Theme: AR-VR

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Meghnad Saha Institute of Technology

Department of Computer Science and Engineering

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Message from the Department

Congratulations on the successful publication of our Annual Departmental Magazine in March 2022! Despite the challenging circumstances of the past two years, your resilience and dedication have been truly remarkable. The magazine stands as a testament to your unwavering commitment and exceptional talent. I commend each and every one of you for your valuable contributions, insightful articles, and innovative research. I also extend my gratitude to the faculty, staff, and editorial team for their support. Your achievements have not only enriched our department but have also brought immense pride to our institution. As you continue your journey in Computer Science, I am confident that the knowledge and experiences gained during this time will empower you to overcome future challenges. Congratulations once again, and may this publication serve as a source of inspiration for your future endeavours.

Departmental Mission and Vision

Vision of the Department

To attain a global platform in academics, research and innovation by preparing competent computer engineers to cater for the needs of industry and society at large.

Mission of the Department

DM1: To address the dynamic & growing needs of the software industry by creating quality professionals with a strong focus on principles of Computer Science and Engineering.

DM2: To provide state-of-the-art infrastructure to facilitate the research work for enhancing the knowledge in emerging technologies including machine learning models, data science, cybersecurity, and IoT etc.

DM3: To strengthen the industry-academic relationship through collaboration with global IT organizations, healthcare units and relevant institutions for data sharing and developing technology.

DM4: To nurture the students by inculcating the spirit of ethical and social values through creating strong foundation in ethical coding and computational design paradigms.

Departmental Achievement

Participation of Students in Inter-Institute Events

- Total events participated within state – 30
- Total events participated within state – 5

Prizes/Awards by Students:

- Total awards - 9

Placements (Highest LPA):

- Number of students Placed through Campus Interviews - 50
- Highest package – Ritu Banerjee – McAfee – 8.14 L

Higher Studies by Students:

- Ansuj Ghosh – M.TECH (CSE), MAKAUT, WB,
- Avishek Saha – MS (CYBER SECURITY), PACE UNIV., NY, USA
- Tirthankar Biswas – MS (CSE), IU, BERLIN, GERMANY

Faculty Achievement:

- FDP participated – 22
- Seminar/ Workshop/ Tech. Talk/ Competitions Organized – 7

Faculty Technical Quotes

Recent Trends in AR-VR

Augmented Reality (AR) and Virtual Reality (VR) technologies are transforming the way we interact with digital content, and their use cases have rapidly expanded in recent years. From gaming to education, AR-VR is finding applications across multiple industries. In this article, we will explore some of the recent trends in AR-VR technology.

Retail is one of the industries that has shown significant interest in AR-VR technologies in recent years. AR technology is being used by retailers to enhance the in-store shopping experience for customers. AR technology allows customers to interact with digital content in real-time and visualise products in a more realistic way, giving them a better understanding of the product features and specifications. Virtual reality, on the other hand, has been used to create immersive virtual shopping experiences. Retailers are using VR to create virtual showrooms, where customers can browse and purchase products without leaving their homes. With the COVID-19 pandemic, the use of VR in retail has gained even more importance, as it allows customers to shop safely from the comfort of their homes.

AR-VR technologies are also being adopted in education to enhance the learning experience for students. AR technology is being used to create interactive and engaging learning experiences that help students understand complex concepts. For example, AR can be used to create 3D models of human anatomy, allowing medical students to visualise the human body in a more immersive way. VR technology is being used to create virtual field trips, where students can explore historical sites, museums and other locations that may not be possible to visit physically. VR technology can also be used to create immersive simulations that allow students to practice skills in a safe and controlled environment.

AR-VR technology is also transforming the healthcare industry. AR technology is being used to assist surgeons during surgeries, allowing them to visualise medical images in real-time and make more accurate decisions. AR technology is also being used to train medical professionals, allowing them to practice complex procedures in a safe and controlled environment. VR technology is being

used to help patients with mental health disorders, such as anxiety and phobias. VR therapy can simulate exposure to real-life situations that trigger anxiety, allowing patients to gradually overcome their fears. The integration of AR-VR technology with Artificial Intelligence (AI) and the Internet of Things (IoT) is opening up new possibilities for businesses. AI can be used to analyse data generated by AR-VR applications, providing insights that can help businesses make more informed decisions. IoT can be used to connect AR-VR devices to other devices and sensors, creating a more immersive and interactive experience. For example, IoT can be used to connect AR-VR devices to smart home devices, allowing users to control their environment with voice commands or gestures.

In recent years, there has been a significant increase in investment in AR-VR technology. According to a report by CB Insights, AR-VR start-ups raised $7.2 billion in funding in 2020, a 41% increase from the previous year. This increase in investment is a testament to the growing interest in AR-VR technology and its potential to transform multiple industries. Gaming has been one of the primary applications of AR-VR technology. AR technology has been used to create location-based games that allow players to interact with real-world objects and environments. VR technology is being used to create immersive gaming experiences, allowing players to feel like they are inside the game.

AR-VR technologies are rapidly evolving, and their use cases are expanding across multiple industries. The adoption of AR-VR technologies is rapidly evolving, and their use cases are expanding across multiple industries. The adoption of AR-VR has the potential to revolutionize the way we interact with digital content, and it is likely that we will see even more innovative use cases for AR-VR in the future. As technology continues to improve, AR-VR is becoming more accessible to businesses of all sizes, and we can expect to see more widespread adoption in the coming years. The future of AR-VR looks bright, and it is an exciting time to be involved in this rapidly growing field.

Education and Training using AR-VR

The use of Augmented Reality (AR) and Virtual Reality (VR) in education and training has been gaining popularity in recent years, as these technologies offer immersive and engaging learning experiences that traditional teaching methods may not be able to provide. AR and VR technologies can help students learn and retain knowledge better, as they offer interactive and realistic simulations that mimic real-life situations. In this article, we will explore the benefits of using AR and VR in education and training, as well as some of the most promising applications in this field.

