JOURNAL OF NORTHEASTERN UNIVERSITY
Volume 26 Issue 02, 2023 ISSN: 1005-3026 https://dbdxxb.cn/ Original Research Paper

AUCTUS: AN AR-BASED TOOL TO SUPPORT ENGINEERING EDUCATION

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ABSTRACT
An augmented reality (AR) based computer science engineering education app is a mobile application that utilizes AR technology to provide a more immersive and interactive learning experience for students studying computer science and engineering. The app utilizes AR to overlay digital information and elements onto the real world, allowing students to visualize and interact with concepts in a more tangible and engaging manner. The app can include a variety of features, such as interactive 3D models of computer hardware and software systems, virtual labs and simulations, and interactive quizzes and games. This type of app has the potential to revolutionize the way computer science and engineering is taught, by providing a more interactive and immersive learning experience for students.

KEYWORDS: Augmented Reality; Mobile App; Education Platform; Learning, Engineering, Computer Science

INTRODUCTION
The development of augmented reality (AR) has become a major innovation that has altered how people think about how to make their vision better.

Submitted: 22/04/2023 **Accepted**: 10/05/2023

Engineers have had incredible access to cutting-edge content thanks to AR. It has been used in a variety of fields and industries, including education, architecture, the military, and others.With a variety of rendering and development tools, AR is expected to be the next huge thing in content delivery. Augmented reality is a direct or indirect view of the real world. Combining elements that stimulate the senses results in an input. The physical environment is supplemented with things like graphics, video, and sound.

The education industry has seen one particular use of augmented reality.AR is used by numerous professors and instructors, along with a variety of platforms, to instruct and train students.A conventional book can use the 3D model and animation to illustrate complicated ideas that benefit from greater visualization.As an alternative, AR might be used to provide visitors a tour of the researcher's lab and its tools.Using a range of tools will help with this.

A user can get started without spending any money with the aid of free tools like Openspace3d, Mixare, and AR toolkit. Platforms have been used by educators to provide interactive learning experiences for their students. The educational sector has seen one specific application of augmented reality. Teachers have used these platforms to give their pupils interactive learning opportunities.Users can view and interact with digital content and information in the actual environment. Applications for augmented reality (AR) in education make use of this technique to enhance learning by offering immersive and interactive content that can be accessed through a device's camera.Augmented reality in education can be helpful in encouraging students to interact with and learn new content in a more immersive and engaging way.

RELATED WORKS

Jiri Motejlek and EsatAlpay et al. [1] has been designed to follow the principles of the faceted analysis approach. The taxonomy's goal is to assist educators, developers, and researchers in educational technologies in fully comprehending the facets of VR/AR.In Alejandro Álvarez-Marín1 et al. [2] A measurement instrument based on the proposed TAM model was used. Because of their ability to explain a person's attitudes toward using a given technology, the variables attitude toward using (ATU) and behavioral intention to use (BIU) were used.Christopher Flinton and Philip Anderson et al. [3] Suggest a strategy to address this issue: "create a simplified experience structure initially and increase complexity as the experience progresses," which, while presented in the context of an AR video game, can still be applied. The use of augmented reality (AR) in the automotive industry provides an ideal setting for testing the effects of sensory disruption on reaction times. FieldBit, a company that uses AR in a similar way, uses smart eyewear and phones to provide remote assistance to engineers. XiuquanQiao,PeiRen,SchahramDustdaret al. [4] presented a survey of Web AR in three focused subject areas. Although Web AR is still in its infancy, the cutting-edge research and development results and the various Web AR implementation approaches discussed in this paper will serve as guidelines and a reference entry for researchers and developers.In order to highlight principles in electronics engineering, this article [5] focuses on the employment and effects of augmented reality (AR). The delivery of circuit-related content makes use of and is tuned to certain augmented reality elements. Compared to traditional workstations, social

