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Data-Driven Augmented Reality for Scout Password Recognition in Interactive Learning Environment

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Abstract

Scout password is an essential component of scout science, used for communication through secret codes. Learning scout passwords has traditionally relied on conventional methods, where coaches provide material and exercises during weekly meetings. Due to infrequent practice opportunities, this approach often limits students' ability to engage deeply with the material. To address these challenges, this research introduces a data-driven augmented reality (AR) application designed to enhance the learning experience by making scout password recognition more interactive and accessible. The proposed tool leverages AR technology to provide real-time visualization of movements and auditory cues, creating an immersive and engaging learning environment. By integrating data-driven insights into the AR application, the learning process is tailored to individual student needs, ensuring effective understanding and retention of scout codes. The development process follows the Multimedia Life Cycle methodology, providing a structured and iterative approach to creating a user-friendly and impactful application. This innovative AR-based tool aims to transform traditional scout learning methods, offering students a more dynamic and interactive way to master scout password communication while addressing the limitations of conventional teaching practices.

Keywords

Scout password, Augmented Reality, Multimedia Life Level Cycle

Introduction

Pramuka, or Praja Muda Karana, is a scout movement as an institution that organizes non-formal educational activities that aim to improve youth resources and realize an increase in rationalism (Nainggolan, 2016). Scouts are generally extracurricular activities found in schools and Indonesian non-governmental agencies, which are a forum for various skills with educational teaching methods and learning in codes commonly known as codes (Ruzana et al., 2024). In scouts, many

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activities and materials are studied, including studying codes. Codes are whole words that can replace other words (Kurniawan et al., 2021). Codes in scouts can usually be in movements or writing that are more directed at codes to solve a challenge or obstacle.

Learning scout codes for scout members usually uses traditional (conventional) methods, namely by providing material while imitating the way of saying and moving taught by their instructors. This method makes it difficult for scout members to understand the movements in scout codes because scouts usually only meet once a week. With the advancement of science and technology today, learning using smartphones will further increase the desire and interest of members in learning scout codes. In this modern era, members spend more time with smartphones than studying using pocketbooks. This shows that technology, including augmented reality technology, plays a vital role in learning.

Augmented reality is a technology that combines the real and virtual worlds. It can be applied to Android mobile device applications because the AR system analyzes objects captured in real-time. The concept of AR is interactive in real-time and is a 3D animation (Hadi, 2023). Unlike virtual reality, which completely replaces reality, augmented reality only adds or complements reality to almost resemble reality. Android is an operating system for mobile phones based on Linux, including operating systems, middleware, and applications (Fitrani & Dhani, 2024).

To overcome the above problems, researchers researched to create an Android application with a combination of augmented reality technology and applied the marker-based Tracking method. Marker Tracking is a method using markers or markers with patterns that can be read by the camera (Virgiawan et al., 2020). This research was conducted to create a scout code learning media that is easier and creates a different atmosphere in the learning process. So, scout code learning can be used by students as a learning media that can be accessed anywhere.

It can be understood that the presence of learning media helps the learning process, which students can easily understand to support the process of getting to know, understand, and practice the movements in scout codes.

Literature Reviews

The Pramuka, or Praja Muda Karana, is a scout movement in Indonesia aimed at improving youth resources through non-formal education. This educational program focuses on developing rationalism, social responsibility, and self-discipline among its members (Nainggolan, 2016). Typically, scouts are extracurricular activities found in schools and non-governmental agencies, providing a platform for various skill-building activities. In these settings, learning often involves codes—systematic, symbolic representations of communication (Ruzana et al., 2024). In the context of Pramuka, these codes often involve movements or written forms that convey meaning or solve challenges, with one of the most essential forms being semaphore and Morse codes (Kurniawan et al., 2021).

The traditional approach to teaching these scout codes involves direct instruction, where members imitate the movements and actions demonstrated by their instructors. However, this method can be challenging for students since scout meetings are infrequent and usually occur only once a week. As a result, learners often need help grasping and retaining the information presented fully. With the rapid advancement of technology, there is a growing opportunity to enhance the learning experience, primarily through integrating smartphones.

