

(19) World Intellectual Property Organization  
International Bureau



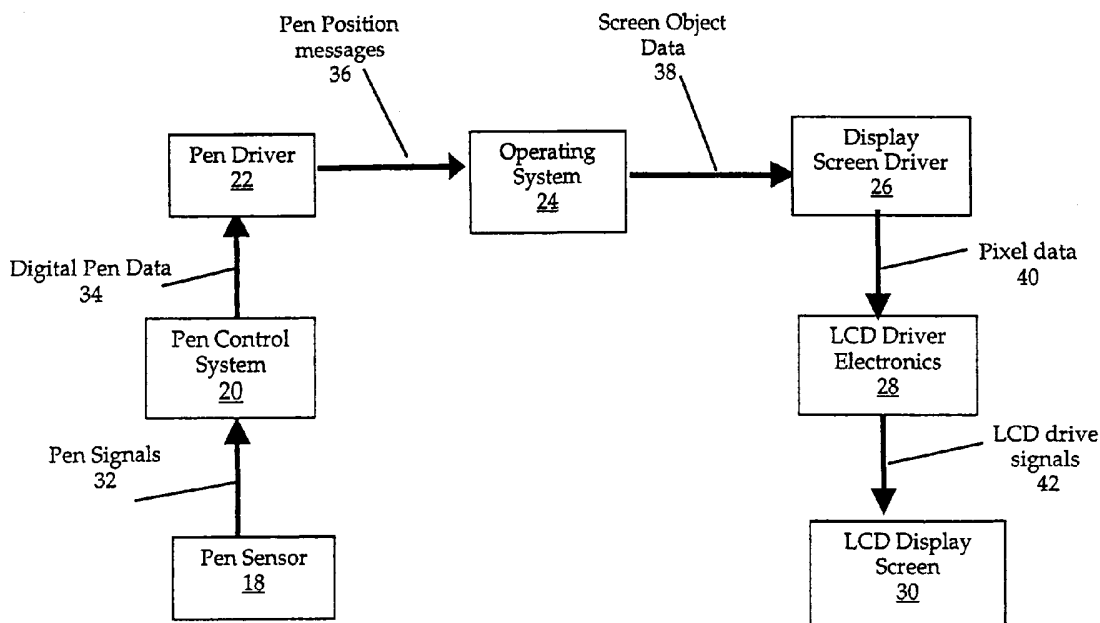
(43) International Publication Date  
27 December 2002 (27.12.2002)

PCT

(10) International Publication Number  
**WO 02/103669 A1**

- (51) International Patent Classification<sup>7</sup>: **G09G 5/00**
- (21) International Application Number: PCT/US02/17242
- (22) International Filing Date: 31 May 2002 (31.05.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
09/877,411 7 June 2001 (07.06.2001) US
- (71) Applicant: **SYNAPTICS, INC.** [US/US]; 2381 Bering Drive, San Jose, CA 95131 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (72) Inventors: **FOOTE, Geoffrey**; 43 Argyle Street, Cambridge CB1 3LR (GB). **GILLESPIE, David, W.**; 16100 Soda Springs Road, Los Gatos, CA 95033 (US).
- (74) Agent: **COPPES-GATHY, Nicole, E.**; Sierra Patent Group, LTD., P.O. Box 6149, Stateline, NV 89449 (US).
- Published:**  
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: METHOD AND APPARATUS FOR CONTROLLING A DISPLAY OF DATA ON A DISPLAY SCREEN



(57) Abstract: A user interface of a smart compact device employs a combination having a display screen (30) in combination with an activating object that is capable of reporting X and Y position information (36) in a first state and a second state. Selected data is displayed or hidden depending on whether the first state or second state is detected (18).

5           METHOD AND APPARATUS FOR CONTROLLING A DISPLAY OF DATA  
ON A DISPLAY SCREEN

BACKGROUND OF THE INVENTION

10           The invention relates generally to smart compact devices, and specifically to the display and manipulation of information on such devices by the use of a pen input system capable of sensing the proximity of the pen.

          There are now many computerized devices capable of storing and accessing large amounts of data that employ quite compact displays. Examples of such smart compact devices are smart handheld devices, such as PDAs and smartphones. Other smart compact devices may be kiosks or other equipment that is physically large, but with displays that are compact compared to those of traditional computers. These smart compact devices are commonly used for storing and accessing personal data such as contact addresses and calendar information. A smart compact device has an operating system, running on a microprocessor, with a display screen and an activating object, such as a finger, pen, and the like, used with a pointing device. The pointing device is used to control the actions of the operating system through a user interface. The display screen is typically an LCD module, and the pointing device is, for example, a resistive touchscreen. The operating system will typically be an event driven operating system with a graphical user interface, such as a windowing operating system, but may also be a text-based user interface.

25           A graphical user interface typically is made up from screen objects, which can be control objects, such as scroll bars, combo boxes, buttons and drop down lists; data objects, such as text windows and bitmapped images; and combinations of the two, such as hyperlinks within text. The user can store and retrieve information from the smart compact device by manipulating the screen objects of the graphical user interface with the pointing device. Control objects often have a control action associated with them, such as closing a window, or opening a file.

          The graphical user interface on a smart compact device is often derived from graphical user interfaces that are well known on desktop computers, where the pointing device is often a mouse or a touchpad. A key difference between desktop computers and smart compact devices is that the display screen on a smart compact device is typically

5 320x240 pixels or less in size. This small size makes it difficult to present the data stored in the smart compact device in an easy to use way.

A second key difference is that the graphical user interface of a desktop computer is typically driven by a pointing device that is capable of generating both X and Y position data, and one or more bits of status information. An example of this status information is  
10 mouse button state. The pointing device on a smart compact device can usually only provide X and Y position data in one state, for example the position where the user has touched a resistive touchscreen.

Techniques that are used in the graphical user interfaces of desktop computers to manage large amounts of data on a display screen include multiple overlapping windows and  
15 pop-up data, which provides extra information about control and data objects in a graphical user interface when the mouse pointer is positioned over them. An example of an implementation of pop-up data is Microsoft's ToolTips.

Multiple overlapping windows are of little use on a smart compact device, since the overhead of window borders, title bars etc., become prohibitive on a small display screen.  
20 Pop-up data relies on the pointing device being able to provide at least two states with X and Y position data, so that a screen object may be pointed to trigger the pop-up data, and then selected. Existing pointing devices on smart compact devices do not have this capability, and so pop-up data is difficult to implement in a user-friendly manner.

Attempts have been made to implement pop-up data on smart compact devices using  
25 a pointing device that has only one X and Y position state. Microsoft's PocketPC generates pop-up data in some situations if the pointing device is held on a control object for a period of time. An alternative implementation is described in Patent EP 0 996 052 A2, where tapping the pointing device switches modes to display pop-up data. Neither of these approaches is intuitive for the user, and so pop-up data implemented in this way detracts  
30 from the usability of the smart compact device.

A further challenge with the user interface of a smart compact device is that smart compact devices, unlike desktop computers, are generally used in a variety of environments, often ease of use and quick access to data is of paramount importance. A standard measure of the usability of the user interface of a smart compact device is the number of taps or other  
35 discrete actions that a user must make to perform a specific task e.g. dialing a phone number.

Pointing devices that are capable of generating X and Y position data while reporting

5 several status bits are well known in desktop computers. In addition to the standard mouse, inductive graphics tablets are common. Also, inductive pen sensing systems have been used for pen-based tablet computers, which are characterized by a large form factor. The use of an inductive pen system in a small form factor device, such as a PDA, has also been disclosed in WO 00/33244. In all these cases the pen system is capable of generating X and Y  
10 position data with several status bits, where the status bits may depend on whether the pen is touched to the screen or not. The ability to report X and Y position while not touching the screen is referred to as proximity sensing.

