Promotion of the Motif Kujang Design by A* Algorithm Application in the Labyrinth Education Game

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Abstract
Kujang (Sundanesse cleaver) as one of the cultural heritages of the Sundanese people (residents of West Java, Indonesia) has various attributes. These attributes can be used as a media for learning culture by the community. Currently the introduction of Kujang is only limited to general information. In fact, each attribute of the Kujang contains a very meaningful cultural philosophy. One of the cultural philosophies on the Kujang is shown in the motif design of the Kujang. This study aims to build a digital promotion media of Kujang through a labyrinth educational game which is implemented using the A* algorithm. The use of the A* algorithm is expected to guide educational game users to find the final destination of the maze by choosing the fastest path. In this educational game, there are five choices of labyrinth paths that formed from five motif Kujang designs. This research shows the novelty that refers to the application of the motif Kujang design as a labyrinth route. The labyrinth route which is formed from five motifs Kujang i.e. : tapak nanggala, tirta sadana, nagabandang, waruga sungsang, and hanjuang, which has different route difficulty levels. Based on the results of the usability test, it shows that globally the respondents show a level of comfort in using educational games at the level of 71.72%. The interactive and interesting promotion of the motif Kujang design can be done through this game by providing an experience of exploring the maze paths based on the motif kujang design. The labyrinth education game based on the motif Kujang design is able to perform well in the aspects of control (82.25%), efficiency (70.75%) and effects (70.01%). This game still shows moderate level in learnability performance (63.95%). This research is still limited to the creation of labyrinth paths based on the motif Kujang design and has not been equipped with the strengthening of information on the meaning of other cultural attributes contained in the motif Kujang design. Therefore, the opportunity to develop research towards strengthening information on the meaning of attributes integrated with the appropriate algorithms is very potential.

Keywords:
A* algorithm, Cultural attributes, Educational game, Kujang, Promotion media

1. Introduction
Kujang is one of the traditional weapons of West Java which is a cultural heritage of the Indonesian people. Kujang contains historical value and has the characteristics of design and prestige based on shape, variety, part, use and stratification of ownership in the past (Munandar & Raya, 2014). Pamor is a certain motif, pattern, or contour on the blade of a sharp weapon resulting from the use of various materials, burning, and metal forging techniques. Pamor is a kind of texture on a traditional weapon blade in the form of a knife made of two or more metal elements resulting from the folding process using high forging techniques. Based on the existing catalog, the raw material for making pamor kujang is an industrial standard raw material that has certain characteristics and treatment standards based on the metal producing industry standard. The types of metals used consist of high, medium, and nickel carbon steels. Although the cleaver is an icon of West Java, many do not know the various types of cleaver and pamor cleaver. Even though there are various types of cleaver and various pamor that have philosophies in them. Learning media greatly influences interest in learning (Taurusta et al., 2019). Zeng et al., 2020 also said that to make learning media more interesting, unique, fun and educational by making educational games that integrate game knowledge, create real problem situations for students, stimulate motivational learning, and effectively
improve student learning. To strengthen the sustainable image associated with local culture-based cleaver products (Tosida et al., 2019) also made augmented reality (AR) based application. The kujang game enhancement was also carried out by Tosida et al. (2020a) through AR is integrated with the animated Sundanese folklore film.

Several studies on educational games and the application of the A* algorithm, including Mufida (2016) regarding the application of the A* algorithm in Arabic vocabulary learning games. The results of his research show that the A* algorithm is used to make enemy movements or the Non Player Character (NPC) to pursue the player character. Febliama et al. (2019) also conducted research on the A* algorithm which is applied to enemies in the Pac-man game so that players face obstacles to achieve game goals. Hu et al. (2012) discussed finding a path around obstacles in a real-time strategy game. Khantanapoka and Chinnasarn (2009) discussed about the A* algorithm is an efficient classical algorithm for solving the shortest path problem. The efficiency of the algorithm depends on the evaluation function used to heuristic estimates of the value of the shortest path from the current node to the target. When the peak coordinates are known, the heuristic value of the shortest path is usually generated by the distance (Li et al., 2018). This study proposes a depth direction A* to increase the efficiency of avoiding obstructive objects in mapping and finding the shortest path from multiple layers in 2D & 3D real time strategy for multi layer games.

