JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Enhancing Education Through Avatar-Based Augmented Reality: A Case Study of AugRem Application

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ABSTRACT

This research paper investigates the potential of augmented reality (AR) technology in revolutionizing education through the development of AugRem, an avatar-based AR application. The objective of AugRem is to create an immersive and interactive learning environment that enhances student engagement and understanding. By overlaying virtual objects on the real world, AugRem aims to bridge the gap between theoretical concepts and practical experience. This paper provides an overview of the development process, including the utilization of Unity Software and Vuforia Software. Furthermore, it explores the impact of AR in education, discussing its benefits, scope, and applicability. The findings highlight the transformative potential of AugRem in making learning more visual, attractive, and accessible to students.

Keywords: Augmented Reality, Education, Immersive Learning, 3D Modeling, Interactive Applications, Mobile Devices, AR Technology.

I. INTRODUCTION

Background Study: Augmented Reality (AR) has emerged as an innovative technology capable of transforming conventional approaches to education. While previous efforts have explored 2D presentations, many concepts remain challenging to comprehend due to their limited representation. AugRem aims to leverage AR technology to enhance the educational experience by seamlessly integrating virtual objects into the real world. By combining theoretical knowledge with practical understanding, AugRem seeks to make learning more engaging and immersive. The rise of popular AR applications like Snapchat, Pokémon Go, and TikTok has increased public awareness and acceptance of AR technology, paving the way for its integration into the education sector. The versatility of AR extends beyond specific age groups or educational levels, making it suitable for a wide range of academic settings. Its applicability spans across the entire spectrum of schooling, ranging from early childhood education through college, and even in professional workplaces.

II. OBJECTIVE

The primary objective of this research is to introduce AR into classrooms through the development of AugRem, an avatar-based AR application. AugRem aims to transform the learning process by providing students with an interactive and visually appealing environment. By creating a 3D model that seamlessly integrates with the real world, AugRem seeks to blur the boundary between virtual and physical realities, enhancing student engagement and understanding. Leveraging the power of 3D animation, AugRem intends to offer a realistic and captivating experience to users.

III. PURPOSE, SCOPE, AND APPLICABILITY

Purpose: This research seeks to examine the possibilities and benefits of integrating AR technology into the field of education and its ability to replace traditional learning materials such as textbooks, physical models, and posters. By harnessing the widespread availability of smartphones among students, AR applications offer a cost-effective and accessible solution for enhancing the learning experience. Engaging and interactive AR learning can have a profound impact on student engagement and outcomes. AugRem aims to facilitate better visualization and immersion in subject matter, resulting in improved learning outcomes.

Scope: This research focuses on the development and evaluation of the AugRem application. By enhancing students' conceptual understanding and visual literacy, AugRem has the potential to revolutionize traditional teaching methods. Through image recognition and tracking, AugRem allows students to scan textbook covers and access interactive 3D models, providing additional context and enhancing comprehension. The utilization of AR in educational settings is already underway, and with

further advancements, the scope of application is expected to expand.

Applicability: Augmented Reality technology has broad applicability across various fields and educational levels. It has already found successful applications in entertainment, military training, engineering design, robotics, and manufacturing. The concept of Augmented Reality textbooks, where visualizations and interactions are brought to life through specialized software or mobile apps, showcases the potential for enhancing traditional learning materials. By seamlessly integrating digital content into printed books, AugRem enables a dynamic and interactive learning experience, even for individuals without a strong computer background.

IV. LITERATURE REVIEW

The integration of augmented reality (AR) technology within educational environment has attracted considerable interest due to its potential to enhance learning experiences and improve student outcomes. Extensive research has been conducted to explore the various possibilities and benefits of AR applications in the field of education. Research findings demonstrate that AR has the ability to bridge the gap between theoretical concepts and practical understanding by providing interactive and immersive experiences. Within the field of education, AR applications have achieved success in diverse disciplines such as science, mathematics, engineering, and history, empowering students to visualize intricate concepts and actively participate in hands-on learning activities.

