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Design of High Accurate IRIS Recognition System using Matlab

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***Abstract*— In non-cooperative environments, iris images are often affected by adverse noise, making them difficult to segment. Significant progress has been made in areas such as automatic iris segmentation, edge detection, and boundary detection over the past few years. Previously, iris segmentation was carried out using CNN-based methods. The Artificial Neural Network (ANN) is the technology we use in our project. An iris recognition system uses pattern recognition that supports images of high-quality iris images as part of its biometric recognition system. An iris recognition system mainly uses infrared light. The simulation results of the biometric image processing algorithm that we developed for iris recognition have been provided. In our project, we aim to obtain highly accurate results. For the Feature extraction process we are using Gabor wavelet transform, In order to improve segmentation performance, we would like to evaluate more efficient strategies to exploit the spatial relationship between the iris mask, inner and outer iris boundaries.**

Keywords—Iris Segmentation, CNN, ANN, Edge detection, Boundary detection.

I. INTRODUCTION

When iris recognition is based on visible light, it will raise pigmentation, which will allow the recognition systems to exploit the color patterns, making identification much easier. In other words, pigmentation patterns contain a lot of information that can be utilized to determine a person's identity. The visible light reflections in these types of systems can, however, result in a significant amount of noise in the gathered images. Typically, an iris recognition system consists of three modules. The modules are image acquisition, pre-processing, as well as feature extraction, and encoding.

As part of this introductory section, a brief overview of biometric concepts, types, our motivation for doing this work, and our objectives is presented.

Biometric systems are the automated systems used for identifying the ways of verifying or recognizing the identity of a person based on certain characteristics, Such as Physiological and Behavioral characteristics. Physiological features are more reliable than one which adopts behavioral features. As the common Efficient biometric modalities are fingerprint recognition, face recognition, Iris Recognition, and Voice Recognition. Biometrics are extremely difficult to forge cannot be forgotten or stolen, making it an extremely convenient, accurate, and irreplaceable method of authentication for individuals, which has some advantages over traditional Cryptography methods.

The interdisciplinary topic has become increasingly popular as it involves Biometrics and cryptography. Biometric information is unique and permanent information about the individual and cannot be replaced, unlike passwords or keys. As soon as an adversary compromises the biometric data of a user, the data is lost forever, causing a huge financial loss. Therefore, one of the major concerns is how a person's biometric data can be protected after it has been collected.

Recently, the demand for personal identification has grown significantly. Due to the uniqueness, non-invasiveness, and stability of human iris patterns, iris recognition is increasingly gaining popularity as a biometric technique over other methods. There have been so many commercially available systems developed to process iris images and perform identification or verification procedures since the first automatic iris recognition system was introduced by J Daugman in 1993. From among the numerous iris recognition systems, Daugman and Wilde's approaches represent the most significant and distinguished ones.

By using different image acquisition and iris segmentation methods, the system differs from Daugman's in some aspects. Almost all techniques since have been developed using the basic concepts outlined in the pioneering work of Daugman and Wilde. Many of the new advances in research as well as commercial products were the result of Daugman's original approach.

A typical iris recognition system procedure consists of fivesteps: Acquisition and Pre-processing, Normalization, Segmentation, Feature extraction, and classification. Along with the iris, irrelevant parts such as the pupil, sclera, and eyelids are visible.

Existing methods for feature extraction utilize features such as zero-crossing representations, phase information, local intensityvariation, statistical methods, and texture analysis. Local intensity variations were analyzed by Daugman using Gaussian-Hermit moments and Ma et al by using the wavelet transform. To extract phase information and zero crossings wavelet transform was also computed. Gabor filter was used to capture the textures. For all of these methods, gray level images of iris were used for all steps of iris recognition.

After the necessary preprocessing, a simple segmentation method using Gaussian filters is employed followed by a canny edge detector. The major edge of the eye can be determined easily from here, from which the iris boundary is located. In order to represent the iris in fewer dimensions, the segmented images are then subjected to feature extraction.

