HAAR CASCADE CLASSIFIER ALGORITHM TO RECOGNIZE SCATTERED OBJECTS

Muhamad Rikat Rifaldi[1], Nelly Indriani W., S.Si., M.T.[2]

[1,2] Universitas Komputer Indonesia
Jalan Dipatiukur No. 112-116, Coblong, Bandung, Jawa Barat 40132
E-mail : rikatrifaldi@ymail.com[1], nelly.indriani@email.unikom.ac.id[2]

ABSTRAK

The Hidden object games are games that use sharp eyes in search of hidden objects. These objects can be arranged at random, horizontal, vertical and visible part, as in a game of hidden object there is a difficulty in recognizing objects due to the position of the object searched for hidden object position or only visible part just so those objects are hard to find, so develop by a simulator game hidden object to get a solution in recognizing multiple objects scattered images.

The application simulator game hidden object to detect scattered objects using image processing by using *haar* cascade classifier method. In this type of game scattered objects located in a map that is been provided game, to play this type of game users first select a map which contained the scattered objects place, then the system looking for image and object marks all scattered objects a place hidden in the map correspond to the objects that will be detected. Performance tes results of simulator games the hidden object show that this simulator can help in detecting scattered objects. Application of detection of scattered objects on games hidden object using *Haar Cascade Classifier* method, and can detect scattered objects by an object in the form of performance testing of its normal position, 90 degrees, 180 degrees, 270 degrees and seen some 83.5% value is detected.

Keywords: Game, Haar classifier cascade, haar-like features, hidden object..

1. INTRODUCTION

This section will be presented regarding the background to the problem, the intent, purpose and theory is used.

1.2 Background Problem

This type of game is a hidden object game that uses a sharp eye for recognizing objects. In this type of game objects scattered from an object image located on a grid. To play the type of game it should search and find images and object marks all the scattered objects lying hidden in the picture object on the grid so that the player can continue the game. In these types of games hidden objects, hidden objects scattered list has been provided and there is usually some objects that it's hard for players to look for according to the percentage of the results that have been obtained from the Division of the questionnaire stated that there are some objects that are hard to find by 57.4% value and that States are not hard 42,56%. The settlement of these types of games hidden object this is finding all the objects spread over the layout of the object horizontally, vertically, diagonally and can also look the part.

Previous studies with the title of *haar classifier cascade* and *adaboost* algorithm for the detection of many faces in the classroom [1]. Where the research was done by comparing the image of the test sample with 8 people and every man has 8 image of the face and facial position, perpendicular to the rotation of 15o rotation to the right, 15o to the left, and lift the Chin 15o up and down head

1.2 Purpose and Objectives

Based on the issues examined, then the purpose of this research is to get a solution in recognizing multiple objects scattered images regardless of the position of object and the object's rotation is located. While the goals are expected to be achieved in this research is to know the performance of the algorithm accuracy in haar classifier cascade to find the requested image objects in the object images are scattered..

1.3 *Haar Like Fiture*

Haar Algorithm using the method statistikal in doing detection of objects. Each feature of *Haar-like* feature defined in the shape of the feature, such as the coordinates of the feature and also the size of the feature . Featured will be in training is the featured process of cropping. As for the various variations featured haar:

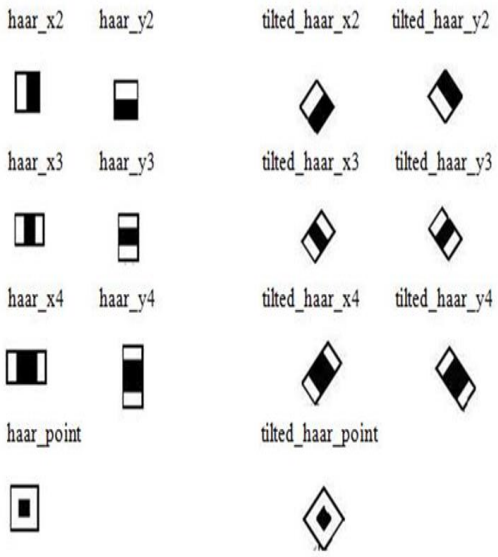


Image 1. Haar like feature [2]

Each feature is divided into two parts, namely, part white and part black. Use of due processing feature to take place much faster than processing the image perpiksel so suitable to apply the process of detection of objects in real time. In the current study to calculate the value of a feature on an image of Haar and on different scales quickly using a technique called integral image..

