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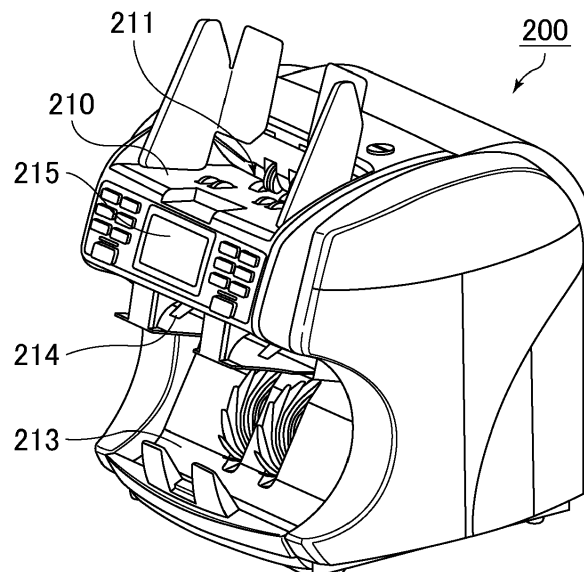
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(54) **MONEY HANDLING DEVICE AND METHOD FOR CONTROLLING MONEY HANDLING DEVICE**

(57) The present invention provides a money handling device having excellent quality and small variation in quality due to machine difference, and a method for controlling a money handling device capable of ensuring excellent quality and reducing a variation in quality due to machine difference. The device includes a sensor, a sensor storage that stores an identification information piece of the sensor, a device storage, the device storage and the sensor being provided at different positions, a

unit that calculates a correction value of the sensor and that stores the identification information piece into the device storage after or during the correction value calculation processing, and another unit that compares the identification information pieces stored in the sensor storage and the device storage to determine whether they match each other. The device does not execute recognition processing when the identification information pieces do not match each other.

FIG. 1
(a)



Description

TECHNICAL FIELD

[0001] The present invention relates to money handling devices and methods for controlling money handling devices. The present invention specifically relates to a money handling device including a sensor unit configured to collect data for recognition from money and a method for controlling the same.

BACKGROUND ART

[0002] Conventional money recognition units mounted in money handling devices undergo initial adjustment and operation confirmation by certified workers before shipment on their sensor units and control boards provided in the money recognition units, so that the quality of the devices is assured and variation due to machine difference is reduced. If malfunctions occur in sensor units or control boards in the market, the malfunctioning parts are replaced and the new sensor units or control boards again undergo adjustment similar to that before shipment in a certified predetermined repair environment.

[0003] For exemplary techniques relating to appropriate use of such replacement parts, JP 2013-232223 A discloses a system for preventing use of imitations by checking whether a part (e.g., a filter) to be mounted on a machine in treatment is a genuine part.

[0004] JP 3266002 B and JP 4690532 B each disclose a recognition unit that is used for a device such as a copier or a printer including a replaceable part (e.g., an ink cartridge) and that recognizes whether a replacement part is genuine.

[0005] JP 4707373 B discloses an electronic device such as a copier or a printer including a replaceable part (e.g., an ink cartridge). This electronic device can prevent a reduction in reliability of the device due to malfunctions of third-party products.

SUMMARY OF INVENTION

[0006] Money handling devices including sensor units require precise adjustment because even a slight machine difference (individual difference) in performance between the sensor units has a significant influence on the recognition results by the money recognition unit. Thus, even if a genuine sensor unit is used, repair, replacement, or conversion of a sensor unit by a route other than the regular route, in other words, by an uncertified worker, with an uncertified tool, and/or through an uncertified step may cause a recognition failure by the money recognition unit, causing processing errors in money handling devices. For example, money handling devices may cause many rejections.

[0007] The techniques disclosed in the above patent documents fundamentally aim to prevent unauthorized use of non-genuine products, and do not aim to assure

the quality of devices even when genuine products may cause machine difference in performance.

[0008] In response to the above current state of the art, an object of the present invention is to provide a money handling device having excellent quality and small variation in quality due to machine difference, and a method for controlling a money handling device capable of ensuring excellent quality and reducing a variation in quality due to machine difference.

[0009] One aspect of the present invention is directed to a money handling device including:

- a sensor unit configured to collect data for recognition from money;
- a sensor storage unit provided in the sensor unit and configured to store an identification information piece of the sensor unit;
- a device storage unit provided at a position different from a position of the sensor unit;
- a correction value calculation/storage processing unit configured to execute:

correction value calculation processing for calculating a correction value of the sensor unit with the sensor unit mounted; and
storage processing for storing the identification information piece of the sensor unit stored in the sensor storage unit into the device storage unit after or during the correction value calculation processing; and

an identification information piece determination unit configured to execute, at least in turning on the power, a first determination processing for comparing the identification information piece of the sensor unit stored in the sensor storage unit with the identification information piece of the sensor unit stored in the device storage unit to determine whether the identification information pieces match each other, wherein the money handling device is configured not to execute recognition processing when the identification information piece determination unit gives a determination result that indicates the identification information pieces do not match each other.

[0010] In another aspect of the present invention, the money handling device further includes a money recognition unit that includes the sensor unit, wherein the device storage unit stores an identification information piece of the money recognition unit, wherein the correction value calculation/storage processing unit, in the storage processing, further stores the identification information piece of the money recognition unit stored in the device storage unit into the sensor storage unit, wherein the identification information piece determination unit executes not only the first determination processing but also a second determination processing

for comparing the identification information piece of the money recognition unit stored in the device storage unit with the identification information piece of the money recognition unit stored in the sensor storage unit to determine whether the identification information pieces match each other, and

wherein the money handling device does not execute recognition processing when the identification information pieces do not match each other in at least one of the first and second determination processings by the identification information piece determination unit.

[0011] In another aspect of the present invention, the correction value calculation/storage processing unit executes the storage processing after the correction value calculation processing.

[0012] In another aspect of the present invention, the correction value calculation/storage processing unit is configured to execute the storage processing when the correction value is calculated in the correction value calculation processing.

[0013] In another aspect of the present invention, the correction value calculation/storage processing unit executes the storage processing during the correction value calculation processing.

[0014] In another aspect of the present invention, the correction value calculation/storage processing unit stores the correction value into at least one selected from the sensor storage unit and the device storage unit.

[0015] Another aspect of the present invention is directed to a method for controlling a money handling device including a sensor unit configured to collect data for recognition from money, the method including:

a correction value calculation/storage processing step including:

correction value calculation processing for calculating a correction value of the sensor unit with the sensor unit mounted; and
storage processing for storing an identification information piece of the sensor unit stored in a sensor storage unit into a device storage unit after or during the correction value calculation processing, the sensor storage unit being provided in the sensor unit, and the device storage unit and the sensor unit being provided at different positions; and

at least in turning on the power, an identification information piece determination step including determination processing for comparing the identification information piece of the sensor unit stored in the sensor storage unit with the identification information piece of the sensor unit stored in the device storage unit to determine whether the identification information pieces match each other, wherein the money handling device does not execute recognition processing when the identification

information piece determination step gives a determination result that indicates the identification information pieces do not match each other.

5 **[0016]** The money handling device of the present invention is capable of having excellent quality and small variation in quality due to machine difference. The method for controlling a money handling device of the present invention can provide a money handling device having
10 excellent quality and small variation in quality due to machine difference.

BRIEF DESCRIPTION OF THE DRAWINGS

15 **[0017]**

Fig. 1(a) is a perspective view of an appearance of a banknote handling device of Embodiment 1.

20 Fig. 1(b) is a cross-sectional view of an internal structure of the banknote handling device of Embodiment 1.

25 Fig. 2 is a functional block diagram of a banknote recognition unit of Embodiment 1.

Fig. 3 is a flow chart of a method (operation) for controlling the banknote handling device of Embodiment 1, illustrating the procedure of calculating a correction value of each sensor unit.
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Fig. 4 is a flow chart of the correction value calculation/storage processing step illustrated in Fig. 3.

35 Fig. 5 is another flow chart of the correction value calculation/storage processing step illustrated in Fig. 3.

40 Fig. 6 is a flow chart of the method (operation) for controlling the banknote handling device of Embodiment 1, illustrating the procedure of banknote recognition.

