(54) **GESTURE CONTROLS FOR MULTI-SCREEN HIERARCHICAL APPLICATIONS**

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(57) **ABSTRACT**

Control of a computing device using gesture inputs. The computing device may be a handheld computing device with a plurality of displays. The displays may be capable of displaying a graphical user interface (GUI). The plurality of displays may be modified in response to receipt of a gesture input such that a hierarchical application having related GUI screens are modified in response to the gesture input. The modification may include changing the hierarchical application from being displayed in a single screen mode to being displayed in a multi screen mode or vice versa.

100

102

104

DISPLAY

DISPLAY

110

112

106
TOUCH
SENSOR

116
PROCESSOR

108
TOUCH
SENSOR

114

BATTERY

118

COMMUNICATIONS
MODULE

126
ANTENNA

130
I/O
MODULE

HARDWARE
BUTTONS

134

120

MEMORY
MODULE

122

AUDIO
MODULE

124

CAMERA
MODULE

128

ACCELEROMETER
MODULE

132

FIG.1

136

138a D1	138b D2	138c D3	138d D4	138e D5	138f D6

FIG.2A

142 1.1	144 1.2	146 1.3

FIG.2B

140

148a 4	148b 5	148c 6

FIG.2C

166

FIG.2D

138

D1

102

168

FIG.3A

166

104

170

FIG.3B

D2

138

172a

102

FIG.3C

X

148

102

172b

FIG.3D

102

D1

D2

138a

138b

104

174

FIG.3E

148

X

102

138

D2

104

175

FIG.3F

156

A1

175

FIG.3G

148   102

X

168

FIG.3H

152   102

A1

168

FIG.3I

152   138

A1   D2

102

174   104

FIG.3J

102   152   152   104

A1

174

FIG.3K

TAP

190

192

186

LONG PRESS

190

192'

188

DRAG

190

192

194

176

FLICK

190

192"

194

178
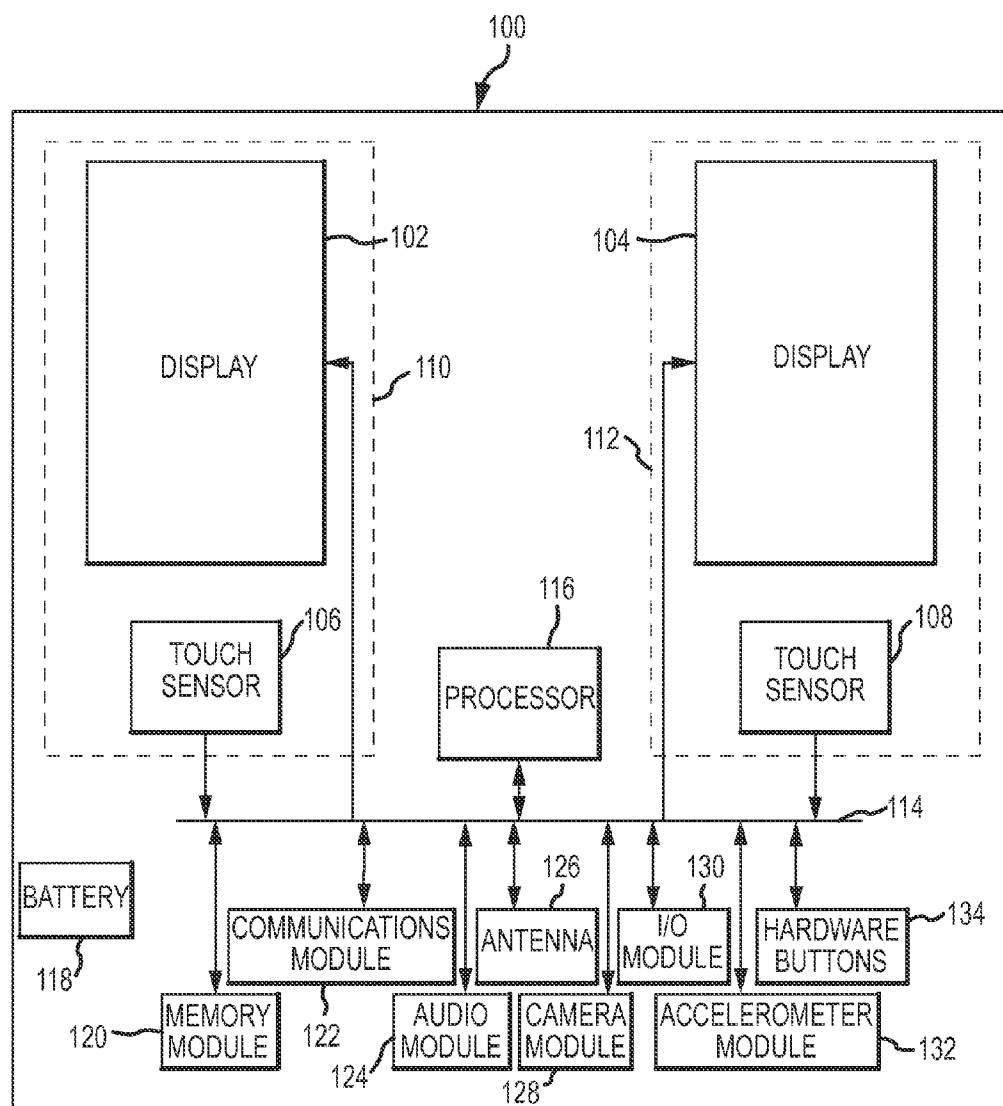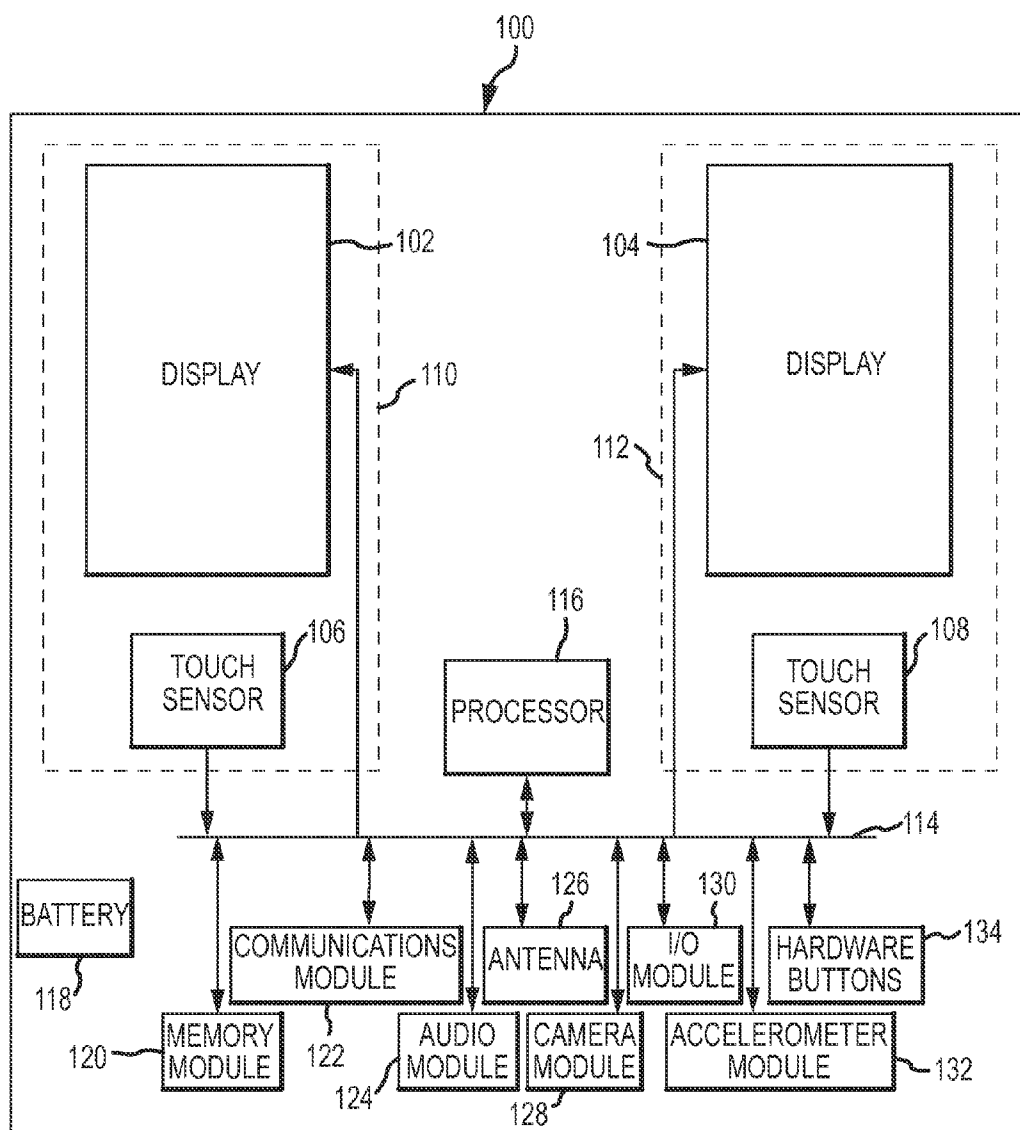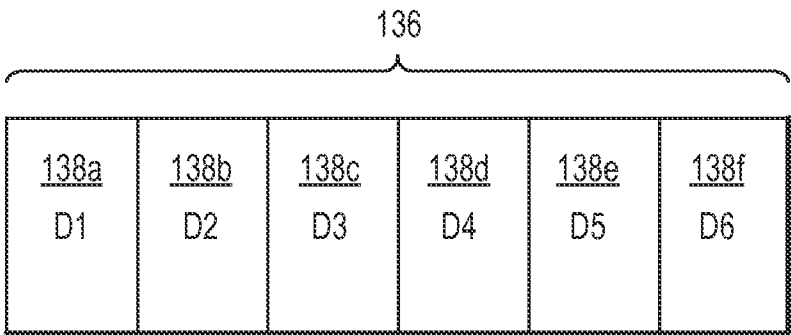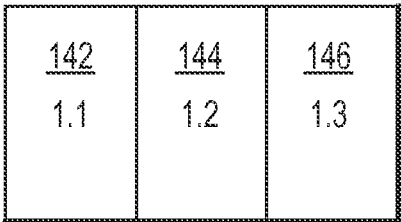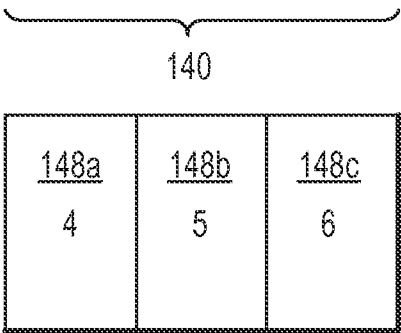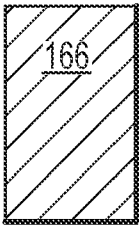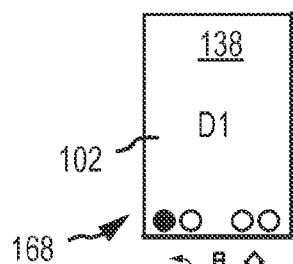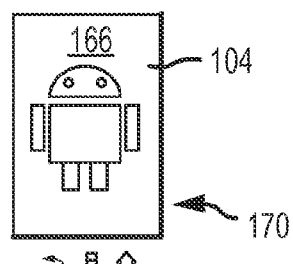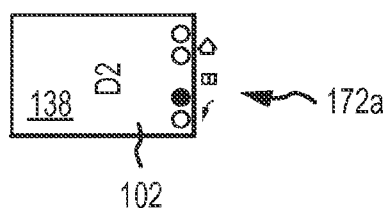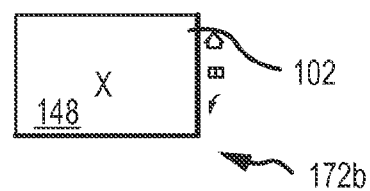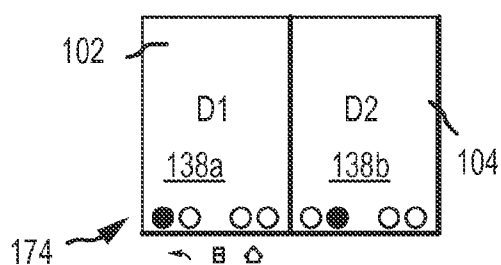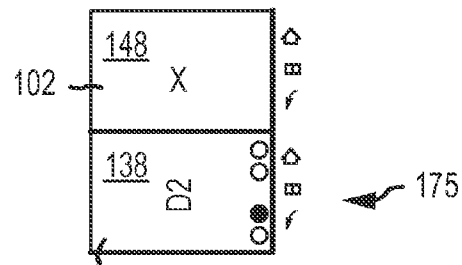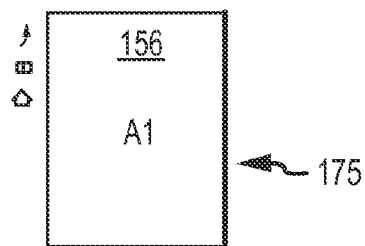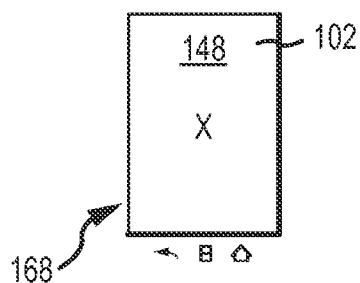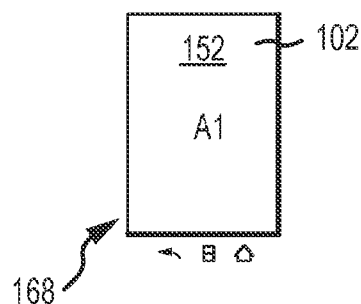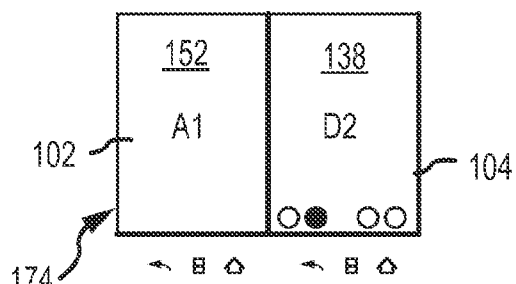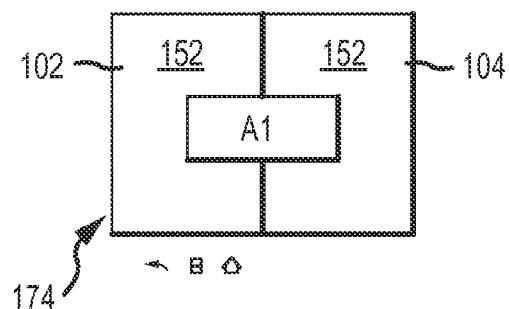
FIG.4

