Project Komodo: Catalyzing Browser-Based Virtual Reality Teaching and Learning in the Library

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University of Illinois at Urbana-Champaign
Introductions

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Interim Head, Mathematics Library
Medical and Bioengineering Librarian
Assistant Professor, Grainger Engineering Library
Assistant Professor, Carle Illinois College of Medicine
Research and Instruction Coordinator, IDEA Lab
VR@Illinois Campus Steering Committee
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Chair, ACRL Digital Scholarship Section (2021-2022)
Introductions

William H. Mischo
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Berthold Family Professor Emeritus in Information Access and Discovery
Fellow, American Association for the Advancement of Science
Recipient of Frederick G. Kilgour Award for Research in Library and Information Science
Introductions

Robert Wallace
IDEA Lab Operations Manager
Project Komodo Team Lead

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Komodo Project Manager

David Tamayo
Komodo Unity Developer
2021 Best Emerging Technology Application (BETA) Award
Awarded by the ALA Reference and User Services Association Emerging Technology Section
Project Komodo

- Immersive Teaching and Learning Platform
- Domain Modules
- Crowd Sourced Development
- Web Portal
- Browser-Based
- Social VR
- Accessibility
- Data Capture (Assessment)
Immersive Teaching and Learning Platform

• Lessons learned from remote learning during pandemic
• Multimodal teaching and learning (Beyond Zoom)
• Most VR apps developed for gaming market
• Available VR apps are for very specific use cases
• Limited functionality
• Limited or no customizability
• Incur a cost or have restrictive licenses
• Barriers for scalability
Komodo Domain Modules

• Create custom VR experiences
• Available from web portal
• Customize source code to add additional functionality
• Does not require significant programming/coding expertise
Crowd Sourced Development

• Limited funding and expertise available
• Do not have to replicate programming of core functionality
• Instructors can focus on their subject-specific needs
• Subject specific media and functionality
Is Virtual Reality a fad?

Global Augmented Reality, Virtual Reality, and Mixed Reality market is forecast to reach $30.7 billion USD in 2021, rising close to $300 billion by 2024.

VR@Illinois Seed Grants

### VR@Illinois Seed Grants

<table>
<thead>
<tr>
<th>Department</th>
<th>Number of Grants</th>
<th>Department</th>
<th>Number of Grants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountancy</td>
<td>1</td>
<td>French and Italian</td>
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<td>Advertising</td>
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<td>Geography and Geographic Information Science</td>
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<td>Illinois Fire Service Institute</td>
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<td>Anthropology</td>
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<td>Informatics</td>
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<td>Architecture</td>
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<td>Journalism</td>
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<td>Atmospheric Sciences</td>
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<td>Landscape Architecture</td>
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<td>Media and Cinema Studies</td>
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<td>National Center for Supercomputing Applications</td>
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<tr>
<td>Civil &amp; Environmental Engineering</td>
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<td>Political Science</td>
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<tr>
<td>College of Media</td>
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<td>Psychology</td>
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<td>Comparative and World Literature</td>
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<td>Recreation, Sport, and Tourism</td>
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<tr>
<td>Computer Science</td>
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<td>Registered Student Organization (VR Club)</td>
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<tr>
<td>Crop Sciences</td>
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<td>Social Work</td>
<td>1</td>
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<td>Education</td>
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<td>Technology Services at Illinois</td>
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<tr>
<td>Electrical &amp; Computer Engineering</td>
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<td>Urban and Regional Planning</td>
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<td>English</td>
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<td>Veterinary Clinical Medicine</td>
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<tr>
<td>Entomology</td>
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<td>Women, Children and Family Health Science</td>
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</table>

Step Into VR Workshops

Step Into VR Workshops


Web Portal

- Domain Modules are free and open source to public
- Easy to use GUI
- One point of access
Browser-Based

• Accessible from any networked device
• No downloads or software installation required
• Compatible with most 6DOF headsets
Scalable

