Journal of Intelligent Decision Support System (IDSS) 7 (2) (2024), pp. 203-209

Published by: Institute of Computer Science (IOCS)

Journal of Intelligent Decision Support System (IDSS)

Journal homepage: www.idss.iocspublisher.org

Android based letter recognition application with augmented reality implementation

Pandhu Pramarta[1], Irfan[2]

[1] *Informatics Engineering, Faculty of Engineering and Computer Science, Indraprasta University PGRI, Indonesia*
[2] *Information Systems, STI&K College of Information and Computer Management Jakarta, Indonesia*

Article Info

Article history:

Received Apr 24, 2024
Revised May 23, 2024
Accepted May 25, 2024

Keywords:

Augmented Reality;
Children's Education;
Learning Applications;
Letter Recognition;
Unity 3D.

ABSTRACT

Recognition of letters is an important basis in the process of learning to read in children. The use of Augmented Reality (AR) technology in education offers interactive methods that can increase interest and effectiveness of learning. This research aims to develop an Android-based application that uses AR to help children recognize letters. This application was developed using Unity 3D with the help of Vuforia SDK which allows effective implementation of AR. The methods used in this research include literature study, application design and development, as well as evaluation through technical testing and user testing. Testing is conducted to assess the functionality, user engagement, learning outcomes, and technical performance of the application. The results showed that the AR application was successful in improving letter recognition skills among children, with a high level of engagement and positive feedback from users. Although the application shows good performance on high-spec devices, technical challenges such as lag and frame rate drops on low-spec devices require further optimization. This research confirms the potential of AR as a valuable learning tool, especially in elementary education. The implications of this study suggest that further development and integration of AR technology in educational curricula can significantly improve the teaching and learning process, especially in facilitating distance learning and more immersive and interactive learning experiences. Further research is needed to explore possible applications of AR technology in broader educational contexts. Keywords: Augmented Reality, letter recognition, Unity 3D, Vuforia, children's education, learning applications.

Corresponding Author:

Irfan,
Information Systems,
STI&K College of Information and Computer Management Jakarta,
Jl. Bri Radio Dalam No.17 1, RT.14/RW.3, Daerah Khusus Ibukota Jakarta 12140, Indonesia
Email: irfan@staff.jak-stik.ac.id

Introduction

In the digital era that continues to develop, the use of technology in all aspects of life is increasingly important, especially in the field of education (Collins & Halverson, 2018; Sharma, 2019; Sutarna, 2019). Augmented Reality (AR) technology has demonstrated its capacity to enhance engagement and learning encounters in a more immersive and interactive way (Alzahrani, 2020; Dunleavy & Dede, 2014; Yuen et al., 2011). In the context of basic education, letter identification is a fundamental element in encouraging children's literacy progress. By using applications that integrate AR technology with commonly used

platforms such as Android, significant prospects arise for introducing new dimensions to conventional teaching approaches (Crofton et al., 2019; Fitria, 2023; Syed et al., 2022)

AR and VR technology have many benefits in education, such as improving learning, motivating students, and helping students who have difficulty understanding complex concepts. AR and VR technology also allows students to carry out experiments and develop creativity without having to pay expensive fees (Chen & Liu, 2020; Chin & Wang, 2021; Petrov & Atanasova, 2020). However, the use of AR and VR technology in education also has several financial and considerations that need to be taken into account, such as obstacles in downloading programs, AR markers, student smartphone requirements, network limitations for accessing the Resources section, and limitations on assessment questions (Nadeem et al., 2020; Syed et al., 2022; Yaniawati & Indrawan, 2021)

For example, the zSpace® application uses AR/VR technology that allows students to group, run experiments, and develop creativity without having to spend a lot of money. This application also allows students to group, carry out experiments, and develop creativity without having to pay expensive fees.

The Android letter recognition app, coupled with AR technology, seeks to integrate traditional educational methods with cutting-edge technology. Through this app, children can engage in interactive exercises that use real-world settings as a backdrop for learning the alphabet. This approach not only increases the attractiveness of the learning experience, but also facilitates better understanding and retention of knowledge. An implementation of Android-based reading learning media for early childhood has also been carried out, which uses qualitative descriptive methods for research. This application offers several features, namely recognizing letters, recognizing syllables, varying syllables, consonants, and word sequences. Children can learn independently accompanied by their parents, and this application has received a positive response from children and parents (Ratnawati & Vivianti, 2020)

This application is useful for children learning hijaiyah letters, but can also help with other letters. By using AR, children can see dynamic, lifelike letters that improve learning and retention. Apart from that, this application can help you learn Javanese, Arabic or Latin letters. Incorporating AR technology into children's education is a progressive step towards creating a more immersive and stimulating learning environment. By leveraging AR, we can offer educational opportunities that not only enhance understanding, but also encourage cognitive and physical development in young students.

