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IRIS RECOGNITIONFOR SECURE ACCESS

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Abstract- *Providing secured access to physical locations and to data is the primary concern in many personal, commercial, government andmilitary organization. Classic solution to this includes carrying an identifying document and remembering a password. But, classical Solutionhas problems like forgetting to carry the identifying document, forgetting the password, and includes a high chance of forgery. The emergence of biometrics has helped to address these problems. Amongst all the forms of biometrics, the iris has been preferred because every iris is unique to a degree that the probability of 2 irises being identical is 1 in 10^{78} .So, we are using iris recognition to provide secure access.First, user have to registerhis iris image using RFID tag& it is saved in database. When user wants access, he swap RFID tagand his current iris image taken by IR camera is compared with iris image registered by same RFID tag& depending on that authentication is given.Instead of comparing current iris image with all images in database ,one to one matching is done to improve the speed of system.Here,Segmentation is done by using canny operator and circular Hough transform,Daughman'srubbersheet model is used for normalization and features are extracted.Then,matching is performed on score basis.*

Keywords-*Iris recognition, RFID tag ,Canny operator, circular Hough transform,Daughman'srubbersheet model*

I INTRODUCTION

With an increasing emphasis on security, the need for automated personal identification system based on biometrics has increased. The practical applications for biometrics are diverse and expanding, and range from healthcare to government, financial services, transportation and public safety and justice. Such applications are on-line identification for E-Commerce, access control of a certain building or restricted area, off-line personal identification, financial automated teller machine (ATM). Recently, iris recognition is becoming one of the most important biometrics because iris patterns possess a high degree of randomness and stable over time. Using iris recognition in ATM a customer simply walks up to the ATM and looks in a sensor camera to access their accounts. The camera instantly photographs the iris of the customer. If the customers iris data matches the record stored a database access is granted. At the ATM, a positive authentication can be read through glasses, contact lenses.

In this paper,user is registered using RFID card and his iris is segmented, normalize,its features are extracted and store registered iris image in the form of bit stream in database. When user required to access a particular environment to which security is provided, RFID card is swapped.Then,iris image of user is captured, segmented, normalize and bit pattern is generated after feature extraction which is matched with the bit pattern registered by same RFID. Depending on matching user is authenticate to access particular environment.

II. LITERATURE REVIEW

This describes the information about the data acquisition system and gives the information about related work and the summary related work.The concept of Iris Recognition was first proposed by Dr. Frank Burch in 1939.It was first implemented in 1990 when Dr. John Daugman created the algorithms for it.

1. Segmentation: First, actual iris region is isolate orlocalize from the digital eye image.Different approaches are:

Daugman'sIntegro-differential Operator –J. Daugman assumes both pupil and iris are localized with circular form andapplies the following operator

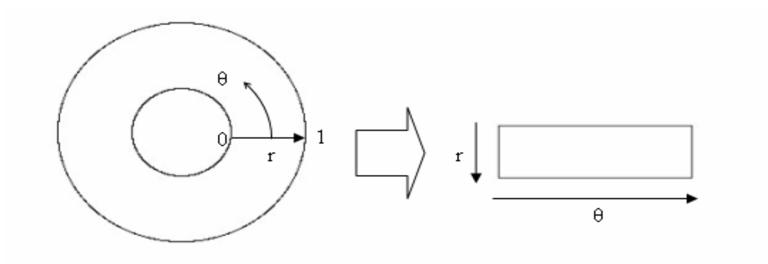
$$\max(r,x_0,y_0) \left| G_\sigma(r) * \frac{\partial}{\partial t} \oint_{r,x0,y0} \frac{I(x,y)}{2\Pi r} ds \right|$$

Here, $I(x, y)$ is an image; ds is circular arc of radius r; (x_0, y_0) are center coordinates; Symbol * denotes convolution; and $G(r)$ is a smoothing function[1].This process works very effective on images with enough separability between iris, pupil and sclera intensity values.It works excellent only in ideal imaging conditions.

Hough transform- An automatic segmentation algorithm based on the circular Hough transform is employed by Wildes et al. The circular Hough transform can be used to determine the radius and centre coordinates of the pupil and iris regions [3].

