Application Oriented Semantic Multi-touch Gesture Description Method

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Abstract. To make multi-touch gestures better fit applications and facilitate the recognition of multi-touch gestures, this paper presents an application oriented semantic multi-touch gesture description method. Multi-touch gestures are divided into atomic and combined gestures. The atomic gesture corresponds to a single trajectory and is represented by the shape feature of the trajectory; the combined gesture is consisted of multiple trajectories and modeled by atomic gestures with spatial, temporal and logical relationships. Semantic constraints of a specific application are added and represented by the accessible relationship between entity states and combined gestures. A description tool is developed and examples show that this method is independent of multi-touch platforms and system environments, and it can improve the recognition efficiency. It should be of significant utility to advance the use of multi touch technology.

Keywords: Human-computer interaction, multi-touch, multi-touch gesture description.

1 Introduction

Multi-touch technology [1] allows users to interact with applications through natural hand gestures and even permits multiple users to work together through collaborative hand gestures. It has gained much attention recently due to widely-disseminated research conducted by Han et al. [2] and with the advent of the iPhone [3] and Microsoft Surface [4].

Multi touch technology can be divided into two parts, one is the multi touch platform including physical setup, detecting, locating and tracking touch points, and there have been significant advances in this part [5]; the other is multi touch gesture, including gesture description and recognition. Multi-touch gesture is the bridge between users and applications, mapping users’ operations into specific application functionalities, and it plays an important role in bringing multi touch into wide use. At present, multi touch gesture studies have mostly focused on recognition, belonging to the research hotspot of dynamic gesture recognition. Very few studies are dedicated to the multi-touch gesture description methods, however robust and customizable multi-touch gestures are of urgent need to advance the application of multi touch technology.
Multi-touch gesture description is to describe multi-touch gestures in a manner both users and computers can understand. It should be easy to customize multi-touch gestures for different applications and users, and robust enough to users’ differences on the same gesture. It should also facilitate the recognition process. Moreover, the description result should be seamless migrated to applications with different system environments like multi-touch platforms and operation systems.

This paper addresses these issues via an application oriented semantic multi-touch gesture description method. Multi-touch gestures are decomposed into atomic gestures and combined gestures, where an atomic gesture is represented by the shape feature of a touch point trajectory, and a combined gesture is composed of atomic gestures with temporal, spatial and logical relationships. Semantic constraints extracted from the application are added on combined gestures and represented by accessible relationship between entity states and combined gestures. During the description process, firstly map the users’ intentions into combined gestures and decompose them into atomic gestures, then define the accessible relationships between combined gestures and entity states according to semantic constraints. The solution proposed here should prove to be of significant utility to bring multi-touch into wide use.

Section 2 of this paper presents the related works to the topic, while Section 3 outlines the description framework. In Section 4, we detail our description method. In Section 5 we develop a multi-touch gesture description tool based on our method, and analyze the description results for a specific application; a summary and directions for future work are offered in Section 6.

2 Related Works

While there are many studies on developing different kinds of novel multi-touch platforms and applications, there is little effort or organized activity on generalizing or standardizing multi-touch gesture description principles other than some definition of available gestures for specific applications.

Wu et al. [6] proposed a set of design principles for constructing multi-hand gestures on touch surfaces in a systematic and extensible manner, including gesture registration, relaxation, and reuse, and developed a set of gestures to embody these principles. The user evaluation assessing the usability of these gestures is of significant utility to following interface designers.

Elias et al. [7] presented a multi-touch gesture dictionary containing a plurality of entries, each corresponding to a particular chord. The gesture dictionary may take the form of a dedicated computer application used to look up the meaning of gestures, or to assign user-selected meanings to gestures. It can be incorporated with all computer systems like desktop, notebook, handheld, and so on.

Songyang Lao et al. [8] brought forward a model composed of three levels (action, motivation and computing, and mappings rules between them). The model allows users to reuse touch types in different platforms and applications in a more systematic manner.

These are all very useful contributions to multi-touch gesture description, and more amounts and varieties of such work are required to advance it considering the early stage of our understanding in this area.