FIG.5A

FIG.5B

FIG.6A

FIG.6B

106'

196

104

102

FIG.7A

106"   108"

196

104

102

FIG.7B

208

206

210

204

176'

190

192
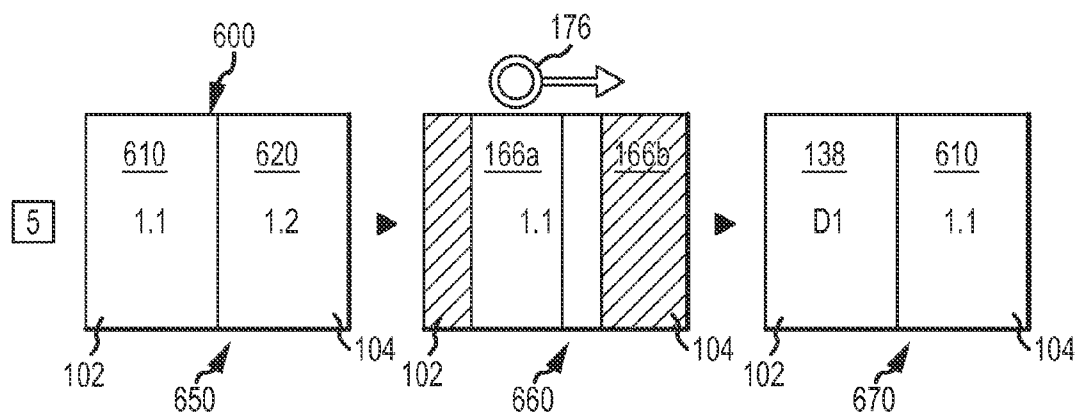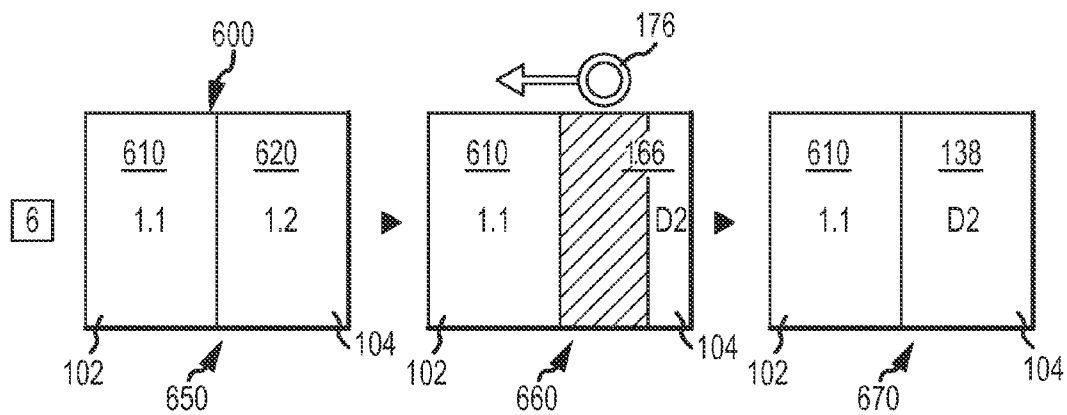
FIG.8

GESTURE CONTROLS FOR MULTI-SCREEN HIERARCHICAL APPLICATIONS

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Ser. No. 61/389,000, filed Oct. 1, 2010, entitled "DUAL DISPLAY WINDOWING SYSTEM"; Provisional Application Ser. No. 61/389,117, filed Oct. 1, 2010, entitled "MULTI-OPERATING SYSTEM PORTABLE DOCKETING DEVICE"; and Provisional Application Ser. No. 61/389,087, filed Oct. 1, 2010, entitled "TABLET COMPUTING USER INTERFACE". Each and every part of the foregoing provisional applications is hereby incorporated by reference in their entirety.

