Design and Implementation of AR/VR (Mixed Reality) For Education

Mr. Kushal A. Sawadhakar[1]
M.E (Computer Engineering) Jagdambha College of Engineering& Technology, Yavatmal.Maharashtra. India
Prof. S. A. Murab[2]
Head of Department (Computer Engineering) Jagdambha College of Engineering & TechnologyYavatmal. Maharashtra. India
Prof. A.A.Kolpykwar[3]
Assistant Professor (Computer Engineering) Jagdambha College of Engineering & TechnologyYavatmal. Maharashtra. India

ABSTRACT
Students in today's generation used technological gadgets a lot. Engaging these tech-savvy students in the learning process with their preferred learning style is a daunting task. The differences in teaching and learning styles result in problems such as disengagement of students, loss of learning aptitude, and loss of knowledge retention. Recent innovations in visualization technologies such as Virtual Reality (VR)and Augmented reality (AR) provide avenues that allow these students to engage in a social, collaborative and active learning environment. AR/VR refers to an immersive digital environment that simulates physical presence in places in the real or imagined worlds whereas MR represents the merger of real and virtual worlds to produce new environments and visualizations. Using three controlled experiments these two emerging technologies are investigated to enhance the educational experience. The results indicated that these technologies significantly enhance the learning experience and engage students in an active learning process.
Keywords: Virtual Reality, Mixed Reality, Mozilla Hub, Augmented Reality.

I. INTRODUCTION

Most of the teaching environment lacks a real contextual learning environment in the classroom.The teaching methods are single and it is difficult to inspire students'association andcreativity. Application of the teaching process and teaching

Results are poor. So it is difficult to meet the task requirements of real jobs. The root cause of these problems is the poor teaching experience, which cannot provide learners with a real learning environment, intuitive and three-dimensional spatial experience. The maturity of VR technology and AR technology, as well as the learner-centered, emphasis on teaching experience and the urgent need for adaptive learning, have driven the appearance of the VR/AR teaching experience system. VR achieved a brand-new state of human-computer interaction. It can obtain intuitive and real perceptions such as sight, hearing and touch by operating objects in the virtual world [1]. By combining virtual objects and the real world, AR can simultaneously display the information of the real world and the virtual world, enabling learners to use 3D models to enhance the visual perception ability of real-world situations [2].VR enhances sensory interactivity by constructing a simulated virtual world. The main features are: immersion, interactivity and imagination. Immersion allows learners to eliminate external disturbances and immerse themselves in virtual reality to gain an immersive feeling. Interactivity is based on the learner's head, hands, eyes, language and body movements to adjust the image and sound presented by the system. Imagination is to acquire visual,auditory, tactile, kinesthesia and other perceptions simultaneously in the virtual environment, enhance the learner's perception of the learning content, the high sensitivity and rational understanding of the cognitive content, so that to make the user to deepen the concept and sprouts new association, andmotivate the learner's creative thinking.

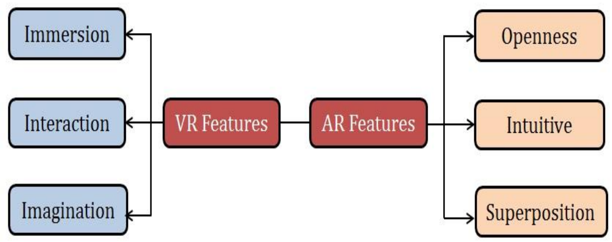

Fig1.AR/VR Features

AR is a bridge connecting virtual world and real world. It ischaracterized by superposition and openness. It superimposes virtual information in the real world, enhances visual, auditory and tactile sense, and enables learners to experience the combination of real world and virtual world in the senses.An innovative approach that has emerged is to bring participants into a 3D shared virtual environment in systems based on Avatar Mediated Communication, such as Mozilla Hubs. An avatar is a user's visual embodiment in a virtual environment. Because the avatars of all participants occupy the same virtual environment, participants can experience some of the spatial interaction and mobility that exists in real-world interactions. Therefore, Avatar Mediated Communication platforms can complement video-conferencing platforms by addressing one of their fundamental limitations, which is the lack of a 3D shared space.

