

POINTING DEVICE FOR A COMPUTER

The present invention generally refers to a pointing device for a computer equipped with a monitor or a displaying screen, particularly for a personal
5 computer. More specifically, the present invention refers to a pointing device able to be operated without using user's hands, and to an embodiment of a component for such pointing device.

During last years use of programs and operating
10 systems for computers has become widespreaded, in particular for that class of computers known as personal computers, equipped with graphic interfaces. These graphic interfaces have become so widespreaded since they can be used by users that have not
15 received a specific training and/or specialization, simply and intuitively. Moreover these interfaces allow a user to very quickly learn to use a program, or a group of programs, for a computer and also to reach, with little efforts, a relatively high
20 efficiency and execution speed.

These graphic interfaces, in fact, allow a user to give to the computer, or more precisely to the program being executed by the computer, a very high number of commands, even complex ones, without the
25 need of keying them in on the computer keyboard. This

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allows obtaining the above-mentioned advantages since it is not necessary any more to learn necessary language and syntax to correctly give the above commands.

- 5 These commands are given by moving a cursor, or pointer, represented on the computer screen or monitor. This cursor is used to select graphic symbols, such as icons or fields, shown on the screen and eventually to drag these graphic symbols from one
10 screen point to another.

Originally, keyboard arrow keys were used to control the cursor movements on a screen. This system however is rather uncomfortable and slow, and therefore pointing devices have been developed and adopted that
15 allow greater speed and efficiency.

- The most widely known and spreaded of such pointing devices is the so-called "mouse". This device essentially comprises a small housing made of plastic material, that can be made slide on a plane surface.
20 Inside the housing a ball is contained that rests on the plane where the mouse is located and that is free of moving so that it rolls due to mouse displacements on the plane. These ball is associated with transducers adapted to detect the rotation thereof.
25 In this way it is possible, by detecting the

displacement of the ball contained within the mouse, to use the mouse displacement itself to control a corresponding movement of the cursor on the personal computer screen. Two or more push-buttons are further
5 typically located on the mouse, and they are used by a user to send commands to the personal computer, for example when he must select or drag a graphic symbol. This device can be extremely easily and intuitively used and further allows to quickly and accurately
10 control the cursor movement on the personal computer screen. For these reasons it has been widely spreaded.

Similar types of pointing devices have further been developed suitable to perform the same functions as
15 of the mouse. These devices have been generally developed to be employed with a portable-type personal computer for which use of a mouse is generally unsuitable or uncomfortable. One of the most spreaded ones is known as "trackball" and it is
20 a static device whose operation however is substantially similar to the mouse one. In a trackball, in fact, a ball is always present and is associated with transducers adapted to detect the rotation thereof. This ball however is directly
25 accessible by the user that rotates it by means of a

hand finger.

It can therefore be noted that a common feature of all previously-described prior art pointing devices is requiring a manual operation by the user. This
5 causes inconveniences that limit the potentials to use such devices.

In fact, these pointing devices make one of the user hands busy, thus limiting the chance thereof of carrying out other actions, simultaneously when using
10 the pointing device, such as: writing, keying-in on the personal computer keyboard, reading a book, holding a telephone handset, etc. In case a person needs to carry out one or more of these operations, simultaneously when using a pointing device, he needs
15 therefore to stop an activity to be able to perform another one with following losses of time and concentration. Moreover, should a user be a disabled person, that cannot use one or both hands, use of a traditional type of pointing device, like a mouse,
20 can be a problem or can even be impossible.

A second type of inconveniences is the loss of efficiency occurring with traditional pointing devices. In fact, every time the cursor must be moved in a predefined point of the screen, the user must
25 first focus his eyes onto such point and afterwards

move his hand in order to displace the mouse, and therefore the cursor on the screen, to the desired position. During such movement, the user is able to check the displacement imparted to the mouse by
5 checking, observing the screen, the movement imparted to the cursor on the screen. Movement and placement of the cursor on the screen therefore occurs by means of a control system, that can be defined of the loop-type, performed by the user and that uses well-known
10 eye-hand coordination mechanisms. This way of operating allows a human eye to control the cursor movement simply and intuitively and also to obtain a high positioning accuracy.

This way of operating however has also the
15 disadvantage that it does not allow the user to get the maximum possible pointing speed. In fact, to be able to coordinate cursor movements on the screen and hand movements, the user must necessarily observe beforehand the screen portion where he wishes to move
20 the cursor and then displace the mouse in order to reach such position. In case a user needs moving the cursor to a screen position that is away from the one where it is, time is also wasted due to the need by
the user to focus his eyes alternatively on the
25 position where the cursor is and on the position

where the cursor must go. All of these inevitably slow down the cursor positioning.

Object of the present invention is realizing a pointing device that allows satisfactorily solving
5 all the above-mentioned problems.

