3D Camera Pose History Visualization

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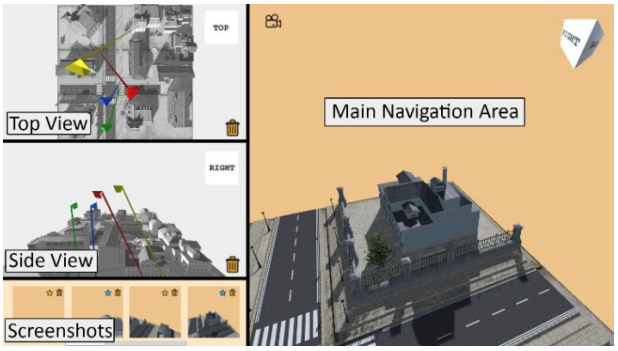

Figure 1: The current prototype for the camera pose history visualization system consists of the main navigation area, top and side views of the 3D world that let users identify saved camera poses and a list of saved cameras images taken from these poses.

Figure 2: A saved view from the study that shows three boxes (glow not shown in the study). Participants had to revisit this camera pose and then look for a single ball hidden inside one of these three boxes.

1. ABSTRACT

Navigating in 3D environments imposes a high cognitive load on users as control of 6 or more degrees of freedom for the camera is required. Most 3D interaction tools thus provide some form of assistance for 3D navigation. For example, some systems limit the DOF users can interact with [1], other systems utilize multiple views to help users navigate the environment [3]. A related problem is that revisiting a previous camera location and/or pose is also difficult. Our work enables users to recognize where they have been before by giving them the ability to revisit their navigation history. This improves 3D navigation as users can move more efficiently through the virtual environment by going back to previously visited places.

2. Camera History Visualization Tool

Our camera history visualization tool (figure 1) let users return to previous views without having to explicitly navigate to the corresponding camera pose using mouse and keyboard in a desktop workplace. The visualization also allows users to identify their position in relationship to previously visited views and the environment. This also help to identify unexplored areas of the environment. Each saved camera is shown as a pyramid icon with the corresponding saved pose. Color is used to classify cameras based on time spent in that view and the alpha channel is used to show the distance to the current camera.

Users save camera views by pressing the 'S' key. Each saved view has a heuristically determined zone of influence around its position, where only new changes in rotations can be saved. To return to a previous pose, users only need to click on the camera icon. If multiple views are saved for a given position, users can scroll through them. Other supported interactions include deleting cameras and views, favoring/bookmarking certain views and accessing favorite/bookmarked views using the function keys.

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3. User Study

We conducted a study with 4 participants (M=1, F=3) to evaluate our new camera history visualization system. Our study was divided in two parts: first, participants were asked to navigate to four specific views and to save them to create a consistent history. Then, participants were asked to find four different balls hidden inside boxes. All the boxes were visible from the initial saved views (figure 2), but users needed to move the camera to see the inside of the box. Participants were free to save more views in this second part of the study. All users were able to complete the task within 15 minutes (avg. 10.5min). The results from a 7 point Likert scale (1-7) questionnaire are displayed below:

Questions	Mean	STD
Ease of interaction with top / side view	5.25	1.30
Ease of interaction with saved cameras view	5	0.71
Perceived speed of interaction when choosing a previous view images.	5.75	1.09
Perceived speed of interaction when choosing between views	5.25	1.30
Did you find the top/side view useful	6	0.71
Did you find the saved cameras view useful	5.5	1.12
Did you find go to favorite / bookmark view useful?	3.75	0.83

Most participants agreed that our tool is a useful and fast way to navigate to previous camera poses. Yet, limitations of our current prototype are that it can get difficult to find a specific view if users do not remember the pose and that the top / side views can get crowded with icons.

4. REFERENCES

[1] D. Scheurich and W. Stuerzlinger. 2013. A One-handed Multi-touch Mating Method for 3D Rotations. In *CHI '13* Extended Abstracts, 1623-1628.

[2] A. Khan, I. Mordatch, G. Fitzmaurice, J. Matejka, and G. Kurtenbach. 2008. ViewCube: A 3D Orientation Indicator and Controller. In *I3D '08*, 17-2