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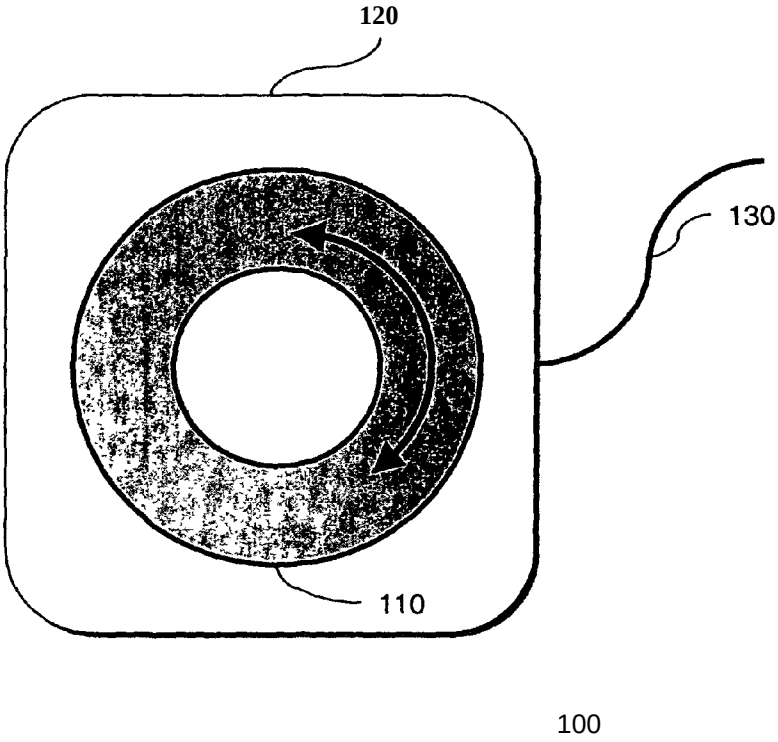
(54) Title: NUMERIC VALUE ADJUSTMENT USING CIRCULAR TURN WHEEL



(57) **Abstract:** An input device for inputting numerical values into a computer includes a support and a turn wheel rotatably mounted on the support. Also included are means for converting the position and/or rotation of the turn wheel into an information signal and means for sending the signal to a receiving device.

WO 2007/031161 A2

TITLE

NUMERIC VALUE ADJUSTMENT USING CIRCULAR TURN WHEEL

BACKGROUND OF THE INVENTION

Field of the Invention

[0001 1 The invention relates to the field of input devices. In particular, **the** invention relates to the input of numerical values using **a** circular turn wheel.

Description of the Related Art

[0002] Certain tasks carried out by a computer user require frequent numerical input. For example, complex professional applications such as picture processing, Computer-Aided Design (CAD) or the layout of complex documents require frequent input and/or adjustment of numerical values, such as for example to **set** dimensions, sizes, colors, etc.

[0003] Tfï s often required to be able to change a numerical value continuously, in order to quickly cover or review an entire range of values, such as for **example** when doing fine adjustments.

[0004] In the state of the art, it is known to provide **a** keyboard for typing in numerical values. However, using such a keyboard requires moving **the** hand from **a** graphical input device, such as a mouse, to the keyboard, which is disruptive to the work-flow.

[0005] In the state of the art it is further known to use a mouse to adjust sliders. However, the utilization of a mouse for numerical input does not provide sufficient precision, especially if the range of values is large over a small **area.** Utilizing **an** input device, such as a mouse, to adjust numeric values **at** a constant **rate** requires repetitive motion until a minimum or maximum is reached.

OBJECT OF THE INVENTION

[0006] **It** is therefore an object of the present invention to provide **an** input **device** with a precise handling that eliminates the need to interrupt work-flow when entering numerical values.

[0007] **It** is a further object of the invention to provide an input **device with a** precise handling that minimizes repetitive motion when entering numerical values.

[0008] **It** is yet another object of the invention to provide an input **device that** gives a user a more efficient way to adjust numeric values in numeric intensive applications, making the user less prone to erroneous data input and providing increased on-screen feedback on data being adjusted.