According to the present invention, this object is reached by means of a pointing device whose features are pointed out in the claims following the present description.

10 A further object of the present invention is a particularly advantageous embodiment for a major component of such pointing device.

Further advantages and features of the present invention will appear from the following detailed
15 description, performed with the help of the accompanying drawings, provided as a non-limiting example, in which:

- figure 1 is a schematic representation of an embodiment of the pointing device according to the
20 present invention associated with a personal computer,

- figure 2 is a schematic representation, similar to figure 1, showing the use of a pointing device according to the invention by a user,

25 - figure 3 is a schematic block representation of an



embodiment of the device according to the invention,

- figures 4 and 5 are two schematic representations of a component of the pointing device according to the invention, suitable to show the operation thereof,

- figure 5A shows another embodiment of the diaphragm to be used with the device according to the invention;

- figures 6 and 7 are two schematic representations, similar to figure 4, showing the operation of the component in figure 5,

- figure 8 is a schematic block representation showing in more detail an embodiment of the device according to the invention,

- figures 9 to 11 are schematic representations showing three possible alternative embodiments of a component of the pointing device according to the invention, and

- figure 12 is a schematic representation of an alternative embodiment of the pointing device according to the invention.

Purpose of the pointing device according to the present invention is essentially allowing the movement and placement of a cursor on a computer or personal computer screen, by a user, without the need

of using the hands. In order to obtain such cursor movement, instead, the displacement of a different part of the user body is used, in the specific case this part being the head.

5 For a better understanding, the configuration of the pointing device according to the invention will now be described, with reference to figure 1. As can be noted, a traditional type of personal computer EL is shown in figure 1. The personal computer EL includes
10 a monitor MON, composed of a typical cathode-ray tube, and a keyboard KB, as input/output devices.

This personal computer EL has further been associated with a pointing device according to the invention. Two essential components for this pointing device are
15 an optoelectronic transmitter TX and a corresponding optoelectronic receiver RX. These optoelectronic transmitter TX and receiver RX are connected to an electronic processing unit ECU that is in turn connected to an input port of the personal computer
20 EL, typically the input port where a traditional pointing device, like for example a mouse, is connected.

The operation of the pointing device according to the invention will now be described. The transmitter TX
25 emits a beam of electromagnetic radiations, for

example in the infra-red band, adapted to be received by the receiver RX. This receiver RX is substantially an angle sensor, that is, it is able to detect its own angle with respect to a source of radiations, that is with respect to the transmitter TX. The receiver RX is, obviously, realized in order to be able to measure its own orientation, with respect to the transmitter TX, into space, that is, it is an angular coordinate measuring device.

The pointing device then uses information related to receiver RX orientation to control cursor movements on the monitor MON of the personal computer EL. In a presently preferred embodiment, information are used related to angular coordinate variations, and not to absolute angular coordinates, by which the receiver RX is oriented with respect to the transmitter TX to control cursor movements. This is done to make the pointing device according to the invention completely compatible with traditional pointing devices, such as the mouses. In a conventional type of mouse, in fact, information are employed that are related to mouse displacements on a plane, and therefore related to the position variation and not to the absolute position, to control cursor movements on the screen.

Alternatively, it is possible to also send absolute

angular coordinates instead of variations thereof in order to emulate absolute pointing devices, such as joysticks, particularly used in games and simulations programs.

- 5 The way of using the pointing device according to the invention is therefore clear. Suffice it to make the receiver RX integral with the user head, and thereby he can control the cursor movement on the screen by simply moving his head. This type of movement is
10 extremely natural and intuitive since it is already natural per se to move, at least partly, the head in order to follow the direction of the eyes.

Figure 2, similar to figure 1, do shows the way of using the pointing device according to the invention.

- 15 In figure 2 and following ones, parts and elements already described with reference to figure 1 have been designed again with the same alphanumeric references.

- As can be noted, in figure 2 a user of the personal
20 computer EL wears a pair of glasses OC to which the receiver TX is applied. It is therefore enough that the user moves his own head, thereby changing orientation of the receiver RX assembled on the glasses OC, in order to move the cursor on the screen
25 MON. In doing this, the user can constantly keep his

eyes focused onto the cursor with a clear increase in speed and efficiency. Moreover, user hands remain completely free and can be thereby employed to carry out other tasks.

5 As known, traditional pointing devices comprise at least one key or push-button, and generally these keys are two or three even if, de facto, in the majority of cases one is enough, suitable to give commands to personal computer EL, for example to
10 select or drag a graphic symbol. These commands consist in keeping the push-button pressed, or released, so that information, or commands, sent to personal computer EL is of the binary type.

The pointing device according to the invention also
15 comprises a component adapted to perform this function, that is to give a binary command, and that has been generically represented as a push-button INT in figure 1.