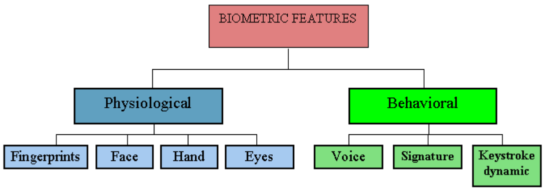
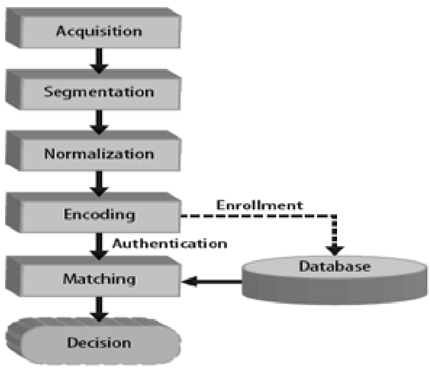


Fig1: Biometric Features

The above biometric classification shows that physiological and behavioral features out of which we are focussing mainly on iris part of the human being. It measures the unique patterns in your eyes colored circle inorder to verify your identity and authenticate it. Biometric iris recognition is a contactless fast and accurate solution that can be used at long distances. Certain solutions that make use of the technology require just a glance from the user. The use of iris scanning devices in personal authentication applications has been around for several years. There has been a notable drop in the price of systems that rely on iris recognition, and this trend is likely to continue. In both verification and identification modes, the technology works well. Experts have said that iris scanning is a far more secure form of biometric authentication than say, voice recognition, fingerprints or toe prints and that it's fast, efficient and easy.

II. LITERATURE SURVEY

Wang et al. in (2002) described an efficient iris recognition technique, in which segmentation was initially



performed by applying a median filter followed by a Canny operator to identify sclera edges, and balloting the maximum circle to determine the outer iris borders. It is determined by measuring the inner boundary in terms of a rectangular interperiod. Using the rough boundary identified iris image, the image is then segmented by using an effective Integro Differential operator. When multiple eyelashes are detected, the variance of the threshold is used to detect each eyelid. The histogram Hough transformation is used to detect single eyelashes. In the normalization stage, a size and rotation invariant concentric circular iris representation is obtained. The independent component analysis coefficients were used to extract the features from the 128 x 40bit unwrapped iris image, followed by the average Euclidean distance classifier.

The approach Daugman (2004) proposes is an improvement over what he proposed in 1993. The model is designed to deal with noise disturbances that occur when acquiring an iris image of a human eye. In addition to the Integro-Differential operator described earlier, an algorithm was developed to detect the eyelids, which uses arcuate edges and spline parameters instead of circular edges in the Integro-Differential operator. The paper provides a solution to detect eyelid occlusion, which improves on his earlier work.

Abiyev et al. (2008) have simulated an iris recognition system based on neural networks (NN). The iris inner circle is detected by detecting the pupil region using a 10x10 rectangular area technique. The effect of eyelids is removed using the linear Hough transform while eyelashes are removed using a thresholding technique, and then the image is enhanced to improve the contrast and brightness. The gradient-based learning approach is used in order to classify the pattern and it is proposed that 99.2integrodifferential5 percent accuracy can be achieved.

III. SOFTWARE IMPLEMENTATION

Using the methodology presented in the previous chapter, this section explains how we would implement the IRIS (biometric identification system). In the course of creating our research work, we employed the following steps: pre-processing, segmentation, normalization, feature extraction, and matching of the captured images, with the final step being the identification of the captured image. As follows, we describe the various steps one by one. The following parameters were used during the software implementation process of the iris recognition algorithm.

- Pre-processing
- Image Segmentation
- Edge detection
- Canny Edge detection and Localisation
- Sobel Edge detection
- Gamma Correction
- Hysterisis threshold
- Circular Hough Transform
- Normalization
- Feature Extraction
- Gabor wavelet Transform
- Matching

Iris Recognition:

Fig2: Framework of Iris Recognition

Image pre-processing and normalization is major part of iris recognition systems. The stages involved in the Iris recognition system are:

As Fig 1 shows, most iris recognition systems consists of five basic stages leading to a decision:

- The *acquisition* module defined the action of retrieving an image from some source.
- The *segmentation*module localizes the iris's spatial extent in the eye image by isolating it from other structures in its vicinity, such as the sclera, pupils, eyelids and eyelashes.
- By transforming the segmented iris image from cartesian to polar coordinates, the *normalization* module uses a geometric *normalization* scheme.
- To create a binary code, the *encoding* module uses a feature-extraction routine.
- Based on the *matching* module, the generated code will be compared to the encoded features stored in the database

Segmentation:

In order to recognize the iris, the digital image of the eye must first be divided into its individual regions. The region of the iris is approximated by two circles, one for the boundary between the iris and the sclera and one for the boundary between the iris and the pupil. The upper and lower parts of the iris are normally covered by the eyelids and eyelashes.