These devices, which students are increasingly familiar with, can be used to increase engagement and facilitate the learning of scout codes. Augmented Reality (AR) technology, which combines real and virtual worlds in real time, offers a potential solution. AR can be applied in Android-based applications to improve learning by providing interactive, 3D-based experiences that enhance understanding and retention (Hadi, 2023). The integration of AR not only brings innovation to the learning process but also aligns with the interests of today's tech-savvy students, who often spend more time on their smartphones than with traditional textbooks (Fitrani & Dhani, 2024).

In this context, research was conducted to create an Android-based learning application that integrates AR technology using the marker-based Tracking method. The Marker Tracking method uses patterns or markers that the camera can detect, triggering specific content such as 3D animation of scout code movements. This development aims to address the challenges faced by traditional learning methods and provide a more interactive, engaging, and accessible way for scout members to learn codes, particularly in a format that can be used anywhere at any time. Such a learning tool can help overcome the limitations of traditional methods, offering a flexible and more effective approach to learning.

Further studies and research on the use of AR in educational settings support the concept of integrating AR into various learning media. For example, Artawan et al. (2023) explored the development of AR as a learning medium for vocational school students, specifically in pneumatic components. This research highlighted how AR could assist teachers in delivering complex material more effectively by providing a more interactive and visual learning experience. Similarly, Alamsyah et al. (2023) developed AR-based learning media for recognizing semaphore passwords, enabling students to visualize semaphore movements in real time. This approach aligns with the goals of integrating AR into scout code learning, offering students a more immersive and hands-on learning experience.

The study by Yit Meng et al. (2022) on AR in Android applications for finding rented houses in Pekanbaru City further exemplifies the growing trend of using AR in various sectors. Their research focused on utilizing AR to enhance location-based services, improving how users can search for rental properties. Though not directly related to education, the study emphasizes the broader potential of AR applications in everyday life, underscoring the relevance and applicability of this technology in diverse fields, including education.

The literature on AR in education highlights its potential to revolutionize traditional learning environments by making abstract concepts more tangible and engaging. The research supporting the integration of AR in scout code learning aims to leverage these technological advancements to enhance the educational experience for Pramuka members. By utilizing

smartphones and AR technology, this study seeks to bridge the gap between traditional learning methods and modern technological solutions, offering an innovative way for students to learn and practice scout codes.

Methodology

1. Data Collection Methods

To solve the problems that lead to the purpose of making this program, the data collection methodology used is as follows:

a. Literature Study

A literature study is a study that takes data from libraries, reads, records, and processes research materials (Melinda & Zainil, 2020). In this study, the author uses a literature study by searching for the information needed to obtain and understand literature through various media. Researchers look for references from books, magazines, and the internet in the form of articles, scientific journals, and forums related to this final assignment to help solve problems in research and application creation.

b. Observation

The observation technique collects data by directly reviewing the studied Object (Qi et al., 2021). In this study, the author systematically observes the problems in the surrounding environment to obtain accurate and convincing data.

2. Application Development Method

This study used the Multimedia Development Life Cycle (MDLC) method for application development, which has six stages: concept, design, material collecting, assembly, testing, and distribution (Sintaro et al., 2020).

a. Concept

Formulate the basics of the multimedia project to be created and developed, especially on the objectives and types of projects.

b. Design

This is the stage where the creator or developer of the multimedia project describes in detail what will be done and how the multimedia project will be created.

c. Material Collection

It is the process of collecting everything needed for the project. Regarding the material to be delivered, multimedia files such as audio, video, and images will be included in the presentation of the multimedia project.

d. Compilation and Creation

The materials and multimedia files obtained are assembled and arranged according to the design.

e. Trial

A trial must be conducted after the multimedia project's results are finished. The trial is conducted by applying the multimedia project's results to minor learning.

f. Distribution

The stage of duplication and distribution of results to users. Multimedia must be packaged well according to the distribution media, whether via CD/DVD, download, or other media.

