IMPLEMENTATION OF LINEAR CONGRUENT METHOD ALGORITHM IN ANIMAL INTRODUCTION EDUCATION GAME BASED AUGMENTED REALITY

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Abstract

Today, recognizing kinds of animal for the children is generally done by using a media guide, a poster image. However, this media is still considered to have shortcomings. Children tend to quickly get bored and less interested in the learning patterns, due to lack of interactivity of existing learning media. So the conventional learning less attractive and optimal. This paper aimed to establish the animal recognition learning applications by applying Augemented reality technology based on Android. The research methodology used includes collecting data by interview and literature study, the development of systems using the RUP method that consists of four stages, namely inception, elaboration, construction and transition, as well as th problem solving algorithm using LCM (Linear Congruent Method). LCM algorithm implementations carried out the stage of construction to randomize the animals in the game that made the introduction. Thus, the results of this paper is a game featuring animals with 3D objects. based testing, game applications have been made able to introduce animals in early childhood.

Keywords: Game, Android, Augmented Reality, Animal, Linear Congruent Algorithm Method.

1. INTRODUCTION

Educational games are games that have been designed to teach players about certain topics, expand concepts, reinforce development, understand a historical or cultural event, or help them learn skills as they play. The emergence of various kinds of games, including educational games, is also influenced by the development of technology around us.

Apart from bringing many benefits, technology has penetrated almost all aspects of life. One of the most developed technology products is a smartphone. One of the uses of smartphone technology in education is being used as a learning medium. Learning media in general is a tool for teaching and learning. Not a few of smartphone technology can make it easier for early childhood to learn, such as textbooks that can contain text, math formulas, pictures that tell history, and so on. Smartphone technology can provide new learning that can make young children more interested in interesting features.

Childhood is a period of development, where all abilities develop. This has led to many parents who provide teaching from an early age to improve children's abilities. However, early childhood have a tendency to learn according to their interests. So that parents need interesting methods and media to provide learning. The first thing that is taught to early childhood is to introduce the environment from objects, plants, animals and others. One of the lessons that is often done is the introduction of animals. The problem in

the process of recognizing animals using 2D shapes in books or images does not describe the animal clearly and can only describe the animal from one point of view. With advances in learning media technology, it is not only 2-dimensional, but can be made more attractive in the form of 3D animation to games where learning is inserted. One of them is the Augemented Reality game, which depicts animation in 3D which makes animal images more interesting. This makes children interested in playing it but must still be under the supervision of parents. The AR game that develops uses a camera to detect markers which then displays an animated object. For small children it is quite difficult to point the camera at objects properly and a marker is needed in 2D.

Augmented Reality-Based Animal Introduction Educational Game is an educational game to introduce animals. In this game you have to answer as many as possible to get the highest score. In essence, this game is more like an image guessing game. Players are assigned to answer the animals that appear, animal recognition games are one of the most interesting applications, especially children, where they can learn while playing games with 3D output.

Linear Congruent Method (LCM) is often used to generate random numbers in computer game applications such as puzzle games, lettering games and quiz applications. In the puzzle game, the Linear Congruent Method (LCM) is used to randomize the positions of the puzzle numbers to be arranged. In the game of composing letters, the Linear Congruent Method (LCM) is used to scramble the letters and in the quiz game the application of the Linear Congruent Method (LCM) is used to scramble questions or questions.

This research made an Android-based Augmented Reality Animal Recognition Educational Game using the Linear Congruent Method (LCM) Algorithm to randomize the animals in the game so that users don't get the same animal in the Augmented Reality-Based Animal Recognition Educational Game.

Based on the above background, the authors are interested in taking a research topic with the title "IMPLEMENTATION OF LINEAR CONGRUENT METHOD ALGORITHM IN ANIMAL IDENTIFICATION EDUCATION GAME BASED ON AUGMENTED REALITY".

