iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56965

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Augmented Reality in Education

Yogesh Choudhary[1], Gaurav[2], Lalit Mohan Gope[3], Aditya Kumar Gupta[4], Aman Sehgal[5] , Khushwant Virdi[6]
Department of CSE, Chandigarh University, Mohali, India

Abstract: ***Augmented reality-based education platforms are a new initiative that aims to change the way students interact with the curriculum. The program uses advanced computer vision to reconcile the physical world of books, photographs and educational models with a rich digital content system, multimedia language. By doing this, it creates an interactive and interactive learning experience that encourages students to understand complex concepts. The main goal of the program is to bridge the gap between traditional education and the dynamic digital age. The platform transforms static learning materials into interactive three-dimensional learning tools by integrating augmented reality (AR). Users simply point their mobile phone or AR-equipped glasses at a physical object and the app will quickly find it and provide important details such as 3D models, videos and detailed descriptions. Key elements of an AR-based learning platform include a powerful computer vision system for object recognition, a user-friendly mobile app or AR glasses interface, a comprehensive library of educational content, and user experience management. Integration of these elements allows students to explore complex concepts on their own in an engaging way. Teachers can also use this platform to develop learning content and customize classes to meet individual learning needs. The program incorporates educational innova- tions and remaining traditional issues for understanding and collaboration. It has the potential to improve classroom learning, distance learning, and lifelong learning. Augmented reality-based education platforms represent a major breakthrough in education technology, integrating physical and digital spaces to empower students of all ages.***

Index Terms: Education, Augmented Reality, AR

I. INTRODUCTION

Technology has been integrated into education and the results have shown positive effects on learning and teaching standards. Technology-based classrooms will introduce new teaching materials. This is because technology deals with real-world problems, up-to-date information, simulation of ideas, and communication with experts in the field. It is also thought that the use of technology for educational purposes supports traditional teaching methods. Integrating technology into the curriculum is part of effective teaching. Not only are teachers required to spend much of their time using computers, theyare also expected to be innovative and confident in using new technologies in the classroom. The integration of technology also provides opportunities to improve student learning and classroom engagement.

Therefore, recent research aims to better understand the practices used in the discipline fromthe students' perspective, including various media, computer- based simulations, animation, and statistical software shows that using a variety of media tools to explain content increases understanding and encourages effective collaboration among students. Augmented reality (AR) is a new technology thatcan be used in education.

Although there is a lot of researchon AR, very little research has been done in the field ofeducation. In recent years, research on AR has increased due to the effectiveness of technology.[2] AR is used in many areas of education. AR provides a good way to represent models, especially those that require visualization. AR also encouragesinteraction between real and virtual environments and enables the use of interactive content for devices.

II. PROBLEM STATEMENT

Some of the problems faced by the traditional education system have led to the application of Augmented Reality (AR)technology to solve these problems:

A. Lack of Student Participation

TRegular Instruction For students especially on abstract or difficult subjects It is often difficult. AR creates an interactive and immersive learning experience that sparks students' imag- ination and increases engagement. This makes the students more interactive and it also eases their learning experience asit makes complex topics easy to understand.

B. Difficulty in Perception

Conceptual concepts in subjects such as science and mathe- matics can be difficult for many students. Learn to understand. AR visualizes these concepts in 3D, allowing students tointeract and better understand abstract concepts.

C. Limited Access to Services

Not all schools have access to advanced testing equipment, artifacts, or field trips. AR brings these resources into the classroom, giving students virtual access to a variety of learning materials and experiences.

D. Different Learning Styles

Students have different learning styles and interests. Some students learn best by reading, while others are visual or tactilelearners. AR enables more inclusive and personalized learningby supporting different learning styles.

E. Regarding Special Educational Needs

Students with disabilities often require special educational equipment. AR applications are adapted to various needs to provide accessible and flexible content for students with disabilities.

F. Outdated Textbooks

Old textbooks can quickly become outdated, especially on subjects such as science and technology. The AR app providesreal-time updates and interactive content to ensure students receive the latest information.