BACKGROUND

[0002] As the computing and communication functions of handheld computing devices become more powerful, the user interface and display elements of such devices have evolved by attempting to adapt user interface regimes developed for personal computers for use with handheld computing devices. However, this attempt to adapt prior user interface regimes has been met with various hurdles.

[0003] For instance, the majority of current handheld computing devices make use of a physical keypad for user interface. Many different implementations of physical keypads exist that vary in orientation and relationship to the device screen. However, in every case the physical keypads take up a certain percentage of the physical space of the device and increase the weight of t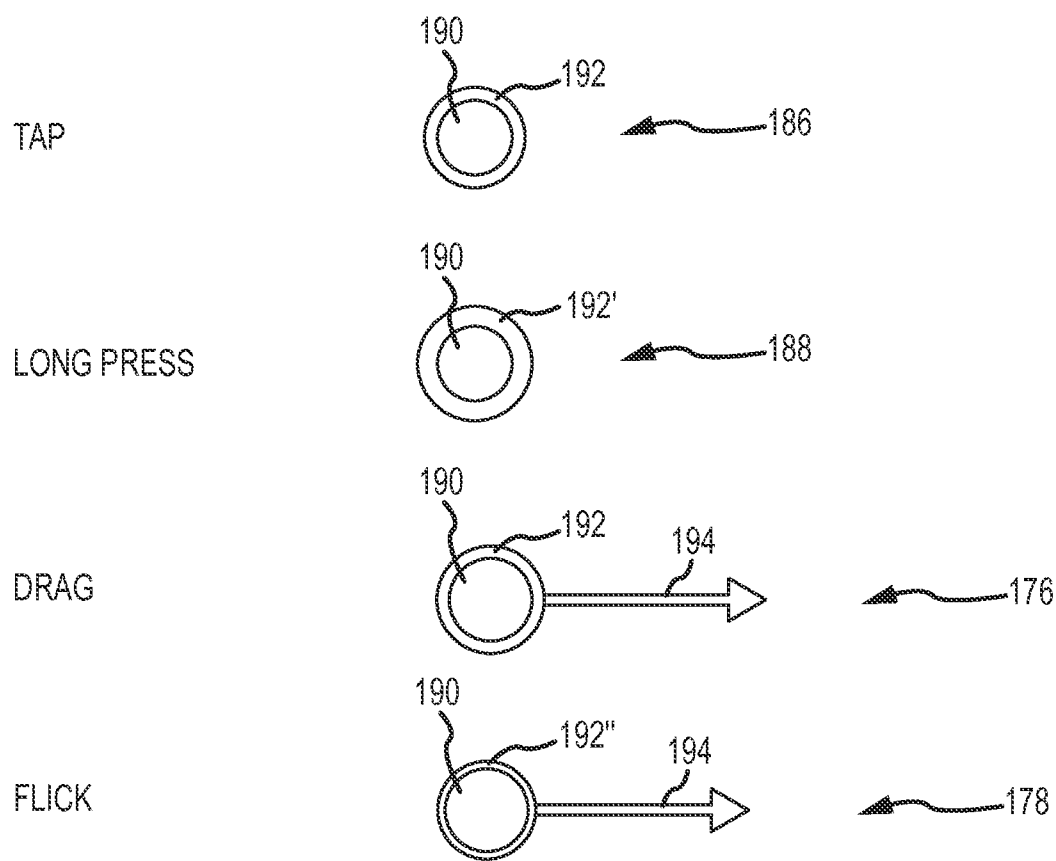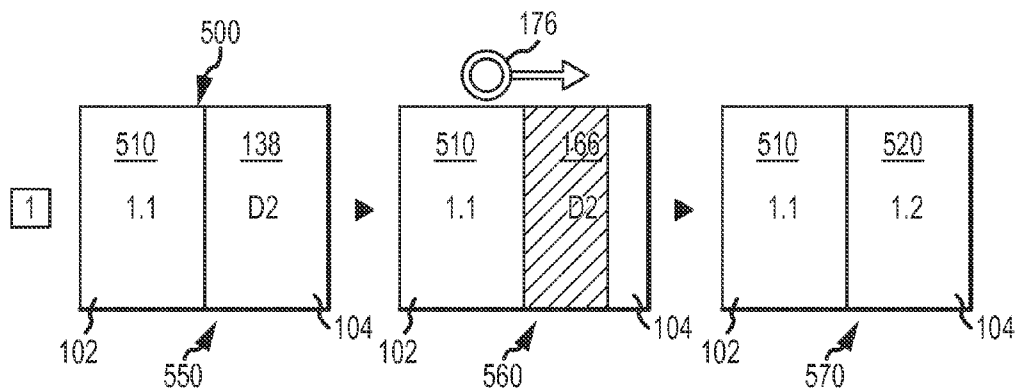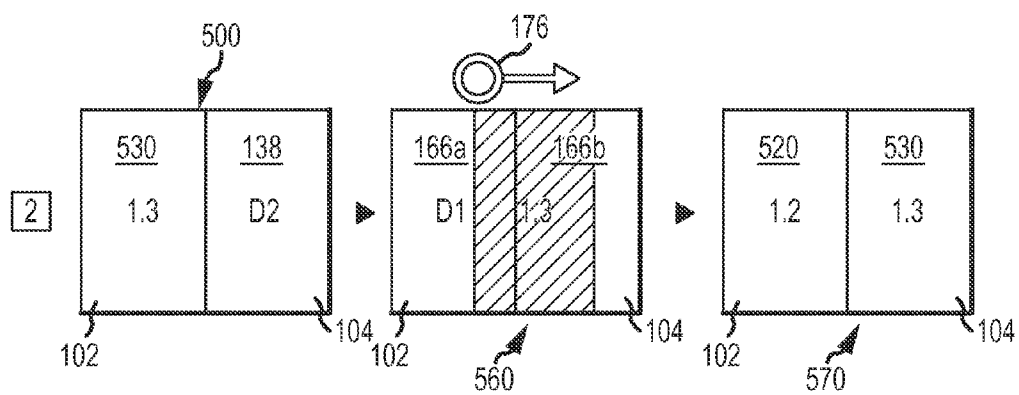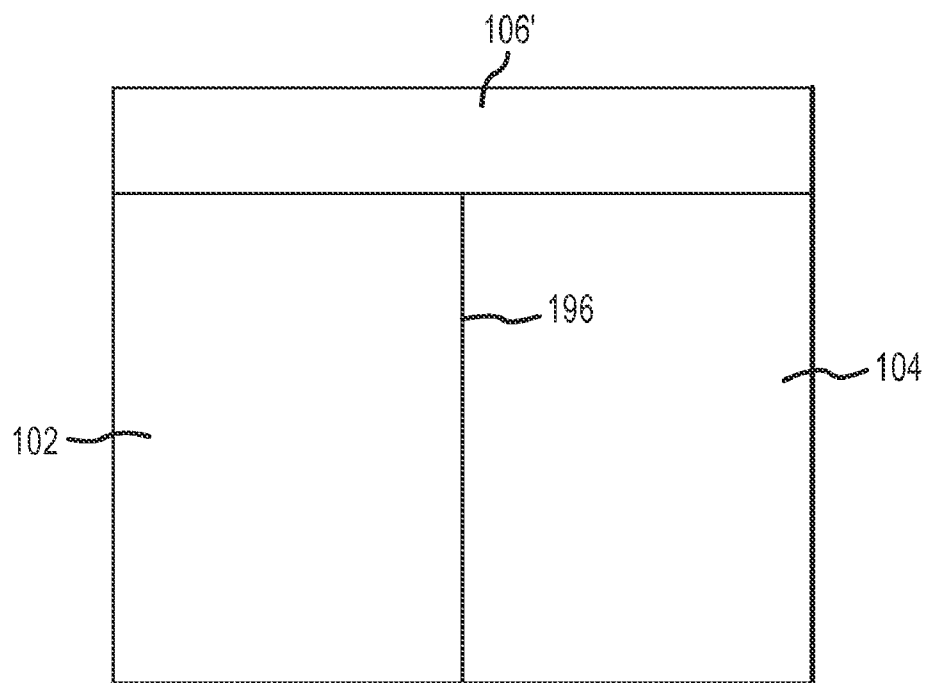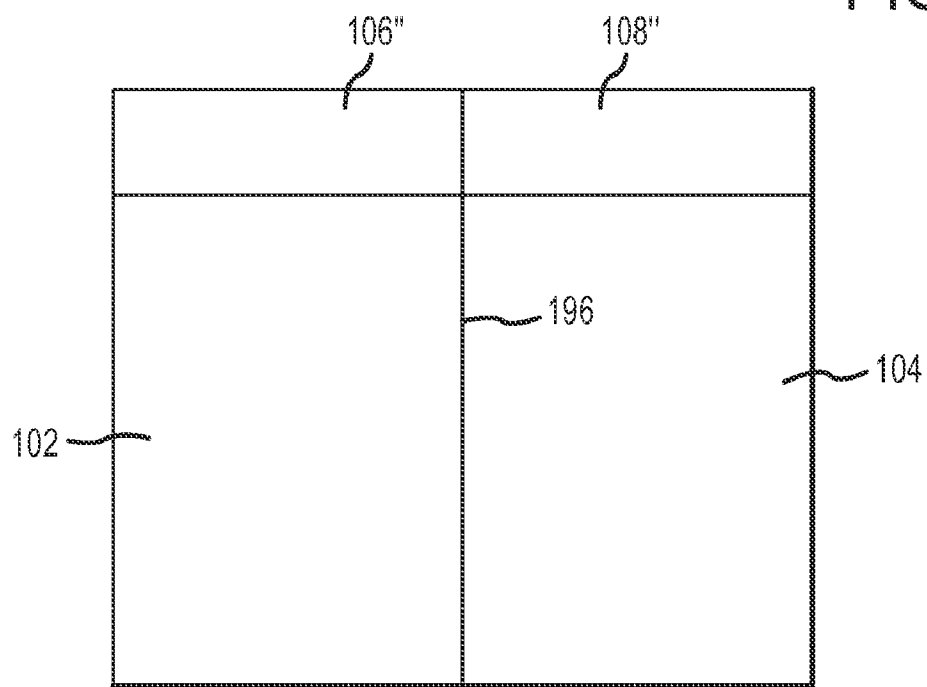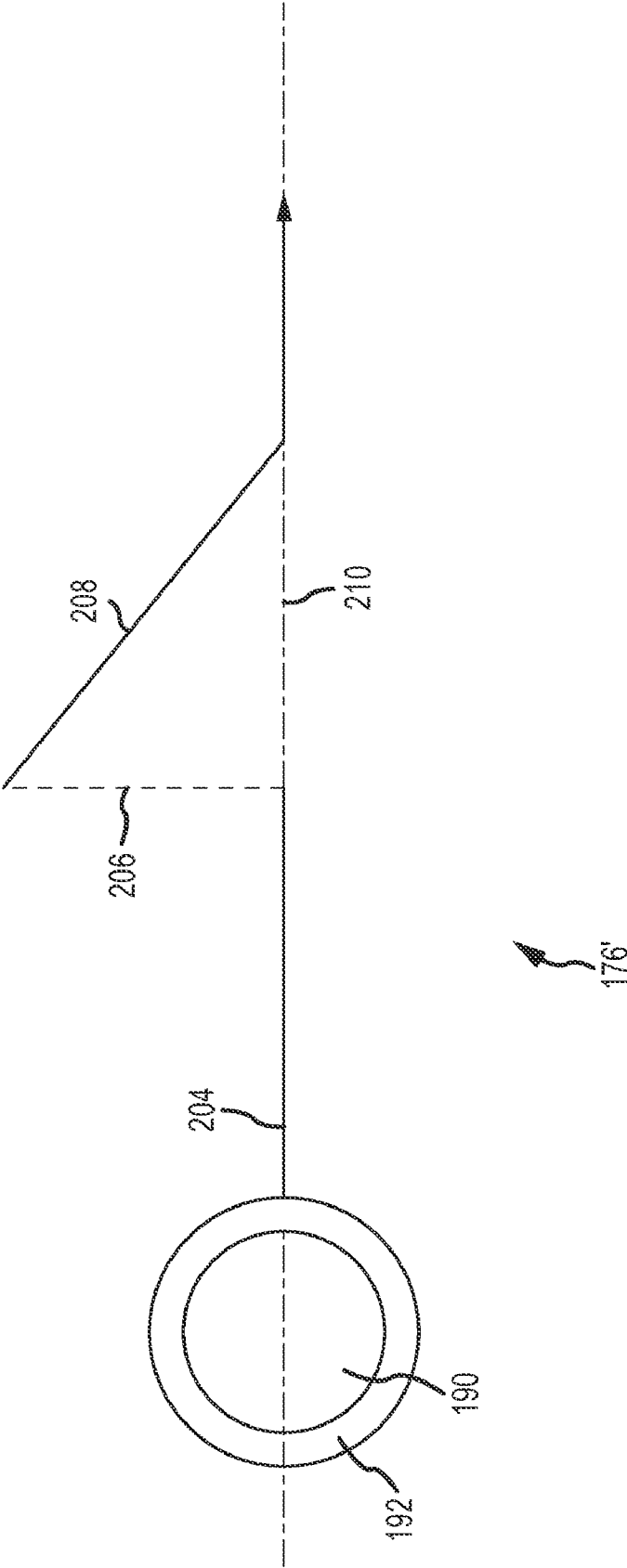he device. In addition to the disadvantages of size and weight, physical keypads are not configurable in the same manner as a touch screen based user interface. While certain limited forms of physical keypads currently have, on the keys themselves, configurable displays, such as eInk or OLED surfaces, to allow for reconfiguration of the keys, even in these cases, the physical layout of keys is not modifiable. Rather, only the values associated with the physical keys on the keypad may be changed.

