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INTERACTIVE WEB-BASED FLOOD SIMULATION SYSTEM AS AN EDUCATION PLATFORM FOR HYDROLOGICAL CONCEPTS

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Recent developments in web technologies make it easy to manage and visualize large data sets with general public. Novel visualization techniques and dynamic user interfaces allow users to create realistic environments, and interact with data to gain insight from simulations and environmental observations. The floodplain simulation system is a web-based 3D interactive flood simulation environment to create real world flooding scenarios. The simulation systems provides a visually striking platform with realistic terrain information, and water simulation. Students can create and modify predefined scenarios, control environmental parameters, and evaluate flood mitigation techniques. The web-based simulation system provides an environment for students to learn about the flooding, flood damage, and effects of development and human activity in the floodplain. The system utilizes latest web technologies and graphics processing unit (GPU) for water simulation and object collisions in the floodplain. The system provides various scenarios customized to fit the age and education level of the users. This presentation article provides an overview of the web-based flood simulation system, and demonstrates the capabilities of the system for various flooding and land use scenarios.

INTRODUCTION

The project aims at developing a web-based interactive simulation environment to introduce hydrological concepts in engineering and science curriculum. This project builds upon the preliminary work done during Google Summer of Code 2013 program. The project integrates new web-based technologies and developments in teaching hydrological concepts in a game-style fun and engaging educational simulation environment. The platform will have two simulation options to support virtual and augmented reality technologies (Figure 1). The simulation environment will be integrated to the curriculum, and provide an interactive learning environment and hands-on experience in hydrological concepts for students from various engineering and science backgrounds.

In this project, a web-based interactive game-style hydrological simulation environment will be developed. The simulation will introduce concepts in hydrology like watershed, precipitation, river network, drainage, flood inundation, reservoirs, levees, and etc. Students will be able to load various environmental scenarios, control specific parameters in the scenario settings, and observe the actual effects of the flooding in Iowa communities. The platform will allow students to control reservoir water levels, levee locations, and several management actions to mitigate flooding, and test management actions in real-life scenarios, and evaluate

their performance in their actions. The platform will create a smooth animation of the flooding within the watershed and calculate the damage (e.g. area under flood, property, life, direct and indirect costs, etc.). The platform will include scenarios for historical events (e.g. 2008 Iowa Floods), and integrate real-time rainfall data and flood maps, and allow students to work with actual data for several communities in Iowa. The instructor will be interactively load scenarios and demonstrate historical events through a web-browser in the class. The platform will be optimized for use with tablets on iOS and Android platforms. The concepts will be explained with definitions and references to online resources in the platform for further learning and study opportunities.

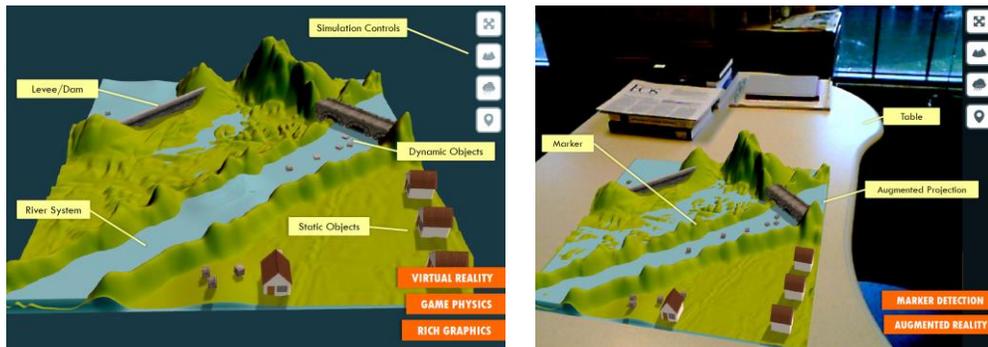


Figure 1. a) virtual reality mode; b) augmented reality mode

Students will be interactively provided hands-on experience in hydrological concepts, management actions, and effects of flooding in actual communities in Iowa. The platform will raise the student's interest in environmental curriculum. Integration of real-time data resources make it easy for students to work with actual data. Rich visualizations and animations will attract students, and game-style performance evaluations will provide a competition environment for better management actions via in-game scores for saving land and reducing damage of floods with proper action. The platform will also integrate gesture based technologies to allow students to interact with the platform using their hands and body movement. The proposed project will assist instructors as an interactive simulation environment in supporting their curriculum.

Benefits of the proposed project are listed below:

- ✓ New hydrological and environment concepts can be easily integrated into the online learning environment
- ✓ Student will be able to get hand-on experience on flooding with actual data and communities in Iowa
- ✓ Web-based platform will make it easy for any instructor to integrate the platform to their curriculum using a web-browser
- ✓ Students will learn how hydrological systems work and how they are connected to each other
- ✓ Game-style performance measures and high-scores list will engage students in competing for better flood mitigation scenarios historical and actual events
- ✓ Rich visualizations and animations will allow students to observe hydrological concepts and their effects in real-time

- ✓ Online training platform will serve as a 24/7 hydrology lab for students to access from their home, and reduce the load or need for teaching assistants

The platform will be integrated to the curriculum of the course, 'Information Systems for Resource Management', which is cross-listed in 4 departments (Civil and Environmental Engineering, Mechanical and Industrial Engineering, Geography, and Electrical and Computer Engineering). The platform can be used to enhance the teaching effectiveness of any course with hydrological concepts. A large audience from various engineering and science courses can utilize the platform for their teaching and research purposes. The success of the project will be assessed through quizzes, and feedback from the students and teaching assistants (TAs). Training will be provided to TAs with an orientation. An additional outcome will be the student's evaluations of the learning platform (e.g., what worked or not, what needs improvement, etc.). Surveys will also be conducted for measuring students' engagement and satisfaction with the platform.

The simulation systems provides a visually striking platform with realistic terrain information, and water simulation. Students can create and modify predefined scenarios, control environmental parameters, and evaluate flood mitigation techniques. The web-based simulation system provides an environment for students to learn about the flooding, flood damage, and effects of development and human activity in the floodplain. The system utilizes latest web technologies and graphics processing unit (GPU) for water simulation and object collisions in the floodplain. The system provides various scenarios customized to fit the age and education level of the users.