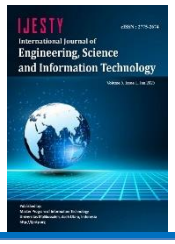
International Journal of Engineering, Science and Information Technology
Volume 5 No. 1 (2025) pp. 381-387
ISSN 2775-2674 (online)
Website: http://ijesty.org/index.php/ijesty
DOI: https://doi.org/10.52088/ijesty.v5i1.772
**Research Paper, Short Communication, Review, Technical Paper**



# Application Introduction and Learning Geometry of Space to Student Elementary School Using Method Rolling Hash Based on Android

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*The manuscript was received on 10 June 2024, revised on 1 September 2024, and accepted on 14 January 2025, date of publication 23 January 2025*

## Abstract

Along with technological advancements, smartphones have evolved from being just a means of communication to now being multifunctional devices that reflect the status of their users and offer various features, such as cameras, music and video players, video calls, voice recorders, games, and internet access. These innovations' progress made them widely used by humans in their activities. One of the innovations that utilizes this technology is a building space introduction and learning application explicitly designed for elementary school students, using the Android-based Rolling Hash method. This application is an interactive educational tool that provides comprehensive information about building spaces, explains the various forms of building spaces, provides applicable examples, and offers solutions to related problems. This application's primary focus is implementing the Rolling Hash algorithm for string matching, which was chosen for its ability to perform fast and accurate matching in answering questions. By implementing this algorithm, the application can efficiently handle various questions involving strings, enhancing students' learning experience. This application uses Java programming language with ADT IDE for Eclipse and SQLite as a database system to store and manage data. The result of this final project is a learning application that not only facilitates the introduction of building space concepts to elementary school students but also shows how modern technology can improve learning methods. The Rolling Hash algorithm proved its effectiveness in fast and precise string matching, providing an optimal solution for this educational application and presenting a model of how technological tools can support primary education innovatively and practically.

***Keywords***: *Smartphone, String Matching, Rolling Hash, Geometry, Android.*

## 1. Introduction

Nowadays, mobile phones have shifted from being a communication tool to a multi-functional one showing users' class [1]. Call it a function in the form of a camera, music player, video, video call, voice recorder, game, internet access, and various other applications [2]. With all these multiple functions, all levels of society need to utilize them daily, including elementary school students as educational people. Elementary school students, especially first graders, are transitioning from kindergarten to elementary school [3]. At that time, they will usually only do and remember what they like and want, for example, in terms of learning. Fun learning methods will increase memory and motivate students to study even with subjects they generally consider difficult, such as math. Learning math is usually less attractive to some elementary school students because it is considered difficult to understand. Learning is a must for students, especially elementary school students, who come to school every day to learn. Many children find math difficult, making them lazy in learning and repeating lessons [4].

Therefore, learning innovations that are fun and easy for students to understand are necessary for their learning development, especially by utilizing current technological developments such as applications [5]. Using applications that students usually favor is hoped to

increase their enthusiasm for learning and make it easier for them to understand a lesson. Applications are made so elementary school students can learn enthusiastically and quickly because they are not fixated on books [6]. In this study, the authors discuss how important learning is. We must know, especially children, because many think that learning is very dull, so the teaching and learning taught at school are less able to be mastered by children; here, the authors want to tell that learning. At the same time, playing is a compelling way to attract children's attention and enthusiasm for learning even more in developing learning applications, as discussed in this paper, using the Rolling Hash method as a string matching method. Rolling Hash is an algorithm usually used to match strings; the definition of Rolling Hash itself is a function used to generate hash values from a series of grams [7].

## 2. Literatur Review

### 2.1. Learning Application

Based on the definitions of applications and learning that have been explained, applications can be interpreted as programs designed to carry out certain functions for their users, including in the context of data processing to solve specific problems [8]. Meanwhile, learning is the interaction process between learners and educators and learning resources in an environment that aims to gain knowledge, skills, and attitude formation [9]. Therefore, learning apps can be defined as programs or software designed to support learning by facilitating more effective interaction between learners and learning resources and promoting access and use of various learning resources [10].
Learning apps play an essential role in modernizing teaching and learning methods in education, allowing the learning process to occur anytime and anywhere, per the principle of lifelong learning [11]. These applications assist educators in delivering materials more interactively and engagingly and enable learners to learn independently and purposefully. By utilizing the right computing technology, learning applications can improve the learning process's efficiency, effectiveness, and flexibility, thus helping learners achieve their learning goals more optimally [12].