Based on the background description above, there are several problem identifications, namely as follows:

1. The existing Augmented Reality-Based Animal Recognition application only displays animal descriptions.
2. The existing Augmented Reality-Based Animal Recognition application does not enter a username.
3. Application of Augmented Reality-Based Animal Recognition that there are no questions and answers.
4. The existing Augmented Reality-Based Animal Recognition Application does not have a Highscore

So that these researchers do not get out of the research objectives, the authors provide limitations for this study. The following are the limitations of the research that will be carried out:

1. The game application is made using the Unity tool.
2. The programming language used is C #.
3. Games made can only be played offline and can only be played by one person (single player).
4. This game is based on android Augmented Reality.
5. The Linear Congruent Method algorithm is used for animal randomization in the Augmented Reality-Based Animal Recognition Educational game.
6. This game only displays 10 3D animal objects.
7. Scoring is based on how many players answer the animal, starting

from the time the first game starts to the end.

8. High score The game that will be built uses a high score system, if the player has got a higher score than before, the username will appear on the main high score display.

2. RESEARCH METHODOLOGY

2.1 Data Collection Methods

1. Observation
   This observation is carried out by analyzing similar applications that already exist in the Playstore.
2. Literature study
   Literature study is a way of collecting data by looking for theoretical foundations from various sources, including books, journals, which are related to the discussion of this research.
3. Questionnaire
   Conducting questionnaires to several parents of students as a reference for data collection that can help in the process of making an application.

2.2 System Development Methods

The system development method used to make this application is the RUP (Rational Unified Process) system development method. RUP (Rational Unified Process) is a software development approach that is carried out iteratively, focuses on architecture (architecture-centric), is more directed based on use cases (use case driven). RUP is a software engineering process with well defined and well structured. (Rosa A. S and M. Saladin: 2016).

The RUP has four stages that can also be carried out iteratively, namely the Inception, Elaboration, Construction, and Transition stages which can be seen in Figure 1.

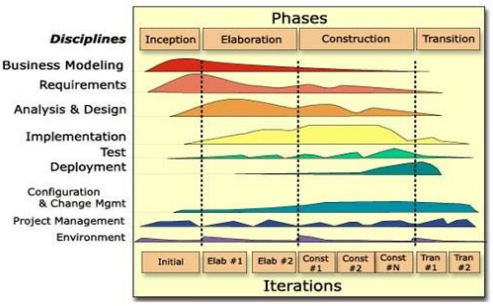

Figure 1. Stages of the RUP Method

According to Rosa A. S and M. Shalahuddin (2016: 129-131) the RUP (Rational Unified Process) system development method is divided into 4 (four) stages, namely:

1. Inception (Beginning)
   This stage is the earliest stage where at this stage the data collection process will be carried out in this study, namely by means of observation and literature study of existing games and those related to the development of the game.
2. Elaboration (Planning)
   This stage is more focused on planning game application architecture, and can detect risks that may occur at the most critical stage because the goal is to analyze the problem. At this stage, the software design will be carried out iteratively through activities such as business modeling, requirements, analysis and design. The algorithm used is the Linear Congruent Method which is applied in randomization in the game and the Linear Congruent Method Algorithm for randomizing numbers in the game. Meanwhile, the design built at this stage includes designing use cases, scenarios, activities, classes, and sequence diagrams.
3. Construction (construction)
   In the contruction stage, it is the stage for building software until the software is ready for use. This stage is more on the implementation and testing of systems that focus on implementing software in program code. The programming language

used for making this game uses the Java Android programming language. In making assets using the blender tool. This stage produces a product that will be submitted to the user.

4. Transition (Transition)
   This transition stage is the last stage where it is focused on how to deliver the finished software to the user. At this stage, testing will be carried out using UAT to determine user responses and provide an assessment of whether this application can be well received or not.

2.3. Problem Solving Methods

The problem solving method used by the author is the Linear Congruent Method algorithm. The random number generated by the computer is a pseudo random number, because it is generated using arithmetic operations. Many algorithms or methods are used to generate random numbers. Linear Congruent Method (LCM) is a method of generating random numbers that is widely used in computer programs. LCM makes use of a linear model to generate random numbers defined by:

Xn + 1 = (aXn + c) (mod m)

Where: n: nth random number

a and c: Linear Congruent Method constants.

M: the maximum limit of random numbers.

