A Virtual Reality Approach for Minimizing Information Loss in Multi-User, Scalable Environments

Bryan Dickens, Gabe Harms, Steve Sellers, Owen Shartle, Computer Science and Engineering

Conrad S. Tucker, Ph.D., Engineering Design and Industrial Engineering

{ctucker4, bid5098}@psu.edu

8/4/2015
PRESENTATION OVERVIEW

• Background
• Motivation
• Literature
• Methodology
• Case Study
• Results
• Conclusions
Knowledge Dissemination

(C. E. Shannon – A Mathematical theory of communication, 2001)
Knowledge Dissemination

Research Motivation

Tucker, Dickens, 2015
Source= Educators
Knowledge Dissemination

Research Motivation

Tucker, Dickens, 2015
Receivers=Students
Knowledge Dissemination

Source → Encoding → Channel → Decoding → Receiver

Feedback

Research Motivation

Tucker, Dickens, 2015
Variation in the Feedback: Brick and Mortar vs. Virtual Environments

Brick and Mortar Learning

- Engagement
- Interest
- Delight
- Boredom
- Confusion
- Frustration

Online Learning

- ?
- ?
- ?
- ?
- ?
- ?

Research Literature

Tucker, Dickens, 2015
Limitations of Existing Online Approaches

Quantifying Receiver’s Sentimental Feedback

Average Sentiment VS Average Assessment Score Per Student

Average Assessment Score

Average Sentiment Score

(Tucker, Dickens, and Divinsky, 2014)
# Bridging the Gap Between Brick and Mortar and Virtual Environments

<table>
<thead>
<tr>
<th>Researchers</th>
<th>Conclusion Drawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>(N. Di Blas, C. Poggi, and T. C. Reeves, 2006)</td>
<td>Previous and concurrent virtual reality environments enhance engagement, attitudes, skills, knowledge, and social relationships for students.</td>
</tr>
<tr>
<td>(N. Firth, 2013)</td>
<td>The Oculus Rift with accompanying Unity IDE was the best development platform for which to proceed for virtual reality learning environments.</td>
</tr>
<tr>
<td>(G. R. Loftus and E. M. Harley, 2012)</td>
<td>Information dissemination is a common problem across all sensory systems in regards to audial and visual data.</td>
</tr>
<tr>
<td>(N. Armstrong and S.-M. Chang, 2007)</td>
<td>Instructors felt a difficulty connecting with students in a large virtual or real world class.</td>
</tr>
</tbody>
</table>
Research Hypothesis

Information Loss in real world learning environments is greater than information loss in VR environments.

v.s.
Variation in the Message Quality in Brick and Mortar Environments

\[ F(D, \theta, A) = \min \left( \frac{D}{\cos(\theta) \times \text{count}(A)} \right) \]

Subject to: \( D > 0; \ -90^\circ < \theta < 90^\circ; \ 60 \text{ dB} < A < 70 \text{ dB} \)
Proposed Immersive Virtual Environment
Immersive VR Demo
Environment

• Built classroom-like room in Unity 3D
• Placed 100 observation objects in place of students as “receivers”
• Simulated Professor at the front of a classroom podium emitting an audio sample of a lecture.
• Various Scripts added to measure telemetry and simulate real-world 3D audio and microphone listening
Visual Data Results

Seat dispersion based on receiver’s distance $D$
Audial Data Results

Front Row vs Back Row

Audio decibel Value (dB)

Time (s)

Seat 5  Seat 96

Audial Samples from Front vs Back Row
Complete representation of seat scores for receivers in the brick and mortar learning environment
VR Improvement to the learning environment information loss
Conclusion

• The VR learning environment created starts all receivers at the measured ideal distance from the source, allowing redundancy at the same spot.

• The VR learning environment allows for customization on your location based on your personal preferences

Future Work

• Expanding this Virtual Learning Environment into development for different communication use cases.
• Include additional extensions to VR with a 3D scanner and Emotiv Epoch.