1.4 Digital Imagery

The image is a representation, resemblance of an object. Image as output of a system of data recording can be photographic optics, analog in nature in the form of video signals or digital in nature that can be directly stored in a storage medium.

A digital image is the image that can be processed using a computer. Stored in a computer's memory is simply numbers that showed great intensity at each pixel. Because digital image shaped numerical data, then the digital image can be processed using computer [3].

1.4.1 *Grayscaling*

Grayscale is a type of image that handle the gradation of black and white, which produces the effect of gray color. In this picture, the colors are expressed with intensity. In this case the intensity range from 0 to 255. A value of 0 is black and 255 States declared white. The conversion of normal images (RGB) image to grayscale is done using the formula.. [3].

Grayscale=(0.299*R)+(0.587*G)+(0.114*B)

1.4.2 *Tresholding*

Tresholding used to set the number of degrees of keabuan on the image ... Tresholding process this is basically the process of conversion quantization on the image, so to do tresholding with degrees of keabuan can use the formula [4]:

"g(x,y) = " {1 if f(x,y)>T
{0 if f(x,y)≤T)

Description:

· If the white level keabuannya > T

· Black level if keabuannya < = T

The process will produce a binary image tresholding, i.e. image that has him value the level of keabuan which are black and white. In general the process grayscale image tresholding to generate binary image is as follows:

1.5 UML (Unified Modelling Language)

UML (Unified Modelling Language) is one of the highly reliable tool in the world of object-oriented systems development. This is because the visual modeling languages UML provides that makes it possible for developers to create blueprints over their vision in the form of standard, easy to understand and are equipped with an effective mechanism for sharing (sharing) and communicate their design to another [5]. UML is a modeling language of aggregations that are developed by Booch, Object Modelling Technique (OMT) and Object Oriented Software Engineering (OOSE) [8]. Grady Booch Booch method from very well known with Object Oriented Design method name. This method makes the process of analysis and design into the four iterative phases, namely the identification of classes and objects, identify the semantics of the object and class relationships, the details of interface and implementation. Booch method advantages are rich with detail and notation element.

1.5.1 *Use Case Diagram*

Use Case The Diagram is a description of the function of a system from the perspective of the user. Use case works by describing a typical interaction between the user (users) a system with its own system through a story of how a system is used. The sequence of steps that are explained between users and the system is called a scenario. Each scenario describes the sequence of events. Each sequence is initialized by people, other systems, hardware or timeline. Thus the usual said in brief use case is a set of scenarios that are coupled together by General purpose user [6].

1.5.2 Use Case Scenario

A diagram that shows the use cases and actors can be a good starting point, but do not provide enough detail for the system designers to really understand exactly how the system concerns will be met. Use Case Scenario is the best way to reveal this important information in the form of the use of the description of each case should be accompanied by text-based one.[6]

1.5.3 *Class Diagram*

The Class Diagram is a diagram used to show some class and packages that exist in the system software we are developed. Class diagram gives an overview of the static system diagram software and the relationships that exist within it. [6]

1.5.4 *Sequence Diagram*

Sequence Diagrams are used to describe the behavior of a scenario. This diagram shows a number of examples of objects and message (the message) that is placed between these objects in a use case. [6]

1.5.5 *Activity Diagram*

Activity Diagrams are used to describe the procedural logic, business processes and the flow of work in many cases. Activity Diagram has a role as does the flowchart, but the difference is activity diagram supports parallel behaviour whereas flowchart unbiased [6].

2. THE CONTENT OF RESEARCH

The following is an analysis and testing that is conducted in research.

2.1 Analysis Problem

The introduction of the scattered objects are in a hidden object game, in recognizing the image objects based on the position of the object more than one object and accuracy in detection. Therefore made an application to the detection of objects scattered to apply simulation type games hidden object. Its main goal is to get the solution in recognizing multiple objects regardless of the position of the object is located. To perform detection of objects on hidden object games type as for the algorithm to be used to recognize objects scattered is *haar classifier cascade* algorithm. Application of Computer Vision is quite widely used in security or protection system, one being the introduction of the scattered objects [7]. Object detection system spread included into technological development became more important in some fields such as a security system, control system [1]. The methods used to detect objects scattered is *Haar classifier Cascade*, i.e. methods which can be seen from the presence of objects scattered and this method has a high accuracy in detecting an object.

2.2 Analysis Of The Game

Hidden object games are games that can be resolved by way of finding all of the objects in the picture are hidden in the grid Board. To find the hidden images of objects in the grid Board then the layout of the object may be located vertically and horizontally.

