Security System Implementation of Safe Deposit Box Using Iris Pattern Based Matlab

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Abstract. This research explains about a biometric system that uses iris pattern for Safe Deposit Box Users. Matlab is used for processing the iris pattern. In the process of image processing, there are several processes such as segmentation, extraction and identification. The initial phase of segmentation will be proceed using canny edge detection then continued by hough circle transform to detect the center circle of iris. The second process is by extracting where the image of segmentation will be proceed by using haar wavelet transformation, the image will be changed to another form by decomposition of the vertical and horizontal image of the iris in order to get the data from iris image of user. The last phase is identification. In this stage, hamming distance method that will read the iris data in the database that has get through both phases and compare it with image captured by the webcam camera. If the image of user has been detected, then the safe deposit box will be opened. The advantages of this system is the iris pattern is very stable and different form each individual so it is not easy to be manipulated. The average identifying of this research is 76.70%. As security system, using iris pattern can be developed to prevent unwanted act.

1. Introduction
Information technology is developing rapidly. Without exception in security system technology continues to be developed. Unfortunately conventional security system is still used [1]. Such as name, password, and identification card can be lost or stolen. Thus, there is tremendous interest in improved methods of reliable and secure identification of people [2]. Iris pattern is being considered to improve the security system and decrease manipulation because of the stability and different each individual. Compare with fingertips, iris is more stable because its inherent isolation from external environment, impossible to modifying without unacceptable risk to vision and physiological response to light. And also in iris there is no genetic penetrance in the expression [3]. Iris recognition is process to analyze the random pattern of iris [4]. A typical iris recognition system includes six main stages [5]. The first stage, image identification that is done with capturing the series of images of the iris using cameras. The second stage, image preprocessing that means the control of size, color and light of the image. The third stage, segmentation which includes iris and pupil boundary detection, and additionally detect eyelids and eyelashes. The fourth stage, normalization means converting the iris region into form like a rectangle. The
fifth stage is extracts features from the normalized iris image and encodes these features that is suitable for recognition. The last stage is comparison the features created by imaging the iris with stored features in database.

The bank facilities, Safe Deposit Box gives the customer service to keep their important things and protect from theft or robbery [6]. Strengthens the security in safe deposit box make the customers feel safe and comfortable leaving their valuable things.

2. Method

Block Diagram describe a system that would be designed, each diagram has different function. Block diagram system was shown on Figure 1:

![Figure 1. Block diagram system](image1)

As shown in Figure 2, webcam used for capture image of iris pattern. Process block include database, Matlab and Microcontroller. The function of Matlab is processing image of iris pattern then Arduino uno act as servo motor. Output function is to open and close the lock on safe deposit box.

Instrument design is explaining about the whole system that would be designed and implemented such as hardware and software planning [7]. The box is not the real safe deposit box like in the bank but only imitation. Its material is wood with dimension 30 x 15 cm. Inside the box placed microcontroller arduino and motor servo.

![Figure 2. Safe deposit box imitation](image2)
2.1 Hardware Design

In designing hardware will be explained configuration of arduino uno, motor servo SG90 and webcam, where all module are supporting the system. On the door of safe deposit box will be attached an arduino and a motor servo that connected with notebook to receive order for opening and closing the key. Webcam is an important device in system design, to operate webcam need PC or notebook that connected with USB port. Arduino used as media to receive command from matlab software if system detected safe deposit box user. Arduino has 14 I/O digital pin, 6 input analog pin, power 5V and ground.

2.2 Software Design

In this description will be explained about application design that has been made on GUI (Graphical User Interface) as shown on Figure 3.

![Figure 3. Matlab R2015a GUI display](image)

The following is explanation about function on GUI display:
1. **Axes1** is displaying image acquisition that captured by webcam
2. **Axes2** is displaying image of iris pattern
3. **Axes3** is displaying the result of segmentation and extraction processing
4. **Axes4** is displaying the result of matching iris pattern image
5. **Configure Camera** is use for configuring webcam
6. **Capture** is use for capturing iris pattern user
7. **Reset** is use for restarting program
8. **Exit** is use for closing from running program
9. **Process** is used for processing an image of iris to obtain proper data.
10. **Identification** is used for matching the captured iris image with the iris image in the database.
11. **Open** is used for opening a Safe Deposit Box.
12. **Closed** is used for closing a Safe Deposit Box.

