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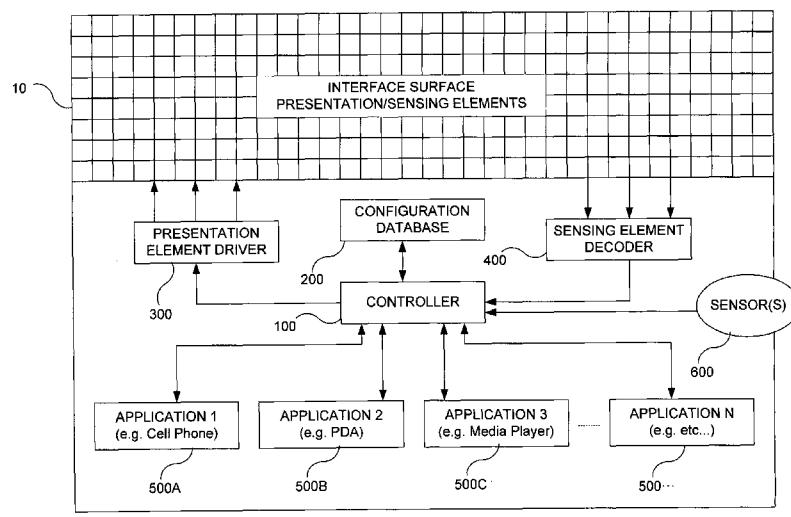


FIG. 1

(57) Abstract: Disclosed are methods, circuits, apparatus and systems for human machine interfacing with a computational platform or any other electronic device such as a cell-phone, smart-phone, e-book, notebook computer, tablet computer, etc. According to some embodiments, there may be provided an adaptive touch-screen input arrangement such as a keyboard, keypad or any other touch screen input arrangements including one or more input elements such as rendered or projected keys or buttons which may be projected onto or rendered on a touch screen display. The adaptive touch-screen input arrangement may be adapted to alter the size, shape or location of input elements within proximity of a finger, limb or implement used by a user to touch the screen.

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**METHODS CIRCUITS APPARATUS AND SYSTEMS FOR HUMAN  
MACHINE INTERFACING WITH AN ELECTRONIC APPLIANCE**

**FIELD OF THE INVENTION**

[001] The present invention generally relates to the field of electronics. More specifically, the present invention relates to a methods, circuits, apparatus and systems for facilitating human interface with electronic devices such as mobile devices, cell phones, Personal Digital Assistants (“PDA”), digital cameras, or any integrated combination of electronic devices.

**BACKGROUND**

[002] In recent decades, electronic technology, including communication technology, has revolutionized our everyday lives. Electronic devices such as PDA's, cell phones, e-books, notebook computers, mobile media players and digital cameras have permeated the lives of almost every person living in the developed world – and quite a number of people living in undeveloped countries. Mobile communication and computing devices, especially, have become the means by which countless millions conduct their personal and professional interactions with the world. It has become almost impossible for many people, especially those in the business world, who use these devices as a means to improve productivity, to function without access to their electronic devices.

[003] However, with this tremendous proliferation in the use of electronic devices, there has developed a tradeoff between enhanced productivity and simplicity or

convenience. As handheld devices evolved to perform more and more tasks, the complexity of the interfaces required to interact with these devices has likewise increased. Many of today's handheld devices come equipped with some variation or another of a full typewriter keyboard. Some devices have fixed keyboards which are electromechanical in nature, while others have project a keyboard, a key pad or some variation of either onto a display associated with a touch screen sensor array. Because of the need to keep mobile or handheld devices compact enough to carry around, many of the physical and virtual (i.e. projected keyboards and keypads) implemented on these devices have keys or other interface components which are quite small relative to an average human finger, thus difficult to operate.

[004] Thus, there is a need for improved methods, circuits, apparatus and systems for interfacing with an electronic device.

### **SUMMARY OF THE INVENTION**

[005] According to embodiments of the present invention, there are provided methods, circuits, apparatus and systems for human machine interfacing with a computational platform or any other electronic device such as a cell-phone, smart-phone, e-book, notebook computer, tablet computer, etc. According to some embodiments of the present invention, there may be provided an adaptive touch-screen input arrangement such as a keyboard, keypad or any other touch screen input arrangements including one or more input elements such as rendered or projected keys or buttons which may be projected onto or rendered

on a touch screen display. The adaptive touch-screen input arrangement may be adapted to alter the size, shape or location of input elements within proximity of a finger, limb or implement used by a user to touch the screen.

