Research Proposal

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Interactive & Immersive Environments:

Technology Integration for Multimedia Communications

for

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Abstract

Immersive & Interactive Technologies are on the forefront of training and education in numerous industries, and represent some of the most cutting edge technologies of this decade. The hypothesis put forth in this Proposal is that Immersive & Interactive environments are more effective in learning and training, and can leverage emerging technologies as Augmented Reality for learning and business purposes.

This Proposal seeks to examine the use of such technologies, and to expand on their uses and features for use in academic, entertainment and business environments. Literature review, technology development and research collaboration between different institutions and businesses are incorporated into the study.

Immersive & Interactive Technologies in Education

Nature of the Problem

This study will research the application of Immersive & Interactive technologies for learning, it's effectiveness as a learning tool, and examine various applications for training and education. Research will focus on two general themes or concepts: using and expanding existing technologies, and creating content for learning purposes in Immersive & Interactive environments.

Why this is Problematic

Old teaching models conflict with rapidly developing technologies in classroom environments in all levels of education, creating problems for educators and students. The use of advanced technologies may increase learning and be more effective in teaching students concepts and hands-on skills in a multitude of topics and industries.

Significance of Study

The application of Immersive & Interactive technologies could fundamentally change the way students learn and instructors provide learning in all levels of education and training. Such technologies are on the cutting edge of computer programming, learning environment design and content development in education, and show substantial promise for widespread adoption in public schools and institutions of higher learning and industry.

Both instructor and students can benefit from the use of Immersive & Interactive technologies, that build upon existing network infrastructures and computer modeling technologies for instructional or training purposes. The use of hands-on activities as a learning tool is well-documented[i]; an Immersive & Interactive environment takes such activities a step further by placing the student in an environment or provides interaction with tools that allow a high-level of simulation, and can produce sophisticated computer models in a variety of topic areas.

Appropriateness of Study

Immersive & Interactive technologies are now maturing into complex and sophisticated systems, designed for a variety of purposes. Heavily reliant on high-speed processing and data

transmission, computer systems are now able to support the kinds of processing and display hardware needed for Interactive environments. A large consortium of companies and universities are now participating in the development of Immersive & Interactive technologies for education and training purposes. Numerous collaborative opportunities for research and development are available, especially between universities in developed countries.

As cloud systems and mobile computing now become more ubiquitous, this study is relevant in its application to education during a time of technology integration into schools and colleges.

For a list of colleges and institutions participating in Immersive & Interactive research and development, visit: http://immersiveeducation.org/showcase .

Known Academic Research

When computing and networking became readily available to users, much research was conducted in the 1990s regarding Interactive models for learning. Since then, with the advent of multi-core processors and broadband networks, the complexity of Immersive & Interactive systems has continued to draw research interest.

The Journal of Immersive & Interactive Education[ii] contains references to articles and papers discussing Immersive & Interactive technologies, located online here: http://jied.org/1/1/index.html

Methods

Much of the research has been conducted using hands-on experiments involving subjects and observers, collecting quantitave data from interaction with systems and qualitative data from observation. This appears to be the standard method of evaluation, and one that will be followed in this study.

The use of existing facilities can reduce the time needed to evaluate systems, and their effectiveness in a learning capacity.

Building on Existing Research

Much of the current research is very theoretical and conducted using research models outside of test environments. As such, many are simply literature reviews with little application or technology aspects to the study.

I plan to build on the existing body of knowledge in this area by applying Immersive & Interactive technologies to learning groups in different programs-of-study, to develop Immersive & Interactive content, expand upon the technology and to study its effectiveness in learning and training. It is my aim to work with a group of researchers at different universities that are building Immersive & Interactive technologies, and to create enhancements for their models, as well as multimedia content that can be used in research testing.

An end result of this research can be the packaging together of technologies to provide turn-key solutions to schools and colleges in deploying Immersive & Interactive systems in academic studies.

Definition of Research Aims

General and Specific Aims

The general aim of the project is to research and understand the development of Immersive & Interactive technologies, and what applications are being investigated by the development community.