- Not restricted to third party platforms
- Open source and free
- Headset agnostic
- Does not require a high end computer
<table>
<thead>
<tr>
<th>Headset (HMD)</th>
<th>Extended Reality Technology</th>
<th>Type</th>
<th>Maximum Playable Area</th>
<th>Max Resolution</th>
<th>Max Refresh Rate</th>
<th>Degrees of Freedom</th>
<th>Hardware Platform</th>
<th>Retail</th>
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<tbody>
<tr>
<td>Google Cardboard</td>
<td>VR</td>
<td>Seated (Phone)</td>
<td>Unlimited</td>
<td>2560x1200</td>
<td>90Hz</td>
<td>6DOF</td>
<td>PC</td>
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<tr>
<td>HTC Vive</td>
<td>VR</td>
<td>Room Scale (Standalone)</td>
<td>Unlimited</td>
<td>2560x1200</td>
<td>90Hz</td>
<td>6DOF</td>
<td>PC</td>
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<td>Room Scale (Standalone)</td>
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<td>2880x1600</td>
<td>90Hz</td>
<td>6DOF</td>
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<td>HTC Vive Focus</td>
<td>VR</td>
<td>Room Scale (Standalone)</td>
<td>Unlimited</td>
<td>1660x900</td>
<td>90Hz</td>
<td>6DOF</td>
<td>Built-in</td>
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<td>HTC Vive Pro w/Wireless Kit</td>
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<td>2560x1440</td>
<td>72Hz</td>
<td>3DOF</td>
<td>Built-in</td>
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<td>VR</td>
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<td>Unlimited</td>
<td>3200x1440</td>
<td>72Hz</td>
<td>6DOF</td>
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<td>VR</td>
<td>Room Scale (Tethered)</td>
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<td>2160x1200</td>
<td>90Hz</td>
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<td>$499</td>
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<td>VR</td>
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<td>80Hz</td>
<td>6DOF</td>
<td>PC</td>
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<td>Playstation VR (PSVR)</td>
<td>VR</td>
<td>Standing (Tethered)</td>
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<td>1920x1080</td>
<td>120Hz</td>
<td>6DOF</td>
<td>Playstation 4 Console</td>
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<table>
<thead>
<tr>
<th>Headset (HMD)</th>
<th>Date Released</th>
<th>Initial Cost per Unit</th>
<th>Number Owned</th>
<th>Date Available for Loan</th>
<th>Date Available for Loan</th>
<th>Total Circulation (as of February 2020)</th>
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<td>Oculus Rift</td>
<td>March 2016</td>
<td>$399</td>
<td>19</td>
<td>January 2017</td>
<td>221 Checkouts (35,780 minutes)</td>
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<td>March 2019</td>
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<td>July 2019</td>
<td>23 Checkouts (189,328 minutes)</td>
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Scalable

• Oculus is dominant in consumer market
• HTC has largely focused on enterprise headsets
• Google and Apple rumored to be developing new headsets
• Many VR apps exclusive to one platform or another
• VR apps may only be available for certain headsets within same brand
• Komodo largely overcomes those challenges
Social VR

- Conferencing functionality
- Voice, chat, and screen sharing
- Can interact within headset or from a browser screen
- Shared social experience
Accessibility

- Users can engage with or without VR headset
- Speech-to-Text
- Future work: Hand tracking and haptic feedback
Data Capture (Assessment)

- Allows capture of data during sessions
- Tracks movement of headset and controllers throughout the experience
- Evaluate and assess student engagement with the virtual experience and content
- Data protected using industry standards and in compliance with FERPA
- Live recordings of sessions for asynchronous viewing
Komodo Technologies

In its current phase, Komodo will provide out-of-the-box features like runtime model imports, real-time voice, text, and video chat, social VR, avatar presence, and data analytics.