II. RELATED WORK

The use of VR for education has been suggested to increase presence, motivation, and engagement [2][5][6] summarized the use of VWs (Virtual Worlds) at 19 surveyed institutions. Many of the VWs used Second Life, OpenSim, and Unity3d. The VWs were used for the following activities: role play activities, machinima, virtual tours, Ph.D. students, staff or faculty development, career services, and institutional marketing. Additionally, all of the institutions were using VWs for "research, collaboration, and communication." The VWs were primarily used with standard desktop interfaces.

The virtual event was described as "fairly successful" with the exception of technical problems. Second life was also used for the remote program committee meeting of IEEE [7]. Results suggested that not many users had technical difficulties, even with little experience. Users did not prefer Second Life to a face-to-face meeting, likely due to the lack of presence of desktop VR. Campbell et al. (2019) found headset VR improved presence, closeness, and arousal, for business meetings, when compared to video-based meetings. Additionally, they reported that female participants preferred VR avatars to real-life imagery. Borst [2] showed a benefit of incorporating live guidance by a teacher into networked VR for virtual field trips by small classes, finding high ratings of presence, social presence, and other factors. Simulator sickness was not found to be substantial, but external distractions were found problematic when present.

Recently, Mozilla Hubs [3] is gaining recognition for remote VR presentations. Hubs are a web-based social VR platform that supports many devices. Le et al. used it for virtual poster session. They observed an increased sense of presence. Hubs were also used for the ieee VR conference as an optional meeting platform. Ahn et al. discuss survey results and observations made at the conference, and they provide insights about future directions for virtual conferences in the face of the covid19 pandemic. Steinicke et al. (2020) ran a preliminary study comparing group meetings in VR (headset and desktop) via Mozilla Hubs and with video conferencing via Zoom. They reported higher social presence with headset VR than with Zoom video for a group meeting.

III. METHODOLOGY

We used Hubs because it is "lightweight" and usable on many devices including desktops, standalone headsets, and PC-driven headsets. Other social VR platforms such as AltspaceVR, Engage, Virbela, VR Chat, etc. have varying levels of accessibility in terms of cost and portability, but we expect substantial feature overlap when used for lectures. Feature comparisons can be found online [8].Hubs features are rudimentary but support key aspects of remote VR classes. Features that we used include: upload/download of lecture slides and videos, per-user selectable avatars with tracked head and hands, live stream video of the teacher, viewing capabilities like maximizing content with a button, walk/fly/teleport navigation, voice/text chat, and emojis emitted from avatars.Depending on a viewing condition, each student in the study attended with a headset or on their desktop. Student presentations were given via students presenting in VR headsets. Various headsets were used by the students: five Oculus Quests (four standalone and one PC-driven via Oculus Link), four Oculus Rift CV1s, one Oculus Rift S, one Windows Mixed Reality HP headset, one Windows Mixed Reality Odyssey+ headset, and one HTC Vive. All of these devices have 6-degree-of-freedom tracking and 2 hand controllers [4]. We believe 6-dof head tracking is essential for a good experience, because 3-dof devices suffer from a visual-proprioceptive mismatch that contributes to motion sickness. Monitor sizes for desktop viewing ranged from 13 to 42 inches, with a median of 17.5 inches.

AR/VR teaching experience system model design mainly focuses on how to implement the experience system, how to design the system physical structure. The experience system is divided into five levels, from the bottom to the top, AR/VR base layer, AR/VR space layer, AR/VRlogic layer, teaching data mining layer, teaching adjustment layer. The implementation process is to use the underlying physical device to enter the AR/VR learning space, and learners enter the database to intelligently retrieve the experience environment and experience context according to the needs in the learning space. The learner learns the state and data in the learning space and analyzes it through the teaching data mining layer, and then feeds back to the teaching adjustment layer to achieve the dynamic update of the learner's learning experience.