[0004] Other methods may provide increased user configurability of physical keypads. These methods may include stickers and/or labels that can be added to keys to reference modified functions or plastic overlays on top of the keypad denoting different functional suites. For instance, the ZBoard keyboard, meant for laptop or desktop computer use, incorporates a dual layered physical keyboard which separates the keys and their layout from the connections which send signals to the machine. As such, different physical keyboard inserts for different applications can be inserted into a holder allowing full configurability such that the orientation and layout of the keys in addition to their denotation of function is configurable. This model could be extended to handheld computing devices; however, the rate at which such a modular keypad can change functions is much slower than a touch screen user interface. Furthermore, for each potential functional suite, an additional physical key layout must be carried by the user, greatly increasing the overall physical size and weight of such implementations. One advantage of a physical keypad for handheld computing devices is that the user input space is extended beyond the user display space such that none of the keys themselves, the housing of the keys, a user's fingers, or a pointing device obscure any screen space during user interface activities.

[0005] A substantial number of handheld computing devices make use of a small touch screen display to deliver display information to the user and to receive inputs from the user. In this case, while the configurability of the device may be greatly increased and a wide variety of user interface options may be available to the user, this flexibility comes at a price. Namely, such arrangements require shared screen space between the display and the user interface. While this issue is shared with other types of touch screen display/user interface technology, the small form factor of handheld computing devices results in a tension between the displayed graphics and area provided for receiving inputs. For instance, the small display further constrains the display space, which may increase the difficulty of interpreting actions or results while a keypad or other user interface scheme is laid overtop or to the side of the applications in use such that the application is squeezed into an even smaller portion of the display. Thus a single display touch screen solution, which solves the problem of flexibility of the user interface may create an even more substantial set of problems of obfuscation of the display, visual clutter, and an overall conflict of action and attention between the user interface and the display.

[0006] Single display touch screen devices thus benefit from user interface flexibility, but are crippled by their limited screen space such that when users are entering information into the device through the display, the ability to interpret information in the display can be severely hampered. This problem is exacerbated in several key situations when complex interaction between display and interface is required, such as when manipulating layers on maps, playing a game, or modifying data received from a scientific application. This conflict between user interface and screen space severely limits the degree to which the touch based user interface may be used in an intuitive manner.

SUMMARY

[0007] A first aspect of the present invention includes a method for controlling a plurality of displays of a handheld computing device. The method includes executing a hierarchical application on the handheld comparing device. The hierarchical application includes a plurality of related familial screens. The method further includes displaying a first screen of the plurality of related familial screens on a first display of the plurality of displays and receiving a first gesture input at the handheld computing device. In turn, the method involves modifying at least one of the plurality of displays in response to the receiving such that a second screen of the plurality of related familial screens is displayed on one of the first display and the second display and the first screen is displayed on the other of the first display and the second display.

[0008] A second aspect of the present invention includes a method for controlling a plurality of displays of a handheld computing device. This method includes executing a hierarchical application on the handheld comparing device. The hierarchical application includes a plurality of related familial screens. The method further includes displaying a first screen of the plurality of related familial screens on a first display of the plurality of displays and a second screen of the plurality of related familial screens on a second display of the plurality of displays. A first gesture is received at an input at the handheld computing device. In turn, the method includes modifying at least one of the plurality of displays in response

to the receiving such that only the first screen is displayed in one of the first display and second display.

[0009] A third aspect of the present invention includes a handheld computing device. The device includes a processor that is operable to execute a hierarchical application comprising a plurality of related familial screens. Also, a first display in operative communication with the processor is operable to display at least one of the related familial screens. Additionally, a second display in operative communication with the processor is operable to display at least one of the related familial screens. The device includes a touch gesture sensor (e.g., a touch sensitive portion) that is in operative communication with the processor and is operable to receive a touch input. The processor, upon receipt of a gesture, is operative to modify at least one of the first display and second display to change the related familial screens displayed.

[0010] A number of feature refinements and additional features are applicable to the foregoing aspects. These feature refinements and additional features may be used individually or in any combination. As such, each of the following features that will be discussed may be, but are not required to be, used with any other feature or combination of features of any of the aspects presented herein.

