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(54) **GESTURE CONTROLLED SCREEN REPOSITIONING FOR ONE OR MORE DISPLAYS**

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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 the displays are changed from a first state to a second state. The change of the displays from the first state to the second state may include moving a GUI from a first display to a second display. Additionally, a second GUI may be moved from the second display to the first display. The gesture input may comprise multiple touches, such as a pinch gesture.
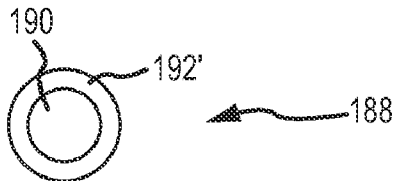
100

102

104

110

DISPLAY

DISPLAY

112

106

116

108

TOUCH
SENSOR

PROCESSOR

TOUCH
SENSOR

114

BATTERY

118

COMMUNICATIONS
MODULE

ANTENNA

I/O
MODULE

HARDWARE
BUTTONS

134

126

130

120

MEMORY
MODULE

122

AUDIO
MODULE

CAMERA
MODULE

ACCELEROMETER
MODULE

132

124

128

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

102

148

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
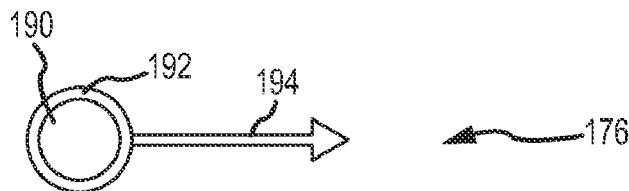
A1   D2

102

104

174

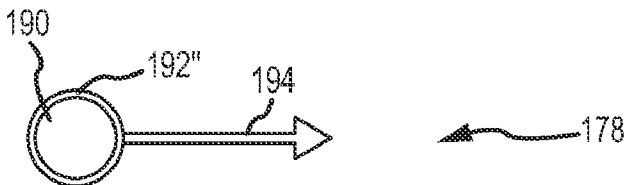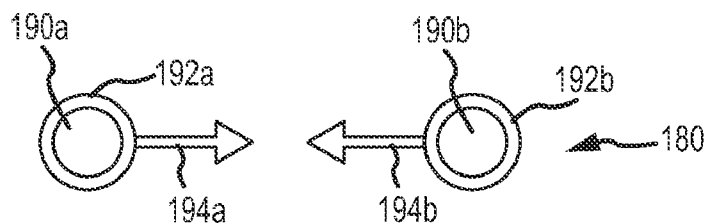**FIG.3J**