Since this component INT must not be used
20 continuously, it can be composed of a push-button or key of the traditional type, as shown in figure 1. Alternatively, a key of keyboard KB of the personal computer EL can perform this function. In this way, when a user wished to give a binary command, or
25 "clic" as is commonly known in the art, to the

personal computer EL, he can operate such key INT, located on the working plane, with a hand.

With this arrangement, however, part of the advantages obtained with the pointing device according to the invention are lost. In fact, by using a binary command INT with a traditional key, the user is forced, even though occasionally, to use a hand.

In some alternative embodiments, the pointing device according to the invention therefore provides using sensor or control devices adapted to allow a user to give a binary command to the pointing device without the need of using his hands.

The control device INT can therefore be composed, for example, of a voice sensor prearranged to recognize a certain word, or sound, pronounced by a user.

Alternatively, the control device INT can be composed of a pressure sensor connected to a small closed tube made of elastomeric plastic material that can be operated by the user by pressing his teeth. The binary command is obtained from the pressure unbalance generated inside the elastomeric tube compressed by the teeth and detected by a pressure sensor, for example of the extensometric type. The elastomeric tube, that is the only part subjected to

wear, is a very low-cost component and can be replaced in few seconds without using tools (in addition to wear, it is convenient that it is replaceable for hygienic reasons).

5 It is also possible to apply an extensometric sensor on a portion of the user's skin so that the binary command can be given by contracting a muscle, for example the jaw muscle, or by flexing an articulation.

10 A further alternative is using a push-button that can be actuated by feet, for example of the type used in some dictaphones.

In this way a user can therefore completely operate the pointing device according to the invention
15 without ever using his own hands that remain therefore completely free.

Figure 3 shows, for a better understanding, a block diagram showing the major components for the pointing device according to the invention. As can be noted,
20 the figure shows the transmitter TX and the receiver RX that are adapted to generate signals controlling the cursor positioning on the screen MON of the personal computer EL, and the sensor INT through which a user gives binary commands to the pointing
25 device.

Both the transmitter TX and the receiver RX, and the sensor INT are connected to the processing unit ECU of the pointing device. In particular, those three components TX, RX, INT are connected to a control
5 unit UC, that is part of the processing unit ECU. Function of this control unit UC is driving the transmitter TX and receiving, decoding and processing signals generated by receiver RX and sensor INT. Function of the control unit UC therefore is
10 substantially extracting, from signals generated by receiver RX and sensor INT, information indicating commands given by the user.

The control unit UC is further prearranged to transmit such information to the computer, or
15 personal computer, EL. This occurs through an interface IF whose function is converting information processed by the control unit UC into the format and according to the protocol required by the computer EL. Important function of such interface IF is
20 therefore also making the pointing device according to the invention completely compatible with traditional pointing devices and, possibly, allowing the use thereof with computers operating with different protocols or standards by only modifying
25 one component of the pointing device.

For a better understanding, the operation of the receiver RX will now be described with reference to figures 4 to 7. As previously said, the receiver RX is substantially an angular coordinate measuring
5 device. The receiver RX in practice detects its own axis orientation with respect to a point into space, that is specifically the transmitter TX.

The receiver RX is essentially composed of a plurality of photosensitive elements and of one
10 screen or diaphragm, suitable to block radiations, having at least one opening. According to a presently preferred embodiment, the receiver RX comprises four photosensitive elements F1, F2, F3, F4 arranged on a plane and whose shape is substantially rectangular or
15 squared and evenly arranged, in order to form a configuration with two axes of symmetry, for example at vertexes of a rectangle or square as shown in figure 4. A direction, perpendicular to the planes of screen LS and photosensitive elements F1, F2, F3, F4,
20 will be conventionally designed as receiver RX axis hereinbelow.

In front of such photosensitive elements F1, F2, F3, F4 a diaphragm LS is placed, shaped as a plane parallel to that of the photosensitive elements F1,
25 F2, F3, F4, at a certain distance from the

photosensitive elements themselves, having an opening substantially arranged at the configuration center composed of the photosensitive elements F1, F2, F3, F4 and having, for example, a substantially
5 rectangular or squared shape. For example the area designed with LA in figure 4 corresponds, as shape and position, to the opening provided in the diaphragm LS. Function of the diaphragm LS, equipped with an opening, is causing the radiation emitted by
10 the transmitter TX to differently impinge onto the photosensitive elements F1, F2, F3, F4 according to the receiver RX orientation with respect to the transmitter TX.

Take for example into account the case shown in
15 figure 5. In figure 5, to simplify, a situation has been shown where the receiver RX is oriented at an angle α with respect to the transmitter TX instead of being directly aimed towards the transmitter TX. To simplify, a single angle on a plane has been taken
20 into account instead of a pair of linearly independent angles into space, and consequently figure 5 only shows photosensitive elements F1 and F2. As can be noted, since the receiver RX is oriented at an angle α with respect to the
25 transmitter TX, beams emitted by the transmitter TX

are not perpendicularly incident with respect to diaphragm LS and photosensitive elements F1, F2, F3, F4 planes.

