VIRTUAL AND AUGMENTED REALITY

Student Research Report

Research In A Project Concept Students Using AR Technology For A Dedicated Lecture

By,

Name: Tom Jojo Palamattam
Matriculation Number: 00821354

INTRODUCTION

Augmented reality is often considered as one of the fastest growing technologies right now. Augment reality is described as any technology that can bridge the gap between virtual and real worlds and can be achieved by combining the real world with virtual objects in 3D with real-time interaction. "A situation in which a real-world setting is dynamically layered with coherent location or context-sensitive virtual information" is a popular definition of augmented reality. AR includes Graphics, sounds, and tactile feedback, which are then incorporated into the real world. Overall, augmented reality improves the user experience and aids in the spreading of knowledge, education, and health. Computer Vision and Computer Graphics are both used in AR. It requires vision to gain a thorough grasp of the real world, as well as graphics to make it functional. The virtual world is modeled based on the real world and then is projected on the target. In virtual reality, the user perception is completely based on computer-generated virtual information whereas in augmented reality the user perception is a blend of virtual and real-world objects. So, AR is not meant to replace virtual reality but rather provides a supplemental role to it.

History of AR in Education

The long history of AR began with the introduction of the first head-mounted display in 1968 by Ivan Sutherland which was used to demonstrate wire-frame drawings. The next major step was the creation of an Artificial Reality laboratory in 1974 known as Video-place where a combination of projectors and video cameras created silhouettes. The term ‘Augmented Reality’ was only coined in 1990 by Boeing researcher Tom Caudell. The further developments in AR were carried out by Virtual Fixtures by Louis Rosenberg in 1992, The first AR theater production in 1994, Battlefield Augmented Reality System (BARS) in 1999, AR Toolkit by Hirokazu in 2000 etc. Kato [1]. One of the first AR tools developed in the field of education was Construct3D in 2005, A dynamic 3D model system that helped students not only to collaborate but also allowed them to operate and manipulate the 3D model [4]. The big breakthrough of augmented reality into the education sector was when a Japanese publishing company Tokyo Shoseki, created textbook apps that work with augmented reality apps on cellphones, allowing students to listen to characters come to life.

Types of Augmented Reality [2]

- **Marker-based AR:** Requires a camera and a visual object such as QR code. Sometimes, Orientation and position are calculated to position the contents.
- **Marker-less AR:** Utilizes location-registered technologies to provide data based on user position.
- **Projecion-based AR:** Projects data to physical surfaces.
- **Superimposition-based AR:** An augmented view replaces fully or partially the original view.

AR Technologies [5]

The education sector is undergoing tremendous transformation as a result of rise in technology and digitization. High school and university students no longer want to study by merely reading books and copying texts. No, they want to use technology to its full capacity in the classroom. Despite its ubiquitous application in many sectors of modern life, augmented reality in education is still a new and untested notion. According to the New Jersey Institute of Technology, "augmented reality has the potential to revolutionize learning in schools more than almost any technology in recent times."

The means of education can differ according to the fields of study or skills of the lecturer. These means can range from non-interactive media such as books to interactive media that invokes a wide variety of senses. AR combines sensory modalities such as touch, sight, and hearing, in addition to supplementing the dynamic notion of instructional methods. The potential benefits of augmented reality in formal education, such as improved academic achievement, retention of information, engagement, and motivation, have been thoroughly studied. As technology progresses, more hardware and software can be added to the AR technology concept. For example, the advancements in hand-held computing added more opportunities for AR including the creation of mobile-AR. This includes making use of location-registered technologies such as GPS and is less obstructive when compared to head-mounted displays.

So, how might augmented reality be employed in the classroom? First, augmented reality technologies enable learners to engage in realistic exploration in the actual world, with virtual items such as texts, videos, and images serving as supplemental materials for learners to perform investigations of their surroundings in the real world. The addition of a layer of location-based information to existing places is one of the most prevalent AR uses. Second, augmented reality technologies can be used to combine real-world and digital learning resources. Augmented reality allows students to experience scientific phenomena that are not conceivable in real life (e.g., chemical reactions).

