Web Interface for Daylighting Design and Feedback

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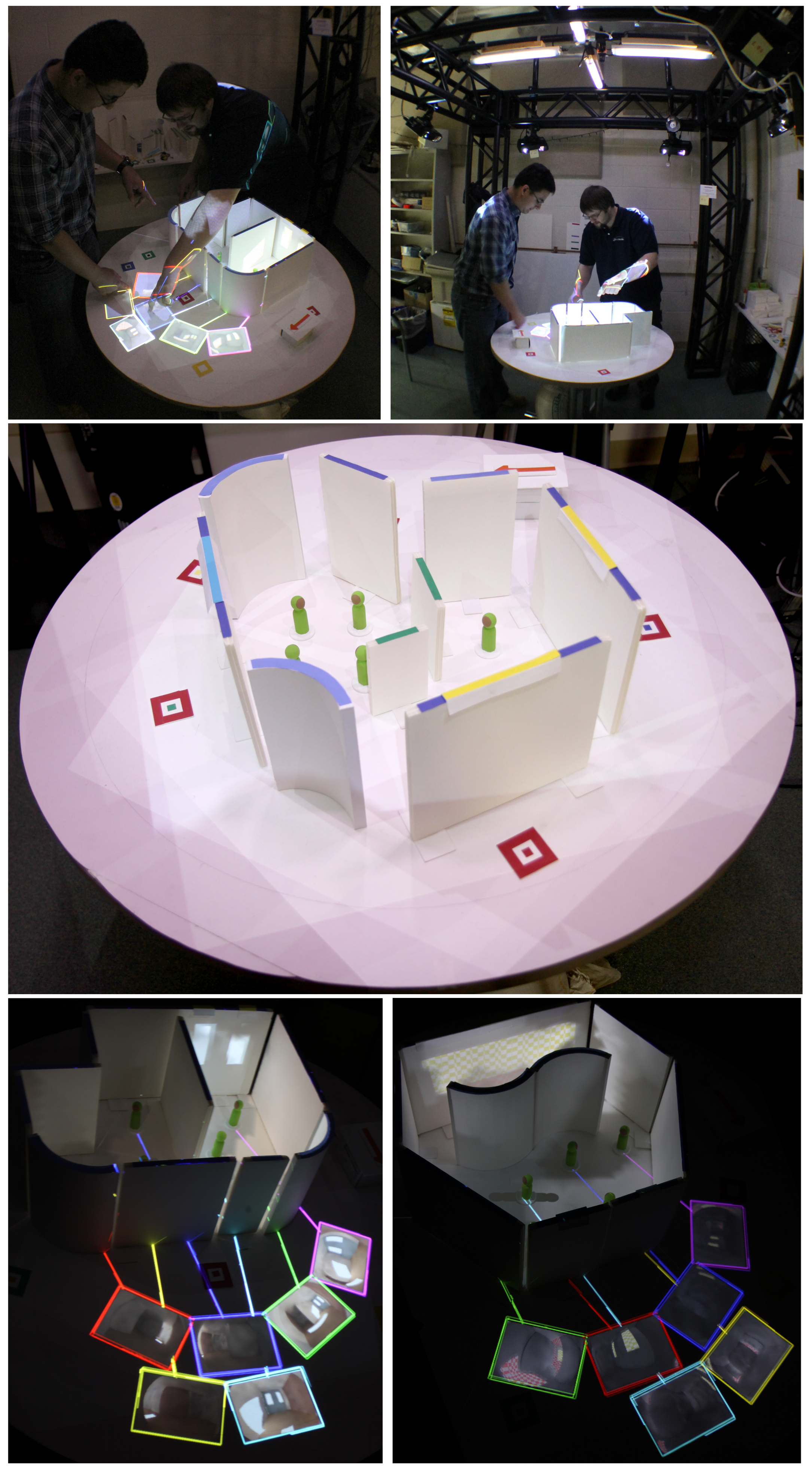
Motivation



Current Research on the development of a spacial augmented tangible user interface for daylight simulation offers architects a novel approach in collaborative room design. [1,2]