presence is higher in AR systems because they adhere to real-world norms and maintain social customs [10]. [6] Research is beginning to focus on and investigate novel qualities, such as novel user profiles, novel entirely virtual environments, and contexts where AR apps could be used more extensively. Apps can also show and explain aspects of reality that are difficult for people to perceive, such as dangerous areas or areas that are so small, they can't be replicated in a typical style. [7] Empirically, studies support the use of augmented reality in undergraduate computer programming courses. A number of studies have discovered that using AR results in better learning. Higher education has the opportunity to improve their training using a methodology to boost motivation and engagement by utilizing an AR-based platform.Also, [8] the favorable performance of the apps that demonstrate creative potential is highlighted by the qualitative research we conducted, not just for the youngest users but also for other demographic groups.There are various researches, development being carried out in the AR technological field, and deployment of Web AR-enabled service provisioning can also be further fueled by ongoing improvements in all of the computer and networking technologies [9].

PROPOSED METHOD

Technology based on augmented reality has the potential to completely change how computer science and engineering are taught and studied.

Teachers can use augmented reality (AR) to design engaging, immersive learning experiences that help pupils understand difficult ideas more thoroughly. We suggest creating an augmented reality (AR)-based educational software for students studying computer science and engineering. The Fig. 1 represents the overall architectural structure of the proposed system.

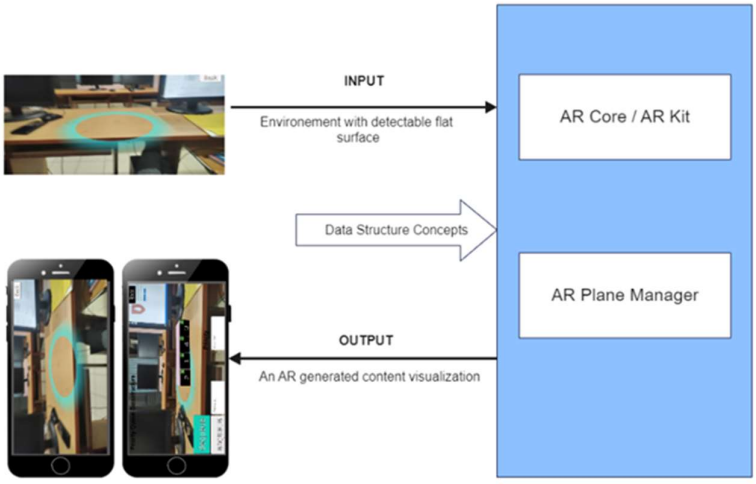

Fig. 1 Proposed Method Architecture

With the use of augmented reality (AR), the app would allow students to interact with abstract ideas in a virtual setting. Students could see and modify complicated systems, practice problem-solving techniques, and gain a deeper understanding of how concepts relate to the

outside world by utilizing the software. The programme may be used in a variety of locations, including classrooms and laboratories, and it would be accessible on a variety of devices.Students studying computer science and engineering could benefit greatly from this app in terms of learning outcomes and job success.

TECHNOLOGIES USED

A. Unity

In addition to being the best real-time programming platform available, Unity includes a robust ecosystem built to help you succeed. It is one of the most widely used pieces of software for creating augmented and virtual reality content in 2019. You may complete a variety of jobs related to video game design using the application, Unity. Unity gives video game developers access to a 2D and 3D platformer. The game engine offers a variety of AR features, making it an effective choice for tackling the technology from various angles and with various motives. Surrounding Throughout the software's development, Unity's huge ecosystem of information in the form of tutorials, forum postings, and developer guides served as a valuable resource. It is fundamentally a component-based system with an editor that serves as an interface to display the relationships between GameObjects. These serve as the engine's building blocks and serve as containers for various scripts and components. For instance, parts with details about a cube's position, rotation, and size are added to a game object. If the cube should move independently, a script that routinely modifies the position value of the associated component can be included. A physics engine that can convert a speed value to a change in position over time is also offered by Unity. It keeps track of an object's physical limits so that walls or floors can be built that other items cannot pass through. Typically, 2D UI elements are displayed on a canvas that simulates the phone's display. Components also affect how these items are positioned and sized. ARCore offers a virtual camera that moves within the Unity world coordinate system in accordance with the movements of the smartphone in order to display AR features. Its virtual characteristics are comparable to those of the phone camera, allowing GameObjects positioned in front of it to be displayed directly onto the camera feed.

