Rangku Alu – A Traditional East Nusa Tenggara Game in Android Platform

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Abstract. Rangku Alu is a traditional Indonesian game originated from Manggarai, East Nusa Tenggara, which is played using two pairs of bamboos or sticks in motion until the opponent’s foot is wedged by the bamboos. However, nowadays the game is rarely played, as the rapid development of technology, the game can be played individually by anyone through an online game using media devices such as mobile or PC. Rangku Alu is a game where the moves of a dancer or player varied in each dance. In this research, Fisher-Yates Shuffle algorithm was used as a randomization method to determine the next moves to prevent the tap areas to appear at the same place more than once in a row. From the results, it shows that the tap areas have never been appeared at the same place in succession twice or more.

1. Introduction

Digital cultural perseveration has become a new field in the area of multimedia. The digitalization of culture has become a trend nowadays. Virtual Reality [1], Augmented Reality[2], Game[3], Computer Vision, and Mobile Games all of the areas has been related to preserving our culture. The traditional game as part of cultural heritage has become unknown right now, especially for our children’s generation. The traditional game is a simple game played by children in the past to direct and lead them to be part of social events and community activities. However, nowadays the game is rarely played, as the rapid development of technology; the game can be played individually by anyone through an online game using media devices such as mobile or PC. This research positively affects the traditional game which begins to lose its existence as a medium of entertainment in the past.

Rangku Alu is a traditional Indonesian game originated from Manggarai, East Nusa Tenggara, which is played using two pairs of bamboos or sticks in motion until the opponent’s foot is wedged by the bamboos [4]. How to play the Rangku Alu Game begins by dividing the players into two teams, Player / Jumper team, which consists of 1–4 players, and Guard Team consisting of 4 players. The guard team squatted square and hold two bamboos in charge of moving them while singing the dance song, or other traditional songs. Jumper group whose turn to play will jump on the sidelines of bamboo according to the rhythm of the bamboo motions. The Jumpers should avoid their foot to get wedged by bamboos [4].

The property or tools used in Rangku Alu is four pieces of 2 meter-long bamboo; due to its difficulty of finding bamboo nowadays, it is usually replaced with scout sticks of the same size. The playground area should also be considered when playing this game. The field with the hard and non-grassy ground is the perfect place for this game because the grass can trigger the risk of slipping.
during the play. Rangku alu is a game where the moves of a dancer/player varied in each dance. In determining the next possible moves is required a randomization method to build Rangku Alu game.

Juardi et al described some of the cultural preservation on Android-based game. In 2013 who built Karapan Sapi game using waterfall method model that is Requirement Analysis and Definition, System and Software Design, Implementation and Unit Testing, Integration and System Testing, Operation and Maintenance. They successfully created an educational game of "Karapan Sapi Race" with an attractive, entertaining and easy to play gameplay [5].

In 2013, Farizi et al. developed an Angklung simulator game on Android-based Smartphone through Game Design and Technical Design stages. These stages are then implemented and developed using AndEngine in Java. Based on the unit test results and integration, it can be concluded that the module unit of the game program met the functional requirements of the design. The performance test result shows an optimum performance when the game runs on a Smartphone that has a minimum processor of 600 MHz [6]. In 2015, Ovy Rizki performed a test on ball moves to determine the sensitivity level of an object and a test on a random function to determine the percentage of the random events occurrence possibility in Bekel adaptation game [7]. Fisher-Yates algorithm implementation has been applied by Ryan et al. (2015) to a 3D Unity based insect’s species identification in The Lost Insect application with user satisfaction percentage at 80% and the rate of easy to use application is at 66.25% [8].

In this development, authors intended to build a game application that is accustomed from the traditional game of Rangku Alu by applying Fisher-Yates Shuffle as a method in determining the next possible moves in Android-based Rangku Alu game which will be performed particularly in its Random Mode.

2. Methodology

The proposed method for this research will provide an overview of the general architectural plan to be used in this development. Starting from users accessing the mobile to users facing the user interface that contains detailed information about the system that has game logic connected to the database to receive data from the system usage which returned to users. Details of the general architecture will be explained further in subsequent chapters. General architecture implemented by authors to build the Android-based game of Rangku Alu can be seen in Figure 1.

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**Figure 1.** General architecture of the proposed method
In Figure 1, to access the game, it begins with selecting the Start menu which consists of "Play," "Score," and "Quit." In menu "play" the user will be presented with a selection of modes for game variation, and a choice of songs before entering the game area. This game has two types of modes that are normal mode and random mode. If random mode is chosen, then the tap area will be processed using Fisher-Yates Shuffle algorithm as in Figure 2. Otherwise, the tap area will be concocted manually. Then the system will receive input from the user as the user touches the same object with the tap area. An additional 100 points will be added to the user score. Otherwise, the game ends, and the high score will be stored in the database.

![Flowchart of Fisher-Yates Shuffle Algorithm](image)

**Figure 2.** Flowchart of Fisher-Yates Shuffle Algorithm

2.1. Game Logic

Game Logic is the primary flow of Rangku alu game. Game Logic uses the randomization function to determine every next possible move during the game. For more detailed explanation can be seen as follows.

