Cost-Effective 3D Stereo Visualization for Creative Learning

E

R. S. Kamath
Chatrapati Shahu Institute of Business Education and Research, India

R. K. Kamat
Shivaji University, India

INTRODUCTION

Technology-enhanced learning which has become a reality with the pervasive penetration of Information and Communication Technology (ICT) in almost all the walks of higher learning is by now not a new concept, but is still quite new in many educational institutions and settings. The pragmatic view by many researchers, first hand entails, that the chalk-and-talk environment is being both less and less relevant and effective to 21st Century digital age students, and does little or no justice to the learning of academically underprepared students (Dongale, Patil & Kamat, 2015). Especially in the domain of 'Engineering Education' it is clearly evident that Progress in computers and various technologies have changed traditional methods for teaching. Previously dominated by simulation and animation, now the educators are realizing that both the above said tools and techniques alone cannot substantiate true real-sense learning for users. This explores need for more advanced technologies in order to improve learning. In this context, the VR technology has found numerous applications in the field of education. The growth dynamics VR area reveals it's market size to $407.51 million which will encompass more than 25 million users by 2018 (Marketsandmarkets.com, 2015). The main challenge of VR technology, however is the exorbitant cost due to the inherent sophisticated hardware and software which inhibits its inculcation in the education paradigm. In the backdrop of above, we present a cost effective 3D stereo visualization system conceived, designed and developed by us for creative learning in the most cost effective manner.

The chapter is structured as follows: We open up with a brief overview of technology inculcation in education, which showcases the gradual progression from simple simulation and animation techniques to more sophisticated ones like VR. We also present the very notion of VR for the benefit of the broad audience of the chapter. The focus then shifts to the VR tool we developed, its system architecture, technical features and cost effectiveness. The manuscript then actually portrays setting the experimental environment for VR based pedagogy and thereby highlights its potential role in presenting the insight in realization of experiential learning in different domains.

BACKGRAOUND: PROGRESSION OF EDUCATION TECHONOLOGY FROM SIMULATION, ANIMATION TO VIRTUAL REALITY

With the embryonic digital age, there has been intense discussion all over the globe, particularly in the last decade about the use of technology for personalizing the learning environment. VR is the fascinating area in computer application research (Vafadar, 2013). In recent years, 3D technologies in modeling, printing and stereoscopic have symbolized the true cutting edge in educational

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systems (Dalgarno et al., 2010). The use of 3D glasses, stereoscopic 3D content and virtual environments in all curriculum areas to improve 21st century teaching and learning has been the buzz word in all the spheres of academics (Alpaslan & Sawchuk, 2004). The 3D in the Classroom has been clearly the winner over its 2D counterpart in improving the teaching-learning in the classroom. An interesting account of all these developments at the global level has been summarized in the following paragraph.

Pedagogic experts believe that merely theoretical explanation without actual implementation makes learning experience invaluable. Instead of listening only to lectures, if students get real experience in a virtual wrapper can achieve the learning outcomes. In this context VR is real winner and gained immense popularity in the education spheres. It provides a visually appealing technique for presentation of teaching material. It motivates student community by encouraging active participation rather than passivity. For example, a computer-based flight simulator in which pilots can attain flying skills in the absence of a real airplane ought to instill the right kind of skills. Many studies have been conducted on the applications and effectiveness of virtual Reality in education and training. Studies show that a virtual environment can stimulate learning because of it's a tight coupling between illustrative and experiential information (Hamada, 2008). Yahaya incorporated immersive VR technology in creating learning environment (Yahaya, 2004). His investigations indicate that learners gets engaged in real world problems associated with VR environment and it really helps in gaining the subject understanding. Elomar has explained the use of VR technology in learning environment through the 'experiencing of real phenomena'; new educational possibilities by the integration of education with VR (Elomar, 2012).

Dalgarno et al. have explained applications of 3D immersive virtual worlds in education and its implementation in education institutions across New Zealand and Australia (Dalgarno et al., 2010). The authors of the above referred study have discussed overall research design with results from the Australian/New Zealand perspective. The main finding of this study is the variety of ways of using 3D virtual worlds by academicians.

Yet another paper by Piovesan et al., explained the application of VR in education. This research presents educational software, which permits students to manipulate objects in 3D with a simple interface (Piovesan et al., 2012). The software referred in the research is based on VRML for the design of models and PHP for web publishing. Manseur has discussed the use of VR tools and its applications in science and engineering education (Manseur, 2005). In particular, the VRML for model design is presented and subsequently the development of visualization tools for education has been depicted. Researcher has explained the combination of VRML with other software tools to create interactive VR solutions to support teaching and learning.

Teaching with 3D technologies is attracted by students' community as confirmed from research from case studies around the world. Learning accompanied with 3D video, interactions and simulations in virtual environment is attaining significant increase in performance, retention, abstract concept mastery, and more.

Well known VR tools developed in this context are (engagingeducation.net, 2015):

- **3D Ladibug Document Camera:** A dynamic document camera that can show objects and manipulate them in 3D stereoscopic by using the 3D software and hardware
- **Presente 3D:** An add-on to Microsoft PowerPoint, using which students can attach 3D stereoscopic to their presentations
- **Kid Pix:** An image processing tool that can be used to create pictures and videos in 3D anaglyph
- **Hasbro My3D:** A nifty gadget that facilitates students to get the immersive experiences sensation like walking through the Solar System