[0011] In one embodiment, the gesture input may be directional, and the modifying may correspond to a direction of the gesture input. That is, the result of the modifying operation may be carried out such that at least a portion of the modifying occurs in the direction of the gesture. In one embodiment, the gesture input may be a drag gesture.

[0012] In another embodiment, the first screen may be a parent screen and the second screen may be a node screen of the parent screen. For instance, the node screen may be related to the parent screen as a child thereof. Alternatively or additionally, the first screen may be a node screen and the second screen may be a parent screen of the node screen. The modifying may include displaying the second screen in the second display. Additionally, the modifying may include displaying the first screen in the second display and displaying the second screen in the first display.

[0013] In still another embodiment the handheld computing device may be a smartphone. Additionally, the first display and second display may be positionable with respect to each other between an open and closed position. For instance, when in the open position, the first display and the second display may be concurrently visible from the vantage point of a user. Additionally, when in the closed position, only one of the first display and the second display may visible from the vantage point of a user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a schematic view of an embodiment of a handheld computing device.

[0015] FIGS. 2A-D are graphical representations of an embodiment of a handheld computing device in various instances of operation.

[0016] FIGS. 3A-K are graphical representations of an embodiment of a handheld computing device provided in different positions, orientations, and instances of operation.

[0017] FIG. 4 includes graphical representations of various gesture inputs for controlling a handheld computing device.

[0018] FIGS. 5A and 5B are graphical representations of one embodiment of a handheld computing device functioning in response to a received gesture input.

[0019] FIGS. 6A and 6B are graphical representations of another embodiment of a handheld computing device functioning in response to a received gesture input.

[0020] FIGS. 7A and 7B are schematic views of embodiments of a handheld computing device provided with touch sensitive devices.

[0021] FIG. 8 is a graphical representation of an embodiment of a gesture input.

DETAILED DESCRIPTION

[0022] The present disclosure is generally related to gesture inputs for interaction with a computing device. The interface controls are particularly suited for control of devices that have one or more displays capable of displaying graphical user interfaces (GUIs) on a handheld portable device. The following disclosure may, in various embodiments, be applied to other computing devices capable of displaying and responding to a GUI (e.g., laptop computers, tablet computers, desktop computers, touch screen monitors, etc.) and is not intended to be limited to handheld computing devices unless otherwise explicitly specified.

[0023] FIG. 1 depicts an embodiment of a handheld computing device 100. The handheld computing device 100 may include a first display 102 and a second display 104. Additionally, while two displays (102, 104) may be shown and described below with regard to the functionality of various embodiments of handheld computing devices, a handheld computing device may be provided that includes more than two displays. In any regard, the first display 102 and the second display 104 may be independently controllable. The displays may be operative to display a displayed image or "screen". As used herein, the term "display" is intended to connote device hardware, whereas "screen" is intended to connote the displayed image produced on the display. In this regard, a display is a physical hardware that is operable to render a screen. A screen may encompass a majority of the display. For instance, a screen may occupy substantially all of the display area except for areas dedicated to other functions (e.g., menu bars, status bars, etc.) A screen may be associated with an application and/or an operating system executing on the handheld computing device 100. For instance, application screens or desktop screens may be displayed. An application may have various kinds of screens that are capable of being manipulated as will be described further below. In an embodiment, each display may have a resolution of 480 pixels by 800 pixels, although higher and lower resolution displays may also be provided.

[0024] A screen may be associated with an operating system, an application, or the like. In some instances, a screen may include interactive features (e.g., buttons, text fields, toggle fields, etc.) capable of manipulation by way of a user input. The user input may be received by various input devices (e.g., a physical keyboard, a roller ball, directional keys, a touch sensitive device, etc.). In some instances, a screen may simply include graphics and have no ability to receive an input by a user. In other instances, graphics features and input features may both be provided by a screen. As such, the one or more displays of a handheld computing device, the screens displayed on the one or more displays, and various user input devices may comprise a GUI that allows a user to exploit functionality of the handheld computing device.

[0025] The handheld computing device 100 may be configurable between a first position and a second position. In the

first position, a single display (e.g., the first display **102** or the second display **104**) may be visible from the perspective of a user. Both displays **102, 104** may be exposed on an exterior of the handheld device **100** when in the first position, but the displays **102, 104** may be arranged in a non-adjacent manner such that both displays **102, 104** are not concurrently visible from the perspective of a user (e.g., one display may be visible from the front of the device **100** and the other display may be visible from the back of the device **100**).

[0026] The handheld computing device **100** may also be provided in the second position such that the displays **102, 104** may be concurrently viewable from the perspective of a user (e.g., the displays **102, 104** may be positioned adjacent to one another). The displays **102, 104** may be displayed in the second position such that the displays **102, 104** are arranged end-to-end or side-by-side. Additionally, the displays **102, 104** may be arranged in a portrait orientation or a landscape orientation with respect to a user. As will be discussed further below, a portrait orientation is intended to describe an arrangement of the handheld computing device, wherein the longer dimension of the display of the handheld computing device is vertically oriented (e.g., with respect to gravity or the perspective of a user). A landscape orientation is intended to describe an arrangement wherein the shorter dimension of the display of the handheld computing device is vertically oriented (e.g., with respect to gravity or the perspective of a user). Furthermore, the longer dimension and shorter dimension may refer to each display individually or the combined viewing area of the one or more displays of the device. Thus, when the individual displays are arranged in a portrait orientation, the overall display area may be arranged in a landscape orientation, and vice versa. Additionally, the displays and screens may be in different respective orientations. For instance, when the displays are in a landscape orientation, one or more screens may be rendered in a portrait orientation on the displays or vice versa.

[0027] The handheld computing device **100** may be manipulated between the first position (i.e., a single display visible from a user's perspective) and the second position (i.e., at least two displays concurrently visible from the user's perspective) in a variety of manners. For instance, the device **100** may include a slider mechanism such that the first and second displays **102, 104** are disposable adjacent to one another in a parallel fashion in a second position and slideable to the first position where only a single display is viewable and the other display is obscured by the viewable display.

[0028] Alternatively, the device **100** may be arranged in a clam shell type arrangement wherein a hinge is provided between the first display **102** and the second display **104** such that the displays **102, 104** are concurrently visible by a user when in the second position (i.e., an open position). The displays **102, 104** may be provided on an interior clam shell portion or an exterior clam shell portion of the device **100**. In this regard, both displays **102, 104** may be visible from the front and the back of the device, respectively, when the device is in the first position (i.e., the closed position). When the device **100** is in the open position, the displays **102, 104** may be provided adjacent and parallel to one another. Alternative arrangements of the handheld computing device **100** are contemplated wherein different arrangements and/or relative locations of the displays may be provided when in the first and second position.

[0029] In addition, the first display **102** and the second display **104** may be provided as entirely separate devices. In

this regard, a user may manipulate the displays **102, 104** such that they may be positioned adjacent to one another (e.g., side-by-side or end-to-end). The displays **102, 104** may be in operative communication when adjacently positioned such that the displays **102, 104** may operate in the manner provided in greater detail below when adjacently positioned (e.g., via physical contacts, wireless communications, etc.). A retention member (not shown) may be provided to retain the separate displays **102, 104** in an adjacent position. For instance, the retention member may include coordinating magnets, mechanical clips or fasteners, elastic members, etc.

[0030] While the foregoing has referenced two displays **102** and **104**, alternate embodiments of a handheld device may include more than two displays. In this regard, the two or more displays may behave in a manner in accordance with the foregoing wherein only a single display is viewable by a user in a first position and multiple displays (i.e., more than two displays) are viewable in a second position. Additionally, in one embodiment, the two displays **102** and **104** may comprise separate portions of a unitary display. As such, the first display **102** may be a first portion of the unitary display and the second display **104** may be a second portion of the unitary display. For instance, the handheld computing device **100** (e.g., having a first and second display **102** and **104**) may be operatively connected to the unitary display (e.g., via a connector or a dock portion of the unitary display) such that the first display **102** and the second display **104** of the handheld computing device **100** are emulated on the unitary display. As such, the unitary display may have first and second portions corresponding to and acting in a similar manner to the first and second display **102** and **104** of the handheld computing device **100** described below.

[0031] The handheld computing device **100** may further include one or more input devices that may be used to receive user inputs. These input devices may be operative to receive gesture inputs from a user, and, accordingly, may be referred to generally as gesture sensors. A number of different types of gesture sensors may be provided. Some examples include, but are not limited to traditional input devices (keypads, track-balls, etc.), touch sensitive devices, optical sensors (e.g., a camera or the like), etc. The discussion contained herein may reference the use of touch sensitive devices to receive gesture inputs. However, the use of touch sensitive devices is not intended to limit the means for receiving gesture inputs to touch sensitive devices alone and is provided for illustrative purposes only. Accordingly, any of the foregoing means for receiving a gesture input may be used to produce the functionality disclosed below with regard to gesture inputs received at touch sensitive devices.