Benefits of AR and VR in Education and Training transforming the educational wing. In terms of Enhanced Learning Outcomes, AR and VR technologies offer a more engaging and immersive learning experience than traditional teaching methods, which can help students learn and retain knowledge better. Studies have shown that the use of AR and VR in education can increase student engagement, motivation, and knowledge retention, leading to improved learning outcomes. In Realistic Simulations, AR and VR technologies can provide realistic simulations that mimic real-life situations, allowing students to practice skills and decision-making in a safe and controlled environment. This is particularly useful in fields such as healthcare, where students can practice surgical procedures or medical diagnoses in a virtual environment before performing them on real patients. In the area of Personalized Learning, AR and VR technologies can be customized to meet the

individual learning needs of each student. For example, students can choose their own learning path and pace, and the technologies can adapt to their level of understanding, providing personalized feedback and guidance. AR and VR technologies can be more cost-effective than traditional teaching methods, as they can be used to provide training and education without the need for expensive equipment or materials. For example, a VR headset can provide a realistic and immersive training experience for a fraction of the cost of a real-world training scenario. In terms of Accessibility, AR and VR technologies can provide education and training opportunities that are accessible to people who may not have access to traditional training methods. For example, people in remote areas or with mobility impairments can access training and education through AR and VR technologies.

In Healthcare Training, AR and VR technologies are being applied to provide training for medical professionals, allowing them to practice surgical procedures, medical diagnoses, and other medical scenarios in a safe and controlled environment. For example, the University of Nebraska Medical Center has developed a VR simulation that allows medical students to practice surgical procedures on a virtual patient before performing them on real patients. In STEM Education, AR and VR technologies are being used to provide immersive and interactive learning experiences in Science, Technology, Engineering, and Mathematics (STEM) education. For example, the *Labster* platform offers VR simulations of laboratory experiments, allowing students to practice and learn laboratory skills in a safe and controlled environment. Towards Language Learning: AR and VR technologies are being used to provide immersive language learning experiences. For example, the *ImmerseMe* platform offers VR simulations of real-life language scenarios, allowing learners to practice their language skills in a realistic and immersive environment. In the area of Soft Skills Training, AR and VR technologies are being used to provide training for soft skills such as leadership, communication, and teamwork. For example, the *Mursion* platform offers VR simulations of workplace scenarios, allowing learners to practice their soft skills in a safe and controlled environment. AR and VR technologies are being used in Special Education to provide education and training opportunities for people with disabilities. For example, the Autism Glass Project uses AR technology to provide social cues and feedback to children with autism, helping them to better understand social situations.

While AR and VR technologies offer many benefits for education and training, there are also some challenges and limitations that need to be addressed. One of the main challenges is the cost of the technology, which can be prohibitive for some schools and organizations. Additionally, there may be technical challenges related to setting up and maintaining the technology, as well as ensuring that it is accessible to all learners. There may also be concerns around the quality and accuracy of the educational content provided through AR and VR technologies, as well as the potential for students to become too reliant on the technology and less able to apply their learning in real-world scenarios.

Despite these challenges, the potential benefits of using AR and VR in education and training are significant, and the technology is rapidly evolving to address some of the limitations. As more schools and organizations invest in AR and VR technologies, we can expect to see new and innovative applications of these technologies in the education and training field. The use of AR and VR has the potential to revolutionize the way we learn, providing more engaging, immersive, and personalized learning experiences that can help learners of all ages and abilities to reach their full potential.

Design and Architecture using AR-VR

Design and architecture have been the foundation of our built environment for centuries. From the pyramids of Egypt to the skyscrapers of New York City, every structure around us has been designed by an architect. The field of architecture and design has seen a lot of technological advancements in recent years, and one of the most significant ones is the integration of Augmented Reality (AR) and Virtual Reality (VR) in the field. These technologies have the potential to revolutionize the way architects and designers approach their work.

AR and VR can be used in a variety of ways in the field of architecture and design. From conceptualization to construction, these technologies can provide architects and designers with a new way of visualizing and communicating their ideas. Let's take a closer look at how AR and VR can be used in the field of architecture and design. One of the biggest challenges architects and designers face is visualizing their designs in three dimensions. Traditional 2D drawings and blueprints can be difficult to understand for clients, and even for architects themselves. With the help of AR and VR, architects can create virtual 3D models of their designs, which can be explored by clients and team members in real-time. AR can be used to overlay digital models onto the physical world, allowing architects and clients to see how the design will look in real-life settings. For example, an architect can use AR to overlay a virtual 3D model of a building onto an empty lot, giving clients a sense of how the building will look in its actual surroundings. VR, on the other hand, allows architects and designers to immerse themselves in their designs. By putting on a VR headset, architects can walk through a virtual representation of their design, giving them a sense of scale and proportion that is impossible to achieve with 2D drawings. AR and VR can also be used to facilitate collaboration between architects and other team members. With the help of these technologies, architects and designers can work together in real-time, even if they are in different locations. AR can be used to share digital models with team members, allowing everyone to see the design in real-time. This can be particularly useful during design reviews, where team members can provide feedback on the design as it is being developed. VR can be used to create virtual meeting rooms, where team members can meet and discuss the design in a shared virtual space. This can be particularly useful for teams that are geographically dispersed, as it allows everyone to come together in a virtual environment. In Construction Visualization, AR and VR can also be used during the construction phase of a project. With the help of these technologies, architects and contractors can visualize how the design will look once it is built. AR can be used to overlay digital models onto the physical world, allowing contractors to see how the design will look in real-life settings. This can be particularly useful for contractors who are working on complex projects, as it allows them to see how different components of the design will fit together. VR can be used to create virtual walkthroughs of the construction site, allowing architects and contractors to explore the design in a virtual environment. This can be particularly useful for identifying potential issues before construction begins, as it allows team members to see how the design will look from different angles. In the area of Design Education, AR and VR can also be used to teach design and architecture to students. With the help of these technologies, students can explore virtual 3D models of buildings and structures, giving them a better understanding of how they are designed and built. AR can be used to overlay digital models onto the physical world, allowing students to explore virtual models of buildings and structures in real-life settings. This can be particularly useful for teaching students about the history and architecture of different buildings. VR can be used to create virtual field trips, allowing students to explore different buildings and structures in a virtual environment. This can be particularly useful for students who may

not have the opportunity to visit these locations in person, as it allows them to experience them in a more immersive way.