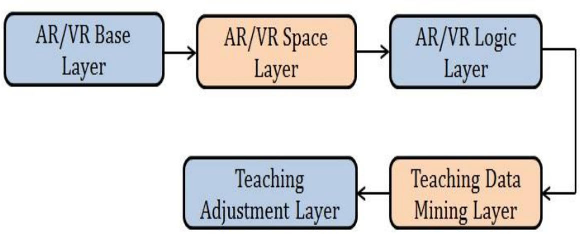

Fig2. AR/VR Teaching System Model Design

3.1. AR/VR base layer

The AR/VRbase layer is the bottom part of the entire teaching experience system, and is also the physical device carrier and platform that enters the learning space, such as HMD, VR glasses, mobile phones, simulation devices, iPad, and so on. The learner enters the virtual platform through the physical device, and the virtual platform is a fusion of one or more learning spaces to ensure the reliability of the learner entering the VR/AR space layer.

3.2. AR/VR Space Layer

The AR/VRspace layer contains various learning spaces of the system, including VR direct interaction space, AR superposition space, shape space, and virtual and real interlaced space [3]. In these spaces, learners can choose their own learning context according to their own learning situations, or they can choose intelligently through fixed and creative modes to understand the learners' knowledge storage and learning abilities, so that learners can be clear about themselves. In order tochoose the best, most suitable learning situation and enhance the sense of learning experience.

3.3. AR/VR Logic Layer

The AR/VRlogic layer achieves the learning of methods, processes and skills in the virtual space according to the characteristics and needs of the learners [4]. This layer implements the physicalintroduction and logical introduction of space. The physical device enters the learning context created by the AR/VRspace layer, and sets the contactor. When the learner touches the contactor during the learning process, the logic introduction will start. The learning situation increases the difficulty node and the mission, and the learner completes the task by learning the knowledge and skills provided in the space to be able to enter the next contactor.

3.4. Teaching Data Mining Layer

The teaching data mining layer mainly analyzes the learner's feedback data learning process and learning state in the AR/VRspace layer, including the proficiency of the learners' knowledge when in the contactor or upgrade and the number of times that learner asks for help when encountering difficulties. Through the analysis and mining of these contents, the best learning path between learners and learning trajectories can be calculated and then be fed back to the teaching data adjustment layer to dynamically optimize the learner experience situation.

3.5. Teaching Adjustment Layer

The teaching adjustment layer is mainly divided into teaching strategy adjustment and teaching experience adjustment, mainly through the feedback of teaching data mining layer to adjust the learning strategy and adjust the learning situation. The teaching strategy adjustment is to personalize the teaching methods, set suspense or story plots, and attract learners to explore in the learning space. The teaching experience adjustment is to automatically complete the learners' experience scene in learning space according to the plots of teaching strategy adjustment.

IV. IMPLEMENTATION

The AR/VRteaching experience system is an adaptive dynamic adjustment experience system. It can enable learners to experience the learning situation and collect the activity data generated by them learner in the learning space through the switching between the VR learning space and the AR learning space. The data is transmitted to the storage server analyzed by the data mining technology the analysis result is fed back to the computing server, thereby achieve the teaching experience and teaching strategy adjustment of the learning space.

