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Exploring Interactive 3D Object Interaction by Integrating Augmented Reality and Voice Control

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Abstract

This paper explores the integration of augmented reality (AR) and voice command technology in educational settings, specifically focusing on the interactive control of 3D object models. By combining AR with voice commands, students can engage in immersive learning experiences, allowing them to visualize and manipulate digital objects in real-time. This approach enhances understanding of complex concepts, increases student engagement, and offers accessible learning opportunities for all students.

Keywords: augmented reality, voice command, 3D interaction

1 Introduction. Background research

Over the past three years, our team has conducted extensive research into the integration of Augmented Reality (AR) technologies within the educational field. This exploration has involved the design and implementation of various learning style scenarios aimed at enhancing user engagement with educational content [1, 2]. Through this process, we have gained valuable insights into both the potential and the challenges associated with AR applications in education [3]. Our primary objective has been to develop AR applications that cater to diverse learning

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styles, thereby increasing user engagement. By creating immersive and interactive learning environments, we sought to make educational content more accessible and appealing to students. This approach has led to the development of scenarios that are not only visually engaging but also pedagogically effective, leveraging the unique capabilities of AR to provide enriched learning experiences.

We developed mobile applications for learning both math and languages. For language, learning specifically includes apps like the Etymology app (see Fig.1), which uses augmented flashcards,



Figure 1. Personalized cards for learning etymology and morphological terms

and the Multiword Expressions app that, by scanning clock card, generates a list of MWEs related to such terms as “clock”, “watch”, “time”, and “weather” (see Fig. 2).



Figure 2. Multiword Expressions app showing the example “vremea patului” with its English translation, “It’s Bedtime”

Throughout this journey, we have encountered a range of challenges, which can be broadly categorized into four areas: technical, usability,

ethical, and practical considerations of AR applications.

Our applications have been tested on a sample of over 200 pupils and students. Feedback from these users has been instrumental in refining our applications, leading to several upgrades that have improved both the functionality and the user experience. This iterative process of testing and enhancement has ensured that our AR solutions remain responsive to the needs and preferences of students. According to the responses to the 10th quiz question about which scenarios students enjoyed the most, 74.1% of students from Moldova State University (MSU) preferred visualizing 3D objects, and 55.6% enjoyed interacting with animals. See the diagram in Figure 3 for more details.

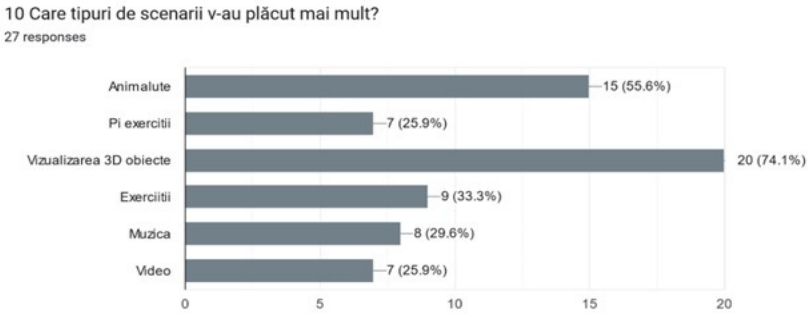


Figure 3. Diagram illustrating responses to the 10th quiz question

Both animal interaction and 3D object manipulation garnered significant interest, not only from MSU students but also from students at Alecu Russo University. When we initially presented the augmented scenario Wolf (v.1.0) to students at Alecu Russo University, they showed interest but found it relatively simple. Based on their feedback, we enhanced the scenario's complexity by adding interactive features to the 3D model. We introduced four buttons that allow the wolf to perform actions such as running, howling, lying down, and fighting, each accompanied by sound. These updates are illustrated in

Figure 4 (Wolf v2.0).



Figure 4. Updated version of the Wolf scenario

Building on our previous work, this research seeks to explore a new recommendation provided by 6th-grade pupils. These students expressed a desire to interact with 3D animals via voice command, suggesting a new avenue for enhancing the interactivity and engagement of AR applications. This research will analyze the feasibility and educational impact of incorporating voice-controlled interactions within AR environments, with the goal of further personalizing and enriching the learning experience for young learners.

By integrating voice command functionality, we aim to create a more dynamic and responsive AR experience that aligns with the evolving expectations of tech-savvy students. This development represents the next step in our ongoing efforts to harness the full potential of AR in education, making learning not only more effective but also more engaging and enjoyable.

2 Voice recognition technology

Voice recognition, also known as speech recognition [4], is a technology that enables a computer or device to identify and process spoken language. It allows users to interact with technology through voice commands, converting spoken words into text or executing specific actions based on the commands. Speech recognition technology has become a central element in millions of homes worldwide, enabling devices to execute commands based on voice input. However, its applications extend far beyond simple voice commands, reaching into various sectors where it makes a significant impact.

The integration of voice recognition in augmented reality is poised to transform the way we interact with digital content and services. By leveraging the power of hands-free interaction, voice-enabled AR is opening up new possibilities for productivity, accessibility, and innovative user experiences. In AR applications, voice recognition allows users to control digital elements without relying solely on physical controllers or touch-based interfaces. This hands-free interaction enables users to seamlessly navigate virtual environments, manipulate 3D objects, and perform various tasks using only their voice, a very useful thing both for people with a preferential auditory learning style and for people with physical disabilities.

By simply speaking commands, students can rotate, scale, or animate 3D animals, exploring different perspectives and behaviors. For example, a student might say, "Make the wolf roar," and the AR system would animate the 3D wolf accordingly, providing an interactive and auditory learning experience. Imagine a biology class where students are learning about animal behavior. With the combination of AR and voice commands, students could bring a virtual safari to life in their classroom. They could command a 3D wolf to walk, observe how a sparrow flies, or explore the movements of a fish in water. This interactive approach allows students to explore the characteristics and habitats of various animals in a controlled environment, fostering a deeper understanding of the subject matter.

3 Integrating Voice Command tech in AR app

Voice command technology further enhances the AR experience by allowing students to control and interact with 3D models using their voice. This hands-free approach not only makes the learning process more engaging but also more accessible, particularly for students with physical disabilities.

In the wolf scenario, voice commands such as ”howl”, ”run”, ”attack”, ”stop”, ”sleep” were integrated, see Figure 5.

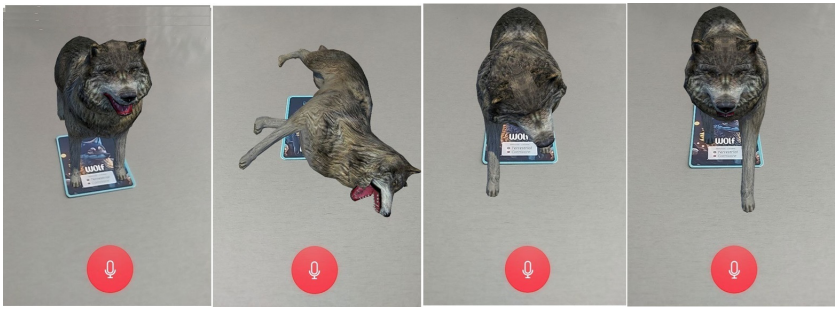


Figure 5. Updated with voice command version of the Wolf scenario

Also in the bear scenario, voice commands such as ”sleep”, ”run forward”, ”attack”, ”eat” were integrated, see Figure 6.

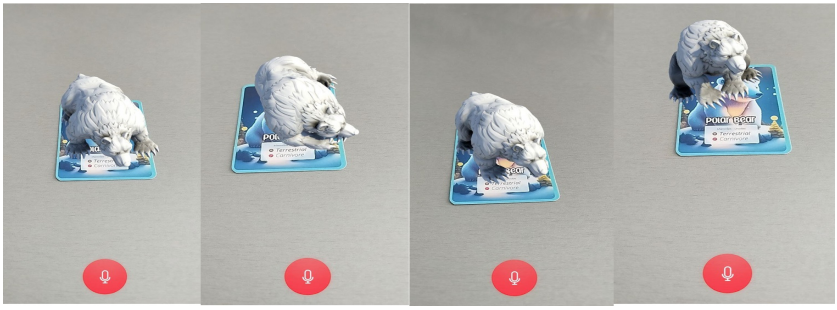


Figure 6. Updated with voice command version of the bear scenario

While the potential of AR and voice commands in education is immense, there are also challenges to consider. Implementing these technologies requires significant investment in hardware and software, as well as training for educators to effectively use these tools in the classroom. Additionally, there may be concerns about screen time and the impact of prolonged exposure to digital devices on students' health. However, with careful planning and thoughtful integration, these challenges can be managed to maximize the benefits of this innovative approach to education.

4 Conclusion

The combination of augmented reality and voice command technology represents a powerful tool for modern education. By enabling students to control 3D objects through simple voice commands, educators can create an immersive and interactive learning environment that enhances understanding, engagement, and accessibility. As these technologies continue to evolve, they hold great promise for transforming education and preparing students for a future where digital and physical worlds are increasingly intertwined.

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