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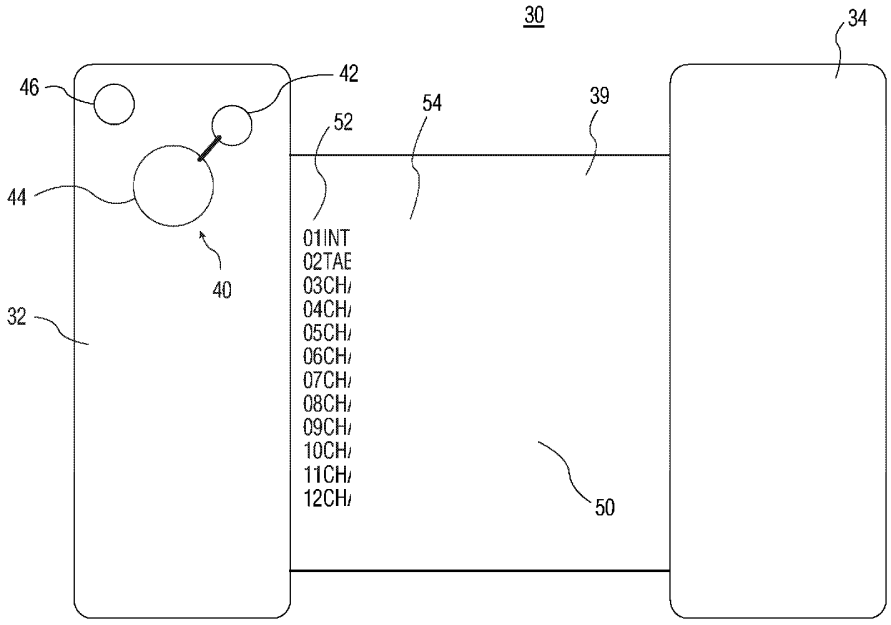
[Continued on next page]

(54) **Title:** APPARATUS AND METHOD TO ENHANCE NAVIGATION IN A USER INTERFACE FOR MOBILE DEVICES



(57) **Abstract:** A mobile device (30) comprising a primary user interface (39) and a secondary user interface (40) provided as an adjunct to the primary user interface (39), wherein the secondary user interface is configured to perform user navigation operations in the mobile device (30) in less time than is required to perform said user navigation operations via the primary user interface.

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APPARATUS AND METHOD TO ENHANCE NAVIGATION IN A USER INTERFACE FOR MOBILE DEVICES

The present application claims priority to U.S. Provisional Patent Application Ser. No. 60/682,639 filed May 19, 2005, incorporated herein by reference, and to U.S. Provisional Patent Application filed June_29, 2005 Serial No.: 60/695,088

This invention relates generally to accessing information stored in mobile devices. More particularly, the invention relates to an adjunct (supplemental) user interface for providing fast user interaction/navigation operations to access information stored in a mobile device.

Users have become accustomed to the conveniences that mobile devices such as global positioning system (GPS) receivers, mobile telephones, personal digital assistants (PDAs), eBook readers, and laptops, have to offer. Technology has made it possible to outfit the present generation of such devices with electrophoretic displays. An electrophoretic display comprises an electrophoretic medium (electronic ink) containing charged particles in a fluid, a plurality of display elements (pixels) arranged in a matrix, first and second electrodes associated with each pixel, and a voltage driver for applying a potential difference to the electrodes of each pixel to cause charged particles to occupy a position between the electrodes, depending on the value and duration of the applied potential difference, so as to display an image or other information. A display device of this type is, for example, known from international patent application WO 99/53373WO, published April 9, 1999, by E Ink Corporation, Cambridge, Massachusetts, US, and entitled Full Color Reflective Display With Multichromatic Sub–Pixels.

Despite the advantages, a significant problem offered by such electrophoretic displays is fast navigation in response to user directed navigation/scrolling operations. Specifically, for display screens based on an electronic ink substrate, the response time to user directed navigation/scrolling operations is slow. This drawback becomes most notable when scrolling or navigating long lists. The slow response time can become a persistent source of frustration for a user who must spend additional time accessing information of interest. The frustration becomes especially apparent in the case of a sophisticated user who is very facile with the operations of the device and must endure the slow response time of the device.

Therefore a need exists to overcome the disadvantages discussed above.

The present invention addresses the above-noted and other deficiencies of the prior art by providing, in a mobile device, a secondary (supplemental) user interface, wherein the secondary (supplemental) user interface has a faster response time to user navigation operations (e.g., scrolling, selection, etc.) compared with the response time of the device's primary user interface. The faster response time is achieved primarily by using a faster technology for the secondary user interface (e.g., LCD technology) as compared with a slower technology used for the primary user interface (e.g., electrophoretic technology).

According to one aspect, a mobile device comprises a primary user interface including primary display means and primary selection means. The primary user interface operating in accordance with a first technology. The mobile device further comprising a secondary user interface including secondary display means and secondary selection means. The secondary user interface operating in accordance with a second technology. The secondary user interface having a faster response time to user navigation operations than the primary interface.

According to another aspect, a method for performing user navigation operations in a mobile device having a primary and secondary user interface comprises: (1) displaying an ordered list in a primary display of the primary user interface, the ordered list comprising menu items and corresponding menu item identifiers; and (2) selecting at least one menu item from the ordered list via the secondary user interface, wherein said selection results in a faster response time than selecting the at least one menu item via the primary user interface. The act of selecting the at least one menu item from the ordered list via the secondary user interface further comprises the act of displaying the menu item identifiers in a display associated with the secondary user interface and selecting the at least one menu item from the secondary user interface display via selection means associated with the secondary user interface.

