A Unified Model for Mapping Gestures to Tracking Sensors in Multi-Surface Environments

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Abstract

Multi-surface environments (MSEs) incorporate a wide variety of heterogeneous devices such as smart phones, tablets, tabletops and large displays into a single interactive environment. To enable natural and seamless interaction between these devices, designers and researchers have proposed a variety of gestures to perform different tasks (such as picking, dropping, flicking, etc.) in MSEs. These gestures often require using the spatial layout of the environment, and the spatial information of devices and users within the environment. This means instrumenting the environment or the devices with tracking technologies. However, implementations of these gestures have been subjective to the designers' choice of sensors and technologies, which typically results in the same gesture being implemented in a number of different ways. The lack of a unified model for mapping gestures to tracking sensors motivates our research. We intend to perform a study to elicit gestures in MSEs, to suggest tracking sensors that would enable these gestures.

Author Keywords

Gestures; interactions; HCI; multi-surface applications; multi-surface environments; multi-display interaction; cross-device interaction.

ACM Classification Keywords

H.5.2. Information interfaces and presentation: User Interfaces – Interaction styles, evaluation/methodology, user-centered design

Interest and Experiences

My research interests revolve around spatial-awareness in ubiquitous environments. My earliest work during my undergrad, involved working with graduate researchers on a framework for building multi-surface applications. My specific contribution was implementing an algorithm for combining input from multiple Microsoft Kinect sensors to track wider spaces and overcome occlusion problems [1]. This framework is now being used to explore MSEs in a number of industrial domains [3, 6] and I have also contributed to follow-up work in my MSc.

For my honors thesis in my undergrad, I did additional explorations in the field of MSEs. My project involved evaluating a device-based tracking approach in comparison to existing room-instrumentation approaches [2]. In that project, a commercial inertial measurement unit (IMU) was attached to a device in order to provide non-central tracking capabilities to each device in the environment.

Overall, my interests lie in exploring novel technologies and approaches, and enhancing existing implementations for achieving spatial-awareness and accurate tracking in multi-surface environments.

Open Research Issues

As mentioned earlier, MSEs integrate a variety of different devices – smartphones, tablets, digital tabletops, and large wall displays – into a single interactive environment [5]. Due to the diversity of these devices, not only could these environments utilize the distinct gestures associated with each of these devices, but also introduce novel cross-device gestures that were not possible before using individual devices.

For example, a tablet device can be used, individually, to perform a simple swipe gesture. However, using the spatial knowledge of devices in the room, a user can perform a swipe gesture to send content to a distant device in the environment -a flick gesture [4]. In a more playful scenario, two users can use their tablet devices to perform a throw and catch gestures by combining the swipe gestures on both tablets with the location and orientation information of both devices in the environment.

However, implementing these gestures requires the use of various tracking technologies, which come with different capabilities, ranges, and functions, leaving the choice of tracking technology for implementing a certain gesture (or set of gestures) subjective, in large, to the researchers' preference and availability of tracking technologies. Given the number of capable sensors and variety of gestures, an open question remains, how can we map the technology to the gestures and the environment? As a result, we propose to first run a gesture elicitation study to gather a set of inter-device gestures within multi-surface environments, and then mapping these gestures to a list of suggested implementation choices for tracking sensors.

We expect this study to produce a general sensor guideline for multi-surface system designers which can streamline the process of deciding on tracking

technologies considerations based on the desired gesture set.

Workshop Goals

As I have just started my master's program, I believe that attending this workshop can contribute to my future work and can lead to follow-on projects during the remainder of my MSc and eventual PhD. I also hope to gain some valuable feedback about my prospective study that was described in this paper, and to have the opportunity to network and exchange of ideas and perspectives with experienced researchers in this area

Bio

My name is Alaa Azazi. I am currently a first-year M.Sc. student in the Agile Surface Engineering lab at the University of Calgary. For the past two years, I had the opportunity to work as a research assistant in the Agile Surface Engineering group under the supervision of Dr. Frank Maurer, during which my interest in the field had started to shape. I hold a B.Sc. in Computer Science and a B.Sc. in General Mathematics, both from the University of Calgary.

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