45 Fig. 7 is a flow chart of a method (operation) for controlling a banknote handling device of Embodiment 2, illustrating the procedure of banknote recognition.

DESCRIPTION OF EMBODIMENTS

50 **[0018]** Preferred embodiments of the money handling device and the method for controlling a money handling device of the present invention are described hereinbelow with reference to the drawings. Hereinbelow, the present invention is described with those directed to banknotes, i.e., a banknote handling device and a method
55 for controlling a banknote handling device, taken as examples. The money as used herein encompasses coins and sheets such as banknotes.

<Embodiment 1>

[0019] With reference to Fig. 1, the structure of a banknote handling device of the present embodiment is described.

[0020] A banknote handling device 200 of the present embodiment may have a structure as illustrated in Figs. 1(a) and 1(b). The banknote handling device 200 illustrated in Figs. 1(a) and 1(b) includes a hopper 210 that can hold multiple banknotes, a feeding unit 211 that can feed out the banknotes held on the hopper 210 one by one, a transport path 212 on which the banknotes fed out of the feeding unit 211 are transported, a banknote recognition unit 100 that executes recognition processing on the banknotes, a stacking unit 213 that stacks banknotes recognized as normal by the banknote recognition unit 100, a rejection unit 214 that stacks abnormal banknotes failing to satisfy predetermined conditions, a display 215 that displays data such as information sent to the banknote handling device 200 and processing results, and a transport unit that transports the banknotes one by one along the transport path 212. The transport unit includes multiple transport means such as rollers and a driving unit, such as a motor, that drives the transport means. The banknote handling device 200 further includes transmissive or reflective optical sensors at the respective positions indicated by the triangles in the figure to detect the transport states of the banknotes in the device. The detection results from these optical sensors may be used to estimate the shape and degree of skewing of each banknote. Using the banknote recognition unit 100 provided within the banknote handling device 200 enables successive handling of multiple banknotes held on the hopper 210, returning of banknotes each determined as a counterfeit note, unfit note, or suspect note to the rejection unit 214, and resulting sorting of the banknotes.

[0021] In the case of banknotes, the contents of the recognition processing by the banknote recognition unit 100 include a variety of functions such as, but not limited to, recognition of the denominations, determination of the authenticity and fitness of banknotes, determination of the orientation and face-up or face-down state of banknotes, acquisition of the external shape information and passing site information of banknotes, and reading of symbols such as figures and characters printed on banknotes.

[0022] Hereinbelow, the structure of the banknote recognition unit 100 is described.

[0023] As illustrated in Fig. 2, the banknote recognition unit 100 includes, as sensor units that collect data for recognition processing from a banknote, an optical line sensor unit 10 that emits multiple types of light such as infrared light and visible light to acquire optical data (optical properties) of a banknote, a magnetism sensor unit 20 that acquires magnetic data (magnetism) of the banknote, a thickness sensor unit 30 that acquires thickness data of the banknote, and a fluorescence sensor unit 40

that emits ultraviolet light to acquire fluorescence data of the banknote. The sensor units 10, 20, 30, and 40 are removably attached to the banknote recognition unit 100 and can be replaced as appropriate.

[0024] The banknote recognition unit 100 executes processing such as banknote recognition processing based on the data acquired by the sensor units 10, 20, 30, and 40. For example, an optical image of the banknote is generated from the optical data acquired by the optical line sensor unit 10 and is used in banknote recognition processing. The magnetic information of the banknote is detected from the magnetic data acquired by the magnetism sensor unit 20 and is used in banknote recognition processing. The thickness of the banknote is detected from the thickness data acquired by the thickness sensor unit 30 and is used in banknote recognition processing and detection processing such as tape detection and double feeding detection. The presence or absence of fluorescence emission from the banknote is detected from the fluorescence data acquired by the fluorescence sensor unit 40 and is used in banknote recognition processing.

[0025] The sensor units 10, 20, 30, and 40 respectively include sensor storage units 11, 21, 31, and 41 each including a storage unit that is a nonvolatile memory, and each optionally further including a volatile memory. The nonvolatile memory of each of the sensor storage units 11, 21, 31, and 41 stores an identification information piece of the respective sensor unit 10, 20, 30, or 40.

[0026] The term "identification information piece" herein means an information piece that enables recognition of the individual of the part. The identification information piece is preferably a serial number.

[0027] In addition to the identification information piece of the respective sensor unit 10, 20, 30, or 40, the nonvolatile memory of each of the sensor storage units 11, 21, 31, and 41 stores attribute information of the respective sensor unit 10, 20, 30, or 40, such as the type, item, lot, version number, number of channels, channel pitch, scan width, acceptable transport speed, wavelength (for the optical line sensor unit 10 and the fluorescence sensor unit 40), and sensor type (for the magnetism sensor unit 20 and the thickness sensor unit 30).

[0028] The banknote recognition unit 100 includes, as a control unit, a control board 50 that controls the sensor units 10, 20, 30, and 40 and executes banknote recognition processing. The sensor units 10, 20, 30, and 40 are coupled with the control board 50. The sensor units 10, 20, 30, and 40 and the control board 50 are each individually attached to the banknote recognition unit 100 in a replaceable manner.

[0029] The control board 50 may include, for example, software programs for achieving a variety of processing, a central processing unit (CPU) that executes the software programs, a variety of hardware controlled by the CPU, processing units (devices) such as a field programmable gate array (FPGA), a device storage unit 51 that includes a storage device such as a volatile or nonvolatile

memory or a hard disk, and a board with these components mounted thereon. The software programs and data for operation of the respective components are stored in the device storage unit 51 or any memory, such as RAM or ROM, or hard disk provided for exclusive use. The device storage unit 51 is also used to store a variety of templates (e.g., reference image data) and threshold values to be used in recognition processing by the control board 50.

[0030] The device storage unit 51 includes a nonvolatile memory. The device storage unit 51 and the sensor units 10, 20, 30, and 40 are provided at different positions (the device storage unit 51 is outside the sensor units 10, 20, 30, and 40). Thus, even when any of the sensor units 10, 20, 30, and 40 is first attached to the banknote recognition unit 100 or is replaced, the nonvolatile memory of the device storage unit 51 is not attached or replaced together with the sensor unit to be attached or replaced.

[0031] The nonvolatile memory of the device storage unit 51 stores the identification information piece of the banknote recognition unit 100. In addition to the identification information piece of the banknote recognition unit 100, the nonvolatile memory of the device storage unit 51 stores attribute information of the control board 50, such as the type, item, lot, version number, type and capacity of the memory, and types and number of interfaces.

[0032] The control board 50 includes a correction value calculation/storage processing unit 52 and an identification information piece determination unit 53.

[0033] The correction value calculation/storage processing unit 52 adjusts the sensor units 10, 20, 30, and 40 (executes sensor adjustment). In other words, the correction value calculation/storage processing unit 52 calculates the correction values (adjustment values) of the sensor units 10, 20, 30, and 40 with the sensor units 10, 20, 30, and 40 mounted on the banknote recognition unit 100. This enables correction of the outputs of the sensor units 10, 20, 30, and 40 into appropriate ones having small variation due to machine difference and channel difference.

[0034] Each correction value is to be added to, subtracted from, multiplied by, and/or divided by (usually subjected to at least one selected from addition, subtraction, multiplication, and division) the output of the respective sensor unit 10, 20, 30, or 40 in sensing by the respective sensor unit 10, 20, 30, or 40.

[0035] Each correction value is usually calculated at initial production (initial adjustment) or at replacement of the respective sensor unit (readjustment). In calculation of each correction value, a predetermined checking tool is used in accordance with the type of the sensor unit. For example, a predetermined sheet of white paper is used for the optical line sensor unit 10, while a predetermined thickness detection tool is used for the thickness sensor unit 30. In other words, these checking tools are sensed by the respective sensor units 10, 20, 30, and 40

and the output values in these sensing operations are compared with the respective reference values, whereby the correction values are calculated.

[0036] The correction value calculation may find that the sensor units 10, 20, 30, and/or 40 need no output correction. In this case, the output of the sensor unit of interest may be used without correction by the correction value. Even in this case, the correction value calculation/storage processing unit 52 executes pairing to be described later.