In these prior art systems, the proximity information has only been used to mimic the status information available from mouse buttons. No inventive extensions to the User  
15 Interface of either desktop computers or smart compact devices have been made that use proximity information in a novel way to enhance usability. Specialized niche applications, such as varying spray density of the aerosol tool in a graphics package, are the extent of the applications to date.

## 20 BRIEF DESCRIPTION OF THE INVENTION

The present invention provides a means for manipulating the presentation of data in the user interface of a smart compact device, using information provided by the smart compact device's pointing device.

The invention allows a screen object to be displayed on the display screen, and pop-  
25 up data associated with the screen object to be accessed. The user accesses the pop-up data by manipulating the pointing device in an intuitive manner. The novel use of pop-up data on a smart compact device to allow simple and easy access to large amounts of data is a key advantage of the invention.

It is a further advantage that the invention is intuitive in use for both novice and  
30 experienced device users.

## BRIEF DESCRIPTION OF THE DRAWING FIGURES

Referring now to the figures, wherein like elements are numbered alike:

FIG. 1 is a diagram showing a typical window on the display screen of a computer,  
35 with a typical screen object.

FIG. 2 is a diagram showing pop-up data, which is displayed when the pointing

5 device has been held over the screen object for a short period of time.

FIG. 3 is a diagram illustrating the present invention.

FIG. 4 shows a typical screen object in the form of a hyperlink.

FIG. 5 shows the same screen object, and its associated pop-up data 20, that has been triggered by holding the activating object above the hyperlink.

10 FIG. 6 shows a typical small display screen on a smartphone showing device status information and a window with directory information containing screen objects such as the contact name, the contact company and an icon intended to trigger the dialing process.

FIG. 7 shows an alternate small display screen on a smartphone, where the contacts do not have a dial icon associated with them.

15 FIG. 8 shows typical data stored for each contact entry in a smartphone including both detailed contact information, and control objects in the form of icons which allow dialing the contact, sending email, or returning the display to the directory listing of FIG. 7.

FIG. 9 illustrates a prior art process of dialing a contact from the directory.

FIG. 10 illustrates a typical prior art process for dialing a number when the contact  
20 name may be ambiguous.

FIG. 11 shows a process for dialing a number according to the present invention.

FIG. 12 shows a process for dialing a number according to the present invention in the case of ambiguous names.

FIG. 13 illustrates a display according to an alternative embodiment, in which the  
25 pop-up data does not have to take up the whole display screen of the smart compact device, but can be displayed on a part of the display.

#### DETAILED DESCRIPTION OF THE INVENTION

Persons of ordinary skill in the art will realize that the following description of the  
30 present invention is illustrative only and not in any way limiting. Other embodiments of the invention will readily suggest themselves to such skilled persons having the benefit of this disclosure.

The prior art of pop-up data on a desktop computer is shown by FIGS. 1 and 2. FIG.  
1 shows a typical window on the display screen 12 of the computer, with a typical screen  
35 object 10. FIG. 2 shows the pop-up data 14, which is displayed when the cursor associated with a pointing device (a mouse) has been held over the screen object 10 for a short period

5 of time.

The invention is shown diagrammatically in FIG. 3. In an illustrative embodiment, the pointing device may be an inductive pen input system, comprising a pen sensor 18 and a pen control system 20, such as that described in publication WO 00/33244, entitled "Position Sensor". This system has the key advantage that it can provide X and Y position data both  
10 when the activating object is touching the display screen and when it is held in close proximity to, but not touching, the display screen, and is able to distinguish between the two states. Alternatively, the first state may require a firm touch while the second "non-touching" state may occur even when the activating object is lightly touching the display screen.

15 In an alternative embodiment, such an enhanced pointing device could also be a capacitive touchpad, capable of sensing an activating object, such as a finger pen, and the like, in close proximity to its surface, as well as when touched to the surface.

In a further alternative embodiment, the enhanced pointing device could be any device capable of providing X and Y position data, and two or more states associated with  
20 that data, those states being a base state (corresponding to a mouse pointer position with no buttons pressed, or a activating object in close proximity to, but not touching a display screen), a selected state (corresponding to a mouse pointer position with the left button clicked, or a activating object touched to the display screen of a smart compact device), and zero or more further extended states (corresponding, for example, to a mouse with the right  
25 button clicked, or a activating object with a side button held in).

In a further alternative embodiment, the enhanced pointing device is an inductive pen input system (or inductive sensing system) that is capable of providing X and Y position data, a base state, a selected state, and zero or more extended states, where the extended states are related to the distance of the activating object from the sensor.

30 In a further alternative embodiment, the enhanced pointing device is a device capable of providing X and Y position data, a base state, a selected state, and extended states, where the extended states are selected by a user-controlled parameter of the enhanced pointing device.

In an illustrative embodiment, the pen control system 20 is driven by software  
35 running on the microprocessor of the smart compact device, the pen driver 22. This pen driver 22 converts the pen data 34 from the sensor system into pen position messages 36,

5 formatted according to the requirements of the operating system 24. These messages contain both the X and Y position data, and flags to signal which one of the states the pen system is reporting.

In an alternative embodiment, the software running on the smart compact device may be structured in a manner other than that shown in FIG. 3, but one that reports of the  
10 activating object position to the user interface.

In an illustrative embodiment, the operating system 24 processes the pen position message and alters the visible state of any appropriate screen object, according to the state of the activating object as reported in the pen position message. If the activating object has been held above a screen object for more than a short length of time (typically 1 second or  
15 less), the operating system will change the state of the screen object so that the pop-up data is displayed. FIG. 4 shows a typical screen object 50, a hyperlink 54. FIG. 5 shows the same screen object 50, and its associated pop-up data 52 that has been triggered by holding the activating object above the hyperlink 54.

In an alternative embodiment, the pop-up data can be triggered immediately when  
20 the activating object is held over the screen object. Such an embodiment can be used, for example, to enable a user to easily dial the correct number from the contacts directory of a smartphone.

FIG. 6 shows a typical small display screen on a smartphone. The display screen 60 is showing device status information 62, 64 and a window 66 with directory information.  
25 Within the window 66, the directory information is shown as lines 68, each containing screen objects, such as the contact name 70, the contact company 72 and an icon 74 intended to trigger the dialing process. An alternative to this screen is shown in FIG. 7, where the contact names 70 do not have a dial icon associated with them.

The data displayed on this screen is a summary or abstraction of the data held in the  
30 smart compact device about each contact. Typically, each contact will have at least the data illustrated in FIG. 8 stored. The window 66 in FIG. 8 is displaying both detailed contact information 80, and control objects in the form of icons, which allow dialing the contact 86 and 88, sending email 84 or returning the display to the directory listing 82 of FIG. 7.

In the prior art smart compact devices that use a resistive touch screen as a pointing  
35 device, the process of dialing a contact from the directory would typically involve the steps shown in FIG. 9. The user would select the display of the directory, tap the desired contact

5 name 70, and then tap the dial icon 88 in the detailed display screen. This involves three discrete user actions.

In an alternative prior-art embodiment, tapping a dial icon in the directory listing (reference numeral 74 in FIG. 6) would dial a number directly. This has two key disadvantages. Firstly, there will usually be more than one number or contact method  
10 associated with each contact, so accessing a detailed screen would still be necessary. Secondly, the small amount of abstracted data visible on the directory screen is not always sufficient to uniquely identify the desired contact.