G. Teacher-Centred Learning

Traditional classrooms can be teacher-centred, with no timefor students to interact. AR supports student learning and encourages collaboration, exploration, and problem solvingamong students.

H. Globalization and Cultural Awareness

AR can facilitate global interaction with students and cul- tural traditions around the world by promoting international knowledge and understanding. It breaks down problem areas and introduces students to different cultures and perspectives.

I. Data-driven Education

AR platforms often collect data on student interaction and performance, allowing teachers to measure individual progress and provide support. Data-driven understanding increases the effectiveness of instructional strategies.

III. RELATED WORK

The concept of augmented reality (AR) and related tech- nologies have indeed evolved over several decades, as your description outlines. Let me rephrase the information in a waythat avoids plagiarism:

The origins of augmented reality (AR) can be traced backto the early 1960s and 1970s when rudimentary forms of AR were used by large corporations for training and visualization purposes. Photographer Morton Heilig created the Senso- rama simulator in the 1950s, which engaged multiple senses, including sight, sound, vibrations, and smells[4]. In 1966, Ivan Sutherland developed the first head-mounted display that allowed users to interact with their environment, laying the foundation for wearable AR devices.

In the 1970s, Myron Krueger developed Video place, an interactive system that allowed users to interact with virtual objects using projectors, cameras, and graphics, although it didn't involve wearable glasses.

The term "virtual reality" was coined by Jaron Lanier in 1989, describing immersive environments created through visualization and 3D effects. However, it was Boeing scientist Tom Caudell who introduced the term "augmented reality" in 1992. Caudell developed applications to assist in training Boeing employees, marking the official recognition of theconcept[2].

In the 1990s and early 2000s[1], various researchers and companies, including AR Tool Kit, AR Quake, Layar Browser, and Total Immersion, contributed to the development of AR technologies. With the proliferation of small mobile devices, AR gained significant momentum, especially in business and entertainment sectors. Steve Mann, a professor at the Uni- versity of Toronto, notably experimented with wearable AR systems in the mid-1990s, paving the way for modern AR applications.

Today, the development of augmented reality continues to advance rapidly, driven by the widespread use of small mobile devices and its applications across various industries, includingbusiness and entertainment.

IV. RELATED WORK

Augmented reality (AR) has many advantages in education as it replaces traditional education and improves education as a whole. Here are a few reasons why augmented reality benefitseducation:

A. *Educational Technology*

AR technology makes learning interactive and participatory. It enables students to see complex concepts and makes it easier to understand abstract concepts. Interactive 3D models can be embedded in textbooks to create a dynamic learning environment.

B. *Improve Memory and Understanding*

AR provides a better learning experience, which often leads to better retention of information. Visualizing content in 3D or experiencing historical events in real life can help students better understand and retain information.

C. *Personal Learning*

AR applications provide customizable and personalized learning for personal learning and study. Students can progresson their own, and AR can make the learning process more con-venient for each student by providing additional explanations or challenges based on student performance.

D. *Real World Application*

AR allows students to apply theoretical knowledge to real situations. For example, medical students can practice in the operating room and engineering students can try challenging work tasks to develop necessary skills before entering theworkforce.

E. *Accessibility and Participation*

AR technology can help students with disabilities. Can provide visual or visual feedback to facilitate learning for students with various learning needs.

F. *Virtual Field Trips*

AR enables virtual field trips to historical monuments, museums, and natural wonders around the world. Students canexplore other inaccessible places and artifacts, expand their horizons and understand the world.

G. *Collaborative Learning*

AR facilitates collaborative learning. Students can worktogether on AR projects, solve problems, and chat instantly wherever they are. This encourages collaboration and com- munication.

H. *Improve creativity and critical thinking*

AR encourages creativity by enabling students to create their own content (the words are true). These processes include critical thinking, problem-solving, and creative skills that contribute to their overall well-being.

