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Implementation of Educational Games Using the Levenshtein Distance Algorithm for Improving Elementary School Students' Word Vocabulary Android

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ABSTRACT

The low motivation of elementary school students in learning Indonesian vocabulary through conventional methods is needed, so an innovative technology-based approach is needed that is able to combine elements of learning and entertainment. Scramble educational games are designed with a mechanism of randomizing letters from a word that must be rearranged by students into correct words. In the answer validation process, the Levenshtein Distance algorithm is used to measure the error rate based on the minimum number of edit operations (substitution, insertion, or deletion) required for the guessed word to be equal to the target word. With the application of this algorithm, the system is not only able to provide a binary right or wrong assessment, but also assess the degree of closeness of students' answers to the supposed word. This allows for more adaptive and educational feedback, such as "almost correct" when the editing distance is low, thus encouraging students to improve answers with more confidence. This research also emphasizes the ease of use through the Android platform, given the high penetration of mobile devices among the public, including elementary school students. The results of the implementation show that the Levenshtein Distance algorithm-based scramble educational game is effective in increasing learning motivation and enriching students' vocabulary, while providing an alternative interactive learning method that is relevant to the development of educational technology.

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1. INTRODUCTION

In today's digital era, technological advances have penetrated into various aspects of life, including the world of education. One of the main challenges in primary education is to foster an interest in learning in elementary school-age children, especially in mastering Indonesian vocabulary. A rich vocabulary is essential for the development of children's language skills, logical thinking, and literacy skills. However, the reality on the ground shows that there are still many elementary school students who have limitations in vocabulary mastery, which ultimately impacts the ability to read, write, and understand the context of the text. Monotonous and less interactive vocabulary learning is one of the main causes of students' low interest in learning in expanding their vocabulary [1].

Listening to the teacher's explanations is less likely to be effective for children who tend to have an active and visual learning style. In addition, the lack of innovative and engaging learning media also reinforces the perception that learning vocabulary is a boring activity. In this context, the use of digital technology, especially

Android-based devices, can be an interesting alternative solution. Android devices, which have now become part of daily life in both urban and rural environments, offer easy access, portability, and opportunities for the development of interactive and fun learning applications [2].

One type of educational game that can be applied to vocabulary learning is Game Scramble, which is a game of shuffling letters in a word that must then be rearranged into the correct word. This kind of game not only trains students' ability to recognize the structure of words and letters, but also hone logical thinking, memory, and speed in thinking. However, the challenge of the development of Game Scramble is how the system can recognize students' answers automatically and accurately, given the possibility of typing errors, incomplete letter writing, or inconsistencies in the order of characters that remain meaningfully relevant.

Levenshtein Distance is one of the well-known algorithms in text processing, specifically in evaluating how similar two strings or words are based on the minimum number of operations (addition, deletion, or replacement of characters) required to convert one string into another. In other words, this algorithm is able to provide a tolerance for typos or character arrays that are close to true, but not identical. This is especially relevant in the context of child users, who often make spelling mistakes despite understanding the meaning or form of the word.

2. METHOD

The Levenshtein Distance algorithm is a method in computer science and computational linguistics used to measure the difference or distance between two strings (text or words) based on the number of edit operations required to convert one string into another. The edit operations in question include three types, namely: insertion, deletion, and substitution of one character. Each operation is counted as a single step, and the minimum number of such operations is the value of the Levenshtein Distance. For example, to change the word "kitten" to "sitting", it takes three steps: replacing the 'k' with 's', replacing the 'e' with the 'i', and adding the 'g' at the end. So, the distance is 3. These distance values help in determining how similar two strings are to each other, so this algorithm is widely used in various applications, such as automatic spell checkers, text searches, speech recognition, and error-tolerant text input systems [3].

This algorithm was developed by Russian scientist Vladimir Levenshtein in 1965. Technically, this algorithm is implemented using dynamic programming techniques, where the results of the calculation of the distance between substrings are stored in a two-dimensional matrix. The matrix is used to fill in the value of the distance between the combinations of characters of the two strings being compared, until the final result is obtained in the lower right corner of the matrix.

2.1 Research Stages

In this section, the stages of research that are applied in completing the research will be described in detail. The tahpan includes a series of systematic steps designed to address the misconceptions that are the focus of the discussion. The stages of the research are as follows:

(1) Analysis of the Tahapa Problem to understand the existing problems and needs that must be met by the system to be built. Analyze the system to be built. System analysis includes data collection, problem identification, and determination of user needs specifications. This result is a clear picture of the system's functions, workflows, and limitations. (2) Design According to the research stage, design is the process of translating the results of the analysis into a design that can be used to include diagram creation, puzzle application design, and user interface design. The goal is to produce a working model that becomes a reference at the implementation stage. (3) Implementation Implementation is the stage of realizing the design into an executable system. At this stage, the design that has been created is converted into program code, integrated with the database, and adapted to the needs of the user. The result is a system that is ready to be tested to ensure fit with the design. (4) Testing The testing stage is carried out to ensure that the system works according to the predetermined specifications. Testing can include functional tests, performance tests, and constraint tests. The goal is to detect errors and ensure the system can be used properly by the end user.