AugRem strives to elevate the learning process by seamlessly integrating virtual elements into the real-world environment. By leveraging smartphone cameras and advanced image recognition technology, AugRem enables students to scan images and access interactive 3D models that relate to their specific educational materials. This approach fosters a more captivating and immersive learning experience compared to traditional methods. Moreover, the utilization of avatars within AR applications has exhibited promising results in terms of enhancing student engagement and motivation.

V. METHODOLOGY

The development of the AugRem application involved several key steps. The basic modules of the application include a login module and a camera module. In the login module, users can create an account or log in if they already have one. The account creation process requires users to provide their name, date of birth, mobile number, username, and password. The login module ensures secure access to the application and personalizes the user experience.

Upon logging in, users are directed to the camera module, which integrates augmented reality (AR) functionality. This module enables users to experience virtual objects superimposed on their real-world surroundings using their device's camera. Key features of the camera module include image scanning, target identification, and the visualization of 3D models. Users can further explore the displayed models by accessing linked Wikipedia pages for additional information. It also includes a comprehensive user feedback system, enabling users to rate the application and provide valuable feedback on their experience.

VI. Data Design

Level 0

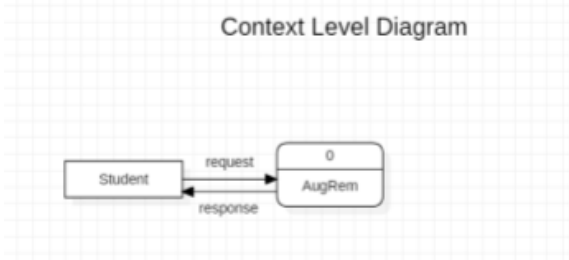


Figure 1: Context level diagram

Level 1

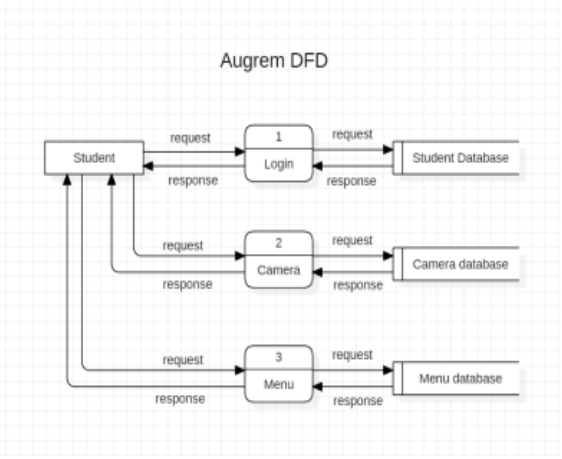


Figure 2: AugRem DFD

Level 2

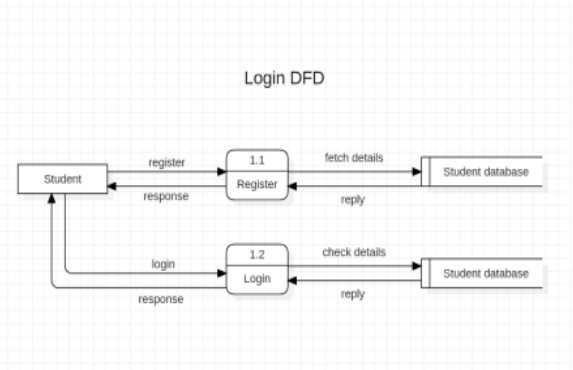


Figure 2: Login DFD

Level 3

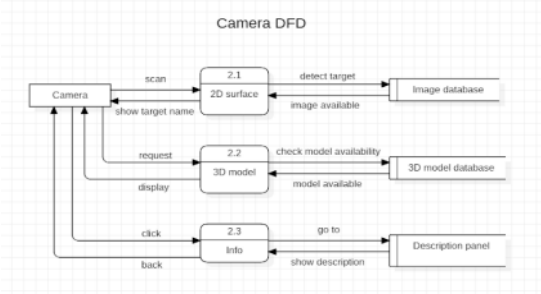


Figure 4: Camera DFD

Level 4

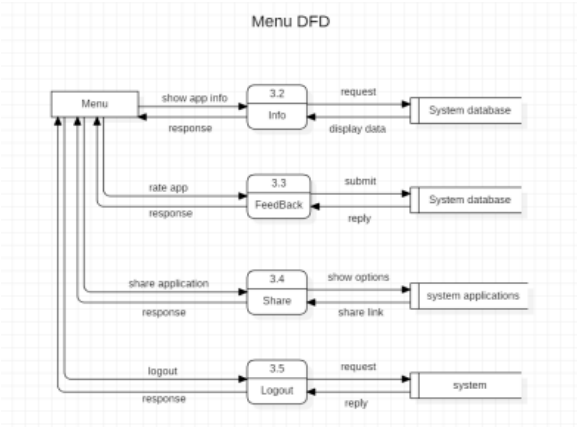


Figure 5: Menu DFD

VII. RESULTS AND DISCUSSION

The AugRem application has undergone several modifications and improvements to enhance its usability and efficiency. Initial user feedback highlighted the need for changes, leading to the removal of certain features and the addition of new ones. For example, the application initially included a 2D image option, which was replaced with an Info button providing detailed information about the models.

The application's performance is subject to certain limitations. Scanning issues, such as problems with image detection due to lighting conditions, detection of surfaces, or blurry images, can affect the accuracy of AR experience. Additionally, the availability of 3D models in the database and internet connection reliability can impact the application's functionality. Authentication problems, such as entering an incorrect password during login, can also be encountered.