[0009] It is still a further object of the invention to minimize mouse motion by letting a user continue to keep the mouse on a model or image, while using **the** turn wheel to increase/decrease values, thereby improving productivity.

SUMMARY OF THE INVENTION

[0010] In a preferred embodiment, the input device according to **the** invention comprises a support; a turn wheel rotatably mounted on **the** support; means for converting the position and/or rotation of the turn wheel into a signal; and **means** for sending the signal to a receiving device.

[0011] In another embodiment, the input device according to the invention further comprises means for detecting whether the turn wheel is pressed down by **a** user.

[0012] In still another embodiment, the input device according to **the** invention **is** integrated with a computer mouse.

[0013] **A** method according to an embodiment of the invention, for inputting numerical values into a computer using an input device, comprises **the steps of**

setting a numerical value N to an initial value; testing whether the turn **wheel is** continuously rotated; and, if yes, increasing the numerical value **N** by **a second** constant.

[0014] Another method for inputting numerical values into a computer according to an embodiment of the invention comprises the steps of setting an acceleration constant to an initial value; testing, whether the angular displacement of **a** continuous rotation of a turn wheel exceeds a given threshold value; and, **if** yes, increasing the acceleration constant and resetting the angular displacement value; and increasing a numerical value N by the acceleration constant.

[0015] A system according to an embodiment of the invention comprises **an** input device as defined above and further a computer, characterized in **that the** computer executes a method for inputting a numerical value.

[0016] In another embodiment of the system may further comprise **a** display device and a graphical display user interface is displayed on the display device.

[0017] In a further embodiment of the system, the graphical display user interface may consist of a possible range of values.

[0018] In still a further embodiment of the system, **a** current value **that is** synchronized to the motion of the turn wheel, may be displayed on **the** display device.

[0019] In another embodiment of the system according to the invention, **the** display user interface is located in immediate proximity to **a** mouse cursor.

SHORT-DESCRIPTION OF THE FIGURES

[0020] Further objects, aspects and advantages of the present invention will become apparent when studying the following detailed description, in connection with the attached drawings, in which

[0021] Fig. Ia shows an input device according to a first embodiment of **the** invention;

[0022] Fig. Ib shows a graphical user interface element in the form of **a** vertical slider that can be controlled by an input device according to another embodiment of the invention.

[0023] Fig. **2** illustrates angular displacement of a turn wheel according to **an** embodiment of the present invention;

[0024] Fig 3 is a schematic overview of a method for linearly increasing **a** numerical value using a turn wheel according to the present invention.

[0025] Fig. 4 is a schematic overview of a method for nonlinearly increasing **a** numerical value using a turn wheel according to the present invention.

[0026] Fig. 5a shows the effect of using a method described **in** Fig. 3 for linearly increasing a numerical value using a turn wheel according to the **present** invention.

[0027] Fig. 5b shows the effect of using a method described in Fig. 4 for nonlinearly increasing a numerical value using a turn wheel according to **the** present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Fig. 1 shows an input device 100 according to a **first** embodiment of **the** invention.

[0029] In Fig. 1, a turn wheel 110 is rotatably mounted on a support 120.

[0030] Using his finger, a user can rotate the turn wheel 110 on the support 120 in clockwise and counter-clockwise directions, as indicated by the double-pointed arrow. The rotating motion can be started anywhere on the turn wheel.

[0031] The support 120 comprises means for converting the position **of the turn** wheel and/or the rotating motion into a signal (not shown). The signal **represents** information about the position and/or the movement of **the** turn **wheel** and/or whether the turn wheel is held down by a user's finger. The signal may **be** in **digital** or analog form.

[0032] The input device 100 communicates with a computer (not shown). In particular, the signal generated by the means for converting the position of **the** turn wheel and/or the rotating motion into a signal, is communicated to the computer.

Communication may take place over a wire 130, as in the present embodiment, or using a wireless connection such as Bluetooth.

[0033] The support 120 may be integrated with a computer mouse.

[0034] The computer comprises means for receiving the signal communicated over the wire (-less) connection 130. The computer does also comprise **means for** translating the information about the position and/or **the** movement of **the** turn wheel that is represented by the received signal, into corresponding increases or decreases of a previously selected numerical value N. The translation **between the** rotation of the turn wheel into corresponding numerical value may **be** linear or non-linear.