METHODS AND MATERIALS

WORKING OF AR

Augmented Reality involves several technologies such as depth tracking, mapping, and localization and can be displayed on screens, glasses, head-mounted display, etc. [2]

1. **Sensors and Cameras**: These components collect information about user interaction and send it into the next phase that is processing. Cameras help in the identification of the surroundings for the generation of 3D models. Cameras can be duty cameras (Microsoft Hololens) or common smartphone cameras.
2. **Processing**: AR devices are computers and require CPU, GPU, RAM, WiFi/Bluetooth, GPS, flash storage, etc. This part determines angle, direction, speed, orientation ,and so on.
3. **Projection:** AR headsets contain miniature headsets which can take data from sensors and then projects the processed content into a surface.
4. **Reflection:** AR devices often have mirrors or an array of small mirrors that are curved to help human eyes to view the visualized images. The goal of the mirror is to provide a proper alignment of images.

AUGMENTED REALITY IN EDUCATION

The potential that arises in education from the combination of smartphones and augmented reality is quite large. Some of them include simplification of complex concepts, extra digital information on topics, etc. [2]

1. **CLASSROOM**

   The use of augmented reality animated content in classroom sessions has the potential to capture students' attention. Adding additional information, for example, a brief biography of a person, amusing facts, historical information about places or events, visual 3D models, etc. would provide pupils with a broader understanding of subjects. When Students experience difficulties when performing their schoolwork, teachers can provide text, audio, or video tips by scanning certain elements of a book. Alternatively, they may come upon beneficial information about the course which could lead to a positive outcome such as improved communication.

2. **EXPLAIN DIFFICULT CONCEPTS AND ABSTRACT**

   AR can take some of the hardest to grasp concept and turn them into 3D models making them easier to understand by the students. This is extremely useful for visual learners and anyone who has to convert theoretical information into a practical understanding.

3. **INTERACTIONS AND ENGAGEMENT**

   By incorporating Augmented Reality into their classes, teachers may engage students in the process with 3-dimensional models. It could be a brief segment of the lesson, such as a teaser, or it could be used to provide extra information on the main topic from a different perspective.

4. **OBJECTS MODELING**

   Manual training, hand exercises, quizzes, and other approaches can help you understand a course better. Medical students may discover that using augmented reality apps is one of the most effective ways to learn human anatomy and investigate more. Augmented Reality is all about interacting with 3D models. The rotation, transparency, color scheme, and styles can all be changed. Finally, rather than using cellphones, more complex animations may be created with specialized devices like holographic glasses.

5. **TRAINING**

   Most of the time, theoretical knowledge is insufficient to obtain proper skills in professional fields. Students, especially in technical fields, need hands-on experience and training in their respective fields. AR could help facilitate this by using augmented tutorials, simulations, and digital modeling and thus gain experience at the end.

AUGMENTED LEARNING APPROACHES

The various instructional and learning approaches adopted into AR learning environments include **roles-based** approach, **location-base** approach, and **tasks-based** approach. Each approach includes several learning approaches and there can be overlapping of some sub-approaches. [5]

1. **Roles based Approach**

   This approach emphasizes the collaboration and interaction between the students. There are mainly three sub-approaches as **Participatory simulations, jigsaw, and role-playing** in this approach. **Participatory simulations** are when the individuals will be the interacting part of a dynamic system and this interaction between them determines the outcome. **Role-playing** is when students are given a

distinct role for a deeper understanding of that topic. The **jigsaw** technique emphasizes teamwork among many roles so that students can finish assignments by role-playing. Students who play distinct roles are provided different pieces of information.

2. **Location based approach**

   Mostly used with location-registered headsets such as smartphones, the Location-based approach focuses on user interaction with the surrounding environment. A location-based approach can give students, a sense of grounded in reality as they interact with the physical environment.