2. Normalization: The normalization process will produce iris regions having constant dimensions such that two images of the same iris taken at different conditions and time will have the same characteristics features at the same locations spatially.Different methods are given below:

Daugman's Rubber Sheet Model – This method assumes that the iris texture changes linearly in aradial direction, in which it maps each point within the iris region in Cartesian coordinates (x, y) to a pair of polar coordinates (r,θ) where r is in the interval [0,1] andθ is the angle in $[0,2\pi]$ according to the following formulas: -



$$x(r,\theta) = (1-r)x_p(\theta) + r\,x_l(\theta)$$

$$y(r,\theta) = (1-r)y_p(\theta) + r\,y_i(\theta)$$

$$\&x_p(\theta) = x_{po}(\theta) + r_p\cos\theta$$

$$y_p(\theta) = y_{po}(\theta) + r_p\sin\theta$$

Fig..1 Daugman's rubber sheet model.

(x_p , y_p) is coordinate of pupil boundary $\&(x_l , y_l)$ is thecoordinate of iris boundary. x_{po},y_{po} is centre coordinate of iris.

Image registration-This approach geometrically transforms a newly acquired image $I_a(x, y)$ into alignment with an image in the database $I_d(x, y)$ according to a mapping function, $(U(x, y),V(x, y))$ such that all the (x, y) image intensity values at $(x, y)-(U(x, y),V(x, y))$ in $I_a$are close to those at (x, y) in I_d[2].This mapping is essentially trying to minimize the following, where the u and v are the displacement determined from the mapping function:.

$$\int_x \int_y (I_d(x,y) - I_a(x-u,y-v))dxdy$$

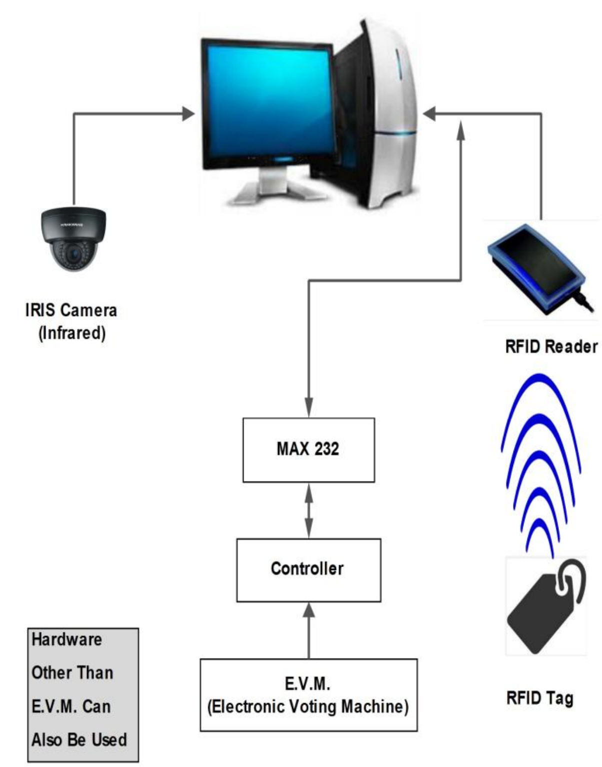
while being constrained to capture a similarity transformation of image coordinates $(x, y)$to(x', y'), i.e.,

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} - sR(\phi)\begin{pmatrix} x \\ y \end{pmatrix}$$

Where s is the scaling factor and $R(\varnothing)$ is a matrix that represents rotation by $\varnothing$. The parameters s and $\varnothing$ have to be recovered using an iterative minimization process.

3.Feature extraction and matching: In Daugman's method iris feature is encoded by extracting the texture phase structure information of the iris with multi-scale 2D Gabor filters into 2048 bit of iris code[1]. For the feature matching module, the Hamming distance is adopted to match iris codes. Wildes et al. proposed a four resolution levels Laplacianpyramid to code the iris pattern and a normalized correlation[2] and Fisher's discriminant is used for pattern matching. Boles and Boashash implemented a technique to extract a set of 1D signals composed of normalized iris signatures at different resolution levels[4.] They obtained the iris representation of these signals via the zero-crossings of the dyadic wavelet transform and then the dissimilarity function between two irises is calculated to compare the new pattern with the reference patterns.