Using AR (Augmented Reality) technology for children's education is a step forward in developing a more engaging and interactive learning experience. With AR, we can provide learning experiences that not only enrich knowledge, but also stimulate children's cognitive and motoric growth.

Augmented Reality, or AR, combines the real and virtual worlds through computer technology, blurring the lines between the two in real-time. This system prioritizes reality, enhancing it with additional details for a more immersive and interactive experience (Hakky et al., 2018). Augmented reality enhances a user's understanding of the world by presenting invisible information through virtual objects. These tools aid user interaction and perception of reality, aiding in the completion of real-world tasks. Augmented reality has the special power of blending the virtual and real worlds, which serves as a valuable aid for individuals who wish to complete tasks in the physical world.

Augmented reality can be applied to all senses, including hearing, touch, and smell. Apart from being used in fields such as health, military, manufacturing industry, augmented reality has also been applied in devices used by many people.

A marker is a marker that is used to display a 2-dimensional or 3-dimensional object that will be detected by the computer. Detection of markers by a computer is done by counting the number of images on the marker, which is usually called image processing. Markers can use certain patterns that will be recognized by the camera, so that when the camera detects the marker, a 3D object can be displayed. AR markers can be categorized into two types: detection using markers (Marker Based Tracking) and without markers (markerless). Marker based computer tracking will recognize the position and orientation of the marker and create a 3D virtual world (Caserman et al., 2019).

Unity is 2 and 3 dimensional game creation software that provides many benefits, including the ease of using several programming languages at once, C#, Boo, and Javascript. The resulting game created with Unity3d will be multiplatform, which means it can be used on all types of devices/operating systems. Unity can take design formats from various software related to 3D design, such as 3ds Max,

Maya, Softimage, Blender, modo, ZBrush, Cinema 4D, Cheetah3D, Adobe Photoshop, Adobe Fireworks, and Allegorithmic Substance. Once these assets are added to a game project, they can be managed via Unity's graphical user interface.

Vuforia is a plugin that helps in creating Augmented Reality (AR) applications for mobile devices. Vuforia is also available to bundle with Unity, called Vuforia AR Extension for Unity. Vuforia is an SDK provided by Qualcomm to help developers create AR applications on smartphones. Vuforia provides a comprehensive, scalable, vision-based AR solution that can change the way industries work by helping close employment gaps, increasing the efficiency of manufacturing processes, and helping users turn 3D and IoT data into more efficient AR experiences.

Vuforia is an SDK (Software Development Kit) for augmented reality (AR) technology that uses computer vision to recognize and calculate markers or target images and 3D objects such as boxes directly. Vuforia is used to help developers apply AR technology that is not limited by 2D or 3D limitations. With Vuforia's technology, developers can use smartphone cameras as input devices, as electronic eyes that recognize specific landmarks, and as graphics processing devices. On the screen, a combination of the real world and the world drawn by the application can be displayed. Vuforia has many features that can be used to develop AR applications, such as object, text recognition, frame recognizer, virtual buttons, object surface identification, cloud-based scanning, image target recognizer, cylindrical target, and targeted object recognizer. To use Vuforia, developers can use Unity 3D as a development platform and obtain the Vuforia SDK for free for the development stage. However, for production use, Vuforia is not free. This SDK has many features that can be used to develop AR applications, such as object recognition, text recognition, frame recognizer, virtual buttons, object surface identification, cloud-based scanning, image target recognizer, cylindrical target, and targeted object recognizer.

Methods and Materials

In developing an Android-based letter recognition application with the implementation of Augmented Reality, the research methodology chosen must be able to overcome the technical and pedagogical challenges of this project.

1. Literature review
   Information about Augmented Reality, Unity 3D, and Vuforia applications is collected from various sources including books, articles, and online tutorials.
2. Observation
   Observation is a process that aims to find learning methods suitable for early childhood that are effective and enjoyable.
3. Planning and designing
   Planning and designing interactive multimedia applications can be done using flowcharts and navigation structures.
4. Testing and Implementation
   Testing and implementation are very important processes in creating a system or application. Testing is carried out to determine the performance, reliability and suitability of the system to user needs. After testing is carried out, the system will be implemented in an appropriate environment, which can be hardware and software. Implementation is carried out by applying the results of analysis and design that have been carried out previously, using a certain programming language, and installing and using the system that has been created.

Results and Discussions

Program analysis is an important step in software development designed to verify, assess, and guarantee the quality and efficiency of the programs created. This analysis process uses a series of methods and techniques to ensure that the program operates as intended and meets user needs.

Main View Testing

In this test, an assessment of the visual aspects of the application being developed is carried out.

