

Abstract

Extending Interaction using Hand Motor Skills and Physical Objects on Capacitive Touch Surfaces

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Generally, creative or speculative activities are performed on planar surfaces. From ancient times, humans have written characters, drawn, or painted on surfaces. Even today, several types of activities are performed on or toward surfaces, such as filling out a document, performing handicraft work on a table, drawing on a canvas, illustrating something on a white board, preparing food on a cutting board, reading braille on a plate, or playing board games.

Surfaces for creative or speculative activity have been computer-augmented by adding the functionality of an I/O device. Touch surfaces, such as those used in trackpads, smartphones, tablet PCs, and smart watches, have become widespread and are currently the most preferred user input method. The interactions on touch surfaces can also be positioned as the history of human and planar surfaces for creative or speculative activities. Touch surfaces provide single-touch, multi-touch, and touch gesture inputs. They show promising potential for expanding touch inputs. However, considering the various human activities on real world surfaces, there are still significant opportunities for improvement.

The purpose of this research is to extend touch interaction techniques by introducing richer finger motor skills towards real world surfaces to operations for touch surfaces. First, this thesis tracks the history of the touch surface and its technical trends. Second, it discusses the uniqueness and differences of my approach compared with various related domains or work for extending interactions on touch surfaces. Following this, to introduce finger motor skills to interactions performed on touch surfaces, I considered two approaches. The first approach uses a physical interface on a touch surface, i.e. sensing various finger motions on the interface and utilizing it for input operations. The

second approach is introducing metaphors of motion that humans perform in the real world (motion metaphor). Similar to swiping or pinching gestures, this approach uses touch input based on operations prompted by the motion metaphors. Based on the above approaches, the research reported in this thesis proposes five novel interfaces. This thesis reports on the design, development, and evaluation for each individual interface proposal .

Through research with the first approach, I discuss the design guidelines for creating physical interfaces for touch surfaces. In previous work, comprehensive discussion on this topic has never taken place.

I then discuss through research with the second approach, how to introduce real world things to the virtual world.

Although it is a very promising concept for intuitive operations, this simultaneously introduces some physical limitations and difficulties. I also discuss this topic and present potential opportunities from the perspective of Human–Computer Interaction. Finally, I summarize features of extending the touch interaction technique discussed in this thesis and discuss future possibilities for touch surfaces.