[0037] In accordance with the type of each of the sensor units 10, 20, 30, and 40, the correction value calculation/storage processing unit 52 successively executes as a single program a series of processing steps such as guidance for a worker in mounting a checking tool, sensing by the sensor unit of interest, acquisition of output data from the sensor unit of interest, a variety of data processing (e.g., amplification, noise reduction, A/D conversion (digitalization), imaging, and image correction) on the output data of interest, and calculation of the correction value based on comparison between the processed output data and the reference data.

[0038] After the correction value calculation processing on the sensor units 10, 20, 30, and 40 or during the correction value calculation processing on the sensor units 10, 20, 30, and 40, the correction value calculation/storage processing unit 52 executes storage processing (pairing) of causing the nonvolatile memory of the device storage unit 51 to store the identification information piece of the sensor unit 10, 20, 30, or 40 that has been stored in the nonvolatile memory of the sensor storage unit 11, 21, 31, or 41 of the sensor unit 10, 20, 30, or 40 on which the correction value calculation processing is (has been) executed. Such pairing of each of the sensor units 10, 20, 30, and 40 in correction of each of the sensor units 10, 20, 30, and 40 (after the correction value calculation processing or during the correction value calculation processing) ensures pairing of a sensor unit having a calculated correction value, i.e., having excellent quality and small variation due to machine difference, with the control board 50. As a result, the correction values of the respective sensor units 10, 20, 30, and 40 are linked with the identification information pieces of the respective sensor units 10, 20, 30, and 40.

[0039] If no pairing of each of the sensor units 10, 20, 30, and 40 is executed after the correction value calculation processing or during the correction value calculation processing, a sensor unit different from the sensor unit having the calculated correction value may be paired with the control board 50 without any adjustment. This may cause disadvantages in terms of quality assurance.

[0040] Further, the correction value calculation/storage processing unit 52 stores the calculated correction value of each of the sensor units 10, 20, 30, and 40 into at least one selected from the nonvolatile memory of the respective sensor storage unit 11, 21, 31, or 41 and the nonvolatile memory of the device storage unit 51. In sens-

ing by each of the sensor units 10, 20, 30, and 40, the control board 50 executes processing of correcting the output of the respective sensor unit as appropriate using the stored correction value.

[0041] In order to improve the processing speed of the correction processing (using the correction value), the correction value calculation/storage processing unit 52 preferably stores the calculated correction value of each of the sensor units 10, 20, 30, and 40 into the nonvolatile memory of the device storage unit 51. This is because the processing speed is faster when the control board 50 refers to its own device storage unit 51 than when the control board 50 refers to the respective sensor storage unit 11, 21, 31, or 41.

[0042] Alternatively, the correction value calculation/storage processing unit 52 may store the calculated correction value of each of the sensor units 10, 20, 30, and 40 into the nonvolatile memory of the respective sensor storage unit 11, 21, 31, or 41. This can eliminate the need for the region for storing the correction values in the nonvolatile memory of the device storage unit 51, so that a variety of sensor units can be more flexibly combined without any restriction by the capacity of the nonvolatile memory of the device storage unit 51. Further, even when the data volume of the correction value increases as a result of sensor performance improvement, the sensor unit of interest can be incorporated into the banknote recognition unit 100.

[0043] At least in turning on the power (the power of the banknote handling device 200), the identification information piece determination unit 53 executes determination processing of comparing the identification information pieces of the sensor units 10, 20, 30, and 40 stored in the nonvolatile memories of the respective sensor storage units 11, 21, 31, and 41 respectively with the identification information pieces of the sensor units 10, 20, 30, and 40 stored in the nonvolatile memory of the device storage unit 51 by the correction value calculation/storage processing unit 52 and determining whether they match each other. When the determination processing by the identification information piece determination unit 53 finds that the identification information pieces of at least one selected from the sensor units 10, 20, 30, and 40 do not match each other, the banknote handling device 200 restricts the working of the banknote recognition unit 100. Specifically, the banknote handling device 200 executes processing of inhibiting execution of recognition processing by the banknote recognition unit 100. This enables detection of unintended replacement of any of the sensor units 10, 20, 30, and 40 and prevention of recognition processing by the banknote recognition unit 100 including an unintended sensor unit, i.e., a sensor unit without quality assurance.

[0044] The banknote handling device 200 may execute the following processing as the processing of inhibiting execution of recognition processing by the banknote recognition unit 100. When the determination processing finds that the identification information pieces of at least

one selected from the sensor units 10, 20, 30, and 40 do not match each other, the identification information piece determination unit 53 sets an error. The banknote recognition unit 100 is designed to check the presence or absence of an error when its mode transits from the mode (standby mode) immediately after starting to the mode (count mode) of executing recognition processing on a banknote under transport. When an error is not set, the mode transits to the mode of executing recognition processing. When an error is set, the mode does not transit to the mode of executing recognition processing. Consequently, when the identification information pieces of at least one selected from the sensor units 10, 20, 30, and 40 do not match each other, the banknote recognition unit 100 cannot execute recognition processing.

[0045] As described above, the correction value calculation/storage processing unit 52 may execute the storage processing (pairing) after the correction value calculation processing or execute the storage processing (pairing) during the correction value calculation processing; still, it usually executes the storage processing (pairing) after the correction value calculation processing.

[0046] In the case of the storage processing (pairing) after the correction value calculation processing, the correction value calculation processing and the storage processing are executed as two commands. This enables determination of whether the correction values are to be stored after the results of calculating the correction values are examined, which is convenient for designers and investigators who investigate malfunctions.

[0047] In the case of the storage processing (pairing) during the correction value calculation processing, the correction value calculation processing and the storage processing are executed as a single command. This is convenient for manual workers during production steps, for example.

[0048] When the correction value of a sensor unit is calculated in the correction value calculation processing in an embodiment in which the correction value calculation/storage processing unit 52 executes the storage processing (pairing) after the correction value calculation processing, the correction value calculation/storage processing unit 52 preferably executes the storage processing on the identification information piece of the sensor unit 10, 20, 30, or 40 of interest. In other words, when no correction value is calculated in the correction value calculation processing, the correction value calculation/storage processing unit 52 preferably does not execute storage processing on the identification information piece of the sensor unit 10, 20, 30, or 40 of interest. This enables more secure prevention of execution of recognition processing by the banknote recognition unit 100 including a sensor unit 10, 20, 30, and/or 40 without quality assurance.

[0049] Next, a method (operation) for controlling the banknote handling device 200 of the present embodiment is described with reference to Figs. 3 to 6. First, the procedure of calculating the correction values of the re-

spective sensor units 10, 20, 30, and 40 is described with reference to Figs. 3 to 5.

[0050] As illustrated in Fig. 3, start of the operation is first followed by waiting for correction value calculation processing on the sensor unit 10, 20, 30, or 40 (step S11). When a worker requests execution of the correction value calculation processing through an application program that runs on a personal computer, the device determines whether the sensor unit that is a target of the correction value calculation processing is mounted on the banknote recognition unit 100 (step S12). In the case of an integrated model such as the banknote handling device 200 as illustrated in Fig. 1, a worker may request execution of the correction value calculation processing by operating not a personal computer but an operation unit such as a touch screen or a set of buttons provided on the banknote handling device 200. In this case, the display 215 of the banknote handling device 200 displays a predetermined screen (hereinafter, correction screen) relating to the correction value calculation processing. When the sensor unit is mounted (step S12: YES), the correction value calculation processing on the sensor unit of interest and the storage processing of storing the identification information piece that has been stored in the nonvolatile memory of the sensor storage unit of the sensor unit of interest into the nonvolatile memory of the device storage unit 51 are executed (correction value calculation/storage processing step S13). When the sensor unit is not mounted (step S12: NO), the display 215 and a personal computer displays warning for the absence of the sensor unit, which is the target of the correction value calculation processing, on the banknote recognition unit 100 (step S14). In the case of the integrated banknote handling device 200, such warning may be displayed only on the display 215.

[0051] Before a worker logs in the application program or the banknote handling device 200 through the correction screen, the device may check whether the worker has an authority to adjust the sensors. This can prevent sensor adjustment without the authority, preventing execution of sensor adjustment by anybody but certified workers.

