

VALUE MEDIUM PROCESSOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an apparatus for judging conditions of securities such as bank bills and monetary bills and more specifically to a value medium processor for judging circulatability of the securities from their break and rupture.

2. Description of Related Art

A so-called "circulatability judgment function" for judging circulatability from break, rupture and the like (hereinafter called "break") of bank bills inserted is provided to recent bank bill processors. As described in Patent Document 1, for example, this function stores in advance a circulatability judgment level of bank bills capable of circulation in a memory, compares a condition level of the bank bill inserted with the circulatability judgment level stored in the memory and rejects the bank bills under a worse condition.

[Patent Document 1] Patent No. 2,801,707

The circulatability judgment function according to the related art rejects the bank bill on the basis of a defective ratio of the bank bill as a whole. Therefore, circulatability judgment is made on the defective ratio in the overall bank bill without discriminating deficiency of an important portion

and that of other portions as in the case of the Singaporean bank bills in which deficiency of the bank bill number lowers the value of the bank bill and in the case of the Indonesian bank bills in which the existence of a transmission window in the plastic bank bills is an important factor for authenticity judgment, for example. For this reason, the circulatability judgment function according to the related art is likely to accept the bank bills the important portion of which should not be originally accepted when the bank bills are under the defective condition such that they can be judged as authentic as a whole.

SUMMARY OF THE INVENTION

In view of the problems described above, the invention aims at providing an apparatus that divides a value medium such as a bank bill into an important portion and a non-important portion, suitably rejects the value medium the important portion of which falls off even under the defective condition such that the bank bill can be judged as normal as a whole, and improves an acceptance ratio for the defect of the non-important portion by allowing the defects to a certain extent.

To solve the problems described above, the invention first judges a kind of a bank bill and its direction when the bank bill is used as the value medium, for example. The term "direction" of the bank bill means a minor direction and a major

direction in consideration of the surface and back of the bank bill. The invention specifies an existence position of pattern information inherent to the value medium as such a bank bill number on the basis of the kind of the bank bill and its direction and calculates a defective area of a region in which the bank bill number exists and a defective area including the other region, for example, the regions other than the bank bill number region, an entire region of the bank bill and the like. The invention judges the defective condition of each region by use of a circulatability reference value for circulatability judgment stored beforehand for each region, and executes a return processing of the bank bill when the bank bill is broken much more than the circulatability reference value.

The invention judges the kind of the bank bill and its direction similarly when the bank bill having a transmission window as in the Indonesian bank bills is used as the value medium, extracts the existence position of the transmission window of the bank bill by use of the kind of the bank bill and its direction and calculates the defective area of the region in which the transmission window exists and the defective area of the region inclusive of other regions. The invention judges the defective condition of each region by use of the circulatability reference value for circulatability judgment stored beforehand for each region and executes the rejection processing of the bank bill when the defective

condition lower than the circulatibility reference value is judged as when the transmission window is closed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view of a bank bill processor according to an embodiment of the invention.

Fig. 2 shows a portion in the proximity of an image acquisition apparatus in the embodiment.

Fig. 3 is a memory map diagram of a storage device in the embodiment.

Fig. 4 is a schematic view of density pattern data stored in a reference information storage area in the embodiment.

Fig. 5 is a functional block diagram of the embodiment.

Fig. 6 is a view showing a conveying direction of a bank bill.

Fig. 7 is a flowchart in the embodiment.

Fig. 8 is a schematic view showing a bank bill number and a transmission window in a bank bill.

DESCRIPTION OF PREFERRED EMBODIMENTS

An embodiment of the invention will be hereinafter explained with reference to drawings. A bank bill processor 1 according to this embodiment serially draws out bank bills P loaded into an insertion port 10, conveys them one by one to an image acquisition apparatus 11, reads surface images there and provisionally stores, as bank bills to be returned, those bank bills P which are judged as NG in a circulatability

judgment in a storage portion 13. The bank bill processor 1 has inside the insertion port 10 a conveying mechanism 12, the surface acquisition apparatus 11, the storage portion 13, a bill accommodation cartridge 14, and so forth. Further, the bank bill processor 1 includes a storage device 15 (Figs. 3 and 5) and a microprocessor constituted by ROM and RAM.

The insertion port 10 accepts charging of the registered bank bills P in a minor direction. A sensor (not shown) for sensing charging of the bank bills P is provided to the insertion port 10 as is known in the art and sensing of the sensor drives the conveying mechanism 12.