AR and VR have the potential to revolutionize the field of architecture and design. From design visualization to construction visualization, these technologies can provide architects and designers with a new way of visualizing and communicating their ideas. They can also facilitate collaboration between team members and can be used to teach design and architecture to students in a more immersive way. However, it's important to note that these technologies are still in their early stages, and there are still some limitations to their use. For example, creating high-quality 3D models can be time-consuming and expensive, and not all clients may have access to the necessary equipment to view virtual models. Despite these limitations, the use of AR and VR in architecture and design is a promising development that is likely to have a significant impact on the field in the years to come. As these technologies continue to evolve and become more accessible, architects and designers will have new tools at their disposal to create innovative and impactful designs that shape our built environment for generations to come.

Student's Technical Speak

3D Graphics and Rendering in AR-VR

Augmented Reality (AR) and Virtual Reality (VR) have rapidly gained popularity in recent years, offering users immersive and interactive experiences that blend the digital and physical worlds. At the heart of these technologies lies 3D graphics and rendering, which play a crucial role in creating realistic and captivating virtual environments. In this article, we explore the significance of 3D graphics and rendering in AR-VR and their impact on shaping the future of digital realities.

AR refers to the overlaying of digital content onto the real world, enhancing the user's perception of their surroundings. VR, on the other hand, immerses users in a fully simulated environment, blocking out the physical world and providing a sense of presence in the virtual realm. In both cases, 3D graphics and rendering techniques are employed to generate and display the virtual objects, characters, and environments that users interact with.

The foundation of 3D graphics lies in computer-generated models, which are mathematical representations of objects and scenes. These models define the shape, texture, lighting, and other visual properties of the virtual elements. Rendering algorithms then transform these models into realistic images or video sequences that can be displayed on AR-VR devices.

Rendering involves the simulation of light interactions within a virtual environment. A technique such as ray tracing or rasterization calculate how light bounces off objects and interacts with materials, resulting in realistic lighting, shadows, reflections, and refractions. These effects contribute to the overall visual fidelity and immersion of AR-VR experiences.

Real-time rendering is a critical aspect of AR-VR, as it requires generating and displaying images at high frame rates to ensure smooth and responsive interactions. Achieving real-time rendering in complex virtual environments can be challenging due to the computational demands involved. However, advancements in graphics processing units (GPUs) and rendering techniques, such as level of detail (LOD) rendering and occlusion culling, have significantly improved the performance and efficiency of real-time rendering in AR-VR.

Another essential aspect of 3D graphics in AR-VR is interaction and user interface design. Users must be able to interact with virtual objects and navigate through virtual environments seamlessly. This involves techniques such as gesture recognition, object tracking, and spatial mapping. 3D graphics play a crucial role in accurately representing user actions and providing visual feedback, ensuring intuitive and immersive interactions.

The combination of 3D graphics and rendering with other technologies, such as motion tracking, depth sensing, and spatial audio, further enhances the realism and immersion of AR-VR experiences. For example, accurate tracking of user movements allows virtual objects to interact realistically with the real world and align with the user's perspective, creating a seamless and believable mixed reality experience.

The applications of 3D graphics and rendering in AR-VR are vast and diverse. In entertainment and gaming, 3D graphics enable the creation of visually stunning virtual worlds, lifelike characters, and immersive gameplay experiences. In education and training, AR-VR simulations provide realistic environments for learning complex tasks and scenarios, offering hands-on experiences without real-world risks. In healthcare, 3D visualization and rendering contribute to surgical planning, medical imaging analysis, and patient education.

However, there are challenges that need to be addressed in the field of 3D graphics and rendering for AR-VR. The realistic representation of complex materials, such as hair, fur, and fluids, still presents challenges in real-time rendering. The need for high-fidelity graphics also places demands on the hardware and processing power of AR-VR devices. Striking a balance between visual quality and real-time performance is an ongoing pursuit in the industry.

In conclusion, 3D graphics and rendering are fundamental to the creation of immersive and captivating AR-VR experiences, bringing virtual worlds to life and enabling users to explore and interact with digital realities like never before. As technology continues to advance, we can expect even more realistic and visually stunning graphics, pushing the boundaries of what is possible in AR-VR and opening up new possibilities for entertainment, education, healthcare, and many other industries.

Display Technology in AR-VR

Bridging the Gap between Virtual and Real Worlds. Augmented Reality (AR) and Virtual Reality (VR) have become increasingly popular in recent years, revolutionizing various industries such as gaming, education, healthcare, and entertainment. Central to the immersive experience of AR and VR is the display technology that enables users to interact with virtual objects and environments in a seemingly real and interactive manner. In this article, we will explore the display technology advancements in AR-VR and their impact on user experience.

When it comes to AR-VR displays, the ultimate goal is to create a seamless integration of virtual and real worlds, blurring the line between what is physically present and what is computer-generated. The primary challenge lies in delivering high-quality visuals that are realistic, responsive, and comfortable for users to wear for extended periods.

One of the most common display technologies used in AR-VR headsets is the Liquid Crystal Display (LCD). LCD panels offer high-resolution images with good color reproduction and brightness. They have been widely adopted due to their mature technology, cost-effectiveness, and suitability for mass production. However, LCDs have limitations when it comes to fast motion rendering and contrast levels, which can result in motion blur and reduced image quality in VR applications

To address the limitations of LCD, another prominent display technology used in AR-VR is the Organic Light-Emitting Diode (OLED). OLED displays offer several advantages over LCDs, including faster response times, higher contrast ratios, and better black levels. These characteristics are crucial for VR, as they contribute to a more immersive experience by minimizing motion blur and enhancing image depth. Additionally, OLED displays can be flexible, allowing for curved screens and lighter headset designs.

MicroLED displays are also gaining attention in the AR-VR industry. MicroLEDs are miniature light-emitting diodes that provide exceptional brightness, contrast, and color reproduction. They offer the benefits of both LCD and OLED technologies, such as high resolution, fast response times, deep blacks, and wide color gamut. MicroLED displays have the potential to deliver stunning visuals with improved power efficiency, making them an exciting prospect for future AR-VR headsets.