Games hidden object consists of a process that is the hidden object searches, the search process the object i.e. searching objects on a grid Board have been unfilled objects arranged randomly. Here is a flowchart of the game hidden object::



Image 2 *Flowchart Game Hidden Object* Secara Umum

2.3 Analisis *Game Hidden Object*

Analysis on hidden object games done to see an overview of the system by using an algorithm haar classifier cascade to find the requested image objects in the object images are scattered. In haar classifier cascade algorithm implements will be built a prototype with an overview of the hidden object games are as follows:

1. Game Board consists of a minimum background i.e. 1 background.

2. Objects that are placed on the Board's search for random background.

3. the object of the search is only done on the position of the object rotation, rotation right 900 900 900 kekiri, rotation, and an upright position.

In a game of hidden object there are a couple of pictures objects scattered at random in a background

that would then be in appropriate detection list images which have been provided, when the image object is found or is detected then the score will be increased by 10 points and when the object is not detected then the score will not be increased or fixed
In building object recognition systems spread, done a few stages. Stages of the introduction of the objects contained in Figure 2:

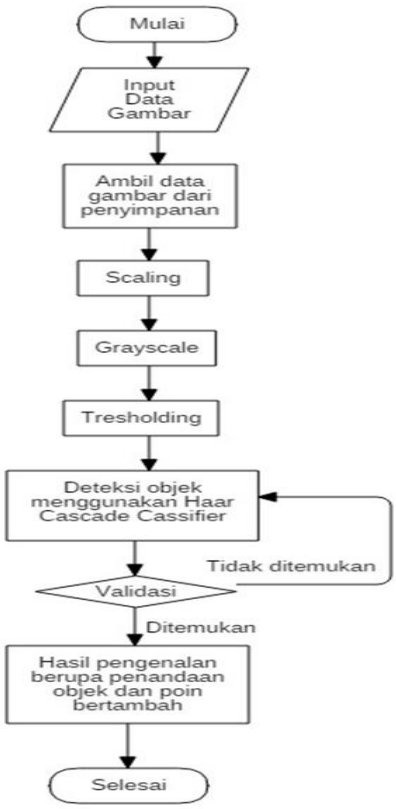


Image 3. *Flowchart* Games Will Be Built

The process object is done by looking for objects that will be sought which have been supplied in board games, in the search object is done sequentially based on the list of objects that will be on the order of detection. Process speed in searches carried out by doing a search as soon as possible.

2.4 Analysis of Data Input

The input data used in the form of imagery that is used for the process of training. The image is placed in the form of image files or photos with jpg image format, dimensions 185x150, 185pixel width, height 150 pixels. After the image is entered into the system then will do the process from the stages that have been known. Each process on the image processing using the values of the pixels of the image for calculation. Each pixel in the image is composed of 3 elements base color that is Red (R), Green (G) and Blue (B), which are often called RGB, and each element has a value between 0-255 that into code color depth of each element. Color image instance has a value of R, G, B as follows:



Image 4. Contoh Citra Masukan

2.5 Analysis Pre Processing

In General, object recognition systems experienced some process before recognizing a object. Each process has a role of each in the running process. The processes involved in the introduction of objects includes the input images, scaling, grayscaling, and algorithms haar classifier cascade resulting in objects that are in the search.
In the analysis of pre-processing image or pattern recognition object is divided into 3 stages:

1. Grayscaling
2. Tresholding

1. Stages of Greyscaling

In this step is done changing the image color to a greyscaleimage, this process is done to simplify the model's image. The colored image will be replaced with the image of the greyscale sesusai with values that have been obtained from the calculation results below. Examples to determine the value of grayscale illustrated with values of R, G, and B, for conversion into grayscale colors used formulas

Grayscale = 0.299*R + 0.587*G + 0.114*B.

Suppose for the pixel at coordinates (123.132) calculations as follows:

Grayscale = (0,299*95) + (0,587*120) + (0,114*28)
= 28,405 + 70,44 + 3,192
= 102,037

From the obtained results to perhitugan coordinates (123.123) = 102.037. The calculation is performed for all the coordinates, then the calculation result of the grayscale is done rounding (rounding) values to the closest. Then the results of the rounding of the coordinates for (123.123) = 102.037 So obtained the image grayscale as follows :

Table 1. The Value Of The Image Grayscale

	0	1	2	3	4	5	6	7	8	9
0	102	132	169	221	246	252	253	254	254	255
1	86	105	98	114	155	228	248	253	254	255
2	85	104	92	105	108	139	234	248	254	255
3	117	120	109	104	99	123	189	250	254	254
4	103	98	105	103	107	140	236	254	254	254
5	100	104	109	110	131	203	252	252	252	255
6	103	111	113	115	149	247	252	250	254	255
7	113	110	118	135	217	250	253	255	255	254
8	108	113	131	172	244	253	253	255	253	253
9	104	113	139	231	252	251	252	252	254	255

The following example changes the image into the image grayscale.