With labyrinth game whose paths are formed from pamor or cleaver blade motifs and by applying the A* algorithm to find the shortest path from the maze.

2. **Research Methodology**

In this research, the method used is the Multimedia Development Life Cycle, where this method has 6 stages, namely concept, design, material collecting, assembly, testing and distributio (Tosida et al., 2019).

2.1 **Concept**

The concept stage is the stage of setting goals, determining the concept of images, providing information at each level, how to use and target users from creating educational games. (Tosida et al., 2020c) The process carried out at the concept stage is to determine the media for the introduction of the pamor cleaver with the media for delivering educational games.

1. The purpose of this pamor kujang educational game is to help the community and the millennial generation so that they know more about the cleaver and the pamor cleaver.
2. Determine the concept of each level in the making, this educational game has 5 levels, each of which has a different background and difficulty. Level 1 is a labyrinth in the form of tapaknanggala pamor, level 2 is a tirtasadana pamor-shaped labyrinth, level 3 is a pamor nagabandang labyrinth, level 4 a warugasungsang pamor-shaped labyrinth, level 5 a pamor hanjuang labyrinth.
3. This application uses the A-star (A*) algorithm to make it easier to find the shortest path of the maze

2.2 **Design**

The process carried out at the design stage is the storyboard design and flow chart. At the design stage, detailed specifications are needed so that the stages are not in doubt and new decisions are needed. However, changes in materials often occur, namely the application part is added or removed (Tosida et al., 2020c)

2.3 **Material Collecting**

At this stage, materials are collected as needed. The results obtained at the material collection stage to support making applications. Material gathering is collecting materials needed in making educational games. Materials or materials needed can be in the form of images of the type .jpg, audio, .wap and .mp3, animation and text. The material needed is obtained from the internet which is modified first according to the needs of the game. (Rahayu et al., 2019) In this stage the search for materials that are suitable for the application will be made, including:

2. Interview as well as extracting deeper information about Kujang Pajajaran at Kujang Pajajaran Gallery, Jl. Raya Parung Banteng No.120 Katulampa, East Bogor, Bogor City

2.4 **Assembly**

At this stage is the stage of making materials, materials are collected based on the design which has been arranged on the storyboard, the navigation structure and flowchart as well as functions are created. Further materials that have been collected are put together to produce an educational game with the pamor kujang labyrinth. (Rahayu et al., 2019)
2.5 Testing
This testing phase is the stage of testing the application that has been made. Testing is done to find out whether
the application is in accordance with the concept or there are still errors that need to be corrected. If something goes
wrong, then return to the design stage and so on until the results are as desired.

2.6 Distribution
This stage is the last stage in the MDLC cycle. Distribution can be done after the application is ready for use
and the function and appearance have been tested. After the creation of the application has been completed, the next
step is packaging the application so that the file type is an executable file (.exe). (Rahayu et al., 2019)

3. Results and discussion
3.1 Design
1. Designing educational game
The design design is an educational game concoction of the pamor kujang labyrinth made more interactive to
make it easier for users and so that users don't get bored when learning traditional cleaver weapons. This educational
game design is based on mobile android so that it can be run more practically The cleaver game android mobile
design can be seen in Figure 1.

![Educational Game Design](image)

Figure 1. Educational game design

2. The design of the navigation structure
The navigation structure is a structure that will explain how the display appears from the navigation buttons
that can be used by the user, the navigation structure design can be seen in Figure 2.

![Navigation Structure](image)

Figure 2. The design of the navigation structure
3. Application design
   At the design stage of this application using the Adobe Photoshop, Blender, Unity 3D application, the design of the application includes designing the game button design, designing cleaver paths and designing the background, sound and other supporting assets. Application design can be seen in Figure 3, 4 and 5.

![Figure 3. Designing a button design](image)

![Figure 4. Path cleaver design](image)

![Figure 5. Background design](image)

3.2 Application Results
   1. Main menu and select level menu display
      The main menu consisting of 4 sub menus, namely the main menu, settings, exit. Level menu will appear when the main button in the main menu is pressed, select this level page to select which level to play. The main menu and select level menu display can be seen in Figure 6.