The first step is to input variables a, c, and m, selecting constants a, c, and m to determine the results of random numbers that are completely unrepeatable. After determining the constants a, c and m, we continue to determine the length of the random numbers and the numbers are directly entered into the formula of the LCM algorithm, so the random number results will not be repeated. LCM algorithm randomization simulation with 10 numbers which will be randomized as follows :

Formula :
Xn+1 = (aXn+c) (mod m)
a = 1
c = 7
m = 10
Penyelesaian :
X0 = 10
X(1) = (1 (10) + 7) mod 10 = 7
X(2) = (1 (7) + 7) mod 10 = 4
X(3) = (1 (4) + 7) mod 10 = 1
X(4) = (1 (1) + 7) mod 10 = 8
X(5) = (1 (8) + 7) mod 10 = 5
X(6) = (1 (5) + 7) mod 10 = 2
X(7) = (1 (2) + 7) mod 10 = 9
X(8) = (1 (9) + 7) mod 10 = 6
X(9) = (1 (6) + 7) mod 10 = 3
X(10) = (1 (3) + 7) mod 10 = 10

From the calculation simulation above, random numbers are obtained, namely: 7, 4, 1, 8, 5, 2, 9, 6, 3, 10 and there is no appearance of the same value when randomizing 10 times.

If the calculated number of a value from the generated random number is the same, the 3D object will not be randomized.

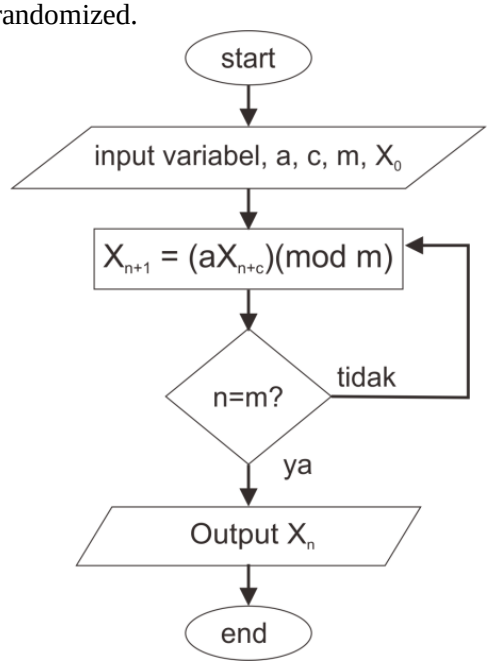

Figure 2. *Flowchart Algoritma LCM*

The advantage of this algorithm is its good speed, because the operations performed are only a few bit manipulation operations. (Nurjana, P. 2017)

In the application, basically is how to match the input in the form of a marker scanned using a smartphone camera which will then be matched using the LCM algorithm. If the detected markers match those in the library, the application will display 3D objects and other additional features. For more details, see the application flowchart in Figure 3.