Another display technology on the horizon is the use of waveguide-based optical systems. Waveguides are transparent substrates that guide light through internal reflections, allowing virtual images to be superimposed on the real-world view. Waveguide-based displays offer the advantage of compactness, enabling sleeker and more lightweight AR glasses. They also provide a wider field of view (FOV) compared to traditional display technologies, which enhances the immersion factor.

Apart from the display technology itself, the form factor of AR-VR headsets plays a significant role in user comfort and adoption. Manufacturers are striving to develop lightweight, ergonomic designs that minimize fatigue and discomfort during prolonged use. Advances in display technology, such as the adoption of flexible OLEDs or MicroLEDs, contribute to reducing the weight and size of headsets, improving overall wearability.

Moreover, resolution and pixel density are crucial factors for achieving realistic and detailed visuals. Higher resolution displays enable sharper images and text, reducing the screen door effect - a visible grid between pixels that can diminish the immersion. Continued advancements in display technology, including increased pixel density, will further enhance the visual fidelity and realism of AR-VR experiences.

The future of AR-VR display technology holds great promise. Researchers are exploring new possibilities such as holographic displays, retinal projection, and even neural interfaces that directly stimulate the visual cortex. These advancements could unlock entirely new levels of immersion and interactivity, bringing us closer to the vision of a fully integrated virtual and real-world experience.

In conclusion, display technology is a crucial component in the evolution of AR-VR experiences. LCD, OLED, MicroLED, and waveguide-based displays are revolutionizing the way we perceive and interact with virtual content. As these technologies continue to advance, we can expect more immersive, comfortable, and visually stunning AR-VR headsets that will reshape the boundaries between the real and virtual worlds, opening up a new realm of possibilities for various industries and ultimately transforming the way we live, work, and play.

Audio Technology in AR-VR

When we think of augmented reality (AR) and virtual reality (VR), our minds often focus on the visual aspects of these technologies. However, audio technology plays an equally vital role in creating immersive and realistic AR-VR experiences. Through spatial audio, sound design, and advanced audio processing techniques, audio technology enhances immersion, elevates storytelling, and adds a new dimension to the virtual world. In this article, we explore the significance of audio technology in AR-VR and its impact on shaping the future of digital realities.

One of the key elements of audio technology in AR-VR is spatial audio. Spatial audio creates a sense of 3D sound by simulating the way sound waves interact with the environment and reach our ears in the real world. By using specialized algorithms and techniques, spatial audio allows virtual sounds to have directionality, distance, and depth, making them appear as if they originate from specific locations within the virtual environment.

Spatial audio not only adds realism to AR-VR experiences but also enhances immersion and presence. For example, when wearing AR glasses or a VR headset, spatial audio can make virtual objects or characters feel more believable by accurately placing their sounds in relation to the user's position. This can create a more convincing sense of being present in the virtual world, where sounds align with the user's visual cues and interactions.

In addition to spatial audio, sound design plays a critical role in shaping the emotional and narrative aspects of AR-VR experiences. Just like in film or video games, carefully crafted sound effects, ambient sounds, and musical compositions can evoke specific emotions, create tension, or guide the user's attention within the virtual environment. Sound design helps to establish the atmosphere and mood, enhancing the overall storytelling and immersion of AR-VR content.

Moreover, advanced audio processing techniques contribute to a more seamless and realistic audio experience in AR-VR. For example, binaural rendering can simulate how sound changes as it interacts with the user's anatomy, providing a more personalized and immersive audio perception. Noise cancellation algorithms can reduce external noise, allowing users to focus more on the virtual audio content. Adaptive audio systems can dynamically adjust sound levels and characteristics based on the user's movements or interactions, ensuring audio coherence and realism.

Audio technology in AR-VR is not limited to headphones or speakers. Haptic feedback systems can complement audio cues by providing physical vibrations or tactile sensations that correspond to specific sounds or interactions. This multisensory approach further enhances the realism and immersion of AR-VR experiences, making them more engaging and impactful.

The applications of audio technology in AR-VR are wide-ranging. In gaming and entertainment, immersive audio can transport players into rich and dynamic virtual worlds, enhancing the sense of presence and excitement. In education and training, spatial audio can provide realistic audio cues in simulations, improving the effectiveness of virtual learning environments. In architectural and industrial design, audio technology can contribute to creating realistic soundscapes and evaluating the acoustic properties of virtual spaces.

However, challenges exist in the field of audio technology for AR-VR. Achieving high-quality spatial audio with accurate localization and appropriate sound propagation in real time requires computational resources and precise calibration. Furthermore, ensuring compatibility and standardization across different AR-VR platforms and devices can be complex, as audio rendering techniques may vary. Collaboration between audio engineers, software developers, and content creators is crucial to address these challenges and push the boundaries of audio technology in AR-VR.

In conclusion, audio technology is an integral part of the AR-VR experience, enhancing immersion, realism, and emotional impact. Spatial audio, sound design, and advanced audio processing techniques contribute to creating a multisensory environment that complements the visual aspects of AR-VR content. As technology continues to advance, we can expect audio technology in AR-VR to further evolve, offering more sophisticated spatial audio rendering, interactive soundscapes, and seamless integration with other sensory feedback systems. This will result in even more immersive and realistic AR-VR experiences, blurring the lines between the virtual and physical worlds and opening up new possibilities for entertainment, education, design, and various other industries.

Cross-Reality Integration in AR-VR

Introduction

Virtual reality (VR) and augmented reality (AR) are two game-changing technologies that have caught the interest of both consumers and enterprises. The idea of cross-reality integration has developed as a viable method to integrate the strengths of both AR and VR, even if each technology has its own distinct advantages and application cases. The idea of cross-reality integration is examined in this article along with its possible effects on numerous businesses. Cross-reality integration can be seen as the seamless blending of AR and VR technology that enables users to easily switch between actual and virtual surroundings. It entails building a networked ecosystem that allows real and virtual things and experiences to coexist. Advanced computer vision, sensor technology, and clever algorithms are used to achieve this integration.