![Figure 6. Display of the main menu and select game level](image)

2. Playing games and help menu display
   The appearance of playing this game has different backgrounds and difficulties because it is based on the level taken from the motif or pamor of the cleaver. Display playing games can be seen in Figure 7. This help display will appear when the help button on the map logo is pressed. This display shows the map or shape of the maze and you will also see the closest route to get out of the maze. This route is formed from the A * (A-Star) algorithm that has been applied. Help display can be seen in Figure 7.
3.3 Discussion

Promotion and learning media is very influential on interest in learning process of kujang motifs that showed in
the map of the game. One of which is using internet technology, computers and even cellphones or smartphones
which have a positive and negative impact. This research uses educational games as a learning medium for
the introduction of pamor kujang. Currently the game is used as an effective promotion and learning medium for
students. The characteristics of the game which is entertaining, attracts visual activities and is fun when playing it
make the game a useful medium to support learning. Educational games can make it easier for the teacher or guide
for children to teach a lesson that can be remembered and easily understood by children. One of them is by using
maze games that can improve children's motor development and train small muscle control, eye coordination,
fingers and stimulate children to be more interested in learning. The applications used to build this game include
Unity3D, this application is used for making game backgrounds, Blender is used to make pamor cleaver models,
Photoshop this application is used to design the main menu button and Microsoft Visual Studio is used for in-game
coding. The programming language used in building this game is C#.

Design and build this pamor kujang recognition maze educational game for promotion the cultural heritage is
used the A* (A-Star) algorithm. The application of the A* (A-Star) algorithm create form the shortest route in the
maze. Making the shortest route in the maze can be formed manually, but the process may be long and ineffective,
therefore in this study the A* algorithm is applied to simplify the creation and effectiveness of the game (Hu et al.,
2012). In this game it has 5 levels and each level has a different form of maze based on the pamor cleaver shape,
each level of difficulty will increase to attract players with different skill levels. The A* (A-Star) algorithm is a
classic algorithm that is efficient for solving shortest path problems. The efficiency of the algorithm depends on the
evaluation function used to heuristic estimates of the value of the shortest path from the current node to the target
Khantanapoka and Chinnasarn (2009). When the coordinates of the vertices are known, the heuristic value of the
shortest path is usually given by the distance. The reason for using the A* (A-Star) Algorithm is that the
implementation is simple and the results are more accurate. suitable to be applied to game applications that require
finding a way by. So, this algorithm is suitable for application in finding paths in maze games. An example of the A
* (A-Star) Algorithm simulation can be seen in Figure 8.
3.4 Application Testing

Testing is done to find out whether the application is in accordance with the concept or there are still errors that need to be corrected. The testing stages are divided into 5 stages, consists of structural, functional, validation, compatibility, and usability testing. Structural testing is a suitability stage to determine whether the application is structured properly according to the design that has been made. The functional testing phase is carried out to find out whether the game that has been made is functioning properly. At this stage an experiment is carried out to determine whether the function of each button or menu on the page can function properly. Based on the trials that have been carried out, the overall button or menu on each page can function and run as desired. The validation testing is carried out to determine whether or not the implementation of the method has been carried out. The validation test results can be seen in Table 1.

Table 1. Validation testing result

<table>
<thead>
<tr>
<th>No</th>
<th>Test area</th>
<th>Map 1</th>
<th>Information of testing</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determining the size of the A* (A-Star) Algorithm Grid in Figure 1 shows the world size X 100 Y 100 grid component. This size is based on the ground in Figure 2 so that you can see a white border in Figure 2 which indicates the algorithm was successfully implemented</td>
<td></td>
<td>Valid</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Determine the starting point or start position and the destination point / target position. in Figure 1 is the component for determining the Start position and Target Position and Figure 2 shows the shortest route which is red which indicates the algorithm was successfully applied</td>
<td></td>
<td>Valid</td>
<td></td>
</tr>
</tbody>
</table>

