



Data input system, and method for inputting data

Field of the Invention

5 The present invention relates to a system for inputting data into a computer (or other electronic device), and to a method for using the system.

Background of the Invention

10 As electronic devices become increasingly pervasive in society, the fact that they require fixed input and output devices such as keyboards and mice will become increasingly problematic. Radically new user interface approaches would be valuable to improve the information flow between the computer and the human user so that people from all avenues can more intuitively, comfortably, and conveniently benefit from the ever-increasing wealth of computerized appliances.

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The user interface to electronic devices in a home or office should go beyond the traditional buttons, remote controls, or keyboards and mice. For example, a user may initiate a certain input function by maneuvering a physical object around him instead of a keyboard and mouse. The usage of electronic devices can also be improved using context awareness. If devices or applications are context-aware, they can recognize their context, namely, who is using them, where they are used, and when they are used. These so-called tangible and context-aware user interfaces can indeed make the way we use electronic devices and applications in our daily lives far more effective than the conventional keyboards and mice. Most likely, these types of user interfaces will become necessities in the future when computers will evolve into minute computers of a volume of 1 cc or so and eventually become invisible to users.

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30 There are many ways of sensing data to enable different forms of input and output to enhance the user interface. One proposal, shown in US 2006/0238520, is for a user to use a proximity-sensing multi-touch surface to



input data, but this has limited applications.

In separate developments, positioning technologies have recently been developed which can enable electronic devices and applications to understand their context. However, they have so far been limited to a certain applications such as supply chain management, asset tracking, sports, mobile robotics, etc. and are yet to be exploited in the consumer electronics domain.

Summary of the Invention

The present invention aims to provide systems and methods for input of data into a host, such as a computer.

In general terms the present invention proposes a system and apparatus which use UWB positioning technology as a means to trace the movement of a UWB communication device moving with a member of a user's body (such as a hand, arm, head, or even foot) quickly and accurately enough to record a trajectory, the system being programmed to recognize the trajectory as a gesture, and extract command data from the gesture.

Thus, the user may be enabled to draw simple pictures and symbols as input commands to an electronic device (a "target device"), for use in program applications running on the target device. It should be noted that this is in contrast to a typical pointer system (such as a mouse) in which a user has to move the mouse to a specific position to effect a command: it is the position of the mouse, rather than its trajectory, which is critical to generating commands.

UWB signaling is especially suitable in the above context because it allows centimeter accuracy in positioning with a relatively high update rate of the order of several tens to hundreds of position updates per second, covering wide enough an area of the order of at least 10 meters. Note that no technology

providing centimeter ranging resolution, high update rate and room-wide coverage area, had been available until the license-free use of UWB radio was recently approved by the FCC in the United States.

5 Certain embodiments of the invention make possible a data input interface which is very intuitive, comfortable and convenient. Even a user not familiar with a given electronic device and application can intuitively operate it simply by expressing a thought or what he wishes to do by drawing pictures or symbols, collectively called images.

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As mentioned above, the system is arranged to extract data from the trajectory of the UWB tag. Preferably this is done by translator software which identifies pre-defined (e.g. standardized or user-defined) gestures and maps them (using a mapping which again may be standardized or user defined) into commands
15 for the target system. Preferably, these commands are compatible with existing GUI dialogue systems, so that the present user interface apparatus can work with existing GUI interfaces.

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For example, when the user is making a notebook PC presentation via a multimedia projector, he can perform often-used operations such as zoom/de-zoom, pick & drop, scroll, pop-in/-out of metadata, direct access to any audio/video segment, etc. by drawing appropriate images by his hand.

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In certain embodiments the UWB tag is attached to a user's hand. However, in other embodiments, the UWB tag may be attached to another part of the user's body, or indeed to an object (e.g., a pointing device) equipped with an UWB tag which the user may manipulate.

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The user interface apparatus disclosed in this report provides an intuitive and natural means to make the way we use electronic devices and applications in our daily lives far more effective than the conventional input and output devices

such as keyboards and mice. This type of user interface will most likely become useful especially in the future when computers are drastically miniaturized and consequently become invisible to users.

