



Game-based Learning and Simulation System using Web Technologies and GPU

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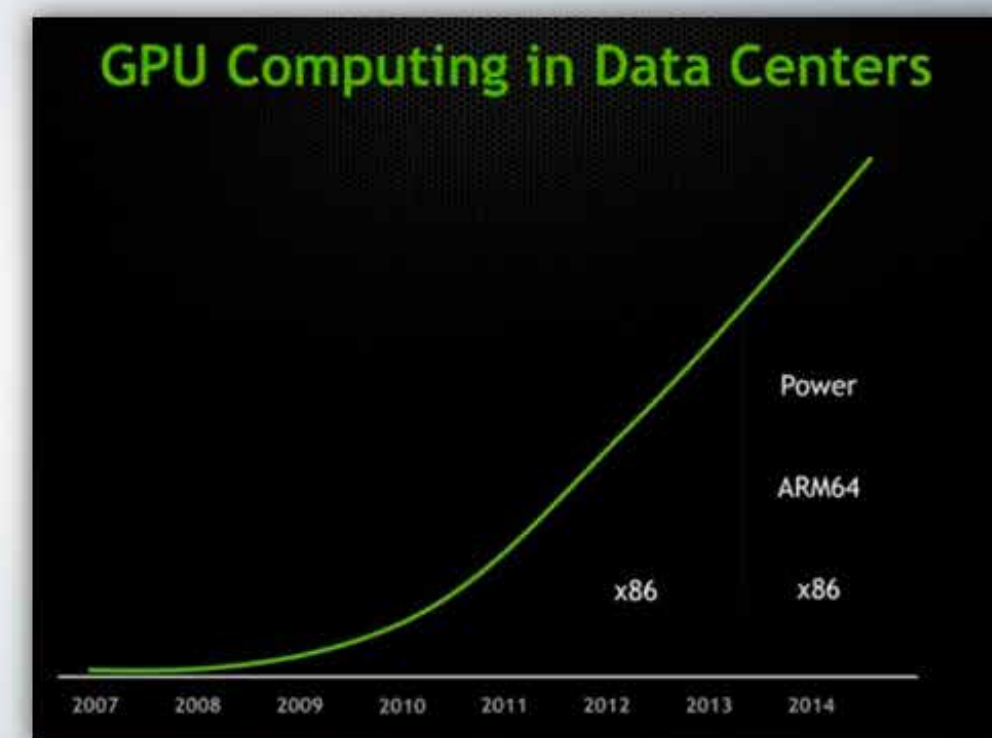
We developed a web-based 3D interactive learning environment for teaching hydrological concepts. The system provides a visually striking platform with realistic terrain information, and water simulation. Students can create scenarios, control parameters, and evaluate mitigation alternatives. The system utilizes web technologies and GPU for water simulation and object collisions on the terrain. The system supports virtual reality, augmented and immersive reality modes, and enables interaction using gesture, body movement and portable devices.

Web 3.0 and GPU Acceleration



JS x 100 - Multicore GPU

- Big Data Analytics
- Rich Interactive Interfaces
- Desktop-like Games
- Scientific Visualization
- Image / Video Processing
- Augmented / Immersive Reality