Results and Discussion

1. Concept

The conceptualization in this study is to describe a problem in the learning media that is currently running so that an identification of estimated needs will be carried out resulting from the observation stage in the initial study by determining the objectives and types of applications to be created. During the learning process, many obstacles are faced, namely limited time and difficulty in understanding delivery. To determine the type of application to be made, the researcher conducted observations of the running system and provided an overview of the proposed system; also conceptualized system needs, functional and non-functional needs.

After identifying the problem, the proposed system is to create an Android-based learning media application that uses augmented reality technology to solve the issues and facilitate learning.

2. Design

After conceptualization, the second step is the design stage. The stage where the multimedia project maker describes and describes in detail the form of the application to be created. With this, the researcher designs the application to determine its needs. This section discusses the Interface Design and design with flowchart diagrams.

a. Interface Design

Interface design or interface design functions to initiate the creation of the display and as a description of the application to be created. As for this design, the application will be made mobile-based with a landscape screen display, namely:

Figure 1. Interface Design

b. Flowchart Design

A flowchart is used here to graphically describe the steps and sequences of procedures of an application or program so that the application can be created sequentially from start to finish.

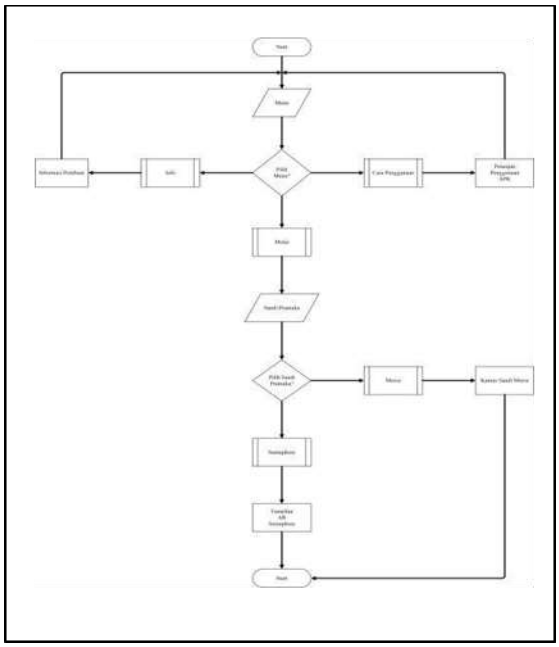

Figure 2. Flowchart Design

3. Collection of Materials

In this discussion, the researcher collects everything needed to make applications, such as materials in scout codes consisting of semaphore and Morse codes; images are also required for scout code markers, namely semaphore code markers.

4. Compilation and Creation

In the assembly stage, the researcher takes action from all the plans that have been prepared and the detailed designs that have been detailed previously. The existing designs are then produced or made according to the design and assembled into an application. I made 3D characters using Blender 3D tools, interface displays using Unity tools, and marker design sections using Photoshop CS6.

5. Testing

The stage after making the application is testing. Testing is an essential part of software development, and it is carried out to determine the accuracy of the application and ensure that it runs well according to the desired plan. The method used in this study is tested directly with Black Box testing. Testing was conducted using an Android smartphone version 9 with a 6.53-inch screen, a Mediatek Helio P70 (12nm) processor, 4GB RAM, and 128 GB ROM.

a. Display Testing

This display test checks whether the application's displays run according to plan or if an error occurs when opened on an Android smartphone.

Table 1. Display Testing

No.	View	Testing Status
1.	Home Page	Show
2.	Settings Page	Show
3.	Info Page	Show
4.	How to Use Page	Show
5.	Password Menu Page	Show
6.	Semaphore Password AR Page	Show
7.	Morse Code Page	Show
8.	Exit Confirmation View	Show

b. Function Testing

After testing the application display, the application functions are also tested to determine whether they can run properly.