B. ARCore

Google has produced a software development kit called ARCore, sometimes known as Google Play Services for AR, to facilitate the creation of augmented reality applications. ARCore uses three primary technologies to merge virtual content with the actual world as seen through a smartphone or tablet camera.The phone can understand and track its position in respect to the outside world thanks to six degrees of freedom, and it can determine the size and location of flat horizontal objects like the ground or a coffee table thanks to environmental comprehension and light estimation.

C. ARCore Tracking

Through concurrent odometry and mapping (COM),ARCore offers an inside-out tracking solution. A tracking method that can correct the registration error of these sensors is possible by using inertial measurements units (IMUs), such as gyroscopes, magnetometers, and accelerometers to calculate the motion of the smartphone. This motion is then combined with

feature points that were extracted from the camera feed. The information provided by the COM is used to create a virtual map, which includes the location of the phone. A new map is produced for each collection of feature points that depicts the surrounding area, and if several of these maps overlap, they combine to form a larger map30.

When employed in larger environments, particularly those that don't offer a considerable number of unique feature points, this strategy can cause issues and works best in smaller ones. On numerous occasions while this programme was being developed, the tracking abruptly changed places. This is most likely caused by the building's repeating aisle layout. It is conceivable for there to be a match between two separate sections of the building when determining feature points for these aisles, leading to a false pose correction.

D. AR Plane Manager

In Unity, the AR Plane Manager is a component used in Augmented Reality (AR) applications to detect and manage flat surfaces, often referred to as planes, in the real world. It is part of Unity's AR Foundation framework, which provides a unified interface for working with various AR platforms such as ARCore (Android).The AR Plane Manager uses the device's camera and AR tracking capabilities to scan the environment and identify horizontal and vertical surfaces like tables, floors, walls, and so on. Once the planes are detected, the AR Plane Manager creates corresponding virtual representations, or "ARPlane" objects, in the Unity scene.

The ARPlane objects provide information about the detected surfaces, such as their position, orientation, size, and boundaries. This information allows developers to anchor virtual objects to the real-world surfaces accurately, creating a more immersive AR experience.The AR Plane Manager also enables features like plane visibility and tracking state management. It allows developers to choose which types of planes to detect (e.g., horizontal, vertical) and configure settings such as plane detection mode and minimum area requirements.

E. Android SDK

Google developed the Android SDK, or Android Software Development Kit, as a tool for the Android operating system.For the creation of Android applications, the Android SDK offers a set of libraries and software development tools.Every time Google releases an upgrade or new version of the Android software, an appropriate SDK is also made available.The upgraded or new version of the SDK now includes certain extra functionality that were absent from the previous version.The Android SDK includes some tools that are essential for building Android applications.With the help of these tools, switching between developing and debugging is effortless.The Android SDK is compatible with a variety of operating systems, including Windows, Linux, macOS, and others.

IMPLEMENTATION STRATEGIES

Computer science and science pose an interesting challenge for AR as these fields contain a multitude of abstract concepts. This presents a challenge that must be addressed when designing the AR-based experience. As designers look to implement AR into the higher

educational environment, there are design and implementation strategies that should be given consideration.An AR user interface applies images, multimedia, and text overlayed onto images of the real world, delivered over the camera. Both the egocentric and exocentric perspective are important elements in development for learning programming. Design should consider enhancing the structures that the learner considers in building programming solutions. The primary demographic for higher education students includes individuals who own smartphones. Researchers found 96% of individuals aged 18 to 29 owned smartphones. This leverages equipment already possessed by students, and does not require the purchase of additional devices such as headset delivered AR devices.In the computer programming classroom, AR can be utilized to portray programming paths in two and three dimensions, and to demonstrate abstract concepts including code commands. In addition, it is important to design AR content that can be accessed both visually and in audio format, to allow for universal design for learning (UDL).