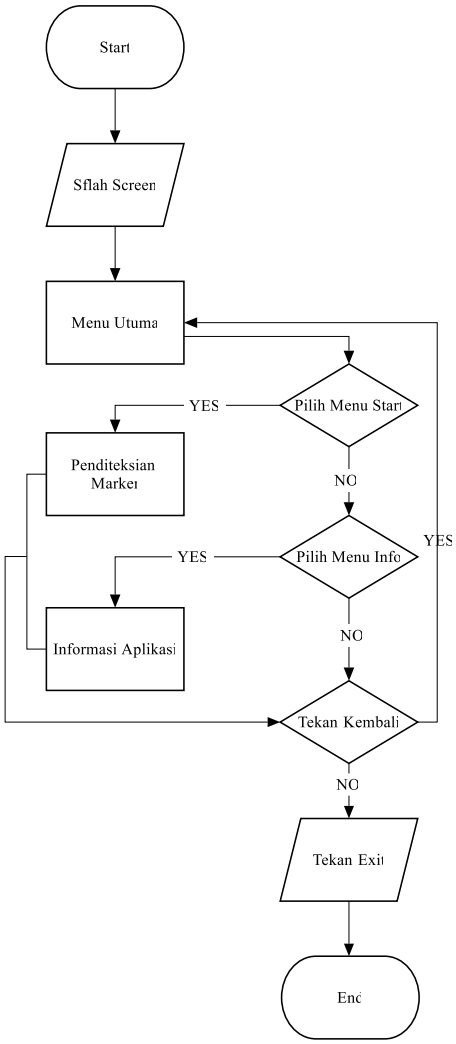

Figure 3 Flowchart Aplication

3. HASIL DAN PEMBAHASAN

3.1 Analisis Sistem

In designing a system, analysis is needed for system requirements. With system analysis, the game to be designed is expected to be better and easier in system development. the purpose of analyzing this system itself is so that the game that will be made is fun and does not saturate the game.

To make a unique game so that users don't feel bored, a system that is able to provide a challenge in operating the game is needed. In the concept of system analysis activities in this chapter will discuss system designs and utilize linear congruent method algorithms.

Where the LCM method is to randomize a 3D object, and in this method it will loop over a certain period of time or after several generation times. This is one of the main characteristics of this method. by using LCM, a 3D object scrambling solution can occur without repeating the previous scramble. Thus, this game application is expected to provide more effective results for randomization of 3D objects.

Broadly speaking, the Game System Flow has several stages, namely:

1. Initialize the Marker

   The initialization process is a stage in a tool that is used as a medium for capturing images, a function or method used by the application library system, namely to activate the camera to be able to capture markers that will be displayed in real time.

2. Marker Detection

   In the process, 3D objects will be initialized first so that they can be used easily in the process of matching patterns to markers.

3. Rendering the Marker Object

   If the user presses the button to run Augmented Reality (AR) after the camera detects the marker that is directed directly, a 3D object will appear.