[0052] The correction value calculation/storage processing step S13 may take either the procedure illustrated in Fig. 4 or the procedure illustrated in Fig. 5.

[0053] In the case as illustrated in Fig. 4, execution of the correction value calculation processing (correction value calculation processing step S21) on a sensor unit is followed by storage of the calculated correction value into at least one selected from the nonvolatile memory of the sensor storage unit 11, 21, 31, or 41 of interest and the nonvolatile memory of the device storage unit 51 (correction value storage processing step S22). Then, the identification information piece of the sensor unit of interest is stored into the nonvolatile memory of the device storage unit 51 (identification information piece storage processing step S23).

[0054] The correction value storage processing step

S22 may be executed after the identification information piece storage processing step S23, or the correction value storage processing step S22 and the identification information piece storage processing step S23 may be executed collectively. Still, as described above, the correction value storage processing step S22 is preferably executed before the identification information piece storage processing step S23. If an identification information piece is stored before a correction value, a case may occur in which the identification information piece is stored but the correction value is not stored because the power is cut before the correction value is stored, for example. This case is not so preferred because the pairing itself can be executed without fail.

[0055] In the case as illustrated in Fig. 5, the identification information piece of a sensor unit is stored into the nonvolatile memory of the device storage unit 51 (identification information piece storage processing step S23) during the correction value calculation processing (correction value calculation processing step S21) on the sensor unit. Then, the calculated correction value is stored into at least one selected from the nonvolatile memory of the sensor storage unit 11, 21, 31, or 41 of interest and the nonvolatile memory of the device storage unit 51 (correction value storage processing step S22).

[0056] In the sensor adjustment, the identification information pieces of the sensor units 10, 20, 30, and 40 each may be used to generate a message identification code (hereinafter, identification code) by HMAC, for example, and the identification codes may be stored in the nonvolatile memories of the respective sensor storage units 11, 21, 31, and 41 or the nonvolatile memory of the device storage unit 51.

[0057] In the sensor adjustment, the control board 50 may acquire, from the nonvolatile memories of the sensor storage units 11, 21, 31, and 41, the pieces of information such as the identification information pieces, the attribute information pieces, and the memory capacities of the respective sensor units 10, 20, 30, and 40 and acquire, from the nonvolatile memory of the device storage unit 51, the pieces of information such as the identification information piece, the attribute information pieces, and the memory capacity of the banknote recognition unit 100. Then, the control board 50 itself may determine the operation specifications of the banknote recognition unit 100 based on the information acquired. This can increase the possibility of standardizing the firmware stored in the device storage unit 51 among multiple types of devices. Specific examples of the operation specifications include the types of recognition processing to be executed, the types of templates to be used, and the acceptable transport speed.

[0058] Next, the procedure of the banknote recognition is described with reference to Fig. 6.

[0059] As illustrated in Fig. 6, the power of the banknote handling device 200 is first turned on (step S31). Then, the identification information piece determination unit 53 compares the identification information pieces of the sen-

sensor units 10, 20, 30, and 40 stored in the nonvolatile memories of the respective sensor storage units 11, 21, 31, and 41 respectively with the identification information pieces of the sensor units 10, 20, 30, and 40 stored in the nonvolatile memory of the device storage unit 51 and determines whether they match each other (sensor identification information piece comparison step S32). When the identification information pieces match each other for all sensor units 10, 20, 30, and 40 (step S32: YES), the recognition processing is determined as being executable by the banknote recognition unit 100 (the identification information piece determination unit 53 does not set an error) and the banknote recognition unit 100 executes recognition processing (step S33). When the identification information pieces of at least one selected from the sensor units 10, 20, 30, and 40 do not match each other (step S32: NO), execution of recognition processing by the banknote recognition unit 100 is inhibited (the identification information piece determination unit 53 sets an error) and the banknote recognition unit 100 does not execute recognition processing (step S34). Then, the display 215 displays warning that the sensor unit(s) 10, 20, 30, and/or 40 are/is not adjusted by a worker having authority (step S35).

[0060] Before or after the sensor identification information piece comparison step S32, the identification information pieces of the sensor units 10, 20, 30, and 40 each may be used to generate a message identification code by HMAC, for example, and each identification code may be compared with the aforementioned identification code for determination of whether they match each other. When they match each other, the procedure may advance to the step S32 or S33. When they do not match each other, execution of recognition processing by the banknote recognition unit 100 may be inhibited. This enables detection of possible forgery of the identification information pieces of the respective sensor units 10, 20, 30, and 40.

[0061] As described above, in the present embodiment, the identification information pieces of the respective sensor units 10, 20, 30, and 40 stored in the nonvolatile memories of the respective sensor storage units 11, 21, 31, and 41 are stored in the nonvolatile memory of the device storage unit 51 after the correction value calculation processing or during the correction value calculation processing. In turning on the power of the banknote handling device 200, the identification information pieces of the respective sensor units 10, 20, 30, and 40 stored in the nonvolatile memories of the respective sensor storage units 11, 21, 31, and 41 are respectively compared with the identification information pieces of the sensor units stored in the nonvolatile memory of the device storage unit 51 for determination of whether they match each other. When they do not match each other, execution of recognition processing by the banknote recognition unit 100 is prevented. This enables detection of unintended replacement of a sensor unit(s) 10, 20, 30, and/or 40 adjusted as appropriate and prevention of execution of

recognition processing in such a case. Accordingly, banknote recognition processing can be executed at high precision based on the collected data from the sensor units 10, 20, 30, and 40 adjusted as appropriate and variation in the results of banknote recognition processing due to machine difference can be reduced. In other words, the banknote handling device 200 can be made to have high quality and small variation in quality due to machine difference.

<Embodiment 2>

[0062] In the present embodiment, features unique to the present embodiment are mainly described, and the same contents as those in Embodiment 1 will not be elaborated upon here. The components having a similar or the same function in both the present embodiment and Embodiment 1 are provided with the same reference sign, and these components will not be elaborated upon in the present embodiment.

[0063] In the present embodiment, the correction value calculation/storage processing unit 52 executes not only the storage processing (pairing; hereinafter, also referred to as first storage processing) described in Embodiment 1 but also a second storage processing (pairing) of storing the identification information piece of the banknote recognition unit 100 stored in the nonvolatile memory of the device storage unit 51 into the nonvolatile memories of the sensor storage units 11, 21, 31, and 41.

[0064] The correction value calculation/storage processing unit 52 may execute the first storage processing before the second storage processing, or may execute the second storage processing before the first storage processing, or may execute the second storage processing during the first storage processing. When the first (or second) storage processing is performed before the second (or first) storage processing, they are usually executed as serial processes in the stated order. When the second storage processing is executed during the first storage processing, these processes are usually executed as parallel processes. In other words, the correction value calculation/storage processing unit 52 has a function of maintaining a plurality of operations included in these processes at the execution mode simultaneously. When the second storage processing is executed during the first storage processing, these processes may be executed as parallel processes. In other words, the correction value calculation/storage processing unit 52 may have a function of executing a plurality of operations included in these processes simultaneously.

[0065] In the present embodiment, the identification information piece determination unit 53 executes not only the determination processing (hereinafter, first determination processing) described in Embodiment 1 but also a second determination processing of comparing the identification information piece of the banknote recognition unit 100 stored in the nonvolatile memory of the device storage unit 51 with the identification information

piece of the banknote recognition unit 100 stored in the nonvolatile memory of each of the sensor storage units 11, 21, 31, and 41 by the correction value calculation/storage processing unit 52 and determining whether they match each other. When the determination processing by the identification information piece determination unit 53 finds that the identification information pieces do not match each other in at least one selected from the first and second determination processings, the banknote handling device 200 executes processing of restricting the operation of the banknote recognition unit 100 and inhibiting execution of recognition processing by the banknote recognition unit 100. This enables detection of unintended replacement of any of the sensor units 10, 20, 30, and 40 at higher precision and more secure prevention of execution of recognition processing by the banknote recognition unit 100 including an unintended sensor unit, i.e., a sensor unit without quality assurance.