Image 5. The RGB Image Into a Grayscale Image

2. Stages of Tresholding

Next is the thresholding phases are used to change the image of the results of the binary image into grayscale. Results of grayscale at coordinates (123,123) with a value of 102 the T value is then compared with a threshold, threshold taken worth 160 because the value of the condition of the black and white image on the threshold clearly visible.

Table 2. Nilai Citra Grayscale Menjadi CitraBiner.

	0	1	2	3	4	5	6	7	8	9
0	0	1	1	1	1	1	1	1	1	1
1	0	0	0	1	1	1	1	1	1	1
2	0	0	0	0	0	0	1	1	1	1
3	0	0	0	0	0	0	0	1	1	1
4	0	0	0	0	0	0	0	1	1	1
5	0	0	0	0	0	0	0	1	1	1
6	0	0	0	0	0	0	1	1	1	1
7	0	0	0	0	0	0	1	1	1	1
8	0	0	0	0	0	1	1	1	1	1
9	0	0	0	0	1	1	1	1	1	1

Berikut adalah contoh gambar hasil *Tresholding*:



Image 6. Tresholding Image

2.6 ***Analisis Integral Image***

Integral image is a technique to calculate quickly the features by changing the value of each pixelnya into a new image representation. As for the workings of the integral image i.e. by summing the values in the subset on a matrix of images. With this image, then the integral calculation to get the value of a feature Haar can be obtained with a fast time. After the stage value threshold do next calculate the value of the integral image whose data is taken from the value of the threshold calculation process done with equations.

$$s(x,y) = s(x,y)+s(x-1,y)+s(x,y-1)-s(x-1,y-1)$$

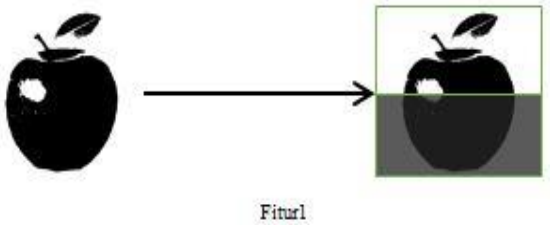
The following is a matrix of 150, 185 but for example calculated with the size 10 x 10.

Table 3. Matrik Biner 150x158

	0	1	2	3	4	5	6	7	8	9
0	467	471	475	479	483	487	491	495	499	503
1	564	568	573	578	583	588	593	598	603	608
2	658	662	667	672	678	684	690	696	702	708
3	750	754	759	764	770	776	782	789	796	803
4	840	844	849	854	860	866	872	879	887	895
5	928	932	937	942	948	954	960	967	976	985
6	1015	1019	1024	1029	1035	1041	1047	1054	1064	1074
7	1100	1104	1109	1114	1120	1126	1132	1140	1151	1162
8	1183	1187	1192	1197	1203	1209	1215	1224	1236	1248
9	1265	1269	1274	1279	1285	1291	1298	1308	1321	1334

2.7 Haar Features Like Feature Selection

The algorithm using the statistikal method in the detection of objects. In every feature of haar like feature defined in the shape of the feature, and the size of the coordinate diantranya featured from the feature. Feature that will might not trained is a feature of the process of data input feature. Haar Like fiture is used to find the best features found on the image that shows the important components of the object. Next determine the kind of haar will be applied on the results of the previous calculation. This is done by evaluating every feature against the input data by using the value of the feature. The features that have the biggest limit between the object and not the not the object.