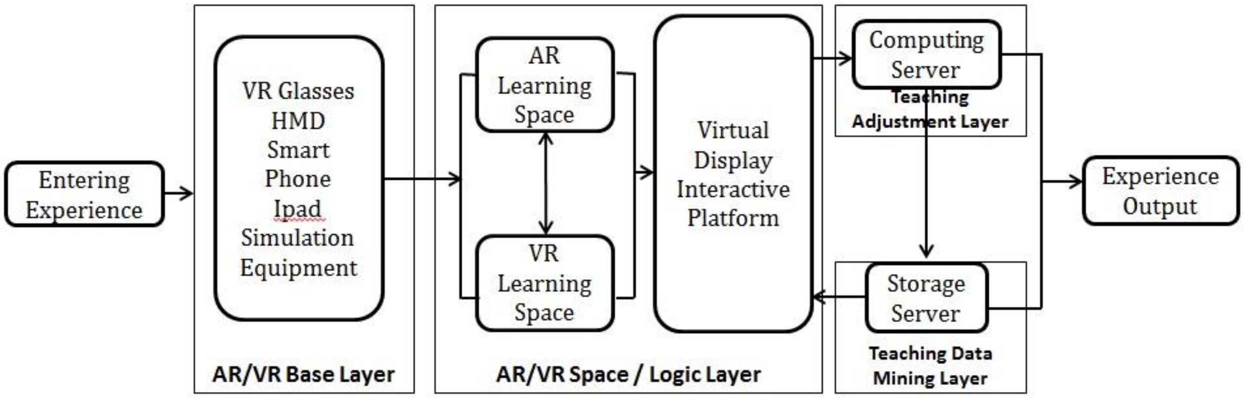

Fig3.AR/VR Teaching System Project Flow Design

4.1. AR/VR Learning Space Entry

The AR/VRlearning space needs to be accessed from the AR/VRbase layer, and correspondinghardware devices such as VR glasses, HMD, smart phones, and emulation devices are required. Thesedevices can provide direct or indirect access to the learning space. The selected learning space can be asingle space or two mixed spaces.

4.2. AR/VR Learning Space Conversion

AR/VRlearning space conversion is mainly based on virtual reality interactive platform. Through thedatabase resources and JDK, SDK development platform, the fusion of VR model system and ARmodel system is implemented. According to the needs of the learners, different resources are used totransform and interact among the learning spaces. The combination of virtual and reality andsuperposition of each other greatly enhances the sense of reality of the teaching experience.

4.3. AR/VR Spatial Data Analysis

According to the learning goal, the learner enters the corresponding VR/AR space by means of VR orAR, and can select different learningmodes depended on the proficiency of knowledge mastery in thespace. The system records the learner's entire learning trajectory and learning action data and then submits it to the storage server for analysis and production of the results through data mining techniques.

4.4. AR/VR Teaching Adjustment

Through the feedback of the teaching data mining layer, the computer server selects the most suitable learning situation and learning task for the learner according to the result, so that besides the reality, the learner can also experience the comfort in the learning situation, and increase the enthusiasm of the learner to learn, encouraging learners to continue to learn.

4.5. AR/VR Experience Output

Experience output refers to the experience and feelings that learners have gained in completing the learning process. Learners enter the learning space, choose the learning situation, complete thelearning tasks based on the learning objectives, and the difficulties encountered in the learning spacecan be analyzed, fed back, adjusted by the system, and finally reach the optimal experience path.

V. CONCLUSION AND FUTURE WORK

There are numerous opportunities for blending these technologies into today's and future classrooms which closely match the life and education styles. As the cost of technology is becoming cheaper day by day, it can be envisaged that the academic institutes may find it easier to procure and implement them in classes. They have equal applicability in traditional as well as continuing education and workers' training. Last but not least, these technologies support the active learning style which is becoming popular among the current academics in most disciplines.

AR/VR technologies support remote learning and can bring people together regardless of geographical distances. All of the experiences would work just as well whether the teacher and student are in the same room, or across the world from each other. Students learn better by interacting with each other. we describe our efforts to develop and apply avatar-based virtual 3D social spaces created with the Mozilla Hubs platform to complement Zoom lectures in teachingThey immensely help and improve student's understanding of the subject matter, knowledge gained, and retained. As a whole, the students' interest in the courses is immensely increased and their ability to interact and collaborate with the fellow students is significantly improved. These technologies have several shortcomings which must be considered before their implementation.

VI. REFERENCES

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