Since receiver RX sizes are relatively small, of the
5 order of a few millimeters, while the distance between receiver RX and transmitter TX is relatively long, typically 50 cm to 1 m, radiations emitted from transmitter TX can be considered, as a first
10 approximation, mutually parallel, as though they came from a source of radiations infinitely located. Due to such reason, in figure 5, a beam of radiations incident onto the receiver RX is represented by two parallel, straight lines obliquely oriented with respect to the planes of the receiver RX itself.
15 These two straight lines are naturally slanted by an angle α with respect to the normal to such planes, that is the receiver RX axis.

This causes the radiation emitted by the transmitter TX to differently impinge onto the photosensitive
20 elements F1, F2, F3, F4 of the receiver RX. In the specific case shown in figure 5, for example, the incident radiation sensibly differently impinges onto the two photosensitive elements F1 and F2 arranged as mutually adjacent, and more specifically it impinges
25 onto the photosensitive element F1 much greatly than

onto the photosensitive element F2.

If the diaphragm LS opening is centrally arranged with respect to the photosensitive elements F1, F2, F3, F4, the radiation emitted by the transmitter TX
5 would equally impinge onto the photosensitive elements if the axis of the receiver RX is directly oriented towards the transmitter TX, that is with a null angle α . In the case, shown in figure 5, where the axis of the receiver RX is oriented at a non-null
10 angle α , portions stricken by incident radiations from photosensitive elements F1 and F2 will respectively be increased and decreased by an amount or distance X. This amount X can be easily detected since the photosensitive elements F1 and F2 generate signals
15 indicating the amount of incident radiation impinging thereon. The distance X can therefore be immediately detected starting from signals generated by photosensitive elements F1, F2. Since the distance X is, as a first approximation, equal to $D \sin \alpha$, being D
20 the distance between the photosensitive elements F1, F2 planes and the diaphragm LS plane, angle α too can be detected.

The above-described situation is obviously related to detection of a simple angle α . It is however clear
25 that by using four photosensitive elements F1, F2,

F3, F4 it is possible to detect the orientation of receiver RX into space, that is it is possible to detect an orientation by measuring two angles α and β .

5 The above system can also easily be realized by using a detector structure (for example of the above type with four photosensitive elements F1, F2, F3, F4) and a short-focal lens (not shown) that replaces the eye iris. A focal that is short means that it is much
10 shorter than the distance between sensor and transmitter, so that the radiations incident on the lens can be considered as parallel. By using a lens projecting the radiation on the plane of the photosensitive elements (for example F1 and F2 in
15 figure 5), their relative lighting is univocally linked to the angle α formed by the incident radiations with the optical system axis.

An extremely low-cost practical embodiment of the above structure is obtained with a spheric lens (not
20 shown) directly resting on the center of the four photosensitive elements F1, F2, F3, F4: the need of a spacer between lens and photodetector is therefore removed.

Figure 6 and 7 show two cases where it is clear how
25 the incident radiation onto photosensitive elements

F1, F2, F3, F4 is differently divided onto the various photosensitive elements F1, F2, F3, F4 according to the orientation of receiver RX with respect to transmitter TX. Figure 6 and 7 in fact
5 show an area LA stricken by the incident radiation emitted by the transmitter TX in case of two different orientations of the receiver RX axis.

In figure 4 the area LA is represented instead in the case where the receiver RX axis is directly oriented
10 towards the transmitter TX. As can be noted in this latter case the portions of the photosensitive elements F1, F2, F3, F4 stricken by the incident radiation are perfectly equal one to the other, obviously assuming that the diaphragm LS opening is
15 central and symmetric with respect to the photosensitive elements F1, F2, F3, F4.

As soon as the axis orientation for receiver RX moves from such direction, even of a small amount, exactly oriented towards the transmitter TX, the division of
20 the incident radiation on the photosensitive elements F1, F2, F3, F4 changes and is unbalanced. In this way it is possible to detect angles α and β along two mutually orthogonal directions, that will be designed as X and Y hereinbelow, showing the axis orientation
25 for receiver RX with respect to transmitter TX,

starting from signals indicating the intensity of the incident radiation onto each one of the photosensitive elements F1, F2, F3, F4.

Another preferred embodiment of the receiver RX
5 provides a plurality of photosensitive elements F1, F2, F3, F4 quite similar to those mentioned above, together with a screen or diaphragm LS' (shown in Figure 5A). The diaphragm LS' has again a substantially rectangular or squared shape, but is
10 completely made of transparent material apart from at least one central part C thereof, where it is made of a material that prevents the passage of radiations therethrough, thereby screening the incident radiation from the photosensitive elements F1, F2,
15 F3, F4. This at least one central part C has a substantially rectangular or squared shape, corresponding to the shape of the diaphragm LS' and included therein. The operation of this embodiment of the receiver RX is complementary to the one of the
20 previous embodiment and mentioned above: its working principle is substantially identical to the above-stated one, as is evident for a skilled person in the art.

