Master of Disaster

Virtual-Reality Response Training in Disaster Management

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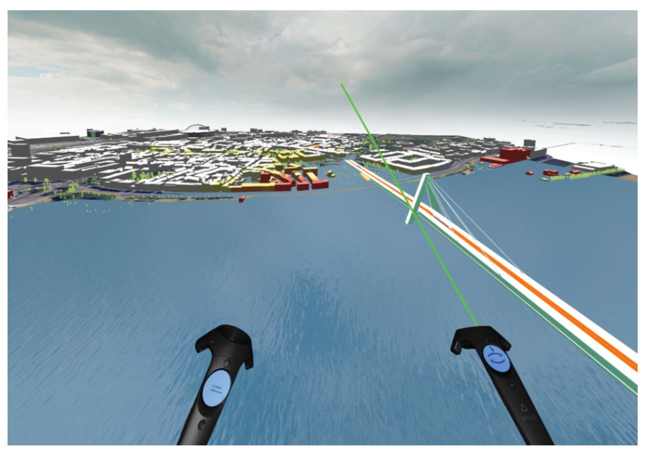
PROBLEM

Flood simulations allow flood managers to predict possible flooding events, which are the basis for the development of response plans to mitigate flood risks.
Field personnel has to be trained to execute these response plans during emergency situations.
Virtual reality (VR) offers a safe and inexpensive way to create training environments for different scenarios as an alternative to costly or unfeasible physical training environments.

CONTRIBUTIONS

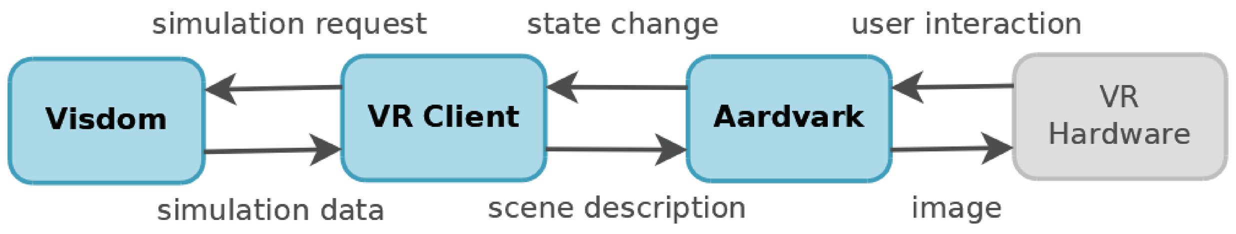
We present a flood response training system with the following features:

- ► Collaborative operator-trainee setup.
- ► Client-server architecture using the remote flood simulation system Visdom [1].
- ► Fast data updates on the VR client.
- ► Smooth flood animation for large scenes.
- ► Manipulation of boundary conditions of the simulation from within the VR client.
- ► Interactive navigation through time and scenarios, in VR.