According to one embodiment, the secondary user interface comprises a display device based on liquid crystal diode (LED) technology and a scroll wheel as a selection means. The primary display device including a display device and selection means based on electrophoretic technology. The secondary user interface based on LED technology having a faster response time to user navigation operations than the primary user interface based solely on electrophoretic technology.

According to another embodiment, the secondary user interface comprises a display device configured as a series of icons integrated on the periphery of the primary display device of the primary user interface. The icons being based on the same electrophoretic technology as

used in a primary display device, but with a much shorter switching time. It is noted that shorter switching times can be realized in one way by using direct drive icons that operate using higher drive voltages. Alternatively, the icons of the display device can be based on a faster switching electrophoretic technology. As a further alternative, the icons can be based on LC, OLED or electrowetting technologies. The selection means of the secondary user interface is embodied as an up/down item selector for controlling scrolling operations associated with the icons of the secondary user interface display device. The primary display device and selection means being based on electrophoretic technology. The secondary user interface based on a series of icons and associated selection means having a faster response time to user navigation operations than the primary user interface based solely on electrophoretic technology.

In yet another embodiment, the secondary user interface comprises a secondary display device configured as a series of LEDs integrated on the periphery of the display of the primary display device of the primary user interface. The selection means of the secondary user interface is embodied as an up/down item selector for controlling scrolling operations associated with the second LED based display device. The primary display device and selection means being based solely on electrophoretic technology.

In yet another embodiment, the secondary user interface comprises a secondary user display device configured as a series of LEDs or icons integrated on the periphery of the display of the primary display device of the primary user interface, as described above. However, the present embodiment differs from the previously described embodiment in that the selection means of the secondary user interface is embodied as a mechanical selector (e.g., dial or slider on a side of the primary display) for selecting at least one item.

In each of the embodiments described herein, a more responsive secondary user interface provides a user with faster interaction/navigation operation within the mobile device than can be otherwise provided by using only the slower primary user interface based solely on electrophoretic technology.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

FIG. 1 is a view in the extended configuration of a rollable display device including a primary and secondary user interface, wherein the secondary user interface comprises a scroll wheel/selector and LCD in accordance with one embodiment of the present invention;

FIG. 2 is a view in the extended configuration of a rollable display device including a primary and secondary user interface, wherein the secondary user interface comprises up/down selector and plurality of icons in accordance with one embodiment of the present invention;

FIG. 3 is a view in the extended configuration of a rollable display device including a primary and secondary user interface, wherein the secondary user interface comprises up/down selector and plurality of LEDS in accordance with one embodiment of the present invention; and

FIG. 4 is a view in the extended configuration of a rollable display device including a primary and secondary user interface, wherein the secondary user interface comprises a dial selector in accordance with one embodiment of the present invention, and

FIG. 5 is a view in the extended configuration of a rollable display device including a primary and secondary user interface, wherein the secondary user interface comprises a mechanical slider in accordance with one embodiment of the present invention.

A key feature of the present invention is to provide a faster response time to user navigation operations in a mobile device by using a secondary (supplementary) user interface as an adjunct to the device's primary user interface, wherein the faster response time is realized by virtue of using a technology for the secondary user interface that is more responsive than the technology used for the primary user interface.

In one embodiment, the primary user interface is based on electrophoretic technology while the secondary user interface is based on a faster LCD technology.

It is well known that displays based on electronic ink substrates (i.e., electrophoretic technology) typically exhibit slow response times with regard to user interaction/navigation operations. A disadvantage of the slow response times experienced by the user is that the user is required to spend additional time accessing certain information from the device. The problem is most pronounced when the user scrolls or navigates in long lists. For example, given an exemplary list of ten items, assume a user wishes to select the last item from the list. In the case of a display based on an electronic ink substrate (electrophoretic technology), scrolling one step at a time, the response time of the e-ink display will be on the order of 5.4

seconds (9 steps x 0.6 seconds/step). By comparison, an LCD display can perform the same operation on the order of 20 – 50 milliseconds (100 times faster).

To overcome the slow response times associated with user interfaces based on electrophoretic technology, the present invention provides a secondary (supplementary) user interface based on a technology other than electrophoretics as an adjunct to the slower primary user interface based solely on electrophoretic technology to enhance or speed-up the user interaction/navigation time required to access information.

Embodiments of the invention are discussed below with reference to **FIGS. 1-4**. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to those figures is for explanatory purposes as the invention extends beyond these limited embodiments.

FIGS. 1 - 5, in which like elements share like reference numbers, are views of a user interface made in accordance with exemplary embodiments of the present invention.

First Embodiment

In one embodiment, as illustrated in **FIG. 1**, a rollable display device **30** is shown in an extended configuration in which an electrophoretic based viewing portion **39** of the rollable display device **30** is rolled out to display information to the user. As used herein, the terms "extended" and "extended configuration" are defined as the configuration in which the first and second housings **32, 34** of the rollable display device **30** are separated, as shown, and the electrophoretic based viewing portion **39** of the rollable display device **30** is extended in which the viewing portion **39** is visible to the user. The viewing portion **39** is defined herein as a primary user interface of the rollable display device **30**.

