# Comparative Analysis between Verieye's and Libor Masek's Algorithm in Iris Recognition

INGRID CHRISTIANI
Computer Science
UndergraduateProgram
BINUS University
Jl. Kebon Jeruk Raya No. 27,
Jakarta 11530
INDONESIA
ingrid@binus.ac.id

BENNY SENJAYA
Department of Industrial
Engineering
BINUS University
Jl. Kebon Jeruk Raya No. 27,
Jakarta 11530
INDONESIA
bsenjaya@binus.edu

BENS PARDAMEAN
Computer Science
GraduateProgram
BINUS University
Jl. Kebon Jeruk Raya No. 27,
Jakarta 11530
INDONESIA
bpardamean@binus.edu

*Abstract:-* The study is to comparethe performance of iris recognition algorithm between the open source algorithm (Libor Masek) and the commercially available one (VeriEye by Neurotechnology).There are five processes to evaluate the performance: 1) resize the bath iris images' resolution from 1280x960 to 640x480, 2) convert the images from JPEG2000 to JPEG format, 3) convert the images into grayscales using Matlab, 4) run the images with both Libor Masek and VeriEye algorithm, 5) measure the performance of the two algorithms usingReceiver Operating Characteristic (ROC) curve and the operational time framework. The ROC curves show that VeriEye's algorithm performs better than Libor Masek's. However, there is no significant difference in the processing time between the two algorithms.

*Key-Words:* - VeriEye, Libor Masek, Biometric, Iris, Iris recognition, Bath images

## 1 Introduction

Biometric technology is an automatic method of identification of a person based on their physiological or behavioral characteristics such as fingerprint, iris pattern, facial feature, voice, odor, signature, and speech[1]. The use of biometric technology has increased tremendously nowadayssuch as in banking for authentication, apartment complex for access control, airport security for border control, and national identification.

Among biometric technology, iris has attracted a lot of attention [2] because of its physical characteristics such as the uniqueness of the iris pattern and the system accuracy [3]. The iris is considered an internal organ located behind the cornea which makes it very difficult to modify, and if it happens, the risk will be at the eye and cannot be rebuilt [4].

This study aims to evaluate the better performance ontwo different algorithms, one that is commercially available on the market and the other one that is an open source algorithm. Performance has always been an important factor in biometric technology. Various tests were already conducted by National Institute of Standards and Technology (NIST) on the algorithm accuracy whether it was for iris, face, or fingerprint system [5].In an environment where throughput and security are priorities, there is no place for a bottleneck that could be caused by failures in identifyingan individual.

The algorithms that will be compared are VeriEye's algorithm by [6] and the algorithm by Libor Masek [7] for the open source algorithm. The performance measurement that will be compared are the error rates, False Accept Rate (FAR) and False Reject Rate (FRR),and the time that will use the operational time framework by [8].

## 2. Problem Formulation

As of writing, there has been no comparison between the performance of the commercially available and the open source algorithm namely Libor and VeriEye.

The main purpose of this study is to evaluate the performance of the commercially available and the open source algorithm using Bath iris images database. The study could contribute to an implementer or developer when they are choosing which algorithm to use when budget is a problem but performance is not an option.The result will show whether the open source algorithm (Libor Masek) would perform as good as the commercially available one (VeriEye) in terms of their FAR, FRR, and the time. The other benefit is opening the door for developing application that could incorporatethe open source algorithm if the result is promising.

The Bath iris images database was used for the study [9]. For this study, only 100 iris images were used due to the limitation of time.

This studyused a PC with Windows XP Professional SP2 installed, Intel ® Core ™ i3 CPU 540 @ 3.07Ghz, and RAM 3.24 GB DDR2. And for the list of software is as follows:

1. MATLAB® R2009 to modify and to run Libor Masek's algorithm
2. VeriEye algorithm by Neurotechnology
3. Microsoft Excel for data entry
4. SPSS to perform statistical analysis (t-test)
5. Ivan Image Converter to convert the JPEG2000 to JPEGuncompressed format

During the study, there were some limitations that the authors found and needed some modifications. The source code for Libor Masek's was modified on the calculation of the FAR and FRR error rate because it was very time consuming. The other limitation was the need of conversion on the size and format of Bath iris image database in order to work with the algorithms.

