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ROBOTIC ARM AND CONTROL METHOD THEREOF

Abstract

A control method of a robotic arm is provided. The control method includes: setting a detection circuit, a comparing circuit and a switching circuit. The detection circuit detects the motion of the robotic arm to generate a detection signal. The comparing circuit compares the detection signal with a low threshold region and compares the detection signal with a high threshold region to generate a comparison signal. The switching circuit switches the robotic arm to a first motion mode or a second motion mode according to the comparison signal.

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Background/Summary

[0001] This is a divisional application of co-pending U.S. application Ser. No. 18/136,828 filed on Apr. 19, 2023, which claims the benefit of Taiwan application Serial No. 111141491 filed on Oct. 28, 2022, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates in general to a robotic arm, and more particularly to a control method of a robotic arm.

Description of the Related Art

[0003] In most teaching methods of a robotic arm, after the operator manually operates the teaching device, the teaching device outputs signals to the controller of the robotic arm, then the controller controls the robotic arm to move in the X/Y/Z directions of a coordinate system to perform translational movement, rotational movement, or axial joint rotation.

[0004] The most commonly seen operation interface of the teaching device of a robotic arm can be a physical key or a software button. To operate the six axes of the robotic arm, at least 12 buttons are needed. The 12 buttons include operation keys for performing translation and rotation on the X/Y/Z axes and switch buttons for switching between inch movement and continuous movement on the X/Y/Z axes. To teach the robotic arm, the operator needs to watch each button of the teaching device. The operator's line of sight must frequently shift between the robotic arm and the teaching device. Such teaching method deteriorates the teaching efficiency of the robotic arm.

[0005] In most intuitive teaching methods of a robotic arm, after the operator manually drags the force sensors on the **6** axes of the robotic arm, the force sensors output signals to the controller of the robotic arm, then the robotic arm accordingly performs translational movement, rotational movement or axial joint rotation move in the X/Y/Z directions of the coordinate system.

[0006] Although the teaching device can provide more operation settings, the operation of the teaching device is complicated, and the teaching device is heavy. Furthermore, as disclosed above, on-site adjustment requires the operator to frequently shift the line of sight between the target object and the teaching device, and therefore cannot be focused on teaching. Besides, despite that the force sensors on the **6** axes can make the operation more intuitive, when it comes to fine-tuning (such as 1 mm pitch), manual dragging may easily overdo and cannot be precisely positioned. Therefore, the present invention provides a control method of a robotic arm for simplifying the teaching process and increasing the accuracy.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to provide a control method of a robotic arm, which simplifies the teaching process for the operator.

[0008] The present invention is directed to provide a control method of a robotic arm, which increases teaching accuracy.

[0009] To achieve the above objects of the present invention, a control method of a robotic arm is provided. The control method includes setting a detection circuit, a comparing circuit and a switching circuit. The detection circuit detects the motion of the robotic arm to generate a detection signal. The comparing circuit compares the detection signal with a low threshold region and compare the detection signal with a high threshold region to generate a comparison signal. The switching circuit switches the robotic arm to a first motion mode or a second motion mode according to the comparison signal.