From what has been stated before, it follows that
25 requirements for the transmitter TX are relatively

few. Essentially the transmitter TX must be placed next to the screen MON of the personal computer EL and must be facing the user so that the receiver RX, during normal use, is always into an area where
5 radiations emitted by the transmitter TX can be detected. Moreover, the transmitter TX must be placed in a static position and be a substantially punctiform source of radiations in order to guarantee the necessary accuracy to the pointing device.

10 It should be noted how the fact that the operation of the receiver RX can be made independent from the distance between transmitter TX and receiver RX and only depends on the angle with which receiver RX is oriented with respect to transmitter TX. This is
15 possible due to the fact that this angle substantially depends on the ratio between the intensities of radiations incident onto the various photosensitive elements F1, F2, F3, F4 and not on the absolute intensities. This clearly is an advantage
20 since a user can modify at will the distance at which he is from the screen MON and check the cursor position only by orienting his own head.

The transmitter TX is applied to the screen MON and the receiver RX made integral with the user's head
25 can be replaced by a transmitter TX made integral

with the user's head that lights a retroreflector, for example a cube edge or a cat's eye reflector, placed next to the screen MON. The connection between processing unit ECU and user's head can thereby be
5 removed.

For a better understanding, a presently preferred embodiment of the device according to the invention will now be described in detail, with reference to figure 8. Figure 8 obviously shows the transmitter TX
10 and the receiver RX that are realized as previously described. The receiver RX is connected to a circuit LOG, essentially comprising a logic network, whose function is extracting information about angular coordinates and total intensity of incident
15 radiation. The circuit LOG then outputs two signals, designed as X and Y, representing angular coordinates and that will be further processed.

Such signals X and Y are sent to a dynamic compressor CD whose function is standardizing the amplitude of
20 signals X and Y as function of the total intensity in order to make the receiver RX operation independent from the distance from the transmitter TX.

The signals X and Y, output from the dynamic compressor CD, are then sent to a synchronous
25 demodulator followed by an amplifier, jointly

designed as ALI. It must in fact be pointed out that the receiver RX receives, in addition to the radiation emitted by the transmitter TX, a high amount of additional electromagnetic radiations that
5 are a strong source of noises and interferences.

Suffice it to see that the receiver RX is substantially oriented towards the screen MON of the personal computer EL, that is a strong source of electromagnetic radiations. Due to such reason it is
10 necessary to exclude as much as possible these noises.

For this purpose, the transmitter TX is driven by means of a periodic signal, typically with a fixed frequency, generated by an oscillator circuit OSC.
15 Such periodic signal, used to drive the transmitter TX, is also sent to the synchronous demodulator ALI. In this way the synchronous demodulator ALI only demodulates signals having the same frequency and phase as of signals emitted by the transmitter TX.
20 With this arrangement, it is possible to exclude in practice all the above-mentioned noises.

At the synchronous demodulator ALI output, therefore, two signals X and Y are available that represent the real angular coordinates of the receiver RX. These
25 signals X and Y are sent to an analogue/digital A/D

converter that converts them into a digital format.
The analogue/digital A/D converter output is in turn
connected to the above-mentioned interface IF that
converts these signals and sends them to the personal
5 computer.

The binary control device INT too is connected to the
interface IF through a circuit TH. Function of such
circuit TH is converting the signal generated by the
binary control device INT into a digital signal.

10 If the binary control device INT is, for example, a
pressure sensor, the circuit TH can be composed of a
threshold comparator circuit.

If the binary control device INT is, for example, a
pedal push-button, the circuit TH can be composed of
15 a bounce-preventing circuit or can be superfluous and
therefore absent.

In this way the interface IF thus receives all
signals, in a digital format, indicating commands
given by a user and transmits them to the computer EL
20 into the correct format.

It is clear that architecture and specific
embodiments described can be modified according to
the design choices performed when realizing the
pointing device according to the invention.

25 For example, it is clear that in order to detect the

angular coordinates into space according to which the receiver RX is oriented, three photosensitive elements are enough. In the embodiments shown, a receiver RX has been described comprising four
5 photosensitive elements F1, F2, F3, F4 only because this highly simplifies the electronic circuits into the unit ECU that will process signals generated by the receiver RX.

Also as regards the binary command device INT,
10 numerous variations are possible, in addition to the described ones, according to application and user preferences.

