Face Recognition For Additional Security At Parking Place

1. Scopus Index
2. Manuskrip awal
3. Email submisi makalah
4. Email hasil reviewer dan notifikasi penerimaan
5. Pernyataan penerimaan manuskrip
6. Manuskrip akhir

Source details

Feedback > Compare sources >

Communications in Computer and Information Science

Years currently covered by Scopus: from 2007 to 2025

Publisher: Springer Nature

ISSN: 1865-0929 E-ISSN: 1865-0937

Subject area: Mathematics: General Mathematics | Computer Science: General Computer Science

Source type: Book Series

View all documents > | Set document alert | Save to source list

CiteScore 2023
1.1

SJR 2023
0.203

SNIP 2023
0.246

CiteScore | CiteScore rank & trend | Scopus content coverage

CiteScore 2023

$$1.1 = \frac{23{,}780 \text{ Citations } 2020 - 2023}{21{,}959 \text{ Documents } 2020 - 2023}$$

Calculated on 05 May, 2024

CiteScoreTracker 2024

$$1.0 = \frac{23{,}677 \text{ Citations to date}}{23{,}034 \text{ Documents to date}}$$

Last updated on 05 March, 2025 • Updated monthly

CiteScore rank 2023

Category	Rank	Percentile
Mathematics General Mathematics	#243/399	39th
Computer Science General Computer Science	#195/232	16th

View CiteScore methodology > | CiteScore FAQ > | Add CiteScore to your site

Face Recognition For Additional Security At Parking Place

Semuil Tjiharjadi, William Setiadarma
Computer Engineering Department, Maranatha Christian University
Jl. Suria Sumantri 65 Bandung - 40164, telp 022-2012186 ext 228/fax: 022-2015154
Email : semuiltj@gmail.com

Abstract

As a country that has a lot of car users, the parking management and its security are quite complicated issues. This paper is described the use of facial recognition system using Eigenface method, to identify the drivers of four-wheeled vehicles. the face of the driver of the car was taken while taking a parking ticket and will be recorded as comparative data source that will be used to identify the driver when paying the parking fee. The results of this research tests performed are able to recognize when the driver out, but the results will be better if the driver's face image capture using multiple cameras so Eigenface face recognition system has enough resources to recognize the driver's face. This system is expected to reduce the number of car thefts committed in parking places.

Keywords*: face recognition, eigenface, car park*

1. INTRODUCTION

Data processing has been performed by humans for a long time. Humans also find mechanic and electronic equipments to help people in the calculation and data processing, in order to obtain faster results. Computers are found today is a long evolution of human inventions since ancient times, in the form of mechanical or electronic appliances.

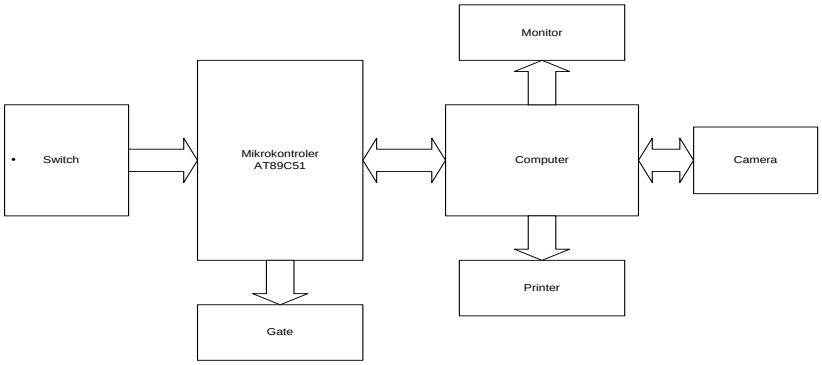
Nowadays computers and supporting tools have been included in every aspect of life and work. Computers are now possess more than just the usual mathematical calculations, including the computer system in a supermarket cashier who is able to read the code of the goods shopping, telephone exchange that handles millions of calls and communications, computer networks and the Internet that connects various places in the world. Many things are easier to use now.

Computer application have shifted from regular computing applications to intelligence system. One of the concept of intelligence is how to program a computer to be able to recognize a person's face by using a camera. This paper describe the concept to recognize persons's face and improve the security in the parking area.

2. DESIGN

2.1 Hardware design

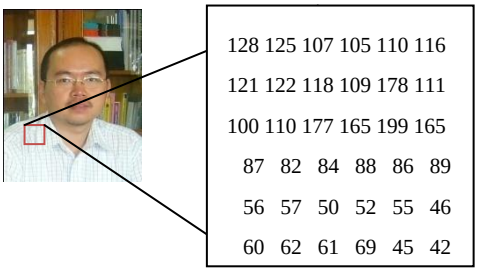
The working principle of this system is the car get into the parking area and the driver will press the entry switch. It will provide the input signal to the microcontroller. The microcontroller will forward the input signal to computer device and digital cameras take drivers pictures. Another signal was given to the printer to print the serial number of parking ticket as the identity of the car while in the parking area. When the car leave the parking area and stop at the out gate then operator will scan the ticket number and once again the camera will take the driver picture and compare it with the database. When the system can recognize the driver then the system will tell the operator. On the other hand, if the system can not recognize the driver then computer will give warning to operator.



Picture 1. Face Recognition System For More Secure at Parking area

2.2 Digital Image

Digital image is an image that can be processed by a computer. For example, in Picture 2, a size of 80x80 pixel grayscale image was taken in part (small box) size 6x6 pixels. Thus, the monitor will display a small box. However, that is stored in the computer's memory is just pictures that showed great intensity in each pixel.



Picture 2. 80x80 pixel grayscale digital image [1]

2.3 Image Processing

Digital image processing is a form of processing information with an image as input, such as drawing a picture or frame of the video. The output is an image that can be used as a function of the image itself.

Picture 3. Differences in color and grayscale images [1]

2.4 Face Recognition

In general, the image of a face recognition system is divided into two types, namely systems feature-based and image-based system. In the first system to use the features extracted from the image components of the face (eyes, nose, mouth, etc.) And then the relationship between these features are modeled geometrically. While both systems use the raw information from the pixel image which is then represented in a specific method, such as Principal Component Analysis (PCA) which is then used for classification of image identity.

A digital image A (m, n) has been described in a two-dimensional plane analogue that was obtained from an analog image A (x, y) on a continuous two-dimensional plane of the sampling process each period that has been digitized. A continuous two-dimensional image (x, y) is divided into N rows and M columns, the point of intersection are both referred to as pixels.

Digital images are numerical data that can be processed by a computer to obtain information available to it, since the digital image is represented in a matrix. Operations on the digital image is basically manipulating matrix elements. Matrix elements can be manipulated single element (pixel), a set of adjacent elements, or all the elements of the matrix. An assortment of image processing operations such as:

- Geometric transformation such as zoom in, zoom out, and rotate images.
- Improving colours like dark, light and contrast adjustment, or convert into a form different colors.
- Merging two or more images.
- Segmentation image.
- Editing and improve digital images and others.

2.5 Principal Component Analysis (PCA)

PCA procedure is basically aimed at simplifying the observed variables by means of shrinking (reducing) dimensions. This is done by removing the correlation between independent variables through the transformation of the independent variable to the origin of a new variable that is not correlated at all or commonly referred to as principal component.

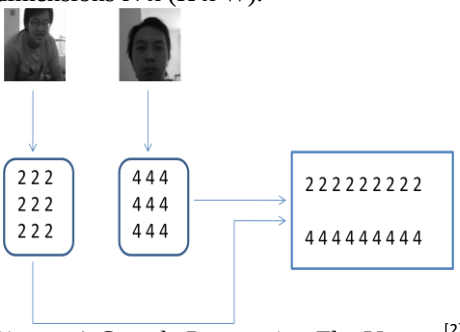
2.6 Eigenface Algorithm

Eigenface is one of face recognition algorithm based on Principal Component Analysis (PCA). To produce Eigenface, large collection of digital images of human faces taken in the same lighting conditions and then normalized and then processed at the same resolution (eg m x n), and then treated as mn -dimensional vector whose components are taken from the value of its pixels.