V. WORK FLOW OF AR

Augmented reality (AR) is changing our perception of theworld by presenting digital information into real-life environ-ments. It works by integrating modern technology, relyingon cameras and sensors in devices such as smartphones andtablets. These devices capture areas of the real world, andspecialized software processes the data to identify patternsor signatures that act as digital enhancements. AR algo-rithms then seamlessly integrated computer-generated images, sounds, or other information into the user's imagination to create an interactive and immersive experience. AR appli- cations use technologies such as Simultaneous Localizationand Mapping (SLAM)[7] to understand the user's locationover time, allowing virtual objects to be placed in the correctlocation in space. Users can interact with, manipulate, orreceive instant messages with these virtual items, enhancingcapabilities in areas ranging from education and gaming tohealthcare and productivity. As AR technology continues toevolve and its applications grow, the boundaries between thedigital world and the physical world will blur in the future, allowing us to understand and interact with the environment.There are various steps in the creation of any content that can be uploaded on the application. These steps includegenerating the idea, making a rough sketch, converting it intoa 3D model, uploading the content and finally viewing the content in AR.

These steps are as follows:

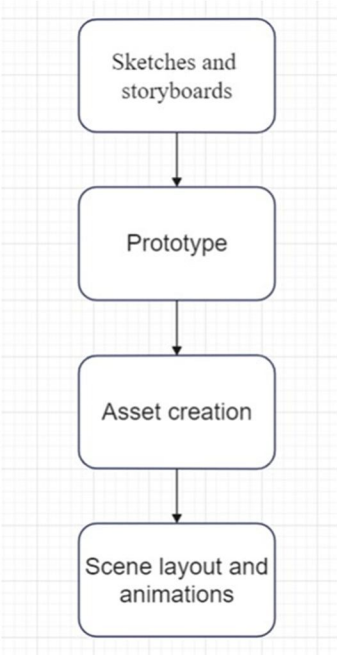


Fig. 1. Content Creation

A. Model Generation

Creating 3D models for augmented reality (AR) is a careful process that combines creativity with functionality. These models form the backbone of AR applications, improving userexperience in education, gaming, design and many other areas.The process begins with a clear vision of the object or situationto be created. Artists and developers; He carefully plans the model, taking into account its purpose, target audience and theAR platform on which it will be sent Professional software, including Blender, Maya[6] and 3ds Max, provide artists with a canvas on which to bring their ideas to life. Artists use simplegeometric shapes and add beautiful details and textures. High-resolution textures are applied to surfaces, creating realistic materials like wood, metal, or fabric. Every element, from the subtlest bump on a surface to the play of light and shadow, is carefully crafted to enhance realism and immersion.

Optimization is paramount in AR model creation[9]. The complexity of 3D models can strain device resources, affect- ing the AR experience's smoothness. Therefore, artists and developers meticulously reduce the model's polygon count, ensuring it maintains visual fidelity while being computa- tionally efficient. Textures are compressed, and unnecessary details are removed without compromising the model's overall appearance. This optimization process guarantees that the AR application runs seamlessly on a wide range of devices, from high-end smartphones to AR glasses.

Textures and materials used in the 3D model are bundled meticulously[13]. These materials not only add colour andtexture to the model but also contain vital information about how light interacts with the surfaces. Artists utilize normal maps, specular maps, and other techniques to simulate surface imperfections realistically. Proper mapping ensures that these textures wrap around the model accurately, enhancing its visual appeal. Once the 3D model is complete, it needs to be exported in aformat compatible with the chosen AR development platform.Common formats like .obj and .fbx preserve the model's geometry, textures, and animations. This database also stores information about the model's skeleton and hardware; This is important for an interactive AR experience with animated characters or objects. Integration with AR platforms such as Unity3D or Unreal Engine is the final step[11]. Here the developers presented the3D model and put it in the code of the AR application. They define interactions, actions, and behaviours that allow users toinstantly control or analyse AR objects. The user interface is designed to help users interact with the AR model. AR applications supported by carefully prepared 3D modelsare changing the way we learn, have fun and create. In edu- cation, complex concepts come to life when students interact with detailed 3D objects[10]. The game creates an immersive world with carefully designed characters and environments. AR speeds up the design process by allowing design andmanufacturing professionals to instantly view and update theirdesigns. In summary, creating 3D models for augmented reality re- quires a balance between graphics and visual effects. wisdom. It is where creativity meets technology, creating the future of communication and redefining the way we see and interact with the world around us.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