[0035] Whether the numerical value is increased or decreased depends on **the** direction of motion of the turn wheel, which may be explicitly represented by **the** signal generated in the input device or may be implicitly derived from **that** information, **e.g.** from successive positions represented by the signal.

[0036] In the present embodiment of the invention, rotating the turn wheel in **a** clockwise manner incrementally increases the numerical value. Continuous movement in a clockwise manner will continue to increase the numerical value, until a preset maximum value is reached.

[0037] Moving counter-clockwise on the turn wheel would decrease numeric values to the minimum. Continuous movement in a counter-clockwise **manner** will continue to decrease the numerical value until a preset minimum value **is reached.**

[0038] Changing from clockwise to counter-clockwise at any **time** will increase and decrease values based on movement.

[0039]—Removing the imgerorthe hand orstopping movement stops **the** value change. Restarting movement will restart value movement from current value.

[0040] Value adjustment is constrained to the current selected application **and** tool. Based on the current tool or mode, only the values that can be **adjusted are** presented to the user.

[0041] As adjustments are being made the user may be presented **with a** heads-up display on a display device (not shown) such as a computer screen on **what is being** adjusted and the current value.

[0042 J Fig. 1b shows a graphical user interface element that is displayed on **the** display device. The graphical user interface element displays a possible range of values (minimum to maximum) and the current value.

[0043] The displayed values are synchronized to finger motion on **the** input device. If the turn wheel is continuously moved in clockwise direction, **the** displayed value is adjusted until it reaches a maximum and the graphical user interface element changes accordingly.

[0044] The vertical slider shown in Fig. Ib is only an example of a possible user interface element that can be controlled by the input device according to **the** invention. Other user interface elements comprise simple value fields, horizontal sliders, etc.

[0045] The graphical display user interface element can be located around **the** immediate proximity of the mouse cursor to minimize disruptions of **the** work flow.

[0046] Fig. 2 illustrates, how information relating to the rotation of **the** turn wheel is expressed, in one embodiment of the invention, as a measured angular displacement ϕ caused by a continuous rotation from an initial position p i to an end position p2.

[0047] An initial position of the turn wheel is designated by pi. In **the** invention, **a** position of the turn wheel is taken as initial if the wheel is either stationary or **the** direction of the rotation is reversed. In the initial position, the angular displacement ϕ is 0 (zero).

[0048] If the user continuously rotates the turn wheel in clockwise direction about the-eentre-G5-until-the-turn-wheel-reaches-target-position-p2, angular displacement becomes ϕ, which is the length of the continuous arc between p i and **p2, drawn** by a dashed line, divided by the radius r (assumed to be 1 in **the** present embodiment).

[0049] Angular displacement ϕ is measured in rad (radians). By convention, **the** direction of the rotation is indicated by the sign: a positive value for ϕ indicates clockwise rotation while a negative value for ϕ indicates counter-clockwise rotation.

[0050] An interruption or reversal of the continuous rotation of the turn wheel leads to a new initial position and to a value of ϕ equalling 0 (zero).

[0051] Fig. **3** shows a method according to one embodiment of the **present** invention, for translating the motion of the turn wheel into **a** linear increase **of a** numerical value.

[0052] For reasons of simplicity, the case of a counter-clockwise rotation **with** negative angular displacement is not considered here, which may **be realized** analogously.

[0053] In step 310, a numerical value N is set to an initial value **cl.**

[0054] In step 320, it is tested whether the turn wheel is continuously **rotated** by testing whether the finger is on the turn wheel.

[0055] If the finger is on the turn wheel in step 320, the numerical value **N is** increased by a second numerical constant c2. By iterating through **the depicted** loop until the continuous movement of the turn wheel in one direction ends, **N** becomes cl + α*c2, where oc is the number of rounds through the loop.

[0056] A result of applying the method according to the above-described embodiment of the present invention is shown in Fig. 5a, for varying angular displacements ϕ. In this concrete example, c1 is 0 (zero).