Eigenface face recognition algorithm steps are :

1. *Flat Vector Preparation*

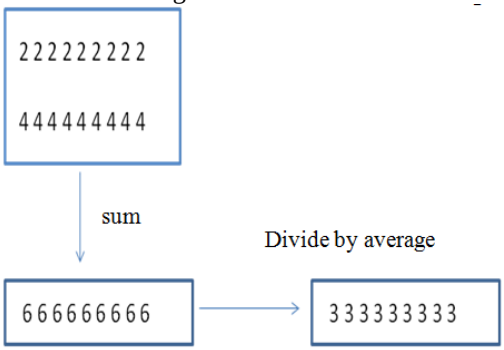
The first step is to develop a training image into one single matrix. For example, the stored image size H x W pixels and the number N of fruit, it will have flat vector with dimensions N x (H x W).



Picture 4. Sample Preparation Flat Vector [2]

2. *Flat Vector average*

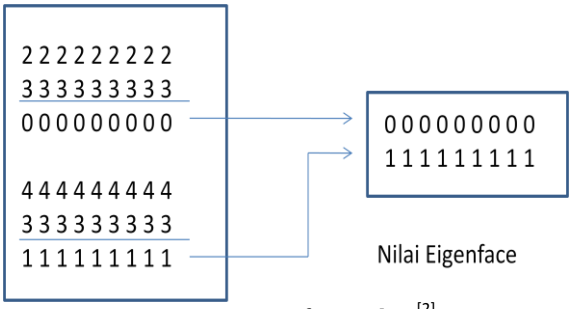
When flat vector obtained, add the whole row in order to obtain a single matrix measuring 1 x (H x W). After that the matrix N was the number of images to obtain Mean flat Vector.



Picture 5. Example average count of FlatVector [2]

3. Determine the value of eigenface

By using the average will be calculated eigenface flatvector for flatvector matrix that has been compiled. How to reduce the rows of the matrix with the average flatvector flatvector. If the score is below zero, change the value to zero.

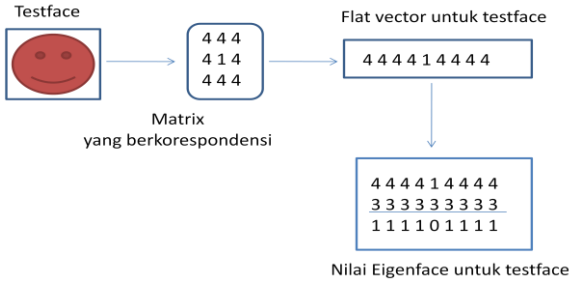


Picture 6 Eigenface value [2]

4. Identification process

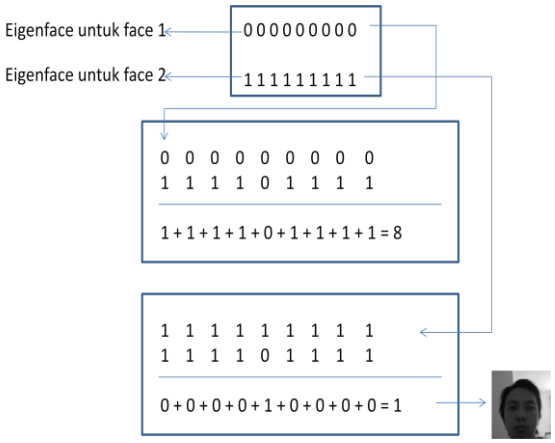
If the given image to be identified (testface), then the identification step is as follows:

Eigenface value calculation for testface matrix, in the same way with the determination eigenface to flatvector.



Picture 7. Contoh Perhitungan Nilai Eigenface untuk Testface

After Eigenface value for test face is obtained, it can be identified by determining the distance (distance) with the shortest eigenvector of Eigenface from training images. Firstly, specify the absolute value of the use of row i of the matrix Eigenface training image with Eigenface of test face, then add the constituent elements of the vector resulting from the reduction of the distance d earlier and found the index i. Do it for all the lines and find the smallest value d.



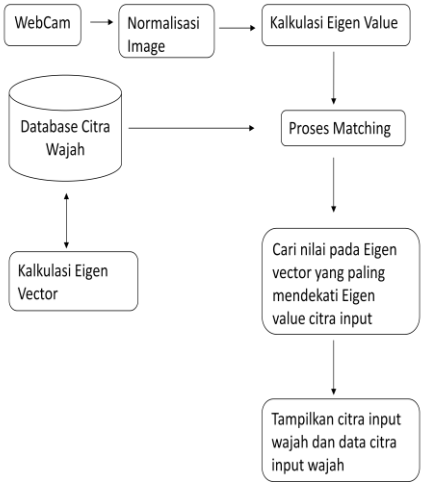
Picture 8. Process of Identifikasi

2.7 Blok Sistem diagram

Note block diagram :

- The face image is captured using a webcam. Results of capturing this is the type .bmp image files.
- The face image is then normalized with several stages. First, the image quality derived color to grayscale. The size of the face image is also uniform, to a size of 80 x 80 pixels.

- Having obtained normalized facial image, calculate the eigenvalues of the face image, such that the value of x.
- In the face image database contains a collection of face images. From this collection of images each of its eigenvalues calculated and collected in a vector which we call eigenvector. Suppose obtained values (x1, x2, x3, ... xn).



Picture 9. Block Diagram

- Matching process is done by matching the value of x with the values of the Eigenvector and find the closest value.
- If the value that is closest to it is found, looking face data corresponding to the last value and show the image of the face and facial image data.

2.8 *Database*

The database consists of table's id to store the data from a face image and setting the table for storing the value of the nearest percentage when recognizing faces. In the table, the primary key is the id with the AutoNumber data type as a place to store the index that is used to index the face image storage. ID number and name of the text data type is used to store the data from a face image. [3]

In the table setting, there is no primary key because it will contain the data one alone. The data will be filled by MinEigen and the value will contain the values to percentages in recognizing faces. The value can be filled through the program.

Tabel 1. Database Id

Field Name	Data Type	Field Size
Id*	AutoNumber	-
Nrp	Text	10
Nama	Text	50

Tabel 2. Database Setting

Field Name	Data Type	Field Size
Nama	Text	50
Nilai	Number	LongInteger

Data access between Microsoft Access and Visual Basic 6, uses ActiveX Data Object (ADO) as the data consumers who use data and OLE DB as the data providers that accommodate and unload the data. The relationship between the application and database components can be seen in Figure 10 and 11. [4]

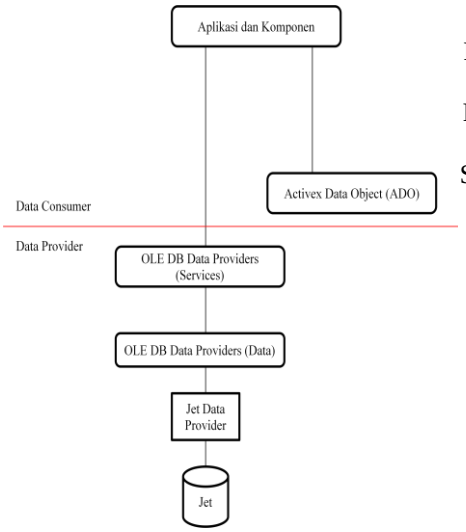


Figure 10. Consumer data and Provider

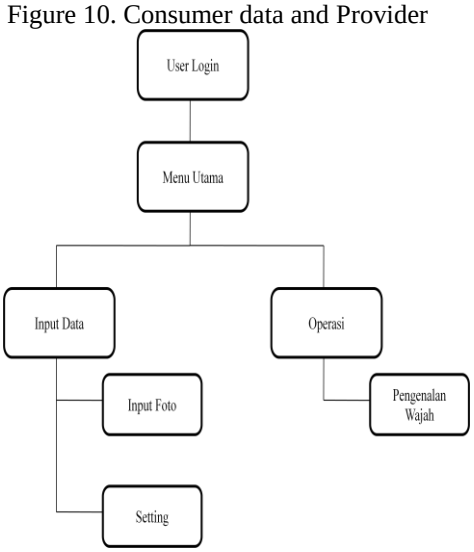


Figure 11. Program Structure

2.9 Program Structure

Menu structure used on facial recognition program can be seen in the following chart:

Specification

User Login : first face recognition.
Main menu : Source and data to leave.
Input Data : use to input data.

