Temporal-Spatial Visualization of Interaction Data for Visual Debugging

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1 Introduction

The design of novel input devices and interaction techniques is a highly demanding task. The interaction designers need programming environments which provide high flexibility and complex functionalities. But above all, such tools have to be easy to learn and should support the analysis and interpretation of the interaction data even for interaction designers with little or no programming experience. Squidy is a Zoomable Design Environment which eases the design, integration and combination of novel input devices as well as appropriate interaction techniques. By providing a simple yet powerful visual programming language based on the pipe-and-filter metaphor combined with details-on-demand techniques, Squidy facilitates rapid prototyping and a fast iteration cycle [König et al. 2009]. Therefore, Squidy offers a versatile collection of ready-to-use nodes such as devices, filters and interaction techniques which can be visually arranged and connected and thereby define the desired interaction technique. This can be for example an optical tracking of a laser pointer's spot to interact with a distant display wall, as can be seen in [Figure 1]. Here, the 2-dimensional position data passes through several filters and finally controls a mouse cursor and a TUIO-based application. However, currently such a visual design of an interaction technique with Squidy requires a deep understanding of the data flow and the semantics of the designed pipeline. Current debugging techniques are based on textual output mostly combined with table-based representations that allow hierarchical navigation. However, they neither provide information about spatial location of data nor follow a chronological sequence. We introduce an approach to visually analyze and interpret the data flow inside the design environment.

2 Our Approach

To recognize interaction patterns like gestures or multimodal input [Bolt 1980], interaction designers need to have a brief overview of the chronological flow of data within a predefined time span. By using the concept of semantic zooming the user is able to navigate to a visual layer that provides a top view to the flow of the interaction data [Figure 2 (b)]. This layer is directly located at each pipe, thus indicating a connection between two nodes [Figure 2 (a)]. The duration of a specific interaction is up to the length of its pattern. Therefore, the time-based view can be manipulated by the user interactively and provide insight into the currently flowing data. The types of interaction data vary in their dimensions of atomic values and so the visual plot of data types also vary in their visual representation. This means that for instance the representation of a position in 2D differs to the representation of a gesture being recognized [Figure 2 (b)]. Users are able to inspect frequent and parallel occuring data at a glance according to its spatial and chronological location. Thus, interaction designers benefit from the insight into the interaction data flow and are able to directly apply changes to it. These changes instantly effect the behavior of the interaction design, providing the possibility to gradually refine and test the configuration at run-time (e.g. changing noise level of a Kalman filter to compensate users' natural hand tremor) and allow the designer to achieve more natural and reliable interaction techniques. In our future research we will focus on the integration of Magic Lenses [Bier et al. 1993] to allow manipulations on the interaction data itself (e.g. ability to annotate data on-the-fly) to provide a deeper insight into users' interaction.

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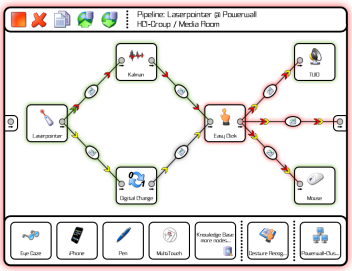

Figure 1: *View of a pipeline in the Squidy Design Environment. The pipeline receives position, button and inertial data from a laserpointer, applies a Kalman filter, a filter for change recognition and a filter for selection improvement and finally emulates a standard mouse to interact with conventional WIMP-applications. The data is alternatively sent via TUIO to listening applications.*

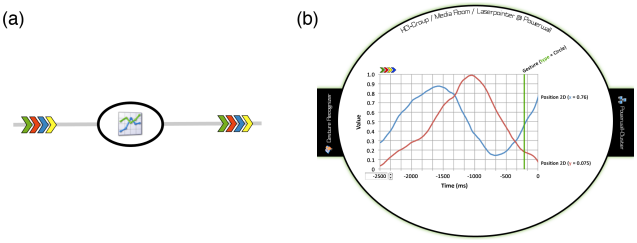

Figure 2: *Dataflow visualization for visual debugging within the Squidy Zoomable Design Environment based on the concept of semantic zooming. (a) Zoomed out representation of the dataflow visualization. (b) Shows a chronological flow of 2-dimensional positions (red and blue) and a gesture (green) that has been recognized by a gesture recognizer filter.*

References

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