3. RESULTS AND DISCUSSION

3.1. Results

Use Case Diagram

The Use Case Diagram is used to visualize in a structured manner the flow of interaction between the Android-based Scramble educational game system and its users. In this design, there is one main actor, namely the user, who plays the role of a player as well as a user of the application. These interactions are illustrated in the Use Case Diagram shown in Figure 1.

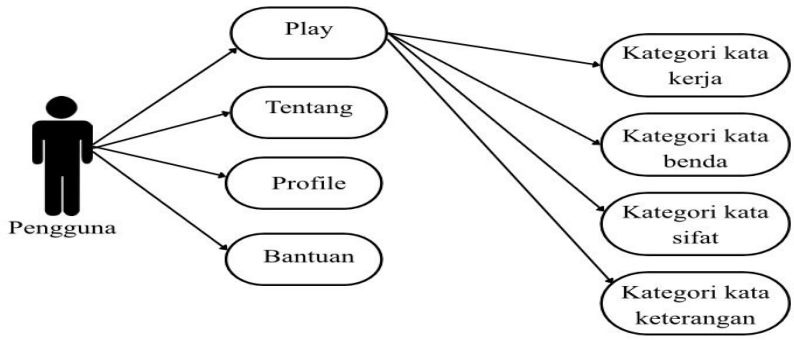
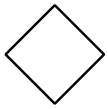


Figure 1. Use Case Diagram

Activity Diagram

Activity diagram describes the workflow (workflow or activity of a system or business process. What needs to be noted here is that the activity diagram describes the activity of the system not what the actor does, so the activity that can be done by the system. The following are the symbols in the activity diagram in table 1:

Table 1. Symbols - Activity Symbols Steepe Diagram

Symbol	Description
 Initial status	Initial state of system activity, An activity diagram has an initial state.
 Activities	Activities that are carried out by the system, Activities are usually more than one.
 *Decision*	Branching Association where if there is more than one choice of activities.
Join	Merger associations where more than one activity is used into one
 Final Status	The end state that the system performs, an activity diagram has an end state.

3.2. Implementation

Main Menu View

In the Android-based Scramble Game view, vocabulary is created using 3D unity software.

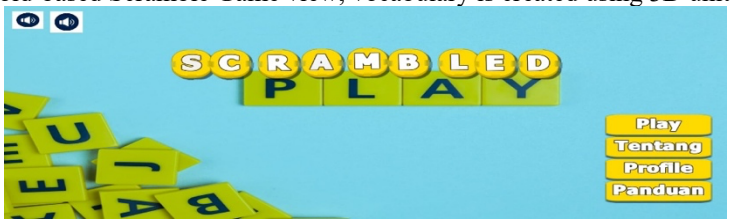


Figure 2. Main Menu View

Game Category View

The Game category menu will display the categories of verbs, adjectives, nouns and adverbs. As shown in the following picture:

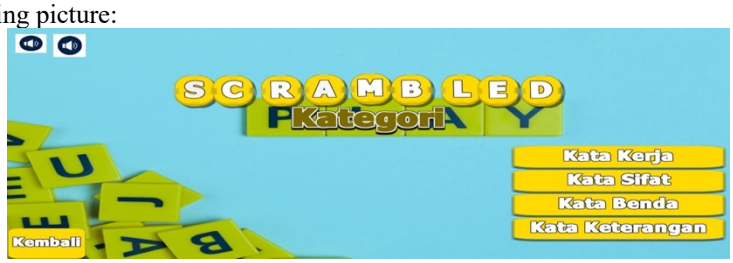


Figure 3. Game Category View

Guide Menu Display

The guide menu display will display the guide information for Android-based vocabulary games. As shown in the following picture:

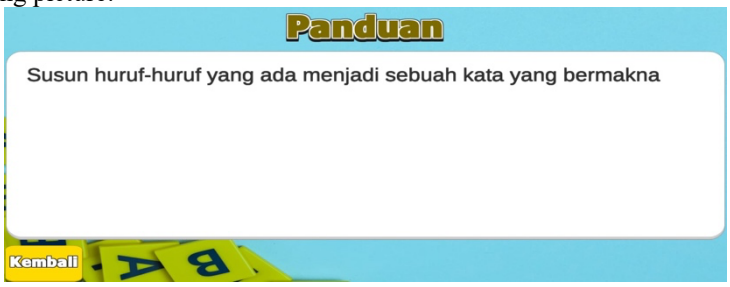


Figure 4. Guide View

Game View On Game

View Android-based vocabulary will display the game from the Game. As shown in the following picture:

Figure 5. Puzzle Game Display

Game Over Display

On the game over display, the game sign is over and out of time as shown in the following image:

Figure 6. Game Over View

4. CONCLUSION

Based on the design that has been carried out and applied to the 3D unity about the implementation of Android-based Scramble educational games with the application of the Levenshtein Distance algorithm aimed at improving the vocabulary of elementary school students, conclusions can be drawn, among others: (1) Android-based Scramble educational game can be used as a vocabulary learning medium for elementary school students. (2) The Levenshtein Distance algorithm can be applied in the game to measure the similarity of words and provide feedback to students' answers dynamically. (3) This Android-based vocabulary Scramble educational game is effective in improving the vocabulary mastery of elementary school students compared to

conventional methods. (4) The implementation of the Scramble Educational Game can be one of the alternative innovative learning media that is fun, so that it can increase student learning motivation.

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