I

mage 7. Define Haar Features

After determining the features of haar further done the calculation from the results of the integral image that has already been done, so it can be known the value of the threshold. Following the calculation of the value of training on 1 against the image of the

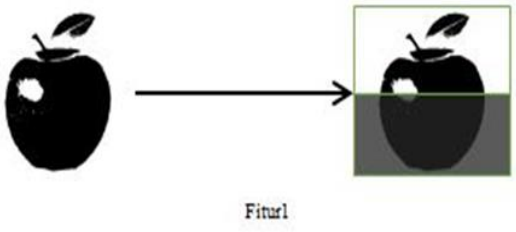
test. Nilai yang didapat fitur hitaThe value of the obtained features black A_{black} = 91, B_{black} = 6905, C_{black} = 183, D_{black} =9775. Sedangkan nilai fitur putih A_{white} = 1, B_{white} = 148, C_{white} = 90, D_{whiteh} = 6876.

f(x)=Sumblack rectangle (pixel gray level) – Sumwhite rectangle (pixel gray level)

$=D_{black} + A_{black} - (B_{black} + C_{black}))-$
$(D_{white} + A_{white} - (B_{white} + C_{white}))$
=(9775+91 – (6905+183)) – (6876+1-(148+90))
= 2778–6639
= -3861.

2.8 Selection Features Haar Like Feature Testing

Next determine the kind of haar will be applied on the results of the previous calculation. This is done by evaluating every feature against the input data by using the value of the feature. The features that have the biggest limit between the object and not the object.



Gambar 8. Define Haar Features

Following the calculation of the value of training on 1 against the image of the test. The value of the obtained features black A_{black} = 91, B_{black} = 6905, C_{black} = 183, D_{black} =9775. Sedangkan nilai fitur putih A_{white} = 1, B_{white} = 148, C_{white} = 90, D_{whiteh} = 6876.

f(x)=Sumblack rectangle (pixel gray level) – Sumwhite rectangle (pixel gray level)

$=D_{black} + A_{black} - (B_{black} + C_{black}))-$
$(D_{white} + A_{white} - (B_{white} + C_{white}))$

=(9775+91 – (6905+183)) – (6876+1-(148+90))
= 2778–6639
= -3861.

Then after he obtained the value of the threshold of the test image, then the value of the results of the training and the test image image have the equation result was caused due to the test image and similar images the rehearse.
On imagery training with features 1 generates value =-3861, whereas in a test image with features 1 has a value =-3861. Thus it can be concluded that an object is a thing that wants to be detected due to the onset of threshold value equation on the trainer's image and the image of the test..

2.9 Test Process

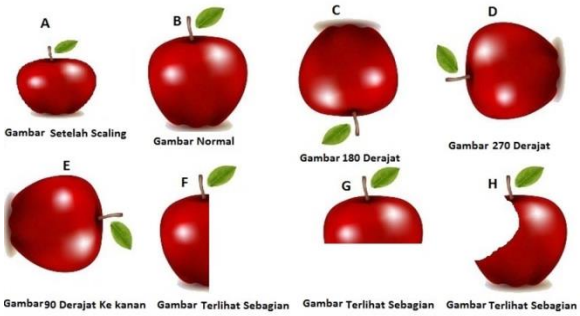
On testing was conducted to test whether the objects that want to be detected as expected or not, if the object does not exist in the list of data to be detected then the system will not perform detection on the scattered objects.

Below is a table of the data objects in the image:

Table 4. Data Objek Gambar

Subjek	Nama Objek	Gambar Objek
1	Clock	
2	Car	
3	Apple	
4	People	
5	Eye	

The test at this stage is done with a few variations of shape objects horijontal, vertical and looks most like is indicated as shown below:



Gambar 9. The Form Object

Below is a table of detection accuracy of objects with different objects, on testing was conducted to test whether the objects that want to be detected as expected or not, if the object does not exist in the list of data to be detected then the system will not perform detection on the scattered objects.

Table 4. Data Object Images

	Subyek	Form object	Subyek Predicted				
			1	2	3	4	5
Actual	1	A		-	-	-	-
		B		-	-	-	-
		C		-	-	-	-
		D		-	-	-	-
		E	*	-	-	-	-
		F		-	-	-	-
		G		-	-	-	-
		H		-	-	-	-
	2	A	-		-	-	-
		B	-		-	-	-
		C	-		-	-	-
		D	-		-	-	-
		E	-		-	-	-
		F	-		-	-	-
		G	-		-	-	-
		H	-		-	-	-
	3	A					
		B					
		C					
		D					
		E					
		F					
		G					
		H					
	4	A	-	-	-		-
		B	-	-	-		-
		C	-	-	-		-
		D	-	-	-		-
		E	-	-	-		-
		F	-	-	-		-
		G	-	-	-		-
		H	-	-	-		-
		A	-	-	-	-	
		B	-	-	-	-	
	5	C	-	-	-	-	
		D	-	-	-	-	
		E	-	-	-	-	
		F	-	-	-	-	
		G	-	-	-	-	
		H	-	-	-	-	

Description :