III. SYSTEMARCHITECTURE



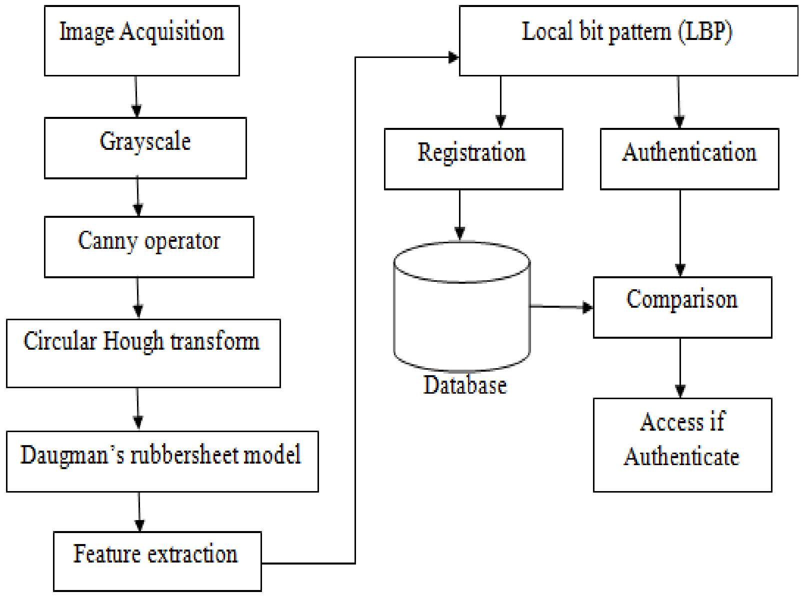


Figure 2 A.General Block Diagram B. Flow chart of whole system operation

3.1Image Acquisition-
The iris is a relatively small (1 cm in diameter), dark object and it is necessary to capture a high quality image of the iris.It is desirable to acquire images of the iris with sufficient resolution and sharpness to support recognition. Also, it is important to have good contrast in the interior iris pattern without resorting to a level of illumination and noises in the acquired images should be eliminated as much as possible.

3.2 Segmentation-
This processconsists in localizing the iris inner (pupillary) and outer (scleric) borders,assuming circular shapes for both of the borders. For that, the iris image is gray scaled and the Canny edge detector is applied to generate the edge map. It first smoothen the iris image using Gaussian filter which is defined as

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

where σ is the standard deviation.
Then it uses a first derivative operator on the smoothed image. Non-maxima suppression isused to set zero values on the pixels that are not actually on the ridge top, so that only the dominating edges are generated. Then it uses two thresholds T1and T2 (T1 >= T2) to control the final output edge map. All the pixels with avalue higher than T1 are marked as edge points. All the pixels adjacent (using eight connectivity) to edge points and with a value higher than T2 are marked as edge points.

Thencircle is found by voting based on circular Hough transform[2]. Each edge point found in the previous step can generate votes for a family of circles with different radii and center points. The maximum value (x, y, r) in the Hough space gives the parameters for the circle.To minimize the search range, the range of radius values of images in the UBIRIS database (database from which iris images are taken for demo purpose) were set manually. In the UBIRIS database, the value of the pupil radius ranges from 25 to 75 pixels and that of the iris ranges from 90 to 160 pixels. So, Hough transform for the inner boundary is performed.

3.3 Normalization-
This part is necessary because different eye images have different size due to distance between the image capturing camera and the human eye and also because of the different positions and angles of the human face. So, if images of same eye have different size then it will be impossible to be compared properly, hence we need to normalize the images to a fixed size that they can be compared easily.Daughman'srubbersheet model (explained in section II) is used for normalization[1].