Applications of Augmented Reality in real world:

1. **Pokemon Go**: Pokemon Go gained widespread popularity as a mobile game that introduced augmented reality (AR) to a large user base. Using their smartphones, players are able to capture virtual Pokemon characters that are seamlessly integrated into real-world environments.

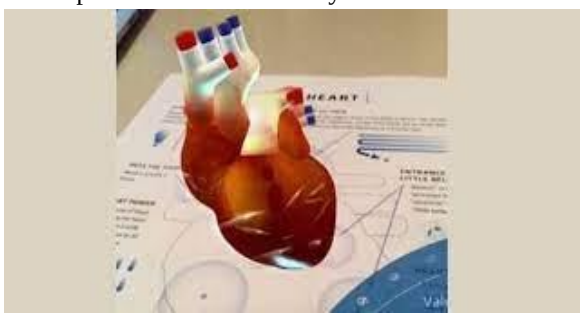
2. **Snapchat AR Filters:** Snapchat offers a range of AR filters that overlay virtual effects, such as animated masks, lenses, and filters, onto users' faces in real-time. These filters have become a popular feature for users to enhance their photos and videos.

3. **Google Maps Live View:** Google Maps Live View utilizes AR technology to provide users with real-time navigation instructions overlaid on the camera view of their surroundings. It helps users navigate and find their way in unfamiliar places.

4. **MeasureKit:** MeasureKit is an AR measurement app that allows users to measure distances, angles, and surfaces using their smartphone's camera. It provides a convenient tool for quick and accurate measurements in various real-world scenarios.

5. **Houzz:** Houzz is an app that helps users with home design and renovation projects. With AR features, users can visualize furniture, decor, and materials in their own space, enabling them to make informed design decisions.

6. **Anatomy 4D:** Anatomy 4D is an educational AR app that allows users to explore the human body in 3D. By scanning printed markers, users can view dynamic 3D models of different body systems and engage in immersive learning experiences about anatomy.



These examples illustrate the diverse range of applications for augmented reality, from entertainment and gaming to navigation, home design, measurement, and education.

VIII. CONCLUSION

In conclusion, AugRem, an avatar-based augmented reality (AR) application, has shown great potential in revolutionizing education by creating an immersive and interactive learning environment. By overlaying virtual objects on the real world, AugRem aims to bridge the gap between theoretical concepts and practical experience, enhancing student engagement and understanding.

The development of AugRem involved leveraging technologies such as Unity and Vuforia Software to create a seamless integration of virtual objects into the real-world environment. The application has been developed with the aim of enhancing the visual appeal and accessibility of learning for students across all levels. The research conducted has underscored the significant potential of AugRem in revolutionizing education by creating a more engaging and immersive learning environment.

