SurfaceConstellations Applications: Use Cases of Ad-Hoc Reconfigurable Cross-Device Workspaces

Figure 1: SurfaceConstellation application (multi-channel audio mixing) using three connected tablets.

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Abstract

SurfaceConstellations is a modular hardware platform that allows users to easily create their own novel cross-device environments by assembling multiple mobile surfaces with 3D printed link modules. Our platform combines the advantages of multi-monitor workspaces and multi-surface environments with the flexibility and extensibility of more recent cross-device setups. The platform includes a comprehensive library of 3D-printed link modules to connect and arrange tablets into new workspaces, several strategies for creating new setups, and a web-based visual configuration tool for creating new setups and automatically generating link modules. We will demonstrate different use-case applications across the design space of reconfigurable cross-device workspaces and the configuration tool.

Author Keywords

Cross-device interactions; reconfigurable workspaces; multi surfaces; multi-display environment.

ACM Classification Keywords

H.5.2. User Interfaces

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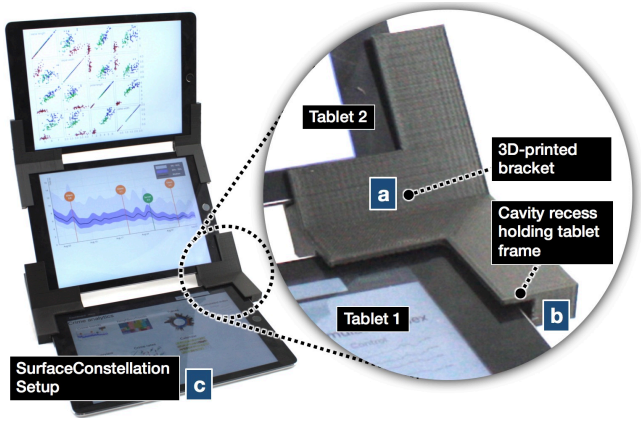

Figure 2. Details of the SurfaceConstellation 3d-printed bracket designs, connecting multiple tablets.

Cross-Device SurfaceConstellations

Since early visions such as Vannevar Bush's Memex [2], multi-display setups have been used to effectively support a variety of desktop computing activities: visual analytics, financial computing [1], business analytics dashboards, or video editing applications. Grudin notes that multi-monitor setups provide "*space with a dedicated purpose, always accessible with a glance*" and "*can facilitate versatility in use*" [3]. This expressive power of multi-display setups has also inspired work in *cross-device interaction*. Cross-device setups allow people to use interfaces that span across several inter-connected tablets, phones, and other devices. Like multi-monitor desktop setups, these systems provide a larger interaction space (e.g. more content displayed simultaneously, additional input space for gesture input) to interact with applications, whilst enabling one to dynamically add or remove devices from such a device ecology (e.g. [7–9, 11]).

We designed *SurfaceConstellations* (published at CHI 2018 [6]) to bridge the gap between the power and effectiveness of multi-monitor workstations with the flexibility and ad-hoc configurability of cross-device computing. To implement this vision, we designed a novel modular platform that enables users to easily assemble a large variety of spatial multi-surface arrangements (e.g., Figure 1 and 3). Our SurfaceConstellations 3D-printed brackets (Figure 2) physically connect tablets and phones to create larger dedicated workstation setups. The modularity of our platform enables a large spectrum of possible multi-surface setups that are easily reconfigurable and can support diverse working styles and applications. Our CHI '18 paper [6] introduces the detailed design space of Surface Constellations (inspired by Codex [4]), details of the 3D-printed brackets, support structures, flexible connections, capacitive links, and details of the application design. The source code for the algorithm creating new brackets (OpenSCAD) and hardware designs (STL format) are available as open-source [10]. In this demo extended abstract, we focus on selected use case applications that we will demonstrate at the conference.

Figure 3. Surface Constellation use case applications: (a) multi-player board game, (b) financial computing, (c) visual analytics.

Demonstration of Use Case Applications

In our live demo at the conference, we will demonstrate the following use case applications:

1. **Multi-channel audio mixing setup** (using the Soundcraft Ui24R server) combining multiple tablets in different configurations for effective access to control level faders, gain, and other controls (Figure 1). This setup also demonstrates the use of weight-balancing support extensions.

2. **Two-player board game,** using the SurfaceConstellation 'bridge' setup, with personal and shared views (Figure 3a).

3. **Financial computing 'trading desk' setup,** using SurfaceConstellation brackets to configure a vertical multi-tablet wall (Figure 3b). Multiple 30-degree brackets allow for a self-supporting setup of the wall.

4. **Visual analytics workstation,** using multiple tablets in a 'hybrid' setup (Figure 3c), where special brackets connect additional phone devices used as a control interface for multi-tablet data visualisations (similar applications like in VisTiles [5]).

Our CHI demonstration will show how to rapidly reconfigure work spaces and how to combine multiple brackets to new SurfaceConstellation setups. Furthermore, we demonstrate how to use the web-based configuration tool to easily create new sets of connection brackets, where the tool is dynamically creating new 3D-printing STL files based on specified parameters such as device type, thickness, angle between tablets and required support extensions (attendees will be able to receive the design and STL files of the constellations they are creating by email).

Conclusion

The SurfaceConstellation platform enables anyone with access to a 3D printer and multiple tablets/phones to design and construct one's own multi-surface workspace. Similar to the research field of cross-device interactions, we anticipate that an increasing number of available touch-screen devices will soon allow people to *use their devices in concert* – and that SurfaceConstellations arrangements can help to facilitate people's interaction with this larger number of devices. Importantly, we made the SurfaceConstellations designs available as open hardware and open software [10]. We aim to inspire users' creativity to build, use, and re-appropriate such environments for various scenarios of use, which we hope takes us one step closer to making cross-device applications available to the masses.

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