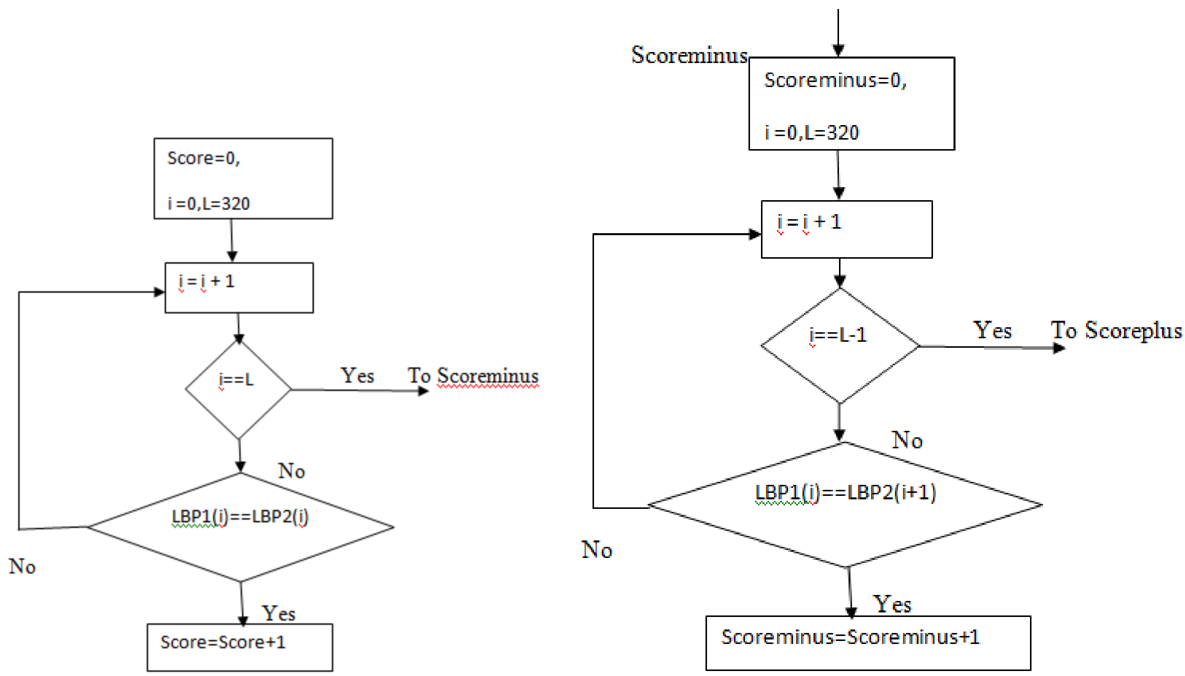
3.4 Feature extraction-

We have used novel technique to extract features in the form of local binary pattern (LBP).The steps involved are as follows-

1) Normalized image is grayscaled.Then,cropped using MATLAB command `imcrop(I,[x1 y1 wwhh])` where I is normalized image and `[x1 y1 wwhh]` are the variables that specifies the size and position of the cropping image where `x1=uint32(angle-WINDOW_SIZE)` ,`y1=unint32(MAX_RADIUS – WINDOW_SIZE)` and range of `angle` is `WINDOW_SIZE+1` to `360-WINDOW_SIZE`. Here, `WINDOW_SIZE=20` and `MAX_RADIUS=75`.
2) For the cropped image, threshold level is determined using `graythresh` which uses Otsu's method for thresholding.Store its value in `level` variable.
3) Convert the grayscale image to a binary image using `im2bw`.It replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black).
4) That, Black and white image is resized to half. Store the center pixel of resized image as first bit of LBP.Repeat the procedure for next `x1 y1` i.e., `angle` incremented by 1 uptill `360-WINDOW_SIZE` value and get next bit of LBP.

3.5 Matching-

After generating LBP of current iris image, it is compared with LBP of registered iris image using matching algorithm shown in figure 3.LBP1 is LBP of registered image and LBP2 is LBP of current iris image. L is total number of bits in LBP i.e., 320. LBP2 is bitwise compared with LBP1and depending on it Score is generated. Then, each bit of LBP1 is matched with the successive bit of LBP2 and Scoreminus is incremented for each match. Similarly, each bit of LBP1 is matched with the precedent bit of LBP2 and Scoreminus is incremented for each match. If one of the among Score, Scoreminus and Scoreplus is greater than threshold, user is authenticated. As LBP consist of 320 bits, maximum match occurs if all the bits are matched i.e., Score becomes 320.But, Maximum match is not possible always. So, threshold is to be set. Here, threshold is 70% of maximum match i.e., 320, approximately 225 is used. So, matching algorithm consist of voting based method.