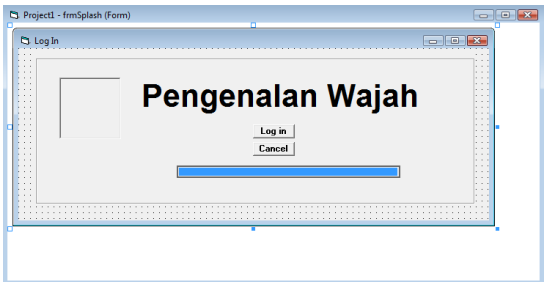
There are 2 options submenu, namely Input Photos, used to call the shots form the facial image and data entry of a face image, and setting, is used to change the face recognition similarity percentage.

2.10 *Input design*

Design input is designed as a user interface where the user can enter either the data input via the keyboard and via webcam. The design input for face recognition program consists of the parts:

1. *Form Login User design*

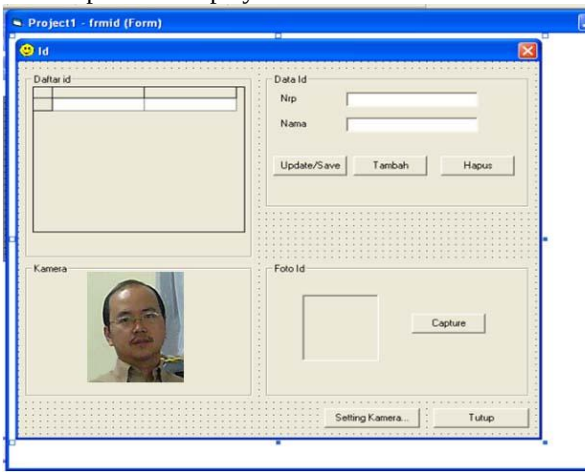
In this form the user is quite simply pressing the button Login to access a menu of facial recognition program.



Picture 10. Form Login design

2. *Form Input* Foto design

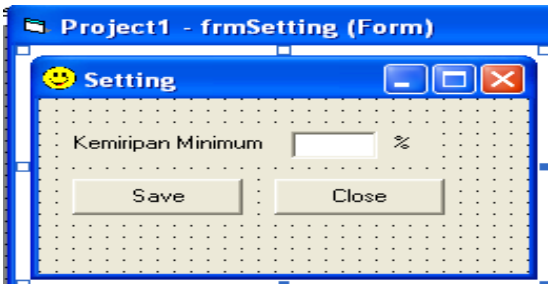
In this form the user can take a picture and fill the face image data of the face image. The components used to capture the image is ezVidcap and to display the database is DataGrid.



Picture 11. Form Input Foto Design

1. *Form Setting Design*

In this form may be a change in the degree of similarity is desired for face recognition.



Gambar 12. Form Setting design

2. *Form Face Recognition Design*

In this form the face image captured from a webcam to a computerized then matched with a face image in a database and data. Face recognition process carried out in this form.

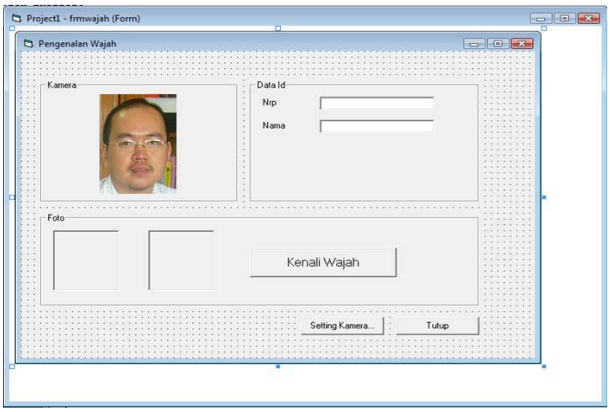
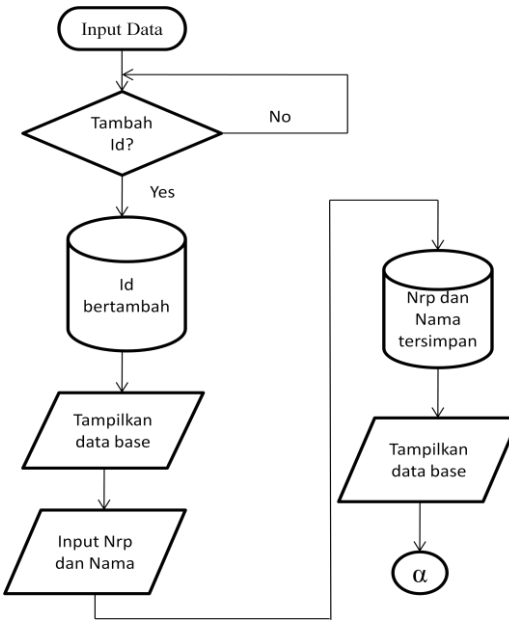
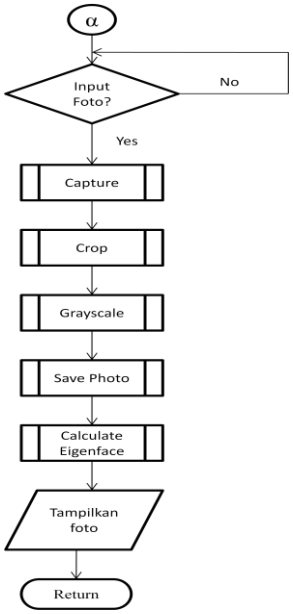


Figure 13. Desain Form Pengenalan Wajah

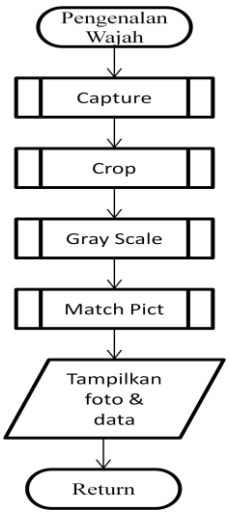
The data flowchart of face recognition program is divided into three parts, their name:



Gambar 11. Input Data Flowchart



Gambar 12. Flowchart Foto Input



Gambar 13. Face recognition

In the process of data input, must first be adding the id first. This is done so that the id of the database by type AutoNumber increases. After being shown on the database and the user can fill Nrp input and the name will be stored in the database then the data will be displayed on the form interface.

In the photo input process, the user will be prompted to capture the image of the user's face. Once captured, the face image obtained will be processed in size to 80 x 80 pixels, lowered into a grayscale image quality, is stored in the database, and will be calculated value eigenface her. Once the photo is displayed on the form interface.

In the process of face recognition, face's image will be captured then the obtained image will be processed in size to 80 x 80 pixels, lowered quality of the image to grayscale, and then the image will be calculated matching its eigenface value and will look for the most value eigenface approached with a face image which is stored in the database.

3. PENGUJIAN

In the process of face recognition, face to be recognized will be captured then the image obtained will be processed in size of 80 x 80 pixels, lowered quality of the image to grayscale, and then the image will be calculated matching its Eigenface value and will look for the most Eigenface value approached with a face image which is stored in the database.

The first observation of data, based on the results that have been obtained of experiments with the same background, but there are other objects in the background, bright lighting, captured face without expression or formal. Experiments were carried out on 5 people as the drivers, each of them were performed the experiment 5 times.