"√"	= TP
"-"	= FN
"*"	= FP

TP (true positives) = when the object detected in accordance with the detected
TN (true negatives) = when the object you don't want detected not detected
FP (false positives) = when the object being detected not detected
FN (false negative) = when the object detected incompatible detected

Table 5. Nilai perhitungan setiap subyek

Subyek 1	**Subyek 2**	**Subyek 3**	**Subyek 4**	**Subyek 5**
Total Testing = 40	Total Testing = 40	Total Testing = 40	Total Testing = 40	Total Testing = 40
TP = 7	TP = 8	TP = 8	TP = 8	TP = 8
FN = 0	FN = 0	FN = 32	FN = 0	FN = 0
FP = 1	FP = 0	FP = 0	FP = 0	TP = 0
TN = 32	TN =32	TN = 0	TN =32	FN =32
Total	Total TP= 39	Total FN = 32	Total FP = 1	Total TN = 128
	200			

Hasilnya : $\frac{TP+TN}{TP+FP+TN+FN} \times 100\%$

$$= \frac{(7+8+8+8+8)+(32+32+0+32+32)}{39+32+1+128}$$

$$= \frac{39+128}{200}$$

$$= \frac{167}{200} \times 100\% = 83{,}5\ \%$$

From the above Test can be analyzed and concluded that the detection has no effect on the number of comparisons with several different objects, only affect the current objects similar to the objects that will be detected only when the object is visible. Then to get the level of accuracy of the object recognition, calculations will be performed on many scattered objects were detected and the introduction. So come by the presentation of success in identifying the subject of the registration (167/200) * 100% = 83,5%.

3. PENUTUP

Based on research on implementation algorithm of Haar classifier cascade for recognizing objects spread out so it can be made a conclusion:

1. Algorithms haar classifier cascade can be used to recognize objects scattered on the game hidden object.

2. object detection Applications spread on games hidden object using Haar Classifier Cascade method, and can detect objects scattered by an object in the form of performance testing of its normal position, 90 degrees, 180 degrees, 270 degrees and seen some 83.5% value is detected.

As for the advice that can be given to future development, among others, are as follows:

1. To improve the accuracy in detecting any type of objects needed samples of positive and negative images much more, especially for any kind of type and shape of the object.

2. The research this time was just a simulation program, then expected in subsequent research can be implemented directly on the game hidden object, so that the application can be more helpful.

4. DAFTAR PUSTAKA

1] Hadi Santoso dan Agus Harjoko.2013. Haar Cascade Classifier Dan Algoritma Adaboost Untuk Deteksi Banyak Wajah Dalam Ruangan Kelas. Jurnal Teknologi,vol. 6, No. 2, pp. 108-115.

[2] Paul Viola and Michaels J. Jones. (2001). Rapid Jones, Rapid Object Detection using Detection using boosted Cascade of Simple Features. IEEE Features. IEEE CVPR .

[3] Hermawati, F. A.2013. Pengolahan Citra Digital Konsep & Teori.Yogyakarta: Andi.

[4] , R. (n.d.). Menentukan Thresholding. Retrieved from http://rubik.web.id

[5] Gunter, G., & Kenny, R. 2008. Digital booktalk: Digital media for reluctant readers. Contemporary Issues in Technology and Teacher Education.

[6] R. S. Pressman, Rekayasa Perangkat Lunak Pendekatan Praktis, Yogyakarta: Andi, 2012.

[7] Fadilsyah. 2007. Computer Vision dan Pengolahan Citra.Yogyakarta. Penerbit Andi.

[8] Martin, R.C.2002.UML for Java Programmers. United States of American: Alan Apt

[9] Muhadjir,N.1998. Metodelogi Penelitian Kualitatif. Yogyakarta: Rake Sarasin.

[10] Suyanto.2014. Artificial Intellegence Searching, Reasoning, Planning dan Learning, Bandung: Informatika Bandung

[11] Chellappa Rama, Theodoridis Sergio. 2014. Academic Press Library In Signal Processing. USA : Academic Press

[12] P.P. Caffier, U. Erdmann and P. Ullsperger, 2005. The spontaneous eye-blink as sleepiness indicator in patients with obstructive sleep apnoea syndrome - a pilot study. Sleep Medicin.

[13] Saha, S., Basu, S., Nasipuri, M., & Kumar Basu, D. (2009). DEVELOPMENT OF AN AUTOMATED RED LIGHT VIOLATION DETECTION SYSTEM FOR INDIAN VEHICLES. IEEE NATIONAL CONFERENCE COCOSYS, 52-64.