[0032] In this regard, the handheld computing device **100** may include at least a first touch sensor **106**. Furthermore, the handheld computing device may include a second touch sensor **108**. The first touch sensor **106** and/or the second touch sensor **108** may be touchpad devices, touch screen devices, or other appropriate touch sensitive devices. Examples include capacitive touch sensitive panels, resistive touch sensitive panels, or devices employing other touch sensitive technologies. The first touch sensor **106** and/or second touch sensor **108** may be used in conjunction with a portion of a user's body (e.g., finger, thumb, hand, etc.), a stylus, or other acceptable touch sensitive interface mechanisms known in the art. Furthermore, the first touch sensor **106** and/or the second touch sensor **108** may be multi-touch devices capable of sensing multiple touches simultaneously.

[0033] The first touch sensor 106 may correspond to the first display 102 and the second touch sensor 108 may correspond to the second display 104. In one embodiment of the handheld computing device 100, the first display 102 and the first touch sensor 106 comprise a first touch screen display 110. In this regard, the first touch sensor 106 may be transparent or translucent and positioned with respect to the first display 102 such that a corresponding touch received at the first touch sensor 106 may be correlated to the first display 102 (e.g., to interact with a screen rendered on the first display 102). Similarly, the second display 104 and the second touch sensor 108 may comprise a second touch screen display 112. In this regard, the second touch sensor 108 may be positioned with respect to the second display 104 such that a touch received at the second touch sensor 108 may be correlated to the second display 104 (e.g., to interact with a screen rendered on the second display 104). Alternatively, the first touch sensor 106 and/or the second touch sensor 108 may be provided separately from the displays 102, 104. Furthermore, in an alternate embodiment, only a single touch sensor may be provided that allows for inputs to control both the first display 102 and the second display 104. The single touch sensor may also be provided separately or integrally with the displays.

[0034] In this regard, the first and second touch sensors 106, 108 may have the substantially same footprint on the handheld computing device 100 as the displays 102, 104. Alternatively, the touch sensors 106, 108 may have a footprint including less of the entirety of the displays 102, 104. Further still, the touch sensors 106, 108 may include a footprint that extends beyond the displays 102, 104 such that at least a portion of the touch sensors 106, 108 are provided in non-overlapping relation with respect to the displays 102, 104. As discussed further below, the touch sensors 106, 108 may alternatively be provided in complete non-overlapping relation such that the footprint of the touch sensors 106, 108 is completely different than the footprint of the displays 102, 104.

[0035] With reference to FIGS. 10A and 10B, various potential arrangements are depicted for the first display 102, the second display 104, and touch sensors 106', 106", and 108". In FIG. 12A, the first 102 and second display 104 are arranged side-by-side such that a crease 196 separates the displays. In this regard, the first display 102 and second display 104 may be arranged in a clam-shell type arrangement such that the crease 196 includes a hinge that allows for pivotal movement between the first display 102 and second display 104 as discussed above. A touch sensor 106' may span the width of both the first display 102 and the second display 104. In this regard, the touch sensor 106' may span the crease 196 without interruption. Alternatively, as shown in FIG. 10B, separate touch sensors 106" and 108" may be provided on either side of the crease 196. In this regard, each of the touch sensors 106" and 108" may span the width of each of the first display 102 and second display 104, respectively.

[0036] In any of the arrangements shown in FIGS. 10A and 10B, the displays (102, 104) may also comprise touch screen displays that may be used in conjunction with touch sensitive portions that are provided separately from the touch screen displays. Thus, displays 102 and 104 may both comprise touch screen displays and be provided in addition to touch sensitive devices 106', 106", and 108". Accordingly, a combination of touch screen displays (e.g., 110, 112) and off display touch sensors (e.g., 106', 106", 108") may be provided for a single device. Touch inputs may be received at both a touch screen display (110, 112) and off display touch sensor (106', 106", 108"). In this regard, gestures received at an off screen display sensor may have a different functionality than the same gesture received at a touch screen display. Also, a touch sensitive device may be divided into a plurality of zones. The same gesture received in different zones may have different functionality. For instance, a percentage (e.g., 10%, 25%, etc.) of the touch sensitive device at the top or bottom of the display may be defined as a separate zone than the remainder of the touch sensitive device. Thus, a gesture received in this zone may have a different functionality than a gesture received in the remainder of the touch sensitive device.

[0037] The handheld computing device 100 may further include a processor 116. The processor 116 may be in operative communication with a data bus 114. The processor 116 may generally be operative to control the functionality of the handheld device 100. For instance, the processor 116 may execute an operating system and be operative to execute applications. The processor 116 may be in communication with one or more additional components 120-134 of the handheld computing device 100 as will be described below. For instance, the processor 116 may be in direct communication with one more of the additional components 120-134 or may communicate with the one or more additional components via the data bus 114. Furthermore, while the discussion below may describe the additional components 120-134 being in operative communication with the data bus 114, in other embodiments any of the additional components 120-134 may be in direct operative communication with any of the other additional components 120-134. Furthermore, the processor 116 may be operative to independently control the first display 102 and the second display 104 and may be operative to receive input from the first touch sensor 106 and the second touch sensor 108. The processor 116 may comprise one or more different processors. For example, the processor 116 may comprise one or more application specific integrated circuits (ASICs), one or more field-programmable gate arrays (FPGAs), one or more general purpose processors operative to execute machine readable code, or a combination of the foregoing.

[0038] The handheld computing device may include a battery 118 operative to provide power to the various devices and components of the handheld computing device 100. In this regard, the handheld computing device 100 may be portable.

[0039] The handheld computing device 100 may further include a memory module 120 in operative communication with the data bus 114. The memory module 120 may be operative to store data (e.g., application data). For instance, the memory 120 may store machine readable code executable by the processor 116 to execute various functionalities of the device 100.

[0040] Additionally, a communications module 122 may be in operative communication with one or more components via the data bus 114. The communications module 122 may be operative to communicate over a cellular network, a Wi-Fi connection, a hardwired connection or other appropriate means of wired or wireless communication. The handheld computing device 100 may also include an antenna 126. The antenna 126 may be in operative communication with the communications module 122 to provide wireless capability to the communications module 122. Accordingly, the handheld computing device 100 may have telephony capability (i.e., the handheld computing device 100 may be a smartphone device).

[0041] An audio module 124 may also be provided in operative communication with the data bus 114. The audio module 124 may include a microphone and/or speakers. In this regard, the audio module 124 may be able to capture audio or produce sounds. Furthermore, the device 100 may include a camera module 128. The camera module 128 may be in operative communication with other components of the handheld computing device 100 to facilitate the capture and storage of images or video.

[0042] Additionally, the handheld computing device 100 may include an I/O module 130. The I/O module 130 may provide input and output features for the handheld computing device 100 such that the handheld computing device 100 may be connected via a connector or other device in order to provide syncing or other communications between the handheld computing device 100 and another device (e.g., a peripheral device, another computing device etc.).

[0043] The handheld computing device 100 may further include an accelerometer module 132. The accelerometer module 132 may be able to monitor the orientation of the handheld computing device 100 with respect to gravity. In this regard, the accelerometer module 132 may be operable to determine whether the handheld computing device 100 is substantially in a portrait orientation or landscape orientation. The accelerometer module 132 may further provide other control functionality by monitoring the orientation and/or movement of the handheld computing device 100.

[0044] The handheld computing device 100 may also include one or more hardware buttons 134. The hardware buttons 134 may be used to control various features of the handheld computing device 100. The hardware buttons 134 may have fixed functionality or may be contextual such that the specific function of the buttons changes during operation of the handheld computing device 100. Examples of such hardware buttons may include, but are not limited to, volume control, a home screen button, an end button, a send button, a menu button, etc.

[0045] With further reference to FIGS. 2A-D, various screens of an embodiment of a device are shown. multiple screens may be shown, only one or a subset of the multiple screens may be shown on the displays of the device at any one moment. In this regard, a screen may be described in a relative location to the displays or other screens (e.g., to the left of a display, to the right of a display, under another screen, above another screen, etc.). These relationships may be logically established such that no physical display reflects the relative position. For instance, a screen may be moved off a display to the left. While the screen is no longer displayed on the display, the screen may have a virtual or logical position to the left of the display from which it was moved. This logical position may be recognized by a user and embodied in values describing the screen (e.g., values stored in memory correspond to the screen). Thus, when referencing screens in relative locations to other screens, the relationships may be embodied in logic and not physically reflected in the display of the device.

[0046] FIGS. 2A-D may display a number of different screens that may be displayed at various instances of operation of a handheld device and are not intended to be presented in any particular order or arrangement. Single screen applications and multi screen applications may be provided. A single screen application is intended to describe an application that is capable of producing a screen that may occupy only a single display at a time. A multi screen application is intended to describe an application that is capable of produc-

ing one or more screens that may simultaneously occupy multiple displays. Additionally, a multi screen application may occupy a single display. In this regard, a multi screen application may have a single screen mode and a multi screen mode.

[0047] A desktop sequence 136 is displayed in FIG. 2A. The desktop sequence 136 may include a number of individual desktop screens 138a-138f. Thus, each desktop screen 138 may occupy substantially the entirety of a single display (e.g., the first display 102 or second display 104 of FIG. 1). The desktop screens 138a-138f may be in a predetermined order such that the desktop screens 138a-138f appear consecutively and the order in which the desktop screens appear may not be reordered. However, the desktop screens 138a-138f may be sequentially navigated (e.g., in response to a user input). That is, one or more of the desktop screens 138a-138f may be sequentially displayed on a handheld device as controlled by a user input.