Note :
√ = indentified face
X = not recogniced face

Table 3. Observation I

	I	II	III	IV	V
Willy	√	√	√	√	√
Oscar	√	√	X	X	X
Rina	√	X	√	X	X
Martha	√	X	√	X	√
Jimmy	√	√	√	√	√

From the first experiment, evidence of failure as much as 8 times. Face is not identified in accordance with the face you want to identify. The success of face recognition gained only 68%.

2nd observation data obtained based on the results of experiments with the same background, but there are other objects in the background, bright lighting, captured face can not have expression. Experiments were carried out on 5 people; each person only has 5 facial database and performed the experiment as much as 10 times.

Table 3. Observation II

	I	II	III	IV	V	VI	VII	VIII	IX	X
Martha	√	√	√	√	√	√	√	√	√	√
Rina	√	√	√	X	√	√	√	√	√	√
Oscar	√	√	√	√	X	√	X	√	√	√
Insan	√	√	√	√	√	√	√	√	√	√
Willy	√	√	√	√	√	√	√	√	√	√

Of the 2nd experiment, evidence of failure as much as 3 times. Face is not identified in accordance with the face you want to identify. The success of face recognition gained through 94%.

3rd observation data obtained based on the results of experiments with the same background is blue, bright lighting, and facial expression captured. Experiments were carried out on 5 people, each person has a database of face as much as 1 face and conducted the experiment as much as 5 times per person. The results are as follows:

Table 4. Observation III

	I	II	III	IV	V
Willy	√	√	√	√	√
Oscar	√	X	√	X	√
Rina	√	√	X	X	√
Martha	√	√	√	X	√
Insan	√	√	X	√	√

From experiment 3, evidence of failure as much as 6 times. Face is not identified in accordance with the face you want to identify. The success of face recognition obtained up to 76%.

4th observation data obtained based on the results of experiments with the same background is blue, bright lighting, and facial expression capture. Experiments were carried out on 5 people, each person has a face database and do as much as 5 faces trial as much as 10 times per person. The results are as follows:

Table 5. Observation IV

	I	II	III	IV	V	VI	VII	VIII	IX	X
Martha	√	√	√	√	√	√	√	√	√	√
Rina	√	√	√	√	√	√	√	√	√	√
Oscar	√	√	√	√	X	√	X	√	√	√
Insan	√	√	√	√	√	√	√	√	√	√
Willy	√	√	√	√	√	√	√	√	√	√

Of the 2nd experiment, evidence of failure as much as 2 times. Face is not identified in accordance with the face you want to identify. Accuracy in face recognition algorithm using Eigenface on the 2nd experiment obtained up to 96%.

4. Conclusion

From the results of experiments that have been conducted, it can be concluded as follows:

- Face recognition applications can be created using eigenface algorithm for face recognition, software Visual Basic, and Microsoft Access as a database of images image.
- Eigenface algorithm works by calculating the average pixel of the images that have been stored in a database. The average pixel value will be obtained eigenface of each image and then will look for the nearest eigenface value of drawing a face image you want to identify.
- The face of someone who can be identified is stored in the database face images that have been processed by the algorithm eigenface, otherwise it would not be recognizable face or faces are recognizable not appropriate.
- The success of face recognition algorithm using eigenface will be higher if the face image database stored more and more. This conclusion is derived from the results of the comparison between the first observational data that were attempted in 5 people with backgrournd who have other objects, but each person has only one face image database, and the data observations 2nd attempted to 5 people with a background that has other objects but each there are 5 people face image database. 2nd observational data with a face image databases more have a higher success rate than the first observational data that there is only one database only, as well as a comparison between the data observations 3rd attempted in 5 people with backgrournd there are no other objects but each person has only one face image database, and the data observations 4th attempted in 5 people with the background there are other things, but every man there are 5 face image database. 4th observational data with a face image databases more have a higher success rate compared with observational data 3rd there is only one database only.

Reference

1. Fatta,Hanif Al., *Rekayasa Sistem Pengenalan Wajah,* C.V Andi Offset, Yogyakarta, 2009.
2. Madcoms, Seri Panduan Pemrograman Database Visual Basic 6.0 Dengan Crystal Report, C.V Andi Offset , Yogyakarta, 2002.
3. Mesran., *Visual Basic*, Mitra Wacana Media , Jakarta, 2009.
4. Sutoyo, T., Edy Mulyanto., *Teori Pengolahan Citra Digital*, C.V Andi Offset, Yogyakarta, 2009.
5. Http://Docs.Google.Com/Viewer?A=V&Q=Cache:Ubtpek_Yzksj:Resources.Unpad.Ac.Id/Unpad-Content/Uploads/Publikasi_Dosen/Pca. (22 Juli 2010)

[ICSIIT2015] Confirmation: New upload for your paper 'Face Recognition For Additional Security Parking Place'

icsiit@petra.ac.id <icsiit@petra.ac.id> Sun, Dec 7, 2014 at 1:28 AM
To: Semuil Tjiharjadi <semuiltj@gmail.com>

Dear Semuil Tjiharjadi,

Recently you submitted a new version for your paper

'Face Recognition For Additional Security Parking Place'

to the conference

'4th International Conference on Soft Computing, Intelligent System and Information Technology'.

Corresponding authors are:

Semuil Tjiharjadi

Please follow the link below to view the paper's detail page:

http://ocs.springer.com/ocs/conference/paper/view/ICSIIT2015/false/48619001

This message was generated automatically by
- The Online Conference System (OCS) -

http://ocs.springer.com/ocs/home/ICSIIT2015

[ICSIIT2015] Request for final upload for paper 'Face Recognition For Additional Security At Parking Place'.

icsiit@petra.ac.id <icsiit@petra.ac.id> Sat, Jan 17, 2015 at 1:24 PM
To: Semuil Tjiharjadi <semuiltj@gmail.com>

Dear Semuil Tjiharjadi,

We are pleased to inform you that your paper

'Face Recognition For Additional Security At Parking Place'

has been accepted for the conference

'4th International Conference on Soft Computing, Intelligent System and Information Technology'.

Please follow the link below to view the paper's detail page:

http://ocs.springer.com/ocs/conference/paper/view/ICSIIT2015/false/48619001

Enclosed please find the reports.

Final Report:

ARGUMENTATION:
Dear author(s):

On behalf of the ICSIIT 2015 Program Committee, we thank you for submitting your paper to the conference. Your paper has gone through a few rounds of reviews & evaluations.

We congratulate you as your paper has been accepted to be published and presented in the conference. Please see the reviewer's comments and do revise your paper accordingly. Kindly submit your final (camera-ready) version before 23rd January 2015.

[Please make sure that your final version conforms to Springer conference paper template (http://www.springer.com/computer/lncs?SGWID=0-164-6-793341-0). Otherwise, your paper may be subjected to rejection by the publisher.]

Separately, each of the authors must fill in the CCIS Consent to Publish form (ftp://ftp.springer.de/pub/tex/latex/ccis/copyrightccis_HD.pdf), sign it, and send it electronically to <icsiit-email>. Please do it also before 23rd January 2015.

At least one of the authors must register to the conference and present the paper. Don't miss the early bird registration that will end on 23rd January 2015.

Thank you for your participation.

Best regards,
Leo Willyanto Santoso (ICSIIT 2015 General Chair)

Reports:

EVALUATION: Reject
CONFIDENCE: HIGH

ARGUMENTATION:

Ratings:
1=poor

The authors present a face recognition system for additional security in parking place.
The authors propose an interesting approach, nevertheless in my opinion, this paper is not ready for publication.
The authors have selected the Eigenface method without any justification. A discussion should be included to compare this method with other approach developed in state of the art. What are the advantages of the selected method (complexity?). What is the detection performances compared to these methods? For validation, I recommend the authors to use open data-bases regrouping thousand of face images. For comparison use for instance common metrics such as ROC curves.
Please, check the English. What do you mean by fruit (section 2.6.1)? Write in english the text in the figure (i.e. figure 7, 8, 9, …. 12)! Bibliography section should be extended according the discussion that justify the method selection and performance comparison. Include page number.
This paper is not ready yet for publication.