FIG. 10 illustrates a typical prior-art process for dialing a number when the contact name may be ambiguous. If the desired contact 70 has the same first name and company as  
15 another contact 71, the wrong contact may be selected initially. Then the user has to click the return icon 82 to return to the directory listing (or perform a similar 'undo' action). Then the correct desired contact 70 must be selected, followed by the selection of the dial icon 88 of the correct contact. This process takes five discrete user actions.

In the present invention, the process is simplified for the user. FIG. 11 shows a  
20 process according to the present invention. The contacts directory is selected, the activating object is held stationary above the desired contact name 70, which triggers the pop-up data and displays the detailed contact information. As part of the same movement the user taps the dial icon 88 to initiate the dialing sequence. This process involves only two discrete user actions, together with a natural, intuitive movement of the activating object.

25 In the case of ambiguous names, the process of FIG. 12 is followed. Once the contacts directory is selected, the activating object is held above the incorrect contact name 71, triggering the pop-up data with the full contact details. Instead of having to tap the return icon 82, the user simply moves the activating object out of the proximity range, and then holds it over the correct contact name 70. The pop-up data shows the detailed information,  
30 and the user can tap on the dial icon 88, initiating dialing. The complete process takes only three discrete user actions, together with a natural intuitive movement of the activating object.

In an alternative embodiment, the removal of the pop-up data may be signaled by another user action, such as the movement of the activating object outside the area of the  
35 display screen occupied by the pop-up data.

It will be recognized by those skilled in the art that the present invention is not



5 limited to use with a contacts directory, but can be used for any application that requires an abstracted display of detailed data, and ready access to the detailed data.

In an alternative embodiment, the pop-up data does not have to take up the whole display screen of the smart compact device, but can be displayed on a part of the display. FIG. 13 illustrates such a display. The activating object is held above the desired contact name 70, which is then highlighted, triggering the pop-up data containing contact details 90 in the lower section of the screen. Moving the activating object to another contact name will cause the pop-up data to change to details of the new contact, dialing the contact can be initiated by tapping the dial icon 88. This embodiment has the advantage that the context of the contact name can be seen together with the contact details. In this embodiment the pop-up data is not removed when the activating object is moved away from the display screen, but remains until an action icon has been selected, pop-up data has been triggered from another contact name, or another application is selected on the smart compact device.

In a further alternative embodiment, the directory listing takes the form of FIG. 14. Here, the display screen in the directory application always has a listing 92, and pop-up data 90 associated with the highlighted contact 70. Holding and moving the activating object in proximity to the display above the listing causes the highlight to move, changing the pop-up data to match the highlighted contact. This allows the user to ensure that the right contact is selected from several ambiguous contacts. Clicking the activating object on the highlighted contact brings up the full information screen of FIG. 8, allowing the user to select the required contact method. This embodiment addresses both key disadvantages of the prior art, while being easy and intuitive for the user.

It is a further advantage of this embodiment that movement of the activating object to the upper or lower extremes of the directory list (Reference numeral 92 of FIG. 14) can cause the list to scroll automatically.

It will be realized by those skilled in the art, that the present invention applies to all classes of screen objects, whether they are used in the software application user interface, as part of a the operating system user interface, or in a smart compact device where the software is not structured in this way, but contains a user interface and an enhanced pointing device. It will also be appreciated that the novel use of the combination of an enhanced pointing device and pop-up data greatly enhances the usability of the user interface on a smart compact device, in a way that has not previously been demonstrated.

5           Alternatively, the behavior of the screen object may be modified by the state information returned by the enhanced pointing device with the X and Y position data, so that more than one control action maybe produced from one control object.

          Alternatively, the pop-up data for a screen object may be triggered by a further extended state of the enhanced pointing device, distinct from the base and selected states.

10           In an illustrative embodiment, the exact method of triggering the pop-up data, the duration of any timings associated with triggering the pop-up data, the range from the display screen that is defined as proximity and the form of any pop-up data will be determined by usability testing so as to maximize the benefit to the user in a given application.

15           While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

          What is claimed is:

## 5 CLAIMS

1. In a smart compact device, a user interface comprising:

a display screen in communication with an activating object that is capable of reporting X and Y position information in a first and a second state;

data displayed on said display screen in response to a selection of said first  
10 state or said second state.

2. The user interface of claim 1, wherein said second state is entered substantially immediately when said activating object is placed in proximity to, but not in contact with, said display screen.

3. The user interface of claim 1, wherein said second state is entered following a  
15 selected time delay period after said activating object is placed in proximity to, but not in contact with, said display screen.

4. The user interface of claim 1, wherein said data displayed on said display screen is displayed or hidden in response to a selection of either said first state or said second state.

20 5. The user interface of claim 1, wherein said user interface employs an inductive sensing system.

6. The user interface of claim 1, wherein said user interface employs a ratiometric measurement technique with a small number of coils that each extend across a sensing area.

25 7. The user interface of claim 1, wherein said smart compact device displays said data in windows.

8. The user interface of claim 4, wherein additional data related to at least part of data displayed on said display screen is displayed in response to said second state.

9. The user interface of claim 5, wherein additional data related to at least part  
30 of data displayed on said display screen is displayed in response to said second state.

10. The user interface of claim 6, wherein additional data related to at least part of data displayed on said display screen is displayed in response to said second state.

11. The user interface of claim 8, wherein said additional data is displayed only

5 after said activating object has been held above the display for a pre-selected period of time.

12. The user interface of claim 9, wherein said additional data is displayed only after said activating object has been held above the display for a pre-selected period of time.

13. The user interface of claim 10, wherein said additional data is displayed only after said activating object has been held above the display for a pre-selected period of time.

10 14. The user interface of claim 6, wherein once said additional data has been displayed, touching said activating object to said display screen on said additional data causes a first action to occur, said first action being different from a second action that would have occurred if said additional data had not been displayed.

15. The user interface of claim 1, wherein said smart compact device is handheld.

15 16. The user interface of claim 1, wherein said activating object is a finger, pen, and the like.

17. A system for presenting and manipulating information in the user interface of a smart compact device, comprising:

20 coupling a display screen in communication with an activating object that is capable of reporting X and Y position information in a first state and a second state;

coupling at least one processing element said activating object;

operating control software for said activating object reporting said X and Y position information and whether said activating object is in said first or said second state;

25 operating an operating system on said at least one processing element that presents data; and

controlling information on said display screen in response to said activating object to selectively hide and display data in response to whether said activating object is in said first state or said second state.

30 18. The system of claim 17, wherein said second state is entered substantially immediately by placing said activating in proximity to, but not in contact with, said display screen.

19. The system of claim 17, wherein said second state is entered following a selected time delay period after placing said activating object in proximity to, but not in

5 contact with, said display screen.

20. The system of claim 17, wherein said data displayed on said display screen is displayed or hidden in response to a selection of either said first state or said second state.

21. The system of claim 17, wherein said user interface employs an inductive sensing system.

10 22. The system of claim 17, wherein said user interface employs a ratiometric measurement technique with a small number of coils that each extend across a sensing area.

23. The system of claim 17, wherein said smart compact device displays said data in windows.

15 24. The system of claim 20, wherein additional data related to at least part of data displayed on said display screen is displayed in response to said second state.

25. The system of claim 21, wherein additional data related to at least part of data displayed on said display screen is displayed in response to said second state.

26. The system of claim 22, wherein additional data related to at least part of data displayed on said display screen is displayed in response to said second state.

20 27. The system of claim 24, wherein said additional data is displayed only after said activating object has been held above the display for a pre-selected period of time.

28. The system of claim 25, wherein said additional data is displayed only after said activating object has been held above the display for a pre-selected period of time.