The conveying mechanism 12 conveys one by one the bank bills P inserted into the insertion port 10 and is constituted by rollers, belts and a motor for driving them.

The image acquisition apparatus 11 has transmission type sensors that are arranged in a major direction with respect to the bank bills P conveyed in the minor direction. As shown in Fig. 2, a light emitting device 110 is disposed on one of the sides of the conveying surface 12a and a light receiving device 111 is disposed on the opposite side through the conveying surface 12a to receive transmitted light of the bank bill P. Incidentally, the light emitting device 110 and the light receiving device 111 may be arranged on one of the sides of the conveying surface 12a at predetermined angles, too.

The storage portion 13 temporarily stores the bank bills

P to be returned. The bill accommodation cartridge 14 accommodates the bank bills P in accordance with the kind of the bank bills.

As shown in Fig. 3, the storage device 15 stores an execution program for driving the processor, reference information for judging the kind of the bills P and the conveying direction of the bank bills P, information representative of the bank bill number and the existence position of the transmission window, information on the circulatability judgment reference of the bank bills P and security information for executing security judgment. These kinds of information are stored respectively in an execution program storage area 150, a reference information storage area 151, an existence position storage area 152, a circulatability judgment reference storage area 153 and a security information storage area 154. As shown in Fig. 4, the reference information storage area 151 for judging the kind of the bank bills and the conveying direction stores in advance density pattern data about transmitted light for each of several check points provided according to the kind of the bank bills and in the conveying direction. The existence position storage area 152 for storing the existence position of the bank bill number and the existence position of the transmission window stores information of rectangular regions A1 and A2 (see Fig. 8) in which the bill number and the transmission window exist

such as distance information from an end of the bank bill P to each side of the rectangular regions including the bank bill number and the transmission window for each of the kind of the bank bills and the conveying direction. The circulatability judgment reference storage area 153 stores a reference value with respect to a maximum defective area of the bank bill number region of the bank bill P that is permitted for circulation of the bank bill P and a reference value with respect to a maximum defective area of the transmission window of the bank bill P to the defective area that is needed for circulation of the bank bill P.

The conveying mechanism 12, the image acquisition apparatus 11, the storage device 15 and the microprocessor operate in cooperation with one another and drive medium information acquisition means 20, bill kind judgment means 21, conveying direction judgment means 22, defective area calculation means 23, circulatability judgment means 24 and security judgment means 25 that are shown in Fig. 5.

Among them, the medium information acquisition means 20 is mainly constituted by the image acquisition means 11 and the microprocessor for controlling the former. The light emitting device 110 irradiates at a predetermined timing the rays of light to the bank bills P serially conveyed from the insertion port 10, receives transmitted light of the bank bill P and acquires black-and-white image data covering the bank

bill P as a whole. To acquire this black-and-white data, a plurality of reference values are set in advance to transmitted light of the bank bill P and classification processing such as "bright", "intermediate" and "dark" is executed for each check point of the bank bill P by using the reference values as shown in Fig. 4. Incidentally, this medium information acquisition means 20 may acquire color image data besides the black-and-white data. When a magnetic sensor and a thickness sensor are provided, magnetic data and thickness data of the bank bill P may be also acquired by using such sensors.

The bill kind judgment means 21 judges the kind of the bank bill P conveyed and judges the kind of the bank bill on the basis of the image information acquired by the medium information acquisition means 20. The conveying direction judgment means 22 judges the direction of the face of the bank bill P conveyed in the minor direction and similarly judges the conveying direction on the basis of the image information acquired by the medium information acquisition means 20. As shown in Fig. 6, when the bank bill P is conveyed in the minor direction, the conveying direction has four patterns, that is, (a) conveying in a first direction with a first face facing upward, (b) conveying in a direction opposite to the first direction with the first face facing upward, (c) conveying in the first direction with the first face facing downward and (d) conveying in the direction opposite to the first direction

with the first face facing downward. The kind of the bank bill P and the conveying direction are judged by comparing the density pattern data of the bank bill P acquired from the image acquisition apparatus 11 with the density pattern data for each of the kind of the bank bill and the conveying direction stored in advance in the reference information storage area 151.