A specific aim is to choose one technology or area of application and expand on it technically. Content development for Immersive & Interactive learning is at the core of this project; one example is the use of Immersive & Interactive technologies for molecular modeling of 'green' fuel compounds for use in transportation sectors by scientists and researchers.

Another is the use of Immersive & Interactive environments for medical procedure training, an area that is rapidly being adopted in the medical community. There are large differences between the network and computer systems used by different hospital groups, this study can engage with a hospital or medical group to upgrade their systems to adopt Immersive & Interactive technology for medical training and procedures.

There are numerous applications for such systems, ranging from entertainment to marketing to procedural training to general education.

Contributing to Understanding

Immersive & Interactive technologies draw upon several existing elements to function, including network processes; software and hardware components; and content presented to the user. I plan on concentrating on the content development side of the project for better understand of the development and modification for future applications, and what software modifications can be made to optimize delivery systems. As such, there will be both a technical and contextual aspect to the research study; these can be 'packaged' to provide tools on which other research can be based, and in which education and industry can leverage for their own purposes.

Research methodology

Research Methodologies considered

There are several different phases to this project which can utilized different research methodologies. Since this project is very technology-oriented, several methodologies to consider include:

- Literature review: researching and reading past and existing research done in the area of Immersive & Interactive technologies;

- Evaluation: looking at the research topic to determine whether it is worthy of future work;

- Mixed methods: combining the collection and analysis of existing technologies and their applications both qualitatively and quantitatively;

- Research design: looking at study types and subtypes to determine best how to evaluate existing research and determine a course of action;

- Inquiry: researching and collaborating with others in the field to determine the level of work being done, and in what manner;

- Audience survey: obtaining data from different audiences to determine the interest in development of Immersive & Interactive technologies;

- Social research & evaluation: using test subjects to evaluate the use and applications of the technology in specific environments or applications;

- Construct validity: analyzing data from audience and social research to determine the level or effectiveness of the technology on processes.

Methodology and Data

This project is divided into several phases, to best organize the time and effort needed for completion. The general approach at the present, is to 1) do a thorough literature review on the subject, and visit researchers & facilities that are working in this area; 2) discuss collaborative opportunities with research institutions and industrial firms located in different parts of the world, and; 3) to design & conduct research methodology for data collection and analysis.

Phase I: because of the rapidly changing technology landscape, it is necessary for me to do a thorough literature review on the past and current research that has been conducted in Immersive & Interactive environments. Visiting of existing facilities will take during this phase. Much of the ground work was done in the 1990s, and then continued into the first decade of the 21st century. A review will give me a fundamental knowledge of the state-of-the-art, and allow me to focus more on specific areas to focus on in the study;

Phase II: after the literature review I will the contact several personals and groups that show promise in the development of the technology to create collaborative work agreements for both technical and content aspects of the projects. It is my hope that at least one institution in the USA, Europe and Asia will agree to collaborate with my study;

Phase III: in this phase I will work to develop new software models and to create content for use in field research. Defining and creating research methods to use in conducting experiments on the use of the technology, and its affect on learning and applications in training will then take place. I hope to collaborate with both in-ground and online experiments with research colleagues in different parts of the world in this phase.

Once these phases are completed, I will be able to compile my results and write a dissertation for publication. One tangible product solution is planned for distribution when complete.

Hypothesis

The initial hypothesis is that Immersive & Interactive technologies can be highly effective learning environments, and that the technology can be applied in different academic programs and areas of training. I will establish guidelines to prove this hypothesis, and use empirical data to support my findings.

Data will be collected during observation of user's interaction with Immersive & Interactive content displays and environments, and during tests in controlled studies. Many groups are using public displays of Immersive & Interactive technologies to gauge user's reactions, existing facilities may be utilized from study collaborators. Other on-campus lab experiments in controlled environments will allow more focused data collection.

Access to Data

Data Access

There are many published reports on research being done in Immersive & Interactive technologies, many are freely accessible online and some require a nominal fee to access. I also plan on attending annual conferences in Europe and the USA on Immersive & Interactive technologies, and visiting facilities at universities and companies working with this technology.

Access Fees

Fees range from a few dollars per article, to hundreds of dollars for full access to libraries offered by providers as SpringerLink and IDM. Much information is publically available through services as GoogleScholars, Sage, Wiley-Blackwell, Reed Elsevier and others.