25 29. The system of claim 26, wherein said additional data is displayed only after said activating object has been held above the display for a pre-selected period of time.

30. The system of claim 22, wherein following displaying said additional data, touching said activating object to said display screen on said additional data causes a first action to occur, said first action being different from a second action that would have occurred if said additional data had not been displayed.

30 31. The system of claim 17, wherein said smart compact device is handheld.

32. The system of claim 17, wherein said activating object is a finger, pen, and the like.

33. A method for controlling a display of data on a display screen, comprising:

- 5                   providing a touch screen in communication with an activating object;  
                  defining a first state and a second state by a first proximity relationship and a  
second proximity relationship between said activating and said touch screen;  
                  sensing a relationship between said activating object and said touch screen;  
                  determining whether said relationship is within said first state or said second  
10   state; and  
                  displaying a first group of data on said display screen if said relationship is  
within said first state and displaying a second group of data on said display screen if said  
relationship is within said second state.
34.   The method of claim 33, wherein said first proximity relationship is contact  
15   and said second proximity relationship is within close proximity to said display screen.
35.   The method of claim 34, wherein said contact is at a first pressure and said  
close proximity is at a second pressure less than said first pressure.
36.   The method of claim 33, wherein said sensing said relationship for a pre-  
selected period of time.

20

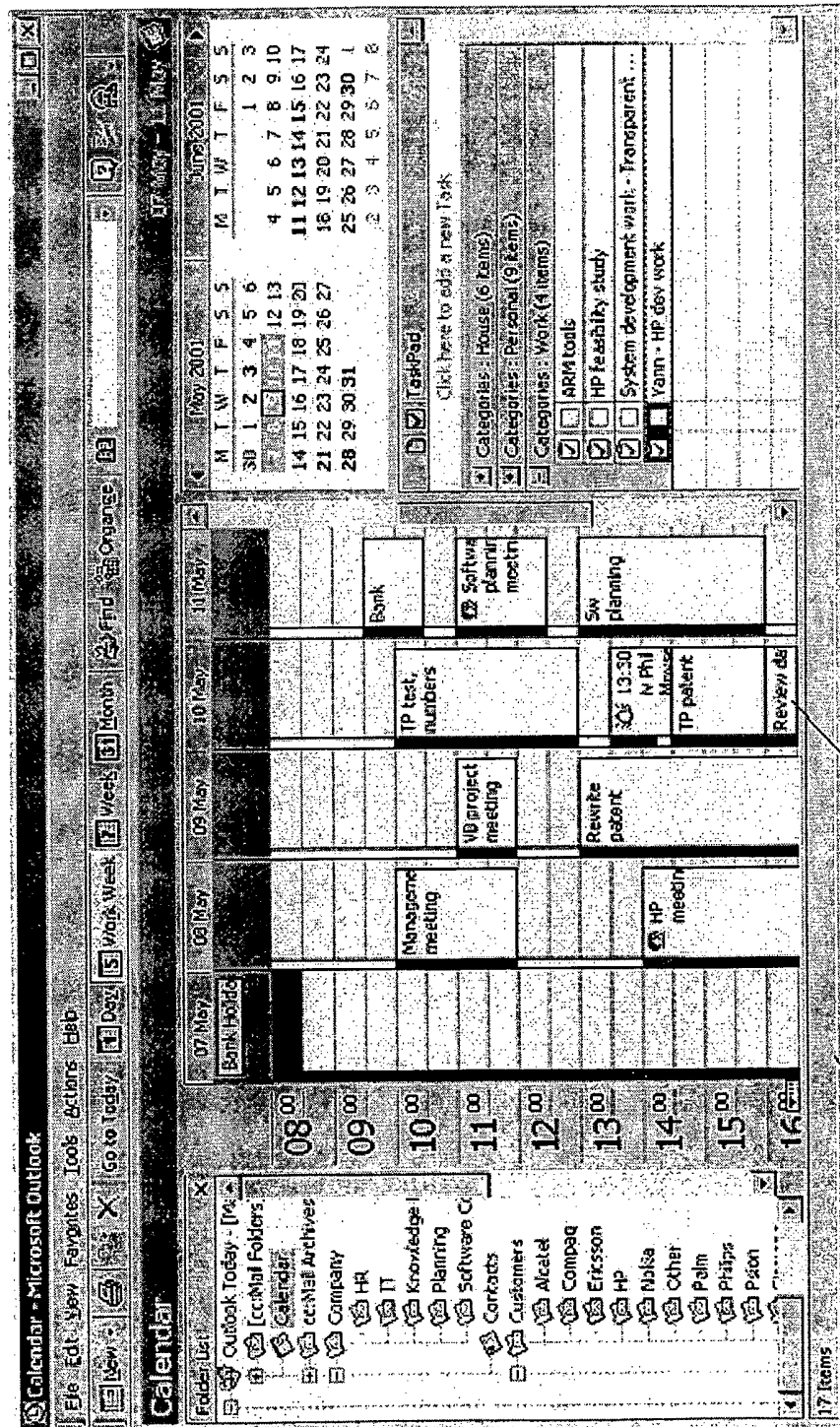


Figure 1

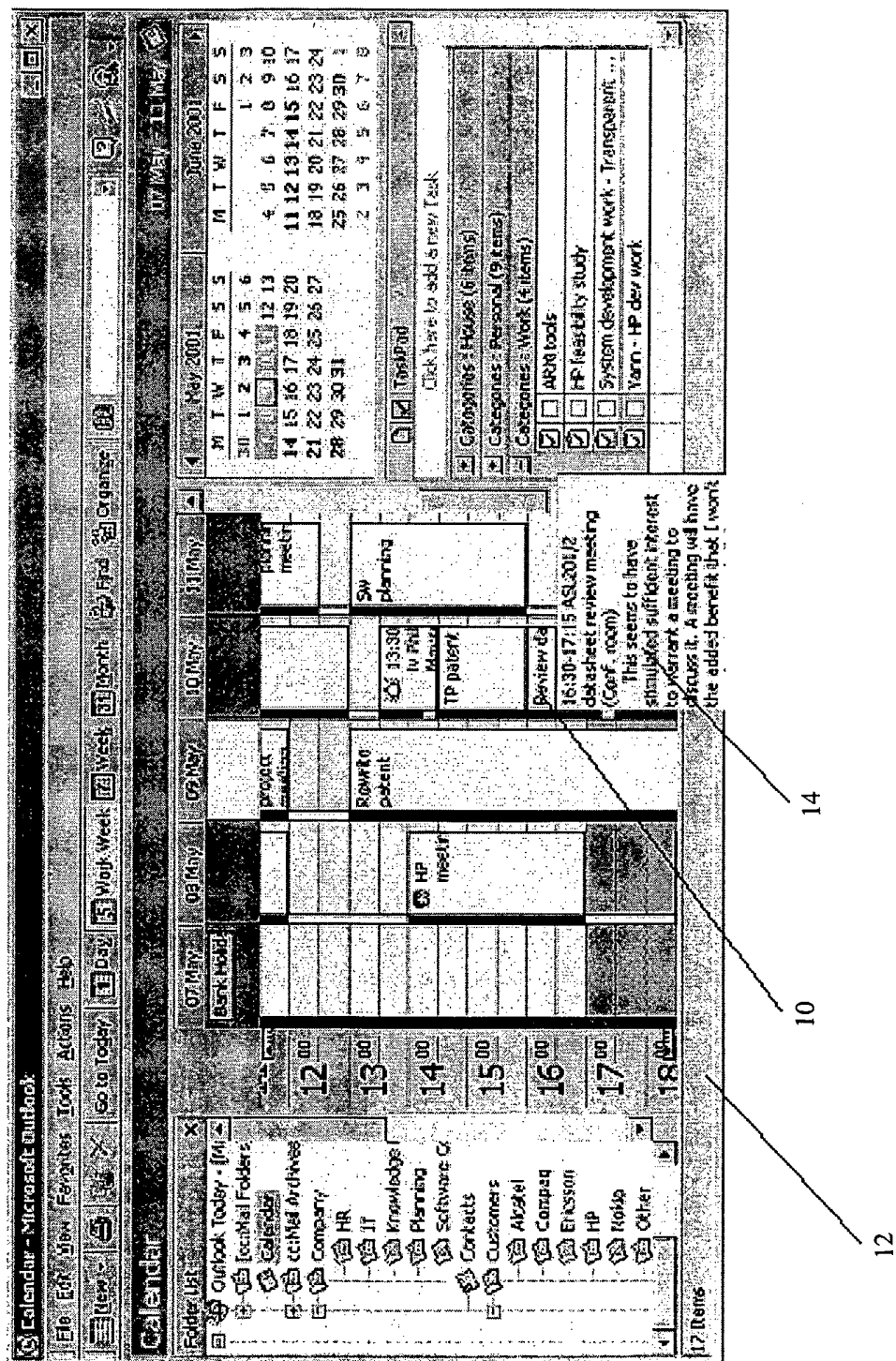


Figure 2



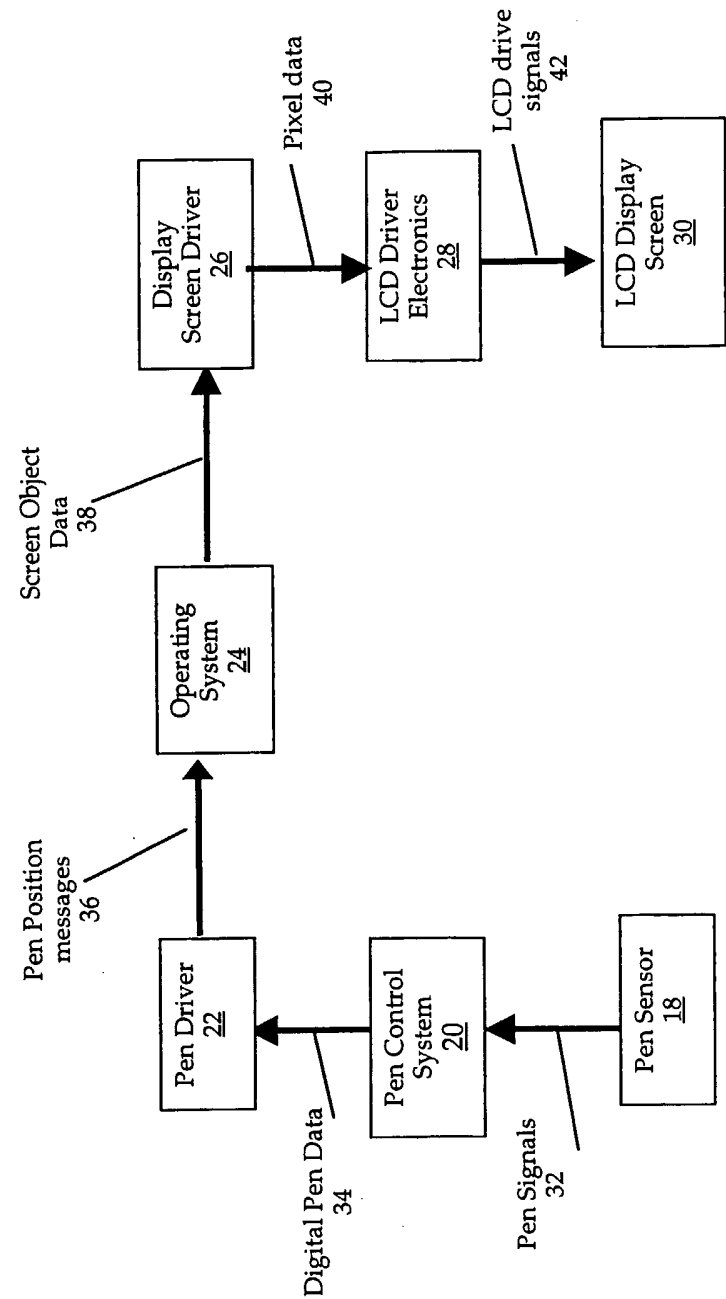
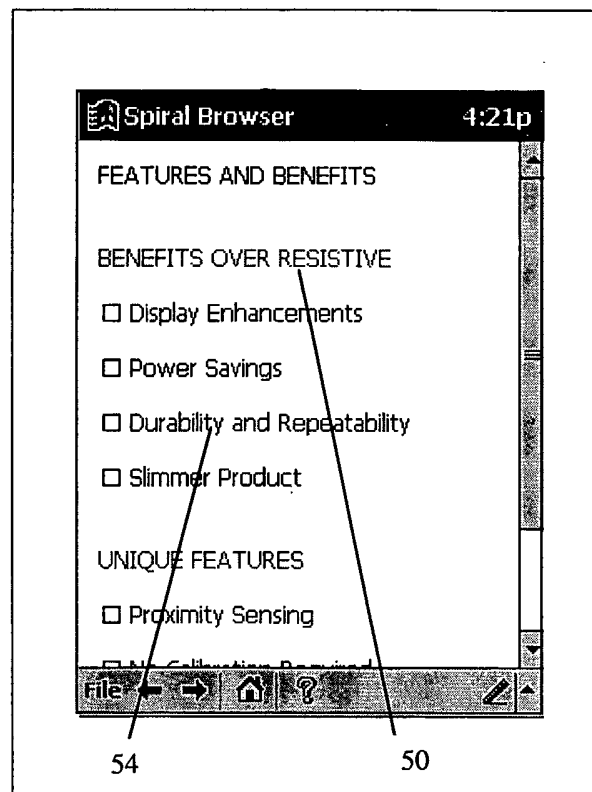
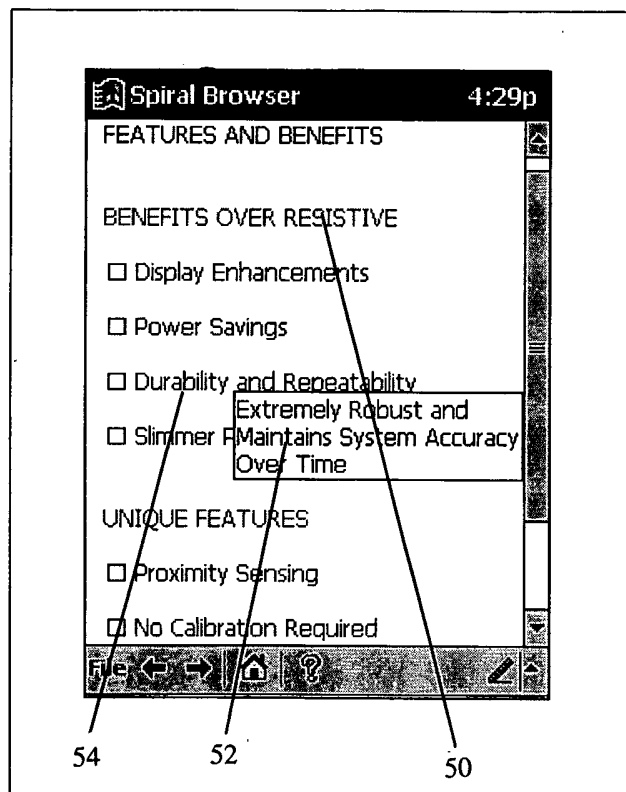