The defective area calculation means 23 first reads out the bill number position and the existence position of the transmission window from the existence position storage area 152 on the basis of the kind of the bank bill and its conveying direction judged by the bill kind judgment means 21 and by the conveying direction judgment means 22, and calculates the defective areas in the bank bill number region A1 and the transmission window region A2. When the defective areas in the bank bill number region A1 and the transmission window region A2 are calculated, the pixels whose transmitted light is judged as "bright" are extracted from the pixels in each region. The defective area is calculated based on the number of the pixels thus extracted. When the defective area of a region A3 other than the frame region is likewise calculated, the pixels judged as "bright" in the region A3 other than the bank bill number region A1 and the transmission window region A2 are extracted and the defective area is calculated from the number of pixels. Incidentally, the term "defective area" is the concept that represents not only the actual area but

includes also the total number of pixels. Generally, because the defective portions such as holes and ruptures do not exist in the bank bill region A1 and the other region A3 (exclusive of the existence region of the transmission window; hereinafter called "other region") in the bank bill P judged as normal, transmitted light is judged as "dark" or "intermediate". In the normal bank bill P in which the transmission window exists, on the other hand, the rays of light transmit through the region in which the transmission window exists and the region is judged as "bright".

The circulatability judgment means 24 judges whether or not the bank bill is suitable as the circulating bank bill from the defective area of each region calculated by this defective area calculation means 23. In this circulatability judgment processing, the defective condition is judged by use of the circulatability reference value set for each of the bank bill number region A1, the transmission window region A2 and the other region A3. When any one of the circulatability judgment proves NG, the output representing that the bank bill P must be returned is created. In setting of the circulatability reference values, the circulatability reference value of the other region A3 as the non-important region is set relatively gently whereas the circulatability reference values of the bank bill number region A1 and the transmission window region A2 as the important regions are set much more strictly. In

consequence, rejection of the acceptance of the bank bill P having only a limited defect of the non-important portion can be prevented.

It will be assumed, for example, that the defective area calculation means 23 calculates the defective areas in the bank bill number region A1 and the transmission window region A2 by extracting the pixels whose transmitted light is judged as "bright" among the number of pixels in these regions, and that the defective area of the bank bill region A1 is found to be a_1 and the transmission window region A2 is a_2 . Similarly, the defective area of the region A3 other than the frame regions is assumed to be a_3 . At this time, the circulatability judgment means 24 compares these values with the circulatability reference value a_1 (reference), a_2 (reference) and a_3 (reference) set for each of the bank bill number region A1, the transmission window region A2 and the other region A3 stored in the circulatability judgment reference storage area 153. The circulatability judgment is OK when $a_1 \leq a_1$ (reference), NG when $a_1 > a_1$ (reference), OK when $a_2 \geq a_2$ (reference), NG when $a_2 < a_2$ (reference), OK when $a_3 \leq a_3$ (reference) and NG when $a_3 > a_3$ (reference).

The security judgment means 25 performs security judgment for the bank bill P that is judged as the bank bill under the good condition as a result of the circulatability judgment. This processing discriminates authenticity of the

bank bill P by reading the security information such as the magnetic information or the micro characters existing inside the bank bill P and comparing the information with the information stored in the security information storage area 154.

Next, the processing flow in the bank bill processor 1 having such a construction will be explained with reference to Fig. 7.

First, when the bank bill P is charged into the insertion port 10, the sensor (not shown in the drawing) provided to the insertion port 10 detects the insertion (Step S1), delivers the bank bills P one by one and conveys each bank bill P to the image acquisition apparatus 11 (Step S2). When the bank bill P is conveyed to the image acquisition apparatus 11, the light emitting device 110 irradiates light at a predetermined timing and acquires the image information of transmitted light of the bank bill P (Step S3). The information of this transmitted light is outputted to the bill kind judgment means 21 and to the conveying direction judgment means 22 and the density pattern data of "bright", "intermediate" and "dark" is generated by use of the predetermined reference values (Step S4). This density pattern data is compared with the density pattern data conforming to the former and extracted from the reference information storage area 151 to discriminate the kind of the bank bill and the conveying direction (Step S5).

Next, the bill number position of the bill kind and the transmission window existence position in the conveying direction are extracted from the existence position storage area 152 on the basis of the bill kind and the conveying direction so discriminated (Step S6). The pixels judged as "bright" in the bill number region A1 are detected to calculate the area (Step 7) and the pixels judged as "bright" in the transmission window area A2 are extracted to calculate the area (Step S8). The pixels judged as "bright" in the other region A3 are detected in parallel to calculate the area (Step S9).