102 — 152   152 — 104

A1

174

FIG.3K

TAP

LONG PRESS

DRAG

FLICK

PINCH
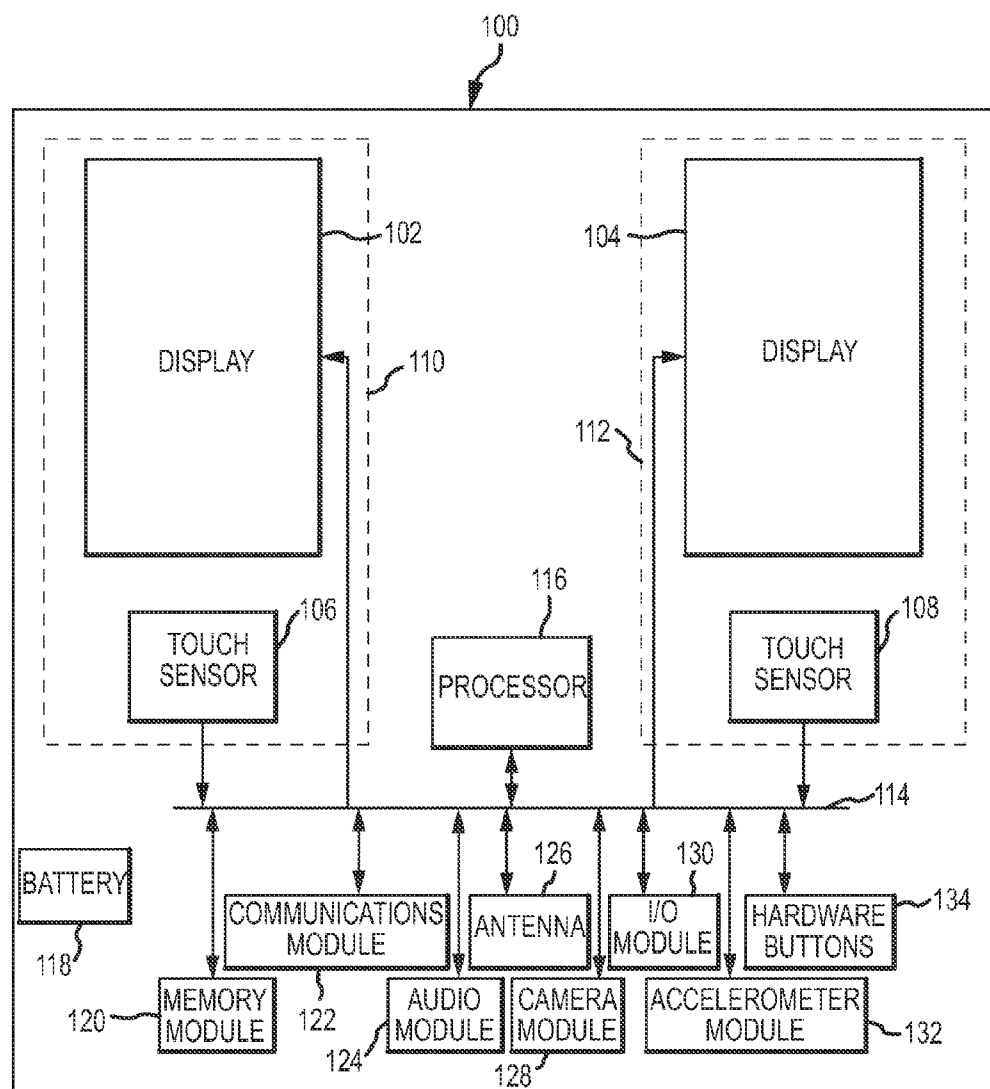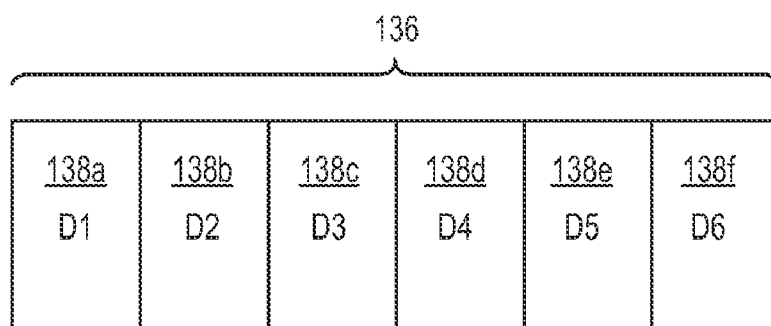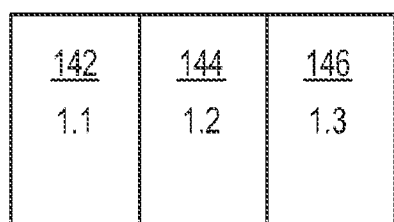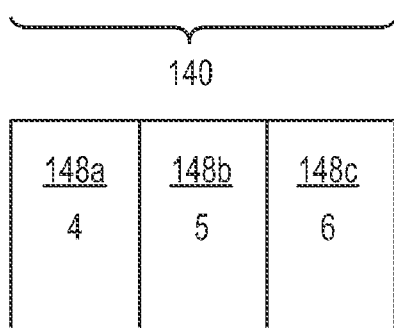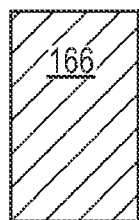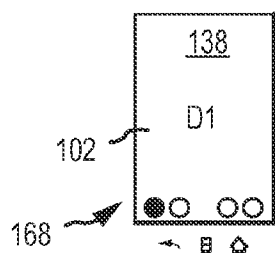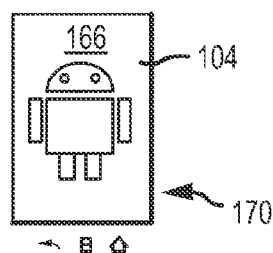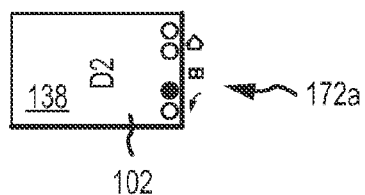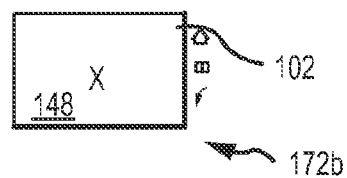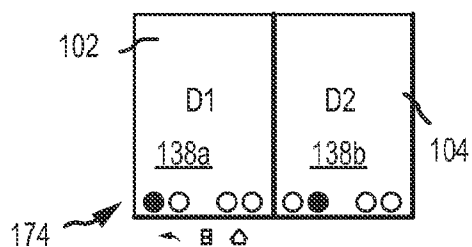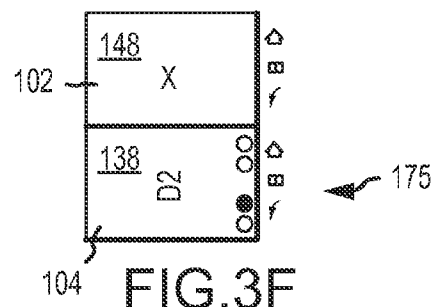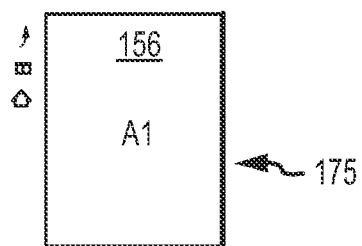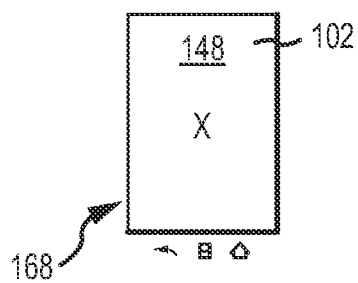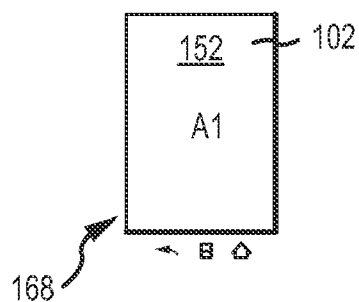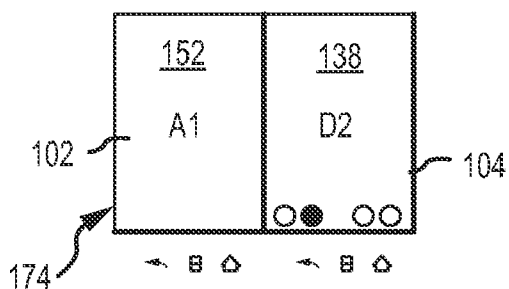
FIG.4