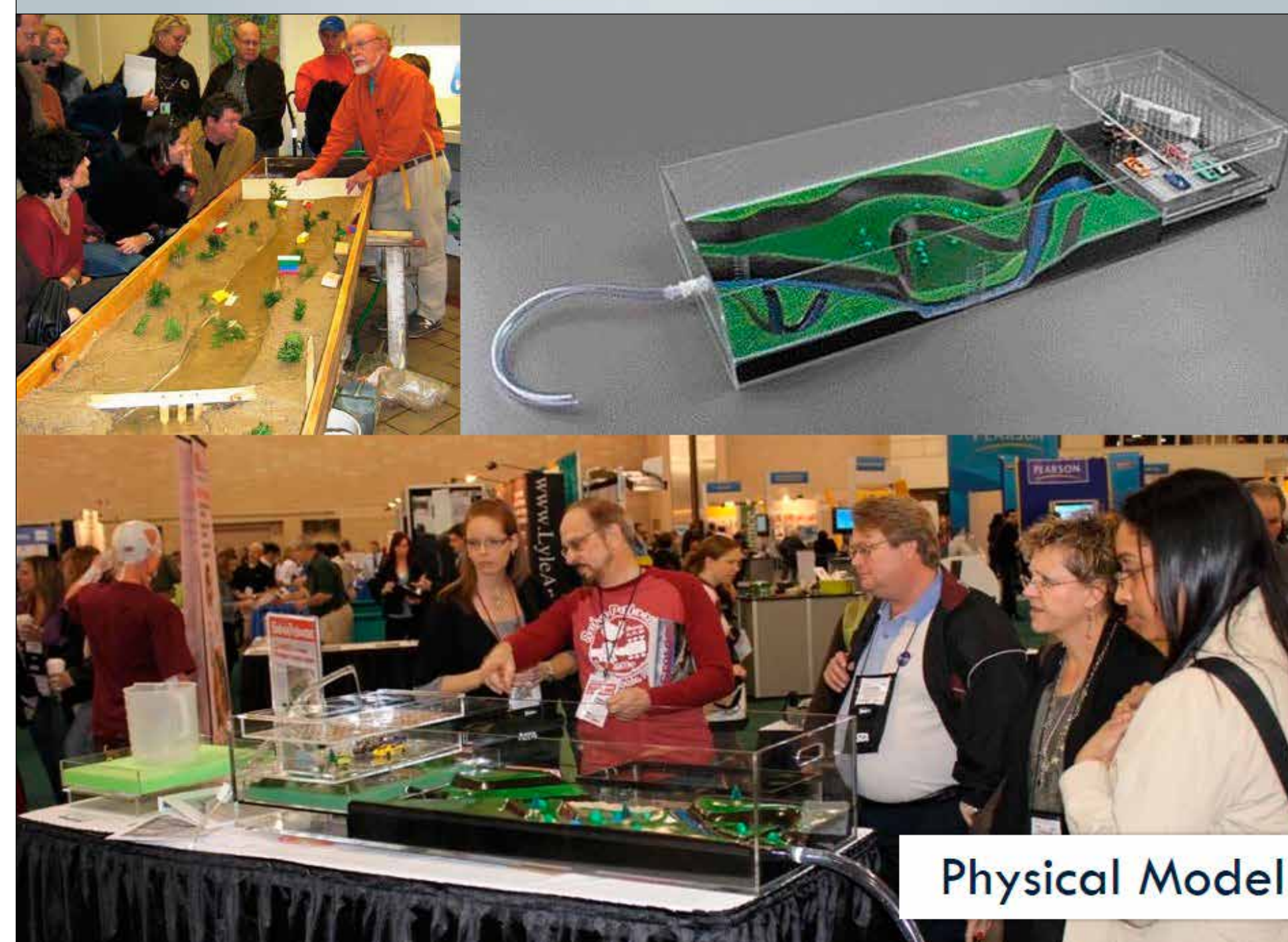


AMD Radeon HD 7990 – 4096 Streaming Processing Units – \$799
8.2 TFLOPs Single Precision compute power (1st 2001, 250th 2007)

Project Background

Goal: Develop a web-based interactive learning and simulation environment to support teaching hydrological concepts in engineering and science curriculum