Canny Edge detection and Localization:

An edge map is created using canny edge detection. The boundary of the iris is located by using the canny edge detection technique. The parameters are the centre coordinates of x and y, the radius r, which are able to define according to the equation.

$$x^2 + y^2 = r^2$$

The horizontal derivatives of the edge detection step are used to determine the outer circular boundary of the iris, and the vertical derivatives are used for determining the location of the eyelids.

Sobel Edge detection:

This calculates the gradient of image intensity at each pixel within the image. From light to dark, it determines the direction of the largest change and the rate of change. It shows how abruptly or smoothly each pixel changes, and therefore how likely it is that pixel represents an edge. Additionally, it shows how that edge is likely to be oriented.

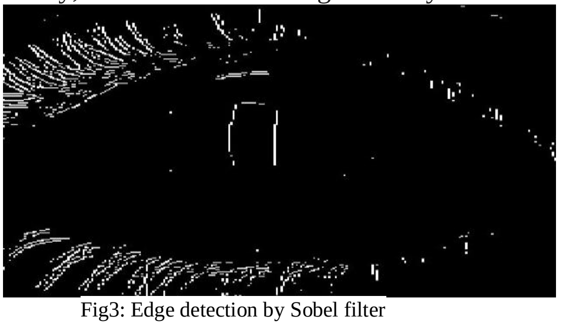


Fig3: Edge detection by Sobel filter

Hough Transform:

The **Hough transform** can be applied to detect the presence of a circular shape in a given image. It is used to detect any shape or to locate the **iris** in the face.

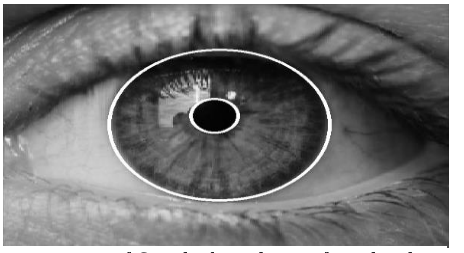


Fig4: Detection of Circular boundaries of pupil and iris

The parabolic Hough transform is used to detect the eyelids, approximating the upper and lower eyelids with parabolic arcs.

Normalization:

As part of the unwrapping process, most normalization techniques transform iris data into polar coordinates. A pupil boundary and limbus boundary are two non-concentric contours. In the case of non-concentric conditions, the iris can be transformed into polar coordinates by varying the reference points. A proper selection of the reference point is very important in defining the radial and angular information with respect to this point. Normalization has an advantage i.e.,It accounts for variations in pupil size due to changes inexternalilluminationthatmightinfluenceirissize.

Fig5: Normalized iris image

Gamma Correction:

There is almost always one thing in common between computer monitors, no matter what manufacturer they are made by. A 2.5 power function is roughly equal to the intensity to voltage response curve for each of them. You don't need to be concerned about it, if you tell your monitor that a certain pixel should have intensity equal to x, it will actually display a pixel that has intensity equal to x ^ 2.5 Because the voltage range sent to the monitor is between 0 and 1, this means that the intensity value displayed will be less than what you wanted it to be. (0.5 ^ 2.5 = 0.177 for example)

Gamma correction function [x]: x ^ y

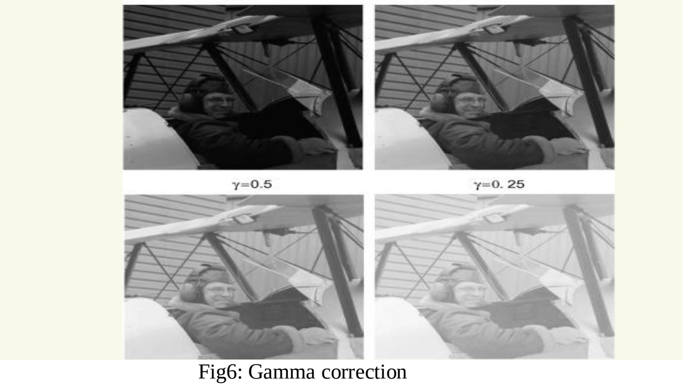


Fig6: Gamma correction

Gabor Wavelet transform:

The textures were captured using the Gabor filter. All iris recognition steps were performed using gray-level images of irises. While a recognition system can compare two unwrapped iris images directly, most systems first use a feature extraction routine to encode the iris's texture. As part of a common encoding mechanism, 2D Gabor wavelets are used to extract the local phasor information of the iris texture.

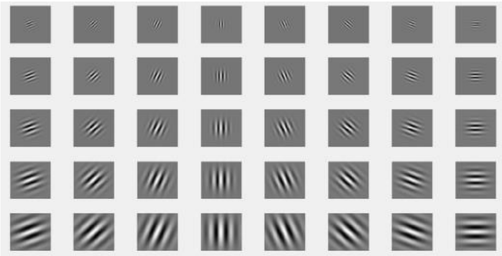


Fig7: Gabor Wavelet

Gabor filters are capable of providing optimal representations of signals in both space and frequency. The Gabor filter is constructed by modulating a sine/cosine wave with a Gaussian.

Gabor filters with different frequencies and with orientations in different directions have been used to localize and extract text-only regions from complex document images (both gray and color). Gabor filters have also been widely used in pattern analysis applications.

II. SIMULATION RESULTS

The Iris images we have taken for this project are the high-quality images. The edges of the Iris patterns are clearly shown in the images. The iris images we are taken from a mobile camera i.e., the format of the captured images is 24bit JPG and the resolution of every image is 920× 518 pixels. So it takes less than 7 seconds to segment it out IRIS from an eye image.

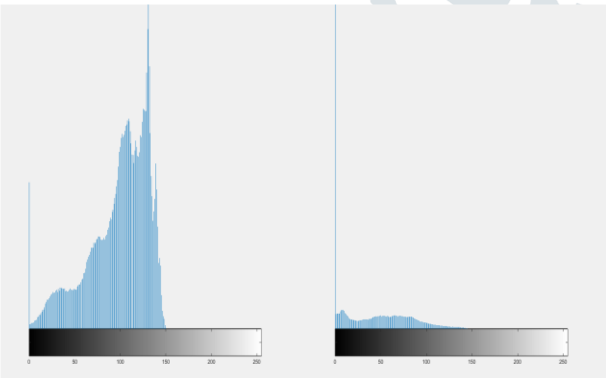


Fig8: Histogram representation of Iris images

In an **image processing**, the **histogram** of an **image** normally refers to a **histogram** of the pixel intensity values. A histogram is a graph that shows thenumber of pixels in an image at each different intensity value.

The **x-axis** of the **histogram** shows the range of pixel values. Since it's an 8 Bpp image, that means it has 256 values of gray or shades of gray in it. That means that the image we have got its darker and the y-axis shows the frequency of these intensities. The main applications of histogram are:

- In digital image processing, histogram is used for simple calculations in software.
- Histograms are used in thresholding as it improves the appearance of the image. It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image.
- The brightness of the image can be adjusted by having the details of its histogram.
- The contrast of the image can be adjusted according to the need by having details on the x-axis of a histogram.
- It is straightforward image-processing technique often used to achieve better quality images in black and white color scales in medical applications such as digital X-rays, MRIs, and CT scans.

