STATE-BASED APPROACH TO GESTURE IDENTIFICATION

RELATED APPLICATIONS

[0001] This application is related to U.S. utility patent application Ser. No. 10/913,105 entitled "Touch Detecting Interactive Display", attorney docket number APPL0053, filed Aug. 6, 2003, and U.S. provisional patent application Ser. No. 60/647,343 entitled "Touch Table Touch Detection and Gesture Recognition Technologies", attorney docket number APPL0058PR, filed Jan. 25, 2005, and U.S. provisional patent application Ser. No. 60/701,892 entitled "Interactive Display Technologies", attorney docket number APPL0065PR, filed Jul. 22, 2005, which applications are incorporated herein in their entirety by this reference thereto.

BACKGROUND

[0002] 1. Technical Field

[0003] The invention relates to interactive displays. More particularly, the invention relates to touch detecting, multi-user, interactive displays.

[0004] 2. Description of the Prior Art

[0005] There are many situations in which one or more individuals interactively explore image based data. For example, a team of paleontologists may wish to discuss an excavation plan for a remote dig site.

[0006] To do so, they wish to explore in detail the geographic characteristics of the site as represented on digitized maps. In most laboratories, this would require the team to either huddle around a single workstation and view maps and images on a small display, or sit at separate workstations and converse by telephone.

[0007] One approach to addressing this shortcoming is a touch detecting interactive display, such as that disclosed in the referenced patent filing "Touch Detecting Interactive Display." In such a system, an image is produced on a touch detecting display surface. The locations at which a user contacts the surface are, determined and, based on the position of the motions of these locations, user gestures are determined. The display is then updated based on the determined user gestures.

[0008] FIG. **1** shows several users operating an exemplary touch detecting interactive display. The users **50** surround the display **100** such that each can view the display surface **150**, which shows imagery of interest to the users. For example, the display may present Geographic Information System (GIS) imagery characterized by geographic **161**, economic **162**, political **163**, and other features, organized into one or more imagery layers. Because the users can comfortably surround and view the display, group discussions and interaction with the display is readily facilitated.

[0009] Corresponding with the display surface is a touch sensor **155** that is capable of detecting when and where a user touches the display surface. Based upon the contact information provided by the touch sensor user gestures are identified and a command associated with the user gesture is determined. The command is executed, altering the displayed imagery in the manner requested by the user via the gesture. For example, in FIG. **1**, a user **55** gestures by placing his fingertips on the display surface and moving them in an outwardly separating manner.

[0010] Many touch sensors used n displays, such as that shows in FIG. **1**, such as the Smart Board from Smart Technologies of Calgary, Canada, provide the coordinates of one or more detected contacts.

[0011] Typically, the contact information is updated over time at discrete intervals, and based upon the motion of the contact locations, user gestures are identified. Determining gestures from the contact information alone, however, provides considerable challenge. Gesture Identification schemes often fail to correctly address imperfections in

[0012] Simultaneity. For example, consider a user intending to initiate two contacts simultaneously and perform a single, coordinated gesture involving the two contacts. Invariably, a slight temporal separation is present between the time the first contact is initiated and the time the second contact is initiated. Based on this separation, many gesture identification schemes erroneously determine that the contacts are associated with two distinct gestures.

[0013] Singularity. For example, consider a user intending to initiate and drag a single contact. The user initiates the contact with a single extended finger inclined at an angle to the touch sensor and drags the finger to one side.

[0014] However, during the dragging motion, the user inadvertently decreases the inclination of his finger, and the user**3** s knuckles initiate a second contact. As the second contact is separated both temporally and spatially from the initial contact, many gesture identification schemes erroneously determine that the second contact is associated with a new and distinct gesture.

[0015] Stillness. For example, consider a user intending to designate an object with a single stationary, short duration contact. Inadvertently, the user moves the contact slightly between initiation and termination. Based on this motion, many gesture identification schemes erroneously determine that the motion is a dragging gesture.

[0016] In each of these cases, the gesture identification scheme has failed in that the intent of the user is not faithfully discerned.

[0017] Systems addressing the above deficiencies have been proposed. For example, in U.S. Pat. No. 5,543,591 to Gillespie et al a touch sensor provides, on a provisional basis, all motions of a detected contact to a host computer, to be interpreted as cursor movements. If, however, the contact is terminated within a short period of time after initiation of the contact and the distance moved since initiation of the contact is small, the cursor motions are reversed and the contact is interpreted as a mouse click. However, while this approach may be suitable for control of a cursor, it is not suitable for control of imagery, where undoing motions may lead to significant user confusion. Thus, despite such improvements, it would be advantageous to provide a more reliable method of classifying user gestures from contact information that more accurately discerns the intent of a user in performing the gesture.