EVALUATION: Accept
CONFIDENCE: MIDDLE

ARGUMENTATION:

Ratings:
1=poor ; 2=fair ; 3=good ; 4=excellent

Evaluation criteria:
a. Technical quality (depth and/or breadth of coverage) : 3
b. Presentation (clarity and readibility): 3
c. Novelty (originality of the idea): 2
d. Importance/Relevance (to ICSIIT): 4

Comments:
Rewrite a paper in the specified format.
Author must revise the whole manuscript by other faculty member to rectify language mistakes.
Distinguish between design and literature review in Design chapter

---

Please upload the final version of the document until Jan 23, 2015 WIB.
This can be done here:
http://ocs.springer.com/ocs/conference/paper/finalupload/ICSIIT2015/false/48619001

Face Recognition For Additional Security At Parking Place

Semuil Tjiharjadi, William Setiadarma

Computer Engineering Department, Maranatha Christian University
Jl. Suria Sumantri 65 Bandung - 40164, telp 022-2012186 ext 228/fax: 022-2015154

Email : semuiltj@gmail.com

Abstract.

As a country that has a lot of car users, the parking management and its security are quite complicated issues. This paper is described the use of facial recognition system using Eigenface method, to identify the drivers of four-wheeled vehicles. the face of the driver of the car was taken while taking a parking ticket and will be recorded as comparative data source that will be used to identify the driver when paying the parking fee. The results of this research tests performed are able to recognize when the driver out, but the results will be better if the driver's face image capture using multiple cameras so Eigenface face recognition system has enough resources to recognize the driver's face. This system is expected to reduce the number of car thefts committed in parking places.

Keywords: face recognition, eigenface, car park

1 Introduction

Data processing has been performed by humans for a long time. Humans also find mechanic and electronic equipments to help people in the calculation and data processing, in order to obtain faster results. Computers is a long evolution of human inventions since ancient times, in the form of mechanical or electronic appliances.

Nowadays computers and supporting tools have been included in every aspect of life and work. Computers are possess more than just the usual mathematical calculations, including the computer system in a supermarket cashier who is able to read the code of the goods shopping, telephone exchange that handles millions of calls and communications, computer networks and the Internet that connects various places in the world. Many things are easier to use now.

Computer application have shifted from regular computing applications to intelligence system. One of the concept of intelligence is how to program a computer to be able to recognize a person's face by using a camera. This paper describe the concept to recognize persons's face and improve the security in the parking area.

2 Concepts

2.1 Hardware Design

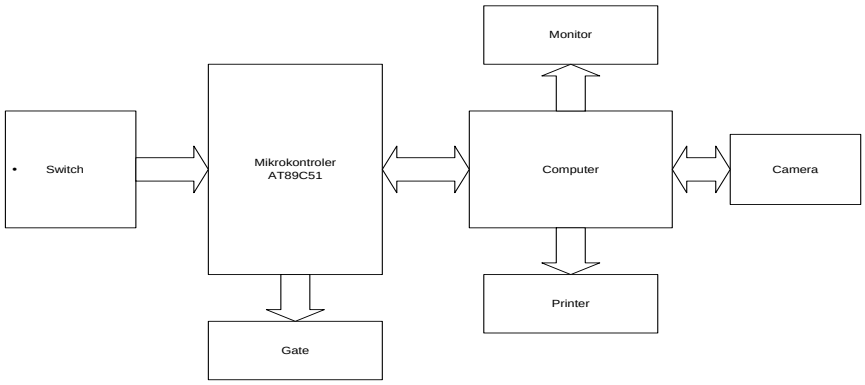


Fig. 1. Face Recognition System For More Secure at Parking area

The driver will press the entry switch when the car get into the parking. It will provide the input signal to the microcontroller. The microcontroller will forward the input signal to computer device. Digital cameras take drivers pictures. Another signal was given to the printer to print the serial number of parking ticket as the identity of the car while in the parking area. When the car leave the parking area and stop at the exit gate then operator will scan the ticket number and once again the camera will take the driver picture and compare it with the database. When the system can recognize the driver then the system will tell the operator. On the other hand, if the system can not recognize the driver then computer will give warning to operator.

2.2 Digital Image

Digital image is an image that can be processed by a computer. For example, in Picture 2, a size of 80x80 pixel grayscale image was taken in part (small box) size 6x6 pixels. Thus, the monitor will display a small box. However, that is stored in the computer's memory is just pictures that showed great intensity in each pixel.

2.3 Image Processing

Digital image processing is a form of processing information with an image as input, such as drawing a picture or frame of the video. The output is an image that can be used as a function of the image itself.

A digital image A (m, n) has been described in a two-dimensional plane analogue that was obtained from an analog image A (x, y) on a continuous two-dimensional

plane of the sampling process each period that has been digitized. A continuous two-dimensional image (x, y) is divided into N rows and M columns, the point of intersection are both referred to as pixels.

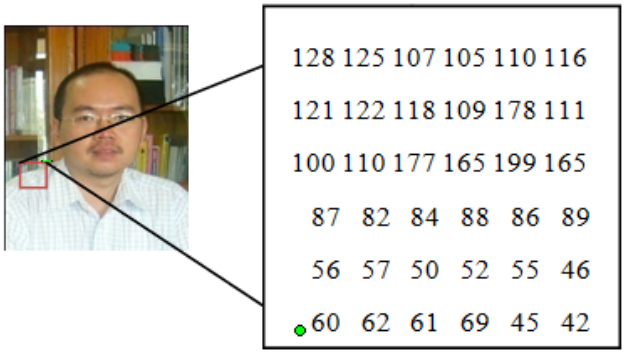


Fig. 2. 80x80 pixel grayscale digital image

Digital images are numerical data that can be processed by a computer to obtain information, since the digital image is represented in a matrix. Operations on the digital image are basically manipulating matrix elements. Matrix elements can be manipulated single element (pixel), a set of adjacent elements, or all the elements of the matrix. An assortment of image processing operations such as:

- Geometric transformation such as zoom in, zoom out, and rotate images.
- Improving colours like dark, light and contrast adjustment, or convert into a form different colors.
- Merging two or more images.
- Segmentation image
- Editing and improve digital images and others

2.4 Face Recognition

In general, the image of a face recognition system is divided into two types, namely systems feature-based and image-based system. In the first system to use the features extracted from the image components of the face (eyes, nose, mouth, etc.) And then the relationships between these features are modelled geometrically. While both systems use the raw information from the pixel image which is then represented in a specific method, such as Principal Component Analysis (PCA) which is then used for classification of image identity.

2.5 Principal Component Analysis (PCA)

PCA procedure is basically aimed at simplifying the observed variables by means of shrinking (reducing) dimensions. This is done by removing the correlation between

independent variables through the transformation of the independent variable to the origin of a new variable that is not correlated at all or commonly referred to as principal component

Fig. 3. Differences in color and grayscale images

2.6 Eigenface Algorithm

Eigenface is one of face recognition algorithm based on Principal Component Analysis (PCA). To produce Eigenface, large collection of digital images of human faces taken in the same lighting conditions and then normalized and then processed at the same resolution (eg m x n), and then treated as mn -dimensional vector whose components are taken from the value of its pixels.

Eigenface face recognition algorithm steps are : [5]

1. Flat Vector Preparation

   The first step is to develop a training image into one single matrix. For example, the stored image size H x W pixels and the number N of fruit, it will have flat vector with dimensions N x (H x W).