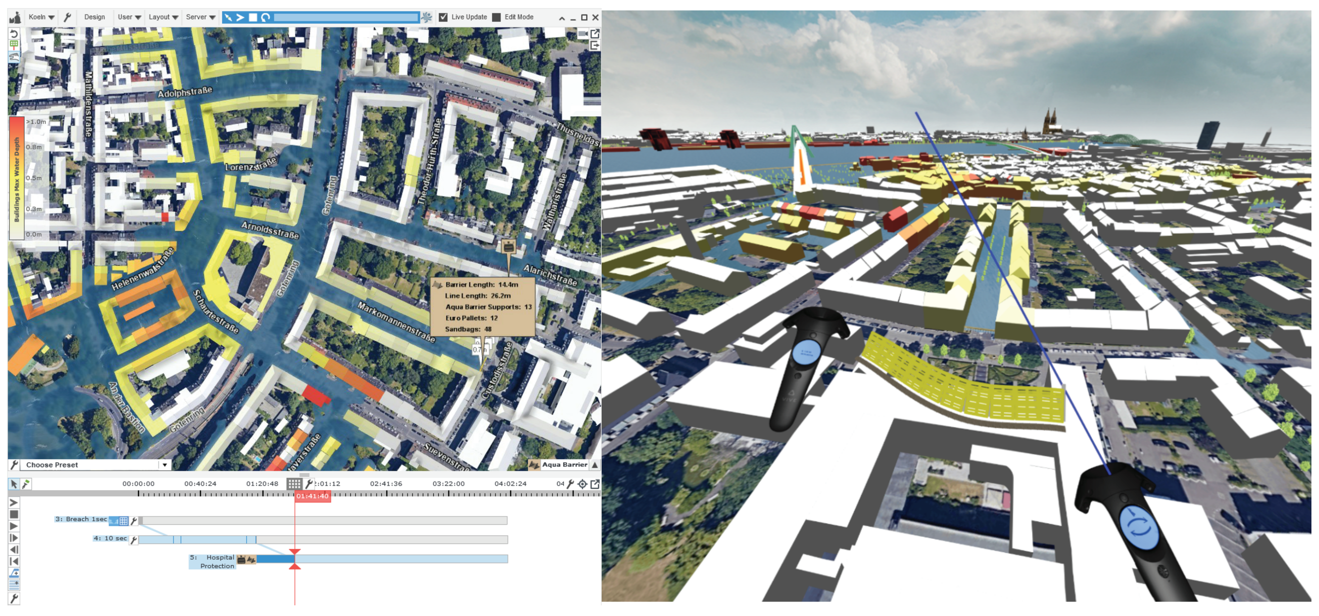
Client-Server Architecture

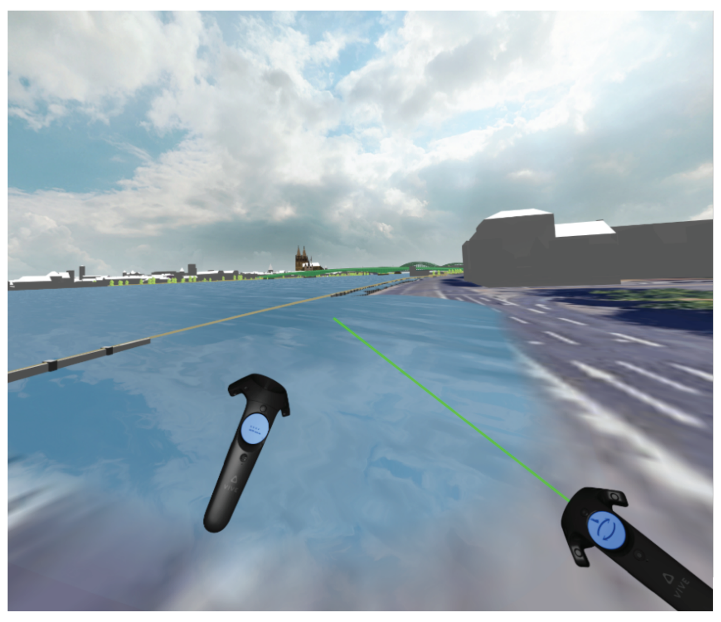
The flood simulation is provided by the decision support and flood simulation system Visdom [1], which runs on the server. The rendering is done on the client, using the high performance rendering engine Aardvark [3]. Our VR client connects Visdom with the rendering engine.



Operator-Trainee Mode

An operator supervises and assists the trainee from a linked desktop application.