Figure 3

**Figure 4**

**Figure 5**

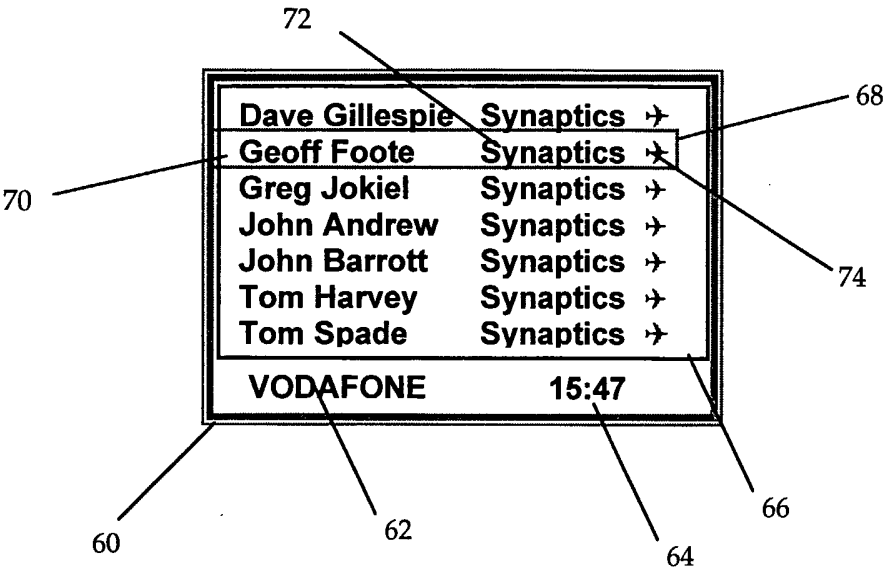


Figure 6

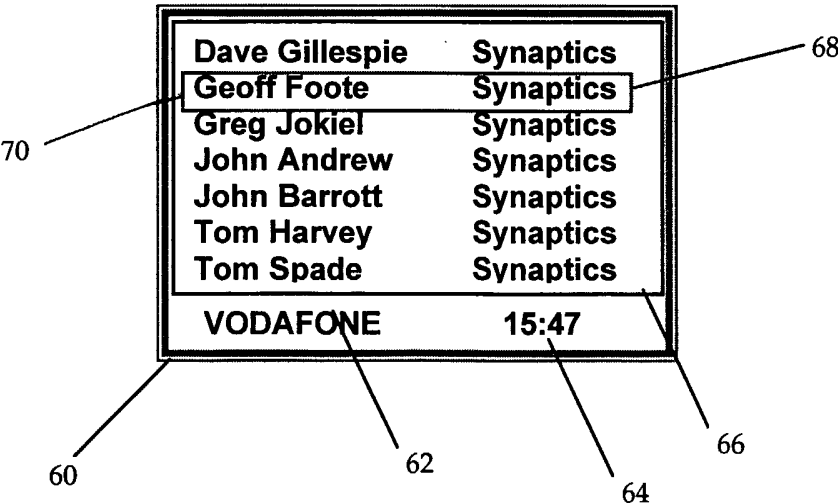