Students need to feel supported in the utilization of AR technology in the classroom. Mobile applications need to include various UI elements offering meta-information and hints for the user. This can be accomplished through design elements that activate direction and guidance from the instructor, support videos, and through navigation within the application. A method for accessing, completing, and submitting assessment materials should be included if it will be utilized as an assessment tool. It should, whenever possible, automatically correct the responses, giving pupils instantaneous automated feedback. According to studies, compared to a standard formative assessment approach, AR-based formative assessment significantly enhanced students' learning motivation and performance.

INDUSTRY RELEVANCE OF AUGMENTED REALITY

Augmented reality (AR) education apps can be useful in a variety of industrial settings. For example, AR can be used to enhance training programs for employees, allowing them to learn new skills or processes in a more interactive and immersive way. This can be particularly useful in industries such as manufacturing or construction, where hands-on training is important.

AR education apps can also be used to improve communication and collaboration among team members. For example, an AR app could be used to visualize complex technical diagrams or instructions, making it easier for team members to understand and follow them. Additionally, AR education apps can be used to enhance customer experiences, particularly in industries such as retail or tourism. For example, an AR app could be used to provide customers with more information about a product or service, or to help them explore a location in a more interactive way.

Overall, the use of AR in education and training can lead to improved efficiency, reduced errors, and increased customer satisfaction.

POSITIVE OUTCOMES

(i)Enhanced learning: AR education apps can make learning more interactive and engaging, which can help students retain information better

(ii)Improved accessibility: AR education apps can provide an accessible learning environment for students with disabilities, as they can present information in a variety of formats, such as audio or visual.
(iii)Greater flexibility: AR education apps can be accessed anytime, anywhere, providing students with greater flexibility in their learning.
(iv)Increased efficiency:AR education apps can streamline the learning process, allowing students to learn at their own pace and reducing the need for in-person instruction.
(v)Enhanced visualization: AR education apps can help students better visualize and understand complex concepts by providing 3D models or simulations.
(vi)Improved collaboration: AR education apps can facilitate collaboration among students, allowing them to work together in a virtual environment
(vii)Enhanced problem-solving skills:AR education apps can challenge students to think critically and solve problems in a virtual setting, helping them develop important problem-solving skills.
(viii)Improved retention:AR education apps can help students retain information better by making learning more interactive and engaging.