B. Model Uploading

Uploading 3D models to AR applications for students to useis an important step in effective learning. This process bridgesthe gap between digital design and real-world application, allowing students to interact with complex content in an engaging and meaningful way.

The first thing to consider when uploading 3D models for students is the choice of a platform or application. Various AR development tools such as Unity3D, ARKit or ARCore[3]provide a powerful environment for the integration of 3Dcontent. These platforms provide tools to import, optimize, andanimate 3D models, making the integration process smoother for developers. There are also user-friendly platforms such as Sketchfab[5] that allow teachers to upload their 3D models directly, eliminating the need for professional skills.

After platform selection, 3D model files (.obj, .fbx, etc.)are placed in the application interface. In this process, it is necessary to ensure that the model maintains its quality and integrity. Structure-related data, information, and animations should be mapped and stored in a way that provides the best view for students. Most platforms also allow teachers to sort examples by topic or subject, making it easier to search for students.

Another important issue is compatibility with various de- vices. AR apps need to be optimized for multiple platforms, including smartphones, tablets, and AR glasses[7]. Compat- ibility testing is important to ensure that the downloaded model performs correctly on different devices and sizes. This step includes quality assurance, where developers evaluatethe model's appearance, interoperability, and performance of different devices and functions.

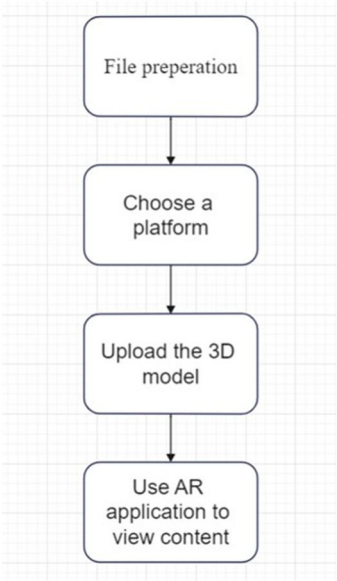


Fig. 2. Content Uploading

Confidentiality and accessibility are important when up-loading 3D models for educational purposes[8]. Teachers must ensure that content complies with privacy policies and school policies. Some platforms have privacy features thatallow teachers to control who can access uploaded content. Password protection, limited access to codes, or integration with the school's secure network can further increase the security of learning AR content. Lessons and advice play an important role in enhancing student learning. Teachers should provide clear and concise instructions on how to access and interact with the AR model14]. This information can be included in the application programming interface or distributed as a user guide or tutorial. Clear guidance allows students to effectively navigate AR applications, ensuring theyget maximum learning benefit from 3D models.Collaboration in AR applications enhances the learning experience. Teachers can create group projects that allow students to explore 3D models collaboratively, encouraging teamwork and peer learn- ing. Some applications even support real-time collaboration, allowing students to interact with 3D models simultaneously regardless of their physical location. A collaborative learning environment encourages participation and enables students to understand complex concepts.

Continuous updates and maintenance are essential to en- sure the continued effectiveness of educational AR applica- tions[14]. Teachers should monitor the models used, write instructions for students, and evaluate the impact of 3D models on learning outcomes.

Based on this feedback, updates can be made to improve existing models, add new content, or improvethe user interface to make learning more efficient and flexible. In conclusion, the process of uploading 3D models to AR applications is a complex and multifaceted process. It involvescareful consideration of the platform, relationships, privacy,guidelines, integrations, and regular maintenance. By using these features effectively, teachers can create an immersive learning environment that stimulates students' imaginations,enhances their understanding, and pave the way for futuregenerations, before education can seamlessly blend technology and creativity.

