ture. Simply put, it means that the number of contact points can be changed (increased or decreased) while a user is interacting. Current multi-touch gestures recognition engines do not fulfill the second prerequisite. For example, Apple® and Synaptics® multi-touch trackpads do not allow a user to perform a continuous sequence of different multi-touch gestures, i.e. a sequence of temporally contiguous multi-touch gestures in which the user does not lift off all his/her fingers until the end of the last multi-touch gesture. Indeed, once a multi-gesture is recognized, the user can not perform another multi-touch gesture until he/she lift off his/her fingers and put back them down on the multi-touch surface. For example, if the system recognizes a pinch gesture performed with two fingers and the user puts an additional finger down after the pinch gesture is recognized, the system will not even try to recognize any three fingers gesture: the user will have to lift its fingers off the multi-touch input device and put back them again in order to perform a new gesture.

[0011] Accordingly, one of the objects and advantages of the present invention is to provide an approach to segment a sequence of user inputs into temporally contiguous elementary multi-touch gestures and hence performing a continuous recognition of multi-touch gestures. Further objects and advantages of the present invention will become apparent from a consideration of the drawings and ensuing description.

SUMMARY OF THE INVENTION

[0012] The present invention extends to methods, systems, and computer program products for continuous recognition of multi-touch gestures. It can be used with any multi-touch device. Multi-touch refers to a system that can independently detect and optionally track the position of two or more contact points at the same time. Illustrative multi-touch devices include, but are not limited to, tables, walls or touch-pads.

[0013] At least certain embodiments of the present invention include a computer environment with applications interacting with a recognition engine to provide gesture operations in their user interfaces. The gesture operations include performing actions, such as rotation or zoom in/out, in response to user's input.

[0014] The invention relates, in another embodiment to a multi-touch gesture recognition method that can detect a plurality of gestures being performed concurrently on at least one multi-touch input device. The method also includes producing different actions for each of the gestures that have been detected.

[0015] The invention will be readily understood by the following detailed description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several aspects of the invention and together with the following description serve to explain the principles of the invention. In the drawings:

[0017] FIG. **1** is a block diagram illustrating an example system configuration according to one embodiment of the invention.

[0018] FIG. **2** is a block diagram illustrating an example distributed architecture in accordance with one embodiment of the invention.

[0019] FIG. **3** is a flow diagram illustrating a multi-touch gesture processing method in accordance with one embodiment of the invention.

[0020] FIG. **4** is a block diagram illustrating the first step of the flow diagram described in FIG. **3**.

[0021] FIG. **5** is a block diagram illustrating the second step of the flow diagram described in FIG. **3**.

[0022] FIG. **6** is a block diagram illustrating the third step of the flow diagram described in FIG. **3**.

[0023] FIG. **7** illustrates a spatial segmentation of contact points to associate each of them with an application.

[0024] FIG. **8** illustrates a filtering process of contact points based on user interface elements.

[0025] FIG. **9** illustrates a spatial filtering process of contact points.

[0026] FIG. **10** illustrates a method to control the continuum of gestures using a finite state machine.

[0027] FIG. **11** illustrates different arrangement of three contact points.

[0028] FIG. **12** illustrates a zoom gesture using two fingers.

[0029] FIG. **13** illustrates a rotation gesture using two fingers.

[0030] FIG. **14** is a flow diagram of a method to distinguish a zoom gesture from a rotation gesture in accordance to one embodiment of the invention.

[0031] FIG. **15** illustrates a multi-touch gesture performed on a user interface element displayed on two multi-touch devices at once.

[0032] FIG. **16** illustrates a multi-touch gesture performed on a user interface element displayed on two remote multi-touch devices at once.

DETAILED DESCRIPTION OF THE INVENTION

[0033] The present invention extends to methods, systems, and computer program products for continuous recognition of multi-touch gestures. Some aspects of the invention are discussed below with reference to FIGS. **1-16**. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as numerous further embodiments and many alternatives ways of implementing the methods of the present invention than mentioned below are possible without departing from the inventive concepts disclosed herein. The specification and drawings are accordingly to be regarded as an illustrative sense rather than a restrictive sense.

[0034] Multi-touch devices can independently detect and optionally track the position of two or more contact points at the same time. It allows a single user to interact with several fingers and multiple users to interact and collaborate on the same display simultaneously. Its ability to have several interactions in parallel allows richer interactions, more particularly multi-touch gestures, which take user experience beyond classic touch interactions such as clicks and drag-n-drop.

[0035] Multi-touch gesture is an interaction where the system interprets several input flows as contributing to a single gesture. The gestures can be either static i.e. a given arrangement of contact points, or dynamic i.e. defined by a continuous movement of one or more contact points across the multi-touch surface. An example of static gesture is ten fingers to invoke a virtual keyboard. An example of dynamic gesture is a two fingers pinch to zoom out (see FIG. **12**).

[0036] A contact point can be associated to a finger, a hand or any other parts of the body.