Core WebXR Application and Networking
Unity, Mozilla WebXR Exporter, Custom Relay API, Custom Build Server

Runtime-Imported Models, Domain Modules
GLTF (Present), Unity Asset Bundles (Future)

Web Portal, Metrics Pipeline
React, Vue, Python, MySQL
Use Cases in 2020

• Materials Science and Engineering Course
• Professor André Schleife
• Fall 2020
Use Cases in 2020

- Fashion Illustration Course
- Critique in VR
- Professor Chiara Vincenzi
- Spring/Summer 2020
Future Directions

We will open-source our base layer and release an SDK. We are anticipating piloting the SDK with students of the CS Virtual Reality computer science course at Illinois.

*Image: Eric Shaffer, UIUC*
Future Directions

• Continue development, build more domain modules
• NSF RETTL grant submitted January 2021
• Scale up platform overtime by securing more funding
• End goal: Campus-wide service
• Release free and open source SDK for use by public
• Interested in a demo, being a beta tester or a development partner? Email cabada@Illinois.edu
Summary: What is the Komodo platform?

- Instantly deploy a VR classroom session.
- Komodo provides social features for class sessions: networked tools, VR avatars, and cross-platform audio and video chat.

- Manage sessions and upload models.
- Komodo helps you schedule sessions and get content in easily. We can store 3D and 2D content for you.

- Analyze student, asset, and session statistics.
- Komodo automatically networks and tracks interactions with content. Our data pipeline shows flexible metrics views in the web portal.
Summary: What is the Komodo platform?

Project Komodo is an SDK and web service that makes it easy for instructors to deploy social virtual reality education apps.

It will soon be an open-source sandbox for the future of immersive instruction, WebXR accessibility, and cross-reality experiments.

We hope to make it an ecosystem catalyzer for instructional VR, starting with the University of Illinois at Urbana-Champaign.
Why the Library?
Why the Library?

• Most visited facilities on campus (1.4 million yearly visits, over 1400 at a time)
• Library as a “place”
• Informal learning environment
• Safe space to learn “out in the open”
• Discipline-neutral
• Values include democratizing access to technology and concepts
• Understanding of emerging tech is information literacy
• Library always involved with providing access to tech (i.e., first public computer labs)
Why VR?
Why VR?

• VR has been available for the past 30 years in some form
• Since 2016, VR has become more affordable, scalable, and adaptable,
• Increasingly being integrated into research and instruction.
• These technologies extend the lab and classroom
• Provide faculty and students with virtual environments
• Generate discipline-specific simulations
• Make learning experience more visceral, engaging, and immersive.
Why now?
Why now?

- “Design thinking” pedagogy in academia
- Emerging tech more scalable and affordable
- Scholarship is increasingly borne digital and reliant on emerging tech
- Library facility spaces being reimagined
- Pandemic has shown need for multimodal tools
Have questions?

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"THE INNOVATOR"

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Lair: Grainger Engineering Library
      Room 157
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      Urbana, IL 61801

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         (217) 300-4686

Super powers: Locating the research materials you need to tackle healthcare's greatest challenges & connecting you to emerging technologies
The presenters would like to thank Technology Services at Illinois, the Center for Innovation in Teaching and Learning, and the staff in the Media Commons in the Undergraduate Library and the Grainger Engineering Library IDEA Lab for their generous support, and invaluable work and contributions to this presentation and to Project Komodo.

Megan Baird
Robert Baird
Yifan Bao
Xianzhuo (Patrick) Cao
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Brandon Dang

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Eric Kurt
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Zhe Liu
Nishi Mehta

Jake Metz
Jamie Nelson
Todd Nelson
Dennis Piehl
Dr. Andre Schleife
Tracy Smith

David Tamayo
Chiara Vincenzi
Robert Wallace
David Ward
Jim Wentworth
Chengyi Zhang
Thank you

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Email: enginlib@library.Illinois.edu

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Email: idealab@library.Illinois.edu

Project Komodo
Website: https://komodo-dev.library.illinois.edu/about
Download Source Code: https://github.com/gelic-idealab