The defective area in the bank bill number region A1, the defective area in the transmission window region A2 and the defective area in the other region A3 are compared with the respective circulatability reference values stored in the judgment reference storage areas (Steps S10 to S12). When any one of them fails to satisfy the reference condition (Step S13), the output is generated to return the bank bill P (Step S14). In other words, when the defective area of the bank bill number region A1 is greater than the circulatability reference value or when the defective area in the transmission window region A2 is smaller than the circulatability reference value, or when the defective area in the other region A3 is greater than the circulatability reference value, the output is generated to return the bank bill P. On the other hand, when all these reference information are satisfied, that is, when the

defective area of the bank bill number region A1 and the defective area in the other region A3 are smaller than the circulatability reference value or when the defective area in the transmission window region A2 is greater than the circulatability reference value, the security judgment processing for the bank bill P is thereafter executed (Step S15). When the bank bill P is judged as the normal bank bill P as a result of the security judgment, the bank bill P is conveyed to and accommodated into the bank bill accommodation cartridge 14 (Step S16). When the bank bill P is judged as a forged bill, the return processing of that bank bill P is executed (Step S14).

As described above, this embodiment discriminates the portion having high importance and the portion having low importance in the bank bill P, individually sets the reference values of the circulatability judgment for the respective regions and judges the defective condition. Therefore, even when the defect is only a limited defect in the non-important portion, rejection of acceptance of such a bank bill P can be prevented and the acceptance ratio of the bank bills P can be improved.

The embodiment of the invention judges the defective condition of the bank bill P by use of the defective area but the defective condition may be judged by determining a defective ratio from the defective area and using this ratio.

In this case, the circulatability judgment reference storage area 153 stores the "ratio" as the circulatability reference value for a specific region and executes the judgment by use of the ratio as the circulatability reference value.

This embodiment detects the four patterns in the minor direction as the conveying direction of the kind of the bank bill. When the bank bills are conveyed in the major direction, however, the four patterns in the major direction may be detected as well. Though this embodiment judges the direction of the bank bills P conveyed, the direction of the bank bills P put on the image acquisition means 11 may be judged besides the bank bills P conveyed.

Though the bank bill processor 1 for judging the detective condition of the bank bills P has been explained in this embodiment, the invention can be applied to all the media having a value besides the bank bills. Examples of the media having the value include a security, a stock, a monetary note, and so forth.

The embodiment given above explains the discrete apparatus. When bank bill processors not having the circulatability judgment function are connected to a network, however, it is possible to down-load a program from a server storing this circulatability judgment program and to use the program. It is further possible to store the circulatability judgment program in storage means of the apparatus by use of

a recording medium such as a CD-ROM.

The invention divides the value medium into the important portion and the non-important portion, sets the circulatability reference value for each portion and judges the defective condition. Therefore, the invention can prevent rejection of the acceptance of the bank bills having only a limited defect in the non-important portion.

CLAIMS

1. A value medium processor for judging circulatability of a value medium from a defective area of said value medium, comprising:

kind judgment means for judging a kind of said value medium;

direction judgment means for judging a direction of said value medium;

region storage means for storing a region in which intrinsic pattern information of said value medium exists for each of the kind and the direction of said value medium;

defective area calculation means for reading the region of said intrinsic pattern information from said region storage means from the kind of said value medium judged by said kind judgment means and from the direction of said value medium judged by said direction judgment means, calculating a defective area of the region of said intrinsic pattern information and a defective area of regions other than the region of said intrinsic pattern information;

judgment reference storage means for individually storing circulatability judgment references for the defective area of the region in which said intrinsic pattern information exists and for the regions other than the region in which said intrinsic pattern information exists; and

circulatability judgment means for judging

circulatability of said value medium on the basis of the respective calculation results and the respective judgment references stored in said judgment reference storage means.

2. A value medium processor for judging circulatability of a value medium from a defective area of said value medium having a transmission window, comprising:

kind judgment means for judging a kind of said value medium;

direction judgment means for judging a direction of said value medium;

region storage means for storing a region in which a transmission window of said value medium exists for each of the kind and the direction of said value medium;

defective area calculation means for reading a region of said transmission window from said region storage means from the kind of said value medium judged by said kind judgment means and from the direction of said value medium judged by said direction judgment means, calculating a defective area of the region of said transmission window and a defective area of regions other than the region of said transmission window;

judgment reference storage means for individually storing circulatability judgment references for the defective area of the region in which said transmission window exists and for the regions other than the region in which said transmission window exists; and

circulatability judgment means for judging
circulatability of said value medium on the basis of the
respective calculation results and the respective judgment
references stored in said judgment reference storage means.