[0066] A method for processing of inhibiting execution of recognition processing by the banknote recognition unit 100 based on the determination results of the first and second determination processings by the identification information piece determination unit 53 may be the processing method as described in Embodiment 1. Specifically, when the identification information pieces do not match each other in at least one selected from the first and second determination processings, the identification information piece determination unit 53 sets an error. The banknote recognition unit 100 checks the presence or absence of an error when its mode transits from the mode (standby mode) immediately after starting to the mode (count mode) of executing recognition processing on a banknote under transport. When an error is not set, the mode transits to the mode of executing recognition processing. When an error is set, the mode does not transit to the mode of executing recognition processing.

[0067] More specific examples of conditions for the operation restriction include the case where the identification information pieces of at least one selected from the sensor units 10, 20, 30, and 40 do not match each other (the case where the first determination processing result finds a matching failure) and/or the case where the identification information pieces of the banknote recognition unit 100 do not match each other for at least one selected from the sensor units 10, 20, 30, and 40 (the case where the second determination processing result finds a matching failure).

[0068] The identification information piece determination unit 53 may execute the first determination processing before the second determination processing, or may execute the second determination processing before the first determination processing, or may execute the second determination processing during the first determination processing. When the first (or second) determination processing is performed before the second (or first) determination processing, they are usually executed as serial processes in the stated order. When the second determination processing is executed during the first deter-

mination processing, these processes are usually executed as parallel processes. In other words, the identification information piece determination unit 53 has a function of maintaining a plurality of operations included in these processes at the execution mode simultaneously. When the second determination processing is executed during the first determination processing, these processes may be executed as parallel processes. In other words, the identification information piece determination unit 53 may have a function of executing a plurality of operations included in these processes simultaneously.

[0069] From the same viewpoint as in Embodiment 1, also in the present embodiment, the correction value calculation/storage processing unit 52 may store the calculated correction values of the respective sensor units 10, 20, 30, and 40 into the nonvolatile memory of the device storage unit 51 or may store the calculated correction values of the respective sensor units 10, 20, 30, and 40 respectively into the nonvolatile memories of the sensor storage units 11, 21, 31, and 41.

[0070] Next, the operation of the banknote handling device 200 in the present embodiment and a method for controlling the banknote handling device 200 in the present embodiment are described.

[0071] In the present embodiment, the identification information piece of the sensor unit that has been subjected to or is subjected to the correction value calculation processing is stored into the nonvolatile memory of the device storage unit 51 (first storage processing) and the identification information piece of the banknote recognition unit 100 stored in the nonvolatile memory of the device storage unit 51 is stored in the nonvolatile memory of the sensor storage unit of the sensor unit of interest (second storage processing) in the identification information piece storage processing step S23 described in Embodiment 1 (see Figs. 4 and 5). These storage processes may be executed as either serial processes or parallel processes, as described above.

[0072] In the present embodiment, as illustrated in Fig. 7, when the identification information pieces match each other for all sensor units in the sensor identification information piece comparison step S32 described in Embodiment 1 (step S32: YES), the identification information piece determination unit 53 compares the identification information piece of the banknote recognition unit 100 stored in the nonvolatile memory of the device storage unit 51 with the identification information piece of the banknote recognition unit 100 stored in the nonvolatile memory of each of the sensor storage units 11, 21, 31, and 41 and determines whether they match each other (recognition unit identification information piece comparison step S36). When the identification information pieces match each other for all sensor units (step S36: YES), the recognition processing is determined as being executable by the banknote recognition unit 100 (identification information piece determination unit 53 does not set an error) and the banknote recognition unit 100 executes recognition processing (step S33). When the identifica-

tion information pieces of at least one of the sensor units do not match each other (step S36: NO), execution of recognition processing by the banknote recognition unit 100 is inhibited (identification information piece determination unit 53 sets an error) and the banknote recognition unit 100 does not execute recognition processing (step S34). Then, the display 215 displays warning that the sensor unit(s) 10, 20, 30, and/or 40 are/is not adjusted by a worker having authority (step S35).

[0073] As described above, the recognition unit identification information piece comparison step S36 may be executed before the sensor identification information piece comparison step S32, or the step S36 and the step S32 may be executed as parallel processes.

[0074] Similar to Embodiment 1, the identification information pieces of the sensor units 10, 20, 30, and 40 each may be used to generate a message identification code by HMAC, for example, during the period from the step S31 to the step S33, and each identification code may be compared with the aforementioned identification code for determination of whether they match each other.

<Modified Embodiments>

[0075] Described in Embodiments 1 and 2 are the cases where the identification information pieces of the respective sensor units 10, 20, 30, and 40 are stored in the nonvolatile memory of the device storage unit 51 of the banknote recognition unit 100. The storage for the identification information pieces of the respective sensor units 10, 20, 30, and 40 may be any component in the banknote handling device 200, and may be any nonvolatile memory of another storage unit of the banknote handling device 200 other than the device storage unit 51 of the banknote recognition unit 100.

[0076] Described in Embodiments 1 and 2 are cases where the sensor units used are the optical line sensor unit 10, the magnetism sensor unit 20, the thickness sensor unit 30, and the fluorescence sensor unit 40. Any types and numbers of sensor units may be used as appropriate. Examples of sensor units other than the above include an ultrasonic sensor unit, an optical sensor unit, a displacement sensor unit, and a capacitance sensor unit. An ultrasonic sensor unit can detect a torn banknote. An optical sensor unit can detect phosphorescence, special ink, and/or a spectrum. A displacement sensor unit can detect the thickness of a banknote, specifically, the presence of tape and/or double feeding. A capacitance sensor unit can detect sticking of a foreign object, limpness, and/or water absorption.

[0077] Described in Embodiments 1 and 2 are the cases where the money handling device and the method for controlling a money handling device of the present invention are respectively a banknote handling device and a method for controlling a banknote handling device. The money handling device and the method for controlling a money handling device of the present invention respectively may be a sheet handling device and a method for

controlling a sheet handling device, or may be a coin handling device and a method for controlling a coin handling device.

[0078] Examples of a sheet as a target to which the present invention is applied include not only banknotes but also a variety of sheets such as checks, gift vouchers, bills, ledgers, documents of value, and card-like media.

[0079] As described hereinabove, embodiments of the present invention are described with reference to the drawings. Still, the above embodiments are not intended to limit the present invention. The structures of the embodiments may be combined or modified as appropriate within the spirit of the present invention.

15 INDUSTRIAL APPLICABILITY

[0080] As described above, the present invention provides a technique useful for executing money recognition processing based on acquisition data from a variety of sensors.

REFERENCE SIGNS LIST

[0081]

10:	optical line sensor unit
20:	magnetism sensor unit
30:	thickness sensor unit
40:	fluorescence sensor unit
11, 21, 31, 41:	sensor storage unit
50:	control board
51:	device storage unit
52:	correction value calculation/storage processing unit
53:	identification information piece determination unit
100:	banknote recognition unit (money recognition unit)
200:	banknote handling device (money handling device)
210:	hopper
211:	feeding unit
212:	transport path
213:	stacking unit
214:	rejection unit
215:	display

Claims

1. A money handling device comprising:

- a sensor unit configured to collect data for recognition from money;
- a sensor storage unit provided in the sensor unit and configured to store an identification information piece of the sensor unit;
- a device storage unit provided at a position dif-

ferent from a position of the sensor unit;
a correction value calculation/storage processing unit configured to execute:

correction value calculation processing for calculating a correction value of the sensor unit with the sensor unit mounted; and storage processing for storing the identification information piece of the sensor unit stored in the sensor storage unit into the device storage unit after or during the correction value calculation processing; and

an identification information piece determination unit configured to execute, at least in turning on the power, a first determination processing for comparing the identification information piece of the sensor unit stored in the sensor storage unit with the identification information piece of the sensor unit stored in the device storage unit to determine whether the identification information pieces match each other, wherein the money handling device does not execute recognition processing when the identification information piece determination unit gives a determination result that indicates the identification information pieces do not match each other.