[0048] Additionally, FIG. 2B displays a hierarchal application sequence 140 of a multi screen application. The hierarchal application sequence 140 may include a root screen 142, one or more node screens 144, and a leaf screen 146. The root screen 142 may be a top level view of the hierarchical application sequence 140 such that there is no parent screen corresponding to the root screen 142. The root screen 142 may be a parent to a node screen 144. One or more node screens 144 may be provided that are related as parent/children. A node screen may also serve as a parent to a leaf screen 146. By leaf screen 146, it is meant that the leaf screen 146 has no corresponding node screen for which the leaf screen 146 is a parent. As such, the leaf screen does not have any children node screens 144. FIG. 2C depicts various single screen applications 148a, 148b, and 148c arranged sequentially. Each of these single screen applications may correspond to a different executing application. For instance, in FIG. 2C Application 4, Application 5, and Application 6 may be executing on the device and correspond to each single screen 148a, 148b, and 148c, respectively.

[0049] FIG. 2D also includes an empty view 166. The empty view 166 may be used during transitions of a screen (e.g., movement of screen between a first display and a second display). It is not necessary that the empty view 166 be interpretable by the user as an effective GUI screen. The empty view 166 merely communicates to the user that an action regarding the screen (e.g., the movement of the screen with respect to one or more displays) is occurring. An application displaying an empty view 166 need not be able to rest, wait, process or interpret input. The empty view 166 may display a screen, or a representation thereof, as it is being moved in proportion to the amount of the screen that has been moved from a first display to a second display as will be discussed in greater detail below. In this regard, the empty view 166 may be used to relate information regarding the position of a screen during a transition of the screen (e.g., in response to gesture). An empty view 166 is only intended to refer to a screen not capable of receiving an input (e.g., a screen in transition). In this regard, the display of an empty view 166 may include an animation or the like showing the response of a screen as it is being moved or changed (e.g., modified into or out of a landscape mode).

[0050] FIGS. 3A-K depict various arrangements and statuses of displays 102, 104 of a device that are possible in various embodiments of a handheld computing device according to the present disclosure. For instance, when in the

first (e.g., closed) position, a closed front display **168** may be visible as shown in FIG. **3**A. The closed front display **168** may correspond with the first display **102** or the second display **104**. The closed front **168** as displayed may be occupied by a desktop screen D1 **138** as shown in FIG. **3**A. Alternatively, an application with a single screen or a multi screen application in single screen mode may be displayed in the closed front **168**. A closed back display **170** may be viewable from an opposite side of the display when the device is in a closed position, as shown in FIG. **3**B. The closed back **170** may display a different desktop screen or application screen than the closed front **168** or may simply display an empty view **166** (e.g., displaying an icon or other graphic) and lack functionality as an interface.

[0051] FIG. **3**C depicts a closed device in a landscape orientation **172***a*. In one embodiment, a landscape mode (i.e., wherein the display is adjusted to display a screen **148** in a landscape orientation) may not be enabled as shown in FIG. **3**C. Alternatively, the landscape mode may be enabled such that the screen **148** is modified when the device is sensed in a landscape orientation **172***b*, such that the screen **148** is rendered in a landscape orientation as shown at FIG. **3**D.

[0052] The device may further be provided in a second (e.g., open) position **174** as shown in FIG. **3**E. In the open position **174**, at least two displays **102**, **104** are arranged such that the two displays **102**, **104** are both visible from the vantage point of a user. The two displays **102**, **104** may be arranged in a side-by-side fashion when in the open position **174**. Thus, each of the two displays **102**, **104** may display separate screens. For instance, the displays **102**, **104** may each display a separate desktop screen **138***a*, **138***b*, respectively. While the individual displays **102** and **104** are in a portrait orientation as shown in FIG. **3**E, it may be appreciated that the full display area (comprising both the first display **102** and the second display **104**) may be arranged in a landscape orientation. Thus, whether the device as depicted in FIG. **3**E is in a landscape or portrait orientation may depend on whether the displays are being used individually or collectively. If used collectively as a unitary display, the device may be in a landscape orientation, whereas if the displays are used separately, the orientation shown in FIG. **3**E may be referred to as a portrait orientation.

[0053] Additionally, when the device is in an open position **174** as shown in FIG. **3**F, a similar dependency with regard to the use of the screens as a unitary display or separate displays may also affect whether the device is in a portrait orientation or landscape orientation. As can be appreciated, each individual screen is in a landscape orientation, such that if the displays are used separately, the device may be in a landscape orientation. If used as a unitary display, the device may be in a portrait orientation. In any regard, as shown in FIG. **3**F, a single screen **148** may occupy a first display **102** and the second display **104** may display a desktop screen **138**. The single screen **148** may be displayed in a landscape or portrait mode. Alternatively, a device in an open orientation **172** may display a multi screen GUI **156** that may occupy both displays **102**, **104** in a portrait orientation as shown in FIG. **3**G such that the individual displays are in a landscape orientation.

[0054] FIGS. **3**I-K depict the potential arrangements of the screens of a multi screen application **152**. The multi screen application **152** may, in one mode, occupy a single display **102** when the device is in a closed position **168** as shown in FIG. **3**I. That is, the multi screen application **152** may be in a single screen mode. Alternatively, when the device is in an open position as shown in FIG. **3**J, the multi screen application **152** may still occupy a single display **102** in single screen mode. Furthermore, the multi screen application **152** may be

expanded to occupy both displays **102**, **104** when the device is in the open position as shown in FIG. **3**K. In this regard, the multi screen application **152** may also execute in a multi screen mode. Various options may be provided for expanding the multi screen application **152** from a single screen mode to a multi screen mode.

[0055] For example, the multi screen application **152** may be maximized from a single screen mode displayed in a single display to two screens displayed in two displays such that a parent screen is displayed in the first display and a node screen (e.g., a child screen) is expanded into the second display. In this regard, each of the screens displayed in the first and second display may be independent screens that comprise part of a hierarchical application sequence (e.g., as shown in FIG. **2**B). Alternatively, the single screen mode of the multi screen application may simply be scaled such that the contents of the single screen are scaled to occupy both displays. Thus, the same content displayed in the single screen is scaled to occupy multiple displays, but no additional viewing area or graphics are presented. Further still, the maximization of the multi screen application from a single screen mode to a multi screen mode may result in the expansion of the viewable area of the application. For example, if a multi screen application is displayed in single screen mode, upon maximization into multi screen mode, the viewable area of the multi-screen application may be expanded while the scale of the graphics displayed remains the same. In this regard, the viewable area of the multi-screen application may be expanded into the second display while the scaling remains constant upon expansion.

[0056] In this regard, an application may have configurable functionality regarding the nature and behavior of the screens of the application. For instance, an application may be configurable to be a single screen application or a multi screen application. Furthermore, a multi screen application may be configurable as to the nature of the expansion of the multi screen application between a single screen mode and a multi screen mode. These configuration values may be default values that may be changed or may be permanent values for various applications. These configuration values may be communicated to the device (e.g., the processor **116**) to dictate the behavior of the application when executing on the device.

[0057] FIG. **4** depicts various graphical representations of gesture inputs that may be recognized by a handheld computing device. Such gestures may be received at one or more touch sensitive portions of the device. In this regard, various input mechanisms may be used in order to generate the gestures shown in FIG. **4**. For example a stylus, a user's finger(s), or other devices may be used to activate the touch sensitive device in order to receive the gestures. The use of a gesture may describe the use of a truncated input that results in functionality without the full range of motion necessary to conventionally carry out the same functionality. For instance, movement of screens between displays may be carried out by selecting and moving the screen between displays such that the full extent of the motion between displays is received as an input. However, such an implementation may be difficult to accomplish in that the first and second displays may comprise separate display portions without continuity therebetween. As such, a gesture may truncate the full motion of movement or provide an alternative input to accomplish the same functionality. Thus, movement spanning the first and second display may be truncated so that the gesture may be received at a single touch sensitive device. The use of gesture inputs is particularly suited to handheld computing devices in that the

full action of an input may be difficult to execute given the limited input and display space commonly provided on a handheld computing device.

[0058] With reference to FIG. 4, a circle 190 may represent a touch received at a touch sensitive device. The circle 190 may include a border 192, the thickness of which may indicate the length of time the touch is held stationary at the touch sensitive device. In this regard, a tap 186 has a thinner border 192 than the border 192' for a long press 188. In this regard, the long press 188 may involve a touch that remains stationary on the touch sensitive display for longer than that of a tap 186. As such, different gestures may be registered depending upon the length of time that the touch remains stationary prior to movement.

[0059] A drag 176 involves a touch (represented by circle 190) with movement 194 in a direction. The drag 176 may involve an initiating touch that remains stationary on the touch sensitive device for a certain amount of time represented by the border 192. In contrast, a flick 178 may involve a touch with a shorter dwell time prior to movement than the drag as indicated by the thinner border 192" of the flick 178. Thus, again different gestures may be produced by differing dwell times of a touch prior to movement. The flick 178 may also include movement 194. The direction of movement 194 of the drag and flick 178 may be referred to as the direction of the drag or direction of the flick. Thus, a drag to the right may describe a drag 176 with movement 194 to the right.