IX. FUTURE SCOPE

The future scope of AugRem is promising, with several avenues for further development and enhancement. Some of the potential areas for future improvement include:

Expansion of the Model Database: AugRem can benefit from the addition of more models, covering a wide range of subjects and topics. This would provide students with a diverse set of interactive learning resources and enhance the application's educational value.

Integration of Sound and Animation: Incorporating sound effects and animations into the models can further enhance the immersive experience for students. This would add a new dimension to the learning process and make it more engaging and interactive.

Interactive and engaging Quizzes: AugRem can explore the inclusion of interactive quizzes and dynamic elements to promote active learning and knowledge retention. This would enable students to test their understanding, receive immediate feedback, and further enhance their learning outcomes.

Offline Functionality: Providing offline access to certain features and content within AugRem would ensure that students can continue learning even in environments with limited or no internet connectivity. This would increase the accessibility and reach of the application.

X. LIMITATIONS

While AugRem offers significant potential for enhancing education, it is important to acknowledge certain limitations. Some limitations include:

Scanning and Image Detection Challenges: These challenges may arise due to factors such as lighting conditions, surface detection, or the quality of scanned images. Enhancing the scanning algorithms and addressing these challenges would contribute to improving the accuracy and reliability of AR experience.

Limited Query Sets: The application's functionality and responsiveness are dependent on the availability of 3D models and queries in its database. Expanding the database and continuously updating it with new content would ensure a wider range of educational resources for students.

Security Considerations: As with any technology that involves user data and personal information, ensuring robust security measures is crucial. AugRem should prioritize data privacy and implement measures to protect user information from unauthorized access or breaches.

Technical Requirements and Accessibility: The effectiveness of AugRem is contingent upon users possessing compatible devices, such as smartphones or tablets, equipped with the requisite hardware capabilities. Ensuring compatibility across a wide range of devices and addressing any accessibility concerns would maximize the application's reach and impact.

By addressing these limitations and capitalizing on the future scope, AugRem can continue to evolve as a valuable tool for transforming education, offering students a learning experience that is both captivating and immersive.

Overall, AugRem has demonstrated the potential to revolutionize traditional educational practices by leveraging augmented reality technology. With further development, refinement, and integration into educational settings, AugRem can contribute significantly to enhancing student learning outcomes and fostering a more interactive and immersive educational experience.