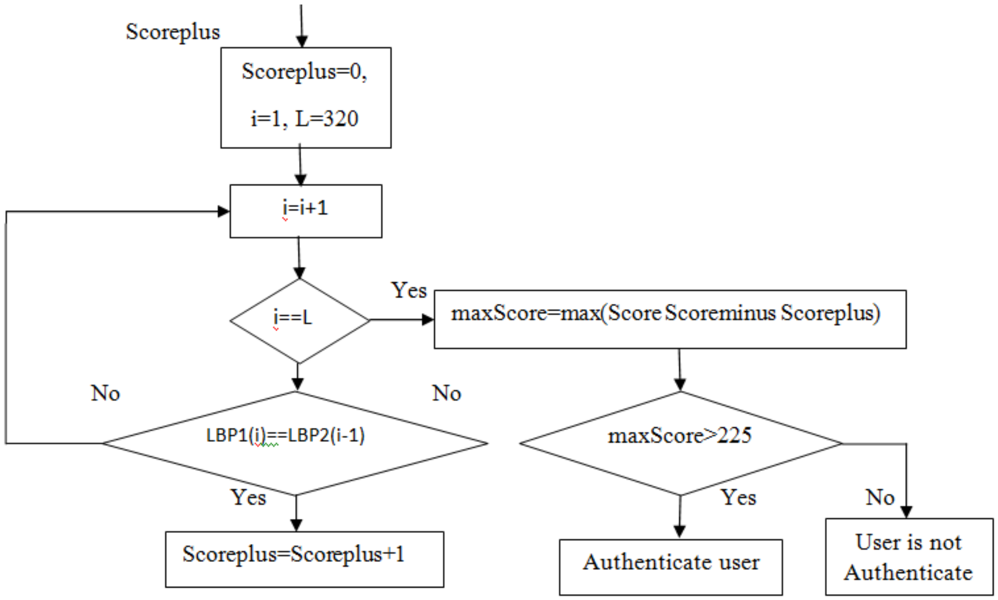


Figure 3. Flow chart of matching LBP

3.6Registration and Authentication-

Our goal is to design password less system which provide secure access so, iris is used to verify a person. If user is first time using iris recognition system, user has to register his iris image(taken by IR camera) by swapping RFID tag. After swapping a number is generated which is assigned to iris image of user. The registered iris image is segmented, normalized, and its feature is extracted in the form of LBP (local bit pattern) which is stored in database. When user wants to access a system, he swaps RFID tag and the same number is generated which is already assigned to registered iris image .Current iris image of user is taken through IR camera and segmented ,normalized ,features extracted in the form of LBP. This LBP is matched (compared) with LBP of image assigned by number which is generated after swapping RFID tag i.e., matched with LBP of registered iris image of user .If LBP of current iris image is matched with LBP of registered image in database ,user is authenticate to access otherwise not.

RFID tag is used to assigns a number to register iris image and its LBP is stored in database. When user swaps same RFID tag, LBP of current iris image is compared only with LBP of registered iris image in database. So, only one to one matching is necessary.

Hardware aspects – Hardware of proposed system have mainly microcontroller,Max232 and ULN2803.After authentication through iris recognition system, user will get access to a particular environment e.g., electronic voting machine. Here, we are implementing hardware to provide access to user to devices working on 230 ac voltage. Hardware setup consist of serial communication between PC (in which MATLAB) and microcontroller to which devices are connected through device driver and relays. Circuit diagram is shown in fig.2