[0057] Fig. 4 shows a method according to one embodiment of the present invention, for translating the motion of the turn wheel as measured by angular displacement ϕ into a nonlinear increase of a numerical value. Again, for reasons of simplicity, the case of a counter-clockwise rotation with negative angular displacement is not considered here, which may be realized analogously.

[0058] In step 4TO, an acceleration constant Z is set to a constant **c3 and the** angular displacement ϕ is set to 0 (zero).

[0059] In step 420, it is tested whether the user still has the finger on **the** turn wheel, that is whether the turn wheel is continuously rotated. If the finger is not on the turn wheel, operation continues with step 410.

[0060] If the finger is on the turn wheel in step 420, then it is tested in **step 430** whether the angular displacement from the initial position ϕ is **greater** or equal to the angular displacement ϕ*. If the angular displacement ϕ* has not been **reached,**

then the numerical value is increased using Z in step 460 and the procedure continues with step 420. If the angular displacement ϕ^* has been reached, **then Z is** incremented in step 440. Then, the initial position is reset in step 450 **and the** operation continues with step 460.

[0061] The value of the acceleration constant Z can be based on **either a fixed** value or based on the amount of time in which a certain angular displacement ϕ **is** achieved. Shorter time would result in a higher acceleration constant.

[0062] Once motion on the circular device is stopped or moved in **the reverse** direction, the acceleration constant **is** not **applied** and **reset.**

[0063] The effect of applying the method as described in connection **with Fig. 4 is** shown in Fig. **5b.**

IN THE CLAIMS

1. An input device for inputting numerical values into a computer, comprising:

a support;

a turn wheel, rotatably mounted on the support;

means for converting the position and/or rotation of the turn wheel into an information signal; and

means for sending the signal to a receiving device.

2. An input device according to claim 1, further comprising means for detecting whether the turn wheel is pressed down by a user.

3. An input device according to claims 1 or 2, wherein the input **device is** integrated with a computer mouse.

4. A method for inputting numerical values into a computer using an input device having a turn wheel, comprising:

setting a numerical value N to an initial value cl;

testing whether the turn wheel is continuously rotated;

if the turn wheel is continuously rotated, increasing the numerical value **N** by a second constant.

5. A method for inputting numerical values into a computer, **comprising the** following steps:

setting an acceleration constant to an initial value;

testing, whether the angular displacement ϕ of a continuous rotation of a turn wheel exceeds a given threshold value ϕ^*;

if ϕ does exceed ϕ^*, increasing an acceleration constant Z and **resetting the** angular displacement value ϕ**;**

increasing **a** numerical value **N** by **Z.**

6. A system comprising an input device according to claims 1 or 2 **and** further comprising a computer, characterized in that the computer executes **a** method according to claim 3.

7. A system according to claim 6, further comprising **a** display **device and** wherein a graphical display user interface is displayed on the display **device.**

8. A system according to claim 7, wherein the graphical display user **interface** consists of a possible range of values.

9. A system according to claim 8, wherein a current value **that is** synchronized to the motion of the turn wheel, is displayed on the display device.

10. A system according to claim 9, wherein the display user interface is located in immediate proximity to a mouse cursor to minimize disruptions of **the** work flow.