XI. Appendix

Appendix A: User Interface Screenshots

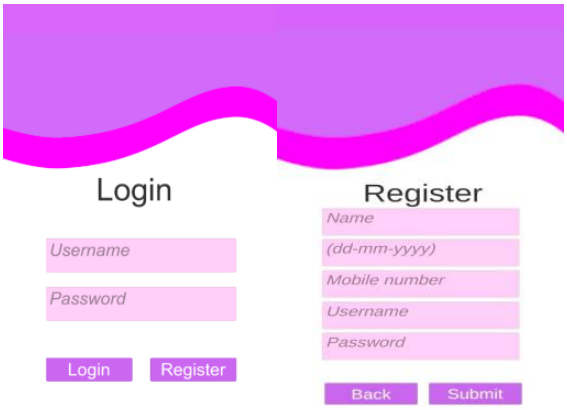


Figure 6: Login

Figure 7: Registration

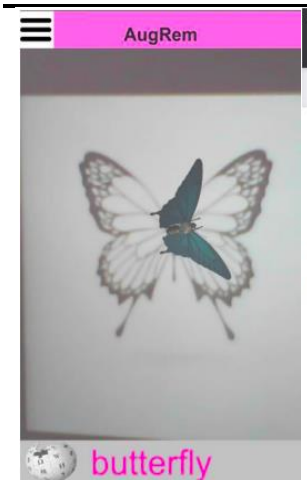


Figure 8: Camera

Figure 9: Wikipedia

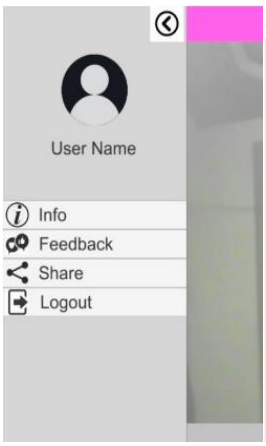


Figure 10: Menu

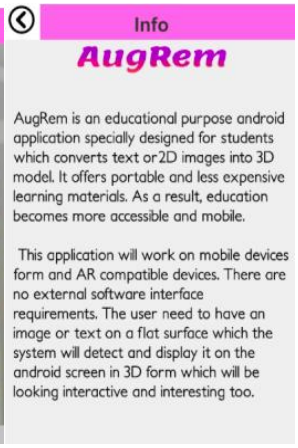


Figure 11: Info

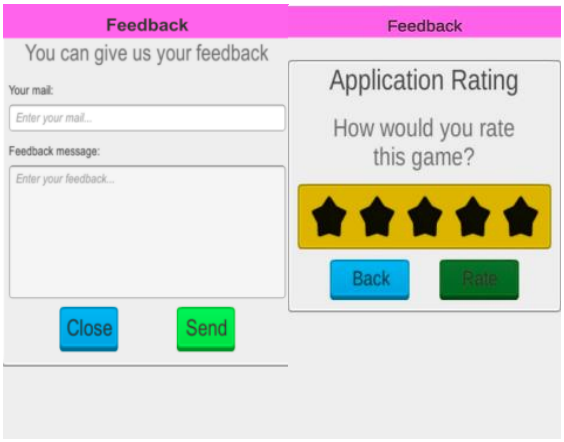


Figure 12: Feedback **Figure 13:** Application Rating

Appendix B: Questionnaire for User Feedback

Feedback questions and ratings

Rating of Different Aspects of AugRem Application

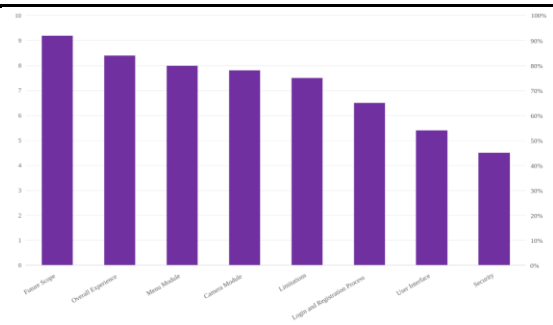


Figure 14: User feedback on AugRem

User feedback was collected through a questionnaire designed to evaluate the user experience of the AugRem application. The questionnaire consisted of several questions, covering different aspects of the application such as overall experience, user interface, login and registration process, camera module, menu module, limitations, security, and future scope. The users were requested to provide their satisfaction ratings on a scale from 1 to 5, with 5 indicating the highest level of satisfaction. A total of 14 participants completed the questionnaire. The results revealed that the overall experience of users was positive, with an average rating of 4.2. The user interface received high ratings, indicating that it was intuitive and easy to navigate. The login and registration process were rated positively, with users finding it straightforward and appreciated the guidance on creating a strong password.

In the camera module, users reported that the image scanning feature worked well, but occasional issues were encountered with image detection. The menu module received mixed feedback, with users finding the "Info" option helpful, but expressing confusion with the "Feedback" option.

Regarding limitations and security, users did not encounter major issues and felt that their data and personal information were adequately protected. However, they expressed a desire for more information on the security measures in place.

The feedback provided valuable insights into the future scope of the AugRem application.

Users suggested additional features such as interactive quizzes and assessments, more models, sounds, animations, and offline functionality. These suggestions align with the goal of enhancing the learning experience and expanding the application's functionality.

In conclusion, the user feedback highlighted the positive aspects of the AugRem application, identified areas for improvement, and provided valuable insights for future development. The feedback will be taken into consideration to further enhance the application and address user needs.

Appendix C: Images of sample 3D models used in the application

The AugRem application utilizes a diverse collection of carefully curated 2D images for scanning purposes. These images act as targets for AR functionality, enabling users to interact with virtual 3D models and access relevant information. By seamlessly

integrating these images, AugRem creates an immersive and interactive learning environment that merges the real and virtual worlds. Each 2D image is selected strategically to provide a unique and captivating AR experience. When scanned, the application identifies the image and overlays a corresponding 3D model, enhancing users' understanding of educational concepts. The additional information associated with each image allows users to explore subjects in greater depth, facilitating a comprehensive learning experience.