FIG.5A   FIG.5B

FIG.6A   FIG.6B

FIG.7A   FIG.7B
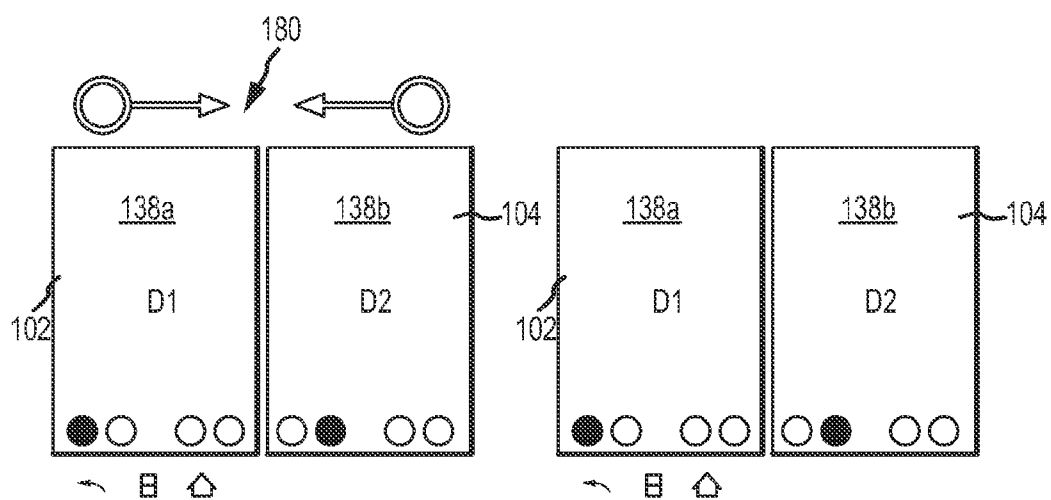
FIG.8A

FIG.8B

FIG.9A

FIG.9B

FIG.9C

106'

196

104

102

FIG.10A

106"   108"