RESULTS

Fig 1. Finding Flat Surface

Fig 2. Detection of Flat Surface

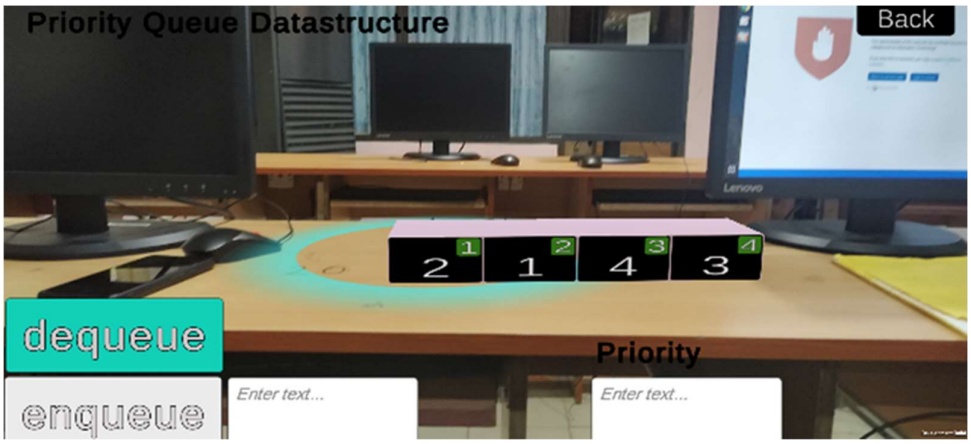

Fig 3. Visualization of Priority Queue Working

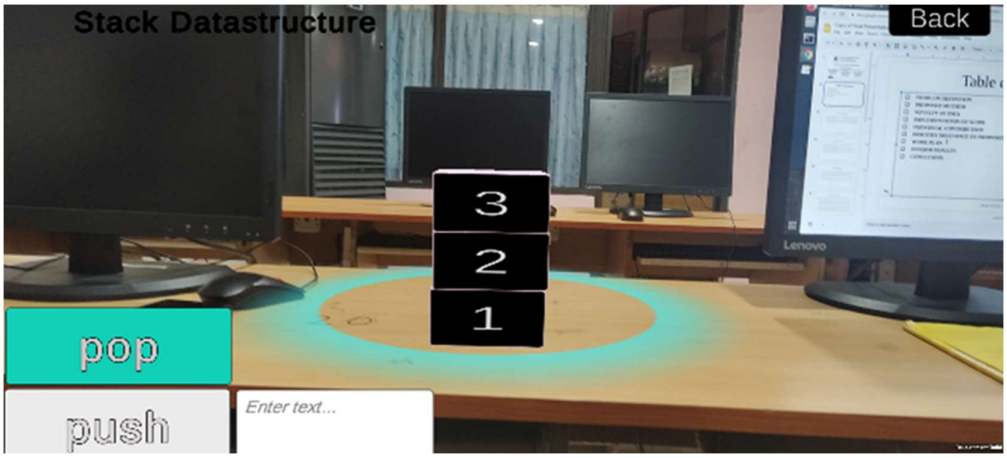

Fig 3. Visualization of Stack Working

CONCLUSION

An augmented reality-based computer science engineering app can offer a number of benefits and potential applications. By overlaying digital information onto the real world, such an app could help engineers and other professionals visualize and interact with complex data in a more intuitive and immersive way. This could potentially lead to more efficient and effective design processes, as well as improved collaboration and communication among team members. In addition, the use of augmented reality technology in an engineering context could also facilitate the creation of new, innovative solutions to real-world problems by allowing engineers to test and prototype designs in a virtual environment. Overall, an augmented reality-based computer science engineering app has the potential to revolutionize the way that engineering projects are approached and carried out, and could have a significant impact on the field of engineering as a whole.

REFERENCES

1] Jiri Motejlek and EsatAlpay.”Taxonomy of Virtual and Augmented Reality Applications in Education”.Ieee Transactions On Learning Technologies, June 2021

2] Alvarez-Marin, A., Velazquez-Iturbide, J. A., & Castillo-Vergara, M. (2020). Intention to use an interactive AR app for engineering education. 2020 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), 2020.

3] C. Flinton, P. Anderson, H. P. H. Shum and E. S. L. Ho, "NETIVAR: NETwork Information Visualization based on Augmented Reality," 2019 12th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), 2019.

4] Lin, P.-H., & Chen, S.-Y. (2020). Design and evaluation of a deep learning recommendation based augmented reality system for teaching programming and computational thinking. IEEE Access, 2020.

5] Jacob, S., Warde, M., &Dumane, P. (2020).” Impact of Augmented Reality as an ICT tool to Deliver Engineering Education Content.” 2020 International Conference on Convergence to Digital World - Quo Vadis (ICCDW), 2020.

6] Javier FombonaCadavieco , María Ángeles Pascual, and Esteban Vázquez-Cano .”Augmented Reality: A New Way to Build Knowledge. Bibliometric Analysis and Apps Testing”. IeeeRevistaIberoamericana De Tecnologías Del Aprendizaje, February 2020

7] Larson, K., & Chambers, R. (2020). AR in the Computer Programming Classroom: A Review of the Literature. IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE), 2020.