[006] According to some embodiment of the present invention, one or more sensors such as: (1) image sensors, (2) image sensor arrays, (3) electrostatic sensors, (4) capacitive sensors, or (5) any other functionally suited sensor may sense a location and/or motion vector of a finger, limb or implement approaching the touch screen. The sensor(s) may provide to the adaptive touch screen-input arrangement an indication of the sensed position or motion vector of the finger/limb/implement relative to the input elements or keys - thereby indicating which input elements or keys are being approached. In response to the indication, the touch screen input arrangement may alter the size, shape or location of input elements within proximity of the sensed finger, limb or implement in order to make them more prominent (e.g. larger or in a better location) and more easily engagable.

[007] According to further embodiments of the present invention, there may be provided a human interface surface (e.g. touch screen display) comprising presentation and sensing elements. The presentation elements and the sensing elements may be integrated into a single substrate material or may part of separate substrates which are mechanically attached to one another in an overlapping manner. According to further embodiments of the present invention, there may be provided a controller (e.g. display drive circuit) adapted to send one or more presentation signals to the presentation elements of the human interface

surface based at least partially on data stored in a presentation configuration table (e.g. virtual keyboard layout including location and size of keys) and based on a current state of the device. The current state of the device may be determined based on one or more signals received from the sensing elements and/or based on one or more signals received from the device.

[008] According to further embodiments of the present invention, the controller may associate a function or device command signal with each of one or more signals received from the sensing elements (e.g. when the sensing element is touched), wherein the association of a command or function may be at least partially based on data from a first data set in the sensing element configuration table. The data selected from the sensing element configuration table may be correlated to data from the presentation configuration used by the controller to send one or more signals to the presentations elements.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[009] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying drawings in which:

[0010] FIG. 1 shows a block diagram of an exemplary mobile device according to some embodiments of the present invention, including an interface surface and various electrical functional blocks to drive and interact the interface surface.

[0011] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

## **DETAILED DESCRIPTION**

[0012] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components and circuits have not been described in detail so as not to obscure the present invention.

[0013] Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "processing", "computing", "calculating", "determining", or the like, refer to the action and/or processes of a computer or computing system, or similar electronic computing device, that manipulate and/or transform data represented as physical, such as electronic, quantities within the computing system's registers and/or memories into other data similarly represented as physical quantities within the computing system's memories, registers or other such information storage, transmission or display devices.

[0014] Embodiments of the present invention may include apparatuses for performing the operations herein. This apparatus may be specially constructed for the desired purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, magnetic-optical disks, read-only memories

(ROMs), random access memories (RAMs) electrically programmable read-only memories (EPROMs), electrically erasable and programmable read only memories (EEPROMs), magnetic or optical cards, or any other type of media suitable for storing electronic instructions, and capable of being coupled to a computer system bus.

[0015] The processes and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct a more specialized apparatus to perform the desired method. The desired structure for a variety of these systems will appear from the description below. In addition, embodiments of the present invention are not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the inventions as described herein.

[0016] According to embodiments, there may be provided an interface apparatus for an electronic device including an adaptive touch-screen input arrangement adapted to alter a size, position or shape of an input element based on signal or an indication from a touchless sensor regarding a position or motion vector of a finger, limb or implement. The adaptive touch-screen input arrangement may include a display functionally associated with a graphics processing circuit adapted to render one or more input elements and to project the one or more elements on the display. The apparatus may include a touchless sensor adapted to sense a position or motion vector of a finger, limb or implement in proximity

with said display. A signal derived from an output of the touchless sensor may be provided to the graphics processing circuit and may cause the graphics processing circuit to alter a feature of one or more projected interface elements – for example the size of an input element (e.g. a keyboard key projected on the display and its associated touch-screen sensor area) in proximity with a position of a finger, limb or implement may be enlarged. The touchless sensor may be selected from a group of sensors consisting of (1) proximity sensors, (2) image sensors, (3) image sensor arrays, (4) electrostatic sensors, and (5) capacitive sensors. The interface apparatus may be part of a computing device, communication device or any other electronic device known today or to be developed in the future.

[0017] Turning now to FIG. 1, there is shown a block diagram of an exemplary mobile device according to some embodiments of the present invention, including an interface surface and various electrical functional blocks to drive and interact the interface surface or touch-screen assembly. The exemplary device may include a controller 100 adapted to regulate signals to a presentation element driver 300, which presentation element driver 300 may be functionally associated with presentation elements (e.g. Light Emitting Diodes, LCD, etc..) of an interface surface 10. The controller may also be adapted to receive signals from a touch sensing element decoder 400, which decoder 400 is functionally associated with touch sensing elements (e.g. touch sensors, etc.) of the interface surface. The controller may also be adapted to receive finger/limb/implement location or motion indications or information from a touchless sensor 600.