[0010] The control method of the robotic arm according to the present invention includes setting a teaching device, a detection circuit, a comparing circuit and a switching circuit. The teaching device includes a forward button, a reverse button and a cycle switch button. The detection circuit detects an output of teaching device to generate a detection signal. The comparing circuit compares the detection signal with a low threshold region and compares the detection signal with a high threshold region to generate a comparison signal. The switching circuit switches the robotic arm to the first motion mode or the second motion mode according to the comparison signal.
[0011] Wherein the detection circuit is an encoder, the detection signal is a speed signal, and the detection circuit detects the motion speed of the robotic arm to generate the detection signal; when the comparing circuit determines that the detection signal is at the low threshold region, the switching circuit switches the robotic arm to the first motion mode; when the comparing circuit determines that the detection signal is at the high threshold region, the switching circuit switches the robotic arm to the second motion mode.
[0012] The first motion mode is a discontinuous movement or a low-speed motion, and the second motion mode is a continuous movement or a high-speed motion.
[0013] The above and other aspects of the invention will become better understood with regard to the following detailed description of the preferred but non-limiting embodiment(s). The following description is made with reference to the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0014] FIG. **1** is a schematic diagram of a robotic arm and a controller according to the present invention.
[0015] FIG. **2** is a first waveform of teaching the robotic arm by an external force according to the present invention.
[0016] FIG. **3** is a first flowchart of a method for controlling the motion mode of the robotic arm according to the present invention.
[0017] FIG. **4** is a second waveform of teaching the robotic arm by an external force according to the present invention.
[0018] FIG. **5** is a second flowchart of a method for controlling the motion mode of the robotic arm according to the present invention.
[0019] FIG. **6** is a flowchart of a method for controlling the resistance of a robotic arm according to the present invention.
[0020] FIG. **7** is a flowchart of a teaching device for controlling the robotic arm according to the present invention.
[0021] FIG. **8** is a schematic diagram of prompting the motion mode of the robotic arm according to the present invention.
DETAILED DESCRIPTION OF THE INVENTION
[0022] The technical methods adopted to achieve the above objects of the present invention and the consequent effects are disclosed in a number of embodiments below with reference to the accompanying drawings.
[0023] Referring to FIG. **1**, a schematic diagram of a robotic arm and a controller according to the present invention is shown. A controller **10** and a robotic arm **20** are connected to each other. For instance, the controller **10** is connected with a joint module of the robotic arm **20**. The controller **10** controls the motion of the robotic arm **20**. The controller **10** receives an input signal Sin according to the output of the robotic arm **20** and generates a switch signal Sw or an output signal Sout according to the input signal Sin, so as to control the robotic arm **20** to perform different modes of motion. Thus, with respect to the motion mode of the robotic arm **20**, the operator can make

selection through an interface setting to generate the output signal Sout to control the robotic arm **20** to move according to a specific motion mode. In the embodiment of FIG. **1**, the output signal Sout is generated by a selection circuit **14** of the controller **10**. In other words, the interface setting can set the selection circuit **14** to generate different output signals Sout to control the robotic arm **20** to perform different motion modes.

[0024] Or, the control method of the robotic arm **20** may include setting a detection circuit **11**, a comparing circuit **12** and a switching circuit **13**. The detection circuit **11** detects the motion of the robotic arm **20** to generate a detection signal Sd. The comparing circuit **12** compares the detection signal Sd with a low threshold region and compares the detection signal Sd with a high threshold region to generate a comparison signal Sc. The switching circuit **13** switches the robotic arm **20** to a first motion mode or a second motion mode according to the comparison signal Sc.

[0025] Referring to FIG. **2**, a first waveform of teaching the robotic arm by an external force according to the present invention is shown. The detection circuit **11** may include a force sensor **21** shown in FIG. **1**, so that the detection signal Sd can be a force signal, wherein the robotic arm **20** can be equipped with six sets of force sensors **21**. The motion of the robotic arm **20** on different axes may include an X-axis movement X, a Y-axis movement Y and a Z-axis movement Z, so that the detection circuit **11** can detect three motion types of the robotic arm **20** to generate a motion signal Sm for respective motion type. When an external force is applied to control the robotic arm **20** to move on the X-axis, the detection circuit **11** detects that the force value of the X-axis movement X is larger than that of the Y-axis movement Y and the Z-axis movement Z shown on FIG. **2**. After the detection circuit **11** generates the motion signals Sm for three motion types, the comparing circuit **12** determines that the level of the motion signal Sm of the X-axis movement X is higher than the levels of the motion signals Sm of the Y-axis movement Y and the Z-axis movement Z and generates a determination signal Sj as indicated in FIG. **1**.

[0026] Meanwhile, the switching circuit **13** fixes (or switches) the robotic arm **20** to the X-axis movement X according to the determination signal Sj. When the external force continues to control the robotic arm **20**, the detection circuit **11** detects the X-axis movement X of the robotic arm **20** to generate the detection signal Sd. As indicated in FIG. **2**, when the comparing circuit **12** determines that the detection signal Sd is at the low threshold region, the switching circuit **13** switches the robotic arm **20** to a first motion mode; when the comparing circuit **12** determines that the detection signal Sd is at the high threshold region, the switching circuit **13** switches the robotic arm **20** to a second motion mode. In other words, the controller **10** firstly obtains the axial direction in which the operator intends to operate, then determines the operator's desired accuracy and automatically adjusts the motion amount of the robotic arm **20**.