### 2.2. Rolling Hash Algorithm

A hash is a set of fixed-length values from text of varying lengths commonly used for data authentication. The function to generate hash values is called a hash function, while the resulting values are called hash values [13]. Rolling hash is a function where the input is processed in a window that moves along with the input. This hash function allows new hash values to be calculated based on previous hash values [14]. This function is expected to save the computational cost of converting string data into hash values. Rolling Hash is also a function used to generate the hash value of a series of grams. The Rolling Hash method formula is as follows:

Rolling Hash = C1 * bk-1 + C2 * bk-2+… + Ck-1* b + Ck ……(1)
Description:
C = character ASCII value
b = base (prime number)
k = many characters
To get the advantage of Rolling Hash, the following hash value H(c2...ck+1) can be done by :

H(c2…ck+1) = H(C2…ck+1) – C1 * b k-1 ) * b + Ck+1 ……(2)

The above formula is to find the hash value of the 2nd to the nth gram. In the hash calculation of the nth gram, the hash value of the n-1th gram is then added to the last character value of the nth gram. That way, there is no need to iterate from the first index to the previous to calculate the hash value for the 2nd to last gram. This can undoubtedly save computation when calculating the hash value for the 2nd to last gram. This can save computation time when calculating the hash value of a gram.

### 2.3. Android Architecture

#### 2.3.1. Application and Widget

Applications and Widgets is the layer where we deal with applications only, where we usually download the application and then install and run the application. The layer contains core applications, including email clients, SMS programs, calendars, maps, browsers, contacts, etc. All applications are written using the Java programming language [15].

#### 2.3.2. Application Framework

Android is an “Open Development Platform,” which means that Android offers developers or gives developers the ability to build excellent and innovative applications. Developers can access hardware and resource information, run background services, set alarms, add status notifications, etc [16]. Developers have full access to the framework APIs like core category applications do. The application architecture is designed so that we can easily reuse components that are already in use. So we can conclude that Applications Frameworks is a layer where application makers develop/create applications that will run on the Android operating system because it is in this layer that applications can be designed and made, such as content providers in the form of sms and phone calls [17].

#### 2.3.3. Libraries

Libraries are the layer where Android's features reside; typically, app makers access libraries to run their apps [18]. Running on top of the kernel, this layer includes core C/C++ libraries such as Libc and SSL, as well as:

1. Media libraries for audio and video media playback
2. Libraries for display management
3. Graphics libraries, including SGL and OpenGL for 2D and 3D graphics
4. SQLite libraries for database support.
5. SSL and WebKit libraries integrated with web browsers and security
6. LiveWebcore libraries covering modern web browsers with embedded web view engine

7. 3D libraries that include implementation of OpenGL ES 1.0 APIs

### 2.3.4. Android Runtime and Linux Kernel

The layer that makes Android applications run where the process uses a Linux implementation. Dalvik Virtual Machine (DVM) is the engine that forms the basis of the Android application framework. The Android Run Time is divided into two parts, namely Core Libraries and Dalvik Virtual Machine [19]. At the same time, the Linux kernel is the layer where the core of the Android operating system is located. It contains system files that manage the processing system, memory, resources, drivers, and other Android operating systems. The Linux kernel used by Android is Linux kernel release 2.6 [20].

## 3. Research Methods

### 3.1. Data Collection

Several methods, such as a literature study, were used to collect the data needed for this research. The literature study is done by gathering information from various books related to this research, studying and understanding guidebooks, and everything considered essential and associated with making this space-building learning application. After obtaining the reference, then design the application by applying the method based on the literature study conducted. Apart from that, other methods used are observation and internet browsing.

The case study in this study is the Construction of the DKI Jakarta Provincial Prosecutor's Office Building Project located on Jl. H.R. Rasuna Said No.2, RT.5/RW.4, East Kuningan, Setiabudi District, South Jakarta City, Special Capital Region of Jakarta 12950. The building consists of 16 floors with a building area of ±25,344 m². The initial implementation time of the project contract is 389 (Three Hundred Eighty Nine) calendar days, starting October 1, 2021, and ending on October 24, 2022. However, the time for implementing the project in the field was not according to the initial schedule due to additional work and less work agreed to end on December 28, 2022, so rescheduling was carried out. The scope discussed in this study is on structural work and architectural work.

### 3.2. Analyze System Requirements

This analysis method stage is the stage of analyzing the system to be built. After the analysis is obtained, the next step is to make an analysis result. The study's results will be a reference for the design of the built system.