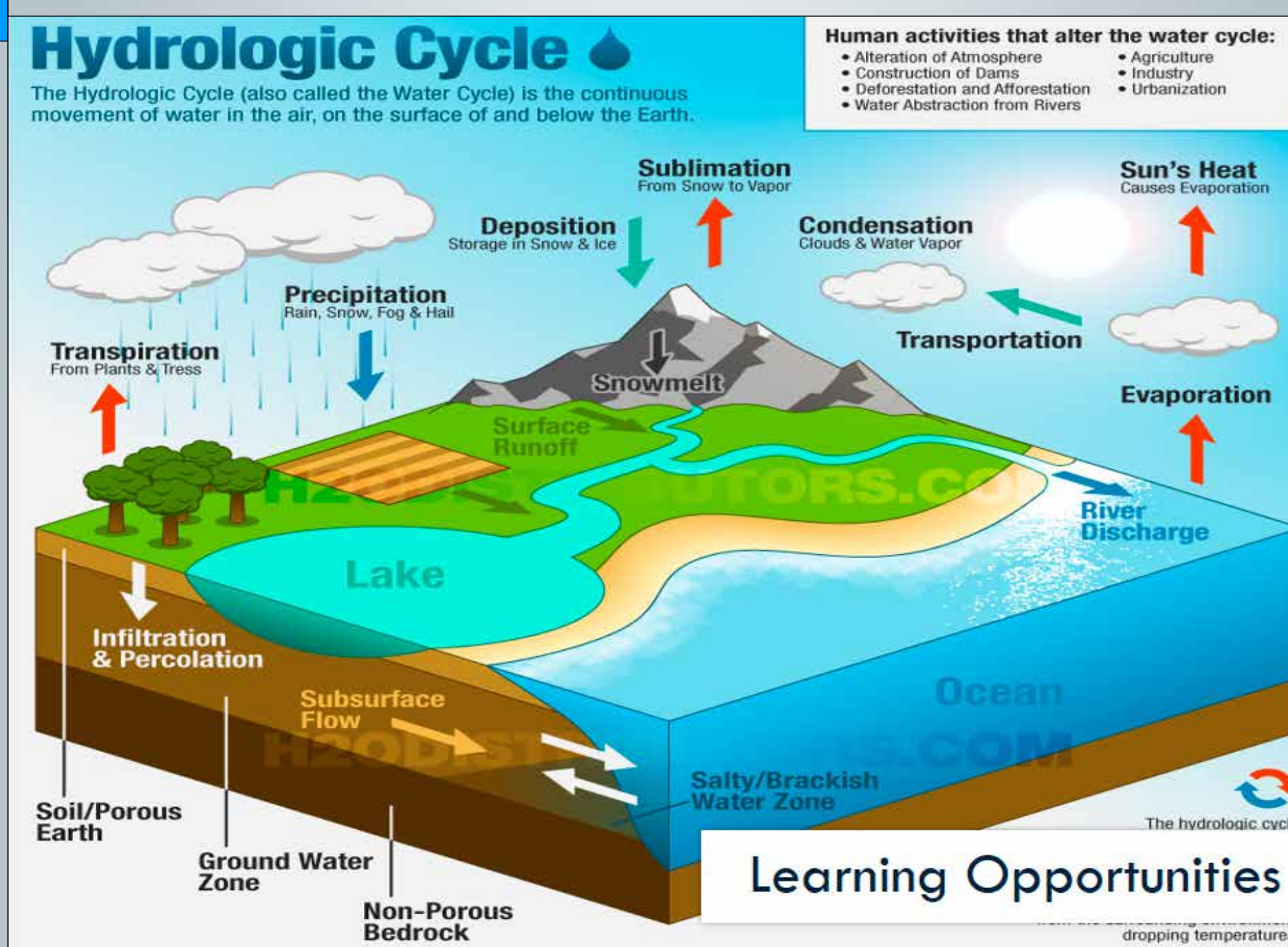
- ✓ First use case on flooding and flood damage
- ✓ Supported UIOWA award to develop the core simulation engine using latest web technologies and novel interaction techniques



Physical Model

Learning Opportunities

- ✓ Support learning **how hydrological systems work** and how they are connected
- ✓ **Hand-on experience** on hydrological concepts with real-time data
- ✓ **Rich visualizations and animations** to observe hydrological concepts in real-time
- ✓ **Easy to integrate** the platform to **curriculum** using a web-browser