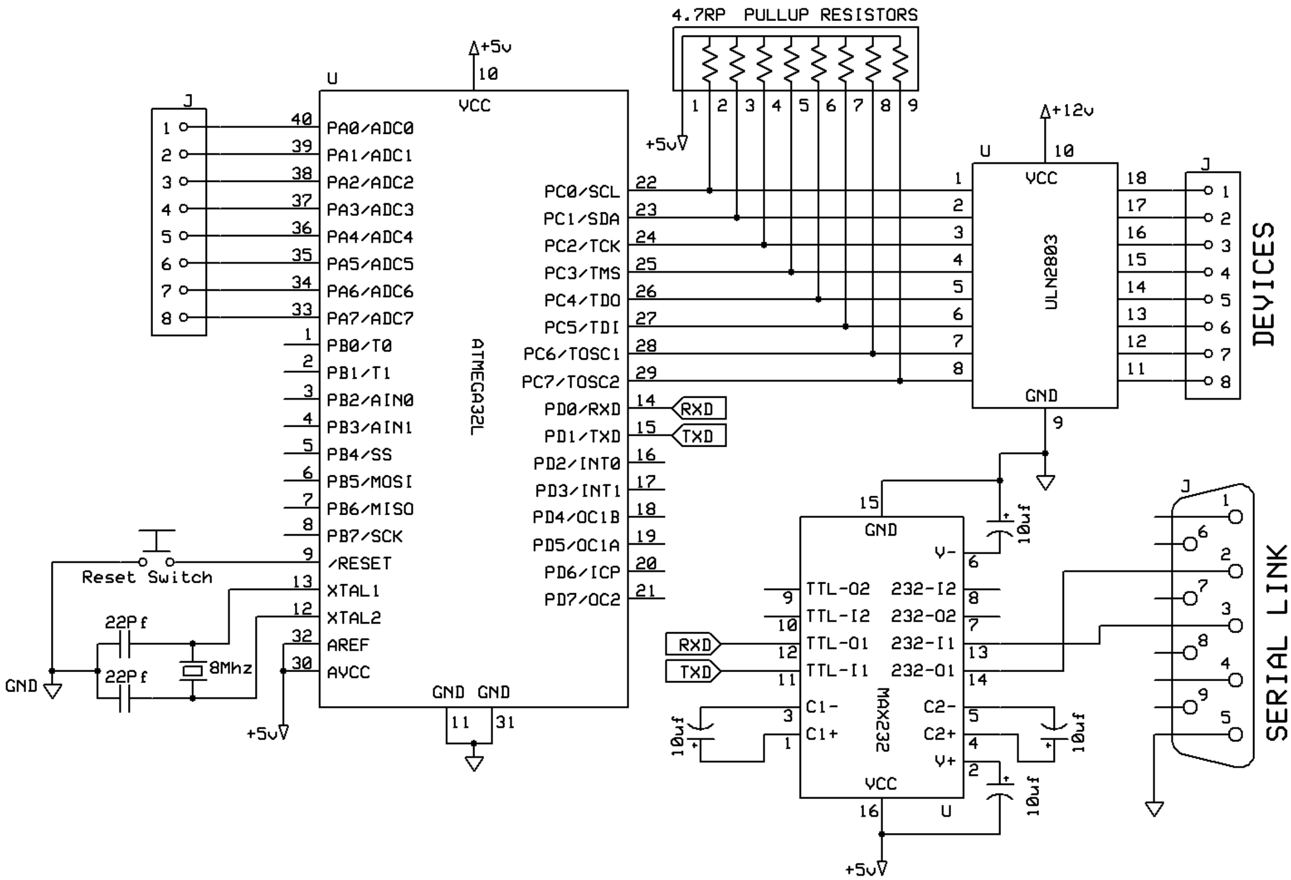


Figure 4. Interfacing of devices with microcontroller

i. MICROCONTROLLER - Atmel microcontroller is powerful device for interfacing with any peripherals. The ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The ATmega32 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits. Port pins can provide internal pull-up resistors (selected for each bit).Devices (to which secure access is provided) are connected to port C of microcontroller through IC ULN2803.

ii. ULN2803- The voltage and current requirements of high power loads are beyond the capabilities of standard logic buffers.So,ULN2803 high voltage, high-current Darlington array is used for interfacing between low-level logic circuitry and multiple peripheral power loads. Typical power loads totaling over 260 W (350 mA x 8, 95 V) can be controlled at an appropriate duty cycle depending on ambient temperature and number of drivers turned ON simultaneously. Typical loads include relays, solenoids, stepping motors, magnetic print hammers, multiplexed LED and incandescent displays, and heaters.The ULN2803 have series input resistors selected for operation directly with 5 V TTLor CMOS. The outputs are capable of sinking 500 mA and will withstand at least 50 V in the OFF state. Outputs may be paralleled forhigher load current capability.

iii.MAX232-In serial communication between AVR and PC, the serial port of the AVR cannot be connected to the PC serial port directly. The RS-232 signals are bipolar and in the range of +12 V and -12 V, while the AVR can only handleTTL-level signals (if powered from a +5-V supply). Also, the data as appears on the RS-232 line is inverted i.e., when the PC wants to send a logic “0”, the voltage onthe RS-232 line is +12 V, and when the PC wants to send out logic “1”, line voltage is -12 V.

So line driver and receiver that converts the RS-232 signal levelsto TTL, and vice versa, is needed [5]. So, MAX232 is used.The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply voltagelevels from a single 5-V supply. Each receiver converts inputs to 5-V TTL/CMOS levels.

Serial communication-Data transmission rates are typically specified as a baud or bits per second rate. For example, 9600 baud indicates data are being transferred at 9600 bits per second.