### 3.2.1. Hardware Requirement Analysis

Hardware in doing this research is essential for making applications. The hardware specifications used in the manufacture of this space-building learning application are as follows:

1. Acer Aspire laptop
2. Intel Processor
3. DDR RAM 2GB
4. 500GB HDD

### 3.2.2. Software Requirement Analysis

Software is also one of the supporting factors in the design stage to make the application. The software specifications used in the design of this build space learning application are as follows:

1. Microsoft Windows 7 Ultimate
2. Microsoft Office 2007
3. Eclipse Juno untuk mobile developer
4. Android SDK
5. Bluestack Android Emulator/android virtual device

### 3.2.3. Input Requirement Analysis

In the system that was built, it has data requirements that are inputted, namely:

1. A collection of learning materials about building spaces for elementary school students. The lesson material for building space is taken from the material in the book supporting learning about building space for elementary school students.
2. A collection of questions related to the subject matter of building space for elementary school students. The questions about building space in this application will be a collection of essay questions on books related to the material taken from the book supporting learning about creating space for elementary school students.
3. Input answer choices from the questions provided. To train application users' understanding of the material available in this application, users can work on questions by answering the questions provided.

### 3.2.4. Process Requirement Analysis

1. At the stage of analyzing this process, there are several processes, namely:
2. The process of introducing the material of building space.
3. Problem selection process
4. Problem information selection process
5. The answer input process is inputting answers from the set of questions available in the database of space-building questions using the Rolling Hash algorithm.
6. The answer-checking process checks the correctness of the answers that users of this application have input.

### 3.2.5. Output Requirement Analysis
The data output displayed by this application displays questions, answer choices, and the results or scores of questions answered.

## 3.3. System Design
The author designs an introduction and learning application for building space at this stage. This application uses Java Eclipse Juno For Mobile Developer and SQLite database. The first step in designing an application is to create an application framework for its appearance.

## 3.4. System Application
System implementation is the last stage of the application process. At this stage, the author conducts a series of tests before the application is made. This application test aims to get errors so that these errors can be resolved immediately before implementation. After there are no more errors, users can use the system immediately.

## 3.5. System Diagram
System diagrams are used to determine what processes occur in the system. The system diagram for this application uses a flowchart. Here is the system of this build space application:

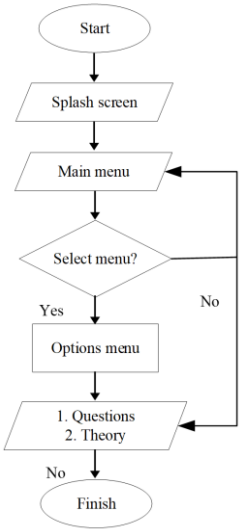


**Fig 1.** Flow Chart User

This flowchart is the beginning or overview of the entire system that has been done. From the Flowchart or flow chart above, it can be seen how the application's user interface looks until the whole. The user interface begins with the user entering the application and immediately entering the opening or splash screen. When the splash screen is finished, the user will enter the display on the main menu; there are several choices when the user has entered the main menu, namely, the material menu of this material menu contains material in the form of images about building space, when the user chooses one of the materials on the material menu an explanation of the image that has been selected about building space will appear, there is also a voice pronunciation of the shape of the building space, the reason is in the form of understanding, formulas, examples of shapes and various forms of building space. On the question menu, there are several questions in the form of images about building space not only questions in this menu, but the user can also choose help info to answer the questions that have been provided in answering the questions the user must pay attention to the time and score if the user runs out of time before being able to answer the question then the user does not get a score. There are several options on the main menu display; the user can select one of these menus, and when the user selects one of the menus provided, the system will immediately execute the command to be selected.

# 4. Results and Discussion

## 4.1. System Analysis
System analysis aims to identify problems in the system, where the application being built includes the operating environment, users, and related elements. Analysis of the system is needed as a basis for the system design stage, which provides for system design, system design, and implementation.

## 4.2. How The Rolling Hash Algorithm Works
This Rolling Hash method is used in the question process, namely when the user inputs the answer to the question that appears, then the system will check whether the answer entered by the user matches the answer contained in the database or not, if it is correct then the system will immediately respond in the form of correct answer output, otherwise if the answer entered by the user is wrong then the system will also react in the form of wrong answer output. In this application, questions are made in images to make it easier for students to recognize and distinguish several forms of building space. Suppose there are only questions in the form of stories or searches. In that case, this must make it difficult for students to understand the pictures of students easily remember them, and elementary school students are usually more interested in learning through pictures, exciting pictures.

## 4.3. System Design

The software design for the completion of the introduction and learning application for this room uses Eclipse, which is an application development tool that uses the Java programming language. SQLite Manager is used for the database that serves as a storage area.