Fig. 1

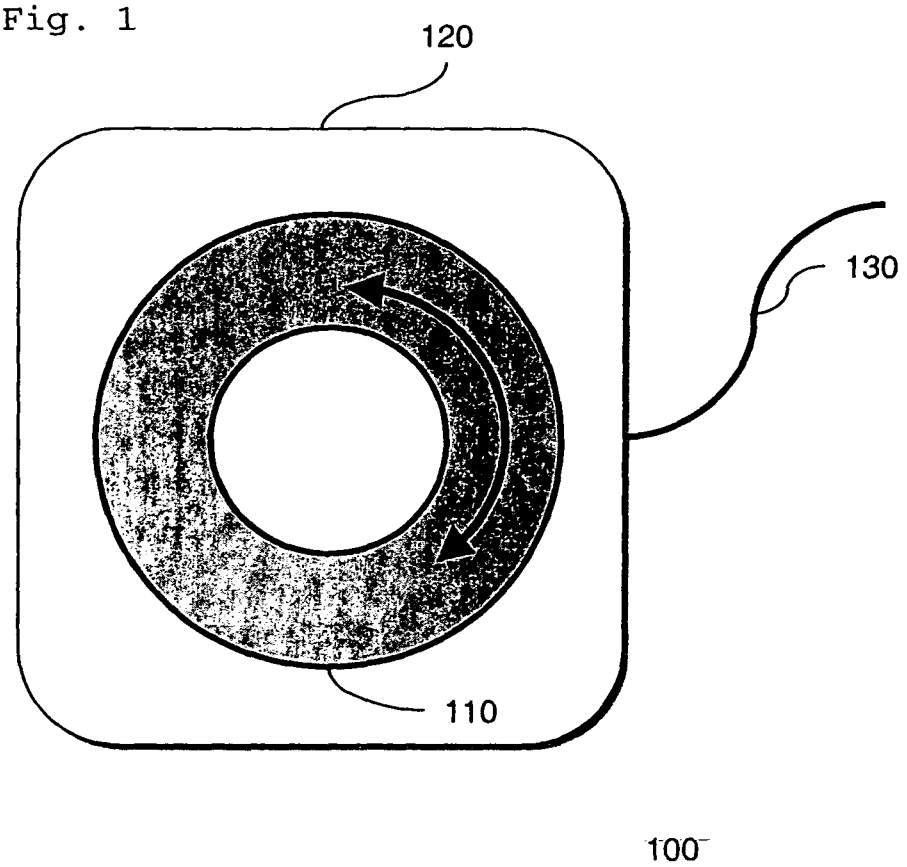
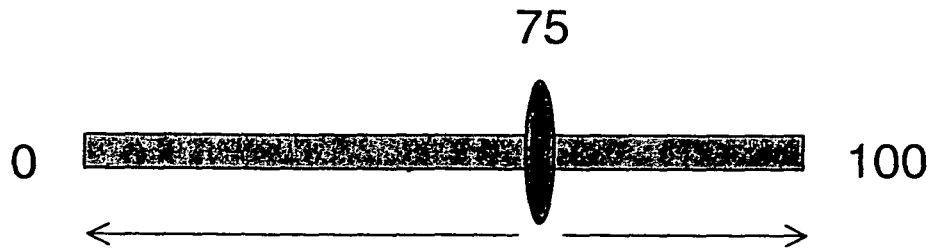