## 3. Problem Solution

The steps that were taken to evaluate the performanceof the algorithm are as follows:

1. Resize the bath iris images' resolution from 1280x960 to 640x480 using a Matlab program
2. Convert the images from JPEG2000 to JPEG format using Ivan Image Converter
3. Convert the images into gray scales format using Matlab program
4. Run the images on both algorithms, the error rates and the time were acquired
5. Run analysis on the performance using ROC generator and SPSS software

The experimental design for this study can be described using the flowchart as shown in Figure 1.

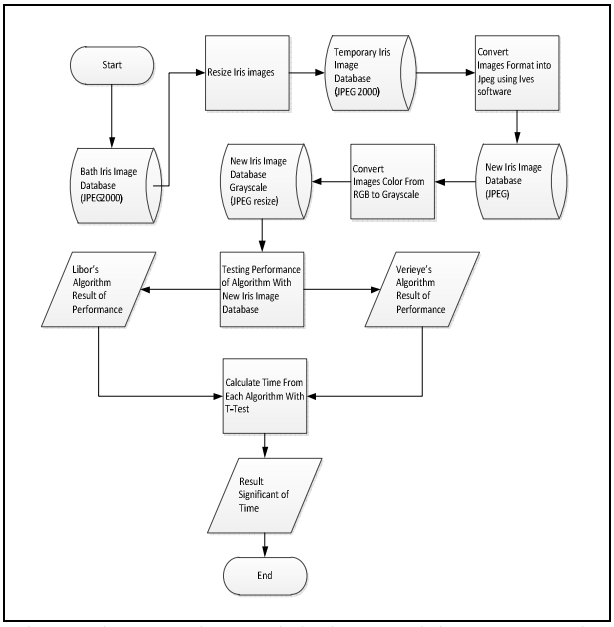


Fig. 1.The experimental design used for comparative analysis study.

The operational time framework that is used in the study is adapted from[8]. The operational time frameworkwas adjusted to only concern with the sample processing and biometric subsystem decision time. The adapted framework is shown in Figure 2.

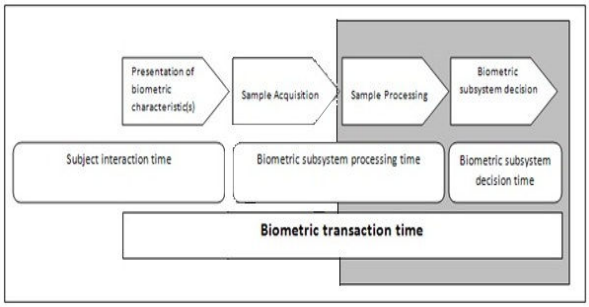


Fig. 2.The operational time framework which was adapted from [8].

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The sample processing time is the phase where it calculates the time of feature extraction and during the matching that produces Hamming Distances. The next process is to calculate the biometric subsystem decision Time. The biometric subsystem decision time in thestudyconsists of a process that determines whetherthe images were accepted or rejected based on the threshold.The FRR and FAR are also calculated in this step.

The statistical analysis method used in this study is t-test and will be run using the SPSS software. The t-test will be used to analyze the performance (time) between LiborMasek's and VeriEye'salgorithm. The images will be run three times on both algorithms to see the data reliabilityin which they produce in the process of identification. Both algorithms will be set equally during the data run.

The FAR and FRR will also be calculated and be used for analysis. ROC curve will be used to display the relationship between the errors. The ROC curves produce by both algorithms will be compared as well.

For this study, a modification is necessary for the Libor Masek's algorithm. Libor Masek's algorithm was developed for education purpose only so a slight modification on the source code is needed to give the same comparison to the VeriEye.

The modifications for the Libor Masek's are shown below:

1. Calculate FMR and FNMR using formula from [10]:

```
D0=Intra;

D1=Inter;

Dmin=min([D0 D1]);

Dmax=max([D0 D1]);

N0=length(D0);

N1=length(D1);

step=(Dmax-Dmin)/N;

cnt=1;

forth=Dmin:step:Dmax

FNMR(cnt)=sum(D0>th)/N0;

FMR(cnt)=sum(D1<=th)/N1;

cnt=cnt+1;

end
```

2. Calculate Hamming Distance:

```
for sub=sub1:Nsub

…

for j=sub+1:Nsub

….
```

and to avoid any repeated images, the following code will be used:

```
str=num2str(sub);

    str1=['template' str];

load(str1);

    template1=template;

    mask1=mask;
```

## 4. Conclusion

Table 1 shows the result from the t-test analysis on the time data.

| | N | Mean | SD | Sig. |
|---|---|---|---|---|
| VeriEye | 1000 | 0.180 | 0.024 | 0.00 |
| Libor Masek | 966 | 0.413 | 0.132 | |

Table 1. T-test result for the performance time.