[0060] In an embodiment, a gesture having movement (e.g., a flick or drag gesture as described above) may be limited to movement in a single direction along a first axis. Thus, while movement in a direction different than along the first axis may be disregarded so long as contact with the touch sensitive device is unbroken. In this regard, once a gesture is initiated, movement in a direction not along an axis along which initial movement is registered may be disregarded or only the vector component of movement along the axis may be registered.

[0061] While the directional gestures (e.g., the drag 176 and flick 178) shown in FIG. 4 include only horizontal motion after the initial touch, this may not be actual movement of the touch during the gesture. For instance, once the drag is initiated in the horizontal direction, movement in a direction other than in the horizontal direction may not result in movement of the screen to be moved in the direction different and the horizontal direction. For instance, with further reference to FIG. 13, the drag 176 from left to right may be initiated with initial movement 204 from left to right along an initiated direction 210. Subsequently, while maintaining contact with the touch sensitive device, the user may input an off direction movement 206 in a direction different than the initiated direction 210. In this regard, the off direction movement 206 may not result in any movement of a screen between two displays. Furthermore, the user may input partially off direction movement 208, where only a vector portion of the movement is in the direction of the initiated direction 210. In this regard, only the portion of the partially off direction movement 208 may result in movement of a screen between displays. In short, the movement of application screens between the first display 102 and the second display 104 may be constrained along a single axis along which the displays are arranged.

[0062] FIG. 5A depicts an embodiment of a handheld computing device. As shown, a first display 102 and a second display 104 are concurrently visible. A hierarchical application 500 may be executing on the device. As such, in the first instance 550, a parent screen 510 (e.g., a root screen of the hierarchical application 500) may be displayed in the first display 102. A desktop screen 138 may be displayed in the second display 104. Other screens may be displayed in the

second display 104 and the depicted desktop screen 138 is shown for exemplary purposes only. At a second instance, a drag gesture 176 from left to right may be received at the device. For instance, the drag gesture 176 may be received at an off display touch sensitive device. In any regard, in response to the receipt of the drag gesture 176, the second display 104 may be changed to reflect an empty view 166. For example, the empty view 166 may include an animated view corresponding with the exposing of a child screen 520. In the third instance 570, the child screen 520 may be displayed in the second display 104. Of note, the parent screen 510 may remain in the first display 102 after receipt of the drag gesture 176. As such, a drag gesture 176 received at the handheld computing device may result in the movement of a child screen 520 into a second display 104 of the device. Of note, the movement of the child screen 520 into the second display 104 may correspond to the direction of the drag gesture 176. As shown, a left to right drag gesture 176 resulted in movement of the child screen into the second display 104 arranged to the right of the first display 102.

[0063] With further reference to FIG. 5B, another embodiment of a handheld computing device is depicted. In FIG. 5B, a child screen 530 (e.g., a leaf screen of a hierarchical application 500 executing on the handheld computing device) may be displayed in the first display 102 at a first instance 550. A desktop screen 138 is shown as being displayed in the second display 104, however other screens could be displayed in the second display 104 at the first instance 550. At a second instance 560, a drag gesture 176 may be received at the handheld computing device. For instance, the drag gesture 176 may be received at an off display touch sensitive device. In response to receipt of the drag gesture 176, the first display 102 and second display 104 may be updated to display a first empty view 166a and a second empty view 166b. The first empty view 166a and second empty view 166b may coordinate to indicate movement of the child screen 530 to the second display 104 such that a parent screen 520 is revealed in the first display 102. In this regard, at a third instance 570, the parent screen 520 may be displayed in the first display 102 and the child screen 530 may be displayed in the second display 530.

[0064] Turning to FIGS. 6A and 6B, two embodiments wherein a hierarchical application 600 is modified from being displayed in a first display 102 and a second display 104 to being displayed in only one of the first display 102 and second display 104 is shown. For instance, in FIG. 6A, a hierarchical application 600 may be executed on a handheld computing device such that a parent screen 610 is displayed in a first display 102 and a child screen 620 is displayed in a second display 104 at a first instance 650. At a second instance 660, a drag gesture 176 may be received at the handheld computing device. As such, the first display 102 and second display 104 may be modified to display a first empty view 166a and a second empty view 166b, respectively. The display of the first empty view 166a and second empty view 166b may indicate movement of the parent screen 610 to the second display 104. The parent screen 610 may obscure the child screen 620 as it is being moved to the second display 104. At a third instance 570, the parent screen 610 may be displayed in a second display 104 (e.g., the parent screen 610 may be moved on top of the child screen 620 such that the child screen 620 is hidden by the parent screen 610). A desktop screen 138 may be exposed in the first display 102 as the parent screen 610 is moved from the first display 102 to the second display 104. Thus, the hierarchical application 600 may be changed from a multi screen mode to a single screen mode in response to the drag gesture 176.

[0065] FIG. 6B depicts another embodiment of the hand-held computing device. In FIG. 6B, a hierarchical application 600 may also be executed on a handheld computing device such that a parent screen 610 is displayed in a first display 102 and a child screen 620 is displayed in a second display 104 at a first instance 650. At a second instance 660, a drag gesture 176 may be received at the handheld computing device. Of note, the drag gesture 176 of FIG. 6B may be in an opposite direction as the drag gesture 176 of FIG. 6A. In this regard, at the second instance 660, the second display 104 may be changed to show an empty view 166. The empty view 166 of the second display 104 may correspond to the movement of the child screen 620 from the second display to the first display (e.g., behind the parent screen 610 shown in the first display 102). At the third instance, the parent screen 610 may be displayed in the first display 102 and the child screen 620 may not be shown (e.g., the child screen 620 may be positioned behind the parent screen 610). A desktop screen 138 may be shown in the second display 104. In other embodiments, a screen (e.g., for another application) that was previously disposed beneath the child screen 620 in the second display at the first instance 660 may be displayed in the second display 104 in the third instance 670.

[0066] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description is to be considered as exemplary and not restrictive in character. For example, certain embodiments described hereinabove may be combinable with other described embodiments and/or arranged in other ways (e.g., process elements may be performed in other sequences). Accordingly, it should be understood that only the preferred embodiment and variants thereof have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

What is claimed is:

1. A method for controlling a plurality of displays of a handheld computing device, comprising:

executing a hierarchical application on the handheld comparing device, wherein the hierarchical application comprises a plurality of related familial screens;

displaying a first screen of the plurality of related familial screens on a first display of the plurality of displays;

receiving a first gesture input at the handheld computing device; and

modifying at least one of the plurality of displays in response to the receiving such that a second screen of the plurality of related familial screens is displayed on one of the first display and the second display and the first screen is displayed on the other of the first display and the second display.

2. The method as recited in claim 1, wherein the gesture input is directional and the modifying corresponds to a direction of the gesture input.

3. The method as recited in claim 2, wherein the gesture input comprises a drag gesture.

4. The method as recited in claim 1, wherein the first screen comprises a parent screen and the second screen comprises a node screen of the parent screen.

5. The method as recited in claim 1, wherein the first screen comprises a node screen and the second screen comprises a parent screen of the node screen.

6. The method as recited in claim 1, wherein the modifying includes displaying the second screen in the second display.

7. The method as recited in claim 1, wherein the modifying includes displaying the first screen in the second display and displaying the second screen in the first display.

8. A method for controlling a plurality of displays of a handheld computing device, comprising:

executing a hierarchical application on the handheld comparing device, wherein the hierarchical application comprises a plurality of related familial screens;

displaying a first screen of the plurality of related familial screens on a first display of the plurality of displays and a second screen of the plurality of related familial screens on a second display of the plurality of displays;

receiving a first gesture input at the handheld computing device; and

modifying at least one of the plurality of displays in response to the receiving such that only the first screen is displayed in one of the first display and second display.

9. The method as recited in claim 8, wherein the gesture input is directional and the modifying corresponds to a direction of the gesture input.

10. The method as recited in claim 9, wherein the gesture input comprises a drag gesture.

11. The method as recited in claim 8, wherein the first screen comprises a parent screen and the second screen comprises a node screen of the parent screen.

12. The method as recited in claim 1, wherein the first screen comprises a node screen and the second screen comprises a parent screen of the node screen.

13. The method as recited in claim 1, wherein the modifying includes displaying the first screen in the first display.

14. The method as recited in claim 1, wherein the modifying includes displaying the first screen in the second display.

15. A handheld computing device, comprising:

a processor operable to execute a hierarchical application comprising a plurality of related familial screens;

a first display in operative communication with the processor and operable to display at least one of said related familial screens;

a second display in operative communication with the processor and operable to display at least one of said related familial screens;

a gesture sensor in operative communication with the processor and operable to receive a gesture input;

wherein the processor, upon receipt of the gesture input, is operative to modify at least one of the first display and second display to change the related familial screens displayed.

16. The device as recited in claim 1, wherein the handheld computing device comprises a smart phone.

17. The device as recited in claim 16, wherein the first display and second display are positionable with respect to each other between an open and closed position.

18. The device as recited in claim 17, wherein when in the open position, the first display and the second display are visible from the vantage point of a user.

19. The device as recited in claim 18, wherein when in the closed position, only one of the first display and the second display are visible from the vantage point of a user.

*   *   *   *   *