection method. It works on three main principle, low error rate well localization of edge point and one response to a single edge. To enhance the older edge detection methods. Canny proposed two new techniques in his algorithm. Non maximum suppression and double threshold to select the edge points. However these two

thresholds use the gradient image are set experimentally. Improved canny edge detection is shown in algorithm2 that is following.

4. Results Discussion

The results of the proposed system can be analyzed by implementing the whole methodology using simulation tool MATLAB®. This proposed system involves two main phases that are training and testing phase.

Performance of the biometric systems is measured by their accuracy in identification, which is calculated using false rejection rate and false acceptance rate. As shown in the Table 1, the FAR and FRR are calculated. Tests are run on the data set of 5 users. Features are generated by using modified Canny Edge Detection Algorithm. Results are reported in the form of FAR and FRR which are obtained for the different values of threshold is calculated. Accuracy is calculated for new proposed technique, which is compared with the accuracy of previous implemented technique canny at segmentation level [14].

Table 1: Accuracy for Canny Vs modified Canny edge detection

Parameters	***Canny Based Iris Recognition***	***Improved Canny Iris Recognition***
FAR	0.96%	0.92%
FRR	0.72%	0%
Accuracy	98.32%	99.08%

5. Conclusion

In the proposed system a new technique is used at level of segmentation. Matching of the system is on the basis of Manhattan Distance. In this the first step of recognition system is segmentation. Which can be performed by both canny and Improved canny to measure compare the performance. The second step is feature extraction and then preparing a template which can be used for matching at testing phase. Performance of Improved canny based iris recognition system is better than the Canny based iris recognition system which can be calculated by calculating accuracy. The accuracy of the proposed system is 99.08%. Future work could go in the direction of using more than one modality to increase the level of security [15] [16].

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