Fig. 1b



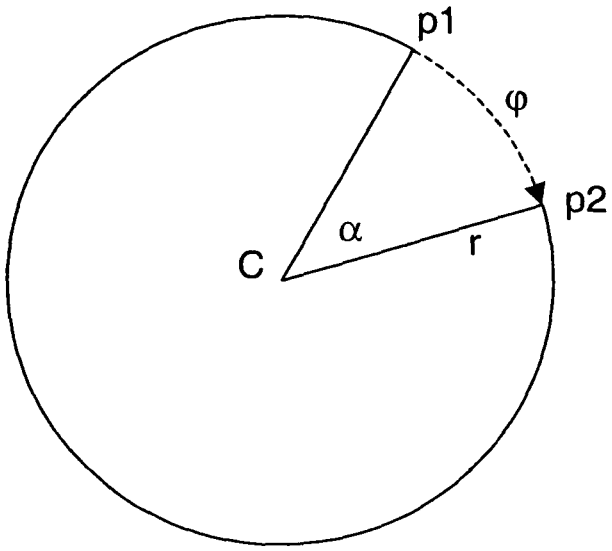


Fig. 2

Fig. 3

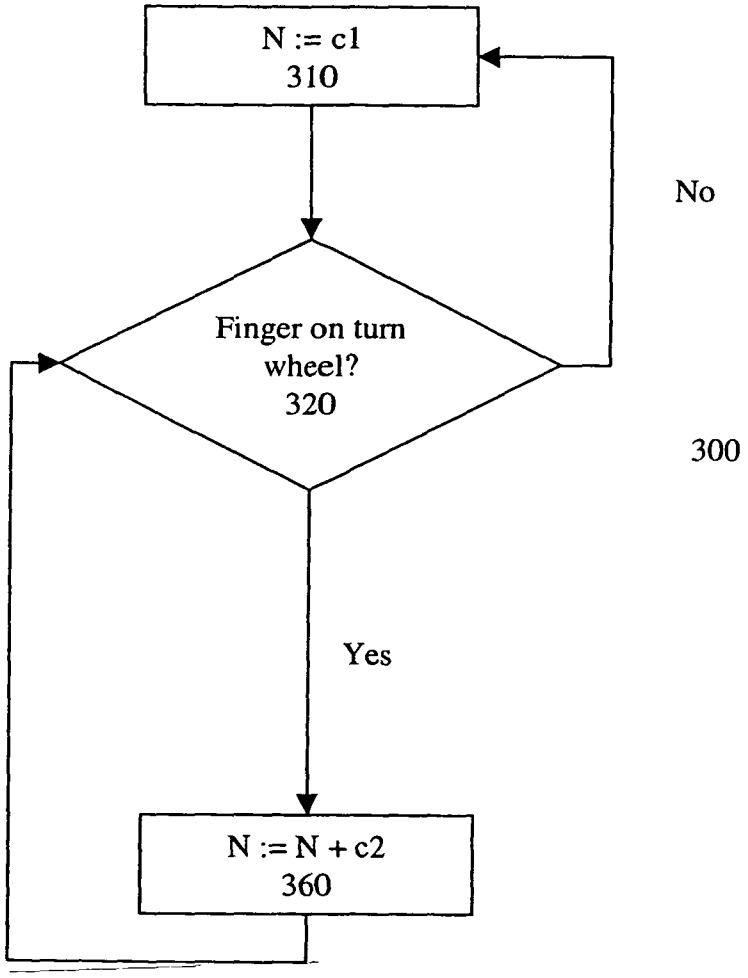
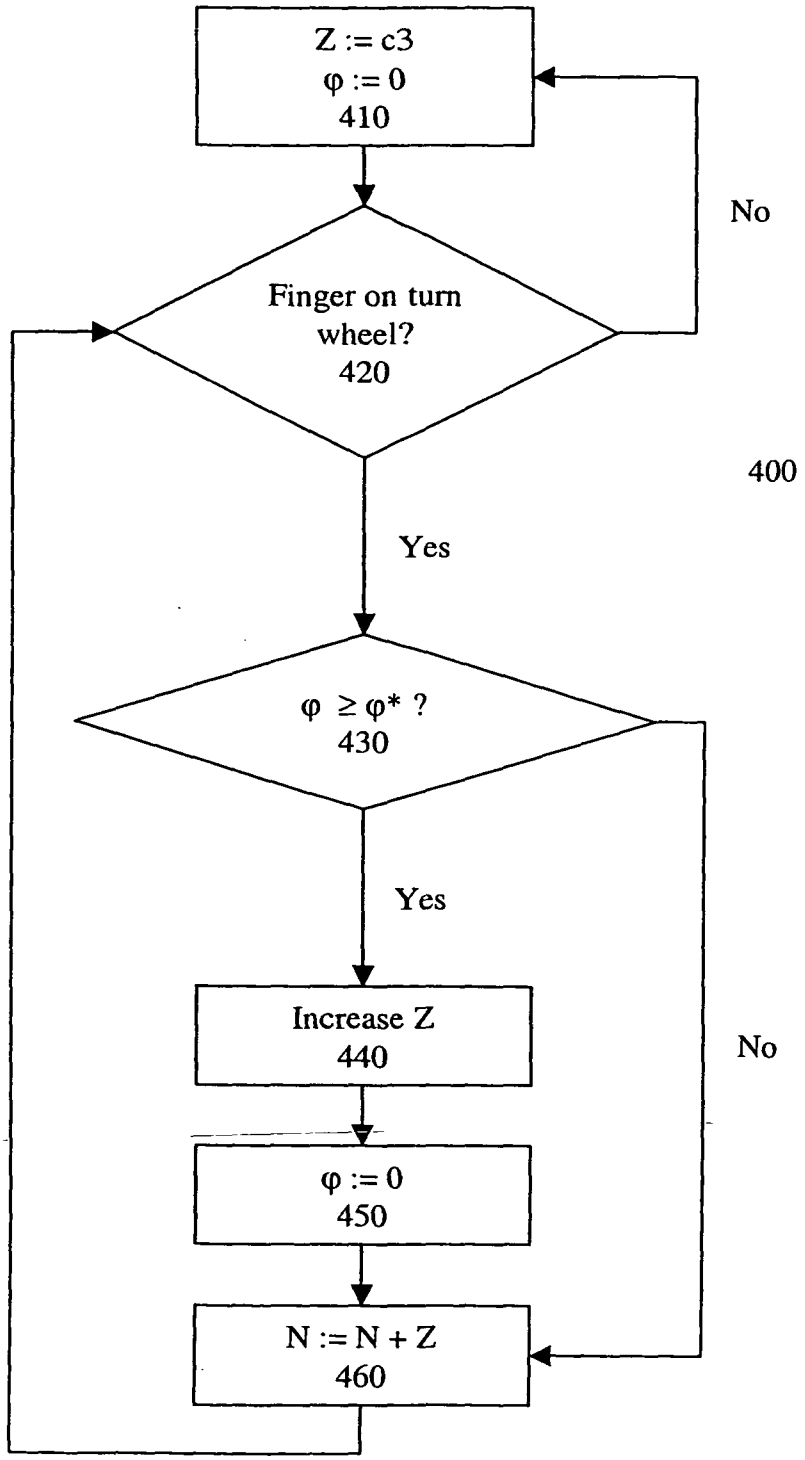