Attending conferences, seminars and facilities visitations will require additional monies for travel and related. Each year there is an Immersive & Interactive education conference held in Europe, and also one in the USA. I plan to attend each of these conferences throughout the duration of my study.

--Rick Kovacic

San Diego, California USA

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References

Learning by Interacting: Comparing the Effectiveness of an Interactive Tutorial with a Standard Electronic Book Interface, http://www.ascilite.org/conferences/coffs00/papers/jeni_paay.pdf. ~2000

Journal of Immersive & Interactive Education: http://jied.org/

MIT Multimedia Lab, https://www.media.mit.edu/ .

Harvard University Mental Imagery and Human-Computer Interaction Lab, http://www.nmr.mgh.harvard.edu/mkozhevnlab/?page_id=9

Immersive & Interactive Interfaces for Engagement and Learning; Chris Dede, Harvard University; http://www.cc.gatech.edu/classes/AY2013/cs7601_spring/papers/Dede_Immersive_Interfaces.pdf. 2009

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Oblong Industries, http://www.oblong.com/company/story/

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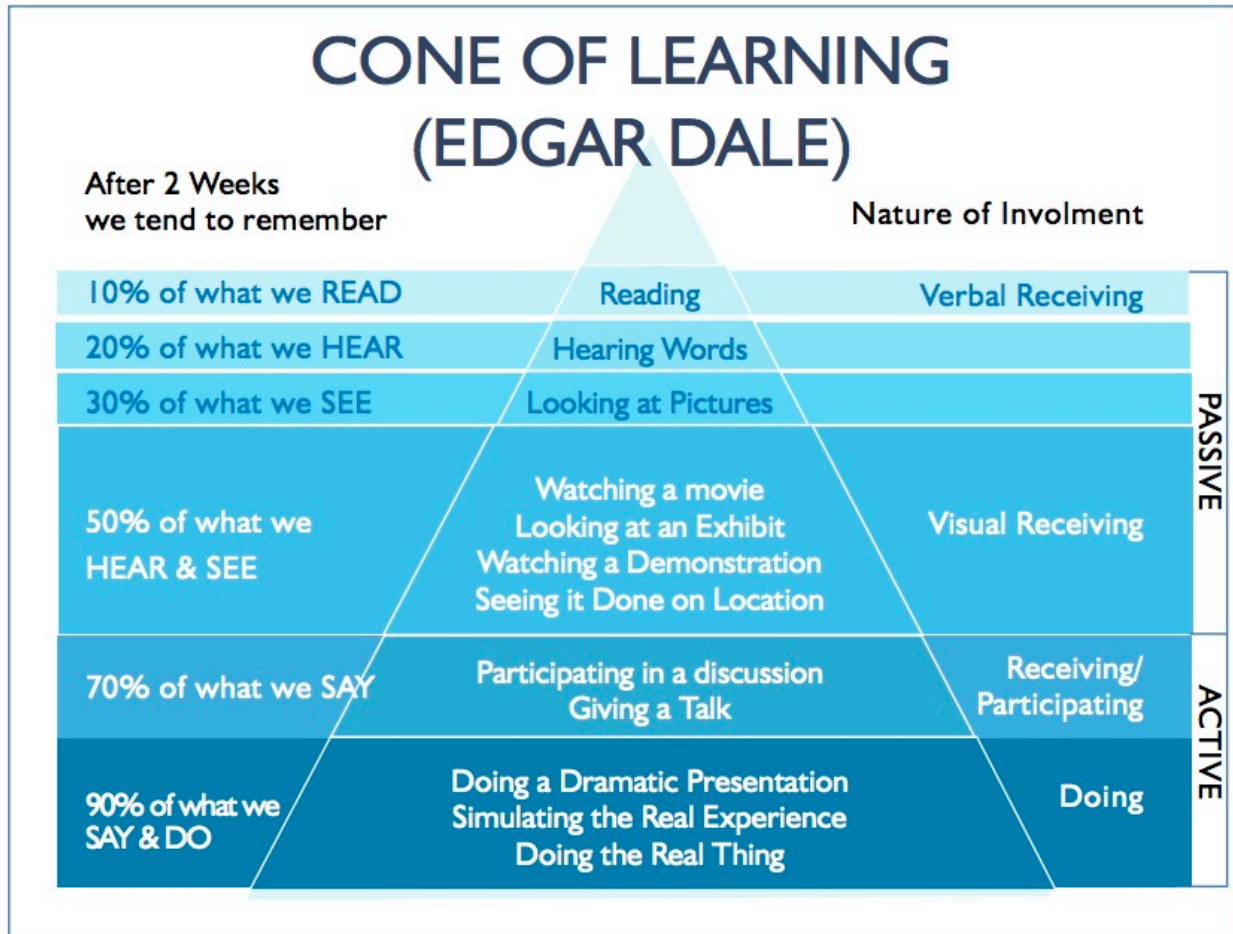
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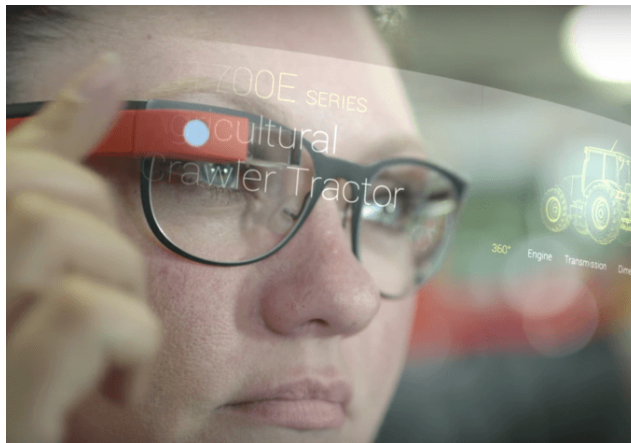An Interactive and Multi-sensory Learning Environment for Nano Education, Linkoping University, Sweden; http://webstaff.itn.liu.se/~karlu20/papers/palmerius12Interactive .pdf ; 2012