### 4.3.1. Usecase Diagram

The use case diagram shows how the system works in general. In this diagram, one User actor can perform four processes: viewing material, questions, about, and exit. As for being able to enter the admin page, the user must already be registered as an admin, while for ordinary users, there are no requirements whatsoever to perform operations; in other words, anyone can become a user.
The following is a design using a use case diagram that will explain simply how this application runs:

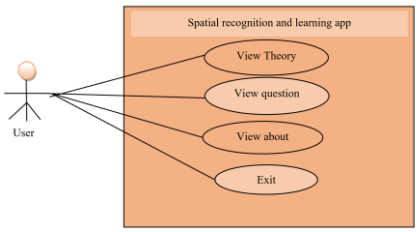


**Fig 2.** Usecase Diagram

### 4.3.2. Activity Diagram

The following is a design using activity diagrams in making this software:

1. Activity diagram for theory data menu
   This activity diagram shows the activity that runs when the user selects the material data menu on the application's main page. When the user selects the material menu, the system processes it and opens the material data display. On the material data page, the user can see the contents of the material and listen to the sound of the selected data by clicking on the image of the space building. Then, the system will search for the material data in the database and display the contents of the space building contained in the material.

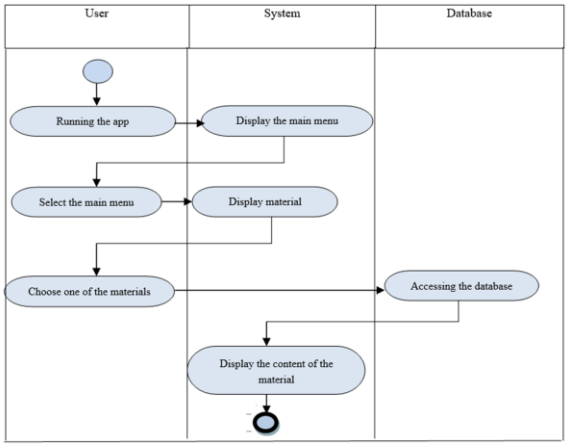


**Fig 3.** Activity Diagram for Theory Data Menu

2. Activity Diagram of Question Data
   This activity diagram shows the activity that runs when the user selects the question menu on the application's main page. When the user selects the question menu, the question will be displayed, and there is also a question help menu in the form of information that is close to the answer to the question; if the answer to the question that appears is correct, then the user gets a score of 10 if it is wrong then 0. Then, the database accesses and provides information about the number of correct and incorrect in the final score information.

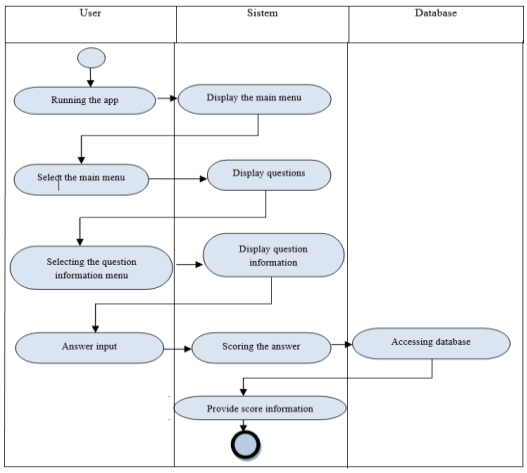


**Fig 4.** Activity Diagram of Question Data

3. Activity Diagram About
   The About menu is a display that displays information about the application. The About menu does not require access to the database and does not require any data processing; it only requires a display. The About menu can be selected from the About button on the main menu.

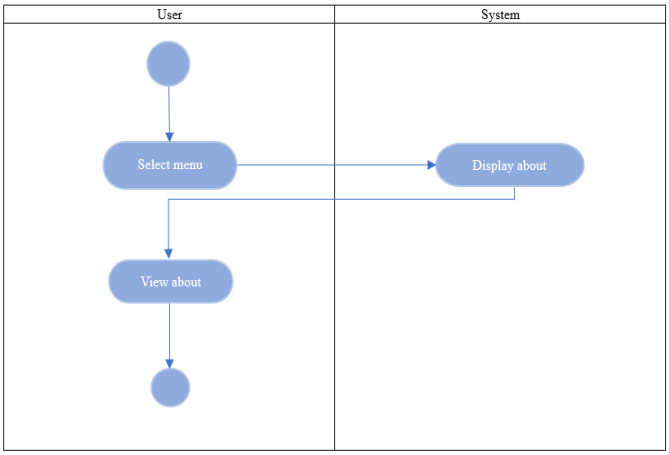


**Fig 5.** Activity Diagram About

## 5. Conclusion

This learning application is designed to help elementary school students relearn the material taught in school more interestingly and interactively so that it can reduce laziness in learning. The material presented includes various lessons, such as spatial figures in mathematics, arranged as attractively as possible to make them easier for students to understand. Learning is packaged in image format with the help of text, making the learning process more visual and exciting. This application also uses the Rolling Hash algorithm to match student answers with answers stored in the database. This allows students to practice answering the questions provided more effectively, improving their understanding and knowledge. With this approach, the application is expected to be a valuable and enjoyable learning tool for students in their daily learning process.

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