Advantages of Cross-Reality Integration

a) Enhanced User Experience: Users can enjoy the best of both worlds thanks to cross-reality integration. They can engage with physical objects while also submerging themselves in virtual worlds, making the experience more interesting and participatory.
b) Cross-reality integration can boost productivity across a variety of industries by combining AR's capacity to overlay digital information onto the actual environment with VR's immersive features. This integration may expedite procedures and boost productivity across a range of fields, from design and production to training and remote collaboration.
c) Extended Application Potential: The merging of several realities creates new opportunities for applications in various industries. For instance, in architecture and construction, virtual building models can be viewed in actual locations, allowing architects to make more precise planning and design decisions. with the medical field, surgeons can project digital patient information onto the operating table to aid with accurate treatments.
d) Social Interaction: By allowing users to share virtual experiences with one another, cross-reality integration has the potential to completely transform social interaction. This integration can overcome distance obstacles and improve communication, whether it's participating in virtual meetings, interacting in virtual worlds, or working together on projects.

Challenges and Consideration

Although the idea of cross-reality integration has a lot of potential, there are a number of issues that need to be resolved.

a) Limitations of the hardware: To achieve seamless cross-reality integration, powerful sensors, cameras, and computational power are needed. For wide acceptance, the creation of lightweight, high-performing devices is crucial.
b) Standards and Compatibility: To enable interoperability and build a strong cross-reality ecosystem, standards must be established and compatibility must be guaranteed between various AR and VR platforms.
c) Ethical and Privacy considerations: Cross-reality integration creates ethical and privacy considerations, as with any newly developed technology. Fostering adoption requires protecting user data, obtaining consent, and addressing any security issues.

Future Prognosis

As AR and VR technology advance, cross-reality integration promises a fascinating new future. We may anticipate further acceptance and creative applications in sectors like gaming, education, healthcare, and beyond as hardware advances and standards develop. Our capacity to move fluidly between the physical and digital worlds will change how we communicate, work together, and consume digital content. By fusing the actual and virtual worlds, cross-reality integration is poised to transform the AR and VR scene. This integration delivers improved user experiences, increased productivity, expanded application potential, and

improved social engagement by utilising the characteristics of both platforms. Even though there are still difficulties, the future appears bright for a world where AR and VR live without conflict, opening up new opportunities in a variety of fields.

Multidisciplinary Applications of AR-VR

Augmented Reality (AR) and Virtual Reality (VR) technologies have rapidly evolved, offering immersive and interactive experiences that transcend traditional boundaries. While these technologies are often associated with gaming and entertainment, their applications extend far beyond these domains. AR-VR is revolutionizing various industries, enhancing training and education, transforming healthcare, enabling remote collaboration, and revolutionizing marketing and design. In this article, we explore the multidisciplinary applications of AR-VR and their profound impact on different sectors.

Training and Education

AR-VR has immense potential in revolutionizing training and education. It provides immersive and realistic simulations that enable hands-on learning experiences. In fields such as healthcare, aviation, and manufacturing, AR-VR enables trainees to practice complex procedures in a safe and controlled environment. It enhances engagement, improves knowledge retention, and allows for personalized learning experiences.

Healthcare

AR-VR is transforming healthcare delivery by enhancing patient care, medical training, and surgical procedures. It enables medical professionals to visualize patient data in 3D, improving diagnosis and treatment planning. Surgeons can use AR-VR to simulate surgeries, improving precision and reducing risks. Additionally, AR-VR can aid in patient rehabilitation, mental health therapies, and pain management.

Architecture and Design

AR-VR is revolutionizing architecture and design industries. It allows architects and designers to create virtual models of structures and environments, enabling clients to visualize and interact with designs before they are built. This enhances collaboration, improves design iterations, and minimizes errors. AR-VR also enables real-time visualization of interior design and spatial planning.

Manufacturing and Engineering

AR-VR is reshaping manufacturing and engineering processes. It enables engineers to visualize and manipulate complex designs, improving prototyping, assembly, and maintenance. AR-VR can overlay real-time data and instructions onto physical equipment,

aiding technicians in repairs and inspections. It enhances efficiency, reduces errors, and facilitates remote collaboration.

Marketing and Retail

AR-VR has transformed marketing and retail experiences. Brands can create interactive and immersive experiences that allow customers to virtually try products before purchasing. AR-VR enables virtual showrooms, where customers can explore and customize products in a virtual environment. It enhances customer engagement, boosts sales, and creates memorable brand experiences.

Entertainment and Media

While AR-VR has its roots in gaming and entertainment, it continues to redefine these industries. It offers more immersive gaming experiences, enabling players to interact with virtual worlds and characters. AR-VR also opens new avenues in storytelling, where users can become active participants in narratives. It enhances live events, allowing remote viewers to experience concerts, sports, and cultural events in a virtual setting.

Collaboration and Communication

AR-VR facilitates remote collaboration and communication, breaking down geographical barriers. Teams can collaborate in a shared virtual environment, working on projects as if they were physically present. This enhances productivity, reduces travel costs, and fosters cross-cultural collaboration. AR-VR also enables virtual meetings and conferences, offering a sense of presence and improving engagement.

These are just a few examples of the multidisciplinary applications of AR-VR. The technology continues to evolve, and its potential impact on various industries is vast. As the hardware becomes more accessible and the software more sophisticated, we can expect AR-VR to become even more integrated into our daily lives. However, challenges remain, such as the need for robust infrastructure, standardization, and addressing ethical considerations surrounding privacy and data security. Collaboration between technologists, industry professionals, and policymakers is crucial to drive innovation, address challenges, and unlock the full potential of AR-VR across disciplines.

In conclusion, AR-VR is transforming industries and experiences by providing immersive, interactive, and transformative solutions that bridge the gap between the physical and digital worlds. With its multidisciplinary applications in training, healthcare, architecture, manufacturing, marketing, entertainment, and collaboration, AR-VR is revolutionizing how we work, learn, communicate, and engage with the world around us. As the technology continues to advance and integrate with other emerging technologies, the possibilities for AR-VR are boundless, promising a future where virtual and real-world experiences seamlessly coexist.

AR-VR in Healthcare

Augmented Reality (AR) and Virtual Reality (VR) technologies are transforming various industries, and healthcare is no exception. The integration of AR-VR in healthcare has the potential to revolutionize patient care, medical training, and treatment outcomes. By providing immersive and interactive experiences, AR-VR enhances medical education, improves surgical procedures, aids in-patient rehabilitation, and enables remote healthcare delivery. In this article, we explore the transformative impact of AR-VR in healthcare.