Another aspect that can be subjected to numerous variations is the shape and location of the receiver
15 RX. In a currently preferred embodiment that is the object of the present invention, the receiver RX is made integral with an eyeglasses mount OC, that can be seen for example in figure 2, worn by a user. If a user does not need eyeglasses, he can anyway wear an
20 eyeglasses mount OC that is not equipped with glasses or is equipped with glasses without corrections.

The receiver RX can be directly integrated within the eyeglasses mount OC, as shown in figure 9, or can be associated, even temporarily, with a traditional
25 eyeglasses mount OC, for example by applying it to an

arm of such mount OC, as shown in figure 10. This embodiment is particularly advantageous if it is desired to transfer the receiver RX from one mount OC to another.

- 5 It is further possible to realize the receiver RX so that it can have particularly reduced sizes by arranging the photosensitive elements along a single line and realizing as many openings into the screen placed in front of the photosensitive elements. The
- 10 photosensitive elements must obviously be staggered with respect to the openings, or vice versa, so that the variations of incident radiations onto the different photosensitive elements allow detecting the receiver RX orientation exactly according to the
- 15 previously-described principle.

By using such arrangement, it is possible to realize an elongated receiver RX having an extremely reduced size. In this way it is possible for example to integrate, or apply, the receiver RX into an

20 eyeglasses mount OC without in practice making its aesthetics worse or heavy.

It is therefore possible to place the receiver RX in a central eyeglasses mount OC position, that is in the part included between the glasses-supporting

25 frames over the nose-rest, as shown in figure 9. The

receiver RX can also be made integral with an arm of the eyeglasses mount OC, next to an hinge connecting the arm itself to the rest of the eyeglasses mount OC, as shown in figure 10. It is further possible to
5 realize the receiver RX in an elongated shape in order to apply it to an upper crosspiece element connecting the glass-supporting frames of the eyeglasses mount OC, as shown in figure 11.

In all previously-described cases with reference to
10 figures 8, 9, 10 and 11, it is possible both to permanently integrate the receiver RX into the eyeglasses mount OC, and to removably apply the receiver RX to a pre-existing eyeglasses mount OC.

Alternative embodiments are further possible wherein
15 the receiver RX is applied to objects that are different from an eyeglasses mount OC. The transmitter TX can be for example applied to an helmet worn by a user. In this way the pointing device according to the invention can for example be
20 integrated into an helmet used in simulation systems adapted to represent a virtual reality.

The transmitter TX can further be applied to an audio headphone or to a microphone worn by a user. This embodiment is particularly advantageous if the user
25 must carry out an activity requiring to use a

headphone.

It is further clear that, in order to make the pointing device according to the invention operate, it is necessary that the receiver RX be connected to
5 the processing unit ECU. This connection has always been shown, in the so-far described figures, as composed of a wire W. It is clear that there are situations where a connection wire W can be undesirable between the user head and the personal
10 computer EL. In such case it is possible, for example, that the communication between receiver RX and processing unit ECU occurs without wires, for example by means of a digital radio or infra-red connection.

15 It is in fact possible, nowadays, to realize radio apparata whose sizes are extremely reduced. This however implies the need of increasing sizes and weight of the receiver RX, in addition to providing it with its own supply through a battery. In this way
20 it is however possible, if this is necessary, to remove the connection wire W.

The pointing device according to the invention can further be used, in an alternative embodiment that will now be described with reference to figure 12, in
25 such a way as to replace the keyboard KB or a

computer, or personal computer, EL allowing to employ such computer EL also for disabled people for whom it is impossible to use the hands.

It is in fact simple to realize a displaying device
5 KBS, whose shape is substantially that of a displaying screen, representing the key arrangement of a normal keyboard for personal computers EL. Such screen KBS can be realized in many ways, for example through a liquid-crystal screen, or simply through a
10 mask back-lit by means of lamps or light emitting diodes. The displaying screen KBS can be placed next to a normal screen or monitor MON of the personal computer EL. Such keyboard displaying screen KBS is connected to the processing unit ECU which is
15 configured in order to control it. Moreover, the processing unit ECU is also connected to an input port of the personal computer EL to which a traditional keyboard KB is normally connected.

More specifically, the processing unit ECU is
20 configured so that when the receiver RX is oriented, not towards the monitor MON, but towards the keyboard displaying screen KBS, it not only makes the cursor disappear from the monitor MON screen (since it is out of field) but it also lits or points out a
25 symbol, or area, of the keyboard displaying screen

KBS, corresponding to the point towards which the receiver RX is oriented and representing a key. Such keyboard displaying screen KBS can also be equipped with its own transmitter or a retroreflector. In this way the user can, by simply orienting his head, select any of the keys representing the keyboard displaying screen KBS connected to the processing unit ECU.

The selection is particularly easy since the processing unit ECU continuously lights, or points out, the text which the user is pointing to at any time. In this way the user can quickly correct his head orientation in order to select the desired key speedily and efficiently.