Fig. 4


Z := c3
φ := 0
410
No
Finger on turn wheel?
420
400
Yes
φ ≥ φ* ?
430
Yes
Increase Z
440
No
φ := 0
450
N := N + Z
460

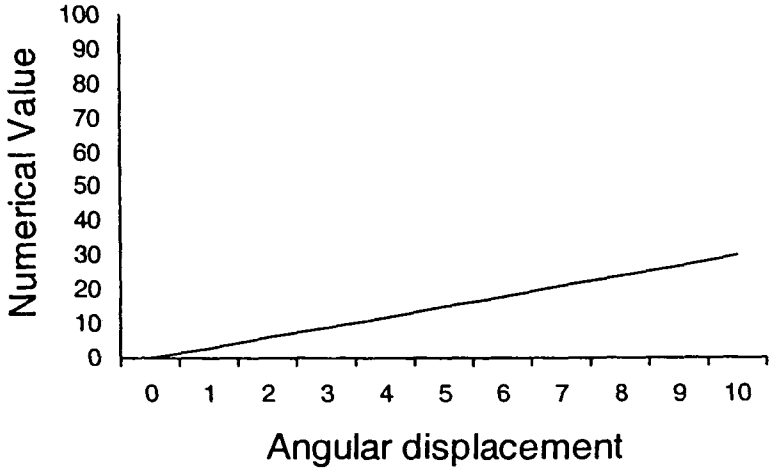

Numerical Value
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10
Angular displacement

Fig. 5a

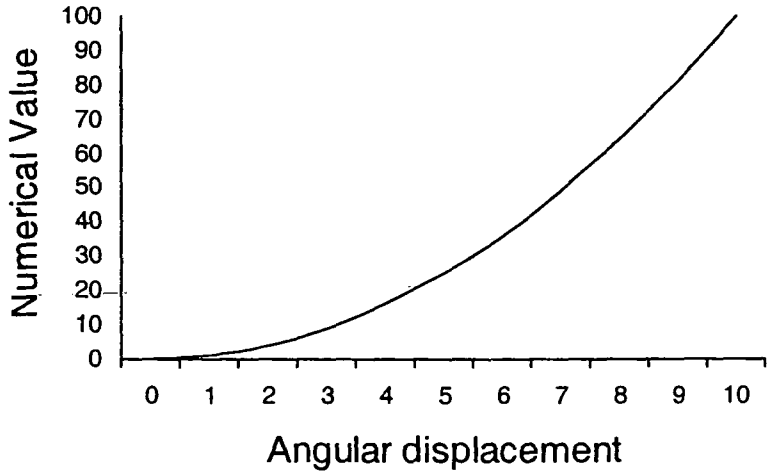

Numerical Value
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10
Angular displacement

Fig. 5b