Table 2. Function Testing

No.	Functions Tested	Test Scenario	Expected Results	Test Status
1.	Settings button	User presses the settings button	Users can see the background sound settings display	Fulfilled
2.	Setting backsound	User presses the backsound on/off image	Backsound off or on	Fulfilled
3.	Back button	User presses the Back button	Users can access the previous page	Fulfilled
4.	How to use menu	User selects the how to use menu	Users can see how to use the application	Fulfilled
5.	Info menu	User presses the info menu	Users can see information from the application created	Fulfilled
6.	Start menu	User selects the start menu	Users can see the display of the scout password menu	Fulfilled
7.	Semaphore menu	User selects the semaphore code menu	The camera automatically opens to display AR from the semaphore code and users can see 3D objects and animations from the semaphore code	Fulfilled
8.	Morse menu	User presses the button from the morse code menu	Users are directed to the Morse code learning display	Fulfilled
9.	Sound logo on morse code	User presses the sound logo on the morse code	Users can hear the Morse code sound for each letter	Fulfilled
10.	Letter selection on morse code display	User presses the A-Z letter button	Users can select the Morse code letters they want to display	Fulfilled

11.	Exit button	User presses the exit button	Users are directed to the confirmation display to exit the application	Fulfilled
12.	YES button on exit confirmation display	User presses the YES button	Application exits	Fulfilled
13.	NO button on exit confirmation display	User presses the NO button	Users remain directed to the main display of the application	Fulfilled

6. Distribution

After conducting independent testing, it is known that the application runs well and that the function has no obstacles, such as errors on each button. The next stage is distribution. This stage involves procuring the application in the form of .apk to be distributed to members or scout leaders to be utilized and used correctly.

The following are the results of the application created:

a. Main Page

Figure 3. Main Page

The image above shows the application's main page. This is the initial display when opening the application, and it displays the menu options, including an explanation of how to use the application, application info, and a menu to start learning scout codes. Some buttons on this main page have their respective functions.

b. Settings Page

Figure 4. Settings Page

Here is a picture of the settings page designed to set the application's background sound. There is a toggle button on this page to turn the music on or off.

c. Info Page

Figure 5. Info Page

Above is an image of the application info display that shows the application's version created and explains what will be learned and obtained by using the application.

d. How to Use Page

Figure 6. How to Use Page

Here is an explanation of the image on the page explaining how to use the application. This method of use is designed so that users can understand how to use the application.

e. Scout Password Menu Page

Figure 7. Scout Password Menu Page

Here is an explanation of the scout code menu image. This scout code page functions so that users can choose the code to be learned. This page has two scout code choices: semaphore and morse codes. For the semaphore code menu itself, users are directed to start learning semaphore codes and the morse code menu to learn morse code.

f. AR Semaphore Password Page

Figure 8. AR Semaphore Password Page

The image above shows the AR semaphore code page to display the semaphore code learning display with Augmented Reality technology with the help of a camera that points to the marker and produces 3D objects and animations of the semaphore code movements.

g. Morse Code Page

Figure 9. Morse Code Page

Above is a display of the Morse code page that illustrates the form of the Morse code learning page with written and sound forms. The display above has a selection button for each letter so that users can choose the letter to be learned. Then, a sound button produces the Morse code sound per letter in the panel display.

h. Exit Page

Figure 10. Exit Page

The image above shows the exit confirmation page display. This confirmation page functions so that users can choose whether to exit the application or not so that when selecting the exit button, the application does not immediately exit the application.

Conclusions

In conclusion, integrating Augmented Reality (AR) technology into scout code learning offers a promising solution to the challenges posed by traditional, conventional teaching methods. The research highlights the limitations of traditional methods, such as infrequent meetings and difficulty understanding the scout codes, particularly semaphore and Morse codes. This study introduces an interactive and engaging platform for scout members to learn and practice these codes by developing an Android-based learning application incorporating AR with marker-based tracking. AR provides an immersive learning experience, enhancing understanding and retention by visualizing the movements and actions associated with the codes in real time.

The literature review further emphasizes the growing significance of AR in educational settings, demonstrating its potential in diverse fields such as vocational education and semaphore code learning. By leveraging smartphones' accessibility and popularity, this AR-based learning tool aligns with modern educational trends, engaging students through technology that resonates with their daily habits.

Ultimately, this research contributes to developing innovative learning media that can be used flexibly and effectively by scout members, overcoming the barriers of traditional teaching methods. The findings suggest that AR technology can be crucial in modernizing the learning process and improving the quality of education in non-formal settings like the Pramuka Scout movement. This approach has the potential to be expanded further, offering valuable insights for the broader application of AR in various educational contexts.

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