IMPLEMENTATION OF AUGMENTED REALITY IN KUNINGAN DISTRICT TOURISM BROCHURE USING SURF ALGORITHM (SPEEDED-UP ROBUST FEATURES)  
(Case Study: DISPORAPAR KUNINGAN DISTRICT)

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Abstract
The Youth Sports and Tourism Department (DISPORAPAR) is an institution that provides information in a variety of fields, including Youth, Sport, Tourism Destination, Institutional and Partnership, and Marketing. In the field of marketing, the promotion of tourist attraction that has been carried out by DISPORAPAR Kuningan Regency is by using brochure media and Instagram social media, where using the media is less than optimal visualization. This study aims to build an android based application that can provide information about tourist attractions in Kuningan Regency. In this application, it will display 3D objects and videos of each tourist attraction. In making this application the technology used is Augmented Reality using the Marker Based Tracking method which is a method in Augmented Reality that requires markers as markers, these markers usually feature black edges and white backgrounds. The Speeded-Up Robust Features (SURF) algorithm is used to detect local features of an image and to design a system using the Unified Modeling Language (UML). The final result of this research is an Augmented Reality application that displays information in the form of 3D objects and interactive tourist attraction videos. It is hoped that this application can help DISPORAPAR in socialization activities and make it easier for people to get information about tourist attractions in Kuningan Regency.

Keywords: The Kuningan District Sports and Tourism Department (DISPORAPAR), Travel Attractions, Augmented Reality, Based Tracking Marker, Speeded-Up Robust Features (SURF).

1. INTRODUCTION

Kuningan Regency is one of the areas in West Java Province that has fertility and natural beauty, a wealth of cultural arts and cool air because it is located at the foot of Mount Ciremai, the highest mountain in West Java and has several Tourist Attractions (DTW).
which is by utilizing augmented reality technology.

The use of technology can help provide more interactive information, such as the use of augmented reality technology. Augmented Reality is a breakthrough and innovation in the growing field of multimedia and image processing. This technology is able to lift an object that was previously flat or two-dimensional, as if it had become real and blended with the surrounding environment (Budi Arifitama, 2017).

In the use of augmented reality technology, an algorithm is needed that aims to detect the local features of an image. The algorithm used is the Speeded-Up Robust Features (SURF) algorithm. The SURF algorithm was first published by researchers from ETH Zurich, Herbert Bay. Based on the description that has been described above the writer will implement augmented reality technology in the promotion of tourist attractions in Kuningan Regency, so in this study the author takes the title "IMPLEMENTATION OF AUGMENTED REALITY IN KUNINGAN TOURISM BROCHURE USING ALGORITHM. SURF (SPEEDED-UP ROBUST FEATURES)".

2. RESEARCH METHODOLOGY

Research methodology is a way to find out the results of a specific problem, where this problem is also called a research problem.

A. Data Collection Method
1. Interview Method
The author conducted an interview with Mrs. Ani Nurhayati, SE., MM as the Tourism Promotion and Information Section in Kuningan Regency.

2. Observation Method
The author made direct observations by visiting DISPORAPAR Kuningan District, and several tourist attractions.

3. Literature Method
The author collects data from books, journals, the internet, and brochures that are relevant to the study in this study.

B. Software Development Methods
The system development method used in designing this software application uses the Rational Unified Process (RUP) work methodology. The iterative process in the RUP globally can be seen in the following figure:

Gambar 1.1 Fase RUP (A. S. Rosa dan M. Salahuddin, 2013)

Based on figure 1.1 the RUP phase has four stages in software development, namely:

1. Inception (data collection)
2. Elaboration (Analysis and Design)
3. Construction (Coding and Implementation)
4. Transition (Testing and Maintenance)
3. RESULTS AND DISCUSSION

A. Ongoing System Analysis

Based on Figure 3.1, the socialization process carried out by DISPORAPAR Kuningan is still using brochure media, and usually the information contained in the brochure is not optimal and less visualized.

B. Analysis of the System To Be Built

Based on Figure 3.2, the proposed system to be built is by utilizing augmented reality technology as a medium to inform DTW to make it more attractive and to maximize visualization.

C. Problem Solving Analysis

Speeded-Up Robust Features (SURF) Algorithm

SURF works on an image as follows:

1. The initial process of this algorithm is to prepare the input image. This input image format changes the RGB image format to a grayscale image.

Converting into image form grayscale, with the formula:

\[
\text{Grayscale} = \frac{R + G + B}{3}
\]

……………………………………… (1)

Bottom right pixel example:
RGB = 91, 47, 21

Grayscale = (R+G+B)/3
= (91+47+21)/3
= 159/3
= 53

If done on all pixels, then below is the result of the calculation of converting an RGB image to a grayscale image:

<table>
<thead>
<tr>
<th>RGB</th>
<th>91</th>
<th>47</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grayscale</td>
<td>53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The image obtained becomes a grayscale image, then it is represented into an integral image.