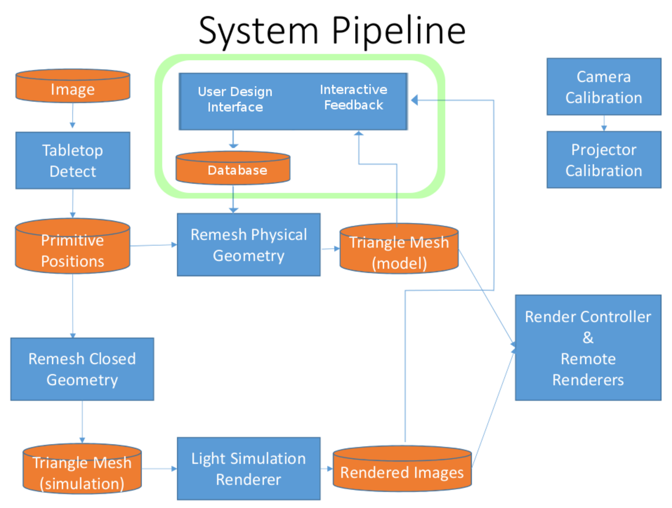
Recent user studies find the tools helpful for visualizing lighting simulations and gives visual feedback to make better use of natural lighting. An Evaluation from this study lead to the extension of the interface to include avatars, illumination visualizations, and additional window models. [1]

More user data is required if we plan to refine this tool for professional use. To collect data , an online interface that deliverers a similar set of features, based on physical system, is under development.

Contributions

Currently a working prototype of the application offer functions similar to the physical system in order to aid in gathering user feedback. We used WebGL and the Raphael graphics libraries to build both the user interface and 3D visualization. The following are the features implemented in our online application.

1. Simple drag-drop user interface to design models with wall primitives
2. Avatar primitives that render geometry to view a POV scene
3. Save and load user created layouts
4. Interactive feedback that allows navigation through the user generated space with daylighting simulation



The current pipe line uses image detection to locate the primitive positions to run lightning simulation on [1, 2], however with our online application we bypass image recognition and directly find the wall primitives and save those positions onto a database for later study. Those primitives go into the graphics pipeline and we get a triangle mesh model and rendered images with lighting textures, that are displayed on the screen as a 3D model.