The first housing **32** of the rollable display device **30** is a base housing that encloses electronic circuitry that performs the computing operations for the rollable display device **30**. The first housing **32** also includes on a front surface, an LCD display **42** and a scroll wheel/selector **44** which collectively comprise a secondary (supplemental) user interface **40** of the rollable display device **30**. The scroll wheel/selector **44** allows a user to interact with the LCD display **42** via rotational movements (+, -). As the scroll wheel/selector **44** is scrolled in the (+,-) directions, the item identifiers **52** are sequentially displayed on the LCD display **42**. For example, scrolling the scroll wheel/selector **44** in the (+) direction may cause the LCD display 42 to sequentially display the item identifiers {01, 02, 03, and so on}. The first housing **32** further includes on its front surface a back knob 46. The back knob 46 has a function of

restoring a preceding layer of a selected menu when the scroll wheel/selector **44** is operated in error.

By way of example and not limitation, an ordered list **50** of menu items **54** and their associated menu item descriptors **52** are displayed on the electrophoretic based viewing portion **39** (i.e., the primary interface **39**) of the rollable display device **30** of **FIG. 1**. In the exemplary ordered list **50** of **FIG. 1**, the various menu items **54** illustrate a table of contents comprised of twelve entries (rows).

Two methods may be used to scroll through the list of menu items **54**. In accordance with one approach, the primary user interface **39** is used exclusively to linearly scroll through the menu items **54**. However, this method incurs a drawback. Specifically, it is an undesirable method in that it is time consuming as a navigation/selection method and therefore frustrating to the user. This is due primarily to the fact that the electrophoretic technology on which the primary user interface 39 is based is relatively slow, as described in the background. To briefly re-iterate, the time required to linearly scroll through each menu item **54** of the ordered list **50** using only the primary user interface **39** is on the order of 0.6 seconds per row for a typical electrophoretic display. Accordingly, in the present example, selecting the 12^{th} (last) item on the list can take on the order of (0.6 x 12= 7.2) seconds.

To overcome this deficiency, the present invention provides a second method for performing navigation/selection in the mobile device 30 to access information stored therein. Specifically, the mobile device **30** of **FIG. 2** includes a secondary (supplemental) user interface **40** as an adjunct to the primary user interface **39**. In the present embodiment, the secondary user interface **40** comprises a scroll wheel/selector **44,** an LCD display **42** and a back knob **46.** The secondary user interface **40** facilitates rapid identification and selection of menu items **54** from the ordered list **50** as compared with the exclusive use of the primary user interface **39**. The menu item identifiers **54** are displayed in the LCD display **42** of the secondary user interface **40** and selected using the scroll wheel/selector **44**, as described above. The secondary user interface **40** provides more significant benefits in the case where the list of menu items is especially long.

By providing a secondary user interface **40**, the mobile device **30** is capable of providing a user with a faster interaction/navigation capability to access information stored within the mobile device **30.** Accordingly, the frustrating wait time associated with the exclusive use of the primary interface **39** is overcome.

Second Embodiment

In a second embodiment, as illustrated in **FIG. 2,** rollable display device **30** has an extended configuration in which the electrophoretic based viewing portion **39** of the rollable display device **30** is rolled out to display information to the user. The first housing **32** of the rollable display device **30** is a base housing that encloses electronic circuitry that performs the computing operations for the rollable display device **30**. The first housing **32** includes on a front surface an up/down selector **64**. The up/down selector **64** constitutes one part of a secondary or supplemental user interface **40** which further comprises a row of icons **66** located on the left hand side of the primary user interface **39** (i.e., the viewing portion) of the rollable display device **30**. As shown, each icon in the row of icons **66** is associated with a respective row of the ordered list **50**.

By way of example and not limitation, an ordered list **50** is displayed on the electrophoretic based viewing portion **39** of the rollable display device **30**, such as the one shown in **FIG. 2**. The exemplary ordered list **50** of **FIG. 2** is a table of contents comprised of twelve rows, where each row includes an item identifier **52** and a corresponding item description **54** (e.g., 03 – Chapter 1).

Two methods may be used to scroll through the list of menu items **54**. As described above, utilizing the primary user interface **39** exclusively to linearly scroll through the menu items **54** is undesirable. A more preferred approach is for the user to rapidly identify and select item descriptions **54** from the ordered list **50** via a secondary or supplemental user interface **40** comprised of an up/down selector **64** and a plurality of icons **66** located on the left hand side of the primary interface 39. The up/down selector **64** highlights and selects a preferred icon from among the plurality of icons **66**. Note that each icon **66** is associated with a respective row of the ordered list **50**. While the ordered list **50** illustrated in **FIG. 2** includes 12 entries, the astute reader will appreciate that the ordered list **50** can, in some cases, be quite extensive (on the order of tens or hundreds of items). The secondary user interface **40** provides a user with the capability to rapidly traverse long lists by providing a faster interaction/navigation with the mobile device **30** than is otherwise possible using only the primary interface **39** of the mobile device **30**. This is achieved by using a more responsive technology for the secondary user interface **40,** thereby precluding the wait time associated with the slower primary interface **39** of the mobile device **30**.

Third Embodiment

In a third embodiment, as illustrated in **FIG. 3**, rollable display device **30** has an extended configuration in which the electrophoretic based viewing portion **39** of the rollable display device **30** is rolled out to display information to the user. The first housing **32** of the rollable display device **30** is a base housing that encloses electronic circuitry that performs the computing operations for the rollable display device **30**. The first housing **32** includes on a front surface an up/down selector **64**. The up/down selector **74** allows a user to interact with a row of LEDs **76** integral with the electrophoretic based viewing portion **39** of the rollable display device **30**. Note that each LED **76** of the secondary user interface is associated with a respective row of the ordered list **50**.

