

## TITLE OF THE INVENTION

Controller for a Game Machine

## BACKGROUND OF THE INVENTION

## Field of the Invention

5           The present invention relates to a controller for a game machine and, more specifically, to a controller used by a player for operating a video game machine.

## Description of the Background Art

          A controller for a TV game machine for home use  
10       (commmercially available as "Family Computer" and "Nintendo Entertainment System") which is manufactured and sold by the assignee of the present invention has been well known as a controller for a game machine (or a game machine operating apparatus). This controller comprises a cross  
15       shaped key top and provided on an operation surface of a housing, and a rubber contact switch provided therebelow, as disclosed in U.S. Patent No. 4,687,200 or in Japanese Utility Model Registration No. 748986. By this  
20       controller, four different instructions can be given to the game machine only by moving a thumb placed on the key top upward, downward, to the left and to the right, and it can be operated easily.

          However, since recent game programs have become more complicated and difficult, the number of operation  
25       switches have been increased. When the number of

operation switches are increased, different switches must be simultaneously operated by plural fingers, and therefore speed of operation tends to be decreased, and miss operation may occur. Such problems make the game  
5 less interesting.

Therefore, when the number of operation switches is to be increased, design of a controller is of much importance. The following conditions must be satisfied to provide good controllability even if the number of  
10 operation switches are increased, from the view point of human engineering.

(1) It is not necessary to move one's hand as a whole to operate a switch.

(2) A switch can be depressed with minimum movement  
15 of a finger.

(3) Direction of movement of a finger is natural and accordant with movement of the joint of one's finger.

(4) As to the index finger or middle finger which can be moved in narrower range compared with the thumb,  
20 only one switch is allotted to one finger, and the key top for the finger is large.

(5) The controller can be fixed when held by both hands.

(6) The controller is light and compact so that it  
25 is easy to hold the controller by both hands.

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10 (7) The controller has durable structure enough to withstand frequent and rough treatment.

Unfortunately, an ideal controller for a game machine satisfying all conditions described above has not yet been realised.

15 Therefore, an object of the present invention is to provide a controller for a game machine which is quite easy to handle and enables quick and correct operation even if the number of operation switches is increased.

20 Another object of the present invention is to provide a controller for a game machine having durable structure enough to withstand frequent and rough handling.

According to the invention, there is provided a controller for a game machine, said controller being held in use by a user between left and right palms, comprising:

25 a flat-shaped, elongate housing having an upper surface, a lower surface and a side surface spatially separating the upper and lower surfaces;

30 upper surface user operating means for generating electrical signals formed at a position on the upper surface of said housing reachable by a thumb of a hand holding the housing; and

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5 side surface user operating means for generating electrical signals formed at a position on the side surface of said housing reachable by an index finger or middle finger of a hand holding the housing;

10 wherein said side surface user operating means includes:

an elongate key member having one end supported and pivotable in said housing near to the centre of said housing in the longitudinal direction and another movable end extending longitudinally along the side surface of the housing toward an end portion of said housing and positioned to have the movable end of the key member exposed,

15 switch means contained in said housing for outputting an electrical signal when depressed by pivoting of said key member, and

20 holding means for holding said switch means in said housing at a position where said switch means can be depressed by said key member.

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therefore, smooth operation is enabled. Further, in the present invention, the key top of the side surface operating means has an elongate surface and arranged along the side surface of the housing. Therefore, a wide  
5 operating range can be ensured below the index finger or the middle finger holding the side surface of the housing. Therefore, even if this operating means is operated by an index finger or the middle finger which has smaller range of movement and slow speed of operation compared with the  
10 thumb, it can be easily operated. Further, in the present invention, the switching means of the side surface operating means is held by the holding means in the housing. Therefore, it can withstand frequent and rough handling. Since the housing of the controller has a flat  
15 shape, it is light and compact and it can be easily held by both hands. Further, since the present invention has simple structure, assembly is easy and it is suitable for mass production.

As described above, the controller for a game machine  
20 in accordance with the present invention fairly satisfies the above conditions (1) to (7). The controller for a game machine in accordance with the present invention has superior controllability, it is inexpensive and durable.

The foregoing and other objects, features, aspects  
25 and advantages of the present invention will become more

apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5        Fig. 1 is a perspective view of a controller for a game machine in accordance with one embodiment of the present invention, viewed from an upper surface.

10       Fig. 2 is a perspective view of the controller for a game machine in accordance with one embodiment of the present invention, viewed from the lower surface.

      Fig. 3 is a fragmental perspective view of the controller for a game machine in accordance with one embodiment of the present invention, viewed from the lower surface.

15       Fig. 4 is a cross sectional view of the controller for a game machine in accordance with one embodiment of the present invention.

20       Fig. 5 is a vertical sectional view of a main portion of the controller for a game machine in accordance with one embodiment of the present invention.

      Fig. 6 illustrates state of operation of the controller for a game machine in accordance with one embodiment of the present invention.

25       Fig. 7 is a block diagram showing one example of a structure of a game machine system to which the controller

for a game machine of one embodiment of the present invention is connected.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Figs. 1 and 2 are perspective views of the appearance of the controller for a game machine in accordance with one embodiment of the present invention. Fig. 1 shows a state viewed from the upper surface of the controller for a game machine, and Fig. 2 shows a state viewed from the lower surface.

10 Referring to Figs. 1 and 2, a controller 10 for a game machine includes a housing 11. A direction designating operator (also referred to as a direction designating switch) 12 which is an example of a first upper surface operating means, and an operation  
15 designating operator (also referred to as an operation designating switch) 13 which is an example of second upper surface operating means are separately provided at the left and the right of the upper surface of housing 11. The arrangement of direction designating operator 12 and  
20 operation designating operator 13 may be reversed. At least one operation designating operator (also referred to as an operation designating switch) 14 which is an example of the side surface operating means which is the characteristic of the present invention, is provided on  
25 the side surface of housing 11 positioned in front of

direction designating operator 12 or operation designating operator 13.

More preferably, a pair of (a total of two) operation designating operators 14 are provided in the left and right positions of the front side surface of the housing 11. In the figure, two operation designating operators are provided, one of which is designated by 14a and another by 14b. The operation designating operator 14 is used for designating a state of operation (for example, state of operation of a character in a video game machine) different from that of the operation designating operator 13.

Further, a select switch 15a and a start switch 15b are provided in the middle of direction designating operator 12 and operation designating operator 13 on controller 10 for the game machine.

Figs. 3 to 5 show details of the controller in accordance with one embodiment of the present invention. Fig. 3 is a fragmental perspective view of the controller viewed from the lower surface, Fig. 4 is a cross section, and Fig. 5 is a vertical sectional view of the main portion.

More detailed structure of controller 10 will be described in the following with reference to Figs. 1 to 5. Housing 11 is divided into an upper half 111 and a lower

half 112. Housing 11 has a flat longitudinal shape. Left and right side surfaces of housing 11 are rounded, so that a user can hold it easily. The central portion of the rear side surface of housing 11 has a concave in the direction of the front side surface so as to facilitate movement of thumbs operating direction designating operator 12 and operation designating operator 13. More preferably, the upper surface of housing 11 has a smooth carved convex shape, and the lower surface has a smooth carved concave shape as shown in Fig. 5, so as to be stable when it is held by both hands, and to fit players hands to facilitate operation.

A switch disclosed in, for example, U.S. Patent No. 4,687,200 is used as direction designating operator 12. More specifically, direction designating operator 12 includes a cross shaped key top 121. A rubber contact 123 constituting four contacts 122 is arranged below key top 121. Rubber contact 123 is placed on a board 16 on which a contact circuit (not shown) is formed. When any of an upper, lower, left and right projecting portion of key top 121 is depressed, rubber contract 123 therebelow is resiliently deformed in the direction of depression of the key top 121. Consequently, contact 122 positioned below the direction of depression of key top 121 out of four contacts 122 of rubber contact 123 is brought into

electrical contact with the contact circuit formed on board 16. Direction designating operator 12 having such a structure serves as a switch designating one of the upper, lower, left and right directions. A cross shaped hole 113  
5 into which key top 121 is inserted is formed on the upper surface near the left end of the upper half 111.

Operation designating operator 13 includes four key switches 13a to 13d. These key switches 13a to 13d are provided at the upper surface near the right end of  
10 housing 11. Key switches 13a to 13d are positioned to be on two lines crossing with each other. The two lines may orthogonally cross each other. Each of key switches 13a to 13d has a cylindrical key top 131. A projection 132 projecting radially is formed on the outer periphery of a  
15 base portion of each key top 131. Four holes 114 into which key tops 131 are inserted are formed on the upper half 111. At the rear surface of upper half 111, a cylindrical guide projection 115 is formed around each hole 114. A groove 116 for guiding projection 132  
20 provided on each key top 131 is formed on the side surface of each guide projection 115. Instead of such groove 116, stripe notches may be provided on inner wall of the side surface of each guide projection 115. A rubber contact 133 for resiliently holding each key top 131 is provided  
25 below each key top 131. Rubber contact 133 is formed of

an elastic rubber on which four contacts 134 corresponding to the key tops 131 are integrally fixed. At portions of the board 16 positioned below each key top 131, a contact circuit (not shown) corresponding to each contact 134 of the rubber contact 133 is formed. A cord 17 for transmitting states of operations of various switches 12, 13, 14, 15a and 15b (see Fig. 7) to a processing unit (CPU) is connected to the board 16, and a signal processing circuit 18 shown in Fig. 7 is provided on the board 16.

Designations given by key switches 13a to 13d to the body of the game machine (not shown) in response to operations thereof are determined by the game program. Contents of designation of key switches 13a to 13d are not fixed on the side of the controller. Therefore, controller 10 treats key switches 13a to 13d as switches designating operation A to operation D, the function of which is not specified. Reference characters A to D are allotted to surfaces of key tops 131 of key switches 13a to 13d or to positions of the upper surface of upper half 111 corresponding to key switches 13a to 13d.

Operation designating operators 14a and 14b include key tops 141. Each key top 141 has a longitudinal shape extending along the side surface of housing 11, and its width is narrower than that of the side surface of housing

11. One end portion of each key top 141 (near the center of housing 11) is axially supported by an axis 142 to be a fixed end. Each axis 142 is inserted and held in an axis receiving portion 117 formed on the rear surface of upper half 111 of housing 11. The other end of each key top 141 is a free end. Therefore, the free end of each key top 141 can rotate about the axis 142. A portion near the free end of each key top 141 is rounded, so that it matches with the shape of the side surface of housing 11.

Two sets of rubber contacts 143 are positioned opposing inner side surface near the free end of each key top in housing 11. The bottom surface of each rubber contact 143 provides a cavity as shown in Figs. 4 and 5, and a contact 144 is formed on the ceiling surface of the cavity. Each rubber contact 143 is contained and held in a corresponding holding member 145. Each holding member 145 is arranged at a position opposing an inner side surface near the free end of each key top 141, in housing 11.

Each holding member 145 may be prepared as a member separate from housing 11. However, preferably, it is integrally formed on the rear surface of upper half 111 of housing 11, as in the present embodiment. Each holding member 145 holds each rubber contact 143, and serves as a stopper for limiting angle of rotation of each key top 141 in a prescribed range. As shown in Figs. 3 to 5, each

holding member 145 is formed as a frame shaped projection having a groove to which the rubber contact 143 is inserted. A board (auxiliary board) 146 is arranged at a position opposing each rubber contact 143 and holding member 145. Each board 146 is inserted to notches formed near left and right corners of the board 16, for example, and fixed to be vertical to the board 16. Contact circuits (not shown) corresponding to contacts 144 of the rubber contacts 143 are formed on the surface of board 146. When each key top 141 is rotated, rubber contact 143 is resiliently deformed, whereby each contact is brought into contact in parallel to the contact circuit on each board 146. The contact circuit formed on each board 146 is connected to a portion of a circuit pattern formed on board 16 through a lead 147.

Assembling step of the controller 10 for a game machine in accordance with the present invention will be described. First, as shown in Fig. 3, upper half 111 is placed with its rear surface facing upward. Then, from the rear surface side of upper half 111, key top 121 facing downward is inserted to hole 113. Thereafter, rubber contact 123 is placed on the bottom surface of key top 121. Thereafter, four key tops 131 facing downward are inserted to four holes 114 of upper half 111. Each key top 131 is positioned such that projection 132

provided on each key top 131 fits a groove formed on each guide projection 115. Thus insertion of each key top 131 to each hole 114 is facilitated. Thereafter, rubber contact 133 facing downward is placed on the bottom surface of each key top 131. Thereafter, each rubber contact 143 is inserted to each holding member 145. Then one end of each axis 12 is inserted to each axis receiving portion 117. Each axis 142 is inserted to a hole formed at a fixed end of each key top 141. Consequently, the fixed end of each key top 141 is axially supported by axis 142. Further, rubber contact 151 including select switch 15a and start switch 15b formed integrally is inserted to hole 118 of upper half 111, which rubber contact facing downward. Thereafter, board 16 is placed on rubber contacts 123 and 133, with each board 146 positioned opposing each holding member 145. Thereafter, lower half 112 is put on upper half 111, and lower half 112 is fixed to upper half 111 by means of screws.

As described above, in the present embodiment, four key switches 13a to 13d included in operation designating operator 13 are arranged in four directions which are crossing or orthogonally crossing. The key switches 13a to 13d can be used as direction designating switches designating upper, lower, left or right direction, based on program processing. In this case, controller 10 for a

game machine can be used for a game which requires two different systems of direction designating operators. For example, in a game of controlling a tank, upper or lower projecting portion of the key top 121 of direction designating operator 12 may be depressed to designate forward or rearward rotation of left caterpillar of the tank. Key switches 13a or 13d of operation designating operator 13 may be depressed to designate forward or rearward rotation of right caterpillar of the tank. In this case, when upper projection of key top 121 and key switch 13a are depressed, tank moves forward (advances). When lower projection of key top 121 and key switch 13d are depressed, the tank moves rearward. When upper projecting portion of key top 121 and key switch 13d are depressed, the tank turns to the left, and when lower projection of key top 121 and key switch 13a are depressed, the tank turns to the right. In such a tank game, operation designating operator 14 may be used to designate emission of missile or gun. In a game requiring only one system of direction designating operator, when operation designating operator 13 is used as the direction designating operator and direction designating operator 12 is used as operation designating operator by preparing an appropriate program, a controller for a game machine which is convenient for a left handed player can be provided.

Controller 10 for a game machine in the above described embodiment includes two key switches 14a and 14b provided on left and right sides of front side surface of housing 11, as operation designating operators 14.

5 Alternatively, only one key switch may be provided on the right side or left side of front side surface of housing 11. Further, by making thick housing 11, two key switches may be arranged juxtaposed on the right side or left side of the front side surface of housing 11. Two key switches  
10 may be provided on each of the right and left sides of the front side surface of housing 11 (four switches in total). In that case, the key switches are operated by the index finger and middle finger of a player holding housing 11. Key top 141 of key switch 14a and key top 141 of key  
15 switch 14b may be formed as a coupled integral one key top, and the central portion of the key top may be axially supported by axis 142.

Methods of using controller 10 for a game machine of the above described embodiment, and effect thereof will be  
20 described in detail.

Fig. 6 shows the state of use of controller 10 for a game machine. Fig. 7 is a block diagram showing an example of a game machine system structure to which controller 10 for a game machine of the present embodiment  
25 is connected.

Controller 10 for a game machine of the present embodiment is used as shown in Fig. 6. More specifically, a player holds left and right ends of housing 11 with his left and right palms. In order to hold housing 11 stably, the player places his index fingers or middle fingers along the front side surface of housing 11. In this state, the player moves or changes inclination of his left thumb to depress any of upper, lower, left and right four projecting portions of the cross shaped key top 121. Thus direction of movement of a character or cursor displayed on a game screen (not shown) is designated. The player depresses key top of any of four key tops 13a to 13d while moving his right thumb. Thus a prescribed state of operation in the game is designated. Further, the player depresses key tops 141 of key switches 14a and 14b by his left and right index fingers or middle fingers. When a key top 141 is depressed by the inner portion of the index finger or middle finger, free end of key top 141 is depressed and rotated about the axially supported fixed end. Thus rubber contact 143 in housing 11 is resiliently deformed, and contact circuit formed on board 146 is short-circuited. Accordingly, an electric signal is provided from the contact circuit.

Referring to Fig. 7, a signal processing circuit 18 includes a shift register capable of parallel input and

serial output. When a parallel write signal is applied from a microprocessor (CPU) 21 of game machine body 20, signal processing circuit 18 reads depression signals from direction designating operator 12, key switches 13a to 13d and 14a to 14b as parallel inputs, and stores and holds the same in the shift register. Then, when a serial read signal is applied from microprocessor 21 of game machine body 20, the signal processing circuit 18 serially outputs data stored in shift register in synchronization with a clock signal CL. Outputs from the shift register are applied to an I/O port 22 and loaded in I/O port 22. CPU 21 determines data indicating states of operation of controller 10 for a game machine loaded in I/O port 22 in accordance with a program set in a memory (ROM) 31 included in a game cartridge 30, and executes game processes in accordance with the result of determination. The game processing includes image processing for moving or changing a character displayed on a game screen, for example. Such image processing is executed by an image processing processor (PPU) 23 under control of CPU 21 in accordance with a program set in memory 31. At this time, a sound source circuit 24 generates analog signals for generating background music or sound effect under control of CPU 21 in accordance with the program set in memory 31.

A program may be adapted to allow a player to

selectively set what function of designation should be allotted to key switches 13a to 13d included in operation designating operator 13 and to key switches 14a and 14b included in operation designating operator 14, at the  
5 start of the game.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of  
10 the present invention being limited only by the terms of the appended claims.



## CLAIMS

1. A controller for a game machine, said controller being held in use by a user between left and right palms, comprising:

5 a flat-shaped, elongate housing having an upper surface, a lower surface and a side surface spatially separating the upper and lower surfaces;

10 upper surface user operating means for generating electrical signals formed at a position on the upper surface of said housing reachable by a thumb of a hand holding the housing; and

15 side surface user operating means for generating electrical signals formed at a position on the side surface of said housing reachable by an index finger or a middle finger of a hand holding the housing;

wherein said side surface user operating means includes:

20 an elongate key member having one end supported and pivotable in said housing near to the centre of said housing in the longitudinal direction and another movable end extending longitudinally along the side surface of the housing toward an end portion of said housing and positioned to have the movable end of the key member  
25 exposed,

switch means contained in said housing for outputting an electrical signal when depressed by pivoting of said key member, and

30 holding means for holding said switch means in said housing at a position where said switch means can be depressed by said key member.

2. A controller as claimed in claim 1, wherein  
35 said switch means includes:



a rubber contact which is resiliently deformed in a depressed direction when depressed by pivoting of said key member and held by said holding means, and

5 a first member provided at a position facing said rubber contact, having a contact circuit which provides an electric signal upon contact with said rubber contact.

3. A controller as claimed in claim 2, further comprising:  
a second member contained in said housing for providing  
10 an electric signal by an operation of said upper surface user operating means, wherein

said member is fixedly engaged with said second member.

4. A controller as claimed in claim 2 or 3, wherein  
said holding means is formed on a rear side surface of  
15 said housing for positioning and holding said rubber contract inserted therethrough and for limiting movement of said key member.

5. A controller as claimed in any preceding claim, wherein  
20 said holding means is formed integrally with said housing.

6. A controller as claimed in any preceding claim, wherein  
25 said surface user operating means includes a left-hand elongate key member and a right-hand elongate key member arranged symmetrically on left and right portions of the side surface of said housing.

7. A controller as claimed in claim 6, wherein  
30 said left-hand elongate key member extends to a position where it can be depressed by the index finger or middle finger of the left hand holding said housing, and  
said right-hand elongate key member extends to a  
position where it can be depressed by the index finger or  
35 the middle finger of the right hand holding said housing.



8. A controller as claimed in any preceding claim, wherein

5 said upper surface user operating means includes first upper surface operating means provided at a position where in use a thumb of one of the hands holding said housing can reach.

9. A controller as claimed in claim 8, wherein said controller is used to control a game having characters and wherein

10 said first upper surface operating means designates direction of movement of a character of the game, when it is operated.

10. A controller as claimed in claim 8 or 9, wherein

15 said upper surface user operating means further includes second upper surface operating means provided at a position where, in use, a thumb of the other one of the hands holding said housing can reach.

20 11. A controller as claimed in claim 10, wherein said controller is used to control a game having characters and wherein

25 said first upper surface operating means gives a first operation designation of a character for the game, when it is operated, and

30 said second upper surface operating means gives a second operation designation of a character for the game, when it is operated.

12. A controller as claimed in claim 11, wherein said controller is used to control a game having characters and wherein



said first upper surface operating means gives designation of direction of movement of a character for the game when it is operated, and said second upper surface operating means gives designation of a change of state of operation other than direction of movement of character for the game, when it is operated.

13. A controller as claimed in claim 12, wherein said second upper surface means includes four operating switches.

14. A controller as claimed in claim 13, wherein said four operation switches include four key tops arranged in four directions orthogonally crossing with each other on the upper surface of said housing, four rubber contacts provided below the key tops, which are depressed by corresponding key tops to be resiliently deformed in the direction of depression, and four contact circuits provided at positions facing the rubber contacts and each of which provides, when a corresponding rubber contact is depressed, an electric signal by contact with said rubber contact.

15. A controller as claimed in claim 14, wherein said four contact circuits are formed on the same board.

16. A controller as claimed in claim 15, wherein a contact circuit for providing an electric signal in response to an operation of said first upper surface operating means is formed on said board.

17. A controller as claimed in any one of claims 11 to 16, wherein

said first upper surface operating means, when operated, directs a first direction of movement of a character for a game, and



said second upper surface operating means, when operated, directs a second direction of movement of a character for the game.

5 18. A controller as claimed in any preceding claims, wherein a rear side surface of said housing is concave in shape.

10 19. A controller as claimed in any preceding claim, wherein said upper surface of said housing is convex in shape.

20. A controller as claimed in any preceding claim, wherein said lower surface of said housing is concave in shape.

15 21. A controller as claimed in any preceding claim, wherein said side surface of said housing is rounded.

22. A controller as claimed in claim 2, wherein the first member is a first board.

20 23. A controller as claimed in claim 3, wherein the second member is a second board.

25 24. A controller for a game machine, substantially as hereinbefore described with reference to the accompanying drawings.

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