196

104

102

FIG.10B

208

210

206

204

176

192

190

FIG.11

GESTURE CONTROLLED SCREEN REPOSITIONING FOR ONE OR MORE DISPLAYS

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 the 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.
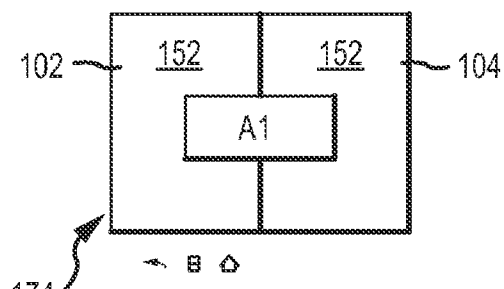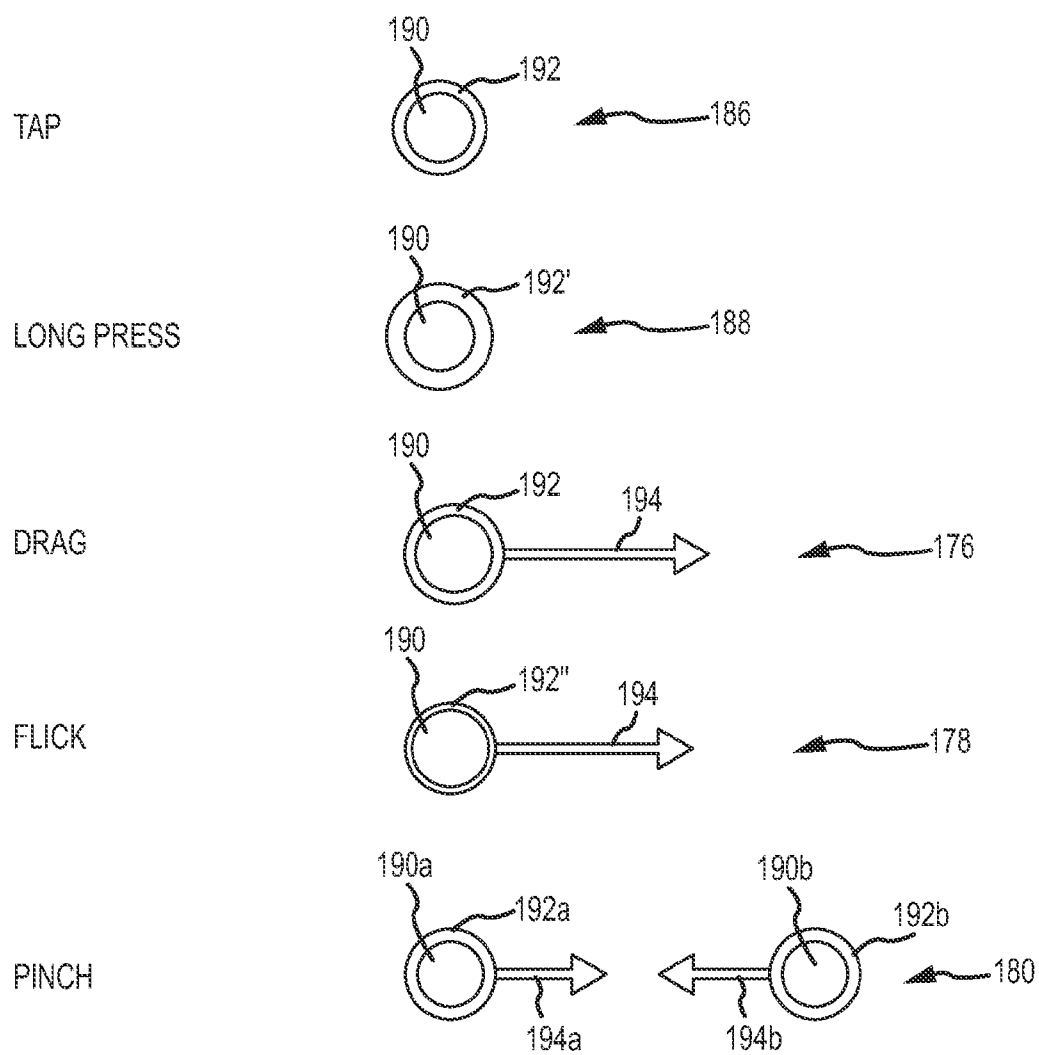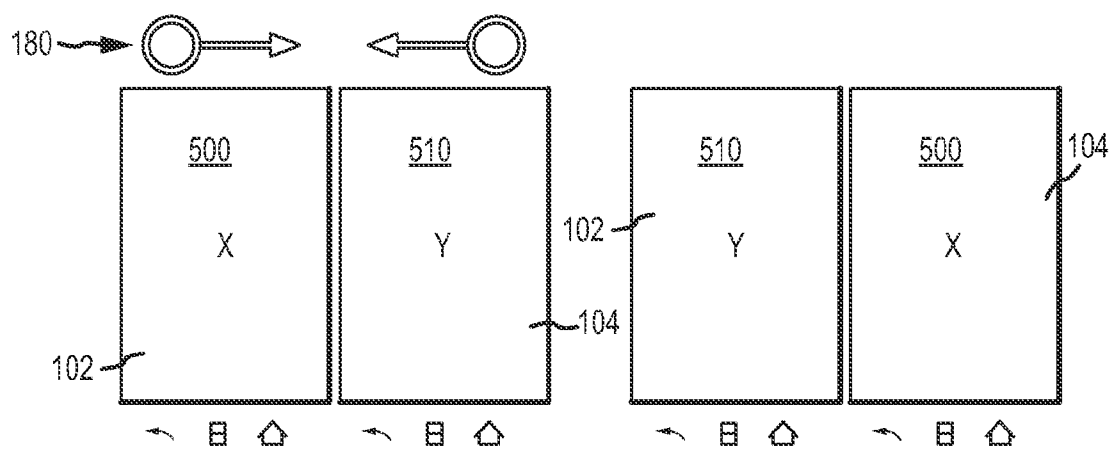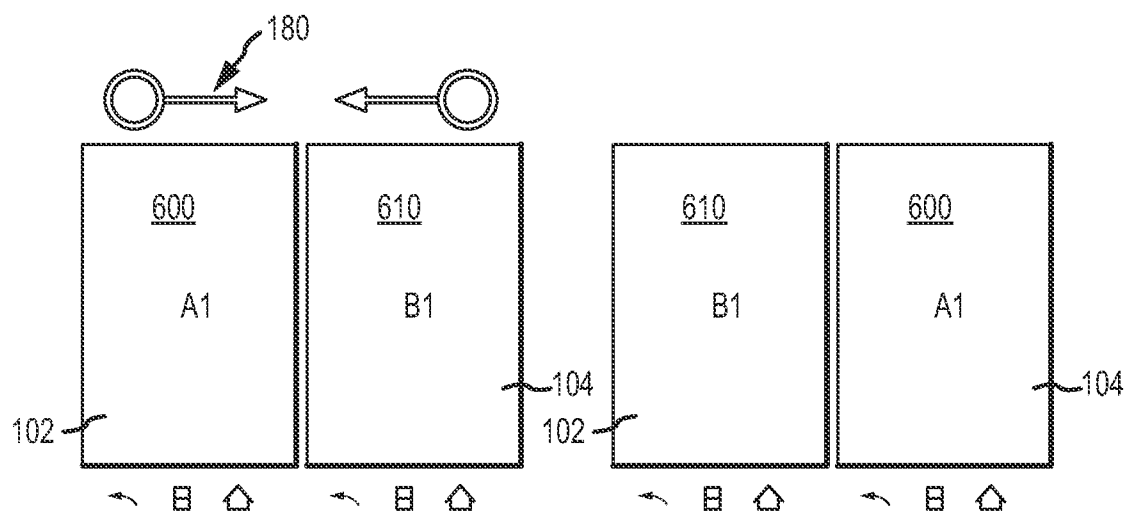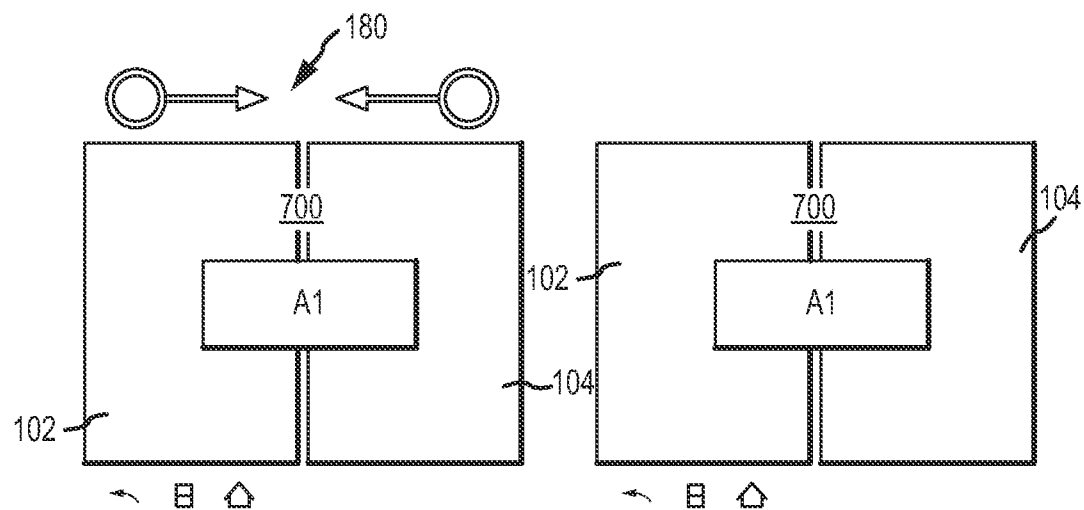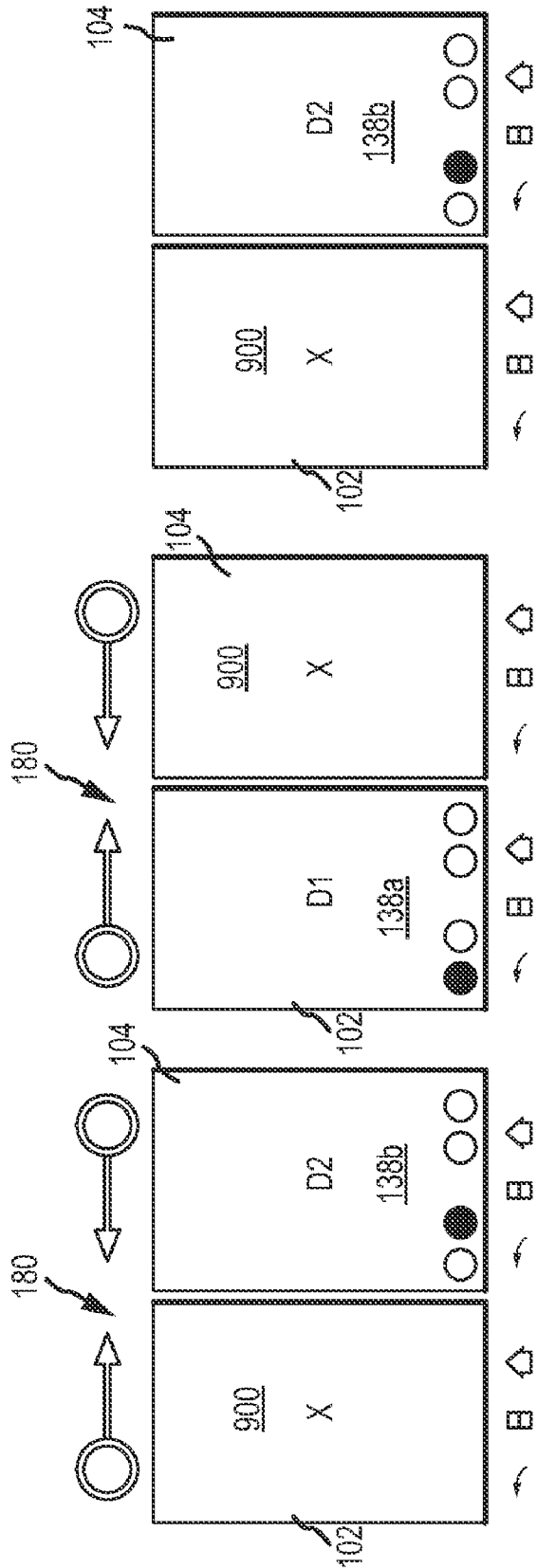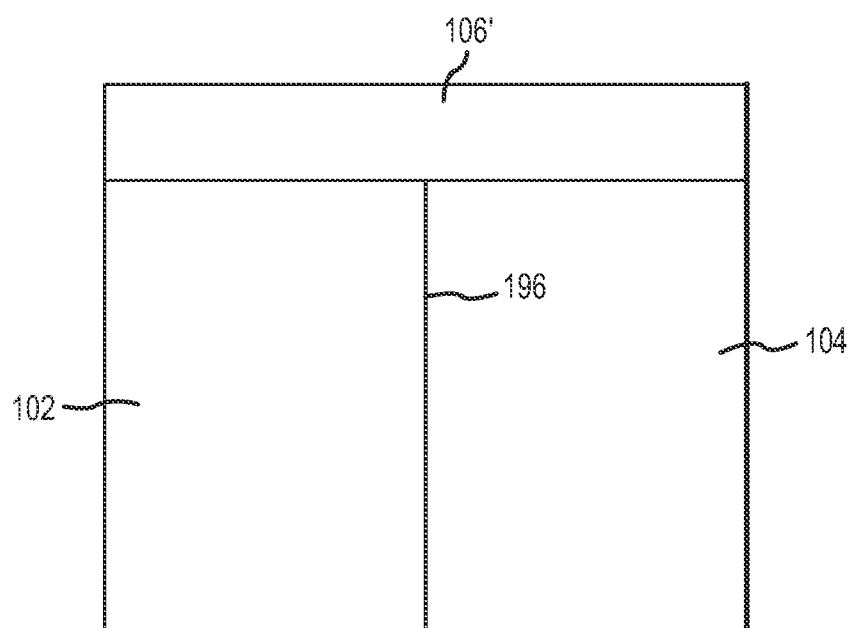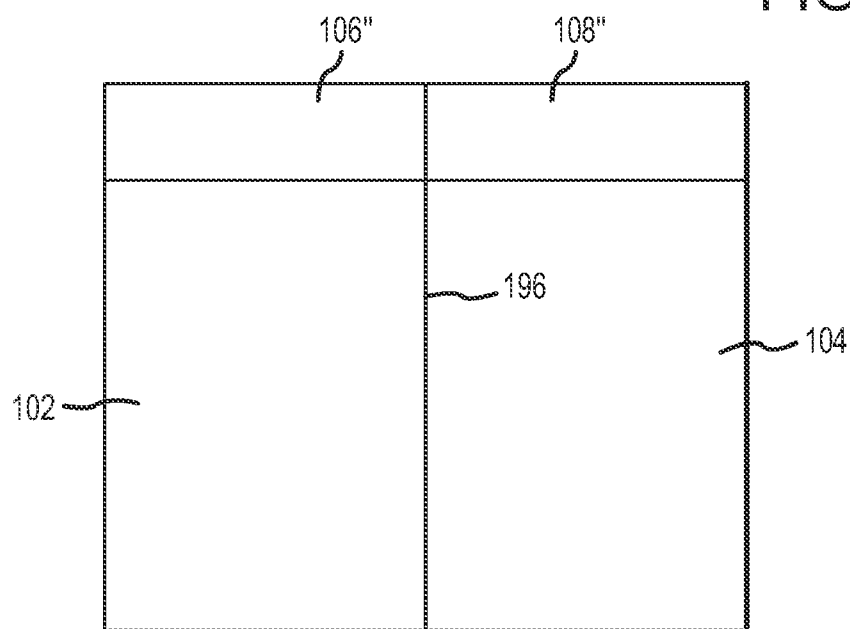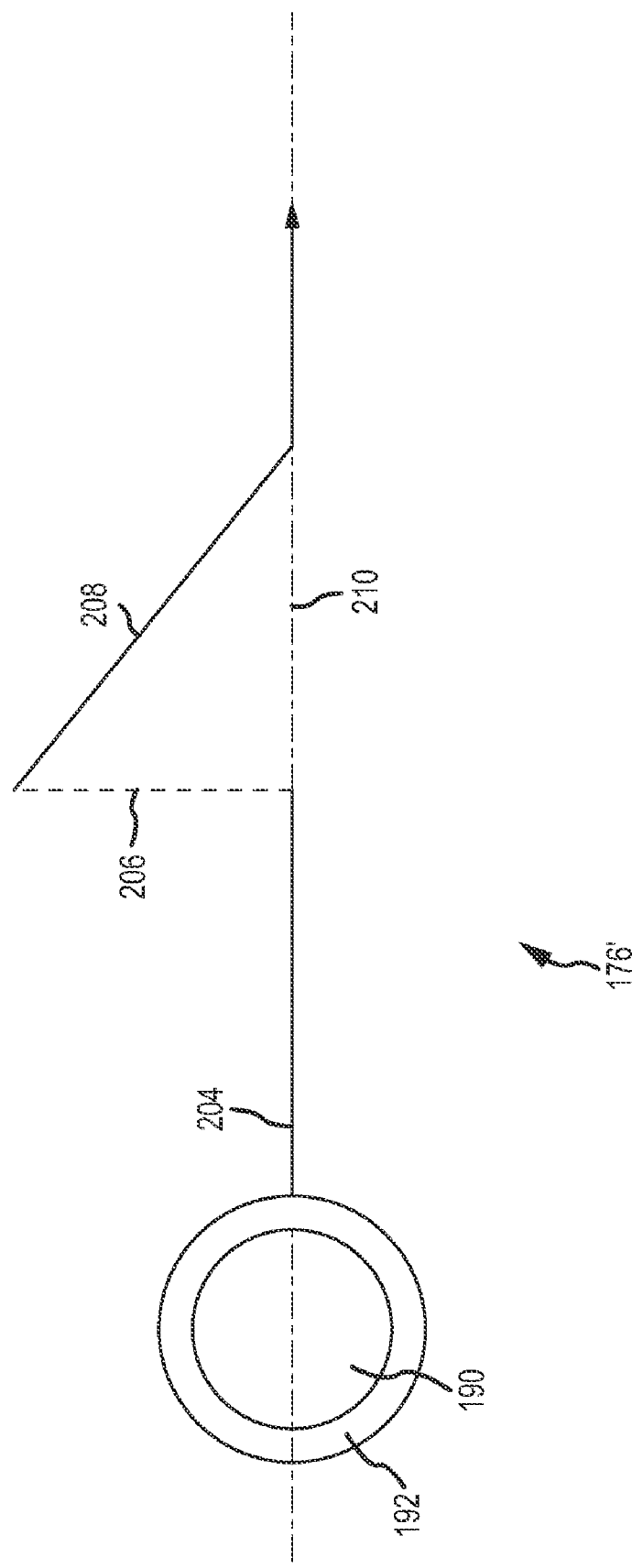
[0004]   Other methods may provide increased user configurability of physical keypads. These methods may include stickers and/or labels that can be added to keys to reference modified functions or plastic overlays on top of the keypad denoting different functional suites. For instance, the ZBoard keyboard, 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 interface commands. 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 displaying a first screen in a first display of the plurality of displays when in a first display state. A first gesture input and a second gesture input are received at the handheld computing device. At least a portion of the first gesture input occurs simultaneously with at least a portion of the second gesture input. In response to this receiving, the plurality of displays are modified from the first display state to a second display state such that the first screen is displayed in a second display of the plurality of displays when in the second display state.