Table 1 shows that VeriEye algorithm is better than Libor Masek algorithm in time with the mean of 0.180and 0.00 for its significant. Libor Masek's algorithm was able to run 966 images because there were segmentation errors with the 34 images. Libor Masek's algorithm could not segment the images might be caused by the location of the iris as shown in Figure 3.

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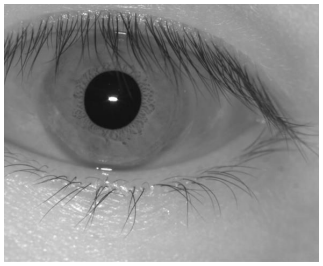

Fig. 3 Segmentation error was found on the image above when ran using Libor Masek's algorithm.

The position of the iris in Figure 3 was not in the centered position like the other segmented images (Figure 4 and Figure 5) which caused the Libor Masek's algorithm unable to detect the iris and the error occurred. The error was not calculated as Failure to Acquire (FTA), because if it did, it would make the Matlab to stop running the process.

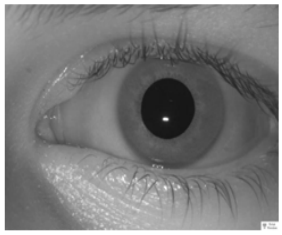

Fig.4 Original Image.

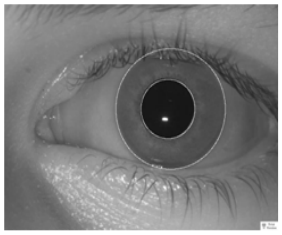

Fig. 5 Segmented Image.

VeriEye's algorithm did not produce any FTA.VeriEye's algorithm produced perfect zero (0) FAR and FRR as shown in the Figure 6 below.

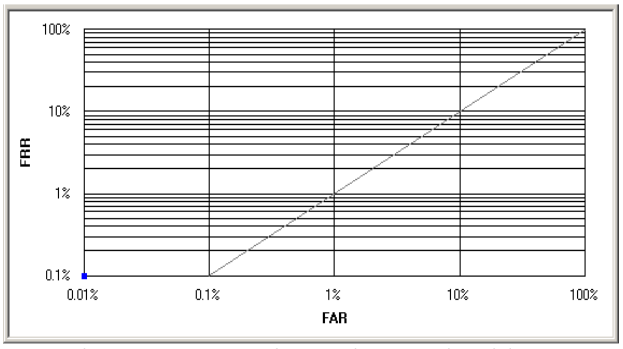


Fig.6.ROC curve for VeriEye's algorithm.

Libor Masek's algorithm produced 46% of FRR with FAR of 1% as shown in Figure 7 below.

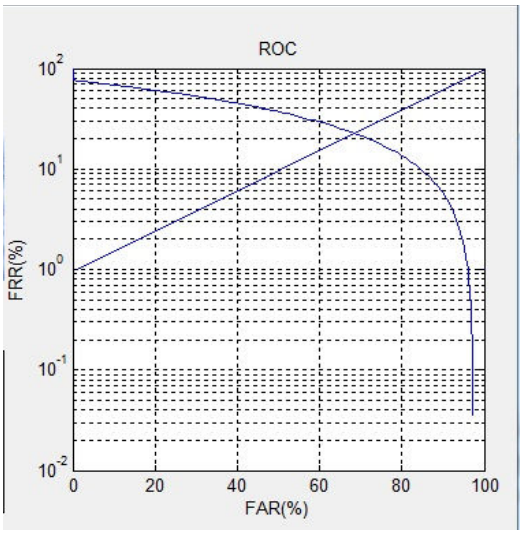


Fig.7.ROC curve for LiborMasek's algorithm.

Even though statistically there was no significant difference on the time's performance, the ROC curves show that VeriEye's algorithm performs much better than the Libor Masek's algorithm.

In conclusion, even though we found that Libor Masek's algorithm does not perform as good as the VeriEye's algorithm, further study can still be done to improve this algorithm. With the open source platform, this could attract developer to incorporate the algorithm in their application and perhaps it could also be translated into other programming languages other than Matlab.

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