VI. LIMITATIONS OF AR

Although augmented reality (AR) technology is a new and promising concept, it has limitations that hinder its widespreaduse and effectiveness in many applications. One of the limitations is hardware limitation[9]. Current AR devices, such as AR glasses and headsets, are often limited in performance andbattery life. This limitation limits the complexity and duration of AR experiences, preventing the technology from deliveringinteractivity and continuity.

Another major limitation of AR is the difficulty in trackingand tracking different locations accurately[13]. AR applications rely on accurate mapping of the physical world andthe ability to track user movements. Inconsistencies in lighting, textures, or obstacles can disrupt AR tracking, causingmisalignment and confusion. Providing robust and reliabletracking in the real world is still a challenge for AR developers.Content design presents another limitation in the field of AR. Creating high-quality 3D models and AR content requiresspecial skills and resources[9]. Creating interactive and engaging AR experiences requires a combination of great creativity,skill, and a significant investment of time. Therefore, creatingAR content can be time-consuming and expensive, which canbe challenging for small businesses, educators, or creators with limited budgets and resources.

In addition, social acceptance and privacy issues are alsoof significant concern. Key limitations facing AR technology. People often feel uncomfortable being recorded or monitored, especially in public places where AR apps can capture and process information in real time. Striking the right balance between improving user experience and confidence is very difficult. It is important for developers and policymakers to ensure that AR applications do not violate personal privacy or security while providing a good and useful experience.

Many AR applications require a stable network connection to function properly, especially when transferring data or accessing cloud resources.[8] A private network or slow networkspeed can disrupt data transfer over time, slowing it down and worsening the overall user experience.

In summary, the limitations of AR technology include hardware limitations and difficulties in accurate tracking and recognition. Maps, the complexity of content creation, authentication and privacy issues. Overcoming these limitations requires ongoing research, technological development, and design thinking to unlock the full potential of AR in many different areas while ensuring compliance and respect forcustomers.

VII. FUTURE SCOPE

The future of augmented reality (AR) in education is very beneficial; It is changing traditional education by pro- viding effective, interactive and personalized learning. An important aspect of development is increased participationin the classroom. AR can turn real-world education into an engaging experience by broadcasting digital content into booksor educational materials. Interactive 3D models, historical simulations, or virtual field trips can bring learning to life and make content visible and engaging for students. Also, AR can create a collaborative learning experience. Students from different parts of the world can collaborate on projects, explore virtual museums together, or participate in interactive experiments that break down problem areas and stimulate world-class studies. This collaboration fosters collab-oration, communication, and cultural understanding important skills in today's connected world. Personal learning is another area where AR is making progress. By analysing a student's academic performance and learning, the AR application can adjust the learning content to meet the individual's needs. Adaptive AR platforms can provide learning opportunities by ensuring all students receive content at their level and level of understanding. This personal approach not only improves understanding but also increases students' confidence and motivation, making learning more effective and meaningful.

Also, AR technology promises to revolutionize job and skills training. Industries such as healthcare, engineering, and manufacturing can use AR applications to provide hands-on training without the need for expensive equipment or physical models. For example, medical students can practice surgery in a virtual environment and engineers can solve complex mechanical problems in AR simulations. Training is effective, provides professionals with confidence that they are ready for real-world competition, and ultimately improves academic quality and career readiness.

In summary, the future scope of AR in education is to trans- form traditional classrooms into dynamic, interactive learning environments. By improving engagement, encouraging collaboration, enabling personalized learning, and transforming business education, AR technology will play a key role in developing the future of education, making learning easier, more engaging, and more effective for students around the world.

VIII. CONCLUSION

Augmented reality (AR) is a transformative force in education, transforming the way we learn and teach. AR makes learning meaningful, understandable and effective by bridging the gap between cognitive and practical experiences through interactive and interactive experiences. The adoption of AR in classrooms around the world brings abstract concepts to life, allowing students to explore complex concepts in depth and understand concepts that previously could not be done throughtraditional methods.