8] J. F. Cadavieco, M. Á. Pascual and E. Vázquez-Cano, "Augmented Reality: A New Way to Build Knowledge. Bibliometric Analysis and Apps Testing," in IEEE RevistaIberoamericana de Tecnologias del Aprendizaje, 2020

9] X. Qiao, P. Ren, S. Dustdar, L. Liu, H. Ma and J. Chen, "Web AR: A Promising Future for Mobile Augmented Reality—State of the Art, Challenges, and Insights," in Proceedings of the IEEE, April 2019.

10] Sereno, M., Wang, X., Besancon, L., Mcguffin, M. J., & Isenberg, T. (2020). “Collaborative Work in Augmented Reality: A Survey.” IEEE Transactions on Visualization and Computer Graphics, 2020.

11] Bhattacharya, K., Shamkh, I. M., Khan, M. S., Lotfy, M. M., Nzeyimana, J. B., Abutayeh, R. F., Hamdy, N. M., Hamza, D., Chanu, N. R., Khanal, P., Bhattacharjee, A., & Basalious, E. B. (2022). Multi-Epitope Vaccine Design against Monkeypox Virus via Reverse Vaccinology Method Exploiting Immunoinformatic and Bioinformatic Approaches. Vaccines, 10(12), 2010

12] Ahmed, S., Raza, B., Hussain, L., Aldweesh, A., Omar, A., Khan, M. S., ... & Nadim, M. A. (2023). The Deep Learning ResNet101 and Ensemble XGBoost Algorithm with Hyperparameters Optimization Accurately Predict the Lung Cancer. Applied Artificial Intelligence, 37(1), 2166222.

13] Nawaz, S., Rasheed, S., Sami, W., Hussain, L., Aldweesh, A., Salaria, U. A., & Khan, M. S. (2023). Deep Learning ResNet101 Deep Features of Portable Chest X-Ray Accurately Classify COVID-19 Lung Infection. Computers, Materials & Continua, 75(3).

14] Gangurde, R., Jagota, V., Khan, M. S., Sakthi, V. S., Boppana, U. M., Osei, B., & Kishore, K. H. (2023). Developing an Efficient Cancer Detection and Prediction Tool Using Convolution Neural Network Integrated with Neural Pattern Recognition. BioMed research international, 2023

15] Shamkh, I. M., Al-Majidi, M., Shntaif, A. H., Deng Kai, P. T., Nh-Pham, N., Rahman, I., Hamza, D., Khan, M. S., Elsharayidi, M. S., Salah, E. T., Haikal, A., Omoniyi, M. A., Abdalrahman, M. A., & Karpinski, T. M. (2022). Nontoxic and Naturally Occurring Active Compounds as Potential Inhibitors of Biological Targets in Liriomyza trifolii. International Journal of Molecular Sciences, 23(21), 12791.

16] Mohammed, N. J., & Hassan, M. M. U. (2023). Cryptosystem in artificial neural network in Internet of Medical Things in Unmanned Aerial Vehicle. Journal of Survey in Fisheries Sciences, 10(2S), 2057-2072.

17] Mohammed, N. J. (2023). Quantum cryptography in Convolution neural network approach in Smart cities. Journal of Survey in Fisheries Sciences, 10(2S), 2043-2056.

18] Mohammed, N. J., & Hassan, M. M. U. Cryptosystem using Artificial Neural Networks for UAV.

19] Mohammed, N. J. (2020). Neural Network Training by Selected Fish Schooling Genetic Algorithm Feature for Intrusion Detection. International Journal of Computer Applications, 175(30), 7-11.

20] Mohammed, N. J., & Hassan, M. M. U. (2021). Robust digital data hiding in low coefficient region of image. International Journal of Innovative Research in Computer Science & Technology (IJIRCST) ISSN, 2347-5552.

21] Hassan, M. M. U. (2021). A Robust Multi-Keyword Text Content Retrieval by Utilizing Hash Indexing. International Journal of Innovative Research in Computer Science & Technology (IJIRCST) ISSN, 2347-5552.