Computer Graphics Literature Review 1

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Paper 1: Augmented Reality versus Virtual Reality for 3D Object Manipulation
(Max Krichenbauer , Goshiro Yamamoto, Member, IEEE, Takafumi Taketom , Member, IEEE, Christian Sandor, Member, IEEE, and Hirokazu Kato, Member, IEEE) (link)
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Paper 2: Virtual Reality and Augmented Reality as a Training Tool for Assembly Tasks
(A.C. Boud, D.J. Haniff, C. Baber, and S.J. Steiner) (link)
Date of Publication**:** 06 August 2002

Introduction:

Currently, Virtual reality (VR) and augmented reality (AR) have become next generation technologies in computer system world. However, although VR and AR depends on different technologies providing very different solutions, both technologies are often 'branded' in the same category. Virtual reality (VR) can be defined as computer based environment, updating based on user inputs and allowing user interaction through number of I/O devices. Augmented reality (AR) can be defined as enhancement of real world.

Augmented reality and virtual reality are two of the ways that tech can change the way you look at the world. Sometimes people think AR and VR are the same thing. Augmented reality and virtual reality are increasingly used in technology, so knowing the difference is important. Both paper present relative advantages of each technology. Paper 1 present the study to directly compare AR and VR in a classical 3D object selection and placement task setting. VR is next generation hardware available to the average user and feasible to use as tool for 3D work. Paper 2 investigate the use of AR and VR as training tool for assembly tasks. It further investigate the task under various VR conditions and context-free AR.

For most tasks it is unknown whether AR has any advantage over VR. Both Paper discusses number of usage of each technology. Augmented and virtual reality both leverage some of the same types of technology, and they each exist to serve the user with an enhanced or enriched experience. Augmented reality enhances experiences by adding virtual components such as digital images, graphics, or sensations as a new layer of interaction with the real world. Contrastingly, virtual reality creates its own reality that is completely computer generated and driven.

Study: Paper 1 present the first study to directly compare AR and VR in a classical 3D object selection and placement task setting. 3D object placement is a very general task

that has possible implications on task performance in almost all 3D interaction tasks. While paper 2 discuss the study of assembly using both AR and VR applications. This study investigates whether the application of VR and AR to permit direct manipulation of assembly components would facilitate training in this activity. Conventionally Information for operator to perform assembly referenced from a combination of engineering drawings and written assembly producedurs. Author conduct research on water pump assembly to evaluate the performance of VR system on assembly. Researchers also develop context-free AR system to displays a static pictorial representation of the water pump's assembly sequence. The aim of the experimentation is to investigate the immediate impact of a given format of media on task performance to operator training and post-training.

For comparing AR and VR in classical 3D object selection, authors conducted experiment and invited users to give some reviews. Participants performed the same task with 3D input device and a traditional 2D computer mouse, in both AR and VR. The task consisted activities like scaling, selecting, transforming the object. The results show a performance increase in AR over VR when a 6DOF 3D input device is used. There was a reduced in effect when participants used mouse. While most participants expressed a preference for either mouse or 3D input device. The paper is the first to give mathematical evidence on whether AR work environment can outperform VR work environment in 3D object manipulation. This result further create new research questions on what causes the respective effects found in the mouse condition, where the visual stimuli of AR did not provide any immediately apparent benefits.

For AR and VR as training Tool for Assembly Tasks study, five participants were selected from the student body of the school. They were asked to assemble a water pump(consisting of 8 separate components) in the real world after providing information to construct plan. VR participants were given brief introduction to use the VR software. Then participants completed the assembly in VE using specific interaction techniques and then asked to complete the assembly task on the water pump in the real world. The same things was asked to the participants using AR system. The time for both process was recorded. At the end of experiment, participants were asked for their opinions for both VR and AR systems. It is proposed that assembly tasks completed using 2D drawings and assembly plans are based on the cognitive phase, where participants require a longer period of time to calculate the correct sequence of actions. Using VR to conduct the assembly tasks uses the cognitive and associative stages, where plans are developed to complete the tasks. VR and AR therefore ought to be superior for learning sequences.

Conclusion: In AR and VR classical 3D object selection study, researchers found that AR consistently outperforms VR even when using a 2D mouse as input device. While there are some indications as to why this might be the case, further research is required to determine specific factors. One most important concern is that how different physical environment affect users. A wider area might encourage users to move more, even in a purely VR environment, or clutter in the background might distract users in the AR condition. People walking around in the area could also have an effect, as it may make users feel uneasy not being able to see them in a VR setup. Important factor in AR is the quality of video. Researchers finally acknowledge that in real world applications VR can realized much better that AR and it will be less expensive since the system does not have to wait for camera images and to perform undistortion and rectification algorithms. This research represents next step towards understanding difference between AR and VR, and opens up new opportunities for future research work.

In AR and VR as training Tool for Assembly Tasks study, the VR and AR conditions were found to outperform the 2D engineering drawing condition. Therefore this two types of realities offer the advantage of improved performance over the conventional approach. VR allows the user to manipulate objects without the use of the real objects and hence offers benefits in applications such as manufacturing, where operators can be trained to assemble a product before the product has been physically manufactured. In terms of training, VR is more flexible than AR in that the environment in which it can be used can be separated from the real environment. For example, in some cases it may not be practical to interact with the real objects due to their non-availability and their associated costs. Both AR and VR have relative merits for training purposes, but their use relies upon the particular application. Therefore before employing these technologies it is important to investigate the task to ensure the benefits offered by both technologies are maximised.

It is not always virtual reality vs. augmented reality– they do not always operate independently of one another, and in fact are often blended together to generate an even more immersing experience.