[0008]   A second aspect of the present invention includes a handheld computing device that includes a processor. The device also includes a first display in operative communication with the processor that is also operable to display a first screen in a first display state. The device further includes a second display in operative communication with the processor, a first gesture sensor in operative communication with the processor that is also operable to receive a first gesture input, and a second gesture sensor in operative communication with the processor that is also operable to receive a second gesture input. The processor, upon receipt of the first and second touch gesture inputs, changes the first and second displays to a second display state such that the first screen is displayed on the second display in the second display state.

2

[0009] A third aspect of the present invention includes another method for controlling a plurality of displays of a handheld computing device. This method includes displaying a first screen in a first display and a second screen in a second display when the plurality of displays are in a first display state. The method further includes receiving a first gesture input at the handheld computing device and a second gesture input at the handheld computing device. At least a portion of the first gesture input occurs simultaneously with at least a portion of the second gesture input. The method also includes modifying the plurality of displays from the first state to a second display state in response to the receiving of the first and second gesture inputs. In turn, the first screen is displayed in the second display and the second screen is displayed in the first display when the plurality of displays are in the second display state.

[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 first gesture input may be a drag gesture in a first direction. The second gesture input may be a drag gesture in a second direction. The first direction and the second direction may be opposite. As such, the first gesture input and second gesture input may combine to define a pinch gesture. At least one of the first gesture input and second gesture input may be received at a touch sensitive device. As such, the gesture inputs may be touch gesture inputs. The touch sensitive device may be an off display touch sensitive device provided separately from the first or second display. As such, the gesture inputs may be received away from the first and second display such that the first and second displays are not obscured when receiving the gesture input. The first touch sensitive portion may be associated with the first display to comprise a first touch screen display, and the second touch sensitive portion may be associated with a second touch sensitive display to comprise a second touch sensitive display. Alternatively, the first touch sensitive portion may be disposed apart from said first display, and the second touch sensitive portion may be disposed apart from said second display.

[0012] In another embodiment, a second screen may be displayed in the second display when in the first display state and the first display when in the second display state. As such, the first screen and second screen may be exchanged between the first display and second display when the device is modified from the first display state to the second display state. The first screen may be associated with a first application executing on the handheld computing device, and the second screen may be associated with a second application executing on the handheld computing device. At least one of the first and second applications may be a single screen application. Additionally or alternatively, at least one of the first and second applications may be a multi screen application executing in a single screen mode. A first desktop screen may be displayed in the second display in the first display state and a second desktop screen may be displayed in the first display in the second display state.

[0013] In another embodiment, the plurality of displays comprise separate portions of a single display. The first dis-

play corresponds with a first portion of the single display and the second display corresponds with a second portion of the single display.

[0014] In still further embodiments, the handheld device may be a smartphone. The first display and second display may be positionable with respect to each other between an open and a closed position. When in the open position, the first display and the second display may both visible from the vantage point of a user. When in the closed position only one of the first display and the second display may be visible from the vantage point of a user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a schematic view of an embodiment of a handheld computing device.

[0016] FIGS. 2A-D are graphical representations of an embodiment of a handheld computing device in various instances of operation.

[0017] FIGS. 3A-K are graphical representations of an embodiment of a handheld computing device provided in different positions, orientations, and instances of operation.