Stage of compatibility testing done by tested the game using several types of smartphones. This testing carried out in order to find out where the game performance capabilities were in each of the existing specifications. The result of this testing can be seen in Table 1. The last stage of testing is usability test. The usability test was conducted by conducting a survey on the audience. The display of the survey results looks presentative for every aspect for requirements as an application improvement where this survey was conducted to 100 respondents, 4 multimedia experts or lecturers and 96 general public and the millennial generation. The gender and age profiles of respondents can be seen in Figures 9. The questionnaire created to see user experience and views of the usability of our software products recommends a minimum of ten users. In particular situations used for diagnostic purposes, then a smaller sample size may be sufficient (Kirakowski & Corbett, 1993). This questionnaire has 4 levels, namely very good, good, good enough, and not good. The percentage results are obtained from very good and good scores. The statements in the questionnaire consist of categories : 1) effect, 2) control, 3) efficiency, 4) learnability. Effect factor is talk about general feeling (emotional) reaction of users to the software they use. Control factor is discuss about the extent to which the user feels that he is able to control the software. Efficiency factor is measure of the extent to which users feel that the software used can help them in their work. Learnability factor is measure of the ease with which the user feels in learning it so that he feels able to master the system (Tosida et al., 2020a; Tosida et al., 2020b). The results of usability test display in Figure 9.
**Table 2. Compatibility testing result**

<table>
<thead>
<tr>
<th>No</th>
<th>Brands and specifications of mobile phones</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Xiaomi Redmi 4A (2016)</td>
<td>Applications can be played but still slow when played</td>
</tr>
<tr>
<td></td>
<td>- CPU (Quad-core 1.4 GHz Cortex-A53)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- RAM (2 GB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- OS (Android 6.0.1 (Marshmallow))</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Samsung J7 Pro (2017)</td>
<td>The application runs well but is still there but it is still a little slow so it is not comfortable when played</td>
</tr>
<tr>
<td></td>
<td>- CPU (Octa-core 1.6 GHz Cortex-A53)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- RAM (3 GB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- OS (Android 7.0 Nougat)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Xiaomi Redmi Note 5 Pro (2018)</td>
<td>The application runs well without any problems</td>
</tr>
<tr>
<td></td>
<td>- CPU (Octa-core 4x1.8 GHz Kryo 260 Gold &amp; 4x1.6 GHz Kryo 260 Silver)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- RAM (4 GB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- OS (Android 9.0 Pie)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Realme 5 Pro (2019)</td>
<td>The application runs very well and is very comfortable to play</td>
</tr>
<tr>
<td></td>
<td>- CPU (Octa-core (2x2.3 GHz Kryo 360 Gold &amp; 6x1.7 GHz Kryo 360 Silver))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- RAM (8 GB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- OS (Android 10)</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 9. Gender and age profile of respondents**

**Figure 10. Graph of the usability test**
4. Conclusion

This labyrinth game as promotion and learning media, success introduce the pamor kujang to student and public. This game is designed as an alternative media for introducing the prestige of the kujang pamor to the general public and the millennial generation. The introduction of the pamor kujang consists of the name pamor kujang and the labyrinth in the form of a kujang. The gameplay used in this game is education and maze puzzles. Then the games are designed for various types (android, offline, single player, 3D / 2D) using software (Unity 3D, Blender and Photoshop). Using the MDLC (Multimedia Development Life Cycle) method as a design method in application development. The algorithm used is Algorithm A* (A-Star) which functions as a path search. By using this algorithm, the closest path will be formed to get out of the maze which will make it easier for players to complete the level in this game.

The structural and functional testing phase of the buttons for moving between scenes in this pamor kujang educational game is in accordance with its function. In the testing phase, the validation of the coordinates of the starting point and the coordinates of the target finish point to make the closest path to get out of the cleaver maze is valid, and at the compatibility test stage to run this game requires an android mobile phone with a minimum of 2 GB of RAM but the game runs a little slow, meanwhile for android mobile phone specifications which have 4 GB of RAM and 8 GB of RAM. Game applications can run well without problems. Usability test of this game shows that there are still deficiencies because the results of the graph show the percentage of learnability is lower than other categories, this is because in this study there is only one learning, namely learning about pamor kujang. However, it can be concluded that the pamor kujang educational game media is quite suitable to be used to help promotion and socialize the pamor kujang through educational games, because the test results from multimedia experts or lecturers and the general public show a value above 50% so that it can increase the attractiveness and interest in studying the prestige of kujang.

References


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