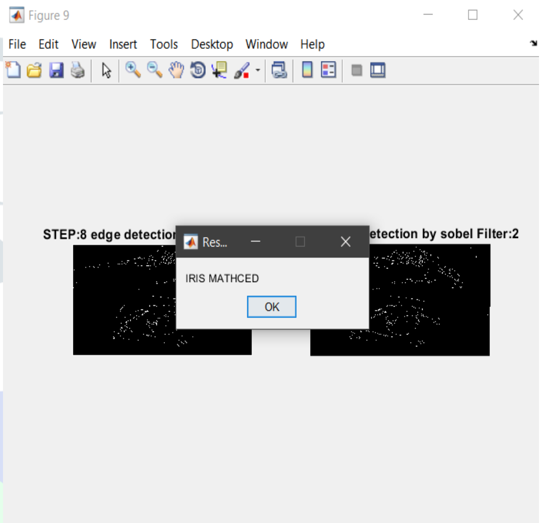


Fig9: Successfully matched

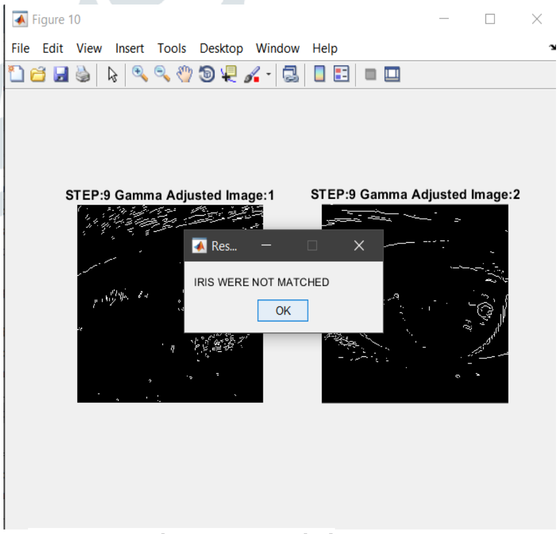


Fig10: Images that are mis-matched

The coding process is completed in the Matlab environment & using image processing tools. After the Matlab code is developed & the simulation parameters & time are set, the Matlab code is run & the various simulation results are observed.

III. IRIS RECOGNITION: ADVANTAGES OF THE PROPOSED METHOD

- Because of its higher degrees of freedom and faster encoding time, iris biometric authentication might be a faster method of authentication than the others.
- No physical contact when scanning (more sanitary).
- Unlike a fingerprint, it ensures hygiene as iris can be scanned from a distance and doesn't require any contact.
- Extremely difficult to be forged. This assures the highest level of security.
- Patterns apparently stable throughout the life.
- Iris Recognition technology easily integrates into existing security systems or operates as a standalone,

Applications

- Number of banks and financial organizations are using iris recognition technology to replace cumbersome and time-consuming password and pin-based systems.
- Cell phone and other wireless-device-based authentication.
- Internet security, control of access to privileged information.
- Driving licenses; other personal certificates.
- Entitlements and benefits authorisation.
- Forensics; birth certificates; tracing missing or wanted persons.
- Credit-card authentication.
- Automobile ignition and unlocking; anti-theft devices.

Limitations

- The accuracy if the iris scanners can be affected by changes in lightning.
- Iris scanners are significantly more expensive than other forms of biometrics.
- Generally require close proximity to camera, which can cause discomfort for some.
- Obscured by eyelashes, lenses, reflections.
- Deforms non-elastically as pupil changes size.

IV. CONCLUSIONS & FUTURE WORK

The research work that is undertaken by team under the guidance of my guide was aimed to develop the identification of human through the iris part of the human eye, Research in this study explores the development of a simple, efficient, and effective method of iris recognition by using a simple segmentation method. A Matlab generated code was used to solve the identified problem after it was run using appropriate modern algorithms.

It has a very low time consumption, i.e., it can identify an IRIS in 7 seconds if the data is stored in the database, and the results of the analysis are quickly declared. Including segmentation, feature extraction, feature selection and dimension reduction, as well as classification time. Based on the successful experiment and encouraging results, it can be said that the proposed system can identify iris quickly and efficiently.

In the proposed system, no database has been used for IRIS images. The Another possibility is to extend the system to other databases, such as a change or improvement in segmentation and feature extraction technique may be able to reduce the average system run time, and other classification algorithms may also be employed to evaluate the system.

Future work

- It is possible to make this system work in real-time.
- Our plan is to add some features to this project in the future.
- By improving efficiency and decreasing time consumption, the system could become more effective.
- In order to increase both accuracy and robustness; a multi-modal systems could be used. This confusion may be a combination of iris and fingerprint biometrics. This allows the integration of two or more types of biometric recognition and verification systems in order to meet the performance requirements.

In our future work, we are planning to develop the real time implementation of the algorithm that we have implemented in this work. The developed code will be dumped on to the hardware & results are going to be observed, microprocessorkits & other type of real time interfacing kits is also thought of.

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