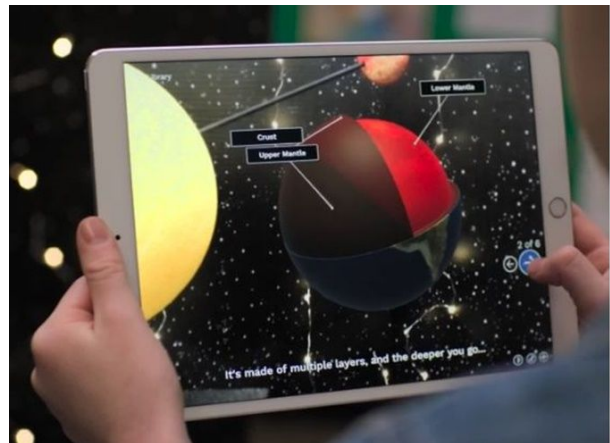# Appendix

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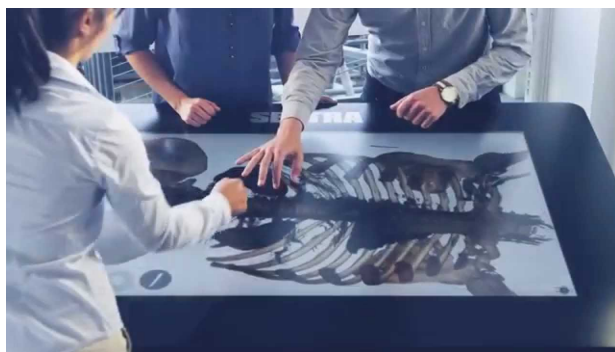