[0027] Refer to FIG. **2** again. The first motion mode is a discontinuous movement, and the second motion mode is a continuous movement. The discontinuous movement refers to inch movement, that is, the minimal movement unit by which the robotic arm **20** moves each time. For instance, if the minimal movement unit of the robotic arm **20** is designed as 1 mm, the robotic arm **20** performs inch movement for the first time, that is, the robotic arm **20** moves by 1 mm then halts. If the detection circuit **11** (that is, the force sensor **21**) continuously detects the movement pushed by the external force, the robotic arm **20** performs inch movement for the second time to move by 1 mm again. The continuous movement is different from the discontinuous movement in that the continuous movement refers to the robotic arm **20** continuously moving in a specific direction without halting. Thus, the detection circuit **11** allows the operator to directly teach the robotic arm **20** to move and perform an inch movement or a continuous movement without having to frequently shifting the line of sight between the robotic arm **20** and the operating interface.

[0028] Referring to FIG. **3**, a first flowchart of a method according to the present invention for controlling the motion mode of the robotic arm is shown. After reading a force value detected by the force sensor **21**, the comparing circuit **12** determines whether the force value is at the low threshold region or the high threshold region for the switching circuit **13** to switch the motion mode

of the robotic arm **20** according to the force value, wherein the robotic arm **20** can switch to a translational movement or rotational movement with discontinuous movement or a translational movement or rotational movement with continuous movement. Take the X-axis movement X of FIG. **2** for instance. The switching circuit **13** can switch the robotic arm **20** to perform the X-axis movement X with discontinuous movement and continuous movement according to different force values. Besides, if the operator intends to control the robotic arm **20** to perform translational movement or rotational movement, the detection circuit **11** can also be used to detect the force value for the switching circuit **13** to perform switching according to the detection result. Therefore, if the detection result is that the force value is small and the operator performs translational movement, the switching circuit **13** switches the robotic arm **20** to perform the X-axis movement X which is discontinuous and translational. Then, the controller **10** can repeatedly detect whether the control of the robotic arm **20** by the external force has changed to the Y-axis movement Y or the Z-axis movement Z.

[0029] Also, when the force value is not at the low threshold region or the high threshold region, the operator can set the output signal Sout generated by the selection circuit **14** through interface setting and control the robotic arm **20** to perform a specific motion mode. For instance, when the force value is between the low threshold region and the high threshold region, the motion mode can be set to the X-axis movement X, which is continuous and rotational; or when the force value is lower than the low threshold region, the motion mode can be set to the X-axis movement X, which is discontinuous and translational. Or, the force value can be divided into a low threshold region and a high threshold region only. That is, whatever force value above the high threshold region (inclusive of the high threshold region) belong to continuous movement, and whatever force value below the high threshold region (exclusive of the high threshold region) belong to discontinuous movement. Thus, there is no need to provide additional interface setting for the operator to perform manual setting. When the operator applies a larger force (such as the high threshold region), this indicates that the operator intends to perform a larger range of motion. When the operator applies a smaller force (such as the low threshold region), this indicates that the operator wants to perform a smaller range of motion. The setting of threshold (or threshold region) depends on actual needs and is not limited by the exemplification of embodiments.

[0030] Referring to FIG. **4**, a second waveform of teaching the robotic arm by an external force according to the present invention is shown. When the robotic arm **20** is not provided with any force sensor **21**, the detection circuit **11** may include an encoder and a computational circuit. Thus, the detection signal Sd can be a displacement signal, that is, the displacement signal is relevant to the amount of rotation of the encoder, and the amount of rotation of the encoder is relevant to the displacement of the robotic arm **20**. Therefore, after the detection circuit **11** continuously detects the displacement X**1** of the X-axis movement X of the robotic arm **20** for a detection time td, the displacement X**2** is obtained from the displacement X**1** through a differential calculation and an absolute value calculation, the displacement X**3** is obtained from the displacement X**2** through an integral calculation. Lastly, the detection circuit **11** generates the detection signal Sd according to the displacement X**3**. Moreover, when the comparing circuit **12** determines that the detection signal Sd is at the low threshold region, the switching circuit **13** switches the robotic arm **20** to the first motion mode; when the comparing circuit **12** determines that the detection signal Sd is at the high threshold region, the switching circuit **13** switches the robotic arm **20** to the second motion mode.