To receive a serial bit stream, the program must monitor the signal. The idle state of the serial TTL signal is "1". As soon as a low-going transition is detected, it denotes the beginning of the Start bit and the start of a transmission [6].Fig.3 shows how the original data is reorganized with a start bit added at the beginning of the data transmission and at the end, an optional parity bit, and one stop bits.

Original byte (MSB … LSB)

D7	D6	D5	D4	D3	D2	D1	D0

Transmitted sequence

Start bit	D0	D1	D2	D3	D4	D5	D6	D7	Parity bit (Optional)	Stop bit

Figure5. Arrangement of original bit sequence in asynchronous serial data transmission.

Sequences of operation for serial communication performed by PC through MATLAB software are as follows:
1)Afterauthenticating user ,serial communication between PC and microcontroller is enabled.
2)Ports are defined, Baud rateof 9600 is set.
3) As no parity is required, set parity bit as none. Set the number of databit as 8and number of stopbit as 1.
4) Configure OutputBufferSize as the total number of bytes that can be stored in the output buffer during a write operation. We configure the default value i.e., 512 bytes.
5) To turn on device connected to microcontroller send a value on serial port. For example, if device is connected to pin2 of port c then value to be sent is 0000 0010.

Softwareaspects :-Basically 2 software are used in above proposed system.

MATLAB®:- All the stages of iris recognition i.e., segmentation, normalization , feature extraction ,matching and providing access to devices through serial communication are implemented using MATLAB®.

MicroC and AVR flash :-MicroC pro for AVR is powerful, feature rich development tool for AVR microcontroller. It is design to provide the programmer with easiest possible solution for developing application for embedded system without compromising performance and control. The software used for burning the program in the microcontroller is the WinAVR (AVR Flash).

IV RESULT

The GUI for iris recognition system is shown in figure6. For registration of user, iris image is loaded. The user swapped RFID tag given to him and register image by clicking on Register New User button.The unique identification number of RFID tag (here, it is 51002BF829AB) is displayed on screen and it is assigned to registered image. To authenticate user, current iris image is loaded .The user swapped same RFID tag and same identification number is displayed on screen. Current iris image is compared with iris image to which unique identification number is assigned by using RFID tag. If match found, a dialogue box containing message 'User Authentication OK' is displayed and user gets access devices connected to Port C of Atmega 32otherwise dialogue box containing message 'user Authentication Failed' is displayed.

