Gaze Interactive Building Instructions

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ABSTRACT
We combine eye tracking technology and mobile tablets to support hands-free interaction with digital building instructions. As a proof-of-concept we have developed a small interactive 3D environment where one can interact with digital blocks by gaze, keystroke and head gestures. Blocks may be moved around by looking at the model world and placed in the construction by a keystroke or a snap head movement.

Keywords
Gaze Interaction, Eye Tracking, Remote Eye Trackers, Head Mounted Eye Trackers

1. INTRODUCTION
Building instructions contain vital information for construction toy sets. Figures show how to make a model step-by-step. Recently, some toy products have provided a digital version supplementing the traditional booklets, which have more to offer than its paper counterpart. For instance, in [1], details can be examined by zoom and rotation; animations show exactly how to place a component and a forward/rewind slider makes it easy to find a particular event in the construction sequence (Figure 1).

The digital format of the building instructions opens up for even more enhancement of the user experience since it may now be operated by several input modalities, like voice, head movement and gaze. For instance, the digital model could zoom in on a particular part that the user looks at, when the user leans towards the tablet.

Touchless interaction with a digital building instruction would be of particular interest when the user is holding pieces in the hands and at the same time would like to activate a function. In fact, this might happen quite often and more often with digital building instruction than with a booklet. As one example, it takes 213 clicks on the forward button to go through the whole procedure of [1] while it only takes 37 page-turns to do this with the booklet.

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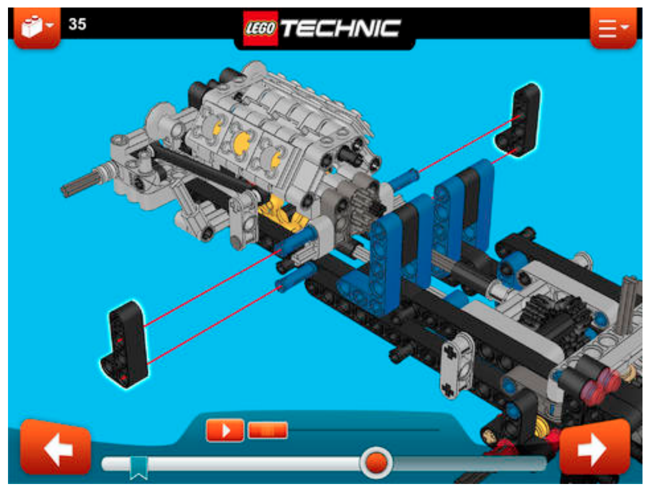


Figure 1: LEGO TECHNIC digital building instruction. The slider between the arrows offers forward-rewind; the play button offers a short animation of where to place the two black bricks. Two-finger pinch will zoom and moving the finger on the tablet will rotate the model.

2. GAZE INTERACTION.
Gaze has been extensively used as an alternative interaction modality in different application areas, for example, communication tools for disabled people, computer games, E-book reading, TV-controls etc. Gaze tracking can be either remote if done with a camera located next to the display, or it can be head-mounted, with the camera fixed close to the eye. There are still many ways that this technology may be improved. Remote systems are challenged when the user moves his head a lot or if the user is wearing glasses. However, the technology has now become affordable, offering gaze tracking systems for tablets, that cost less than 100 $ and has an open SDK. This will make it possible for toy manufactures and game developers to take advantage of gaze inputs – and to analyze afterwards where users where looking during their engagement.

We propose to use eye gaze as an alternate modality to interact with building instructions since it potentially provides convenient hands-free interaction, leaving both hands for uninterrupted construction of the physical model.

3. THE DEMO

In our demonstration, we will show how to use two types of eye trackers: A remote eye tracker from TheEyeTribe (Figure 2) and a low-cost head-mounted eye tracker developed by Diako Mardanbegi at IT University of Copenhagen (Figure 3).