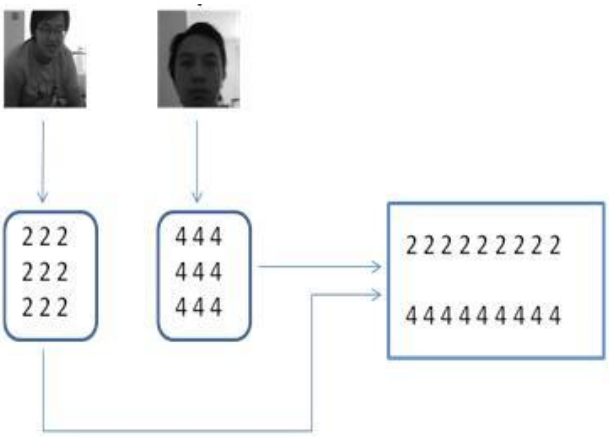


Fig. 4. Sample Preparation Flat Vector [2]

2. Flat Vector average

When flat vector obtained, add the whole row in order to obtain a single matrix measuring 1 x (H x W). After that the matrix N was the number of images to obtain Mean flat Vector

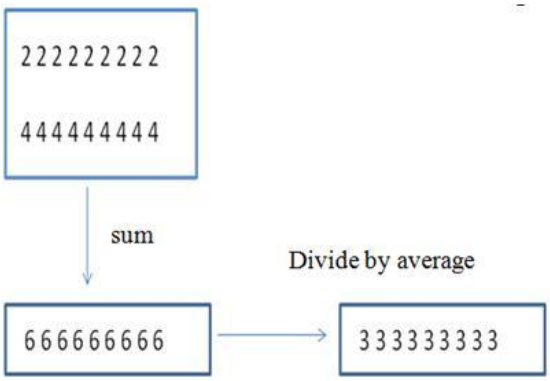


Fig. 5. Example average count of Flat Vector [2]

3. Determine the value of eigenface

By using the average will be calculated eigenface flat vector for flat vector matrix that has been compiled. How to reduce the rows of the matrix with the average flat vector. If the score is below zero, change the value to zero.

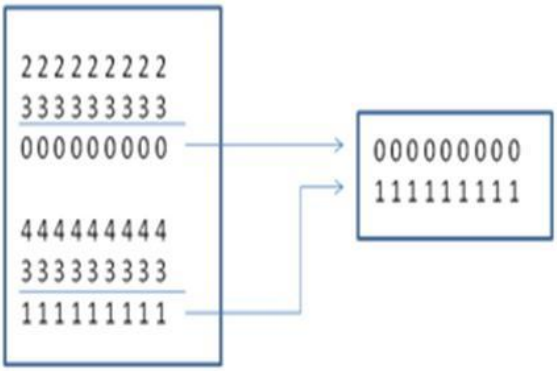


Fig. 6. Eigenface value [4]

4. Identification process

If the given image to be identified (test face), then the identification step is as follows: Eigenface value calculation for test face matrix, in the same way with the determination eigenface to flat vector. [6]

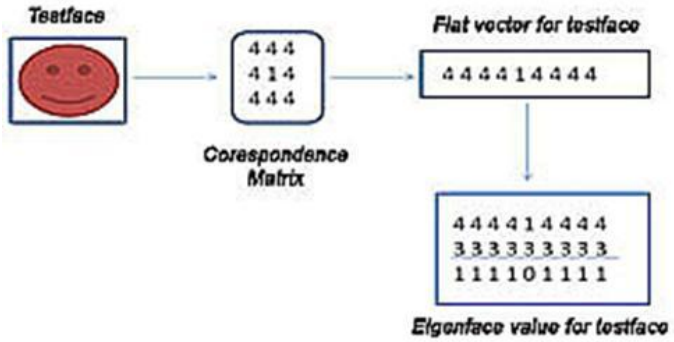


Fig. 7. Example calculation Eigenface value for face recognition

After Eigenface value for test face is obtained, it can be identified by determining the distance (distance) with the shortest eigenvector of Eigenface from training images. Firstly, specify the absolute value of the use of row i of the matrix Eigenface training image with Eigenface of test face, then add the constituent elements of the vector resulting from the reduction of the distance d earlier and found the index i. It will do for all the lines and find the smallest value d. [7]

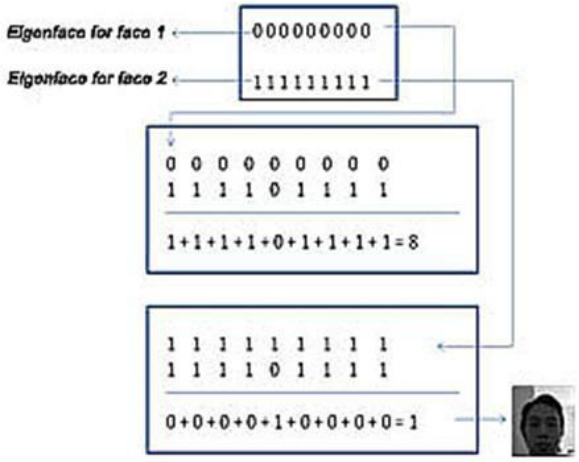


Fig. 8. Process of Identification

3 Design

3.1 Block System Diagram

Note block diagram :

- The face image is captured using a webcam. Results of capturing this is the type .bmp image files.

- The face image is then normalized with several stages. First, the image quality derived color to grayscale. The size of the face image is also uniform, to a size of 80 x 80 pixels.
- Having obtained normalized facial image, calculate the eigenvalues of the face image, such that the value of x.
- In the face image database contains a collection of face images. From this collection of images each of its eigenvalues calculated and collected in a vector which we call eigenvector. Suppose obtained values (x1, x2, x3, ... xn).
- Matching process is done by matching the value of x with the values of the Eigenvector and find the closest value.
- If the value that is closest to it is found, looking face data corresponding to the last value and show the image of the face and facial image data. [8]

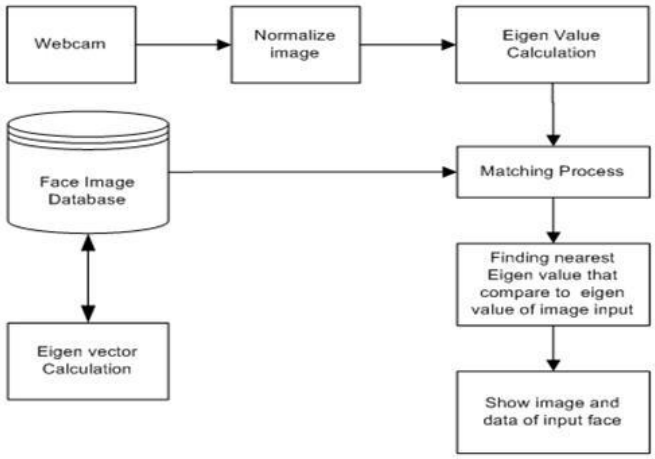


Fig. 9. Block Diagram

3.2 Database

The database consists of table's id to store the data from a face image and setting the table for storing the value of the nearest percentage when recognizing faces. In the table, the primary key is the id with the AutoNumber data type as a place to store the index that is used to index the face image storage. ID number and name of the text data type is used to store the data from a face image. [3]

In the table setting, there is no primary key because it will contain the data one alone. The data will be filled by MinEigen and the value will contain the values to percentages in recognizing faces. The value can be filled through the program.

Table 1. Database ID

Field Name	Data Type	Field Size
Id*	AutoNumber	-
Nrp	Text	10
Nama	Text	50

Table 2. Database Setting

Field Name	Data Type	Field Size
Nama	Text	50
Nilai	Number	LongInteger

Data access between Microsoft Access and Visual Basic 6, uses ActiveX Data Object (ADO) as the data consumers who use data and OLE DB as the data providers that accommodate and unload the data. The relationship between the application and database components can be seen in Figure 10 and 11.

