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Iris Recognition for Secured Internet Banking Using CUDA on GPU

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***Abstract*— Iris continues to become one of the emerging methods of biometric-based identification systems as the need for security system keeps on increasing day-by-day. With a few modifications, this project explains the iris recognition systems developed by John Daughman and have tried to implement the Daughman algorithm using matlab tool. Image pre-processing is the first step which is then followed by extracting iris portion of the eye image. Normalization is applied on the extracted iris part and Gabor Filter is used to construct the Iris features. In order to determine the Hamming distance, which should be a fractional measure of the dissimilarity, two different Iris features are compared. Various experiments performed on images showed that every eye image yielded unique features.**

Keyword – Daughman algorithm, Segmentation, Normalization, Pattern Matching, Feature Extraction.

I. INTRODUCTION

1. Overview

Biometrics are normally used for the identification and verification of a human based on their physiological traits. While Iris method is still considered as a new introduced technique, face and speech recognition techniques have been used for 25 years now. Some other biometric features are handwriting, gait, hand geometry or gestures etc.

The colored part of the eye which lies in the front of the lenses termed as iris. Being the only internal organ which is externally visible, their patterns are unique from one individual to other individual. Probability of two individuals with the same iris patterns is almost zero. The fact that iris remains stable for the rest of an individual's life and varies in pattern, makes it as a very reliable security system.

2. Background

This efficient idea to use iris patterns for identification systems was first put forward by two ophthalmologists named Alphonse Bertillon and Frank Burch. The Iris identification software was first developed by John Daughman in 1992. R. Wildes further added important contributions. The idea of both these great minds was same but the difference occurred only in the code generation process and pattern matching technique. A billion images were tested under Daughman system and the rate of failure was found to be very low. Iriscan Inc. patented his systems and are used on a large scale in Indian technologies, UK National Physical Lab, British Telecom etc.

II. IMPLEMENTATION

A. IMAGE PREPROCESSING

Image pre-processing consists of performing Otus thresholding on image conversion of binary image from grey image. Cleaning of the image is also done By performing morphological operations.

B. HOUGH TRANSFORM

Within a certain class of shapes, a technique is applied to find the imperfect instance of objects with the help of a voting procedure. This technique is called as the Hough transform by which features are extracted. These extracted features are used in various applications like computer vision, image analysis and digital image processing. In a parameter space, the above mentioned voting procedure is carried out through which object candidates are produced in the form of local maxima within a so-called accumulator space which has been explicitly constructed by the algorithm for computing Hough transform[2].

The search can be reduced to 2D, if the circles present in an image are of known radius. To determine the values of (a,b) centre coordinates are the main objectives.

$$x = a + R\cos(\theta)$$

$$y = b + R\sin(\theta)$$

The locus of (a, b) points in the parameter space fall on a circle of radius R centred at (x, y).[6] The actual centre point will be common to all parameter circles and is found with an array that accumulates the Hough values.

Each point in geometric space (left) generates a circle in parameter space (right). The circles in parameter space intersect at the (a, b) that is the centre in geometric space.

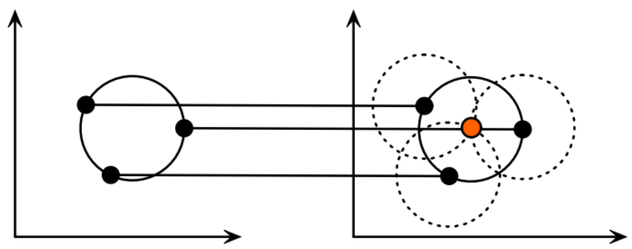

Fig 1. Hough Circle

C. GABOR FILTER

Gabor Filter is named after Dennis Gabor. It is a linear filter which is mostly used for edge detection in image processing. In spatial domain, a 2D Gabor filter is used as a Gaussian kernel function which is modulated by a sinusoidal plane wave[2]. A mammal's brain consists of simple cells present in their visual cortex. These cells can be modeled by using Gabor functions. Hence, there is a lot of similarity between the human perceptual visual system and image analysis done by Gabor function. By multiplying a Gaussian function with a sinusoidal wave, an impulse response is defined. The multiplication-convolution property is called as the Convolution theorem. Because of this property, the impulse response generated by the Fourier transform of a Gabor filter is the convolution of the Fourier transform of the Gaussian function and Fourier transform of harmonic function. The filter has two components namely; the real and an imaginary component which represents the orthogonal directions. These two components can be used individually or formed into a complex number. Gabor filter can be viewed as:

$$g(x, y, \theta, \phi) = \exp(-\frac{x^2 + y^2}{\sigma^2}) \exp(2\pi\theta i(x \cos\phi + y \sin\phi))$$

Algorithm: Gabor filter for Feature Extraction

1. A normalized image is taken in a variable in the matrix form.
2. Variables theta and sigma are initialized with constant values.
3. A filter is defined for applying the Gabor filter in a loop equivalent to the size of the filter.
4. The image stored in matrix format is converted into type double.
5. The image is then convoluted with the filter to obtain two responses.
6. The response is a real and imaginary image which contains distinct features of the original image.

D. PATTERN MATCHING

In pattern matching, two images are compared. Here we have used the Euclidian distance formula for pattern matching of images. At first the images are converted into binary form, then on basis of their binary template we will calculate whether they are matched or not.

```
Algorithm Match( Feature of Input Image, N, Database)

 i=0;
 min=999.99
 T= 0.2
 while(i<N)
 begin
   Y= feature(Database[i])
   X=feature(InputImage)
   Z=Eucledian_distance(X,Y)
   W=norm(Z)
   if(W<min)
   begin
     min=W
       end if
 end while
 if( min < =T)
   begin
    found=1;
   end
```

Where W is the 2-NORM of Z.
T is threshold value.

However to find a match we have to go through every iris feature template in database. If process goes on sequentially then it will take a lot of time, hence degrading the performance. Worst case scenario can be that the user to be found has the last entry in database. One possible solution is that we can perform the matching in database parallely with the CUDA support provided by MATLAB

Parallel Algorithm:

N is no of images in the database
No of threads per block= M
NBLOCKS= N/M

```
__global__ void Parallel_Match (int N,  Vector *Database,
Matrix *InputImage, float *T)
  {
    int idx= threadIdx.x;
    int blockid= blockIdx.x;
    int id_db= blockid*blockDim.x + idx;
     Y= feature(Database[id_db])
    X=feature(InputImage);
    Z=Eucledian_distance(X,Y);
    W=norm(Z);
       if(W<*T)
        match found
   }
```

MATLAB supports CUDA kernel development by providing a high-level language and development environment for prototyping algorithms and incrementally developing and testing CUDA kernels. Parallel Computing Toolbox is required to call GPU-enabled functions or integrate CUDA kernels in MATLAB.

III. Experimental Results

Original Image:

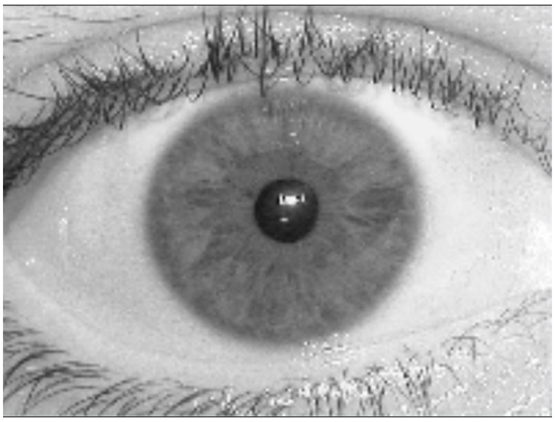

Fig 2. Original image

Inner and Outer Circle detection using Hough transform:

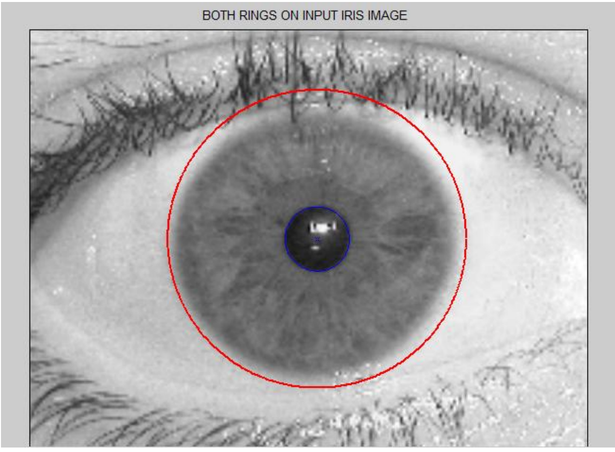

Fig 3. Detection of Circle

IrisSegmentation:

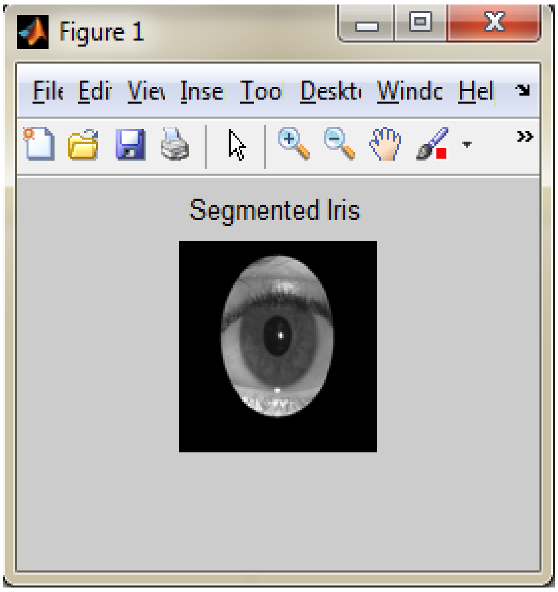

Fig 4. Segmented iris image

Feature Extraction:

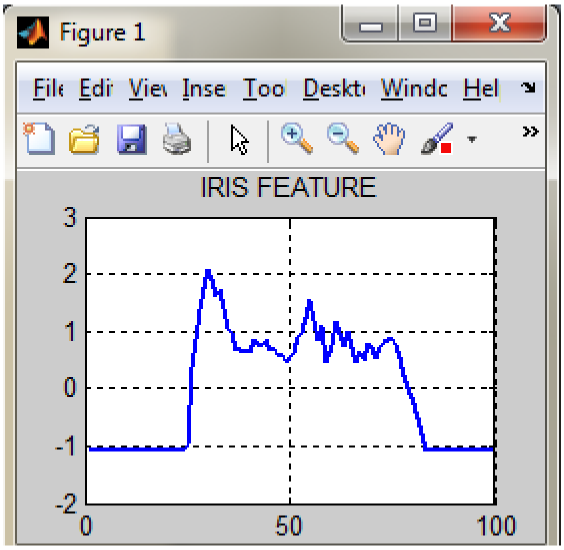

Fig 5. Feature extracted from iris image

Output:

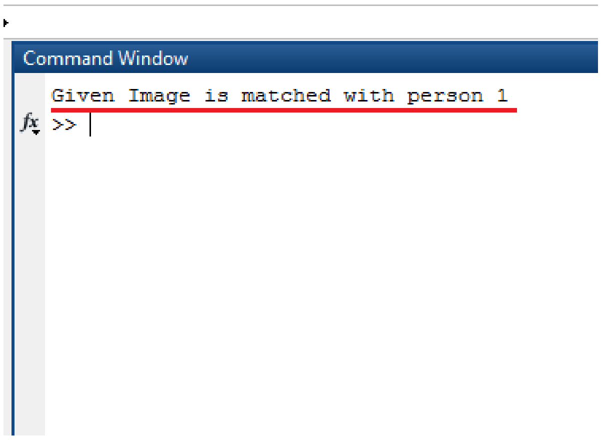

Fig 6. Output

IV. Conclusion

This project work presents a iris recognition system for internet banking. We have enhanced the security of internet banking login system with the use of iris biometric. The uniqueness of the iris and low probability of a false acceptance or false rejection all contribute to the benefits of using iris recognition technology.

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