By way of example and not limitation, an ordered list **50** is displayed on the electrophoretic based viewing portion **39** of the rollable display device **30**, such as the one shown in **FIG. 3** and described above.

Two methods may be used to scroll through the list of menu items **54**. In accordance with one approach, the primary user interface **39** is used exclusively to linearly scroll through the menu items **54**. However, as discussed above, this method is not preferred due to the slow response time incurred. Alternatively, the user if provided with a capability to rapidly identify and select item descriptions **54** from the ordered list **50** via a secondary or supplemental user interface **40**. In the present embodiment, the secondary user interface 40 comprises an up/down selector **74** and a plurality of LEDs **76** located on the left hand side of the primary user interface **39**. The secondary user interface **40** is controlled by a user via the up/down selector **74** which highlights an LED from among the plurality of LEDs **76**. Note that each LED **76** is associated with a respective row of the ordered list **50**. While the ordered list **50** illustrated in **FIG. 3** includes 12 entries, the astute reader will appreciate that the ordered list **50** can, in some cases, be quite extensive (on the order of tens or hundreds of items). The secondary user interface **40** advantageously provides a user with a capability to rapidly traverse long lists by providing a faster interaction/navigation with the mobile device **30** than is otherwise possible using the primary interface **39** of the mobile device **30**. This is achieved by using a more responsive technology (i.e., LED technology) for the secondary user interface **40**, thereby precluding the wait time associated with the slower primary interface **39** of the mobile device **30**.

Fourth Embodiment

In a fourth embodiment, as illustrated in **FIG. 4**, rollable display device **30** has an extended configuration in which the electrophoretic based viewing portion **39** of the rollable display device **30** is rolled out to display information to the user. The first housing **32** of the rollable display device **30** is a base housing that encloses electronic circuitry that performs the computing operations for the rollable display device **30**. The first housing **32** includes on a front surface a mechanical dial selector **84**. The mechanical dial selector **84** allows a user to interact with a row of LEDs **76** integral with the primary user interface **30** (i.e., the electrophoretic based viewing portion **39** of the rollable display device **30)**. Each LED **76** is associated with a respective row of the ordered list **50**.

By way of example and not limitation, an ordered list **50**, described above, is displayed on the primary user interface **30** (i.e., the electrophoretic based viewing portion **39** of the rollable display device **30)**, such as the one shown in **FIG. 4**. A user has the ability to rapidly identify and select item descriptions **54** from the ordered list **50** via a secondary (supplemental) user interface comprised of a mechanical dial selector **84** and a plurality of LEDs **76** located on the left hand side of the viewing portion **39** of the primary user interface **39**. Specifically, a user using the mechanical dial selector **84** highlights (and optionally selects) an LED **76** from among the plurality of LEDs **76** located on the left hand side of the viewing portion **39** of the rollable display device **30**. Note that each LED **76** is associated with a respective row of the ordered list **50**.

The secondary user interface **40** provides a user with the capability to rapidly traverse long lists by providing a faster interaction/navigation with the mobile device **30** than is otherwise possible using only the primary interface **39** of the mobile device **30**. This is achieved by using a more responsive technology (i.e., LED technology) for the secondary user interface **40**, as described, thereby precluding the wait time associated with the slower primary interface **39** of the mobile device **30**.

Fifth Embodiment

In a fifth embodiment, as illustrated in **FIG. 5**, rollable display device **30** has an extended configuration in which the electrophoretic based viewing portion **39** of the rollable

display device **30** is rolled out to display information to the user. The first housing **32** of the rollable display device **30** is a base housing that encloses electronic circuitry that performs the computing operations for the rollable display device **30**. The first housing **32** includes on a front surface a mechanical slide slider **94**. The mechanical slider/selector **94** allows a user to interact with a row of LEDs **76** integral with the primary user interface (i.e., the electrophoretic based viewing portion **39** of the rollable display device **30)**. Each LED **76** is associated with a respective row of the ordered list **50**.

By way of example and not limitation, an ordered list **50**, described above, is displayed on the primary user interface **30** (i.e., the electrophoretic based viewing portion **39** of the rollable display device **30)**, such as the one shown in **FIG. 5**. A user has the ability to rapidly identify and select item descriptions **54** from the ordered list **50** via a secondary (supplemental) user interface comprised of a mechanical slider/selector **94** and a plurality of LEDs **76** located on the left hand side of the viewing portion **39** of the primary user interface **30**. Specifically, a user using the mechanical slider/selector **94** highlights (and optionally selects) an LED **76** from among the plurality of LEDs **76** located on the left hand side of the viewing portion **39** of the rollable display device **30**. Note that each LED **76** is associated with a respective row of the ordered list **50**.

Although this invention has been described with reference to particular embodiments, it will be appreciated that many variations will be resorted to without departing from the spirit and scope of this invention as set forth in the appended claims. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein. The specification and drawings are accordingly to be regarded in an illustrative manner and are not intended to limit the scope of the appended claims.

In interpreting the appended claims, it should be understood that:

a) the word "comprising" does not exclude the presence of other elements or acts than those listed in a given claim;

b) the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements;

c) any reference signs in the claims do not limit their scope;

d) several "means" may be represented by the same item or hardware or software implemented structure or function;

e) any of the disclosed elements may be comprised of hardware portions (e.g., including discrete and integrated electronic circuitry), software portions (e.g., computer programming), and any combination thereof;

f) hardware portions may be comprised of one or both of analog and digital portions;

g) any of the disclosed devices or portions thereof may be combined together or separated into further portions unless specifically stated otherwise; and

h) no specific sequence of acts is intended to be required unless specifically indicated.