When the user has selected the desired key, suffice it that he gives a command, or clic, through the binary control device INT. When this occurs the processing unit ECU transmits to the personal computer EL a code corresponding to the key selected to the input port of the personal computer EL. In this way the pointing device according to the invention can completely replace the keyboard KB of the personal computer EL.

Through such embodiment it is therefore possible to perform keying without ever needing to use the hands.

This embodiment therefore allows a particularly efficient use, by disabled people, of a computer or personal computer EL.

In this case too the pointing device according to
5 the invention is quite compatible with a standard-type keyboard KB.

Various modifications are possible without departing from the scope of the present invention. For example, the receiver RX, instead of being
10 composed of four photosensitive elements or photodiodes F1, F2, F3, F4 can be realized with a single photodiode of the PSD (Position Sensitive Diode) type in its squared arrangement.

Moreover, the receiver RX can be composed of a
15 combination of two photosensitive elements (not shown), each one comprising either a pair of photodiodes or one PSD of the linear type, both these two pairs of photodiodes and these two linear PSDs being mutually arranged orthogonally or in
20 such a way as to be linearly independent one from the other.



CLAIMS

1. Pointing device, provided to be associated with a computer (EL) equipped with a displaying screen (MON), said pointing device being adapted to control
 5 movements of a graphic pointing symbol, or cursor, represented on said screen (MON),
 characterized in that it includes:

- a transmitter (TX) adapted to transmit a beam of electromagnetic radiation, said transmitter (TX)
 10 being able to be made integral with said screen (MON),
- a receiver (RX), adapted to generate signals indicating their own angular orientation with respect to said transmitter (TX), said receiver (RX) being
 15 able to be associated to a portion of a human user body,
- processing means (ECU), connected to said receiver (RX) and said computer (EL), said processing means (ECU) being configured to control a position of said
 20 graphic pointing symbol as function of said signals indicating said angular orientation.

2. Device according to claim 1, characterized in that said receiver (RX) is able to be associated with a user head.

25 3. Device according to claim 1 or 2, characterized in

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that said receiver (RX) comprises an angle sensor adapted to detect its own axis orientation with respect to a position of said transmitter (TX).

4. Device according to claim 3, characterized in that
5 said receiver (RX) comprises a plurality of photosensitive elements (F1, F2, F3, F4) and a diaphragm (LS) having at least one opening and arranged facing said photosensitive elements (F1, F2, F3, F4) and at a distance therefrom.

10 5. Device according to claim 4, characterized in that said photosensitive elements (F1, F2, F3, F4) and said diaphragm (LS) equipped with said opening are formed and arranged so that a variation of said axis orientation with respect to said transmitter (TX)
15 creates a variation of an incident radiation onto said photosensitive elements (F1, F2, F3, F4).

6. Device according to claim 4, characterized in that said receiver (RX) comprises at least three photosensitive elements.

20 7. Device according to claim 4 or 5, characterized in that said receiver (RX) comprises four photosensitive elements (F1, F2, F3, F4).

8. Device according to any of claims 4 to 7, characterized in that it further comprises a spheric
25 lens directly resting on a center of said four





photosensitive elements (F1, F2, F3, F4).

9. Device according to claim 3, characterized in that said receiver (RX) comprises a plurality of photosensitive elements (F1, F2, F3, F4) and a
5 diaphragm (LS') made of transparent material and having at least one central part (C), said diaphragm (LS') being arranged facing said photosensitive elements (F1, F2, F3, F4) and at a distance therefrom, said at least one central part (C) being
10 made of such a material that screens said incident radiation from said photosensitive elements (F1, F2, F3, F4).

10. Device according to claim 9, characterized in that said photosensitive elements (F1, F2, F3, F4) and
15 said diaphragm (LS') are formed and arranged so that a variation of said axis orientation with respect to said transmitter (TX) creates a variation of an incident radiation onto said photosensitive elements (F1, F2, F3, F4).

20 11. Device according to claim 10, characterized in that said receiver (RX) comprises at least three photosensitive elements.

12. Device according to claim 9 or 10, characterized in that said receiver (RX) comprises four
25 photosensitive elements (F1, F2, F3, F4).





13. Device according to any of claims 1 to 12,
characterized in that said processing means (ECU) are
connected to said transmitter (TX) and are configured
in order to drive said transmitter (TX) through a
5 periodic signal.

14. Device according to claim 13, characterized in
that said processing means (ECU) comprise a
synchronous demodulator (ALI), modulated through said
periodic signals, adapted to demodulate signals
10 indicating said incident radiation onto said
photosensitive elements (F1, F2, F3, F4) in such a
way as to output filtered signals indicating only the
incident radiation onto said photosensitive elements
(F1, F2, F3, F4) emitted by said transmitter (TX).