2. The money handling device according to claim 1, further comprising a money recognition unit that includes the sensor unit, wherein the device storage unit stores an identification information piece of the money recognition unit, wherein the correction value calculation/storage processing unit, in the storage processing, further stores the identification information piece of the money recognition unit stored in the device storage unit into the sensor storage unit, wherein the identification information piece determination unit executes not only the first determination processing but also a second determination processing for comparing the identification information piece of the money recognition unit stored in the device storage unit with the identification information piece of the money recognition unit stored in the sensor storage unit to determine whether the identification information pieces match each other, and wherein the money handling device does not execute recognition processing when the identification information pieces do not match each other in at least one of the first and second determination processings by the identification information piece determination unit.
3. The money handling device according to claim 1 or 2, wherein the correction value calculation/storage processing unit executes the storage processing af-

ter the correction value calculation processing.

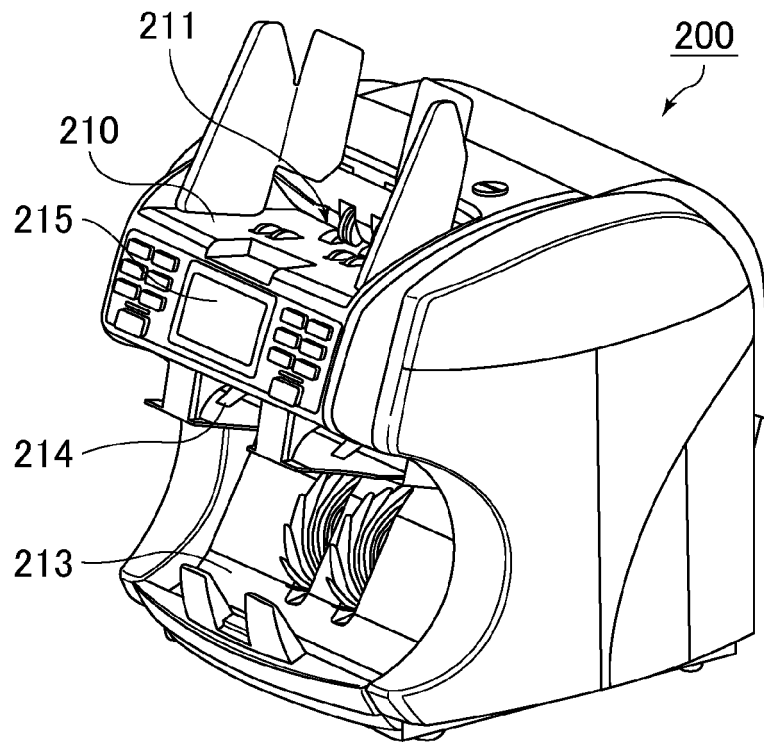
4. The money handling device according to claim 3, wherein the correction value calculation/storage processing unit executes the storage processing when the correction value is calculated in the correction value calculation processing.
5. The money handling device according to claim 1 or 2, wherein the correction value calculation/storage processing unit executes the storage processing during the correction value calculation processing.
6. The money handling device according to any one of claims 1 to 5, wherein the correction value calculation/storage processing unit stores the correction value into at least one selected from the sensor storage unit and the device storage unit.
7. A method for controlling a money handling device including a sensor unit configured to collect data for recognition from money, the method comprising:

a correction value calculation/storage processing step including:

correction value calculation processing for calculating a correction value of the sensor unit with the sensor unit mounted; and storage processing for storing an identification information piece of the sensor unit stored in a sensor storage unit into a device storage unit after or during the correction value calculation processing, the sensor storage unit being provided in the sensor unit, and the device storage unit and the sensor unit being provided at different positions; and

at least in turning on the power, an identification information piece determination step including determination processing for comparing the identification information piece of the sensor unit stored in the sensor storage unit with the identification information piece of the sensor unit stored in the device storage unit to determine whether the identification information pieces match each other, wherein the money handling device does not execute recognition processing when the identification information piece determination step gives a determination result that indicates the identification information pieces do not match each other.

FIG. 1
(a)



(b)