Technology

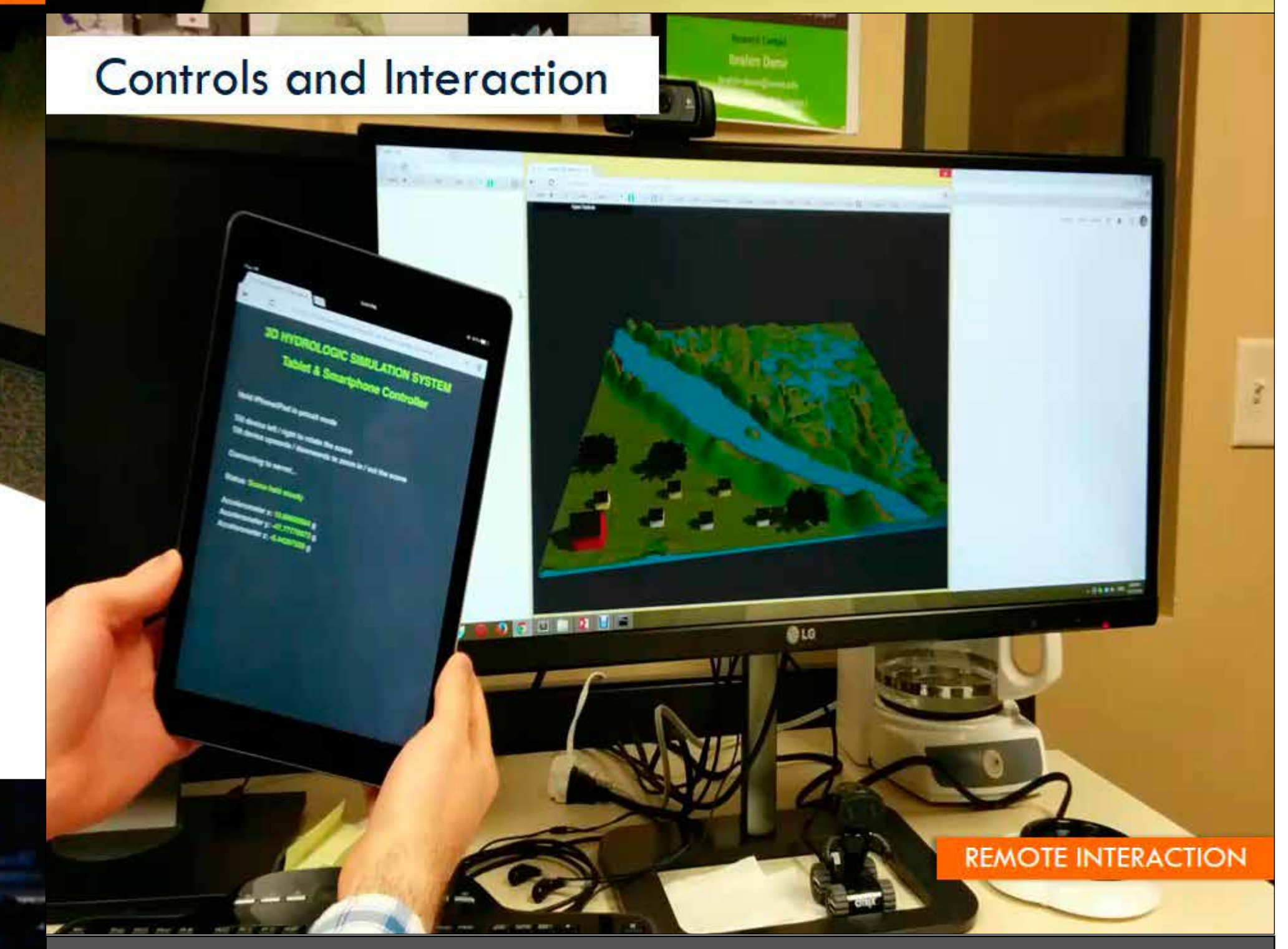
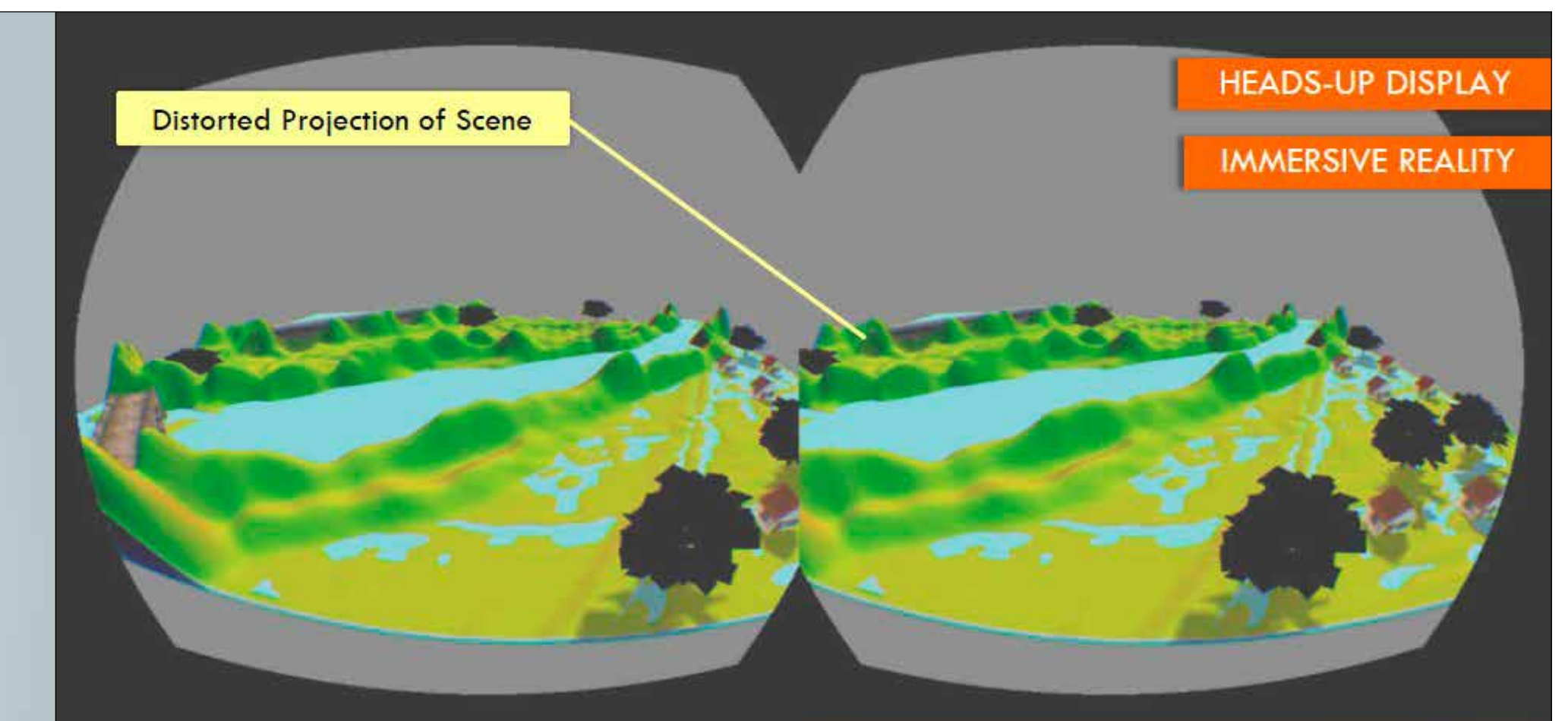
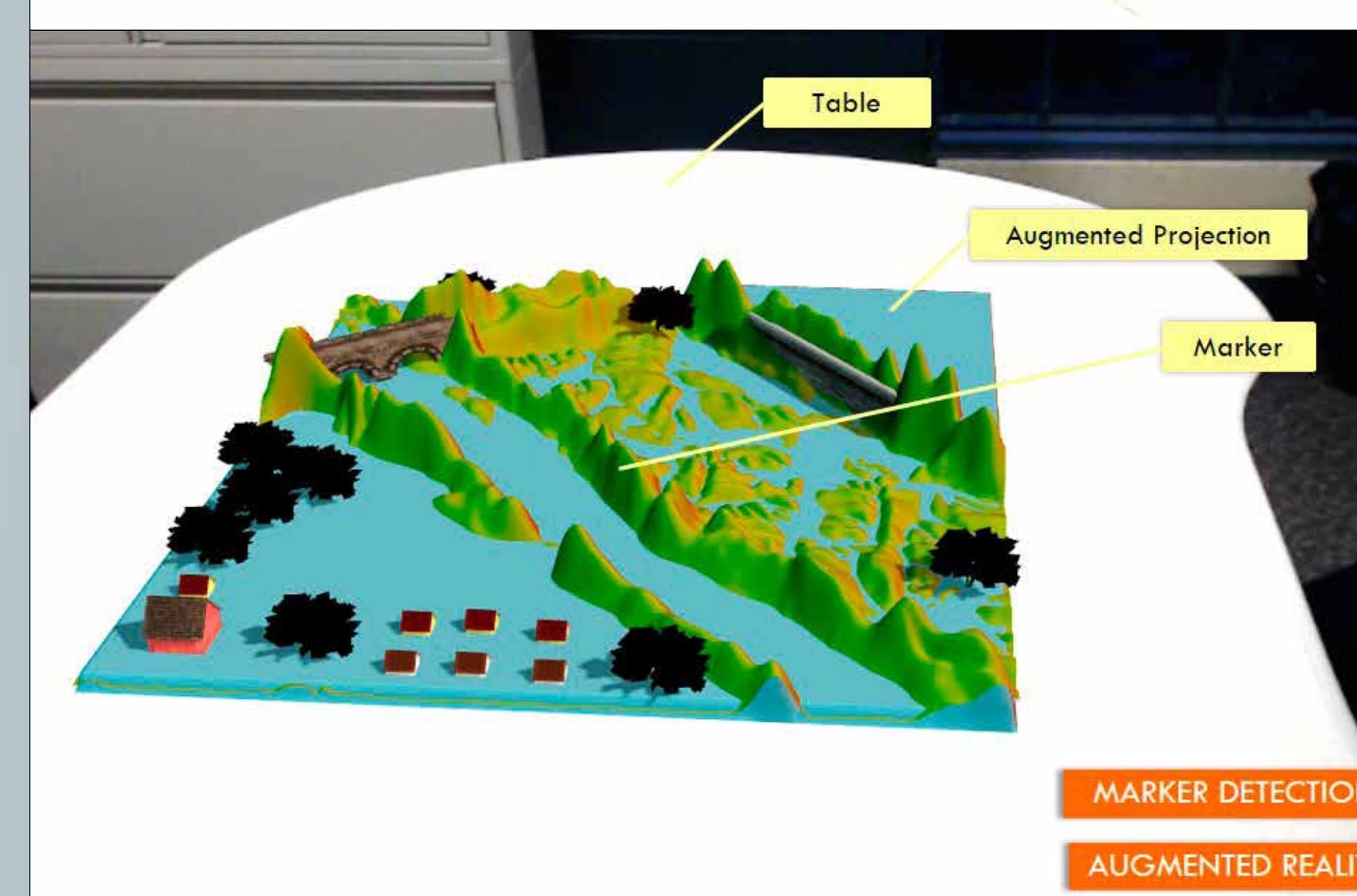
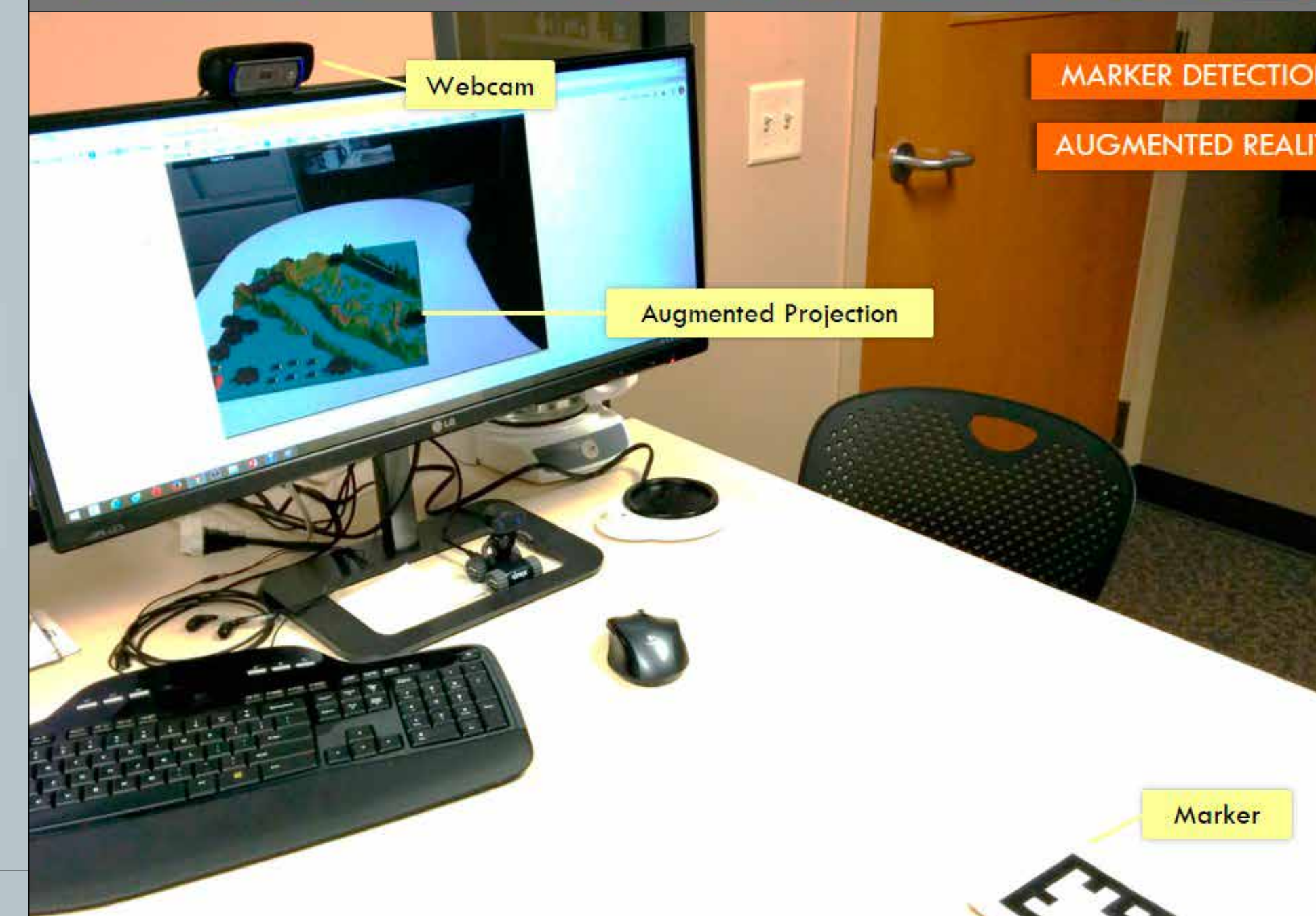
- ✓ HTML5 and JavaScript
- ✓ WebGL (Web Graphics Library)
- ✓ GPU accelerated physics and image processing
- ✓ Augmented Reality Libraries – marker tracking/detection
- ✓ WebRTC – webcam support for Augmented Reality
- ✓ Novel hardware integration [Oculus Rift, Leap Motion, Microsoft Kinect, MYO Armband]