AR has been proven to be a tool for self-directed learning, adapting to different learning styles, and improving learning outcomes. It allows teachers to create a positive, student- centered environment where students engage in learning and develop ideas, creativity, and problem solutions. Additionally, augmented reality breaks down geographical barriers, connects students around the world, and fosters cultural exchange, raising a generation with a global mindset.

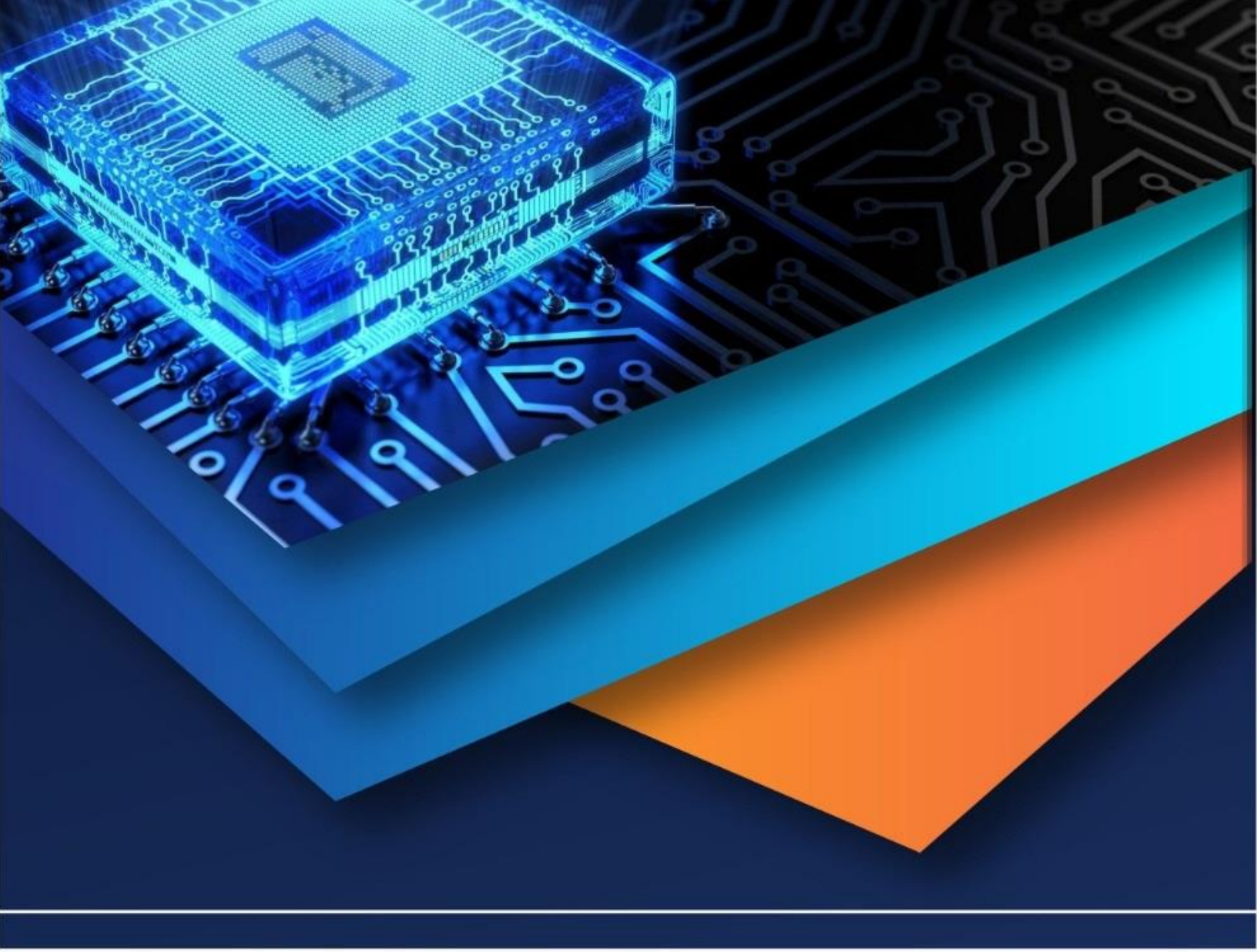
Technology also meets the needs of students with different abilities, making learning more efficient and ensuring that ev- eryone has equal access to information. AR expands horizons by providing a virtual tour, taking students to places they can never physically visit, allowing them to understand world culture, history and natural philosophy.