S(x, y) = i(x, y) + s(x, y) + s(x, y-1) + s(x-1, y) – s(x-1, y-1) …………… (2)

Below is a calculation of all the pixels in the feature boxes.

<table>
<thead>
<tr>
<th>Nilai Pixel</th>
<th>Keterangan</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x,y) = (x)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (y)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (x-1)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (y-1)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (x-1,y)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (x-1,y-1)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (x+1)</td>
<td>0</td>
</tr>
<tr>
<td>(x,y) = (y+1)</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Detecting Feature Points

H(x, σ) = \begin{bmatrix}
Lxx(x, σ) & Lxy(x, σ) \\
Lxy(x, σ) & Lyy(x, σ)
\end{bmatrix}

………………… (3)

Gambar 3.8 Aproximasi untuk orde kedua turunan Gaussinan dengan kernel filter
The results of the convolution between the integral image and the 9x9 filter box in the X, Y, XY directions can be seen in the following table:

### Table 3.10: Results of Convolution

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>XY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

To form a Haar-wavelet, it is necessary to add up the pixels in the convolutional filter box calculation with the x, y, xy images. Starting from the top left, namely: $0 + 0 + 0 = 0$ (Adding per pixel in tables 3.10, 3.11, 3.12 provided that minus numbers are not added). Then continue to the bottom pixel.

### Table 3.11: Result of Convolution

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>XY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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</tbody>
</table>

For the top left first box:

\[
D_x = (0-0) + (289-0) + (297-0) + (1078-297) + (900-188) + (2232-900) = 3411
\]

\[
D_y = (0-0) + (188-0) + (297-0) + (1078-289) + (2232-1078) = 3031
\]

\[
\sum|dx| = 0 + 289 + 297 + 781 + 712 + 1332 = 3411
\]

\[
\sum|dy| = 0 + 188 + 297 + 603 + 789 + 1154 = 3031
\]
$V = \{\sum dx, \sum|dx|, \sum dy, \sum|dy|\}$

$V_1 = \{3411, 3411, 3031, 3031\}$

$V_2 = \{-112, 2382, 4117, 4117\}$

$V_3 = \{-4684, 5436, 9831, 9831\}$

$V_4 = \{3574, 3574, -240, 1698\}$

$V_5 = \{2182, 5064, 2182, 5064\}$

$V_6 = \{-1667, 7341, 13677, 13677\}$

$V_7 = \{8205, 8205, 1264, 4346\}$

$V_8 = \{14393, 14393, -378, -378\}$

$V_9 = \{-26378, 26378, -25824, 25824\}$

The following is an algorithm flowchart to solve the problems the authors face.

A. System Design

**Use Case Diagram**

**Activity Diagram**

**Class Diagram**
A. Main Menu Interface

In Figure 4.1 there are several menus that will be displayed in the application, namely:

a. Scan: To start the camera and detect markers.
b. Description: To display information on a tourist attraction.
c. Instructions: To display instructions for using the application.
d. About: To display application maker information.
e. Exit: To exit the application.
E. White Box Test Results

1. The first node includes a section
   1. public void PlayPause() {

2. The second node includes a section
   7. if(!firstRun && !isPassed) {

3. The third node includes a section
   3. videoPlayerPause();
   4. audioSourcePause();
   5. playIcon.SetActive(true);
   6. isPassed = true;

4. The fourth node includes a section
   2. else if(!firstRun && isPassed) {

5. The fifth node includes a section
   5. videoPlayerPlay();
   6. audioSourcePlay();
   9. playIcon.SetActive(false);
   10. isPassed = false;

6. The sixth node includes a section
   13. else {
       StartCoroutine(playVideo());

From the table and after division into nodes, a flow graph can be formed as shown in Figure 4.8.

![Flow Graph Diagram]

**Formula**

\[ V(G) = (E - N) + 2 \]

So: \( V(G) = (6 - 6) + 2 \)
\( V(G) = 2 \)

So, cyclomatic complexity for Figure 4.8 is 2.

Based on testing with a white box, the program is valid or accepted.

4. CONCLUSION

Based on the results of this thesis research entitled “IMPLEMENTATION OF AUGMENTED REALITY IN KUNINGAN TOURISM BROCHURE USING SURF ALGORITHM (SPEEDED-UP ROBUST FEATURES), the authors can draw the following conclusions:

1. The augmented reality application is made by applying the SURF algorithm.
2. This application provides new innovations in the socialization process in order to help the Youth Sports and Tourism Agency (DISPORAPAR) to convey information about the Tourist Attractions (DTW) in Kuningan Regency.
3. Using augmented reality technology in tourism brochures can provide more interactive information and visualization to be more attractive.

5. ADVICE

The suggestions from the author based on the research results of the thesis that have been made are as follows:

1. It is hoped that this application can be used / applied in the
socialization of tourist attractions in Kuningan Regency.

2. In the next development stage, 3D objects can be made better so that the results are more like the real objects.

3. The interface in the application is made more user friendly.

4. As well as a development in the use of algorithms used for more accurate feature detection / matching.

REFERENCES