Virtual Reality Educational Benefits

Examples of Immersive & Interactive Media

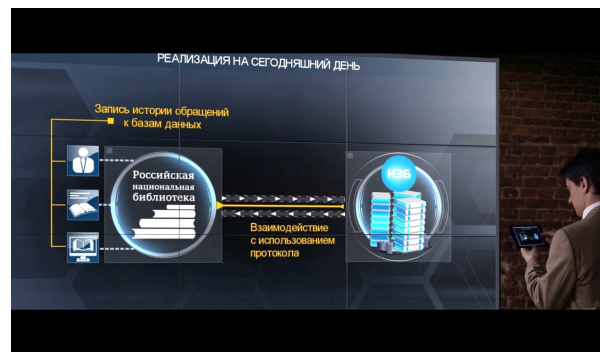*Google Glass for AR*

Apple ARKit

Sectra Table Medical Education tools

i.Pro Interactive Multimedia technology
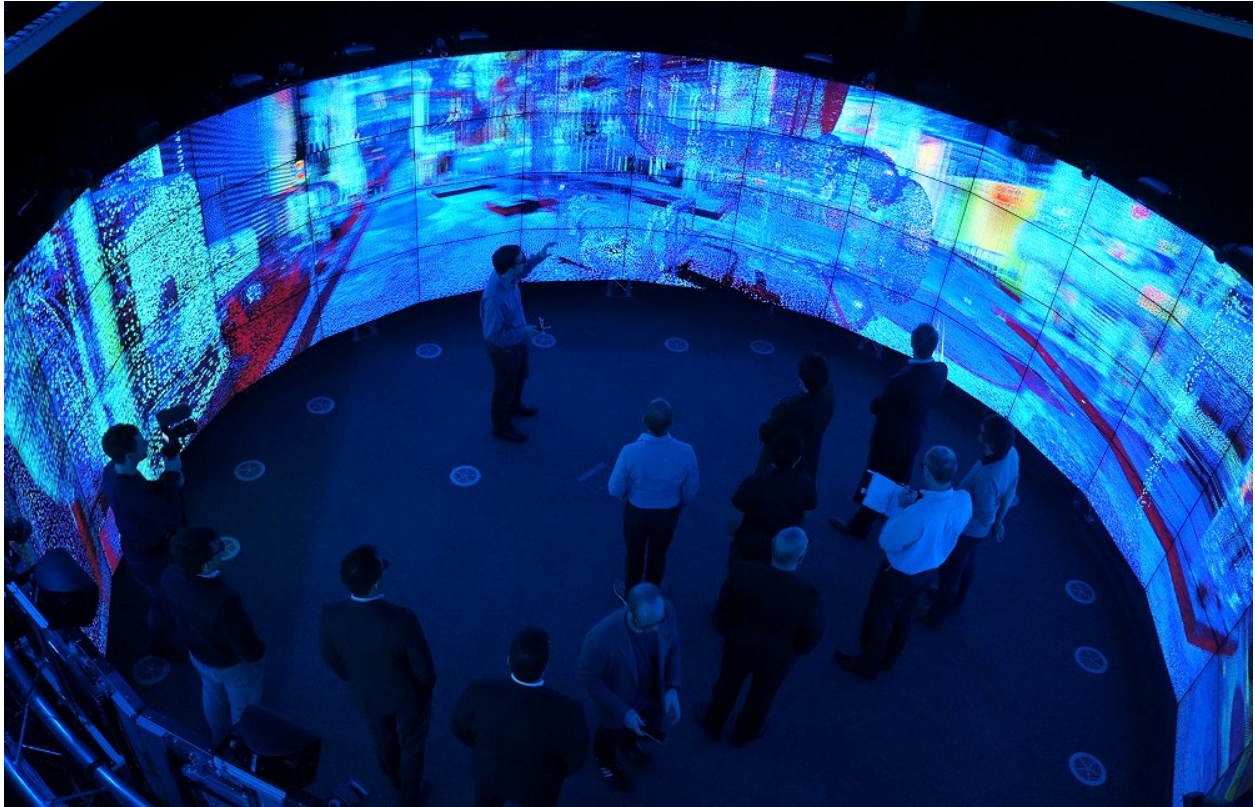

RealView Interactive Holography system

zSpace Interactive Holography system

Touch Screen software for Interactive display

University of Toledo Immersive & Interactive Simulation Center

Monash University CAVE2 Visualization facility

[End of Proposal]

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[i] Learning by Interacting: Comparing the Effectiveness of an Interactive Tutorial with a Standard Electronic Book Interface, http://www.ascilite.org/conferences/coffs00/papers/jeni_paay.pdf. ~2000

[ii] Journal of Immersive Education: http://jied.org/