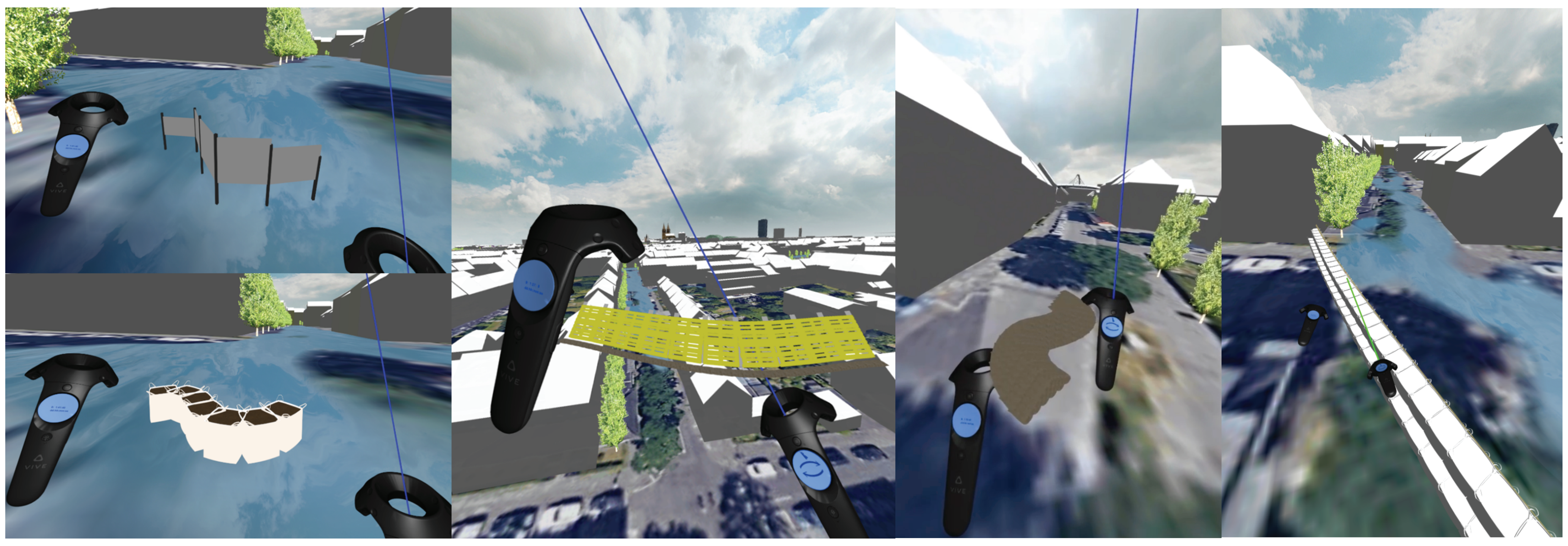




VR rendering of physically correct flooding levels, using a validated, robust simulation [2].

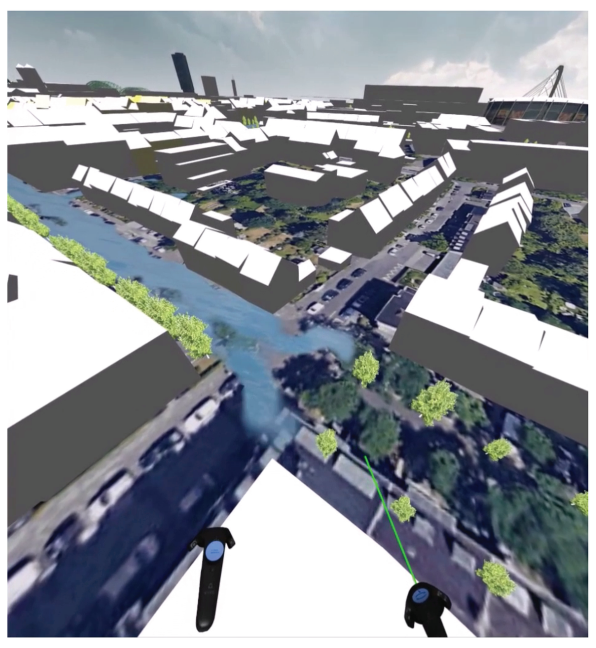
VR Interactions

A trainee can move through the virtual environment and manipulate the boundary conditions of the simulation by placing flood barriers to test protection measures.



Time and Scenario Navigation

Time navigation within a flooding scenario, as well as navigation between multiple simulation runs (scenarios) with different barriers can be done on the desktop client and in VR.



Navigation in VR is done via trackpad input.

RESULTS

We evaluated the performance of our system, using four different city models with different terrain size, cell size, and number of rendered objects like buildings or trees.

Scenario	S1	S2	S3	S4
Terrain	6.99 km^2	51.15 km^2	34.07 km^2	38.69 km^2
Cell Size	5 m	10 m	10 m	10 m
#Buildings	5 696	55 487	37 889	5 038
#Trees	6 008	38 607	30 795	81 693
Frame Times	~11,17 ms	~14,73 ms	~11,56 ms	~11,17 ms

References

[1] J. Waser, A. Konev, and D. Cornel. 2018. On-the-fly Decision Support in Flood Management. GIM International issue November/December (2018), 22–25.
[2] A. Buttinger-Kreuzhuber, Z. Horváth, S. Noelle, G. Blöschl, and J. Waser. 2019. A fast second-order shallow water scheme on two-dimensional structured grids over abrupt topography. Advances in water resources 127 (2019), 89–108.
[3] VRVis. 2019. An Advanced Rapid Development Visualization And Rendering Kernel. https://vrvis.at/research/projects/aardvark

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