CLAIMS:

1. A mobile device **30** comprising a primary user interface **39** and a secondary user interface **40** provided as an adjunct to the primary user interface **39**, wherein the secondary user interface is configured to perform user navigation operations in the mobile device **30** in less time than is required to perform said user navigation operations via the primary user interface **39**.

2. The mobile device of Claim 1, wherein the secondary user interface **40** is based on liquid crystal display technology and performs a user navigation operation on the order of substantially 0.02 seconds and the primary user interface **39** is based on electrophoretic technology and performs said user navigation operation on the order of 0.5 seconds.

3. The mobile device of Claim 1, wherein the primary user interface **39** is based on electrophoretic technology.

4. The mobile device of Claim 1, wherein the secondary user interface **40** is based on liquid crystal diode technology.

5. The mobile device of Claim 1, wherein the secondary user interface is comprised of selection means and display means.

6. The mobile device of Claim 5, wherein said display means is an LCD display **42** and said selection means is a scroll wheel/selector **44**.

7. The mobile device of Claim 5, wherein said display means is a row of icons **66** and said selection means is an up/down selector **64**.

8. The mobile device of Claim 7, wherein the row of icons **66** is based on one of LC, OLED or electrowetting technology.

9. The mobile device of Claim 5, wherein said display means is a row of LEDS **76** and said selection means is an up/down counter **74**.

10. The mobile device of Claim 5, wherein said display means is one of a row of LEDS **76** and a row of icons **66** and said selection means is a mechanical dial selector **84**.

11. The mobile device of Claim 5, wherein said display means is one of a row of LEDS **76** and a row of icons **66** and said selection means is a mechanical slider/selector **94**.

12. A method for performing user navigation operations in a mobile device having a primary and secondary user interface comprises:

(1) displaying an ordered list in a primary display of the primary user interface, the ordered list comprising menu items and corresponding menu item identifiers; and

(2) selecting at least one menu item from the ordered list via the secondary user interface, wherein said selection results in a faster response time than selecting the at least one menu item via the primary user interface.

13. The method of Claim 12, wherein the selecting act further comprises:

a. displaying the menu item identifiers in a display associated with the secondary user interface and

b. selecting the at least one menu item from the secondary user interface display via selection means associated with the secondary user interface.

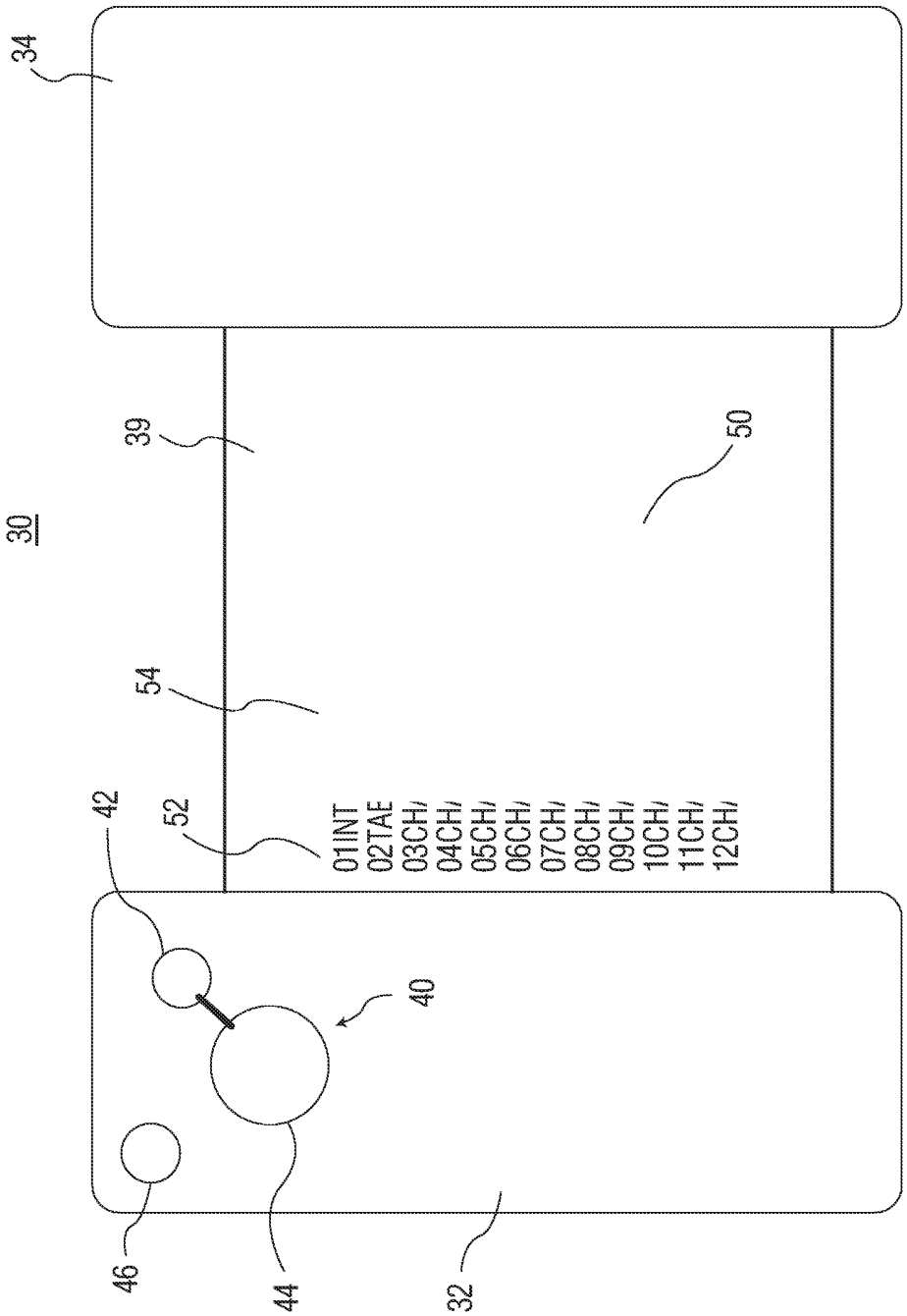
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FIG. 1