Figure 7

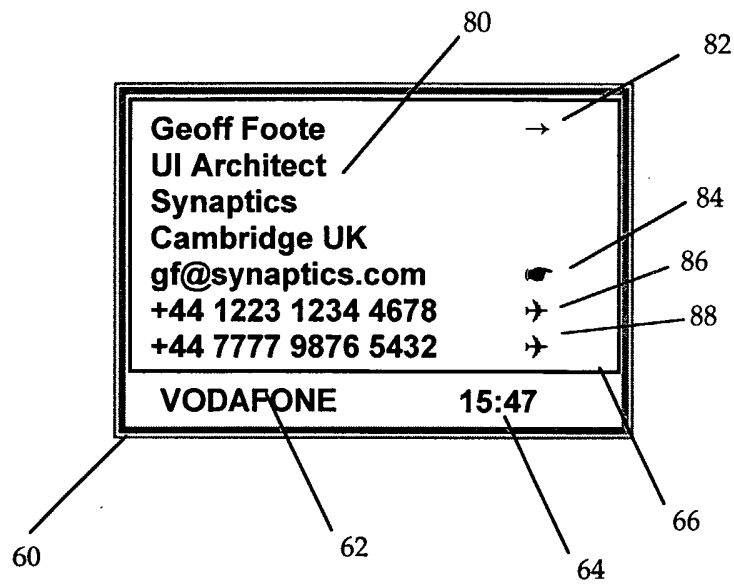
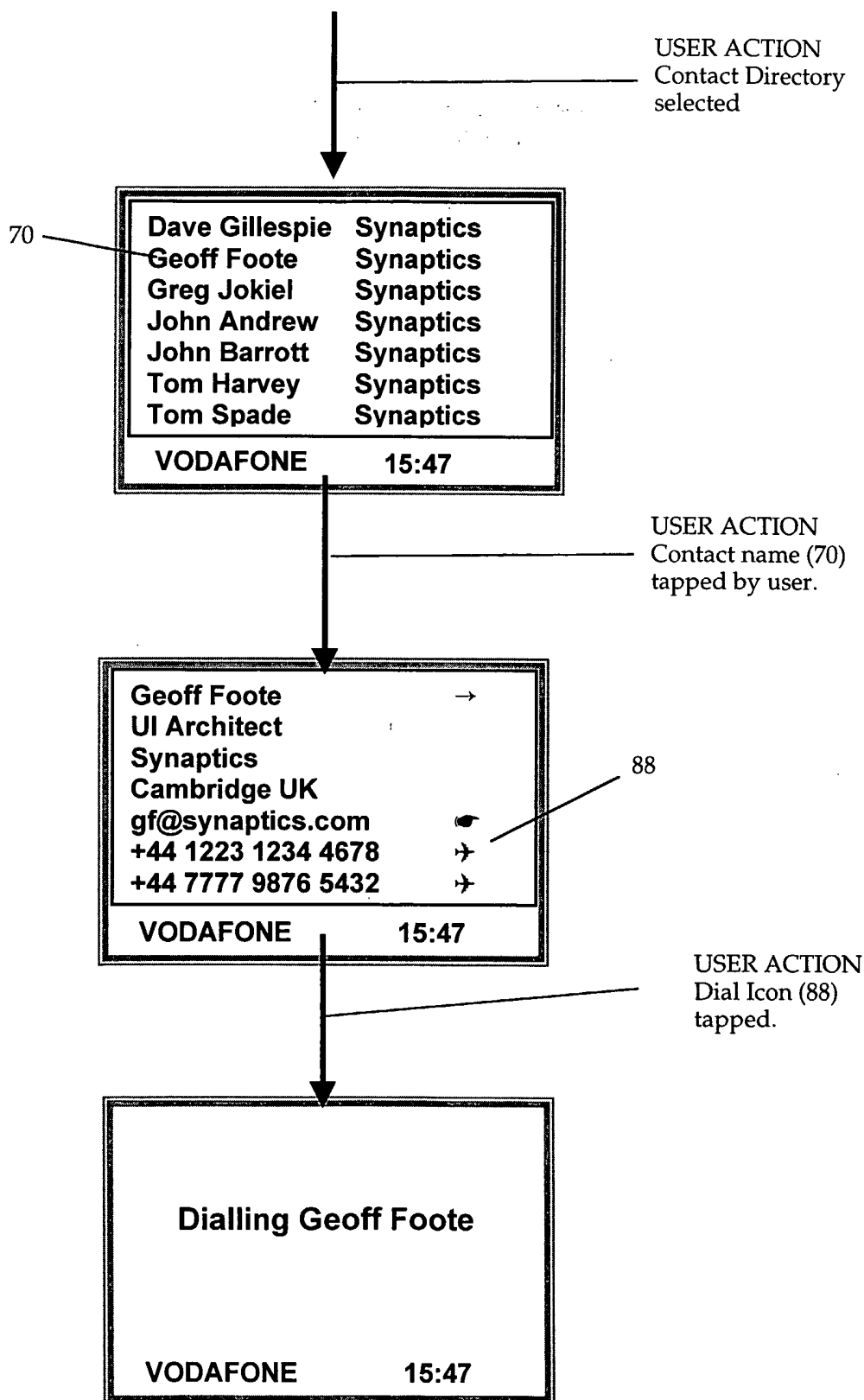
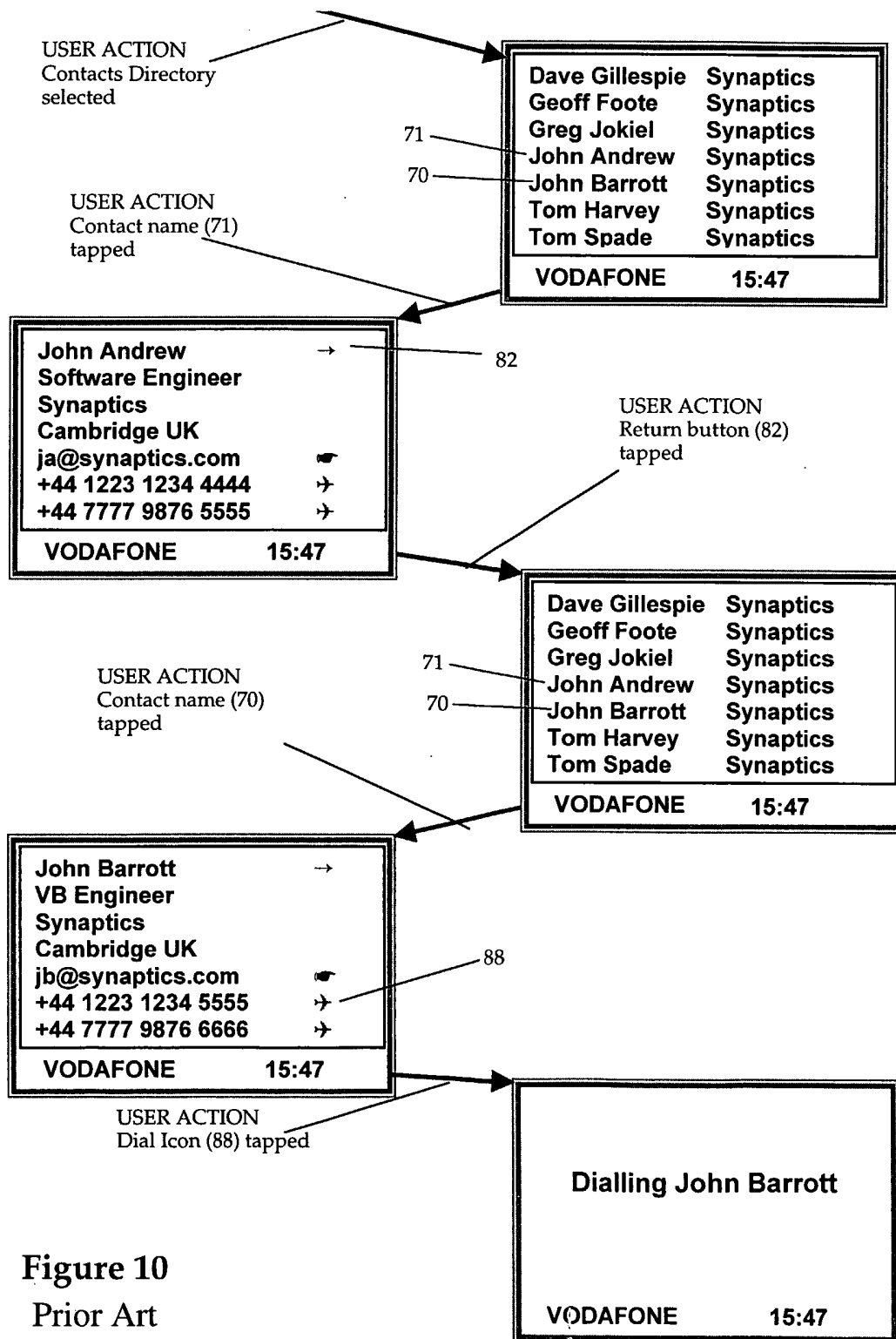


