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IOT Based Security System for Lockers

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Abstract: *The IOT Based Security System for Lockers aims at providing users one of the safest authentication mode to access their lockers. It will use Iris as an authentication mode to access the locker. Since Iris pattern doesn't change from birth till death and no two iris pattern can be same, the system will have the highest level of security. No other person except the authenticated user will be granted access to the locker.The security of access by using key is highly at the risk as anyone can find the key and gain access to the precious things. The increasing theft in day to day life is a major headache.*

Keywords: *Security system, Iris recognition system, Biometric identification, Pattern Recognition*

I. Introduction

IOT Based Security System for Lockers will successfully verify registered user and recognise the person whether the one who accessed the system is the registered user or not.

System will verify a user accessing the locker by using iris detection. The registered user will be given access to the locker.

Intruder to the system will be denied access to the locker. Also, the buzzer will ring to alert the people in the vicinity of the locker with the tolerance of 2. The system will not respond for 30 minutes after the buzzer stops ringing.

Android APP will provide user with access and intruder details.

The system has following features:

- No need to remember password or carry bunch of keys.
- Highly secure as it uses Iris recognition, which is unique for every individual.
- The system is simple and efficient and requires very few components.
- Reduces chances of robbery because of its feature of notification and buzzer sound.
- User can keep track of how many times the locker was opened along with the date and time hence is more secure.

II. System Overview

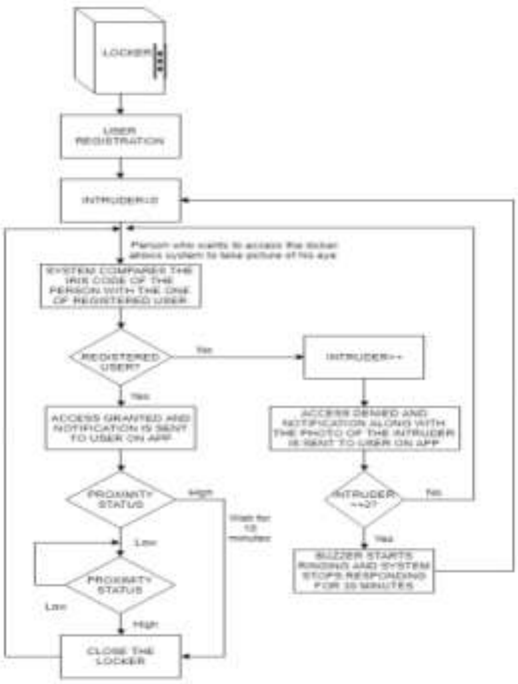

Figure 1: Flow of the system

Figure 1 illustrates the overall control function system. The system communicates with its users via mobile APP. This is a secured and reliable locking system. The system will detect and control unauthorized access for safety of the lockers in banks, at home, offices etc. It is easy to use and requires no special training and equipment. It provides unique Android App, which is accessed by only the authorized person only.

The user will register with the system using android app. When the iris is scanned using camera it compares the iris data in database at the time of request to access. If it matches with the data, system will grant the access to the user.

If the unauthorised person tries to access the locker the system will click the picture of that person and send it to user on his android APP with the push notification stating 'unauthorised attempt to access the system' along with the photograph of the unauthorised person. Buzzer will start ringing after the system exceeds the tolerance limit of unauthorised access. The tolerance by default is 2. The system will not respond for 30 minutes after the buzzer stops ringing.

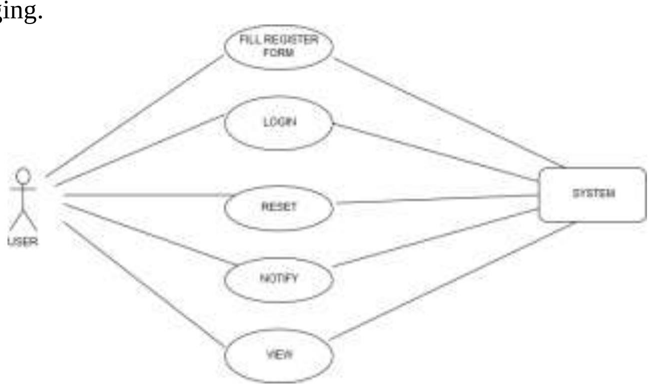

Figure 2: Use case diagram for Android app

User will get the track and the details regarding the access of the locker, such as time and date of access granted in past. Using the app user can see when and how many times he accessed the locker as well as the details about the unauthorised access attempt.

IOT Based Security System for lockers is highly accurate in terms of security and no one can hack or crack the system because of using the Android App which gives user notification of locker access every time we use it.