Figures 4 and 5 explain a flow of system program:

**Figure 4.** Iris Identifying Command Flow
3. Results and Discussion
In this discussion will be explained step in running program for detecting iris pattern. First step is configuring input video type, and then choose device used, in this case use device 1. Figure 6 is the display of camera configuration.

Figure 5. Segmentation and extraction flow

Figure 6. Result after configuration
Image of eyes that has been captured shown in Figure 7.

![Figure 7. Capturing Iris Image](image)

During processing after clicking process button, as shown in Figure 8, windows will appear to choose folder where the image will be save.

![Figure 8. Saving processing image](image)

Figure 9 shown the display of iris image after segmentation and extraction.
3.1 Iris Segmentation Test

Result of segmentation trials are divided in two categories that is succeed where circle will right on iris edge and not succeed where circle far from iris edge. It happened because each iris image has different threshold value. The result will be explained on Table 1.

Table 1. Segmentation result

| No | Segmentation Test  | Test Result | Information |
|----|-------------------|-------------|-------------|
| 1  | Eyes’s image 1    | ![Image](image1.png) | Failed      |
| 2  | Eyes’s image 2    | ![Image](image2.png) | Success     |
| 3  | Eyes’s image 3    | ![Image](image3.png) | Success     |
| No | Segmentation Test     | Test Result | Information |
|----|----------------------|-------------|-------------|
| 4  | Eyes’s image 4       |             | Success     |
| 5  | Eyes’s image 5       |             | Success     |
| 6  | Eyes’s image 6       |             | Success     |
| 7  | Eyes’s image 7       |             | Success     |
| 8  | Eyes’s image 8       |             | Success     |
| 9  | Eyes’s image 9       |             | Success     |
| 10 | Eyes’s image 10      |             | Success     |

3.2 Iris identification Test

Testing carried out on thirty sample where the sample obtained from three different person. Reference of iris image can be identifying or not based on three parameter that are area, perimeter and eccentricity. These parameters will be compared to all iris samples and then if the value is close to the data in database iris image stated “Successfully Identified”, on other side if the value is far from the data iris image stated “Misidentified”. The result in Table 2 showed that half of samples successfully identifying.
### Table 2. Sample test result

| No | User Name          | Test Result | Status  | Information                      |
|----|--------------------|-------------|---------|----------------------------------|
| 1  | Muhamad Anton Riyanto | Failed      | Program fail to identify SDB’s user |
| 2  | Muhamad Anton Riyanto | Success     | Program success to identify SDB’s user |
| 3  | Muhamad Anton Riyanto | Success     | Program success to identify SDB’s user |
| 4  | Muhamad Anton Riyanto | Success     | Program success to identify SDB’s user |
| 5  | Muhamad Anton Riyanto | Success     | Program success to identify SDB’s user |
| No | User Name       | Test Result | Status  | Information                                      |
|----|-----------------|-------------|---------|--------------------------------------------------|
| 6  | Muhamad Anton   | ![Image](image1.jpg) | Failed  | Program fail to identify SDB’s user              |
|    | Riyanto         | ![Image](image2.jpg) |         |                                                  |
| 7  | Muhamad Anton   | ![Image](image3.jpg) | Failed  | Program fail to identify SDB’s user              |
|    | Riyanto         | ![Image](image4.jpg) |         |                                                  |
| 8  | Muhamad Anton   | ![Image](image5.jpg) | Success | Program success to identify SDB’s user           |
|    | Riyanto         | ![Image](image6.jpg) |         |                                                  |
| 9  | Muhamad Anton   | ![Image](image7.jpg) | Failed  | Program fail to identify SDB’s user              |
|    | Riyanto         | ![Image](image8.jpg) |         |                                                  |
| 10 | Muhamad Anton   | ![Image](image9.jpg) | Success | Program success to identify SDB’s user           |
|    | Riyanto         | ![Image](image10.jpg) |         |                                                  |