[0031] Referring to FIG. **5**, a second flowchart of a method for controlling the motion mode of the robotic arm according to the present invention is shown. As indicated in the diagrams, the embodiments of FIGS. **4**-**5** are different from the embodiments of FIGS. **2**-**3** in that the embodiments of FIGS. **4**-**5** are not provided with the force sensor **21** and the displacement of the X-axis movement X is calculated by the computational circuit of the detection circuit **11** to generate the detection signal Sd. Similarly, the comparing circuit **12** compares the low threshold region and the high threshold region according to the detection signal Sd and then generates the

comparison signal Sc for the switching circuit **13** to set the motion mode for the robotic arm **20**. Therefore, without the force sensor **21**, the operator can operate the inch movement or continuous movement of the robotic arm **20** without shifting the line of sight. Remaining technologies of the embodiments of FIGS. **4**-**5** are similar to that of the embodiments of FIGS. **2**-**3**, and the similarities are not repeated here.

[0032] Referring to FIG. **6**, a flowchart of a method for controlling a resistance of a robotic arm according to the present invention is shown. The detection circuit **11** includes a speed sensor. The detection signal Sd is a speed signal. The detection circuit **11** detects the motion speed of the robotic arm **20** to generate the detection signal Sd. When the comparing circuit **12** determines that the detection signal Sd is at the low threshold region, the switching circuit **13** switches the robotic arm **20** to the first motion mode; when the comparing circuit **12** determines that the detection signal Sd is at the high threshold region, the switching circuit **13** switches the robotic arm **20** to the second motion mode. The first motion mode is a low-speed motion, and the second motion mode is a high-speed motion.

[0033] In comparison to the embodiments of FIGS. **3** and **5**, FIG. **6** can additionally have a middle threshold region to differentiate between more speeds. Therefore, when the detection signal Sd is at the middle threshold region, this indicates that the robotic arm **20** is moving at a middle speed. The threshold regions from high to low respectively are high threshold region, middle threshold region, and low threshold region. Then, the switching circuit **13** controls the resistance generated by the motor inside the robotic arm **20** according to the comparison signal Sc. In other words, when the detection signal Sd is at the low threshold region, this indicates that the robotic arm **20** is at a low-speed motion, and the switching circuit **13** switches the robotic arm **20** to a high-resistance mode, that is, the switching circuit **13** switches the motor to remain at the low rotation speed and limits the robotic arm **20** to the low-speed motion, so that the robotic arm **20** can perform a motion with higher accuracy. When the detection signal Sd is at the high threshold region, this indicates that the robotic arm **20** is at a high-speed motion, and the switching circuit **13** switches the robotic arm **20** to a low-resistance mode, that is, the switching circuit **13** switches the motor to remain at the high rotation speed and limits the robotic arm **20** to the high-speed motion, so that the robotic arm **20** can perform a motion with lower accuracy. Therefore, the controller **10** and the motor can dynamically adjust the resistance of the motor according to different accuracy scenarios automatically, so that the operator can quickly drag the robotic arm **20** by hand according to the scenarios without operating additional control device. Thus, the teaching efficiency can be increased.

[0034] Referring to FIG. **7**, a flowchart of a teaching device according to the present invention for controlling a robotic arm is shown. Apart from the control method of a robotic arm disclosed in above embodiments, in which the operator directly drags the robotic arm **20** to complete the teaching process, a teaching device can be used to control the movement of the robotic arm **20** to complete the teaching process. Referring to FIG. **8**, a schematic diagram of prompting the motion mode of the robotic arm according to the present invention is shown. As indicated in FIG. **8**, a teaching device **30** is arranged to control the robotic arm **20**, and the controller **10** is coupled to the teaching device **30** and the robotic arm **20** to control the robotic arm **20** according to an output of the teaching device **30**. As disclosed above, the controller **10** can have a detection circuit **11**, a comparing circuit **12** and a switching circuit **13** arranged therein. The teaching device **30** includes a forward button (+), a reverse button (−) and a cycle switch button (Fn). Thus, the detection circuit **11** detects the output of the teaching device **30** to generate the detection signal Sd. The comparing circuit **12** compares the detection signal Sd with the low threshold region and compares the detection signal Sd with the high threshold region to generate the comparison signal Sc. The switching circuit **13** switches the robotic arm **20** to the first motion mode or the second motion mode according to the comparison signal Sc.