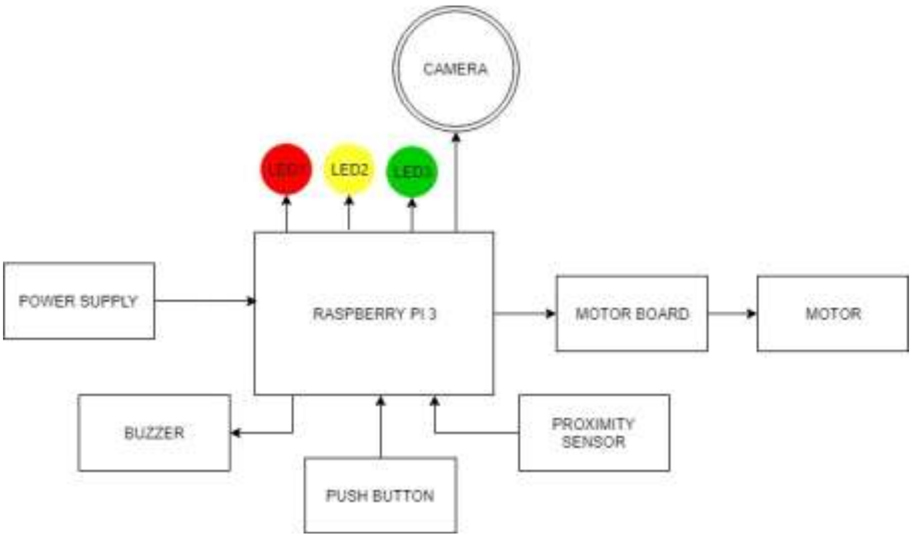

Figure 3: Block diagram of the system

III. Stages of Irisrecognition System

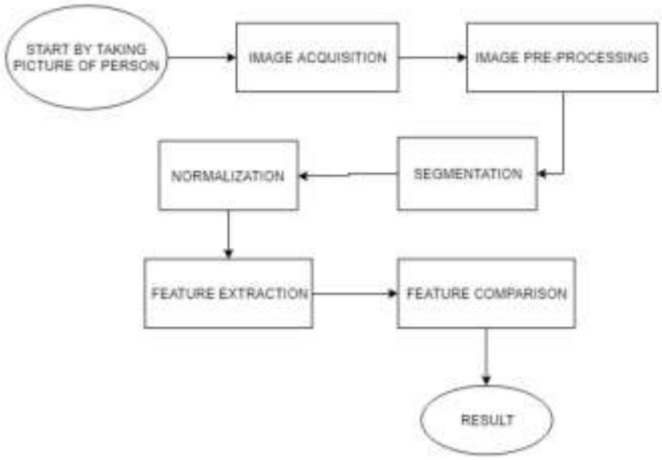

Figure 4: Stages of iris recognition system

A. Image Acquisition

Initial stage of the Iris recognition system is to take photo. The quality of the image taken during image acquisition stage decides the success of other recognitionstages.[7]

B. Image Pre-processing

Initially, a primary processing is performed on iris images, in order to improve and facilitate later processing. In pre-processing stage, to enhance iris outer boundary that is not recognized well in normal conditions, Canny edge detection is used and to enhance Canny iris points, multiplier function is used. Also, image contrast adjustment is performed to make its pixels brighter. [6]

C. Segmentation

Success of the system in upcoming stages is directly dependent on the precision of segmentation stage. The main purpose of segmentation stage is to localize theinner boundary of iris-pupil and outer one of iris-sclera, and to localize eyelids.

Segmentation stage includesfollowing steps:
1)Localization of iris inner boundary: Regarding that illumination intensity is very different in outer and inner parts of the pupil, and pupil is darker compared with iris, theCanny edge detection used in pre-processing stage determines points in iris pupil boundary. Therefore, boundary of the pupil is almost completely detected. After determining edge points, the centre and radius of iris circle are obtained by using circular Hough Transform.[4][5]

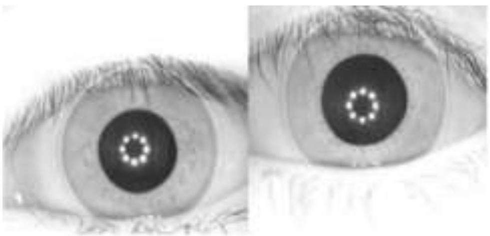

Figure 5: Outer boundary localisation

The circular Hough transform is used to obtain the radius and centre coordinates of the pupil and iris.
The first derivatives of intensity values in an eye image is calculated and then the result is threshold to generate an edge map. Votes are cast in Hough space for the parameters of circles passing through each edge point, using the edge map. These parameters are the centre coordinates x_c and y_c, and the radius r,
$x_c^2 + y_c^2 - r^2 = 0$ (1) [1]

*2) Localization of iris outer boundary:*Edge detection algorithms are able to detect outer iris edges, thushelp in identifyingthe points on edge. Therefore, to detect iris outer boundary, these points have to be recognised and eliminated. Boundaries are enhanced and then extra edge points are identified for elimination. Finally,outer iris boundary is obtained, using circular Hough transform. [4][5]

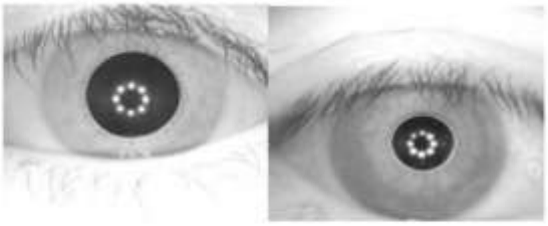

Figure 6: Inner boundary localisation

3) Localization of boundary between eyelids and iris: We can consider the boundary between eyelids and iris as two lines. Properties of the line are obtained by using linear Hough transform to localise them after the edge detection. Canny edge detection is used to detect eyelids boundary. [4][5]

D. Normalization

In normalization stage, an approach based on Daugman's method is used. Iris area is obtained as a normalized strip with regard to iris boundaries and pupillary centre.