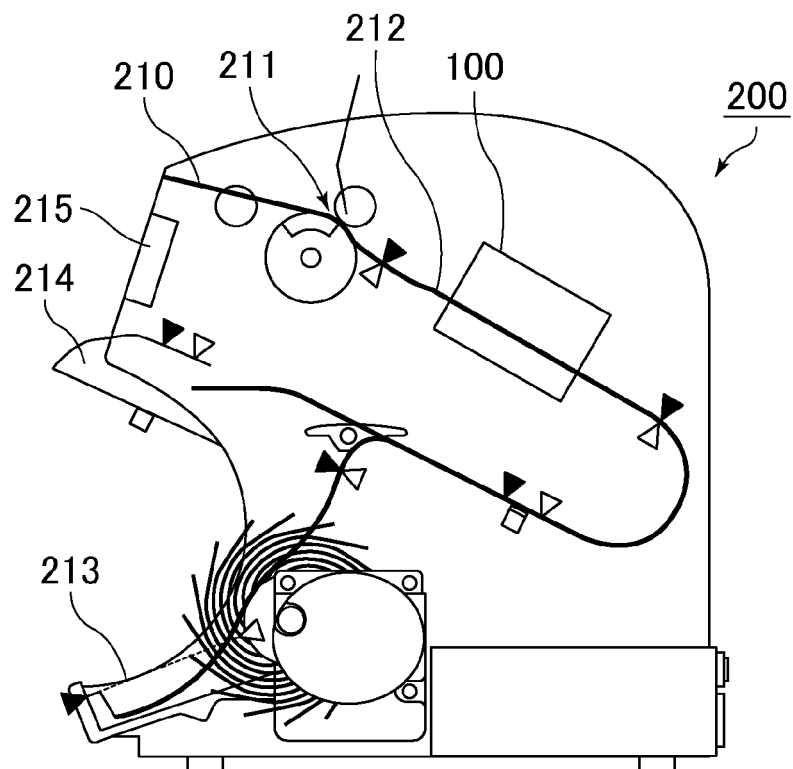


FIG.2

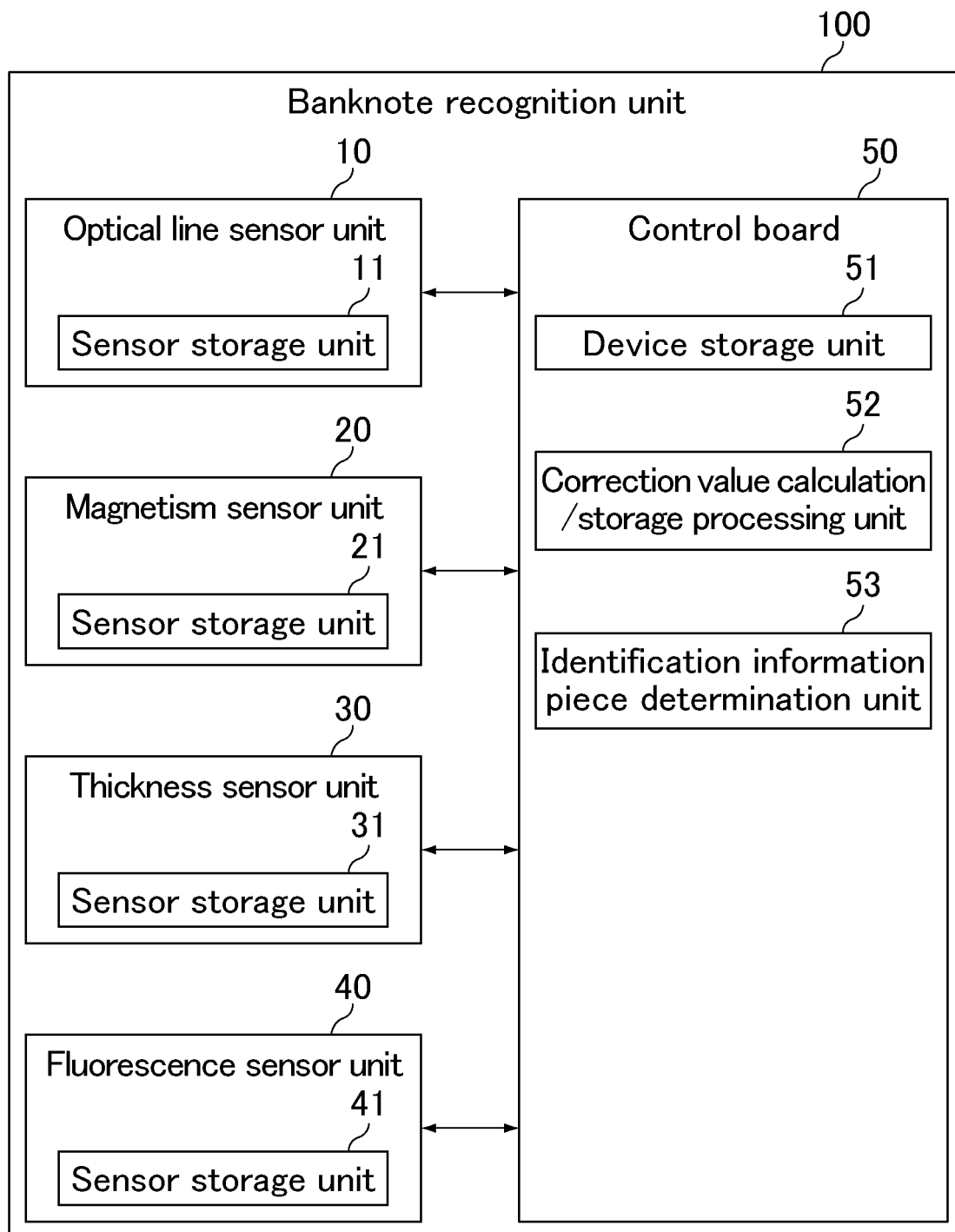


FIG.3

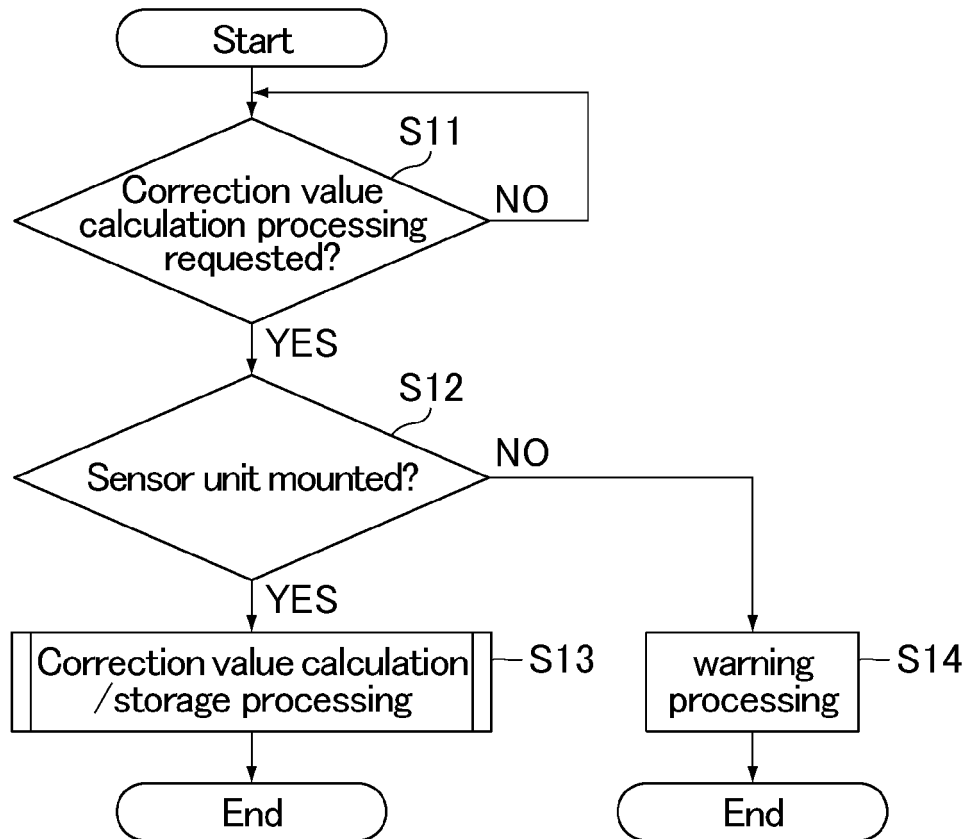


FIG.4

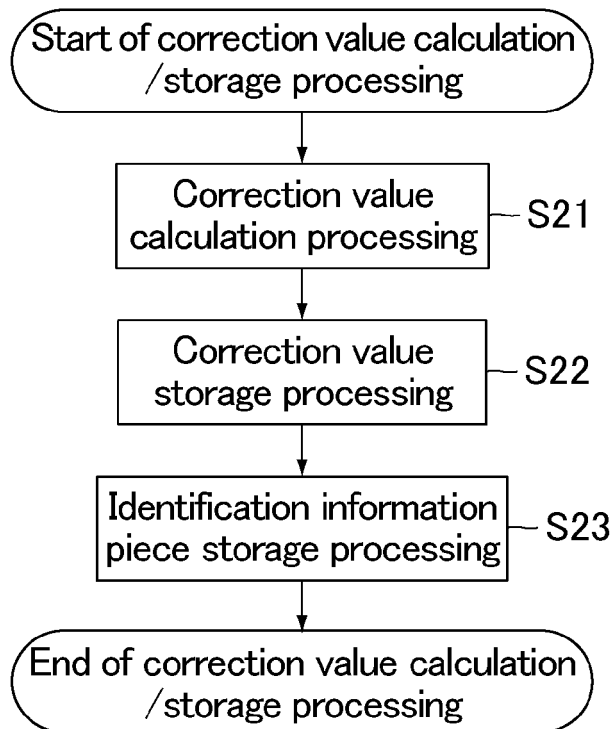


FIG.5

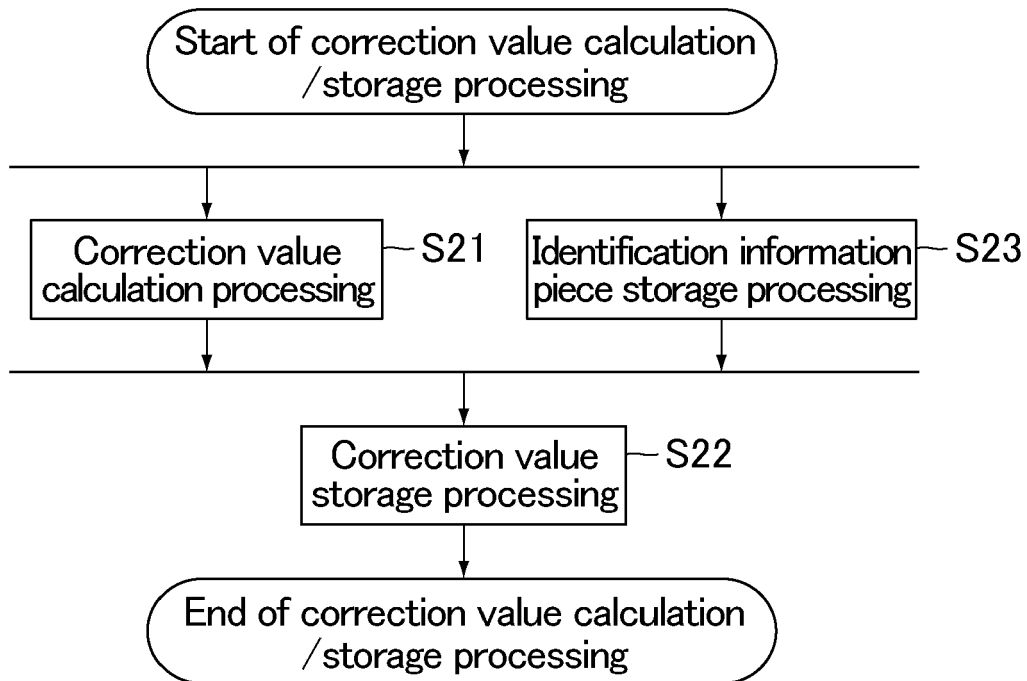


FIG.6

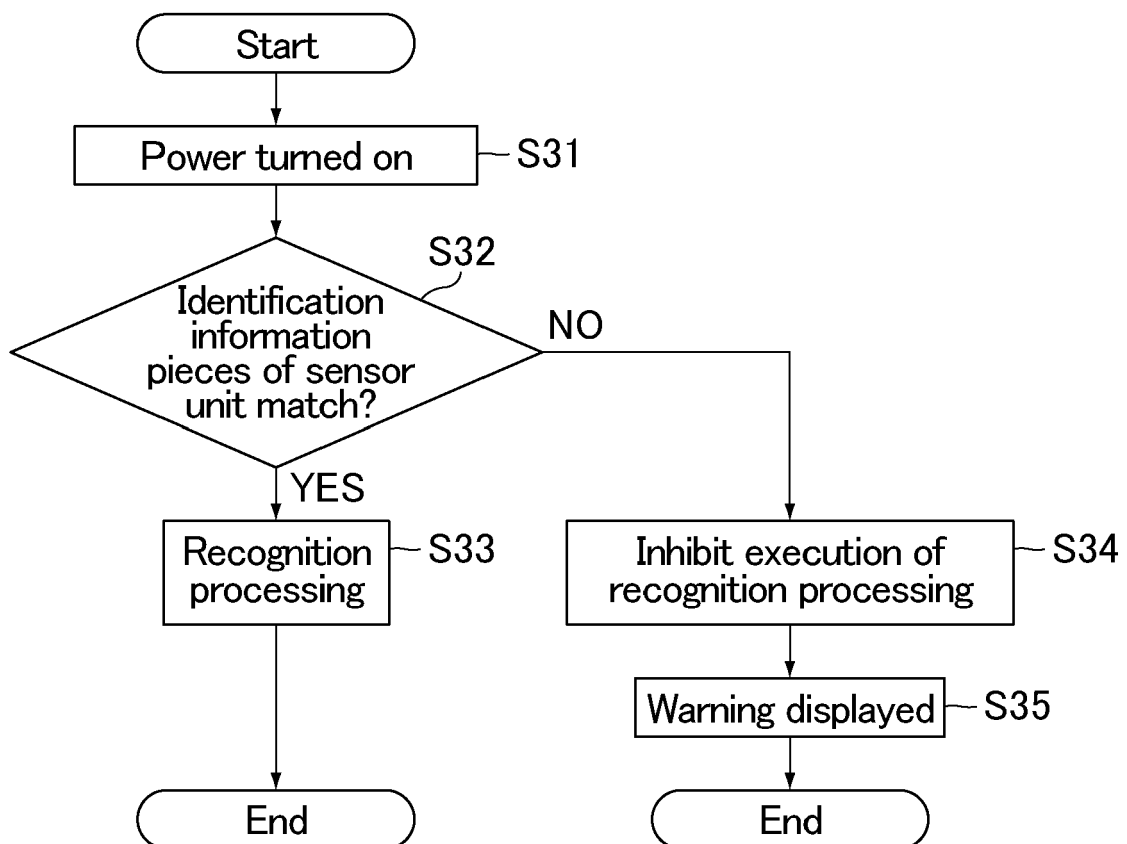
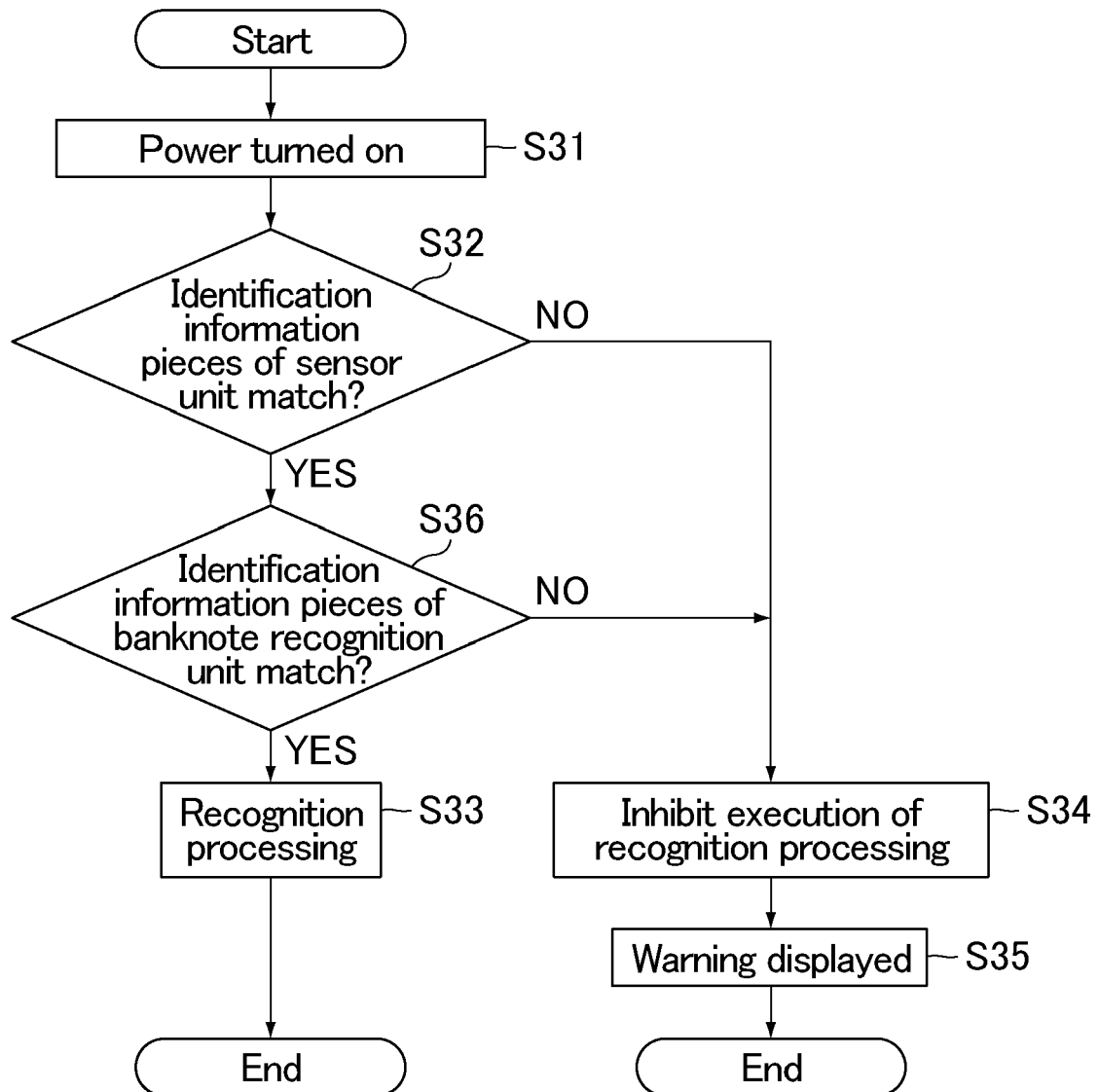


FIG. 7





EUROPEAN SEARCH REPORT

Application Number
EP 20 16 3828

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2017/249807 A1 (KANBAYASHI MAMORU [JP] ET AL) 31 August 2017 (2017-08-31) * paragraph [0061] - paragraph [0064] * * paragraph [0067] - paragraph [0075] * * paragraph [0082] - paragraph [0087] * * paragraph [0102] - paragraph [0111] * * figures 1,8 * * paragraph [0119] *	1-7	INV. G07D7/04 G07D7/12 G07D7/164 G07D11/28 G07D11/40 G07D11/225
X	WO 2018/003915 A1 (GLORY KOGYO KK) 4 January 2018 (2018-01-04) * figures 3-5 * & US 2019/206172 A1 (OJI HIROKI [JP] ET AL) 4 July 2019 (2019-07-04) * paragraph [0041] * * paragraph [0050] - paragraph [0064] *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			G07D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 July 2020	Examiner Seifi, Mozhdeh
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 16 3828

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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30-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017249807 A1	31-08-2017	JP 2016057968 A	21-04-2016
		RU 2649274 C1	30-03-2018
		US 2017249807 A1	31-08-2017
		WO 2016038962 A1	17-03-2016

WO 2018003915 A1	04-01-2018	CN 109155090 A	04-01-2019
		EP 3480794 A1	08-05-2019
		JP 2019144603 A	29-08-2019
		US 2019206172 A1	04-07-2019
		WO 2018003915 A1	04-01-2018

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013232223 A [0003]
- JP 3266002 B [0004]
- JP 4690532 B [0004]
- JP 4707373 B [0005]