5 Brief description of the drawings

Embodiments of the invention will now be described, for the sake of example only, with reference to the accompanying drawings, in which:

10 Fig.1 is a perspective view of a first embodiment of the invention as a user interface to a projection system.

Fig.2 is a block diagram showing the relationships of the main components shown in Fig.1.

Fig.3 is a perspective view of a second embodiment of the invention as a user interface to a home robot.

15 Fig.4 is a block diagram showing the relationships of the main components shown in Fig.3.

Detailed description of the embodiments

20 Fig. 1 is a perspective view of a first embodiment of the invention in which a user 1 enters data into an electronic system which includes a UWB reader 2. A block diagram of the first embodiment is shown in Fig. 2, which shows the steps by which information flows through the system. The UWB reader 2 may be integrated with a personal computer (PC) (not shown) or may be a separate device, e.g. connected to the PC by a cable. The PC drives a projector 3 which
25 projects an image of the PC window onto a screen 4. The user 1 carries a pointing device 5 including a UWB tag. The user 1 stands by the screen where he makes a presentation using his personal computer. A wireless communication path between the user and the personal computer is provided by UWB radio, not using a conventional keyboard and mouse devices operated
30 either by the user 1, his assistant, or someone else. The UWB tag traces the movement of the pointing device 5 which is moved by the user 1 to draw a

simple picture or symbol to indicate a command to control the personal computer. The UWB reader 2 is characteristically capable of providing both high position accuracy and update rate.

5 The trajectory (locus) of the UWB tag is measured by processing the signals received from the tag by a positioning algorithm such as that disclosed in [1], and translator software (e.g. installed in the UWB reader 2) is used to interpret the meaning of the picture or symbol. Once the picture or symbol is recognized by the UWB reader 2, the translator software, which may be customizable by the user himself or standardized so as to associate pictures or symbols to their
10 corresponding commands, for example via an AI (Artificial Intelligence) - based software tool, converts them to corresponding command signals of a user-functional data representation. This provides "user-to-picture" interface. In order to operate the personal computer based on the interpretation of the picture or symbol, a device driver (typically installed in the UWB reader 2) converts the
15 command signal into appropriate device-specific keyboard and mouse signals and sends these signals to the personal computer, either wired or wirelessly, providing a "picture-to-device" interface. Thus, instead of using a keyboard and mouse, the user 1 can control his target device, namely the personal computer and subsequently the projector 3, simply by means of hand-drawing or other
20 gestures to express his intention.

The level of positioning accuracy and update speed preferred for a given UWB positioning system can be estimated based on the following assumptions. We
25 can reasonably assume that a circle of radius of 15 cm or so can be regarded as a typical gesture drawn by a user as an input command. It is also reasonable to assume that the moving speed of an UWB tag is 1 m/s or so and that the update speed of the positioning system may be about 10 Hz. Since one sampling interval is 10 cm, which is obtained by dividing the moving speed by
30 the update speed, 10 sampling points are sufficient to close the circle within a second. Note that the circumference of the circle is a little greater than 94 cm. If

we assume that the positioning accuracy is less than 5 cm, a realistic figure, then all the measured points will form a trajectory confined within a doughnut-shaped ring of radius 15cm or so where the radius of cross section of the doughnut corresponds to the maximum positioning error of 5 cm. These 10 sampling points should be sufficient to approximate the real circle with an acceptable degree of accuracy. In other words, a circle of radius of 15 cm or so, a typical gesture, can be recognizable by a circle-like gesture drawn by the user even at a relatively faster drawing speed of 1 m/s, provided that the positioning system has a positioning accuracy of 5 cm or so with an update speed of 10 Hz or so. Note that the update speed can be made slower in accordance with the moving speed for the same degree of drawing accuracy. Various embodiments of the invention will have different requirements for positioning accuracy and update rate, but it is presently envisaged that the positioning accuracy will typically be at least 10cm, and the update speed be at least 5Hz.