Figure 8



**Figure 9**  
Prior Art



**Figure 10**  
Prior Art

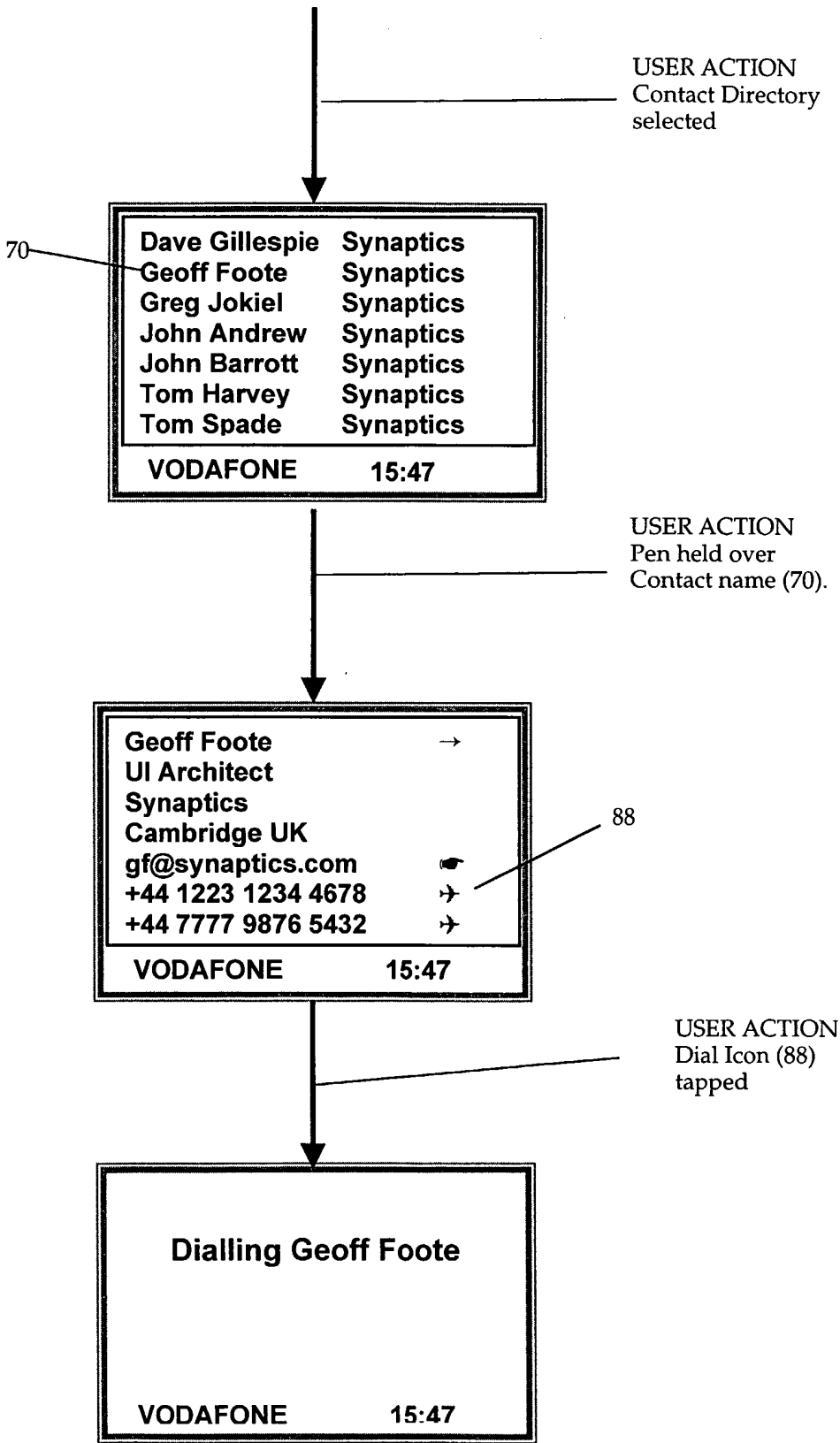


Figure 11



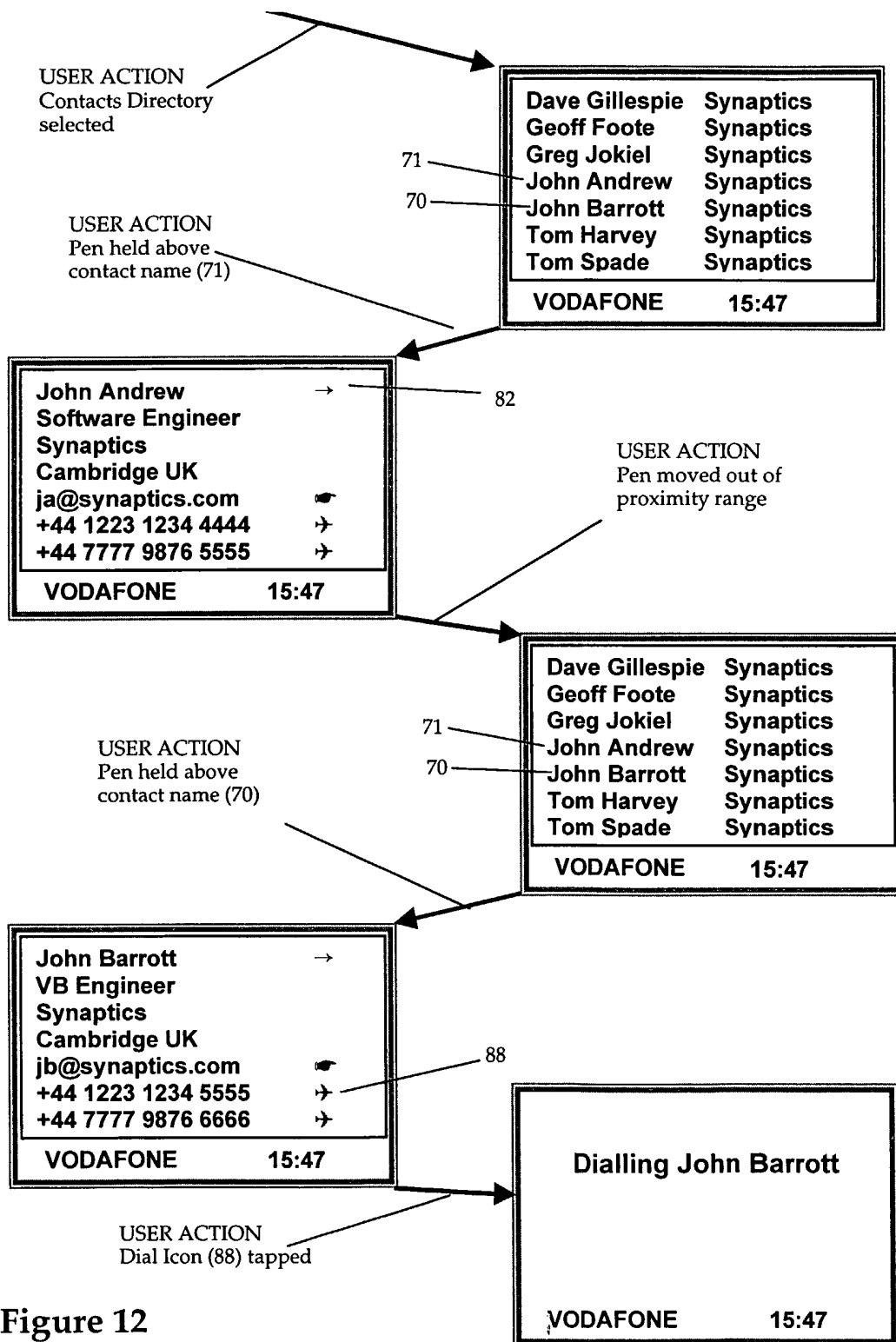


Figure 12

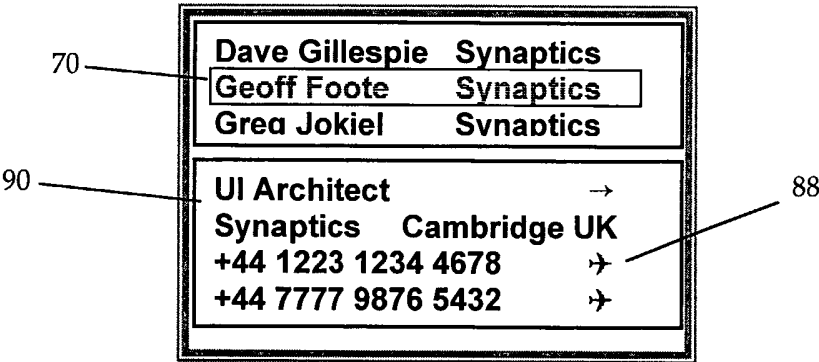


Figure 13

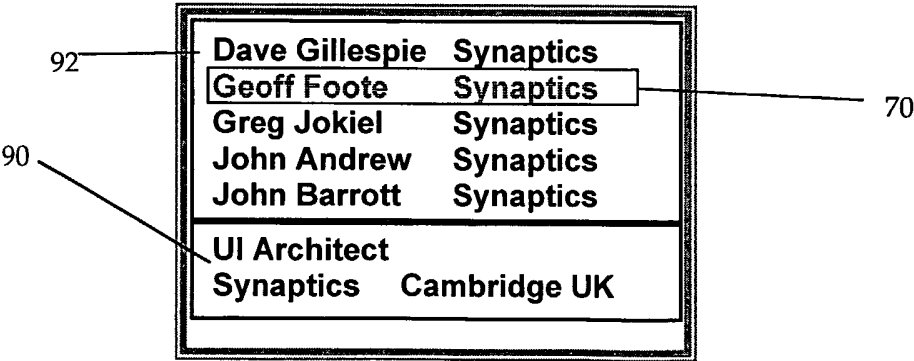


Figure 14

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/17242

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G09G 5/00

US CL : 345/711

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)

U.S. : 345/711, 701, 702, 708, 715, 863, 865, 856

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,861,583 A (SCHEDIWY et al.) 19 January 1999, Abstract, column 5, lines 27-column 6, lines 64, column 18, lines 27-47	1-36
Y	US 5,347,295 A (AGULNICK et al) 13 September 1994, Abstract, column 3, lines 6-column 17, lines 60, Figs. 23-32, 57, 67, and 70-72	1-36

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* 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 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

05 August 2002 (05.08.2002)

Date of mailing of the international search report

05 SEP 2002

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks

Box PCT

Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

RAYMOND J BAYERL

Telephone No. (703) 305-9789