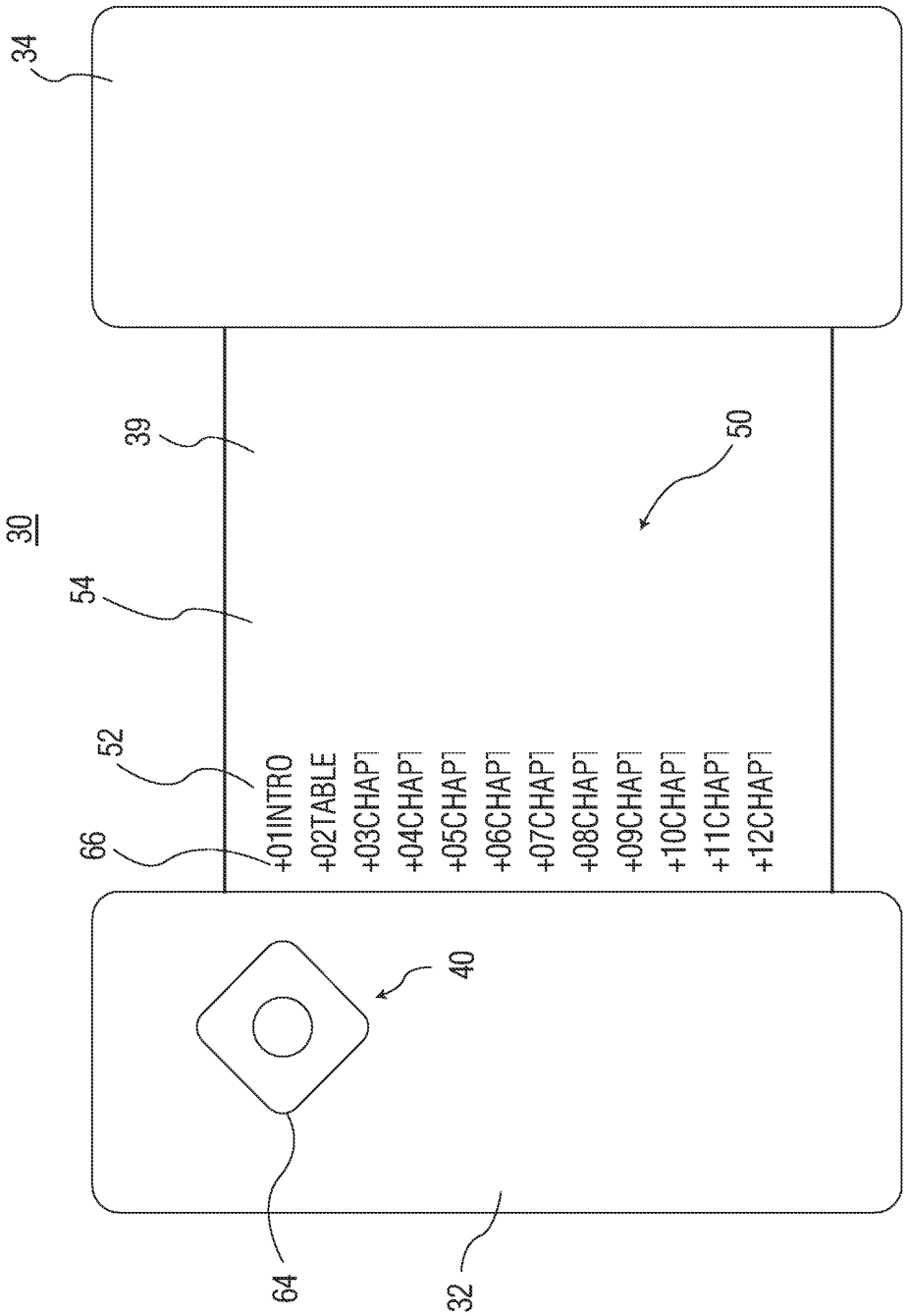
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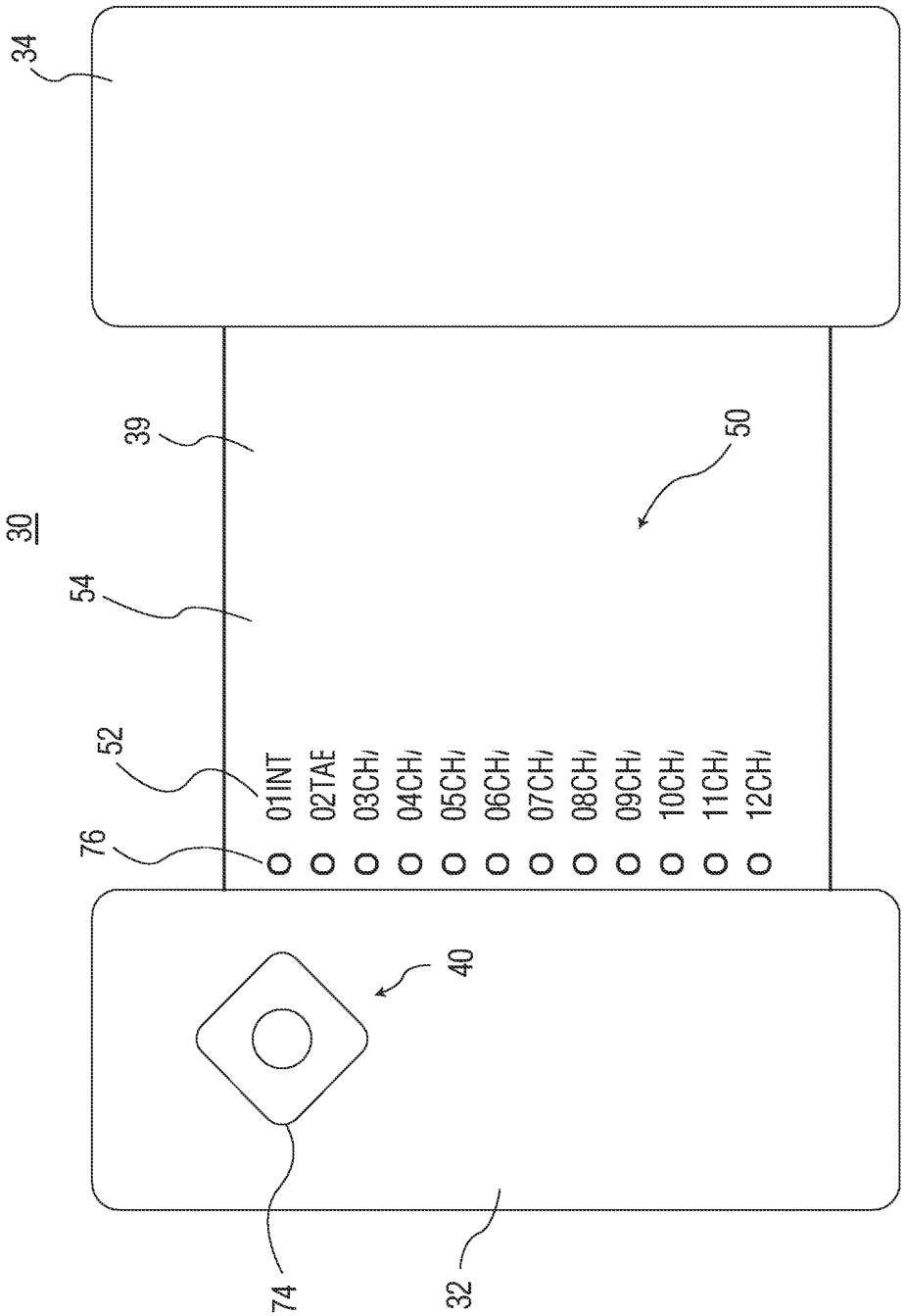
FIG. 2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11CH
12CH
76
40
74
32