15. Device according to claim 14, characterized in
that said processing means (ECU) comprise a dynamic
compression circuit (CD) adapted to standardize said
signals indicating said incident radiation generated
by said photosensitive elements (F1, F2, F3, F4) in
20 such a way as to make said signals indicating said
angular orientation independent from a distance
between said transmitter (TX) and said receiver (RX).

16. Device according to any of claims 1 to 15,
characterized in that said processing means (ECU) are
25 configured in such a way as to control a position of





said graphic pointing symbol as function of variations of said angular orientation.

17. Device according to any of claims 1 to 16, characterized in that said receiver (RX) is able to
5 be applied to an eyeglasses mount (OC).

18. Device according to any of claims 1 to 16, characterized in that said receiver (RX) is integrated with an eyeglasses mount (OC).

19. Device according to any of claims 1 to 16,
10 characterized in that said receiver (RX) is applied to an helmet provided to be used by said user.

20. Device according to any of claims 1 to 16, characterized in that said receiver (RX) is applied to an headphone or to a microphone provided to be
15 worn by said user.

21. Device according to any of claims 1 to 20, characterized in that it includes a sensor (INT) adapted to detect a binary command given by said user.

20 22. Device according to claim 21, characterized in that said sensor comprises a push-button (INT).

23. Device according to claim 22, characterized in that said push-button (INT) is of a type that can be actuated by means of a foot.

25 24. Device according to claim 22, characterized in



that said push-button (INT) is a key of a keyboard (KB) of said computer (EL).

25. Device according to claim 21, characterized in that said sensor (INT) is a pressure sensor that can
5 be actuated by means of a teeth pressure.

26. Device according to claim 21, characterized in that said sensor is an extensometric sensor (INT) applied to a muscle or to an articulation of said user.

10 27. Device according to claim 21, characterized in that said sensor is a voice recognition device (INT) configured in order to recognize a prearranged sound or a word pronounced by said user.

28. Device according to any of claims 1 to 27,
15 characterized in that said receiver (RX) is connected to said processing means (ECU) through a wire (W).

29. Device according to any of claims 1 to 24, characterized in that said receiver (RX) is connected to said processing means (ECU) through a radio or
20 infra-red connection.

30. Device according to any of claims 1 to 29, characterized in that it includes a keyboard displaying screen (KBS), connected to said processing means (ECU) and arranged next to said screen (MON) of
25 said computer (EL) facing towards said user, said





keyboard displaying screen (KBS) showing through
graphic symbols keys of a conventional keyboard
(KB) for computers, said processing means (ECU)
being configured in order to light or point out any
5 one of said graphic key symbols when such symbol is
selected by said user by orienting said axis of
said receiver (RX) along a direction corresponding
to said symbol and to send to said computer (EL) a
code indicating said key when said user
10 simultaneously actuates said sensor (INT).

31. Device according to any of claims 1 to 30,
characterized in that said receiver (RX) is
composed of a single photodiode of the PSD
(Position Sensitive Diode) type in its squared
15 arrangement.

32. Device according to any of claims 1 to 30,
characterized in that said receiver (RX) is
composed of two photosensitive elements, each one
of said photosensitive elements comprising a pair
20 of photodiodes, both these pairs of photodiodes
being mutually arranged orthogonally or in such a
way as to be linearly independent one from the
other.

33. Device according to any of claims 1 to 30,
25 characterized in that said receiver (RX) is





composed of two photosensitive elements, each one of said photosensitive elements comprising a PSD (Position Sensitive Diode) of the linear type, both these linear PSD photodiodes being mutually
5 arranged orthogonally or in such a way as to be linearly independent one from the other.

34.Receiver (RX) able to be employed in a pointing device according to any of claims 1 to 33, characterized in that it is able to be removably
10 applied to an eyeglasses mount (OC).

35.Receiver (RX) according to claim 34, characterized in that it is able to be applied to an arm of said eyeglasses mount (OC).

36.Receiver (RX) according to claim 34,
15 characterized in that it is able to be applied to an upper crosspiece, connecting glasses supports, of said eyeglasses mount (OC).

37.Receiver (RX) according to claim 34, characterized in that it is able to be applied, in
20 a central position included between glasses supports and over a nose-rest of said eyeglasses mount (OC).

38.Eyeglasses mount (OC) comprising a receiver (RX), integrated therinto, able to be employed in
25 a pointing device according to any of claims 1 to





33.

39. Mount (OC) according to claim 38, characterized in that said receiver (RX) is integrated into an arm of said eyeglasses mount (OC).

5 40. Mount (OC) according to claim 38, characterized in that said receiver (RX) is integrated into an upper crosspiece, connecting glasses supports, of said eyeglasses mount (OC).

10 41. Mount (OC) according to claim 38, characterized in that said receiver (RX) is integrated into a central position included between glasses supports and over a nose-rest of said eyeglasses mount (OC).

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