[0035] Refer to FIG. **7** again. The detection circuit **11** is a timing circuit and the detection signal Sd

is a timing signal; when teaching device **30** outputs a forward signal, that is, the operator presses the forward button (+), the detection circuit **11** to detect the change of the forward signal within a duration time to generate the detection signal Sd. When the comparing circuit **12** determines that the detection signal Sd is at the low threshold region, the switching circuit **12** switches the robotic arm **20** to the first motion mode. When the comparing circuit **12** determines that the detection signal Sd is at the high threshold region, the switching circuit **12** switches the robotic arm **20** to the second motion mode. Therefore, the first motion mode is a forward motion with discontinuous movement, and the second motion mode is a forward motion with continuous movement. Within the duration time, when the operator short-presses the forward button (+), the detection circuit **11** detects that the forward signal maintains at the high level for a shorter duration. Conversely, within the duration time, when the operator long-presses the forward button (+), the detection circuit **11** detects that the forward signal maintains at the high level for a longer duration. Therefore, in the present embodiment, the low threshold region and the high threshold region are related to time and can be used to determine whether the operator short-presses or long-presses the teaching device **30**.

[0036] Therefore, after whether the operator short-presses or long-presses forward button (+) within the duration time is determined, the switching circuit **13** can switch the robotic arm **20** to perform a discontinuous movement or a continuous movement. Then, the switching circuit **13** also can switch the robotic arm **20** to perform an X-axis movement X, a Y-axis movement Y or a Z-axis movement Z.

[0037] Moreover, when the teaching device **30** outputs a cycle switch signal, the detection circuit **11** detects the cycle switch signal within the duration time to generate a detection signal Sd. When the comparing circuit **12** determines that the detection signal Sd is at the low threshold region, the switching circuit **13** controls the robotic arm **20** to switch from the X-axis movement X to the Y-axis movement Y. When the comparing circuit **12** determines that the detection signal Sd is at the high threshold region, the switching circuit **13** controls the robotic arm **20** to switch from the X-axis movement X to the Y-axis movement Y, and the robotic arm **20** reciprocates on the Y-axis movement Y for a distance once. Therefore, if the detection circuit **11** detects that the operator short-presses the cycle switch button (Fn) within the duration time, the switching circuit **13** switches the robotic arm **20** to a movement on a different axis. Refer to FIG. **8**. The initial setting of the robotic arm **20** is the X-axis movement X. When the operator short-presses the cycle switch button (Fn) once, the switching circuit **13** switches the robotic arm **20** to move on the next axis, that is, the robotic arm **20** switches from the X-axis movement X to the Y-axis movement Y. When the detection circuit **11** detects that the cycle switch button (Fn) is long-pressed within the duration time, the switching circuit **13** switches the robotic arm **20** to move on a different axis; furthermore, a terminal **23** of the robotic arm **20** is used to prompt the axis to which the robotic arm **20** is switched. As indicated FIG. **8**, if the robotic arm **20** switches from the X-axis movement X to the Y-axis movement Y, the terminal **23** of the robotic arm **20** will reciprocate on the Y-axis for a distance once. Thus, when the operator watches **40** the terminal **23**, the operator can obtain a prompt of the control result of the teaching device **30**. Besides, the initial axial direction of the robotic arm **20** does not affect the cycle switch button (Fn). In the cycle control of switching from the X-axis movement X to the Y-axis movement Y, from the Y-axis movement Y to the Z-axis movement Z, and from the Z-axis movement Z to the X-axis movement X, the operator can set the initial state of the robotic arm **20**.

[0038] Refer to FIGS. **7** and **8** again. The robotic arm **30** may further include a teaching button **22**. When the detection circuit **11** receives a teaching signal and a forward signal of the forward button (+), the switching circuit **13** switches the robotic arm **20** to a translational movement; when the detection circuit **13** receives a teaching signal and an inverse signal of the reverse button (−), the switching circuit **13** switches the robotic arm **20** to a rotational movement. Thus, when the teaching button **22** and the forward button (+) are pressed at the same time, the switching circuit **13** switches the robotic arm **20** to a translational movement according to the output of the teaching device **30**.