[0018] It should be understood that the controller 100 may be a processor, a graphics processor, dedicated control logic or any combination thereof.

[0019] A configuration database 200 may include information used by the controller 100 in regulating signal flow to the presentation element driver. As shown in Fig. 1, the configuration database 200 may include such information as interface element (e.g. buttons or display area) shape and location, display properties, etc., for each of the applications 500A through 500N installed on the device. It should be understood by one of ordinary skill in the art that interface elements such as buttons and displays mentioned above are not physical buttons or displays, but rather virtual elements projected through the presentation surface 10. For each given application 500A through 500N, the configuration database 200 may also include sensing element mapping information corresponding to presentation information/elements associated with given application to specific functions. The controller 100 may use the mapping information to determine which interface element is interacted with (when the screen is touched) by the user and which function/command that interaction is meant to trigger.

[0020] The controller may be adapted to alter the size, shape, location or any other feature of any element projected/rendered by the display elements based on a signal or indication provided by the touchless sensor 600 regarding finger/limb/implement location or motion relative to the sensing surface or any of the elements projected onto the sensing surface. The controller may make an input element towards which the finger/limb/implement is approaching more prominent. The controller may also adjust its touch-sensor element to function

mapping to correlate with the adjusted projected/displayed input element size, shape or location.

[0021] According to some embodiments of the present invention, the touchless sensor 600 may be adapted to determine the position and/or motion of a finger/limb/implement relative to the touch-screen or relative to elements projected/rendered/displayed thereon. The touchless sensor may be part of an image based human machine interface. The image based human machine interface may include one or more image sensors and software running on the controller, on another generable purpose processor or on a dedicated processor. According to further embodiments of the present invention, the sensor 600 may be part of electrostatic sensing arrangement. It should be understood by one of skill in the art that any functionally correlated (i.e. can serve the same function) touchless sensor may be used as part of some embodiments of the present invention.

[0022] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

**CLAIMS**

What is claimed:

1. An interface apparatus for an electronic device, comprising:  
an adaptive touch-screen input arrangement adapted to alter a size, position or shape of an input element based on an indication from a touchless sensor regarding a position or motion vector of a finger, limb or implement.
2. The apparatus according to claim 1, wherein said adaptive touch-screen input arrangement includes a display functionally associated with a graphics processing circuit adapted to render one or more input elements and to project the one or more elements on said display.
3. The apparatus according to claim 2, further comprising a touchless sensor adapted to sense a position or motion vector of a finger, limb or implement in proximity with said display.
4. The apparatus according to claim 3, wherein a signal derived from an output of said touchless sensor is provided to said graphics processing circuit.

5. The apparatus according to claim 3, wherein said touchless sensor is selected from the group of sensors consisting of (1) proximity sensors, (2) image sensors, (3) image sensor arrays, (4) electrostatic sensors, and (5) capacitive sensors.
6. The apparatus according to claim 1, wherein the size of an input element in proximity with a position of a finger, limb or implement is enlarged.
7. An electronic device, comprising:
  - a processor; and
  - an adaptive touch-screen input arrangement adapted to alter a size, position or shape of an input element based on an indication from a touchless sensor regarding a position or motion vector of a finger, limb or implement.
8. The device according to claim 7, wherein said adaptive touch-screen input arrangement includes a display functionally associated with a graphics processing circuit adapted to render one or more input elements and to project the one or more elements on said display.

9. The device according to claim 8, further comprising a touchless sensor adapted to sense a position or motion vector of a finger, limb or implement in proximity with said display.
10. The device according to claim 9, wherein a signal derived from an output of said touchless sensor is provided to said graphics processing circuit.
11. The device according to claim 9, wherein said touchless sensor is selected from the group of sensors consisting of (1) proximity sensors, (2) image sensors, (3) image sensor arrays, (4) electrostatic sensors, and (5) capacitive sensors.
12. The device according to claim 7, wherein the size of an input element in proximity with a position of a finger, limb or implement is enlarged.