To transform iris area to Cartesian coordinates, 128 pupils- centred circles are chosen starting from pupil-iris boundary and then the pixels which are located on them are mapped into a rectangle. As a result, iris area which looks like a circular strip is converted into a rectangular strip. Illumination intensity in segmented iris tissue is then adjusted, i.e. image contrast is applied to bring more clarity into iris tissue. [1][2][6]

1) Daugman's Rubber sheet model.

A Remapping formula is used for converting the points on the Cartesian scale to the polar scale considering the centre of the pupil as reference point.

$$r` = \sqrt{\alpha}\beta \pm \sqrt{\alpha\beta^2 - \alpha - r_1^2} \quad (2)$$

Where r_1 = iris radius

$$\alpha = o_x^2 + o_y^2 \quad (3)$$

$$\beta = \cos(\pi - \arctan\left(\frac{o_y}{o_x}\right) - \theta) \quad (4)$$

An equivalent position is found out on polar axes for each and every pixel in the iris.The normalized image is then interpolated into the size of the original image. A normalised value is obtained by dividing NaN which is obtained by the parts in normalised image by the sum.[1][2][3][6]

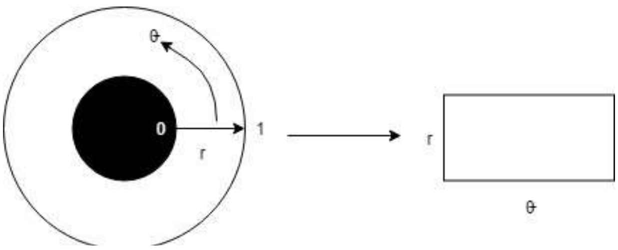

Figure 7: Unwrapping the Iris

E. Feature extraction and iris encoding

To extract features, two-dimensional Gabor Filters are utilized. Through performing Gabor Filters to the image from different orientations, ultimate feature vector is obtained.

Wavelet transform is performed in order to decrease the dimensions in the way that important information existing in tissue can be preserved in spite of downsizing image dimensions. By performing Wavelet transform twice on an image of 256*512, we will have a smaller one of 16*32. This image is used to extract features vector. The encoding obtained in this stage with dimensions of 80*240 enters the next stage of the system namely matching stage.[1][5]

Regarding that some sections of the area chosen for feature extraction may have occlusions caused by eyelids and eyelashes and since it is possible that, because of error in segmentation stage, some parts of sclera be detected as iris area, it is required that a measure be taken to remove these points from the feature extraction stage. To resolve the latter issue that is caused by error when detecting iris outer boundary, 20% of the lower section of the image is eliminated and to resolve the first issue, points of the image that are placed in this section are eliminated from encoding. Two outputs are generated in this stage. First output belongs to transformation of iris to iris encoding and another output belongs to transforming iris noises into encodings.[1][3][5]

1) Gabor Wavelet transform

For the generation of the iris code, the most discriminating feature in the iris pattern is extracted. Extraction of the phase informationis done using 2D Gabor wavelets. It determines which quadrant the resulting phasor lies using the wavelet:

$$\mathrm{h}_{\{\mathrm{R_e},\mathrm{I_m}\}} = sgn_{\{\mathrm{R_e},\mathrm{I_m}\}} \int_{\rho} \int_{\theta} I(\rho,\theta) e^{-i\omega(\theta_0-\emptyset)} \cdot e^{-(r_0-\rho)^2/\alpha^2}$$

$$\cdot e^{-(\theta_0-\emptyset)^2/\beta^2} \rho d\rho d\emptyset \qquad (5)$$

where, $\mathrm{h}_{\{\mathrm{R_e},\mathrm{I_m}\}}$ has the real and imaginary part, having the value 1 or 0, depending on which quadrant it lies in.[1][3]

F. Classification and matching

In the method, Hamming distance criterion is used. Digit 1 is returned if the value of one feature vector is equal to another feature vector in a point and digit 0 is returned if they are not equal and the values returned are then summed up. The best of Hamming distance is found by following equation to attain similarity criterion.

$$\mathrm{HD} = \frac{1}{N}\sum_{i=1}^{N}(x_i \oplus y_i) \qquad (6)$$

In this equation N is equal to total numbers of feature vector points; and x_i, y_i is values of two compared feature vectors.[8]

IV. Conclusion

We describe in this paper the most secured authentication system for lockers. Since biometric authentication is one of the most reliable form of identification and access control, it will take over the physical means of authentication in near future.

The system will use iris recognition which is implemented using edge detection algorithms, hough transform, wavelet transform and daugman's algorithm.

The feature of notifying the user about the intruder access as well as the user access makes the IOT based security system for Lockers more secured and reliable.

Acknowledgement

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