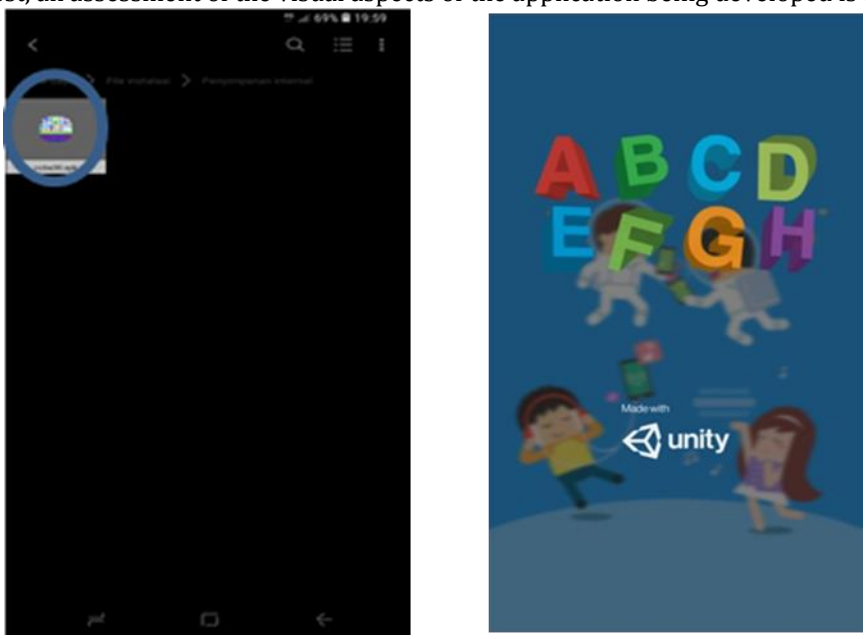

Figure 1. Splash Screen Display

Figure 2. Display on Xiaomi Redmi 5 and Samsung S8 Edge

Figure 3. Augmented Reality Output

Table 1. Application Trial

Name Type Mobile Phone	Specification	Result
Samsung S8 Edge	Network: GSM/HSPA/LTE Screen: 5.8 Inch OS : Android v8.0 Processor : Octa Core 4x2.35 GHz RAM : 4GB Internal : 64 GB	Application Runs well
Xiomi Redmi 5	Network: GSM/HSPA/LTE Screen: 5.7 Inch OS : Android v7.1.2 Processor : Octa Core 1.8 GHz RAM : 3 GB Internal : 32 GB	Application Runs well
Oppo A57	Network: GSM/HSPA/LTE Screen: 5.2 Inch OS : Android v6.0 Processor : Octa Core 1.4 GHz RAM : 3 GB Internal : 32 GB	Application Runs well
Samsung Galaxy Tab 3.7.0	Network: GSM/HSPA/LTE Screen: 7.0 Inch OS : Android v4.1.2 Processor : Octa Core 4x2.35 GHz RAM : 1 GB Internal : 16 GB	Application Runs well

From the table above, the best cellphone for using the "ALPHABET" application is the Samsung Galaxy Tab 3 7.0 cellphone. Because the large screen measuring 7.0 inches makes objects bigger and more real when scanning the marker.

The development and implementation of the Android-based augmented reality (AR) application for letter recognition yielded several key results:

1. Application Functionality:

The AR application, developed using Unity 3D and Vuforia, was successfully integrated and functioned correctly across a range of Android devices. The application was able to recognize and augment letters in real-time, providing interactive and engaging educational content.

2. User Engagement:
   It sounds like the preliminary tests for the augmented reality (AR) application were successful in engaging young learners. AR technology is known for its ability to create immersive experiences, which can be particularly effective in maintaining attention and interest among children. The fact that children were observed interacting with the application and repeatedly engaging with tasks involving augmented letters suggests that the AR technology was effective in enhancing their learning experience.
3. Learning Outcomes:
   Early evaluations showed improvement in letter recognition skills among participants. Pre-test and post-test evaluations indicated a noticeable increase in the ability to recognize and recall letters, suggesting the application's potential as an effective educational

Conclusions

The development of an Android-based letter recognition application with the implementation of Augmented Reality (AR) is an important step in enriching innovative and interactive learning approaches, especially in the context of basic education. In this project, we succeeded in developing an application that utilizes AR technology to help children learn letters more interestingly and effectively. Through literature study, design, development and evaluation methods, we can properly assess the performance and effectiveness of the application. The results showed that the AR application was successful in improving letter recognition skills among children, while maintaining a high level of user engagement. This highlights the potential of AR as an effective learning tool, particularly in early education contexts. However, technical challenges such as suboptimal performance on devices with low specifications indicate the need for further optimization in AR application development. Additionally, feedback from users highlights the importance of providing more comprehensive instructional content and variety to improve user experience. In conclusion, the development of an AR-based letter recognition application is a promising first step in utilizing advanced technology to improve the quality of education. The implications of this research show that the integration of AR technology in learning can open up new opportunities in providing a more dynamic and effective learning experience. However, further development and research are needed to improve these applications and understand their impact more comprehensively in a broader educational context. Through this research, we hope that our contribution can open the door to the development of AR applications that are more advanced and effective in supporting children's learning in the future.

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