2.1.1. Coroutines /timer

Coroutines is a subprogram that has multiple entry points, which are controlled by coroutines itself [9]. It is also known as the asymmetric control because of the mechanisms of the called and caller coroutines. Each coroutine has the same degree. Calling coroutine is called resume. The first resume is
when the coroutine begins, while the next resume will start after the last statement is executed on coroutine, so coroutines can mutually resume as long as possible. Coroutines allow quasi-concurrent execution on other coroutines where coroutines are executed simultaneously yet not overlapping.

Coroutines function is IEnumerator function that authors use as time control function. Coroutines itself is a component of computer program commonly used for multitasking. Coroutines can have more than one entry point which is useful for suspending and resuming during program execution. A coroutine is like a function that can stop the execution and restore control to Unity but then continue where it left off in the next frame. In C#, the coroutine is revealed as in Figure 3.

![Figure 3. Sample of coroutine in C#](image)

The pseudo code of coroutine function in this research is as follows:

```csharp
IEnumerator Fade() {
    for (float f = 0; f < 1; f += 0.01) {
        Color c = renderer.material.color;
        c.a = f;
        renderer.material.color = c;
        yield return null;
    }
}
```

![Figure 4. Pseudo code of coroutine as timer](image)

2.2. Bamboo Animation

Animation of bamboo motions is adjusted using the time calculation given by coroutine function. The bamboo animation is the change of bamboo location in times. The pseudo code of bamboo animation can be seen in Figure 5.

```csharp
class GameManager : MonoBehaviour {
    void MoveBamboo(bool closePosition, bool downPosition) {
        Get Bamboos position when
        openPosition, closePosition, downPosition
        if(closePosition == false AND downPosition == false)
            Bamboos transform position to openPosition
        else if(closePosition == true AND downPosition == false)
            Bamboos transform position to closePosition
        else if(closePosition == false AND downPosition == true)
            Bamboos transform position to downPosition
        else{
            output "there is no such position"
        }
    }
    // called every frame
    void Update()
    {
        //call coroutine so Bamboo won't moved every frame
        //but it get to wait for Coroutine to finish instead
        StartCoroutine(TapPlaying(DelayTime));
    }
}
```

![Figure 5. Pseudo code of bamboo animation](image)
2.3. Appearing Tap Area
The game Logic mechanism on this system has two game modes which are random mode and a normal mode that focused on the tap area. Calling the tap area in normal mode is done manually and continuously or monotonically, while in random mode is done by randomization using the Fisher-Yates shuffle algorithm.

2.4. Fisher-Yates shuffle
Fisher-Yates shuffle is a randomization algorithm which generates a random permutation of a finite set, or in other words, Fisher-Yates shuffle can be used to randomize a set, e.g., a set of arrays containing integers into a set of integers which positions have been randomized [10].

In the random mode of Rangku Alu game, the sequence of tap area appearances is randomized to variations of the game. In Unity, two libraries can be used to get random numbers, which are UnityEngine.Random and System.Random. However, in Rangku Alu, the result of calling the random numbers is expected to be different every time the call is made, so randomization of numbers using two libraries is not enough.

Fisher-Yates shuffle algorithm can be used to prevent the tap area to appear at the same place more than once. The pseudo code of Fisher-Yates shuffle algorithm implemented in Rangku Alu mobile game can be seen in Figure 6.

In Figure 6, the next possible moves to attain from the current area are saved in a single list named "TapArea." For the result of shuffle or tap area randomization, will be stored in a new list named "Result." Fisher-Yates algorithm in the system contains the randpossible function. The steps performed in the function are:

1. Pick a random number, from 0 to length of TapArea -1 list repeatedly.
2. Take an element of TapArea with index [i] and insert it to the Result list in the earliest order or on the index
3. Replace the contents of TapArea [i] with the last element in TapArea.
4. Delete the last element in TapArea. Then the length reduced by 1.
5. This process will be repeated until TapArea list is empty.
6. Then check whether the TapArea list is empty. If it is already empty, then move all the contents of the Result List to the TapArea list.
7. Return to the first step.

This function will return Result [0] value as a possible move.
2.5. Game Over
In system development, the authors built the system design for conditions such as whether the user is not able to continue the game (game over). With this condition, the author hopes that the system can check and call the game over function when the player touches the bamboo or when the player is too fast/too late to hit the tap area.

2.6. The Highest Score Logic
The logic for the highest score is called at the beginning of the game initiation to display the highest score on the user interface, and when the game is over, the logic is able to store the scores to the database automatically.

3. Result and Analysis

3.1. Main Menu Display
The main menu display is the initial display of the game before entering the game display. The main menu display consists of the displays of a start menu, select the mode, select the song, and how to play. Start display (a) is an opening display when the application runs consisting of the menus “Start Play,” “Score,” and “Exit.” Select the mode display (b) is display of selection mode chosen by the players. The mode in Rangku Alu is the tap variations when playing the game. There are two modes in Rangku Alu which are Normal mode and Random mode. Select the song mode (c) is a display where the player is expected to pick a song to be played in the game area as background music. There are three choices of songs, namely "Ampar-Ampar Pisang," "Rasa Sayang," and "Tari Tongkat." How to play display is made to guide the players about the game before it starts. The main menu displays can be seen in Figure 7.

![Figure 7. Main menu display; (a)Start menu; (b) Select the mode; (c) Select the song; (d) How to play](image-url)
3.2. Game Arena Display
Game area display is the game display of Rangku Alu after selecting a song to be played in the game and after reading the How to Play. Game area display can be seen in Figure 8.

![Figure 8. Game arena display](image)

3.3. High score display
High score display is a display to show the obtained score when the game ends. In this screen, ten people with the highest score will be put on the scoreboard. High score display can be seen in Figure 9.

![Figure 9. High score display](image)

3.4. Notification Display
Notification display is a display serves as a notification to the player about the conditions that occur when playing. Notification display can be seen in Figure 10 and Figure 11.
Figure 10. Game pause notification display; (a) Options; (b) Exit confirmation

Figure 11. Game over notification display; (a) Game over of miss jump; (b) Game over of miss click

Figure 10 (a) is notification display when button “pause” is clicked, options given by the notification are to continue the game, to repeat the game and to exit the game. Figure 10 (b) is a display showing confirmation question when button “exit” in Figure 10 (a) display is chosen.

Figure 11 (a) is the display when the player makes a mistake by jumping too late, and Figure 11 (b) is a display showing the game over notification when the wrong tap area is clicked.

3.5. Operational Procedures

Main menu displays as shown in Figure 7, is an initial stage in Rangku Alu game consisting of the displays of start menu, select the mode, select the song, and how to play. In selecting the mode display, there are two modes in Rangku Alu which are Normal mode and Random mode, while in select the song, three choices of songs are provided namely “ampar-ampar pisang,” "rasa sayange" and "Tari Tongkat" for the background music. In rangku Alu, there are variations of footstep movements in both modes. Fisher-Yates shuffle was applied for the footstep movements to determine the next possible moves during the play.

3.5.1. Normal mode

Normal mode in this application is a mode with regular and monotonous tap movements in the game. This mode is aligned with the simplest rules of the real Rangku Alu game, where the pattern of footstep movements has been defined from the beginning.
In normal mode, the sequence of footstep movements is stored in an array. The footstep movements are executed by calling the array elements, one in every few seconds depending on the level of the game.

This footstep movement mechanism will continue and repeat from the beginning when all the array elements have been called. The footstep movements in normal mode can be seen in Figure 12.

![Footstep movements in normal mode](image)

**Figure 12.** Footstep movements in normal mode

### 3.5.2. Random mode

The random mode in Rangku Alu game is more varied, and this is because authors use moves randomization algorithm so that players do not jump with a monotonous rhythm. The possible algorithm for moves randomization is Fisher-Yates shuffle. This algorithm was used to prevent the tap area to appear at the same time more than once.

Figure 13 and Figure 14 are the results of one round of random mode game in two trials, where the positions of tap area which appear consecutively in Figure 13 are not the same as the positions of tap area shown in Figure. 13. The positions of tap area in random mode can be seen as follows.
3.6. Application Testing
Authors performed a test on system to measure the game difficulties. The test was conducted on 20 individuals who play the game application directly. The test result can be seen in Table 1.
Table 1. The Result of Players Difficulty Level Test

Table 1 presents the scores obtained by the player in both game modes which are normal mode and random mode. Normal mode has monitors tap changes while random mode does not. From the observation, the average score in each level can be calculated as follows:

\[
\text{Average score} = \frac{\text{Total Score}}{\text{Number of Players}}
\]

1. Average Score in Normal Mode = 7275
2. Average Score in Random Mode = 6510

The score range in each level on the application is as follows:
- Level 1 = 100-2800
- Level 2 = 2900-3700
- Level 3 = 3800-5300
- Level 4 = 5300-15000
- Level 5 = > 15000

From the calculation result above, the level that possibly reached by 20 individuals who play the game in both normal and random mode is in level 4, thus it can be concluded that Rangku Alu game has a medium high level of difficulties.

4. Conclusion and Future Research
The conclusions that can be drawn from this research are as follows:
1. The implementation of the randomization algorithm Fisher-Yates Shuffle is able to determine the next moves so that this Rangku Alu game has tap variations with two game modes. From the research, it can be concluded that Rangku Alu game has a medium-high level of difficulties based on the average score.
2. In general, the footstep movements in Rangku Alu dance have many variations depending on the dancers. Authors can only adopt the simplest movements and add random footstep movements as variation.

3. Developing mobile game with an attractive interface requires a long and challenging process, so it should be done as a team so that more optimal results obtained.

4. Rangku Alu traditional game in groups or team will become our future study and development.

5. References

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