When the teaching button **22** and the reverse button (−) are pressed at the same time, the switching circuit **13** switches the robotic arm **20** to a rotational movement according to the output of the teaching device **30**. The translational movement and the rotational movement refer to the X-axis movement X, the Y-axis movement Y or the Z-axis movement Z being translational or rotational. Apart from the embodiments of FIG. **3** and FIGS. **5** and **6** in which the motion mode is switched according to the detection of the operation state of the robotic arm **20**, the control method can further detect the output information of the teaching device **30** external to the robotic arm **20**, then switch the motion mode of the robotic arm **20** by the teaching device **30** to simplify the teaching process of the operator and increase teaching accuracy.

[0039] To summarize, the control method of the robotic arm according to the present invention includes setting a detection circuit, a comparing circuit and a switching circuit. The detection circuit detects the motion of the robotic arm to generate a detection signal. The comparing circuit compares the detection signal with a low threshold region and compares the detection signal with a high threshold region to generate a comparison signal. The switching circuit switches the robotic arm to a first motion mode or a second motion mode according to the comparison signal.

[0040] The control method of a robotic arm according to the present invention includes setting a teaching device, a detection circuit, a comparing circuit and a switching circuit. The teaching device includes a forward button, a reverse button and a cycle switch button. The detection circuit detects an output of the teaching device to generate a detection signal. The comparing circuit compares the detection signal with a low threshold region and compares the detection signal with a high threshold region to generate a comparison signal. The switching circuit switches the robotic arm to the first motion mode or the second motion mode according to the comparison signal.

[0041] The detection circuit is an encoder, the detection signal is a speed signal, the detection circuit detects the motion speed of the robotic arm to generate the detection signal; when the comparing circuit determines that the detection signal is at the low threshold region, the switching circuit switches the robotic arm to the first motion mode; when the comparing circuit determines that the detection signal is at the high threshold region, the switching circuit switches the robotic arm to the second motion mode.

[0042] The first motion mode is a discontinuous movement or a low-speed motion, and the second motion mode is a continuous movement or a high-speed motion.

[0043] While the invention has been described by way of example and in terms of the preferred embodiment(s), it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

Claims

1. A control method of a robotic arm, comprising: setting a teaching device, the teaching device comprising a forward button, a reverse button and a cycle switch button; setting a detection circuit to detect an output of the teaching device to generate a detection signal; setting a comparing circuit to compare the detection signal with a low threshold region and compare the detection signal with a high threshold region to generate a comparison signal; and setting a switching circuit to switch the robotic arm to a first motion mode or a second motion mode according to the comparison signal.

2. The control method of a robotic arm according to claim 1, wherein the detection circuit comprises a timing circuit, and the detection signal is a timing signal; when the teaching device outputs a forward signal, the detection circuit detects a level change of the forward signal within a duration time to generate the detection signal; when the comparing circuit determines that the detection signal is at the low threshold region, the switching circuit switches the robotic arm to the first motion mode; when the comparing circuit determines that the detection signal is at the high

threshold region, the switching circuit switches the robotic arm to the second motion mode.

3. The control method of a robotic arm according to claim 2, wherein the first motion mode is a forward motion with a discontinuous movement, and the second motion mode is the forward motion with a continuous movement.

4. The control method of a robotic arm according to claim 2, wherein when the teaching device outputs a cycle switch signal, and the detection circuit detects a duration time of the cycle switch signal to generate the detection signal; when the comparing circuit determines that the detection signal is at the low threshold region, the switching circuit controls the robotic arm to switch from an X-axis movement to a Y-axis movement; when the comparing circuit determines that the detection signal is at the high threshold region, the switching circuit controls the robotic arm to switch from the X-axis movement to the Y-axis movement and the robotic arm reciprocates on the Y-axis movement for a distance once.

5. The control method of a robotic arm according to claim 1, comprising: setting a teaching button, wherein when the detection circuit receives a teaching signal and a forward signal of the forward button, the switching circuit switches the robotic arm to a translational movement; when the detection circuit receives the teaching signal and an inverse signal of the reverse button, the switching circuit switches the robotic arm to a rotational movement.