3. **Tasks based approach**

   The task-based approach focuses on the learning task's design in the AR environment. Game-based, studio-based, and problem-based approaches are among the different sub-approaches involved here. One of the most popular approaches in AR learning is to play **AR games** in the real world but with the help of digital technology to build a fictionalized layer on top of the physical surroundings. **The problem-based approach** is mainly used for promoting self-directed learning and involves problem-solving tasks. **Studio based approach** focuses on learning by design by encouraging students to author their tasks and games.

AR IN DIFFERENT SUBJECTS [4]

1. **Astronomy:** Augmented reality can be used to augment different aspects in astronomy for example, 3D rendered earth and sun can demonstrate the relationship between them.
2. **Chemistry:** AR can demonstrate an interactive workbench that can show the different concepts in chemistry. For example, the structure of atoms and molecules can be augmented.
3. **Biology:** AR can be deployed to study the anatomy and structure of the human body. Lectures can incorporate the 3D computer-generated models of organs in the human body and their shape in real classrooms. Students can also independently learn about biological structures of the human body by using a camera-equipped laptop and AR markers.
4. **Mathematics and Geometry:** Teachers and students can collaborate and interact with each other on issues in shapes and arrangements. Some of the applications of AR in this field include a demonstration of various differential geometries, exploring properties of curves, surfaces, and other geometrical shapes, etc.
5. **Physics:** AR can be used in explaining kinematic properties, presenting an object that dynamically changes over time, explaining real and experimental results, and demonstrating physics simulations.

CONCLUSION AND RECOMMENDATION

CONCLUSION

The unimaginable becomes achievable with augmented reality, and its educational potential is only the beginning. Augmented reality interfaces allow users to engage with the real and virtual worlds in a seamless manner. Learners interact naturally with 3D information, objects, and events using augmented reality technologies..Numerous software and hardware play a pivotal role in obtaining augmented reality applications. The advantages of AR Systems far outweigh their disadvantages. Although there is a gap between the traditional teaching method and cutting-edge AR Systems, researchers like to apply AR into the school curriculum. Currently, the AR technique is trending among mentors around the globe. As a result, the app store and play stores are overloaded with Augmented reality education apps and students show a positive approach to these apps.

To be precise, Even though AR System has various threats to its gain, it will be resolved to obtain promising success in the coming future. This report briefly described the history and evolution of augmented reality. The different types of AR technologies such as marker-based AR, marker-less AR, projection-based, and superposition-based AR were discussed. Furthermore, The report discussed the various advantages and the current state of AR in education. This report also discussed the different stages involved in the working of AR and the components required. The use of AR in classrooms, how AR is used in explaining different concepts, object modeling, and providing technical training to students by AR were also discussed. How different subjects use AR and the different approaches used were also noted here.

FUTURE OF AR [4]

- **Interactive Education:** With the rise in AR technologies, AR lectures will became more interactive over time.
- **Simplicity:** With the coming of automated solutions, AR in education will became simpler and more accessible.
- **Efficiency and Effectiveness:** AR technologies can provide information at the right time and place and is capable of providing rich content. The growing power of mobile devices and head-mounted displays will only accelerate the efficiency of AR technologies.

RECOMMENDATIONS

- Information technology is meant to simplify one's life but the evolution of technologies in modern presentations has become incredibly complex with the inclusion of projectors, computers, and videotapes. One key solution to this problem is automation with augmented reality with the help of various sensors and computer processing. For example, when a professor enters a classroom, the automated system should lower the screen, turn on the projector, and turns on the projector input to the computer [3].