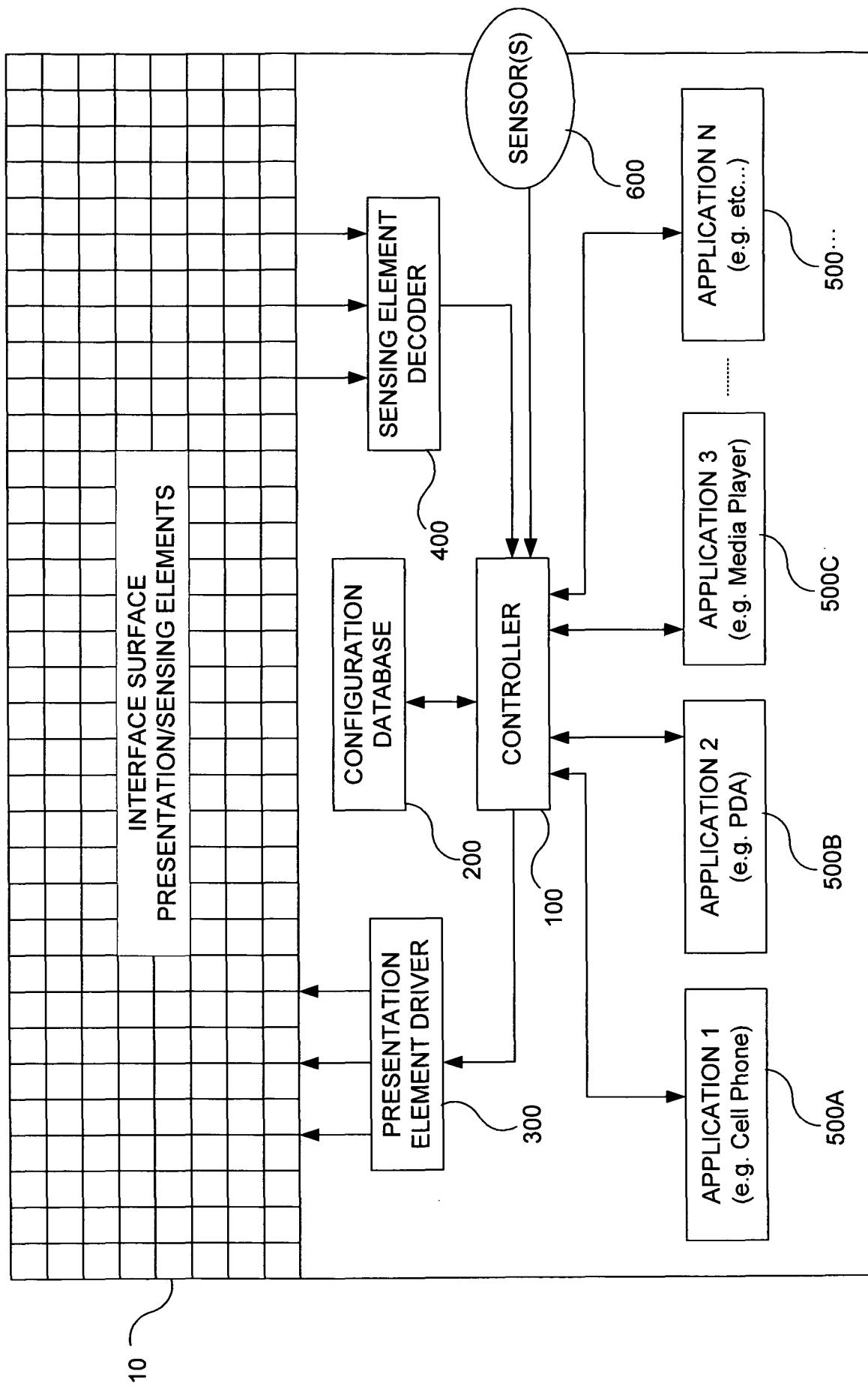


FIG. 1

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/IL 10/00791

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(8) - G06F 3/041 (2011.01)

USPC - 345/173

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): G06F 3/041 (2011.01)

USPC: 345/173

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC(8): G06F 3/041 (2011.01) (keyword limited - see terms below)

USPC: 345/173, 418, 650 (keyword limited - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 PubWEST(PGPB, USPT, EPAB, JPAB); Google; Search Terms: interfac device machine computer phone equipment portable mobile handheld hand-held device machine computer phone equipment touchscreen touch screen input output finger arrang chang plac proximity approach close alter modif chang size shap position location position motion location

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 2008/0111710 A1 (BOILLOT) 15 May 2008 (15.05.2008), entire document, especially; abstract, para. [0043]-[0044], [0048]-[0049], [0051]-[0052], [0057], [0060]-[0061], [0066], [0086]	1-4, 6-10, 12 ----- 5, 11
Y	US 2008/0007533 A1 (HOTELLING) 10 January 2008 (10.01.2008), entire document, especially; para. [0045], [0049], [0057], [0060], [0064]	5, 11
A	US 2007/0236475 A1 (WHERRY) 11 October 2007 (11.10.2007), entire documents	1 - 12
A	US 2006/0164230 A1 (DEWIND et al.) 27 July 2006 (27.07.2006), entire document	1 - 12

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search	Date of mailing of the international search report
27 January 2011 (27.01.2011)	10 FEB 2011
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774