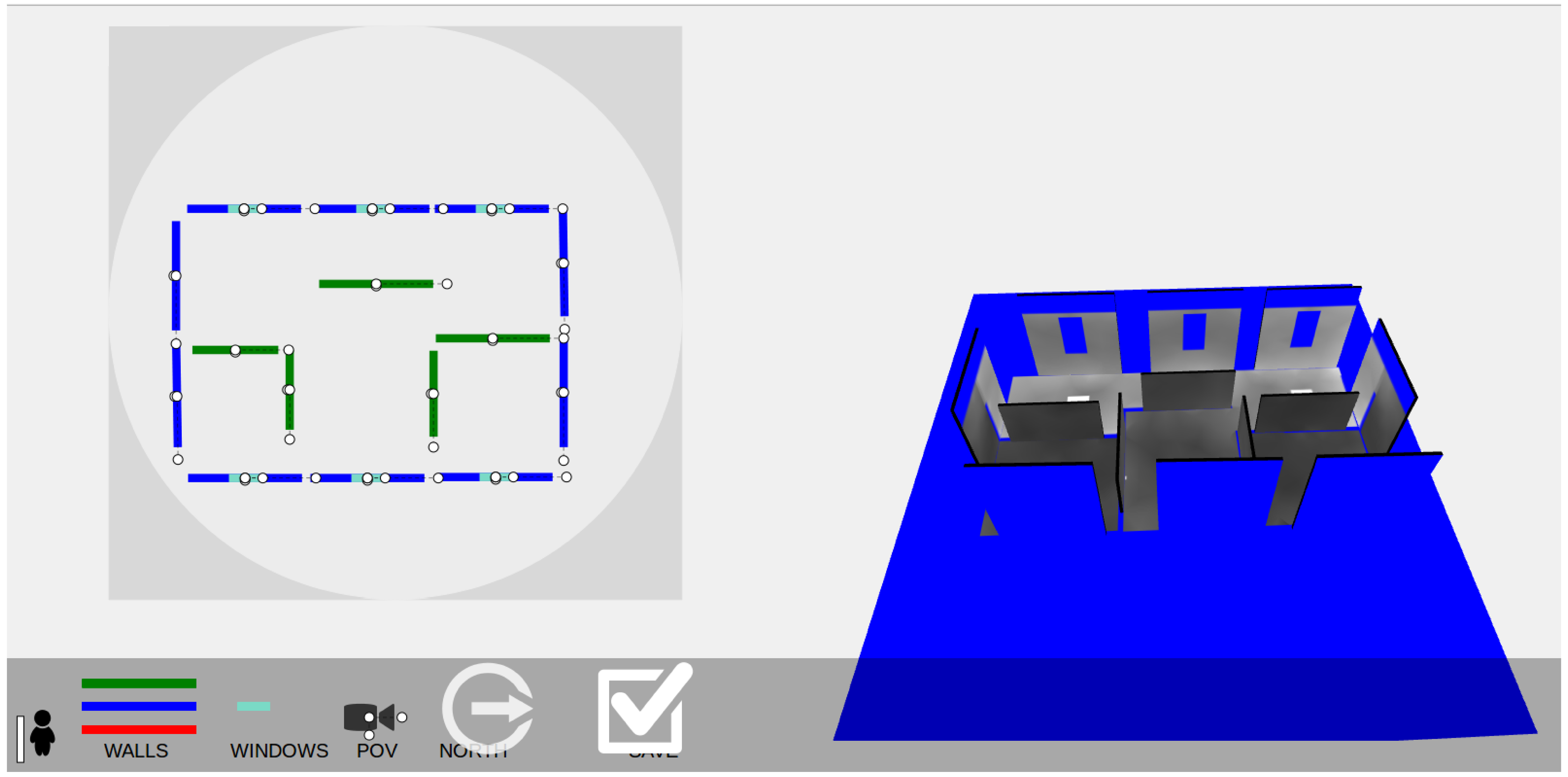
References

[1] Joshua D. Nasman and Barbara Cutler. Evaluation of a tangible interface for architectural daylighting analysis. In *Proceedings of the ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games*, I3D '12, pages 207–207, New York, NY, USA, 2012. ACM.

[2] Yu Sheng, Theodore C. Yapo, Christopher Young, and Barbara Cutler. Virtual heliodon: Spatially augmented reality for architectural daylighting design. In *VR*, pages 63–70, 2009.

[3] Lap-Fai Yu, Sai-Kit Yeung, Chi-Keung Tang, Demetri Terzopoulos, Tony F. Chan, and Stanley J. Osher. Make it home: Automatic optimization of furniture arrangement. *ACM Trans. Graph.*, 30(4):86:1–86:12, July 2011.

User Interface and Interactive Feedback



User Interface: The interface offers a variety of tools to design and create floor layouts including wall selection, window placement, avatar points-of-view, and compass orientation.

Interactive Feedback: After a design is saved, a 3D model of the floor plan renders on the right pane. This rendering is interactive such that can navigate around the model to view lighting from different view points. This view provides feedback which then the user can use alter their model to optimize natural daylighting usage. Moreover lighting visualization incorporated into these view points through avatar tokens can help users better understand illumination in the 3D models.

Future Research

Furniture Optimization: A useful extension of the current pipeline that is under active research is furniture placement to maximize the utility of natural lighting. Previous research [1] offers us a way to visualize over and under illumination of a scene through false color textures. Future extensions of this would be intelligently select where to place common furniture items to maximize the use of natural daylighting. Challenges faced are similar to previous work done on *Make It Home* [3] with the addition of quantifying daylighting usage. A clear set of challenges for implementing this feature is disccuesed blow:

1. Relating illumination values given by the daylighting simulation real world measures.
2. Creating a set of objects a spacial hierarchy of all objects modeled.
3. Creation of a cost function based on [3] with the addition of daylighting
4. Choice of optimization the cost function to yield realistic results simulation