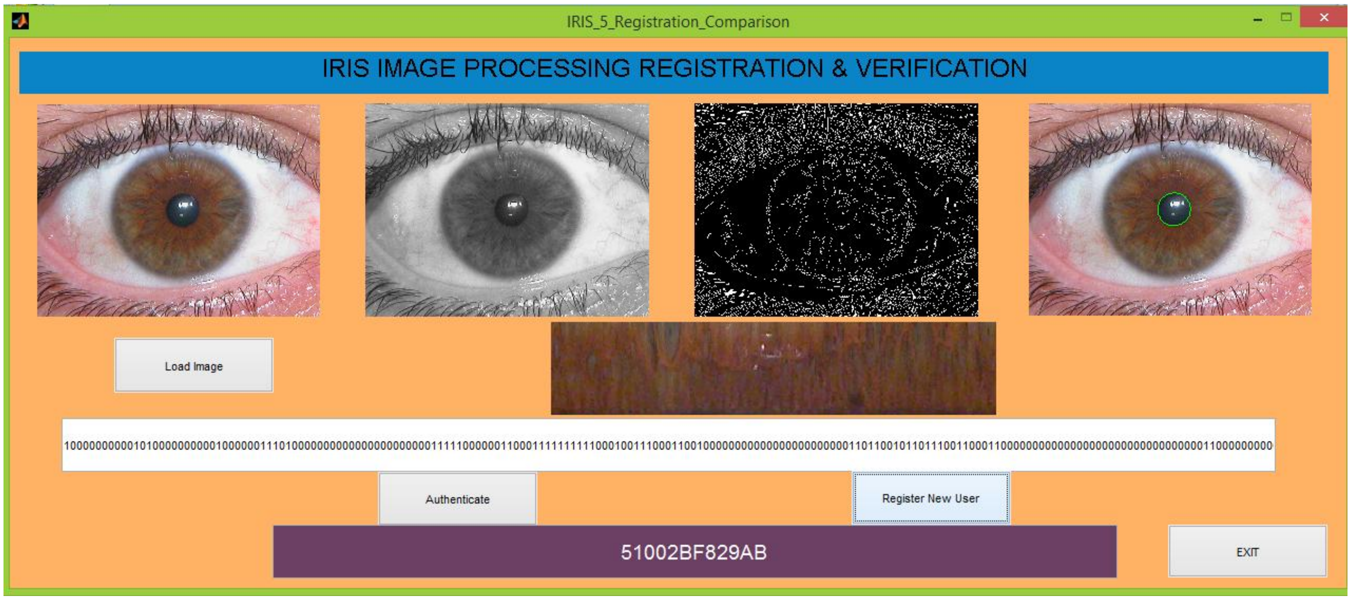


Figure 6 a. Registration of user

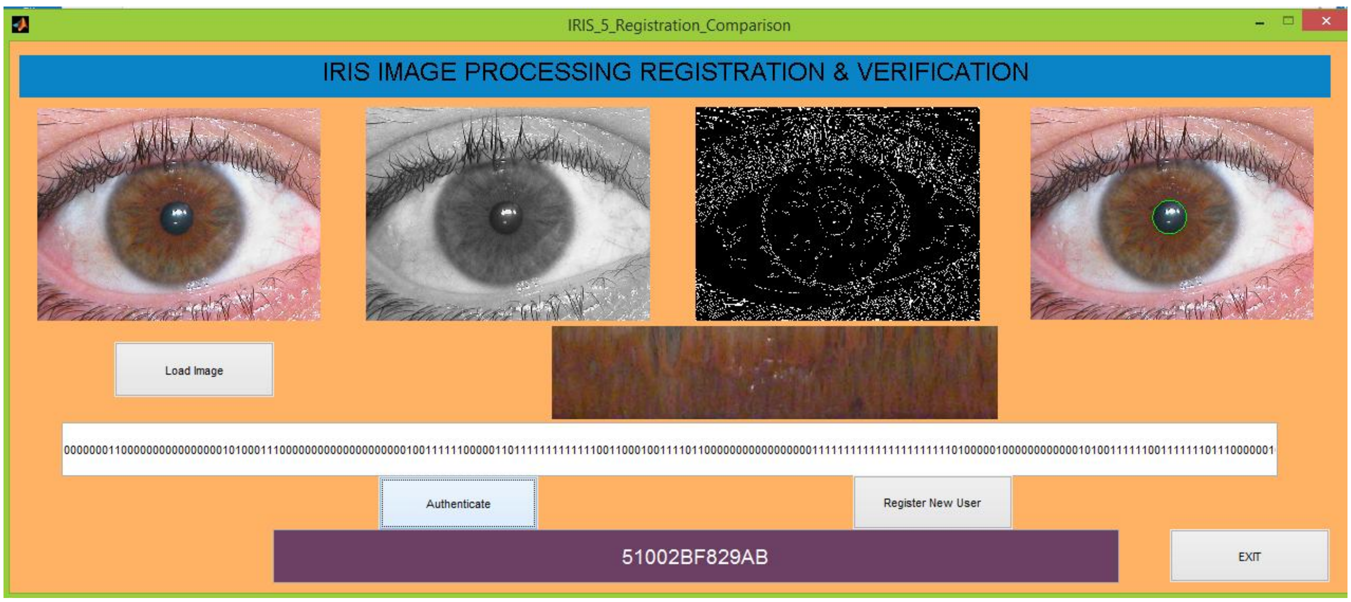


Figure 6 b. Authentication.

In figure 6a and 6b from clockwise view, first image is loaded iris image which grayscaled and shown in next image. Third image is image after application of canny edge operator. The green circle in next image indicates detection of iris pupil boundaries. Next rectangular image is normalised image. The bit stream is LBP of iris.

V. CONCLUSION

We have successfully developed iris recognition system with the use of radio frequency identification technology(RFID).Registration of user using RFID tag assigns unique identification number to user iris image. During authentication same RFID tag is swapped. Instead of comparing current iris image during authentication with all images in database, it is compared only with registered image to which unique identification number is assigned by same RFID tag. So, RFID is used for one to one matching.

Here,Segmentation is performed using circular Hough transform. Features are extracted in the form of local bit pattern and voting based matching algorithm is used.A device to which secure access is provided , is connected to Atmel microcontroller through IC ULN2803 and PC is serially communicated with Atmel microcontroller.

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