Fig. 3 is a perspective view of an alternative embodiment of the invention, operated in an environment such as a living room. In this embodiment the target device is a home robot 13. A block diagram of the above embodiment is shown in Fig. 4, which also shows steps by which information flows within the system). A UWB tag is built in the robot 3, while an UWB reader 12 functions as a single base station. A user 11 holding another UWB tag in his hand plays with the robot 13. There are two UWB communication paths, namely, a channel between the user 11 and UWB base station 12, and a channel between the robot 13 and UWB base station 12. The positioning tag held by the user 11 moves together with the user's hand as the user moves it in a gesture, thereby making a command to control the robot. The meaning of the gesture will be interpreted by translator software (typically installed in the UWB base station 12). The UWB base station 12 can compute the trace of the gesture by processing the UWB signals received from the tag with a positioning algorithm such as that disclosed in [1]. Once the gesture is recognized by the UWB base station 12, the translator software, which may either customizable by the user

himself or standardized so as to associate a set of gestures to a set of the corresponding commands, for example, via an AI-based software tool, converts it to the corresponding command signal of a user-functional data representation. This provides a “user-to-picture” interface. In order to command
5 the robot 13 based on the interpretation of the gesture, a device driver installed in the UWB base station 12 converts the command signal into appropriate device-specific signals and sends these signals to the robot 13, providing a “gesture-to-device” interface. While the robot 13 can autonomously move around the room of its own (guided, for example, by means of another,
10 independent UWB reader/tag system), the user 11 can also communicate with the robot 13 simply by conveying his thoughts to the robot 13 with certain hand movements or other gestures.

Optionally, the guidance system of the robot 13 may make use of the tracing
15 functionality of the UWB base station 12. That is, a UWB tag carried by the robot 13 may be tracked (the communication path shown as 15 in Fig. 4) by a tracing/positioning unit 121 of the UWB base station 12, and accordingly movement instructions can be transmitted to the robot 13 (the communication path shown as 16 in Fig. 4).

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Another possible embodiment of the invention is a control system for one or more home or office appliances (such as light(s), door(s), and/or window(s)). A user controls a UWB tag, and a UWB reader tracks the trajectory of the tag, extracts from the trajectory commands to control the appliances (e.g. to lock or
25 unlock lock systems associated with the doors and/or windows), and accordingly transmits the commands to the appliances. Unlike known systems for controlling appliances, often referred to in the literature, this embodiment does not have to resort to a complex infrastructure consisting of many sensors, like a sensor network, to monitor the room or office conditions for automatic
30 control. The user can make a first gesture to select one of the appliances, and a second gesture (typically after the first data) indicating the command to be

transmitted to the selected appliance. In a simple example, the user-specific representation of data transmitted by the UWB reader to the appliances for this embodiment may consist of an identification code which indicates the appliance(s) covered by the command (there is typically a different such
5 identification code for each appliance being controlled) and a sequence of control data in a typical packet format. An advantage of this user interface apparatus is that its architecture can be so designed as to enable easy installation, low cost and minimal infrastructure, which is a critical requirement for consumer application domain.

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In view of the above variations and other variations that will be appreciated by those skilled in the art, the scope of the invention should be determined not by the embodiments illustrated but by the appended claims.

15 Reference:

[1] Sun XB, et al, Singapore patent application No. 200504866-5, filed on 12 July 2005, publication no. 129319.

Claims

1. A data input system comprising:
 - a UWB tag movable by a user;
 - 5 a UWB reader for determining the location of the tag;
 - a gesture capturing unit for obtaining a trajectory of the UWB tag from the determined location data; and
 - translation software for recognizing the trajectory as a gesture, and converting the recognized gesture into a command to a target system.
- 10 2. A data input system according to claim 1 in which the translation software is operative to recognize the gesture as one of a set of predetermined gestures.
3. A combination of a data input system according to any preceding claim and a target system, the target system being a PC associated with a display
15 device for projecting an image generated by the PC, whereby controlling the position of the UWB tag the user can modify the displayed image.
- 4 A combination of a data input system according to any of claims and a
20 target system, the target system being a robot, whereby by controlling the position of the UWB tag the user can command the robot to perform operations.
5. A combination of a data input system according to any preceding claim and a plurality of target systems, the translation software being operative to
25 interpret a first recognized gesture as a selection command selecting one of the target systems, and a second recognized gesture as a command to be transmitted by the data input system to the selected target system.