[0018] FIG. 4 includes graphical representations of various gesture inputs for controlling a handheld computing device.

[0019] FIGS. 5A and 5B are graphical representations of an embodiment of a handheld computing device functioning in response to a gesture input to change between a first display state and a second display state.

[0020] FIGS. 6A and 6B are graphical representations of another embodiment of a handheld computing device functioning in response to a gesture input to change between a first display state and a second display state.

[0021] FIGS. 7A and 7B are graphical representations of an embodiment of a handheld computing device before and after receiving a gesture input.

[0022] FIGS. 8A and 8B are graphical representations of another embodiment a handheld computing device before and after receiving a received gesture input.

[0023] FIGS. 9A, 9B, and 9C are graphical representations of another embodiment of a handheld computing device functioning in response to a received gesture input to change between a first display state and a second display state.

[0024] FIGS. 10A and 10B are schematic views of two embodiments of a handheld computing device provided with touch sensitive devices.

[0025] FIG. 11 is a graphical representation of an embodiment of a gesture input.

DETAILED DESCRIPTION

[0026] 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.

[0027] 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 piece of hardware that is operable to render a screen. A screen may refer to a majority of the display. For instance, a screen may occupy 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.

[0028] 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.

[0029] 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).

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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 con-

nector 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.

[0035] 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.

[0036] 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.

[0037] 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 presented thereon). 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 presented thereon). 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.

[0038] In this regard, the first and second touch sensors **106**, **108** may have the substantially same footprint on the hand-

held 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**.

[0039] With reference to FIGS. 9A-B, various potential arrangements are depicted for the first display **102**, the second display **104**, and touch sensors **106'**, **106"**, and **108"**. In FIG. 9A, 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. 9B, 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.

[0040] In any of the arrangements shown in FIGS. 9A-B, 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.

[0041] 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 or 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**, it will be understood that 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.

[0042] 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.

[0043] 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**.

[0044] 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).

[0045] 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.

[0046] 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.).

[0047] 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**.

[0048] 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.

[0049] With further reference to FIGS. **2A-D**, various screens of an embodiment of a device are shown. The screens shown in FIGS. **2A-D** are intended to represent the potential screens that may be displayed. Thus, while 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.

[0050] 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 producing 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.

[0051] 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.

[0052] 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 appli-

cation 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 **148***a*, **148***b*, and **148***c* 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 **148***a*, **148***b*, and **148***c*, respectively.

[0053] 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). While shown in FIG. 2D as a grayed screen, an empty view **166** is only intended to refer to a screen not capable of receiving an input. 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).

[0054] 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. 3A. 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 **138** as shown in FIG. 3A. 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. 3B. 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.

[0055] FIG. 3C depicts a closed device in a landscape orientation **172**. 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. 3C. Alternatively, the landscape mode may be enabled such that the screen **148** is modified when the device is sensed in a landscape orientation **172**, such that the screen **148** is rendered in a landscape orientation as shown at FIG. 3D.

[0056] The device may further be provided in a second (e.g., open) position **174** as shown in FIG. 3E. 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. 3E, 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. 3E 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. 3E may be referred to as a portrait orientation.

[0057] Additionally, when the device is in an open position **174** as shown in FIG. 3F, 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. 3F, 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. 3G such that the individual displays are in a landscape orientation.

[0058] FIGS. 3I-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. 3I. 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. 3J, 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. 3K. 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.

[0059] 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 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. 2B). 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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 repre-

sented 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.

[0064] 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.

[0065] 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. **11**, 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.

[0066] Additionally, FIG. **4** depicts a pinch gesture **180**. The pinch gesture **180** may be initiated by a first touch input **190***a* and a second touch input **190***b* to a touch sensitive device. The first touch input **190***a* and second touch input **190***b* may be received at the same touch sensitive device or may be received on different touch sensitive devices. The first touch input **190***a* may be held for a certain amount of time, as represented by the border **192***a*. Also, the second touch input **190***b* may be held for a certain amount of time, as represented by the border **192***b*. The first touch input **190***a* and the second touch input **190***b* may also include corresponding first movement **194***a* and second movement **194***b*, respectively. The first touch input **190***a* may include first movement **194***a* in a direction generally towards the second touch input **190***b*. Also, the second touch input **190***b* may include second movement **194***b* in a direction generally towards the first touch input **190***a*. In this regard, the pinch gesture **180** may be accomplished by user touching the touch sensitive portion of the device in a manner that resembles a user imparting a pinching motion with respect to the device.

[0067] With additional reference to FIGS. **5A** and **5B**, the function of a handheld computing device in response to a gesture input is shown. In FIG. **5A**, a first screen **500** is

displayed on the first display **102**. A second screen **510** is displayed on a second display **104**. The first screen **500** and second screen **510** may be associated with single screen applications, or may be other single screen variants, such as a multi screen application executing in single screen mode. When in the configuration shown in FIG. **5**A, a pinch gesture **180** may be received at the handheld computing device. For instance, the pinch **180** may be received at an off display touch sensitive device (not shown). In response to the pinch gesture **180**, the first display **102** may be changed to the display state shown in FIG. **5**B such that the second screen **510** is displayed on the first display **102**. Also, the second display **104** may be changed to the display state shown in FIG. **5**B such that the first display **500** is displayed on the second display **104**. In this regard, the screens **500** and **510** may be swapped between a first display **102** and a second display **104** upon receipt of the pinch gesture **180**.

[0068] With further reference to FIGS. **6**A and **6**B, a received pinch gesture **180** may also be used to swap screens displayed in a first display **102** and second display **104** wherein the screens are associated with multi screen applications executing in single screen mode. In this regard, FIG. **6**A, Application A1 **600** may be displayed in the first display **102** such that Application A1 **600** is operating in single screen mode and is displayed in the first display **102**. Also, Application B1 **610** may be operating in a single screen mode and may be displayed in the second display **104**. Upon receipt of the pinch gesture **180** when the device is in the configuration shown in FIG. **6**A, the device may change to the display state shown in FIG. **6**B. In FIG. **6**B, Application A1 **600** may be swapped with Application B1 **610** such that Application B1 **610** is displayed by the first display **102** and Application A1 **600** is displayed by the first display **104**.