FIG. 3

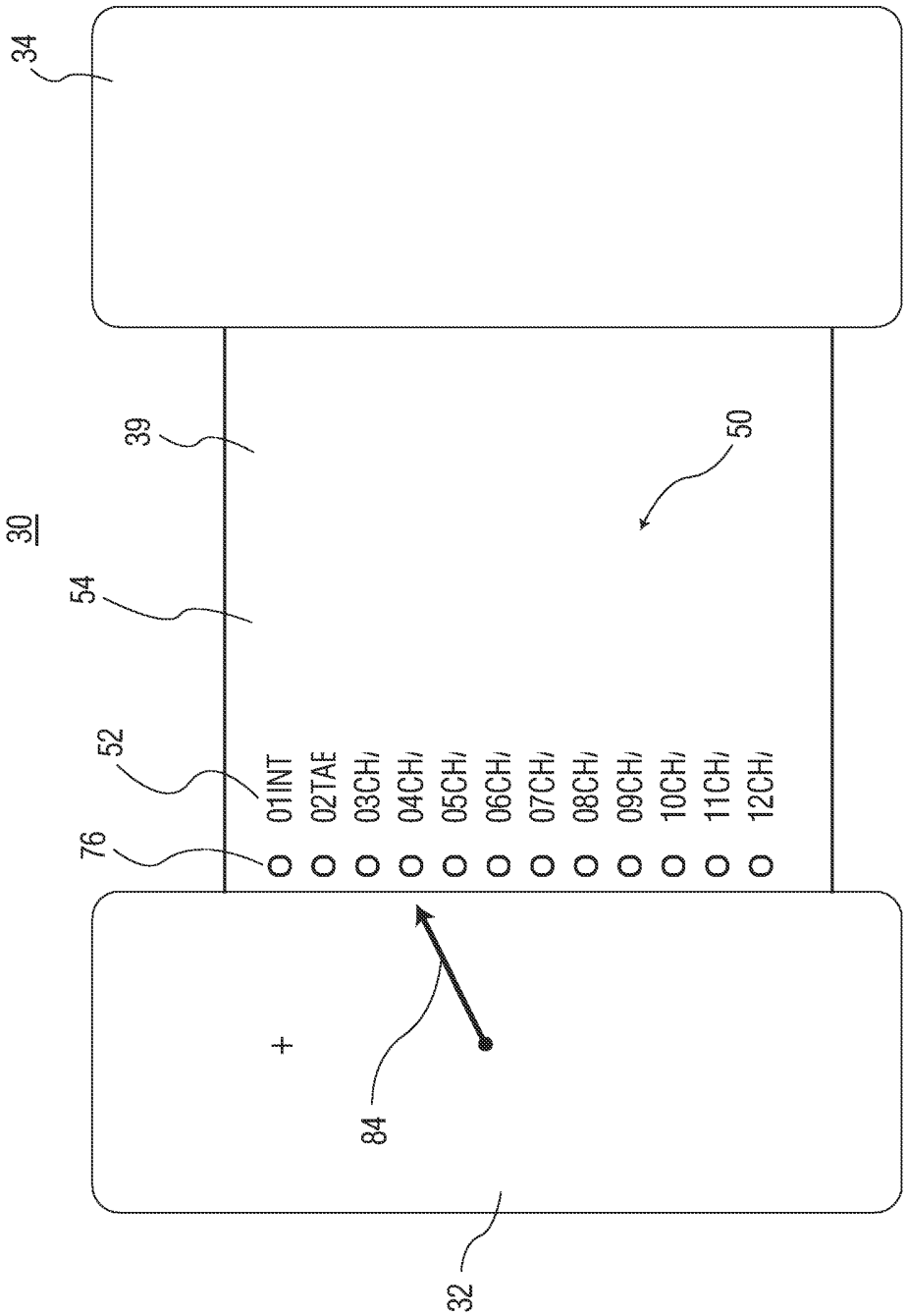
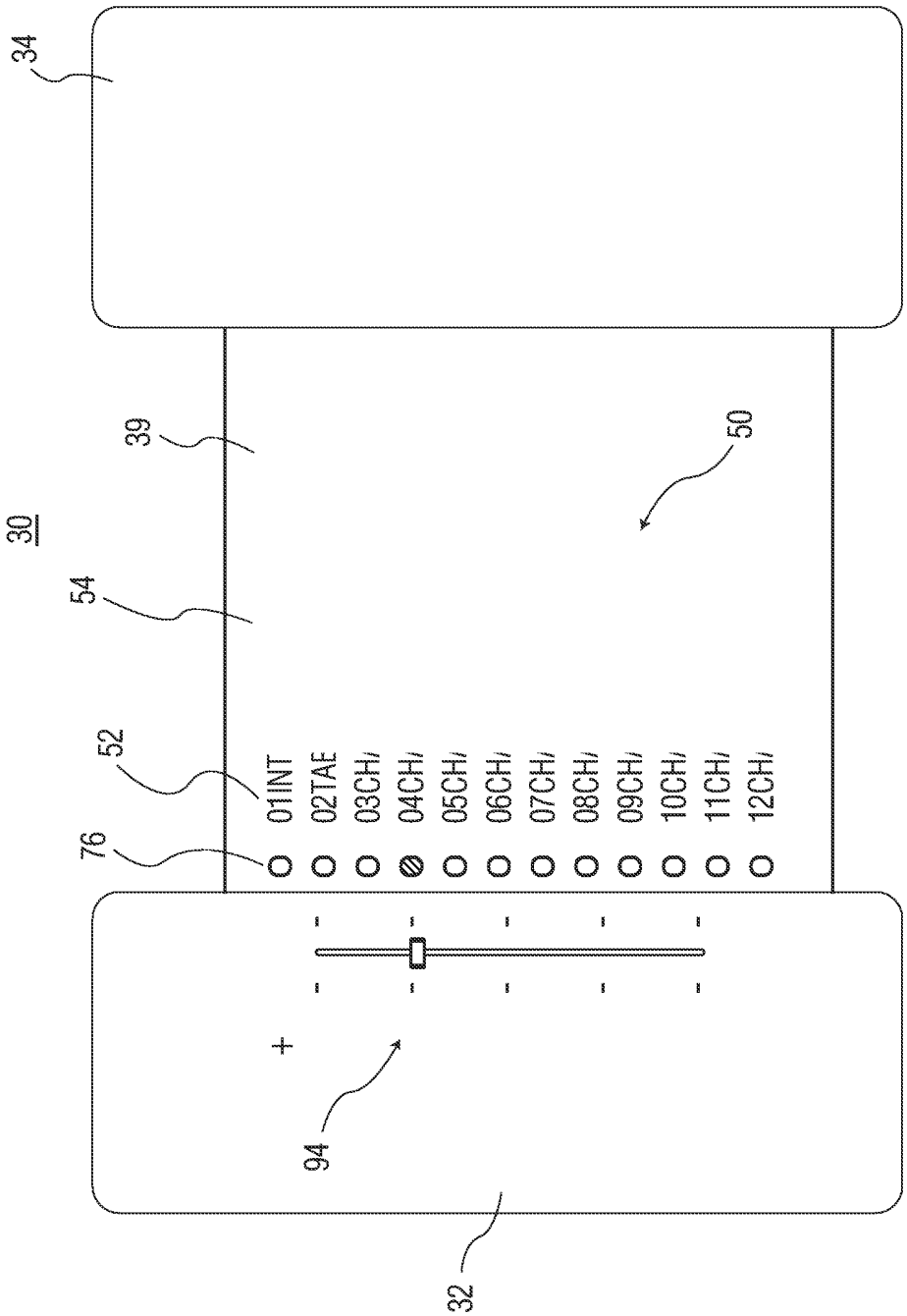

34
39
50
30
54
52
01INT
02TAE
03CH
04CH
05CH
06CH
07CH
08CH
09CH
10CH
11CH
12CH
76
84
32

FIG. 4


34
39
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30
54
52
01INT
02TAE
03CH
04CH
05CH
06CH
07CH
08CH
09CH
10CH
11CH
12CH
76
+
94
32

FIG. 5