Medical Training and Education

AR-VR offers unprecedented opportunities for medical training and education. It enables medical students and professionals to simulate realistic medical scenarios and procedures in a safe and controlled virtual environment. Through virtual simulations, trainees can practice surgical techniques, emergency situations, and diagnostic procedures. This hands-on experience enhances learning, improves skill acquisition, and reduces the risk associated with real-life training.

Surgical Planning and Guidance

AR-VR technologies provide surgeons with advanced tools for surgical planning and guidance. Surgeons can use AR-VR to overlay patient-specific medical images, such as CT scans or MRI data, onto a patient's anatomy in real-time. This allows for precise preoperative planning, enhancing surgical accuracy and reducing complications. During surgeries, AR-VR can provide real-time guidance, displaying critical information directly in the surgeon's field of view, such as vital signs, imaging data, and navigation aids.

Rehabilitation and Pain Management

AR-VR has the potential to revolutionize patient rehabilitation and pain management. It offers immersive environments that can motivate and engage patients during their rehabilitation process. Through interactive exercises and games, AR-VR can improve physical therapy outcomes, monitor progress, and provide real-time feedback. In pain management, AR-VR can distract patients from discomfort by immersing them in virtual experiences that promote relaxation and reduce anxiety.

Mental Health Therapies

AR-VR technologies are being utilized in mental health therapies, providing innovative approaches for treating anxiety disorders, phobias, and post-traumatic stress disorder (PTSD). Virtual environments can recreate triggering situations in a controlled manner, allowing patients to confront and manage their fears in a safe and guided manner. AR-VR therapy sessions offer a more personalized and immersive experience, improving patient engagement and therapeutic outcomes.

Remote Healthcare and Telemedicine

AR-VR enables remote healthcare delivery and telemedicine, bridging the gap between patients and healthcare providers. Through teleconferencing and AR-VR technologies, healthcare professionals can virtually examine patients, provide remote consultations, and guide procedures from a distance. This is particularly beneficial in rural or underserved areas where access to specialized care is limited. AR-VR also facilitates remote monitoring of patients' vital signs and supports home-based care.

Patient Education and Empowerment

AR-VR technologies empower patients by providing them with a better understanding of their medical conditions and treatment options. Through interactive visualizations, patients can explore their anatomy, view 3D representations of their conditions, and comprehend complex medical information more easily. This enhanced patient education fosters informed decision-making, improves treatment adherence, and enhances overall patient satisfaction.

Medical Research and Development

AR-VR technologies are playing a significant role in medical research and development. They enable scientists and researchers to visualize complex biological processes, analyze volumetric data, and simulate drug interactions. AR-VR can aid in drug discovery, molecular modeling, and understanding disease mechanisms. By providing interactive and immersive platforms for research, AR-VR accelerates scientific discoveries and advancements in healthcare. While the integration of AR-VR in healthcare brings numerous benefits, challenges exist. These include the need for standardization, privacy and data security considerations, and the integration of AR-VR with existing healthcare systems.

Collaboration between technology developers, healthcare professionals, and regulatory bodies is crucial to address these challenges and unlock the full potential of AR-VR in healthcare. As the technology continues to advance, we can expect further innovations, such as the integration of artificial intelligence and machine learning algorithms, which will enhance the capabilities of AR-VR in diagnosis, treatment planning, and personalized medicine. With its transformative impact on patient care, medical training, and research, AR-VR is poised to revolutionize the healthcare industry, improving outcomes and shaping the future of medicine.

Internship

Sl. No.	Student Name	Organization	Number of Students
1	AATREYA SINHA	CTS (ELEVATE)	23
2	AKASH PANDIT	LABVANTAGE	
3	ARPAN SAHA	NUTANIX	
4	BISWARUP DEY	CONSUKLTANTS FACTORY	
5	DEEPTANEEL DEY	ODESSA TECHNOLOGIES	
6	ESHIKA CHATTERJEE	CTS, ACCENTURE	
7	MD AAFAQUE ALAM	TCS(NINJA)	
8	NANDANI KUMARI	SOPRA STERIA, LEXMARK	
9	NEHA GUPTA	CTS	
10	NIHARIKA SARKAR	LABVANTAGE	
11	NISHAN BANGA	ERICSSON	
12	RAJLAKSHMI CHAKRABORTY	TCS (NINJA), MCAFEE	
13	RAYAN SHAW	HCL	
14	RITANSHU YADAV	CTS	
15	SAIKAT MAJI	LABVANTAGE/QUALITEST GROUP	
16	SOUMAJIT CHATTERJEE	THOUGHTWORKS	
17	SOURADEEP BANERJEE	CTS	
18	SUBINOY MUKHERJEE	CERNER CORPORATION	
19	SUJAN MUKHERJEE	STOCKEDGE	
20	SUKRITI ADHIKARY	TCS(NINJA), ACCENTURE	
21	SUMAN KUMARI AGARWAL	360 DEGREE CLOUD TECHNOLOGIES	
22	SWAGATA SINGHA ROY	GEOTECH	
23	TRISHAN CHATTERJEE	CTS	

Project Outreach

Step into the future of security with us! In this edition, we proudly present 'Varibox Encryption Algorithm: The New Generation of Hybrid Security Measure for the Era of Quantum Computation.' With boundless enthusiasm, we invite you to explore the forefront of encryption technology. Join us as we unveil this groundbreaking solution, a formidable shield against the challenges posed by quantum computing. Embrace the future of security, where Varibox paves the way to uncharted levels of protection!

Product Name: Varibox Encryption algorithm: The New Generation of Hybrid Security Measure for the Era of Quantum Computation

Product details

The Internet of Things (IoT) industry is constantly expanding and changing, posing major security risks to the entire network. Malicious intrusions into IoT systems can result from the insecure communication link between sensors and the Internet. The execution of classic security algorithms by IoT devices is severely hampered by the lack of computational capabilities in traditional sensors. As a result, lightweight security methods prove to be a workable substitute. In this model a new security technique that uses a special methodology based on a one-way counter value hashing table called VariBox in order to keep up with the current Internet security level. This system combines modular arithmetic with AES and RSA algorithms, as well as Unicode UTF-16 encoding standards. The suggested methodology successfully provides I reduced computational overhead, with overall processing time of 0.1 seconds (VariBox processing time 0.003 seconds), and ii) improves the general security of the IoT data transfer paradigm. When this model is used, the entire range of potential brute force solutions becomes computationally expensive and impractical to calculate in a limited amount of time.