[0069] With additional reference to FIGS. **7**A and **7**B, Application A1 **700** may be a multi screen application that is operating in multi screen mode. In this regard, Application A1 **700** may occupy both the first display **102** and the second display **104**. Upon receipt of a pinch gesture **180** when in the configuration shown in FIG. **7**A, the device may remain unchanged as shown in FIG. **7**B. That is, the receipt of the pinch gesture **180** when the Application A1 **700** is in multi-screen mode may result in no change in the display state of the device. In this regard, in FIG. **7**B, Application A1 **700** is still displayed in both the first display **102** and the second display **104** after receipt of the pinch gesture **180**. Similarly, as shown in FIGS. **8**A and **8**B, a first desktop screen **138**a may be displayed in the first display **102** and a second desktop screen **138**b may be displayed in the second display **104**. Upon receipt of the pinch gesture **180** when the device is in the configuration shown in FIG. **8**A, no change may occur such that the arrangement of FIG. **8**A is maintained in FIG. **8**B such that the first desktop screen **138**a is still shown in the first display **102** and the second desktop screen **138**b is still shown in the second display **104**.

[0070] In contrast, as shown in FIG. **9**A when a single screen of Application X **900** is displayed in the first display **102** and a desktop screen **138**b is displayed in a second display **104**, upon receipt of a pinch gesture **180**, the device may change to a display state shown in FIG. **9**B. That is, upon receipt of a pinch gesture **180** when in the configuration shown in FIG. **9**A, the result may be the single screen of Application X **900** being moved to the second display **104**. In this regard, a first desktop screen **138**a that was previously obscured by the Application X **900** may be exposed. Addi-

tionally, the second desktop screen **138**b that was previously visible in the second display **104** may be obscured. Additionally, if a second pinch gesture **180** is received when in the configuration shown in FIG. **9**B, the device may be changed to a state shown in FIG. **9**C, wherein Application X **900** is moved from the second display **104** to the first display **102**. In this regard, the first desktop screen **138**a that is visible in FIG. **9**B is again obscured by Application X **900** in FIG. **9**C. Additionally, the second desktop screen **138**b may be exposed in FIG. **9**C in the second display **104** that was previously obscured by Application X in FIG. **9**B.

[0071] 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:

displaying a first screen in a first display of the plurality of displays when in a first display state;

receiving a first gesture input at said handheld computing device and a second gesture input at said handled computing device, wherein at least a portion of the first gesture input occurs simultaneously with at least a portion of the second gesture input;

modifying the plurality of displays in response to the receiving step from the first display state to a second display state such that the first screen is displayed in a second display of the plurality of displays when in the second display state.

2. The method as recited in claim **1**, wherein the first gesture input is a drag gesture in a first direction.

3. The method as recited in claim **2**, wherein the second gesture input is a drag gesture in a second direction, and wherein said first direction and said second direction are opposite.

4. The method as recited in claim **1**, wherein at least one of the first gesture input and second gesture input is received at a touch sensitive device.

5. The method as recited in claim **4**, wherein said touch sensitive device is an off display touch sensitive device.

6. The method as recited in claim **1**, wherein a second screen is displayed in the second display when in the first display state and the first display when in the second display state.

7. The method as recited in claim **6**, wherein the first screen is associated with a first application executing on the handheld computing device and the second screen is associated with a second application executing on the handheld computing device.

8. The method as recited in claim **7**, wherein at least one of the first and second applications is a single screen application.

9. The method as recited in claim **7**, wherein at least one of the first and second applications is a multi screen application executing in a single screen mode.

10. The method as recited in claim 1, wherein a first desktop screen is displayed in the second display in the first display state and a second desktop screen is displayed in the first display in the second display state.

11. The method as recited in claim 1, wherein the first gesture input is a touch input received at a first touch sensitive portion of said handheld computing device and the second gesture input is a touch input received at a second touch sensitive portion of said handled computing device.

12. The method as recited in claim 11, wherein said first touch sensitive portion is associated with the first display to comprise a first touch screen display, and wherein said second touch sensitive portion is associated with a second touch sensitive display to comprise a second touch sensitive display.

13. The method as recited in claim 11, wherein said first touch sensitive portion is disposed apart from said first display, and wherein said second touch sensitive portion is disposed apart from said second display.

14. The method as recited in claim 1, wherein the plurality of displays comprise separate portions of a single display, wherein the first display corresponds with a first portion of the single display and the second display corresponds with a second portion of the single display.

15. A handheld computing device, comprising:

a processor;

a first display in operative communication with the processor and operable to display a first screen in a first display state;

a second display in operative communication with the processor;

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

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

wherein the processor, upon receipt of the first and second touch gesture inputs, changes the first and second displays to a second display state such that the first screen is displayed on the second display in the second display state.

16. The device as recited in claim 15, wherein a second screen is displayed on the second display in the first display state and the second screen is displayed on first display in the second display state.

17. The method as recited in claim 15, wherein the first gesture sensor is first touch sensor during and the first display and the first touch sensitive device comprise a first touch screen display, and wherein the second gesture sensor is a second touch sensitive device, and the second display and the second touch sensitive device comprise a second touch screen display.

18. The method as recited in claim 15, wherein the handheld device is a smart phone.

19. The method as recited in claim 18, wherein the first display and second display are positionable with respect to each other between an open and a closed position.

20. The method as recited in claim 19, wherein when in the open position, the first display and the second display are both visible from the vantage point of a user.

21. The method as recited in claim 20, 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.

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

displaying a first screen in a first display and a second screen in a second display, when the plurality of displays are in a first display state;

receiving a first gesture input at said handheld computing device and a second gesture input at said handheld computing device, wherein at least a portion of the first gesture input occurs simultaneously with at least a portion of the second gesture input;

modifying the plurality of displays from the first state to a second display state in response to the receiving step; and

wherein the first screen is displayed in the second display and the second screen is displayed in the first display when the plurality of displays are in the second display state.

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