Additionally, AR prepares students to meet the needs of the future workforce by equipping them with valuable technologi- cal knowledge and skills in the digital age. As AR applications continue to grow and diversify, learning technologies will become more dynamic and flexible to meet the changing needs of learners and educators.

Essentially, realism in education is revolutionary, meaning that learning is not limited to books, but extends to interactive experiences that spark curiosity and foster understanding, love of learning, forever. Moving forward, the adoption of AR in education will not only improve learning outcomes but also create a new generation of thinkers with self-confidence and the ability to solve the problems of the next world. AR's journey in education has just begun, offering endless possibilities and a bright, rewarding future to students around the world.

REFERENCES

[1] R. T. Azuma, "A survey of augmented reality," Presence: Teleoperators and Virtual Environments, vol. 6, no. 4, pp. 355-385, Aug. 1997.
[2] M. Billinghurst and A. Dunser, "Augmented Reality in the Classroom," in Advances in Computer Graphics and Computer Vision. Springer, 2012, pp. 1-20.
[3] H. Kaufmann and D. Schmalstieg, "Mathematics and geometry educa- tion with collaborative augmented reality," Computers Graphics, vol. 27, no. 3, pp. 339-345, Jun. 2003.
[4] C. Dede, "Immersive interfaces for engagement and learning," Science, vol. 323, no. 5910, pp. 66-69, Jan. 2009.
[5] P. Milgram and F. Kishino, "Taxonomy of mixed reality visual displays," IEICE Transactions on Information Systems, vol. 77, no. 12, pp. 1321- 1329, Dec. 1994. [Online].
[6] "ARCore: Augmented Reality at Android Scale," Google Developers. [Online]. Available: https://developers.google.com/ar. [Accessed: Oct. 15, 2023].
[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: Univer-sity Science, 1989.
[8] M. Billinghurst, S. Weghorst, and T. Furness, "Shared space: An augmented reality interface for computer supported collaborative work," in Proceedings of the Virtual Reality Annual International Symposium, 1994, pp. 249-259.
[9] B. Furht and M. Billinghurst, Eds., Handbook of Augmented Reality. Springer, 2011.
[10] D. Schmalstieg and T. Ho¨llerer, Augmented Reality: Principles and Practice. Addison-Wesley, 2016.
[11] A. State et al., "ARToolKit markers: A new approach to 3D tracking," in Proceedings of the 2nd IEEE/ACM International Symposium on Mixed and Augmented Reality, 2003, pp. 225-234.
[12] C. Dunser et al., "AR-based edutainment system for learning mathemat-ics," Computer Graphics Forum, vol. 27, no. 6, pp. 1589-1596, 2008.
[13] M. Fiala, "ARTag, a fiducial marker system using digital techniques," in Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2005, pp. 590-596. [Online]. Available:http://www.hitl.washington.edu/artoolkit/papers/artag.pdf
[14] "Wikitude SDK," Wikitude GmbH. [Online]. Available: https://www.wikitude.com/. [Accessed: Oct. 15, 2023].
[15] R. Grasset et al., "Tangible augmented reality for science learning," in Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality, 2008, pp. 45-54.
[16] A. T. Campbell et al., "DART: A toolkit for rapid design exploration of augmented reality experiences," in Proceedings of the IEEE InternationalSymposium on Mixed and Augmented Reality, 2013, pp. 121-130.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY