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(54) **DISPLAY DEVICE, DISPLAY METHOD, AND DISPLAY PROGRAM**

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(57) **ABSTRACT**

Display devices, methods, and programs detect a position of a user's finger contacting a touch panel. When the user's finger lifts from the touch panel, the devices, methods, and programs detect a distance and a direction from a first position of the user's finger to a second position of the user's finger, in which the user's finger was last detected, calculate a reference moving amount and a moving direction, and update the display position of the image by moving the display position of the image in the moving direction by the reference moving amount, and then update the display position using an updated moving amount, the updated moving amount being the reference moving amount multiplied by a predetermined coefficient of less than one The devices, methods, and programs continue to newly update the display position by repeating the updating of the moving amount.

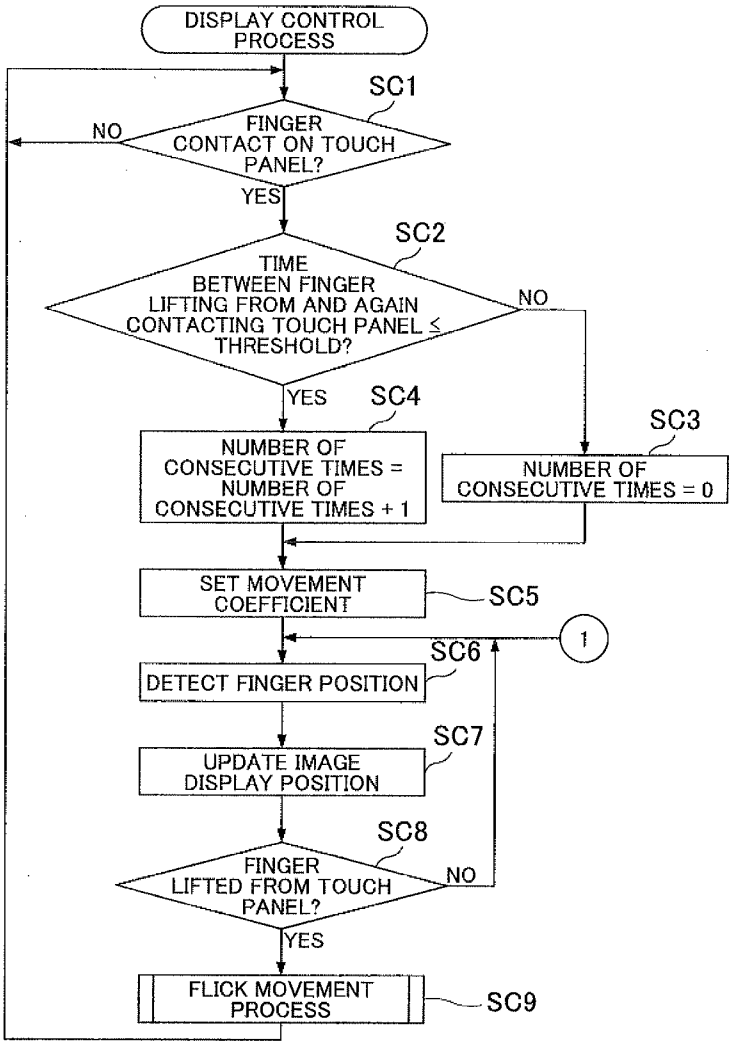


FIG. 1

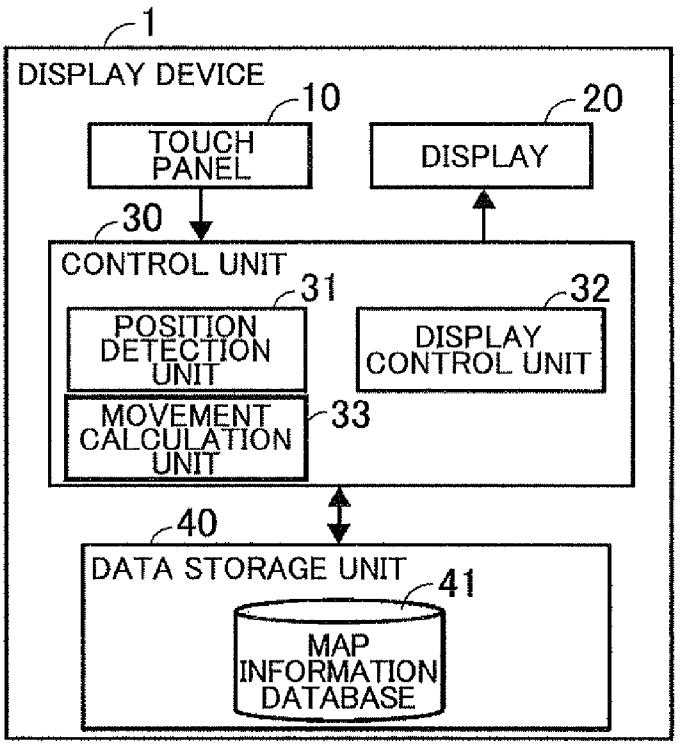

1
DISPLAY DEVICE
10
TOUCH PANEL
20
DISPLAY
30
CONTROL UNIT
31
POSITION DETECTION UNIT
32
DISPLAY CONTROL UNIT
MOVEMENT CALCULATION UNIT
33
40
DATA STORAGE UNIT
41
MAP INFORMATION DATABASE

FIG. 2

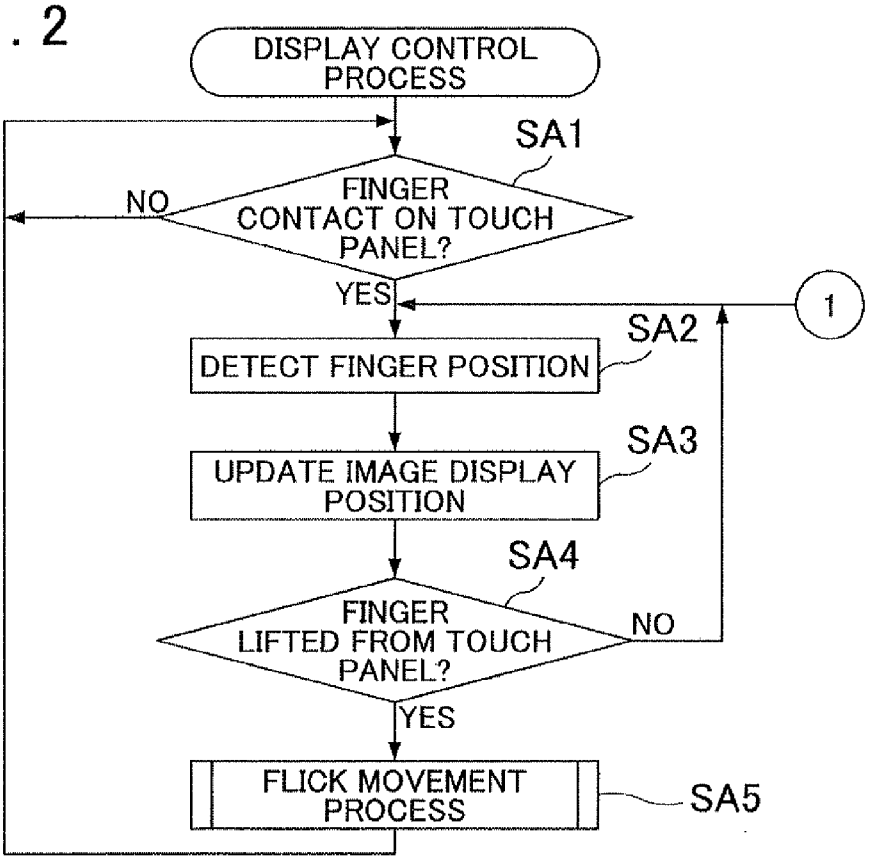

DISPLAY CONTROL PROCESS
SA1
FINGER CONTACT ON TOUCH PANEL?
NO
YES
1
SA2
DETECT FINGER POSITION
SA3
UPDATE IMAGE DISPLAY POSITION
SA4
FINGER LIFTED FROM TOUCH PANEL?
NO
YES
FLICK MOVEMENT PROCESS
SA5

FIG. 3

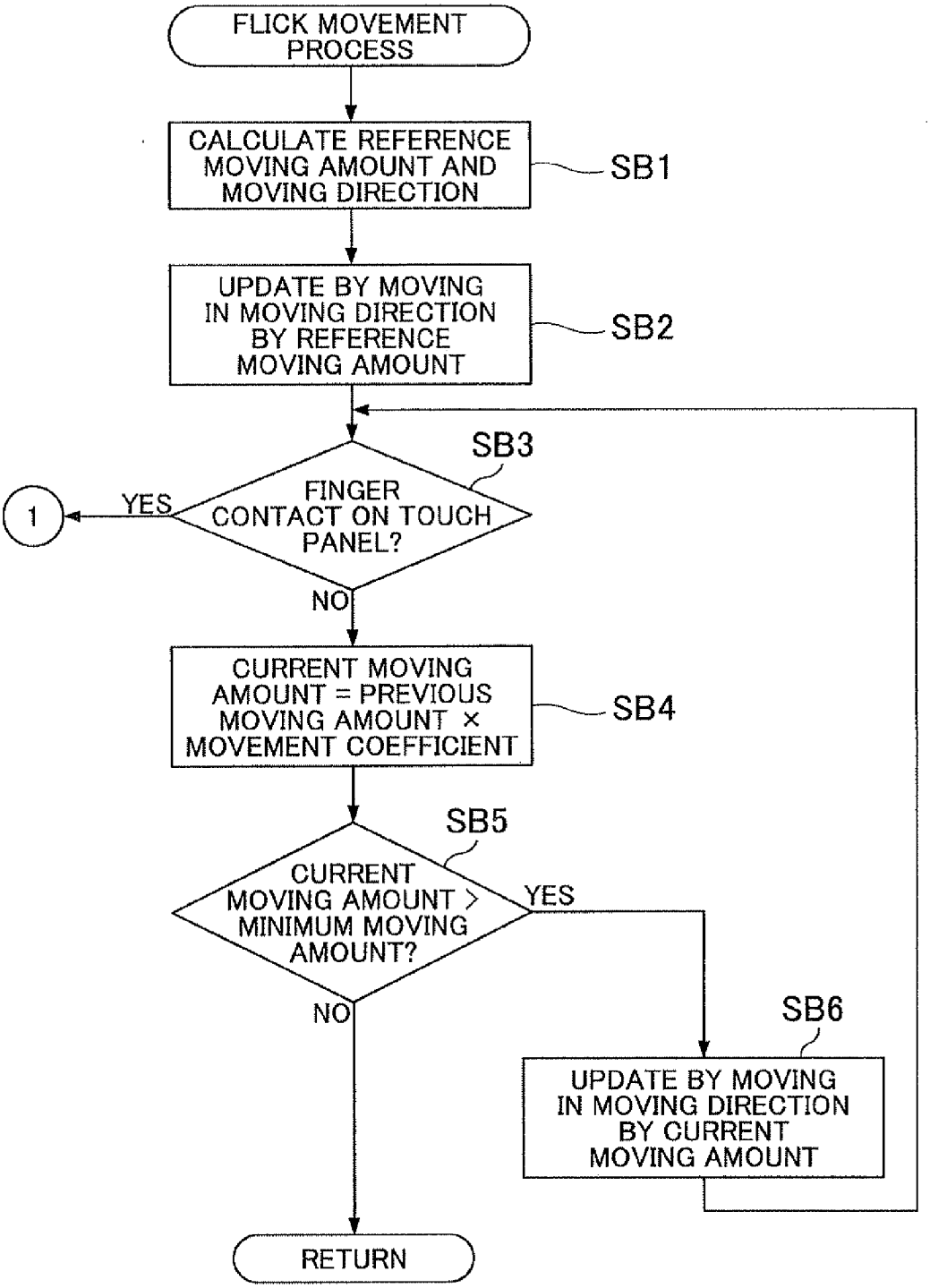

FLICK MOVEMENT PROCESS
CALCULATE REFERENCE MOVING AMOUNT AND MOVING DIRECTION
SB1
UPDATE BY MOVING IN MOVING DIRECTION BY REFERENCE MOVING AMOUNT
SB2
SB3
FINGER CONTACT ON TOUCH PANEL?
YES
1
NO
CURRENT MOVING AMOUNT = PREVIOUS MOVING AMOUNT × MOVEMENT COEFFICIENT
SB4
SB5
CURRENT MOVING AMOUNT > MINIMUM MOVING AMOUNT?
YES
NO
SB6
UPDATE BY MOVING IN MOVING DIRECTION BY CURRENT MOVING AMOUNT
RETURN

FIG. 4A

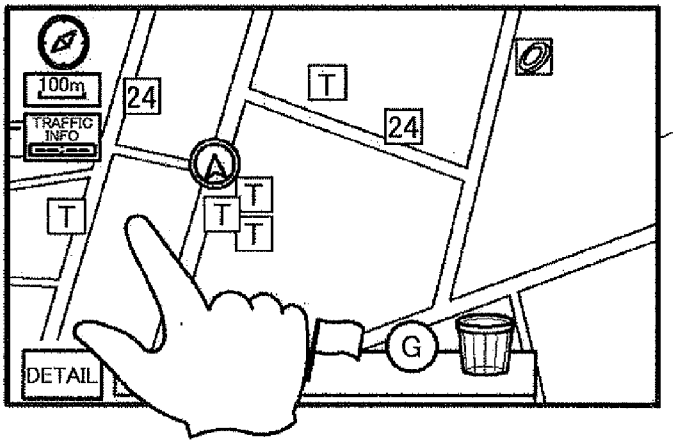


FIG. 4B

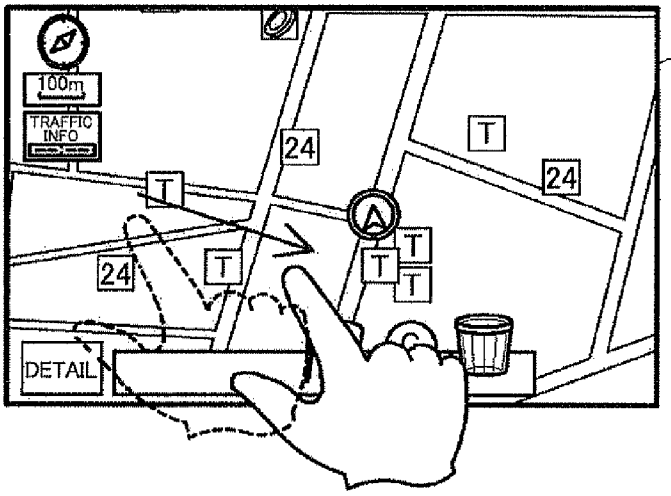


FIG. 4C

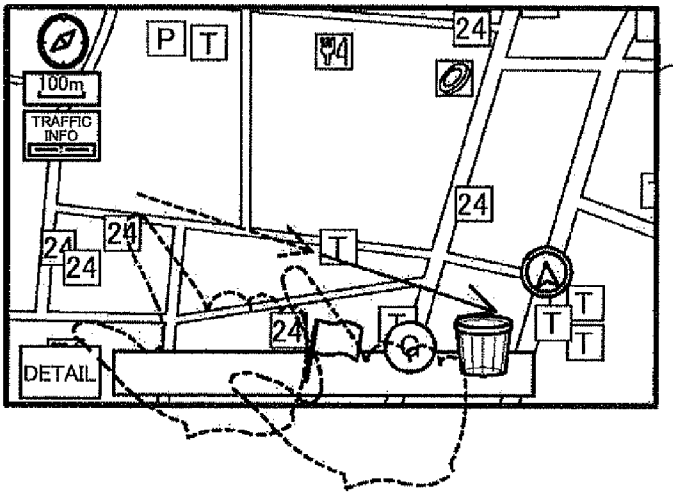


FIG. 5A

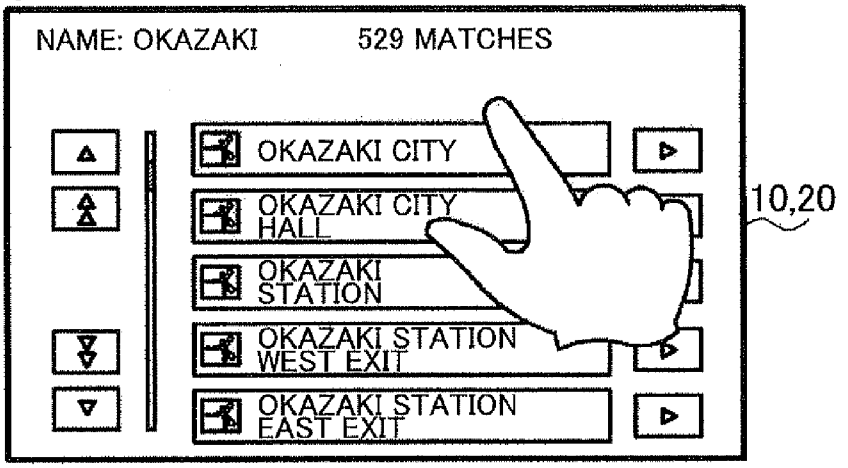


FIG. 5B

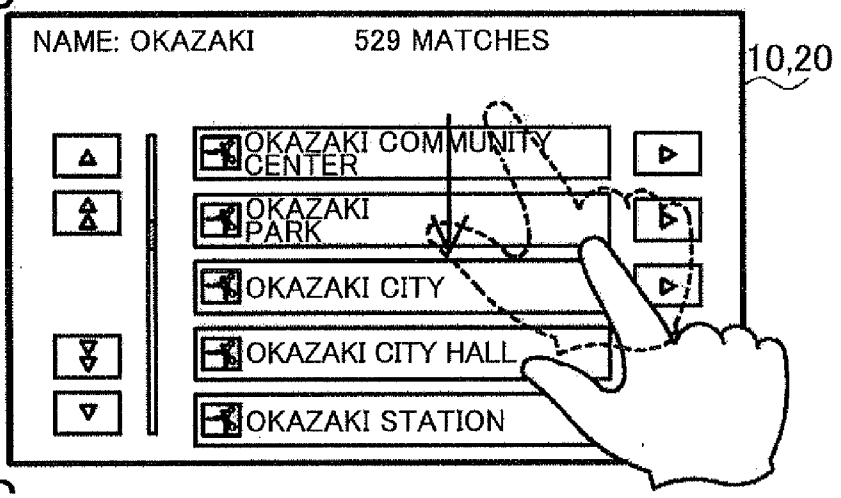


FIG. 5C

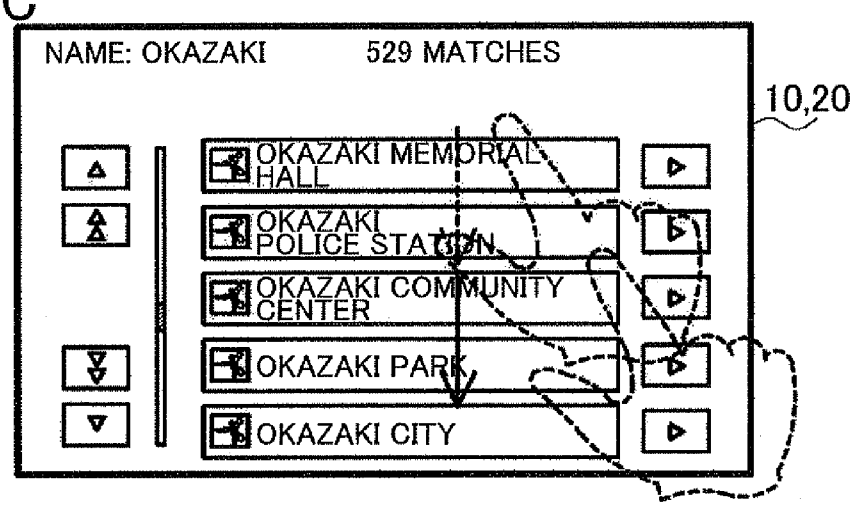
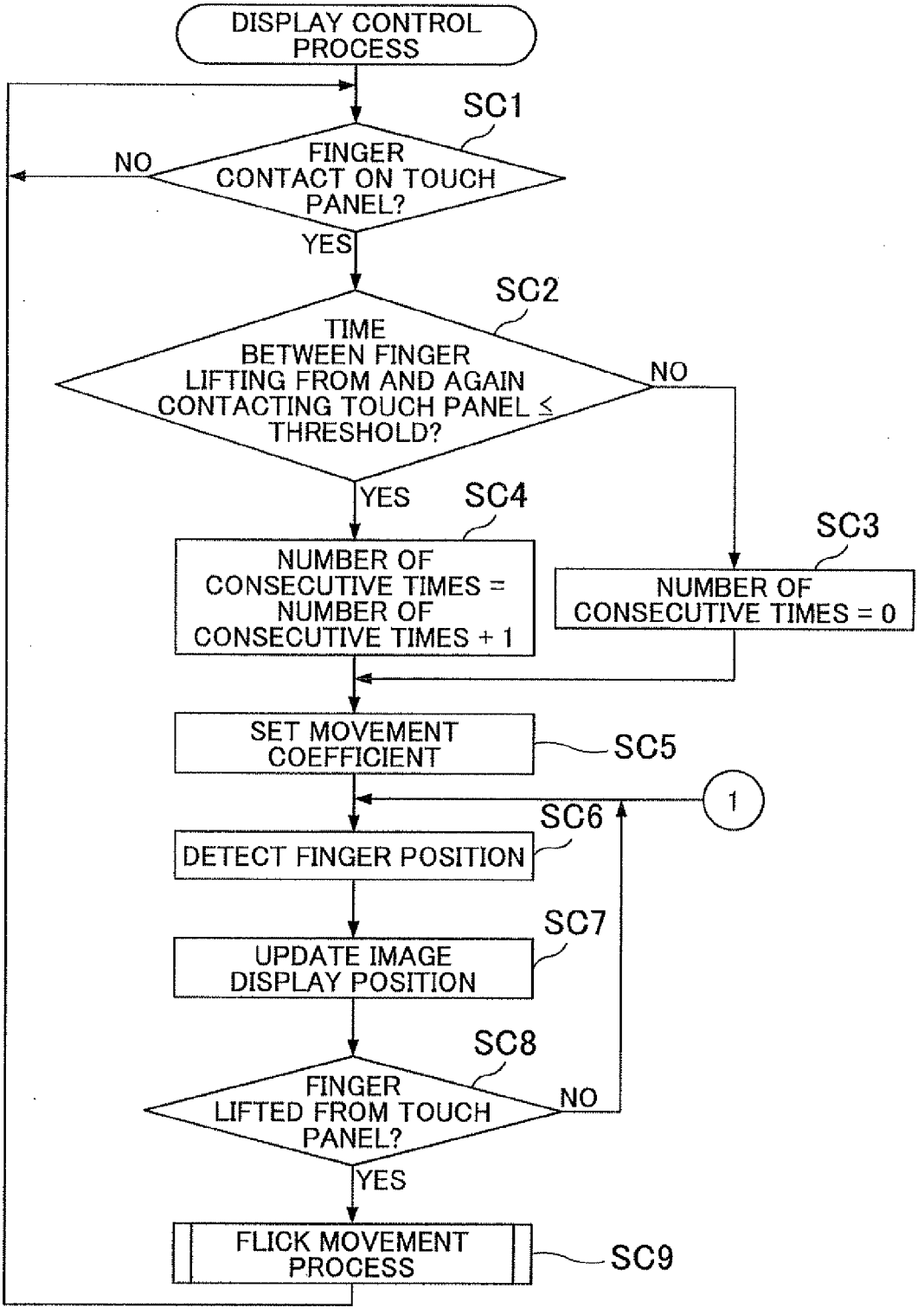


FIG. 6

LAST DETECTED DISTANCE (dots)	TOTAL MOVING TIME (ms)	TOTAL MOVING AMOUNT (dots)
64	5104	2369
32	4736	1163
16	3600	528
8	2368	211

FIG. 7


DISPLAY CONTROL PROCESS
SC1
FINGER CONTACT ON TOUCH PANEL?
NO
YES
SC2
TIME BETWEEN FINGER LIFTING FROM AND AGAIN CONTACTING TOUCH PANEL ≤ THRESHOLD?
NO
YES
SC4
NUMBER OF CONSECUTIVE TIMES = NUMBER OF CONSECUTIVE TIMES + 1
SC3
NUMBER OF CONSECUTIVE TIMES = 0
SET MOVEMENT COEFFICIENT
SC5
1
SC6
DETECT FINGER POSITION
SC7
UPDATE IMAGE DISPLAY POSITION
SC8
FINGER LIFTED FROM TOUCH PANEL?
NO
YES
FLICK MOVEMENT PROCESS
SC9

DISPLAY DEVICE, DISPLAY METHOD, AND DISPLAY PROGRAM

INCORPORATION BY REFERENCE

[0001] The disclosure of Japanese Patent Application No. 2010-239576, filed on Oct. 26, 2010, including the specification, drawings, and abstract is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Related Technical Fields

[0003] Related technical fields include display devices, display methods, and display programs.

[0004] 2. Related Art

[0005] In past car navigation devices and the like, a map shown on a display is scrolled up, down, left, or right, and a list shown on the display is scrolled in a specific direction. Operational input for thus scrolling an image shown on the display includes operational input using a touch panel or a joystick, for example.

[0006] A proposed scroll control device of a screen (see Japanese Patent Application Publication No. JP-A-H10-161628, for example) performs a control that scrolls an image by a vector based on a change vector of an input coordinate while coordinate input is performed by a coordinate input part using a touch panel, and scrolls the image when the coordinate input is stopped by a vector based on a change vector of an input coordinate just before coordinate input is stopped.

SUMMARY

[0007] In the device of the related art described above, the initial scrolling speed after the user's finger lifts from the touch panel is determined by the change vector at the moment the user's finger lifts from the touch panel. Attenuation of the scrolling speed is subsequently set in a manner similar to the action of a friction force. Therefore, the time that the scrolling continues varies greatly in proportion to the magnitude of the change vector at the moment the user's finger lifts from the touch panel. For example, if the user moves his or her finger quickly to scroll an image, the time that the scrolling continues is twice as long if the speed at which the user's finger moves is twice as fast. Thus, the time that the scrolling continues may not always match the user's intention.

[0008] Exemplary implementations of the broad inventive principles described herein provide a display device, a display method, and a display program, which can scroll an image at a speed that reflects a user's intention.

[0009] Exemplary implementations provide a display device, a display, method and a display program, wherein, fore example, if a user's finger lifts from a touch panel, a moving amount calculation unit calculates a reference moving amount and a moving direction of a display position of an image, based on a distance and a direction from a position of the user's finger detected by a position detection unit a predetermined time before the user's finger position is last detected by the position detection unit to the position of the user's finger last detected by the position detection unit. A display control unit first updates the display position of the image by moving the display position of the image in the moving direction by the reference moving amount. Using a value that multiplies the moving amount in a previous update of the image display position by a predetermined coefficient of less than one as the moving amount in a current update, next, the display control unit updates in a predetermined display cycle the display position of the image in the moving direction until the moving amount becomes equal to or less than a minimum moving amount. Therefore, fluctuations in a total moving time of the image can be suppressed with respect to fluctuations in a moving speed of the user's finger when the user lifts his or her finger from the touch panel. Thus, the image can be scrolled at a speed that corresponds to the user's intention.

[0010] According to exemplary implementations, if the moving direction of the display position of the image is limited to a specific direction by the display control unit, the moving amount calculation unit may calculate the reference moving amount based on a distance of the specific direction component between the position of the user's finger last detected by the position detection unit and the position of the user's finger detected a predetermined time beforehand by the position detection unit. Therefore, the image can be scrolled in the specific direction at a speed that corresponds to the user's intention.

[0011] According to exemplary implementations, the image may be a list formed of a plurality of items. In such case, the minimum moving amount is a display width or a display height per list item. It is thus possible to prevent the movement of the list stopping with list items cut off at end portions of a display unit.

[0012] According to exemplary implementations, the image may be a map. In such case, the display control unit may use different values for the predetermined coefficient depending on a scale of the map. Therefore, the map can be scrolled at a speed that reflects the user's intention of wanting to slowly scroll through a wide area map displayed and wanting to quickly scroll through a detail map displayed.

[0013] According to exemplary implementations, the display control unit may determine whether there is an association between the user's finger contacting the touch panel before and after the user's finger lifts from the touch panel, based on a time between the user's finger lifting from the touch panel and again contacting the touch panel. The display control unit may also set the predetermined coefficient to a value that varies depending on a number of consecutive times of associative contact. Therefore, for example, the image can be scrolled at a speed that corresponds to the user's intention of wanting to quickly scroll an image by repeating a scrolling operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a block diagram that illustrates a display device according to a first example;

[0015] FIG. **2** is a flowchart of a display control process algorithm;

[0016] FIG. **3** is a flowchart of a flick movement process algorithm;

[0017] FIGS. **4**A to **4**C are diagrams that illustrate an example of a map displayed on a display, wherein FIG. **4**A is a diagram that shows a user's finger starting to contact a touch panel, FIG. **4**B is a diagram that shows the user's finger moving while in contact with the touch panel, and FIG. **4**C is a diagram that shows an image moved after the user's finger lifts from the touch panel;

[0018] FIGS. **5**A to **5**C are diagrams that illustrate an example of a list formed of a plurality of items displayed on a display, wherein FIG. **5**A is a diagram that shows the user's finger starting to contact the touch panel, FIG. **5**B is a diagram

that shows the user's finger moving while in contact with the touch panel, and FIG. **5**C is a diagram that shows an image moved after the user's finger lifts from the touch panel;

[0019] FIG. **6** is a table that illustrates a relationship in the display control process between a distance from a finger position detected by a position detection unit a predetermined time before a finger position is last detected by the position detection unit to the finger position last detected by the position detection unit, and a total moving time and a total moving amount when a display control unit moves an image in a subsequent flick movement process; and

[0020] FIG. **7** is a flowchart of a display control process algorithm according to a second example.

DETAILED DESCRIPTION OF EXEMPLARY IMPLEMENTATIONS

[0021] Hereinafter, examples of a display device, a display method, and a display program will be described in detail with reference to the drawings. In the following description, the display device is installed in a vehicle as part of a car navigation system.

I. FIRST EXAMPLE

[0022] First, a display device, a display method, and a display program according to a first example will be described. The first example first updates a display position of an image by moving the image display position in a moving direction by a reference moving amount if a user's finger lifts from a touch panel. Next, using a value that multiplies the moving amount in a previous update of the image display position by a predetermined coefficient of less than one as the moving amount in a current update, the example updates in a predetermined cycle the image display position in the moving direction until the moving amount is equal to or less than a minimum moving amount.

[0023] A. Constitution

[0024] First, the constitution of the display device according to the first example will be described. FIG. **1** is a block diagram that illustrates the display device according to the first example. As shown in FIG. **1**, a display device **1** includes a touch panel **10**, a display **20**, a control unit **30**, and a data storage unit **40**.

[0025] 1. Touch Panel

[0026] The touch panel **10** is an input unit that, through pressure from a user's finger or the like, accepts various types of operations that include operational input for moving an image displayed on the display **20**. The touch panel **10** is formed transparent or semi-transparent and provided overlapping with a display screen of the display **20** on the front of the display **20**. A commonly known touch panel that includes an operation position detection unit based on a resistive film, capacitance, or other system may be used as the touch panel **10**.

[0027] 2. Display

[0028] The display **20** is a display unit that displays images based on a control of the control unit **30**. Note that the specific constitution of the display **20** may take on any form, and a flat panel display such as a commonly known liquid crystal display or organic EL display may be used.

[0029] 3. Control Unit

[0030] A controller (e.g., control unit **30**) controls the display device **1**. Specifically, the control unit **30** is a computer configured to include a CPU, various programs that are interpreted and executed in the CPU (including an OS and other basic control programs, and application programs that are activated in the OS to carry out specific functions), and an internal memory such as a RAM for storing the programs and various data. In particular, the display program according to the first example is installed in the display device **1** through any storage medium or network, and configures various portions of the control unit **30** in substance.

[0031] The control unit **30** includes a position detection unit **31**, a display control unit **32**, and a moving amount calculation unit **33** in terms of functional concept. The position detection unit **31** detects the position of the user's finger contacting the touch panel **10** in a predetermined detection cycle. The display control unit **32** updates the display position of information on the display **20** in a predetermined display cycle. The moving amount calculation unit **33** calculates a reference moving amount of the display position of information when the user's finger lifts from the touch panel **10**. The processes executed by the various portions of the control unit **30** will be described in detail later.

[0032] 4. Data Storage Unit

[0033] The data storage unit **40** is a storage unit that stores programs and various data required for operation of the display device **1**, and has a configuration that uses a magnetic storage medium such as a hard disk (not shown) as an external memory device, for example. However, any other storage mediums, including a semiconductor storage medium such as a flash memory or an optical storage medium such as a DVD or Blu-ray disc, can be used in place of or in combination with the hard disk.

[0034] The data storage unit **40** includes a map information database **41**. (Note that database will be abbreviated to "DB" below.)

[0035] The map information DB **41** is a map information storage unit that stores map information. The "map information" is configured to include link data (e.g., link numbers, connection node numbers, road coordinates, road types, number of lanes, travel restrictions), node data (node numbers and coordinates), feature data (e.g., traffic signals, road signs, guard rails, buildings), target feature data (e.g., intersections, stop lines, railroad crossings, curves, ETC toll booths, expressway exits), facility data (e.g., facility locations and facility types), topography data, and map display data for displaying a map on the display **20**.

[0036] B. Processing

[0037] Next, a display control process will be described with reference to the algorithms shown in FIGS. **2** and **3**. FIG. **2** is a flowchart of the display control process algorithm (steps in the descriptions of each process below are abbreviated to "S"). FIG. **3** is a flowchart of a flick movement process algorithm. The exemplary processes may be implemented, for example, by one or more components of the above-described display device **1**. For example, the exemplary processes may be implemented by the control unit **30** executing a computer program based on the algorithms stored in the RAM. However, even though the exemplary structure of the above-described display device **1** may be referenced in the description, it should be appreciated that the structure is exemplary and the exemplary processes need not be limited by any of the above-described exemplary structure.

[0038] 1. Display Control Process

[0039] The display control process is activated, for example, after the display device **1** is powered on and an image such as a map or a list is displayed on the display **20**.

[0040] As shown in FIG. **2**, once the display control process is started, the position detection unit **31** stands by until it is determined on the basis of an output from the touch panel **10** that the user's finger contacted the touch panel **10** (SA**1**: No). If the user's finger contacted the touch panel **10** (SA**1**: Yes), the position detection unit **31** detects a position at which the user's finger (referred to as a "finger position" below as appropriate) contacted the touch panel **10** (SA**2**). The finger position is detected as a coordinate on the touch panel **10**, for example.

[0041] Next, the display control unit **32** updates the display position of the image displayed on the display **20** in response to the finger position detected by the position detection unit **31** at SA**2** (SA**3**). However, the display control unit **32** does not update the image display position if the finger position detected by the position detection unit **31** at SA**2** is the first finger position detected after the user's finger contacted the touch panel **10**. However, if at least one finger position has already been detected by the position detection unit **31** at SA**2** after the user's finger contacted the touch panel **10**, the display control unit **32** specifies a displacement vector of the finger position based on a difference between the finger position detected by the position detection unit **31** in the previous processing at SA**2**, and the finger position detected by the position detection unit **31** in the current processing at SA**2**. The display control unit **32** then moves the image display position by a moving amount that corresponds to the specified displacement vector. Thus, the image displayed on the display **20** is scrolled in response to the movement of the user's finger contacting the touch panel **10**.

[0042] Next, the position detection unit **31** determines whether the user's finger has lifted from the touch panel **10** based on the output from the touch panel **10** (SA**4**). For example, if no contact with the touch panel **10** is detected, the position detection unit **31** determines that the user's finger has lifted from the touch panel **10**.

[0043] Consequently, if the user's finger has not lifted from the touch panel **10** (SA**4**: No), the control unit **30** returns to SA**2**, and the processing from SA**2** to SA**4** is repeated in a predetermined cycle (e.g., 20 milliseconds) until the user's finger lifts from the touch panel **10**. Thus, while the user's finger is in contact with the touch panel **10**, the position detection unit **31** detects the position of the user's finger contacting the touch panel **10** in a predetermined detection cycle (e.g., 20 milliseconds), and the display control unit **32** updates the display position of the image displayed on the display **20** in a predetermined display cycle (e.g., 20 milliseconds) in response to the position of the user's finger detected by the position detection unit **31**.

[0044] FIGS. **4**A to **4**C are diagrams that illustrate an example of a map displayed on the display **20**, wherein FIG. **4**A is a diagram that shows the user's finger starting to contact the touch panel **10**, FIG. **4**B is a diagram that shows the user's finger moving while in contact with the touch panel **10** (performing a so-called dragging operation), and FIG. **4**C is a diagram that shows the image moved after the user's finger lifts from the touch panel **10** (after performing a so-called flicking operation). If a map is displayed on the display **20** as shown in FIGS. **4**A to **4**C, in response to the finger position detected by the position detection unit **31** at SA**2** in FIG. **2**, the display control unit **32** updates the display position of the map displayed on the display **20** in the processing at SA**3**. Thus, as shown in FIGS. **4**A and **4**B, the map display position is sequentially updated in response to the movement of the user's finger contacting the touch panel **10** (movement following the arrow in FIG. **4**B).

[0045] Note that, if the moving direction of the image display position is limited to a specific direction (e.g., a list formed of a plurality of items is displayed on the display **20**, and the moving direction of the image display position is limited to a listing direction of the list items), the display control unit **32** specifies a displacement vector of the finger position based on a difference between the finger position detected by the position detection unit **31** in the previous processing at SA**2**, and the finger position detected by the position detection unit **31** in the current processing at SA**2**. The display control unit **32** then moves the image display position in the specific direction by a moving amount that corresponds to the specific direction component of the specified displacement vector.

[0046] FIGS. **5**A to **5**C are diagrams that illustrate an example of a list formed of a plurality of items displayed on the display **20**, wherein FIG. **5**A is a diagram that shows the user's finger starting to contact the touch panel **10**, FIG. **5**B is a diagram that shows the user's finger moving while in contact with the touch panel **10** (performing a so-called dragging operation), and FIG. **5**C is a diagram that shows the image moved after the user's finger lifts from the touch panel **10** (after performing a so-called flicking operation). In response to the finger position detected by the position detection unit **31** at SA**2** in FIG. **2**, the display control unit **32** updates the display position of the list displayed on the display **20** in the processing at SA**3**. Thus, as shown in FIGS. **5**A and **5**B, the list display position is sequentially updated in response to the specific direction component of the movement of the user's finger contacting the touch panel **10** (the arrow in FIG. **5**B).

[0047] Returning to FIG. **2**, if the user's finger has lifted from the touch panel **10** (SA**4**: Yes), the display control unit **32** executes a flick movement process (SA**5**). The control unit **30** then returns to SA**1**.

[0048] 2. Flick Movement Process

[0049] FIG. **3** is a flowchart of the flick movement process algorithm.

[0050] Once the flick movement process is started, the moving amount calculation unit **33** calculates the reference moving amount and moving direction of the image display position (SB**1**). The reference moving amount and moving direction are the moving amount and direction that serve as a reference for scrolling the image after the user's finger lifts from the touch panel **10**.

[0051] Specifically, the moving amount calculation unit **33** calculates the reference moving amount and moving direction of the image display position based on the distance and direction from the position of the user's finger detected by the position detection unit **31** a predetermined time before the position of the user's finger is last detected by the position detection unit **31** at SA**2** in FIG. **2** (e.g., the finger position detected by the position detection unit **31** in the next-to-last processing at SA**2**) to the position of the user's finger last detected by the position detection unit **31** (e.g., the finger position detected by the position detection unit **31** in the last processing at SA**2**).

[0052] For example, the moving amount calculation unit **33** sets the reference moving amount as a value that multiplies a distance, from the finger position detected by the position detection unit **31** in the next-to-last processing at SA**2** to the finger position detected by the position detection unit **31** in

the last processing at SA**2**, by a predetermined initial speed movement parameter Is (e.g., 0.4). In addition, the moving amount calculation unit **33** sets the reference moving direction as a direction from the finger position detected by the position detection unit **31** in the next-to-last processing at SA**2** to the finger position detected by the position detection unit **31** in the last processing at SA**2**.

[0053] Note that, if the moving direction of the image display position is limited to a specific direction by the display control unit **32**, the moving amount calculation unit **33** calculates the reference moving amount based on the distance of the specific direction component (e.g., the distance in the listing direction of list items) between the position of the user's finger last detected by the position detection unit **31** at SA**2** in FIG. **2** and the position of the user's finger detected a predetermined time beforehand by the position detection unit **31**.

[0054] In such case, the moving amount calculation unit **33** sets the reference moving amount as a value that multiplies a distance of the specific direction component, between the finger position detected by the position detection unit **31** in the last processing at SA**2** and the finger position detected by the position detection unit **31** in the next-to-last processing at SA**2**, by the initial speed movement parameter Is. In addition, the moving amount calculation unit **33** sets the moving direction as the direction of the specific direction component among the direction from the finger position detected by the position detection unit **31** in the next-to-last processing at SA**2** to the finger position detected by the position detection unit **31** in the last processing at SA**2**.

[0055] Next, the display control unit **32** updates the image display position by moving the image display position in the moving direction calculated by the moving amount calculation unit **33** at SB**1** by the reference moving amount similarly calculated by the moving amount calculation unit **33** at SB**1** (SB**2**).

[0056] The position detection unit **31** then determines on the basis of an output from the touch panel **10** whether the user's finger contacted the touch panel **10** (SB**3**). If the user's finger contacted the touch panel **10** (SB**3**: Yes), the control unit **30** ends the flick movement process and returns to SA**2** in FIG. **2**.

[0057] However, if the user's finger is not contacting the touch panel **10** (SB**3**: No), the display control unit **32** calculates the moving amount in the current update as a value that multiplies the moving amount in a previous update of the image display position in the flick movement process by a movement coefficient (SB**4**). Here, a predetermined coefficient of less than one (e.g., 0.99) is used as the movement coefficient.

[0058] Note that, if the image displayed on the display **20** is a map, the display control unit **32** may set the movement coefficient to a value that varies depending on a scale of the map. For example, a formula that calculates the movement coefficient from the map scale may be stored in advance in the data storage unit **40**, and the formula used by the display control unit **32** to calculate the movement coefficient from the map scale. In such case, for example, a larger map scale (that is, a wider map area displayed on the display **20**) results in a smaller movement coefficient. Thus, if the map displayed on the display **20** is a wide area map, the moving amount within the map can be decreased. Conversely, if the map displayed on the display **20** is a detail map, the moving amount within the map can be increased. Therefore, the map can be scrolled at a speed that reflects the user's intention of wanting to slowly scroll through a wide area map displayed and wanting to quickly scroll through a detail map displayed.

[0059] Next, the display control unit **32** determines whether the current moving amount calculated at SB**4** is greater than the minimum moving amount (SB**5**). As the minimum moving amount, a minimum unit that an image displayed on the display **20** can be moved (e.g., one dot) may be used, for example.

[0060] If the image displayed on the display **20** is a list formed of a plurality of items, the minimum moving amount may be a display width or a display height per list item. In such case, the minimum moving amount is the display width per list item when the list items are listed in a display width direction, and the minimum moving amount is the display height per list item when the list items are listed in a display height direction.

[0061] If the determination result at SB**5** is that the current moving amount calculated at SB**4** is not greater than the minimum moving amount (is equal to or less than the minimum moving amount) (SB**5**: No), the control unit **30** ends the flick movement process and returns to SA**1** of the display control process in FIG. **2**.

[0062] However, if the determination result at SB**5** is that the current moving amount calculated at SB**4** is greater than the minimum moving amount (SB**5**: Yes), the display control unit **32** updates the image display position by moving the image display position in the moving direction calculated at SB**1** by the current moving amount calculated at SB**4** (SB**6**). The display control unit **32** subsequently repeats the processing from SB**3** to **586** in a predetermined display cycle until it is determined at SB**3** that the user's finger contacts the touch panel **10**, or it is determined at SB**5** that the current moving amount is equal to or less than the minimum moving amount.

[0063] If a map is displayed on the display **20** as shown in FIGS. **4**A to **4**C, the display control unit **32** repeats the processing from SB**3** to SB**6** in a predetermined display cycle to update the display position of the map displayed on the display **20**. Thus, as shown in FIG. **4**C, even after the user's finger lifts from the touch panel **10**, the map display position is sequentially updated in accordance with the moving direction calculated at SB**1** and the moving amount calculated at SB**4**.

[0064] Alternatively, if a list formed of a plurality of items is displayed on the display **20** as shown in FIGS. **5**A to **5**C, the display control unit **32** repeats the processing from SB**3** to SB**6** in a predetermined display cycle to update the display position of the list displayed on the display **20**. Thus, as shown in FIG. **5**C, even after the user's finger lifts from the touch panel **10**, the list display position is sequentially updated in accordance with the moving direction calculated at SB**1** and the moving amount calculated at SB**4**.

[0065] FIG. **6** is a table that illustrates a relationship in the display control process between the distance from the finger position detected by the position detection unit **31** a predetermined time before the finger position is last detected by the position detection unit **31** to the finger position last detected by the position detection unit **31** (referred to as a "last detected distance" below), and a total moving time and a total moving amount when the display control unit **32** moves an image in the subsequent flick movement process. According to FIG. **6**, for example, in a comparison of the total moving time for a last detected distance of 64 dots and that for a last detected distance of 32 dots, although the last detected dis-

tance doubles from 32 dots to 64 dots, the total moving time is kept to an increase of approximately 1.1 times. In other words, if the user lifts his or her finger from the touch panel **10** while quickly moving his or her finger on the touch panel **10** (if the last detection distance increases), the image is moved while suppressing an increase in the total moving time in line with the user's intention of wanting to quickly finish scrolling.

[0066] C. Effects

[0067] According to the first example as described above, if the user's finger lifts from the touch panel **10**, the moving amount calculation unit **33** calculates the reference moving amount and moving direction of the image display position, based on the distance and the direction from the position of the user's finger detected by the position detection unit **31** a predetermined time before the user's finger position is last detected by the position detection unit **31** to the position of the user's finger last detected by the position detection unit **31**. First, the display control unit **32** updates the image display position by moving the image display position in the moving direction by the reference moving amount. Using a value that multiplies the moving amount in a previous update of the image display position by a predetermined coefficient of less than one as the moving amount in a current update, next, the display control unit **32** updates in a predetermined display cycle the image display position in the moving direction until the moving amount becomes equal to or less than the minimum moving amount. Therefore, fluctuations in the total moving time of the image can be suppressed with respect to fluctuations in the moving speed of the user's finger when the user lifts his or her finger from the touch panel **10**. Thus, the image can be scrolled at a speed that corresponds to the user's intention.

[0068] If the moving direction of the image display position is limited to a specific direction by the display control unit **32**, the moving amount calculation unit **33** calculates the reference moving amount based on the distance of the specific direction component between the position of the user's finger last detected by the position detection unit **31** and the position of the user's finger detected a predetermined time beforehand by the position detection unit **31**. Therefore, the image can be scrolled in the specific direction at a speed that corresponds to the user's intention.

[0069] In addition, if the image is a list formed of a plurality of items, the minimum moving amount is the display width or the display height per list item. It is thus possible to prevent the movement of the list stopping with list items cut off at end portions of the display **20**.

[0070] If the image is a map, the display control unit **32** uses different values for the movement coefficient depending on the map scale. Therefore, the map can be scrolled at a speed that reflects the user's intention of wanting to slowly scroll through a wide area map displayed and wanting to quickly scroll through a detail map displayed.

II. SECOND EXAMPLE

[0071] A second example will be explained here. The second example determines whether there is an association between the user's finger contacting the touch panel **10** before and after the user's finger lifts from the touch panel **10**, and sets a predetermined coefficient to a value that varies depending on a number of consecutive times of associated contact. The configuration of the second example is generally identical to the configuration of the first example unless otherwise noted. For configurations generally identical to the configuration of the first example, the same reference symbols and/or names as used in the first example are assigned as necessary and accompanying explanations are omitted.

[0072] A. Display Control Process

[0073] A display control process executed by the display device **1** of the second example will be described. FIG. **7** is a flowchart of a display control process algorithm according to the second example. The exemplary process may be implemented, for example, by one or more components of the above-described display device **1**. For example, the exemplary processes may be implemented by the control unit **30** executing a computer program based on the algorithm stored in the RAM. However, even though the exemplary structure of the above-described display device **1** may be referenced in the description, it should be appreciated that the structure is exemplary and the exemplary process need not be limited by any of the above-described exemplary structure. Note that, among the display control process according to the second example, SC**1** and SC**6** to SC**9** are identical to SA**1** and SA**2** to SA**5** in FIG. **2**, respectively, and will not be further explained here.

[0074] At SC**1** in FIG. **7**, if it is determined that the user's finger contacted the touch panel **10** (SC**1**: Yes), the display control unit **32** determines whether a time between the user's finger last lifting from the touch panel **10** and again contacting the touch panel **10** is equal to or less than a predetermined threshold (SC**2**). Note that, for example, if it is determined that the user's finger lifted from the touch panel **10** at SC**8** (SC**8**: Yes), the position detection unit **31** stores that timing in the data storage unit **40**, the RAM, or the like, and in subsequent processing at SC**1**, the display control unit **32** references that timing to specify a time that "the user's finger last lifted from the touch panel **10**."

[0075] Consequently, if the time between the user's finger last lifting from the touch panel **10** and again contacting the touch panel **10** is not equal to or less than the predetermined threshold (if the time between the user's finger last lifting from the touch panel **10** and again contacting the touch panel **10** is greater than the predetermined threshold) (SC**2**: No), the display control unit **32** determines that there is no association between the user's finger contacting the touch panel **10** before and after the user's finger lifts from the touch panel **10**. The display control unit **32** thus sets a "number of consecutive times" that indicates the number of consecutive times of associated contact to zero (SC**3**). Note that the "number of consecutive times" is stored in the RAM or the like, for example.

[0076] However, if the time between the user's finger last lifting from the touch panel **10** and again contacting the touch panel **10** is equal to or less than the predetermined threshold (SC**2**: Yes), the display control unit **32** determines that there is an association between the user's finger contacting the touch panel **10** before and after the user's finger lifts from the touch panel **10**, and adds one to the "number of consecutive times" stored in the RAM or the like (SC**4**).

[0077] Following the processing at SC**3** or SC**4**, the display control unit **32** determines the movement coefficient used when the display control unit **32** calculates the moving amount at SB**4** in FIG. **3** in accordance with the number of consecutive times of associated contact (SC**5**). For example, a greater number of consecutive times of associated contact (that is, the more the user repeats a scrolling operation) results in the display control unit **32** setting a larger movement coef-

ficient. Thus, the image can be scrolled at a speed that corresponds to the user's intention of wanting to quickly scroll the image by repeating a scrolling operation.

[0078] B. Effects

[0079] According to the second example described above, the display control unit **32** determines whether there is an association between the user's finger contacting the touch panel **10** before and after the user's finger lifts from the touch panel **10**, based on the time between the user's finger lifting from the touch panel **10** and again contacting the touch panel **10**. The display control unit **32** also sets the movement coefficient to a value that varies depending on the number of consecutive times of associated contact. Therefore, for example, the image can be scrolled at a speed that corresponds to the user's intention of wanting to quickly scroll an image by repeating a scrolling operation.

III. MODIFICATIONS

[0080] While various features have been described in conjunction with the examples outlined above, various alternatives, modifications, variations, and/or improvements of those features and/or examples may be possible. Accordingly, the examples, as set forth above, are intended to be illustrative. Various changes may be made without departing from the broad spirit and scope of the underlying inventive principles.

[0081] For example, the problems to be solved and the resulting effects are not limited to the content described above and may vary depending on the environment in which the inventive principles are implemented and the detailed configuration of the implementation. The above problems may be only partially solved, and the above effects only partially achieved.

[0082] According to the examples described above, as an example, in the display control processes in FIGS. **2** and **7**, each time the position detection unit **31** detects the finger position (SA**2** or SC**6**), the display control unit **32** updates the display position of the image displayed on the display **20** (SA**3** or SC**7**). However, the finger position detection cycle and the display cycle for updating the image display position may use different values.

What is claimed is:

1. A display device, comprising:

a display unit that displays an image;

a touch panel that is provided on a front surface of the display unit; and

a controller that:

detects a position of a user's finger contacting the touch panel in each of a plurality of detection cycles;

updates a display position of the image according to the detected position of the user's finger during each detection cycle; and

when the user's finger lifts from the touch panel:

detects a distance and a direction from a first position of the user's finger to a second position of the user's finger, the first position being detected in a first detection cycle and the second position being detected in a subsequent detection cycle, the first detection cycle being a predetermined time before the subsequent detection cycle, and the subsequent detection cycle being a detection cycle in which the user's finger was last detected;

calculates a reference moving amount and a moving direction of the display position of the image based on the detected distance and direction;

updates the display position of the image by moving the display position of the image in the moving direction by the reference moving amount, and then updates the display position using an updated moving amount, the updated moving amount being the reference moving amount multiplied by a predetermined coefficient of less than one;

when the updated moving amount is more than a predetermined minimum moving amount, newly updates the display position with a newly updated moving amount calculated by multiplying the updated moving amount by the predetermined coefficient; and

continues to newly update the display position by repeating the newly updating of the moving amount until the newly updated moving amount is equal to or less than the predetermined minimum moving amount.

2. The display device according to claim **1**, wherein:

the image is a list formed of a plurality of items; and

the minimum moving amount is one of a display width and a display height per list item.

3. The display device according to claim **1**, wherein the controller:

limits the moving direction of the display position of the image to a specific direction; and

calculates the reference moving amount based on a distance of the specific direction component between the second position of the user's finger and a position of the user's finger detected a predetermined time before the second position.

4. The display device according to claim **3**, wherein:

the image is a list formed of a plurality of items; and

the minimum moving amount is one of a display width and a display height per list item.

5. The display device according to claim **1**, wherein:

the image is a map; and

the controller sets the predetermined coefficient to a value that varies depending on a scale of the map.

6. The display device according to claim **1**, wherein the controller:

based on a time between the user's finger lifting from the touch panel and again contacting the touch panel, determines whether there is an association between the user's finger contacting the touch panel before and after the user's finger lifts from the touch panel; and

sets the predetermined coefficient to a value that varies depending on a number of consecutive times of associated contact.

7. A navigation device comprising the display device of claim **1**.

8. A display method, comprising:

displays an image on a display unit;

providing a touch panel on a front surface of the display unit;

detecting a position of a user's finger contacting the touch panel in each of a plurality of detection cycles;

updating a display position of the image according to the detected position of the user's finger during each detection cycle; and

when the user's finger lifts from the touch panel:

detecting a distance and a direction from a first position of the user's finger to a second position of the user's

finger, the first position being detected in a first detection cycle and the second position being detected in a subsequent detection cycle, the first detection cycle being a predetermined time before the subsequent detection cycle, and the subsequent detection cycle being a detection cycle in which the user's finger was last detected;

calculating a reference moving amount and a moving direction of the display position of the image based on the detected distance and direction;

updating the display position of the image by moving the display position of the image in the moving direction by the reference moving amount, and then updates the display position using an updated moving amount, the updated moving amount being the reference moving amount multiplied by a predetermined coefficient of less than one;

when the updated moving amount is more than a predetermined minimum moving amount, newly updating the display position with a newly updated moving amount calculated by multiplying the updated moving amount by the predetermined coefficient; and

continuing to newly update the display position by repeating the newly updating of the moving amount until the newly updated moving amount is equal to or less than the predetermined minimum moving amount.

9. The display method according to claim **8**, wherein:

the image is a list formed of a plurality of items; and

the minimum moving amount is one of a display width and a display height per list item.

10. The display method according to claim **8**, further comprising:

limiting the moving direction of the display position of the image to a specific direction; and

calculating the reference moving amount based on a distance of the specific direction component between the second position of the user's finger and a position of the user's finger detected a predetermined time before the second position.

11. The display method according to claim **10**, wherein:

the image is a list formed of a plurality of items; and

the minimum moving amount is one of a display width and a display height per list item.

12. The display method according to claim **8**, wherein:

the image is a map; and

the method further comprises setting the predetermined coefficient to a value that varies depending on a scale of the map.

13. The display method according to claim **8**, further comprising:

based on a time between the user's finger lifting from the touch panel and again contacting the touch panel, determining whether there is an association between the user's finger contacting the touch panel before and after the user's finger lifts from the touch panel; and

setting the predetermined coefficient to a value that varies depending on a number of consecutive times of associated contact.

14. A non-transitory computer-readable storage medium storing a computer-executable display program, the program comprising:

instructions for displays an image on a display unit;

instructions for providing a touch panel on a front surface of the display unit;

instructions for detecting a position of a user's finger contacting the touch panel in each of a plurality of detection cycles;

instructions for updating a display position of the image according to the detected position of the user's finger during each detection cycle; and

instructions for, when the user's finger lifts from the touch panel:

detecting a distance and a direction from a first position of the user's finger to a second position of the user's finger, the first position being detected in a first detection cycle and the second position being detected in a subsequent detection cycle, the first detection cycle being a predetermined time before the subsequent detection cycle, and the subsequent detection cycle being a detection cycle in which the user's finger was last detected;

calculating a reference moving amount and a moving direction of the display position of the image based on the detected distance and direction;

updating the display position of the image by moving the display position of the image in the moving direction by the reference moving amount, and then updates the display position using an updated moving amount, the updated moving amount being the reference moving amount multiplied by a predetermined coefficient of less than one;

when the updated moving amount is more than a predetermined minimum moving amount, newly updating the display position with a newly updated moving amount calculated by multiplying the updated moving amount by the predetermined coefficient; and

continuing to newly update the display position by repeating the newly updating of the moving amount until the newly updated moving amount is equal to or less than the predetermined minimum moving amount.

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