Status: Completed

Manpower required Faculty Members: 02

Student Members: 02

Components & Technical specifications: Components and Technical Specifications need to be set up through a series of meetings with project-team members. Estimated cost of the project: 10,000.

Estimated time of completion: 3 Months

Acknowledgement

1. PI: Mr. Subhrapratim Nath, AP, CSE
2. Co-PI: Indrajit Das, AP, IT

Student Coordinator: Mr. Saptarshi Biswas

Link: https://www.tandfonline.com/doi/abs/10.1080/09720529.2021.1968573

Publication Year: 2021

Alumni Speaks

My college and department have helped us a lot to get placed in the company. Especially during such a tough time when the colleges were closed it was very difficult for us to grab jobs. But still our college and department helped us a lot. Our department made sure that our syllabus gets covered at time despite of the tough conditions and special thanks to our placement cell sir's , they guided us very well and gave us ample opportunities to appear for different companies.	 **Name: Nasim Ahmed** **Department: Computer Science & Engineering** **Year of Passing: 2021** **Placed at: TCS**
"Thank you MSIT for everything that I got in last 4 years during my study here. All the best MSIT."	 **Name: Nasim Ahmed** **Department: Computer Science & Engineering** **Year of Passing: 2021** **Placed at: Mindtree**

Industry Expert Quotes

Mr. Arup Chowdhury,
Operations Manager, Accenture:

The Computer Science Department's focus on AR-VR technologies is commendable. Their curriculum equips students with the necessary skills and knowledge to excel in this rapidly expanding field. The department's emphasis on practical applications, coupled with theoretical foundations, ensures that graduates are well-prepared to contribute to the ever-growing AR-VR industry.

Mriganka Sarkar,
Senior Manager, PWC:

I have had the privilege of collaborating with graduates from the Computer Science Department, and I must say that their expertise in AR-VR is truly impressive. The department's commitment to staying at the forefront of this transformative technology is evident in the skills and innovative mind-set of their students. They are well-positioned to make significant contributions to the AR-VR industry.

Research Corner: Faculty Publication

Journals

1. Nath, S., Sing, J. K., & Sarkar, S. K. (2021). Wire length optimization of VLSI circuits using IWO algorithm and its hybrid. Circuit World.
2. Karmakar, T., Biswas, S., Das, I., & Nath, S. (2022). Varibox encryption algorithm: The new generation of hybrid security measure for the era of quantum computation. Journal of Discrete Mathematical Sciences and Cryptography, 1-27.
3. Dey, S., Nath, P., Biswas, S., Nath, S., & Ganguly, A. (2021). Malaria detection through digital microscopic imaging using Deep Greedy Network with transfer learning. Journal of Medical Imaging, 8(5), 054502.
4. S Nath, P., Dey, S., Nandi, S., & Nath, S. An Optimised CPU Scheduling Algorithm with Adaptive Time Quantum Approach. Journal of Operating Systems Development & Amp; Trends, 8(2), 1–18. (2021).
5. Subhash Mondal, Suharta Banerjee, Subinoy Mukherjee, Ankur Ganguly and Diganta Sengupta, “Deep Classifier for Conjunctivitis – A Three-Fold Binary Approach”, Interna-tional Journal of Mathematical Sciences and Computing (IJMSC), vol 8, issue 2, pp 46-54, 2022
6. Diganta Sengupta, Ahmed Abd El-Latif, Debashis De, Keivan Navi, Nader Bagherzadeh, “Reversible quantum communication & systems”, IET Quantum Communication, Volume 3, Issue 1, 15 March 2022, pp 1-4
7. Ramen Pal, Hasina Begum, Somnath Mukhopadhyay, Debasish Chakraborty, Sumit Majumdar and Diganta Sengupta, “Edge Directed Radial Basis Function based Interpolation Towards PCA based PAN-sharpening”, International Journal of Remote Sensing, vol 42, Issue 23, pp - 9038-9058, 2021
8. Mukherjee, A., Chaki, R., & Chaki, N. (2021). Data mining-based hierarchical transaction model for multi-level consistency management in large-scale replicated databases. Computer Standards & Interfaces, 74, 103485.

Conference

1. S. Nayak, S. Das, B. Chakraborty, T. Chakraborty and K. Roy, "Internet of Things (IoT) Based Continuous Growth Rate Monitoring System of Plant Stem," 2022 IEEE VLSI Device Circuit and System (VLSI DCS), 2022, pp. 275-279.
2. Jindal, V., Narayan Singh, S., Suvra Khan, S. (2022). Facial Recognition with Computer Vision. In: Skala, V., Singh, T.P., Choudhury, T., Tomar, R., Abul Bashar, M. (eds) Machine Intelligence and Data Science Applications. Lecture Notes on Data Engineering and Communications Technologies, vol 132. Springer, Singapore.

3. Jindal, V., Narayan Singh, S., Suvra Khan, S. (2022). Application of Robotics in the Healthcare Industry. In: Skala, V., Singh, T.P., Choudhury, T., Tomar, R., Abul Bashar, M. (eds) Machine Intelligence and Data Science Applications. Lecture Notes on Data Engineering and Communications Technologies, vol 132. Springer, Singapore.
4. Debalina Barik, Sutirtha Kumar Guha, Shanta Phani; Study of Fake News Detection Techniques using Machine Learning, 6th International Conference on Information and Communication Technology for Intelligent Systems (ICTIS 2022); Ahmedabad, India; Springer
5. Roy, C., Chakraborty, D., Debnath, S., Mukherjee, A., & Chaki, N. (2021, April). Single Failure Recovery in Distributed Social Network. In Asian Conference on Intelligent Information and Database Systems (pp. 203-215). Springer, Singapore.
6. Mukherjee, A., Chaki, R., & Chaki, N. (2022). An Efficient Data Distribution Strategy for Distributed Graph Processing System. In International Conference on Computer Information Systems and Industrial Management (pp. 360-373). Springer, Cham.
7. Chakraborty, A., Dutta, S., Bhagat, S. N., Guha, S., Biswas, A., & Roy, P. (2021, December). On Exploring the Role of Feature Processing in Gait-based Gender Identification. In 2021 19th OITS International Conference on Information Technology (OCIT) (pp. 285-289). IEEE.