Figure 15: Sample 3D Models

Appendix D: System Requirements

Hardware and software requirements for running AugRem

To create AugRem Application following are the tools required:

- Unity Software
- Vuforia Software
- C# (C sharp)

Unity:

Unity is a comprehensive game development platform that enables the creation of high-quality 3D and 2D animations. It offers cross-platform deployment for mobile, desktop, VR/AR, and consoles, making it an ideal choice for developing video games and simulations. Unity empowers users to design animations and experiences in both 2D and 3D, and it provides a primary scripting API in C# (C Sharp) or JAVA. It is widely used in the visualization industry and offers a powerful toolset for creating immersive applications. In our project, we utilize Unity Software to design the user interface (UI) of our software, allowing users to interact with the application. Additionally, we integrate target and model functionalities using Unity.

Vuforia:

Vuforia is a software development kit (SDK) for mobile devices that enables the creation of augmented reality applications. It leverages computer vision technology to identify and track planar images (Image Targets) as well as basic 3D objects, such as boxes, in real-time. Vuforia Augmented Reality SDK, previously known as Qualcomm's QCAR, is a popular SDK for developing augmented reality applications for mobile devices. In our project, Vuforia acts as a database to store our target images and facilitates image recognition and tracking functionalities.

C# (C Sharp):

C# is a widely used programming language primarily associated with Microsoft's .NET framework. It is utilized for designing web forms, web applications, and Windows applications. C# is particularly popular for web development using ASP.NET. Visual Studio Code is a widely used code editor for C# development. In our project, we leverage the power of C# to implement various functionalities such as assigning colors, creating animations, defining actions, and handling user interactions. Additionally, C# facilitates communication between the application and the server, enabling the exchange of data and responses.

Front End	AugRem
Back End	MySQL / SQL-Lite / Vuforia
Languages	C#
Software	Unity
.NET Platform	C# .NET, ASP.NET
Operating System	Windows 7,8,10, 64-bit, Android SDK
RAM	16 GB
Processor	Intel, Pentium

Figure 16: Hardware and software used

XII. References:

1) Huang, T. C., Chiu, P. S., & Chen, Y. H. (2014). Creating ubiquitous learning experiences across spaces using augmented reality. Educational Technology & Society, 17(3), 38-52.
2) Garzon, J., Pavon, J., & Baldiris, S. (2017). Augmented reality applications for education: Five directions for future research. Lecture Notes in Computer Science. Hansen, R., & Froelich, M. (1994). Defining technology and technological education: A crisis, or cause for celebration? International Journal of Technology and Design Education, 4(2), 179-207.
3) Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Alzahrani, A. I., & Sarsam, S. M. (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. Studies in Educational Evaluation, 66, 100876. Alhumaidan, H., Lo, K. P. Y., & Selby, A. (2018). Co-designing with children a collaborative augmented reality

book based on a primary school textbook. International Journal of Child-Computer Interaction, 15, 24-36.
4) Klopfer, E., Squire, K., & Jenkins, H. (2009). Environmental detectives- the development of an augmented reality platform for environmental simulations. Educational Technology Research and Development, 57(3), 301-324.
5) Chen, R. W., & Chan, K. K. (2019). Using augmented reality flashcards to learn vocabulary in early childhood education. Journal of Educational Computing Research, 57(7), 1812-1831.
6) https://x-tech.am/astonishing-exploration-how-human-heart-beats-through-anatomy-4d/
7) https://pokemongolive.com/post/mapupdates-2022/
8) https://arpost.co/2019/04/10/snap-partner-summit-new-ar-features-snapchat/
9) https://www.gsmarena.com/google_maps_live_view_feature_now_available_to_more_android_and_ios_phones-news-38584.php
10) https://www.macstories.net/reviews/measurekit-brings-ar-measuring-tools-to-the-iphone/
11) https://techcrunch.com/2017/05/03/houzz-adds-a-basic-ar-mode-to-its-ios-apps-to-help-you-shop-for-furniture/