The purpose of the demonstration is to explore new ways of interaction with digital building instructions by use of gaze. We have developed a simple software application, which is basically an interactive 3D block world (See Figure 4) where one can place and interact with primitive 3D LEGO-like blocks by gaze and key/ head commands. One can rotate the 3D model and see different perspectives of the model.

Figure 2: TheEyeTribe Remote Eye Tracker on a tablet

While working with the remote eye tracker, one can place a block in the grid using a gaze and key combination. Gaze position in the grid is highlighted with a light-red color plane. This plane moves when gaze moves over the grid squares. Fixating on a specific square in the grid one can place a cube by pressing a down-arrow on the keyboard. Looking at the two turn-buttons in the lower left and right corner makes the model turn (Figure 4).

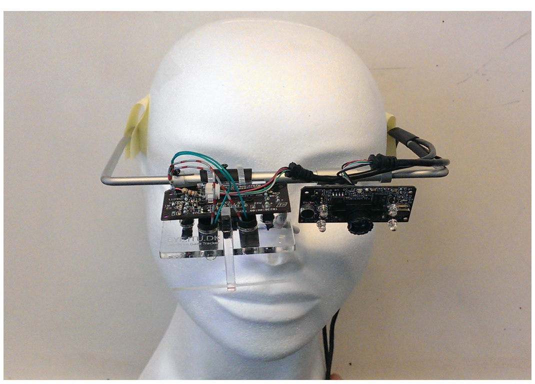
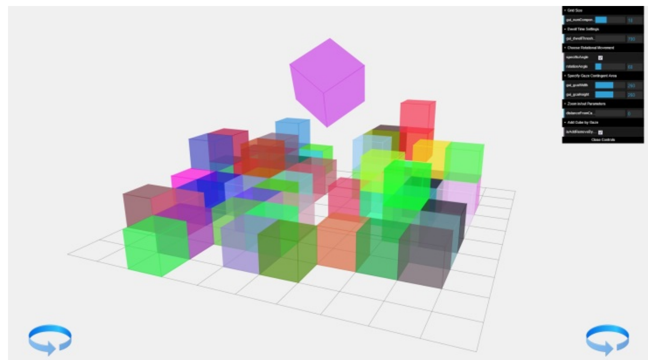


Figure 3: Low-cost head mounted eye tracker

Wearing a head mounted eye tracker, the user may perform a set of predefined head gestures. For example, when fixating on a location at the grid, the user may make a quick head movement to the right and back (a head gesture) which will place a cube at that point. This is similar to pressing a down-arrow key with the remote tracking system.

The demo session will first present a real physical brick model in LEGO DUPLO that the participant should try to build as fast an accurate as possible with gaze when the user has been calibrated to either the remote or the head-mounted tracker. During the interaction, we will record all gaze positions and activations. Then afterwards we will tell the user how well he or she performed in terms of task-time and errors made.

After this short experiment we make a brief interview with the participant, showing how the digital LEGO TECHNICS building instruction works. We will ask them for their suggestions for a best use of gaze interaction in connection with building manuals. This part of demonstration will – hopefully – provide a range of new ideas that can later be explored.



Figur 4: A simple 3D brick world to explore gaze interaction with digital models.

4. FUTURE PERSPECTIVES

The demonstration is conducted with a simple 3D brick world that we have complete control of. However, we expect that gaze tracking systems will support a set of standard interaction possibilities (e.g. dwell time activation and gaze gestures) along with their systems, providing developers of games and digital learning material the possibility to utilize gaze interaction in their specific applications. This would make it possible to interact with a blend of real and virtual objects where hands may be fully deployed on the physical objects while the virtual objects are controlled by other modalities, including gaze.

Finally, children with severe motor disabilities would also be likely users of gaze interactive games and learning materials, since this would allow them to build and explore these media.

5. REFERENCES

[1] LEGO® Building Instructions. The LEGO Group - 06 February 2014. Retrieved March 20, 2014 from https://itunes.apple.com/dk/app/lego-building-instructions/id762279845?mt=8