Functionality

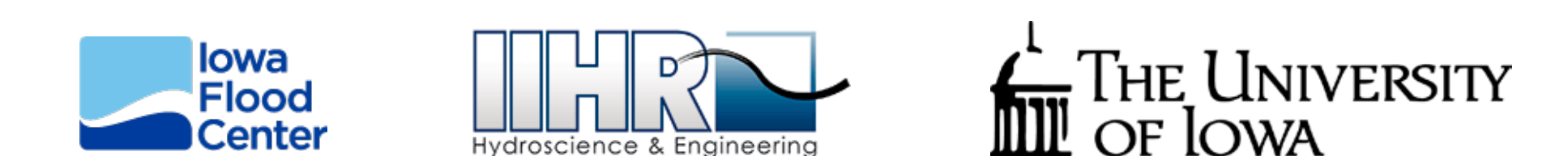
- ✓ Open and modular structure allows easy expansion
- ✓ Physics and Simulation Engine
- ✓ Visualization Modes
 - ✓ Virtual Reality
 - ✓ Augmented Reality
 - ✓ Immersive Reality (Oculus Rift)
- ✓ Controls and Interaction
 - ✓ Desktop (mouse, keyboard)
 - ✓ Remote (tablet, smartphone)
 - ✓ Gesture (Leap Motion, Microsoft Kinect, MYO Armband)

Functionality

- ✓ **Real-time data**
 - ✓ Terrain from Lidar data, water levels from sensors, rainfall, etc using web services
- ✓ **Gamification**
 - ✓ Scenario analysis & challenges
 - ✓ **Social Networks** (compete friends, high score lists)
- ✓ **Education Components**
 - ✓ Load/save scenarios
 - ✓ Experiment with equations/variables
 - ✓ Add new 3d models



This project is based upon work supported by the Iowa Flood Center and the University of Iowa



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