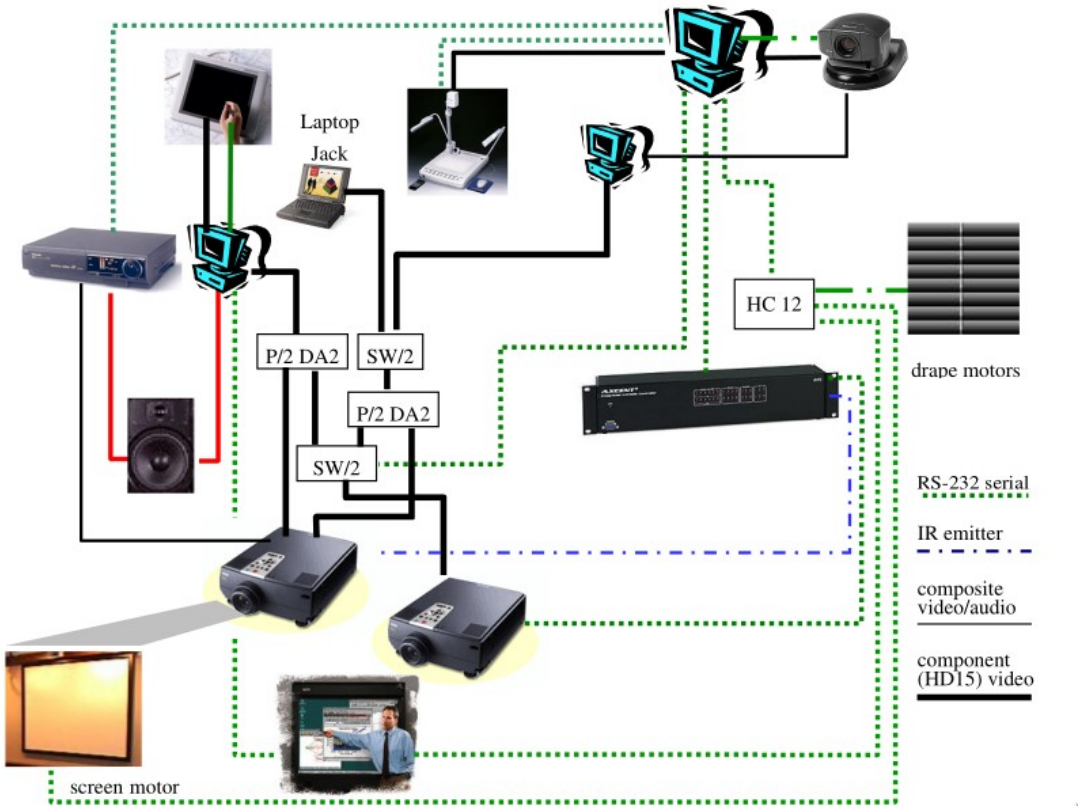

Figure 1: The AMX Accent3 controller is the black module in the center of the image, which drives numerous devices under computer control, and the HC 12 module is the button-panel unit with microcontroller. The SW/2 devices are video switchers, with one running in auto-sense mode to automatically select an active signal on the laptop connection, and the other controlled by the computer. The P/2 DA2 units are video splitters that can provide video output to either projector.

- With the addition of virtual reality, technology can also become an obstruction in the teacher-student relationship. This will cause the teacher to know less about the student and thus the student might not get the required attention from the teacher. This can be overcome by a lecturer feedback system to support the student and the teacher. In this process, The answers from the students during a lecture are collected so that the professor can visualize the performance of each student [6].

- Resource dependence is another major issue that works against the widespread use of AR in the education sector. AR technology has a reliance on resources such as AR headsets where not a lot of students have access to it. The best method to address this problem is to use mobile AR, where lot more people has access to a smartphone. Even then, not all students have AR-capable smartphones. Government programs can be used to fund and ensure that every student has access to AR-capable smartphones [2]

- Two pedagogical issues are emerging from the use of AR. The first one is the resistance coming from parents and teachers against the adaption of AR in schools. The instructional approaches of AR are quite different from the delivery-based traditional teaching methods. This gap between both teaching approaches can be reduced by providing proper support to teachers. Secondly, the flexibility present in traditional teaching methods is absent in AR classrooms. The teachers won't be able to make changes in their teaching styles to tailor towards their students. This can be solved by the usage of authoring tools.

- One of the biggest perceived danger of AR is privacy. Breaking into the system by hackers, the lack of transparent in data collection by AR companies, the location of the data stored, the data sharing to third parties by AR companies are all major concerns in AR sector. One good way to approach this issue is through the usage and promotion of open standards and open source software's.

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