Book Chapters

1. Rana Majumdar, Subhrapratim Nath, Vijay Kumar, “Role of MCDM in Software Reliability Engineering”, Predictive Analytics, Taylor & Francis 1st Edition, pp 1-18 CRC Press,2021
2. Subhrapratim Nath, Rana Majumdar,, “Multiple-Criteria Decision Analysis Using VLSI Global Routing ”, Predictive Analytics, Taylor & Francis 1st Edition, pp 179-198 CRC Press,2021.

Patent/Copyright

1. IOT based Cost Effective Oxygen Concentrator under intellectual property rights, Govt. Of India, Application no: 346552-001 Cbr no: 205452 Cbr Date: 22/07/2021
2. IoT based Gas Chromatography under Intellectual Property Right, Govt. of India. Application no: 350721-001 Cbr no: 208339 Cbr Date: 05/10/2021
3. Forestry & Wildlife Monitoring System with Hybrid Power Charging Station For Airborne Vehicle under intellectual property rights, Govt. Of India, Application no: 202131013270 A, Journal No. 16/2021 Dated 16/04/2021.
4. Gesticulate:A Gesture Controlled Farming Assistance System Using IoT And Computer Vision under intellectual property rights , Govt. Of India, Application no: 202131033395 A, Journal No. 34/2021 Dated 20/08/2021.

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Research Corner: Student Publication

Journal

1. Karmakar, T., Biswas, S., Das, I., & Nath, S. (2022). Varibox encryption algorithm: The new generation of hybrid security measure for the era of quantum computation. Journal of Discrete Mathematical Sciences and Cryptography, 1-27.
2. Dey, S., Nath, P., Biswas, S., Nath, S., & Ganguly, A. (2021). Malaria detection through digital microscopic imaging using Deep Greedy Network with transfer learning. Journal of Medical Imaging, 8(5), 054502.
3. S Nath, P., Dey, S., Nandi, S., & Nath, S. An Optimised CPU Scheduling Algorithm with Adaptive Time Quantum Approach. Journal of Operating Systems Development & Amp; Trends, 8(2), 1–18. (2021).
4. Subhash Mondal, Suharta Banerjee, Subinoy Mukherjee, Ankur Ganguly and Diganta Sengupta, “Deep Classifier for Conjunctivitis – A Three-Fold Binary Approach”, Interna-tional Journal of Mathematical Sciences and Computing (IJMSC), vol 8, issue 2, pp 46-54, 2022.

Research Prospects

Introduction:
The rapid advancement of technology has brought forth a new era of possibilities, with Augmented Reality (AR) and Virtual Reality (VR) emerging as transformative technologies. These immersive technologies have revolutionized various industries, including gaming, entertainment, education, healthcare, and training. For Computer Science students, engaging in research on AR-VR offers an exciting opportunity to explore innovative applications, address technical challenges, and contribute to the ever-evolving field of AR-VR.

1. Enhancing User Interfaces and Interaction Techniques:

One area of research interest in AR-VR is the improvement of user interfaces and interaction techniques. As AR-VR technologies continue to evolve, designing intuitive and efficient interfaces becomes crucial. Computer Science students can explore novel interaction techniques such as gesture recognition, voice commands, and haptic feedback to enhance user experiences in AR-VR environments. By developing innovative approaches, researchers can create more immersive and intuitive interactions, thereby increasing the usability and user satisfaction of AR-VR applications.

2. Real-Time Rendering and Immersive Graphics:

Real-time rendering and immersive graphics play a vital role in creating realistic and immersive AR-VR experiences. Computer Science students can delve into research on efficient algorithms and techniques for rendering complex 3D graphics in real-time. This includes exploring optimization strategies, lighting models, texture mapping, and shader programming. By advancing the field of real-time rendering, researchers can contribute to the development of visually stunning and interactive AR-VR applications that push the boundaries of realism.

3. *AR-VR Applications in Education, Healthcare, and Training*:

AR-VR technologies have immense potential in revolutionizing education, healthcare, and training. Computer Science students can explore the development of AR-VR applications tailored to these domains. For instance, in education, researchers can design immersive learning environments that enhance engagement and knowledge retention. In healthcare, AR-VR can be utilized for surgical training, patient rehabilitation, and mental health therapy. By conducting research in these areas, students can contribute to improving the quality of education, healthcare delivery, and training programs through the application of AR-VR.

4. Impact of AR-VR on Perception, Cognition, and Learning:

Understanding the impact of AR-VR on human perception, cognition, and learning is another research prospect for Computer Science students. By conducting experiments and studies, researchers can investigate how AR-VR environments influence attention, memory, spatial awareness, and learning outcomes. This research can shed light on the cognitive processes underlying AR-VR experiences and guide the design of more effective and impactful AR-VR applications. Additionally, exploring the benefits and challenges of using AR-VR in educational contexts can inform the development of pedagogically sound AR-VR learning environments.

5. Multi-User Collaboration and Social Interaction in AR-VR:

Collaborative and social interactions are essential aspects of human experiences. Computer Science students can explore the challenges and possibilities of multi-user collaboration and social interaction in shared AR-VR spaces. Research can focus on developing frameworks and algorithms that enable seamless communication, coordination, and cooperation among users in virtual environments. By creating immersive and interactive AR-VR platforms that facilitate social presence and collaboration, researchers can unlock new avenues for remote collaboration, virtual meetings, and social experiences.

Conclusion:

Engaging in research on Augmented Reality and Virtual Reality (AR-VR) provides Computer Science students with a unique opportunity to contribute to this rapidly evolving field. By exploring areas such as user interfaces, real-time rendering, applications in various domains, impact on perception and cognition, and multi-user collaboration, students can shape the future of AR-VR. The findings from such research can lead to advancements in interface design, graphics rendering, education, healthcare, and social interaction in AR-VR environments.