3.2 Use Case Design

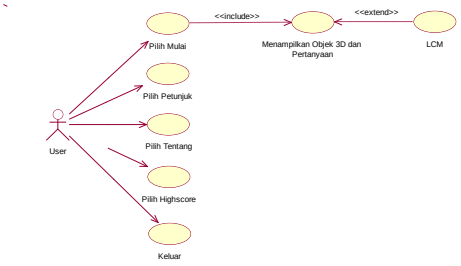

Figure 4. *Use Case* Diagram

3.2 Activity Diagram Design

1. Activity Diagram Start the game

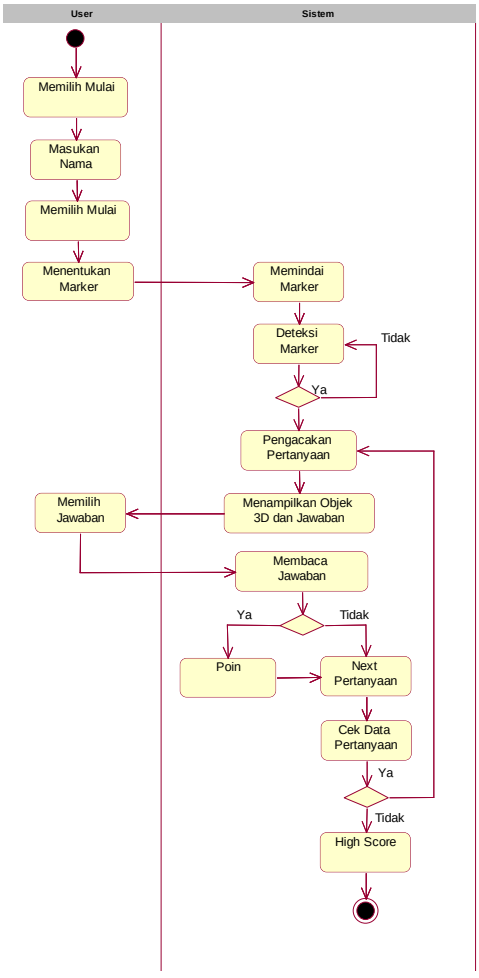

Figure 5. *Activity Diagrams of Starting Games*

2. Activity Diagram Instructions

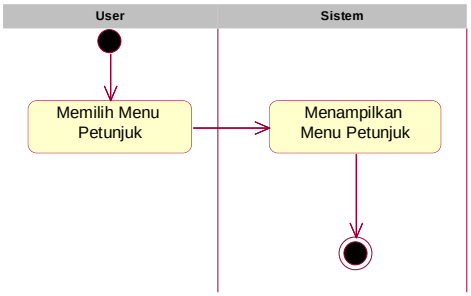

Figure 6. *Activity Diagram Instructions*

3. Activity Diagram About

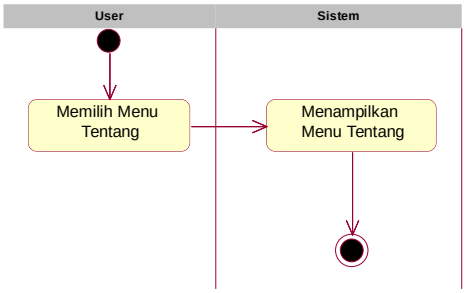

Figure 7 *Activity Diagram About*

4. Activity Diagram Out

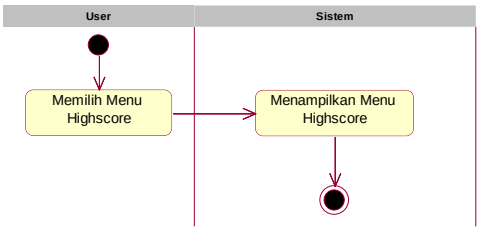

Figure 8 *Activity Diagram Highscore*

a. Sequence Design Diagram

1. Sequence Diagram Starting the Game.

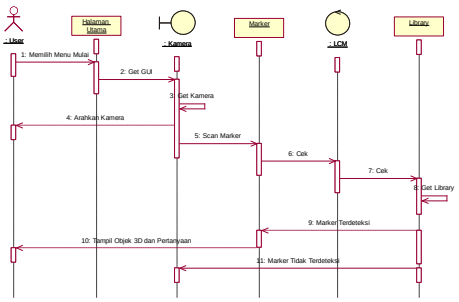

Figure 9. *Sequence Diagram* Starting the Game

2. Sequence Diagram Instructions

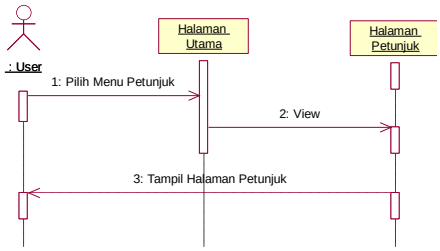

Figure 10. *Sequence Pindai QR*

1. About Sequence Diagram

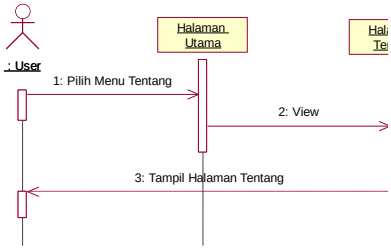

Figure 11 About Sequence Diagram

2. Sequence Diagram High score

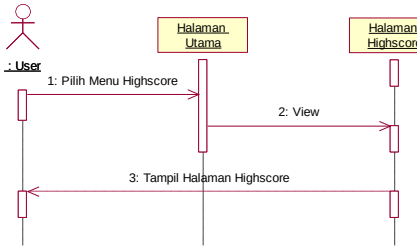

Figure 12 Sequence Diagram HighScore

3.4 Perancangan Class Diagram

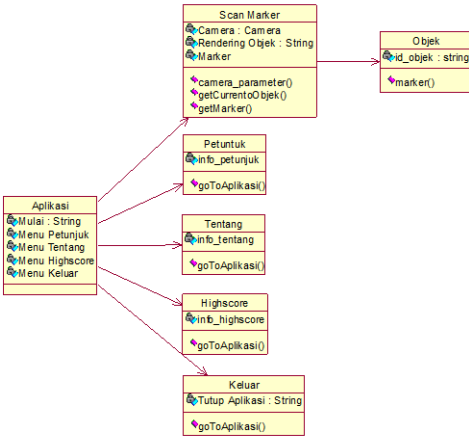

Figure 13. *Class Diagram*

a. System Implementation

1. Main Menu Interface

Figure 14. Main Menu Interface

2. Username Input Interface

Figure 15. Interface Enter username

3. Game Display Interface

Figure16. Game View Interface

4. Interface About Application

Figure 17. About Aplications

5. Application Guide Interface

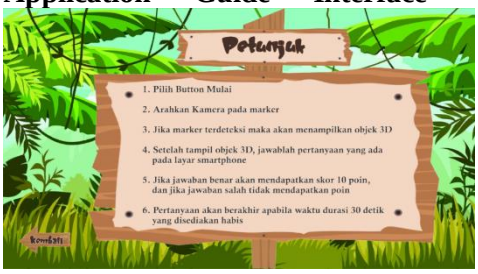

Figure 18. Application Instructions

6. Highscore interface

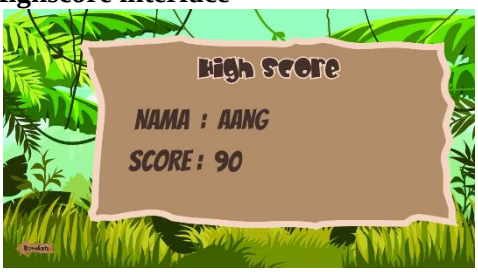

Figure 19. High Score

7. Application Exit Interface

Figure 20. Aplication Out

3.2 System testing

1. White Box Testing

White box testing focuses on the structural controls of the program. White box testing is performed to ensure that all statements in the program have been executed at least once during the test and that logical conditions have been tested. With this method, bias analysis obtains the following white box testing:

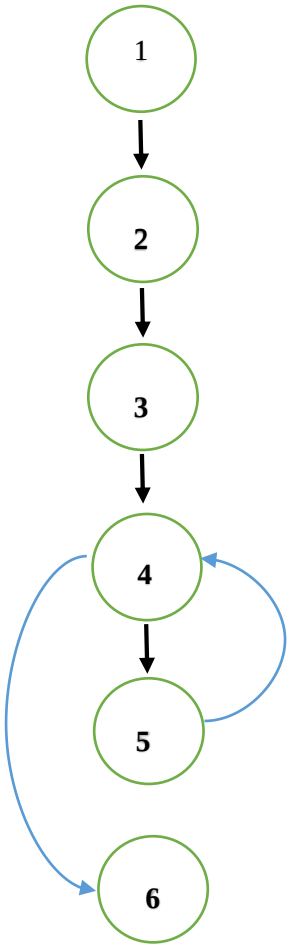

Figure 17. *Flow Graph*

Formula **V(G) = (E – N) +2**

Note:
E = Number of edges in Graph G.
N = Number of nodes in G.
Flow Graph Figure 4.8:
Known :
E (number of edges) = 6
N (number of nodes) = 6
So: V (G) = (6 - 6) + 2
V (G) = 2
So, clyclomatic complexity for Figure 4.8 is 2.
Based on the clycomatic, there are 2 paths consisting of:
Path 1: 1-2-3-4-6-1
Path 2: 1-2-3-5

4. CONCLUSION

Based on the results of research conducted by taking the title "Implementation of the Linear Congruent Method Algorithm in the Educational Game on Animal Introduction based on Augmented Reality", several conclusions can be drawn, namely as follows:

1. Augmented Reality-Based Animal Recognition Educational Game that is made can be used as learning for an early age about animal names in the form of 3D objects.
2. The Linear Congruent Method algorithm can be implemented in the Augmented Reality-Based Animal Recognition Educational Game, namely in the process of randomizing 3D objects.
3. Games that have been made are expected to be able to become a medium of entertainment as well as learning that is played in an android system for the community.

5. SUGGESTIONS

The following are suggestions that are deemed necessary to be considered for further research because in this Augmented Reality-Based Animal Introduction Educational Game is still far from perfect. The authors' suggestions for increasing the use and utilization of this system are:

1. This game needs to be developed again by adding 3D objects.
2. There needs to be a refinement of 3D objects that are more interesting and similar to the original object.
3. There is a need for application development to run on other platforms, namely Ios.

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