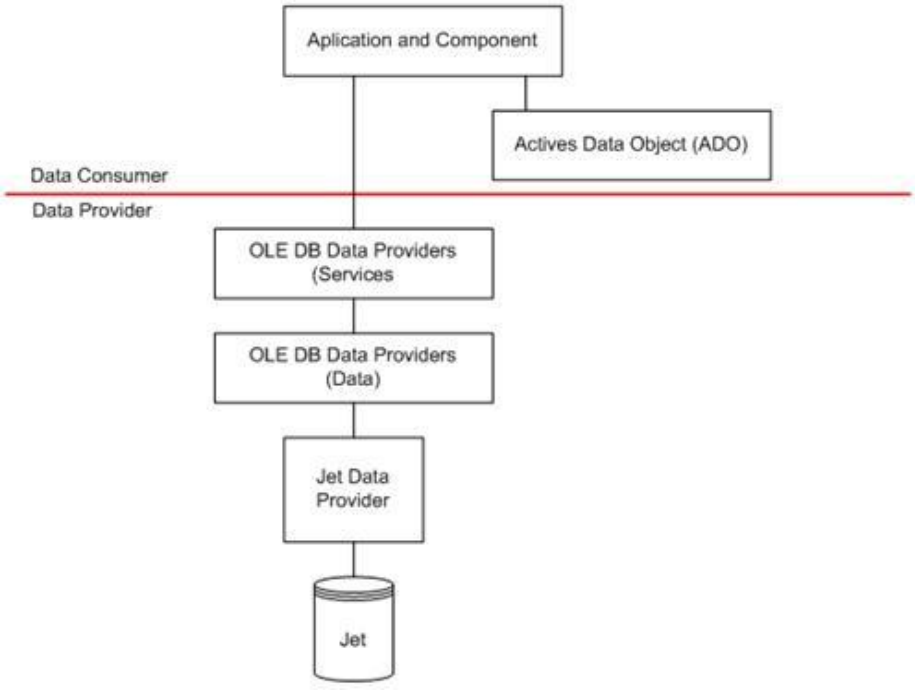


Fig. 10. Consumer data and Provider

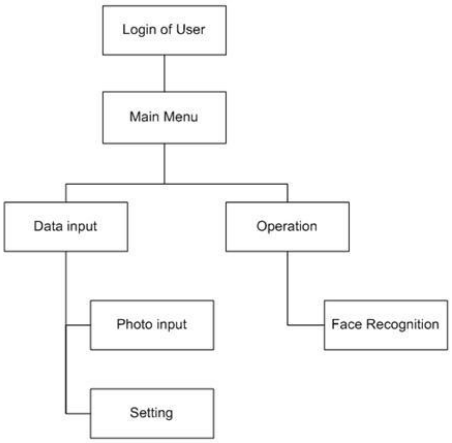


Fig. 11. Program Structure

3.3 Program Structure

Menu structure used on facial recognition program can be seen in the following chart:

User Login : first face recognition.
Main menu : Source and data to leave.
Input Data : use to input data.

There are 2 options submenu, namely Input Photos, used to take photos for the facial image and data entry. The second is setting, that is used to change the face recognition similarity percentage. [9]

3.4 Input Design

Fig. 12. Form Login Design

Design input is designed as a user interface where the user can enter either the data input via the keyboard and via webcam. The design input for face recognition program consists of the parts:

1. Form Login User Design
   In this form the user is quite simply pressing the button Login to access a menu of facial recognition program.

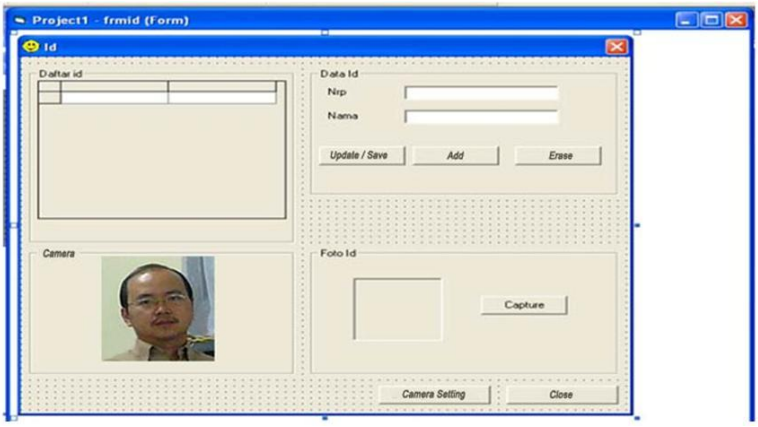


Fig. 13. Form Photo Input Design

2. Form Input Photo Design
   In this form the user can take a picture and fill the face image data of the face image. The component used to capture the image is ezVidcap and to display the database is DataGrid.

3. Form Setting Design
   In this form may be a change in the degree of similarity is desired for face recognition.

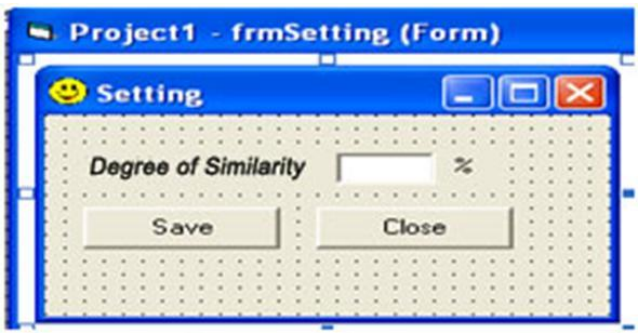


Fig. 14. Form Setting Design

4. Form Face Recognition Design

   In this form the face image captured from a webcam to a computerized then matched with a face image in a database and data. Face recognition process carried out in this form

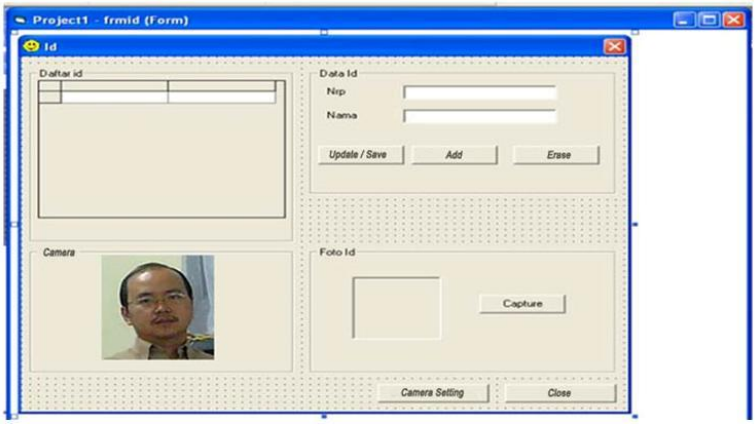


Fig. 15. Face Recognition Form Design

The data Flowchart of face recognition program is divided into three parts.

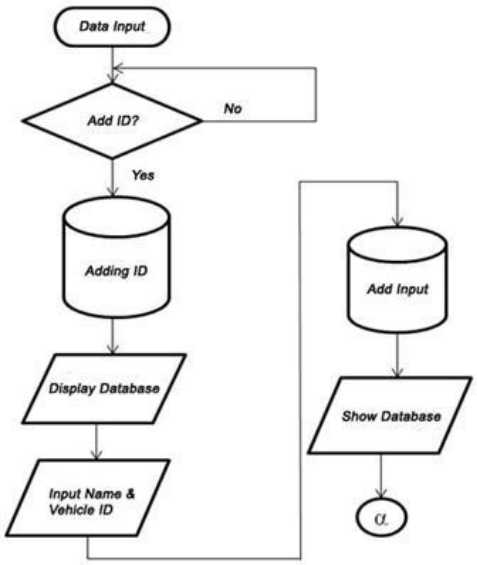


Fig. 16. Flowchart of Data input

In the process of data input, must first be adding the id first. This is done so that the id of the database by type AutoNumber increases. After being shown on the database and the user can fill Name input and vehicle ID will be stored in the database then the data will be displayed on the form interface.