### 3.3 Iris Pattern Testing Data

In identifying process iris pattern, there are three parameter such as area, perimeter, and eccentricity. Where these parameters is essential in image extraction. Table 3 is data regarding image identification.
## Table 3. Data testing result

| No | Area       | Perimeter  | Eccentricity | Success (%) | Failed (%) |
|----|------------|------------|--------------|-------------|------------|
| 1  | 395754     | 5015.922   | 0.895277281 | 76.70%      | 23.33%     |
| 2  | 403424     | 5727.46    | 0.876276532 |             |            |
| 3  | 437507     | 5376.522   | 0.855777937 |             |            |
| 4  | 358468     | 4083.241   | 0.895310976 |             |            |
| 5  | 425029     | 4883.9     | 0.884221441 |             |            |
| 6  | 352622     | 5539.738   | 0.892617458 |             |            |
| 7  | 385798     | 4663.391   | 0.906389094 |             |            |
| 8  | 439362     | 5259.314   | 0.88175336  |             |            |
| 9  | 59499      | 1354.317   | 0.936791208 |             |            |
| 10 | 440657     | 4991.099   | 0.871949028 |             |            |
| 11 | 381985     | 4207.867   | 0.910599548 |             |            |
| 12 | 412748     | 4877.013   | 0.886946049 |             |            |
| 13 | 387958     | 4638.638   | 0.902444689 |             |            |
| 14 | 390992     | 4222.596   | 0.90545729  |             |            |
| 15 | 386373     | 4554.911   | 0.902866401 |             |            |
| 16 | 385269     | 4557.71    | 0.902801519 |             |            |
| 17 | 386527     | 4474.686   | 0.903162103 |             |            |
| 18 | 382277     | 4725.701   | 0.902814649 |             |            |
| 19 | 378472     | 4669.58    | 0.903548865 |             |            |
| 20 | 381955     | 4551.369   | 0.903302455 |             |            |
| 21 | 476636     | 5443.87    | 0.837305224 |             |            |
| 22 | 406452     | 6274.749   | 0.81628183  |             |            |
| 23 | 415105     | 6328.191   | 0.812168005 |             |            |
| 24 | 580372     | 3325.065   | 0.828803379 |             |            |
| 25 | 582848     | 3073.377   | 0.827132954 |             |            |
| 26 | 581692     | 3071.723   | 0.827227601 |             |            |
| 27 | 579903     | 3339.932   | 0.828214399 |             |            |
| 28 | 578879     | 3059.849   | 0.827280526 |             |            |
| 29 | 580711     | 3076.456   | 0.827080678 |             |            |
| 30 | 580771     | 3067.167   | 0.827168503 |             |            |

From the data obtained from testing process from thirty sample showed that there is still error in identifying user iris and there is iris edge that couldn’t cut off well. Edges are points where there is a boundary between
two images region [8]. In the algorithms, shape, smoothness, and gradient value is being considered. This case happened because of image quality is bad or because of the program still not ideal. The quality of the image is decided by the resolution of the image. Different image acquisition cameras with format and resolution may be the cause of bad image quality [9]. Unwanted information such as eyelashes and eyelids which can be done using Sobel operator for detecting the edges for further research [10].

So on from success percentage showed different result from each sample, such as first sample can only identifying 50% of samples. Second and third sample successfully identifying up to 90%. If taken the average from the result, accuracy value from sample test result is in 76.70%.

4. Conclusion

Based on the result of system implementation, test, and analysis for identifying iris pattern, it can be concluded that iris pattern is very efficient to used as security system and not easy to manipulate because iris pattern is stable and different each individual. From the result can be stated the average accuracy presentation in identifying safe deposit box user is 76.70%. Factors that affect iris pattern identifying process are capturing image of iris pattern, interference of eyes such as eyelids and eyelashes.

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