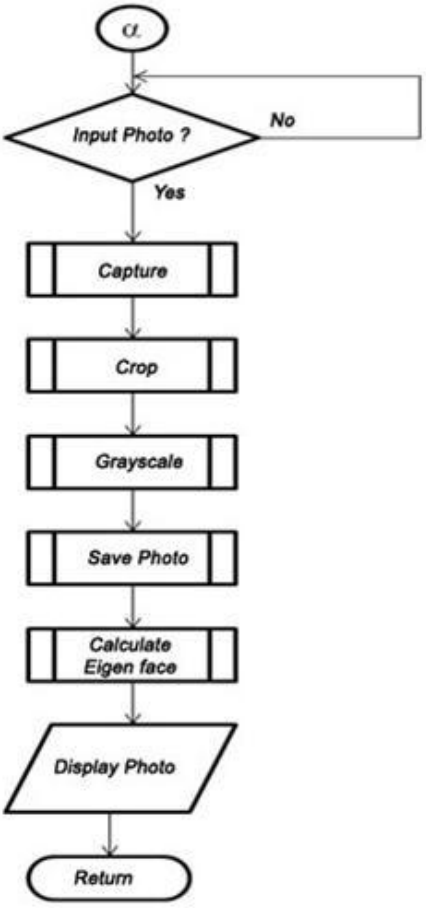


Fig. 17. Flowchart of Photo Input

In the photo input process, the user will be prompted to capture the image of the user's face. Once captured, the face image obtained will be processed in size to 80 x 80 pixels, lowered into a grayscale image quality, is stored in the database, and will be calculated value Eigenface her. The photo is displayed on the form interface.

In the process of face recognition, face's image will be captured then the obtained image will be processed in size to 80 x 80 pixels, lowered quality of the image to grayscale, and then the image will be calculated matching its eigenface value and will look for the most value eigenface approached with a face image which is stored in the database. [10]

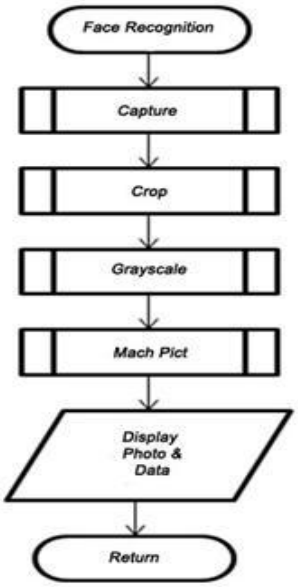


Fig. 18. Face Recognition

4 Testing

In the process of face recognition, face to be recognized will be captured then the image obtained will be processed in size of 80 x 80 pixels, lowered quality of the image to grayscale, and then the image will be calculated matching its Eigenface value and will look for the most Eigenface value approached with a face image which is stored in the database.

The first observation of data, based on the results that have been obtained of experiments with the same background, but there are other objects in the background, bright lighting, and captured face without expression or formal. Experiments were carried out on 5 people as the drivers, each of them were performed the experiment 5 times.

Table 3. Observation 1

	1	2	3	4	5	6	7	8	9	10
Martha	√	√	√	√	√	√	√	√	√	√
Rina	√	√	√	X	√	√	√	√	√	√
Oscar	√	√	√	√	X	√	X	√	√	√
Insan	√	√	√	√	√	√	√	√	√	√
Willy	√	√	√	√	√	√	√	√	√	√

Note :
√ = indentified face X = not recogniced face

From the first experiment, evidence of failure as much as 8 times. Face is not identified in accordance with the face you want to identify. The success of face recognition gained only 68%.

2nd observation data obtained based on the results of experiments with the same background, but there are other objects in the background, bright lighting, and captured face can not have expression. Experiments were carried out on 5 people; each person only has 5 facial databases and performed the experiment as much as 10 times.

Table 4. Observation 2.

	1	2	3	4	5	6	7	8	9	10
Martha	√	√	√	√	√	√	√	√	√	√
Rina	√	√	√	X	√	√	√	√	√	√
Oscar	√	√	√	√	X	√	X	√	√	√
Insan	√	√	√	√	√	√	√	√	√	√
Willy	√	√	√	√	√	√	√	√	√	√

Of the 2nd experiment, evidence of failure as much as 3 times. Face is not identified in accordance with the face you want to identify. The success of face recognition gained through 94%.

3rd observation data obtained based on the results of experiments with the same background is blue, bright lighting, and facial expression captured. Experiments were carried out on 5 people; each person has a database of face as much as 1 face and conducted the experiment as much as 5 times per person. The results are as follows:

Table 5. Observation 3

	1	2	3	4	5
Willy	√	√	√	√	√
Oscar	√	X	√	X	√
Rina	√	√	X	X	√
Martha	√	√	√	X	√
Insan	√	√	X	√	√

From experiment 3, evidence of failure as much as 6 times. Face is not identified in accordance with the face you want to identify. The success of face recognition obtained up to 76%.

4th observation data obtained based on the results of experiments with the same background is blue, bright lighting, and facial expression capture. Experiments were carried out on 5 people, each person has a face database and do as much as 5 faces trial as much as 10 times per person. The results are as follows:

Table 6. Observation 4.

	1	2	3	4	5	6	7	8	9	10
Martha	√	√	√	√	√	√	√	√	√	√
Rina	√	√	√	√	√	√	√	√	√	√
Oscar	√	√	√	√	X	√	X	√	√	√
Insan	√	√	√	√	√	√	√	√	√	√
Willy	√	√	√	√	√	√	√	√	√	√

Of the 2nd experiment, evidence of failure as much as 2 times. Face is not identified in accordance with the face you want to identify. Accuracy in face recognition algorithm using Eigenface on the 2nd experiment obtained up to 96%.

5 Conclusion

From the results of experiments that have been conducted, it can be concluded as follows:

1. Face recognition applications can be created using eigenface algorithm for face recognition, software Visual Basic, and Microsoft Access as a database of images image.
2. Eigenface algorithm works by calculating the average pixel of the images that have been stored in a database. The average pixel value will be obtained eigenface of each image and then will look for the nearest eigenface value of drawing a face image you want to identify.
3. The face of someone who can be identified is stored in the database face images that have been processed by the algorithm eigenface, otherwise it would not be recognizable face or faces are recognizable not appropriate.
4. The success of face recognition algorithm using eigenface will be higher if the face image database stored more and more. This conclusion is derived from the results of the comparison between the first observational data that were attempted in 5 people with background who have other objects, but each person has only one face image database. The 2nd data observations attempted to 5 people with a background that has other objects but each there are 5 people face image database. 2nd observational data with a face image databases more, have a higher success rate than the first observational data that there is only one database only. As well as a comparison between the data observations 3rd attempted in 5 people with background, there are no other objects but each person has only one face image database. The 4th data observation was attempted in 5 people with the background there are other things, but every man has 5 face image database. 4th observational data with a face image databases more have a higher success rate compared with observational data 3rd there is only one database only.

References

1. Fatta, Hanif Al.: Rekayasa Sistem Pengenalan Wajah. C.V Andi Offset. Yogyakarta. (2009)
2. Madcoms.: Seri Panduan Pemrograman Database Visual Basic 6.0 Dengan Crystal Report. C.V Andi Offset. Yogyakarta. (2002)
3. Mesran.: Visual Basic. Mitra Wacana Media. Jakarta. (2009)
4. Sutoyo, T., Edy Mulyanto.: Teori Pengolahan Citra Digital. C.V Andi Offset. Yogyakarta. (2009)
5. M. Turk and A. Pentland.: Eigenfaces for Recognition. Journal of Cognitive Neuroscience. (1991)
6. Davies, Ellis, and Shepherd. Perceiving and Remembering Faces. Academic Press. London. (1981)
7. M. Kirby and L. Sirovich: Application of the Karhunen-Loeve procedure for the characterization of human faces. IEEE Transactions on Pattern analysis and Machine Intelligence. (1990)
8. T. Heseltine, N. Pears, J. Austin, Z. Chen.: Face Recognition: A Comparison of Appearance-Based Approaches. Proc. VIIth Digital Image Computing: Techniques and Applications. vol 1. (2003)
9. Moghaddam, B., Wahid, W.,Pentland.: A. Beyond eigenfaces: probabilistic matching for face recognition. Third {IEEE} International Conference on Automatic Face and Gesture Recognition, (1998)
10. Belhumeur, P N., Hespanha, Kriegman.: D.Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection. (1997)