

Specification

MAGNETIC CARD READER AND MAGNETIC DATA READING METHOD

[Field of the Invention]

[0001]

The present invention relates to a magnetic card reader that carries out at least either of reading and writing magnetic data recorded in a card-like medium made of paper, plastic, and the like; as well a magnetic data reading method.

[Background]

[0002]

Since early times, a card-like medium; for example a credit card, a pre-paid card, a cash card and the like; includes magnetic data such as specific information recorded in a magnetic stripe formed on the card-like medium. Used for recording magnetic data into such a card-like medium is, for example, a frequency modulation (FM) method (F2F method) that makes use of a combination of two types of frequencies. For regenerating magnetic data recorded with such a frequency modulation (FM) method, a magnetic head relatively slides with respect to the magnetic stripe of the card-like medium to acquire the magnetic data as analog signals, which are subsequently converted (demodulated) into digital signals, and then taken into a CPU (a decoding section) (Refer to Patent Document 1). In the case of a magnetic card reader disclosed in Patent Document 1, analog signals output from the magnetic head and amplified through a amplifying section are then demodulated in an F2F demodulating section so as to output a card transfer signal, a clock signal, and a data signal.

[0003]

Generally speaking, in a magnetic card reader of a swiping operation type (by a manual transfer method), resources such as a memory are often provided with restriction in order to materialize an inexpensive configuration (i.e., a magnetic card reader equipped with a small size of memory is used). Therefore, occasionally the size (capacity) of a buffer for storing magnetic data cannot include a sufficient allowance (margin). If once the size of magnetic data read exceeds the size of the buffer, the excessive part of the magnetic data read is omitted, and meanwhile the part of the magnetic data stored in the buffer is transmitted to a higher-level device unconditionally.

[0004]

Patent Document 1: Japanese Unexamined Patent Application

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[Disclosure of the Invention]

[Problems to Be Solved]

[0005]

However, in the case of a magnetic card reader in which data stored in a buffer is unconditionally transmitted to a higher-level device, there exists a problem of environment resistance. In a radio-wave test (an immunity test) in which radio-waves of a certain frequency range are continually transmitted, the magnetic card reader affected by radiation in sympathetic vibration with a circuit constant may misjudge that it has received magnetic data, and it stores the magnetic data into the buffer. Eventually, though the magnetic data itself is meaningless, the magnetic data stored in the buffer is unconditionally transmitted from the magnetic card reader to the higher-level device. As a result, an error handling operation is carried out in the higher-level device. When the magnetic card reader is installed under the same environment as the radio-wave test, the higher-level device needs to carry out error handling operation so frequently that consequently the environment resistance performance such as resistance against radio-waves, resistance against noises, and the like becomes worsened. Furthermore, when the higher-level device is frequently requested to carry out the error handling operation, the operation stability of the system may be weakened.

[0006]

It is a object of the present invention to provide a magnetic card reader that can improve its environment resistance performance.

[Means to Solve the Problems]

[0007]

To achieve the objects described above, the present invention provides the following aspects.

[0008]

(1) A magnetic card reader, for reading magnetic data recorded in a card-like medium by using a magnetic head, including: a storage section for storing the magnetic data read and acquired by using the magnetic head; a comparing section for comparing the total number of data in the magnetic data with a prescribed threshold; and a judgment section for judging that the magnetic data is effective data when the total number of data in the magnetic data is less than or equal to the prescribed threshold in the comparing section.

[0009]

According to the present invention; when "the total number of data" in the

magnetic data read and acquired by using the magnetic head is less than or equal to the prescribed threshold, the magnetic data is dealt with as effective data. Therefore, as far as the effective magnetic data is transmitted to a higher-level device, it is not necessary for the higher-level device to carry out error handling operation so often, and accordingly it becomes possible to eliminate false recognition on data receiving caused by radio waves, and to improve the environment resistance performance.

[0010]

(2) The magnetic card reader; wherein the comparing section compares the total number of data in the magnetic data with the prescribed threshold, if the total number of data in the magnetic data is greater than the number of data in magnetic data stored in the storage section.

[0011]

According to the present invention, the comparing section functions when magnetic data read by the magnetic head exceeds the storage capacity of the storage section. Therefore, it is not required to always fulfill the function of the comparing section. Accordingly, a software-wise processing load can be reduced.

[0012]

(3) The magnetic card reader; wherein the magnetic card reader further includes a counter for counting the total number of data in the magnetic data and the number of the data in magnetic data stored in the storage section.

[0013]

According to the present invention, the counter function makes it possible to easily count "the total number of data" in the magnetic data; and therefore, it becomes possible as described above to improve the environment resistance performance such as resistance against radio-waves, resistance against noises, and the like.

[0014]

Especially, in the present invention, the counter is prepared for counting not only the number of the data in magnetic data stored in the storage section, but also the total number of data in the magnetic data. To describe in detail; in a conventional magnetic card reader, if once the magnetic card reader has read magnetic data (through reading operation) exceeding the storage capacity of the storage section (an uppermost limit of the buffer), counting the number of data in the read data (through reading operation) gets stopped. Then, magnetic data, being detected, is once stored in the storage section, but the conventional

magnetic card reader has a configuration in which the magnetic data is thrown away if the magnetic card reader has read magnetic data being greater than the storage capacity. Therefore, the uppermost limit for counting the number of data is equal to the storage capacity. Consequently, in this case, although the number of data in the magnetic data stored in the storage section can be counted, it is unknown how large number of data in the magnetic data is actually counted (the total number of data in the magnetic data). However, the counter placed in the magnetic card reader according to the present invention can count both the total number of data in the magnetic data and the number of data in the magnetic data stored in the storage section.

[0015]

Incidentally, the "counter" in the present invention may be physically-multiple counters, or it may as well be a single counter having multiple variables. Still otherwise, the "counter" may be a single counter having a single variable but having separate variable ranges individually, or it may as well have any other mode.

[0016]

(4) The magnetic card reader; wherein the prescribed threshold is a value calculated by adding a prescribed number of data to the number of data in the magnetic data recorded in the magnetic card specified according to ISO standards.

[0017]

According to the present invention, when a magnetic card conforming to ISO standards is swiped or inserted, it can be judged accurately whether the magnetic data acquired by using the magnetic head is effective or not. Incidentally, the "prescribed number of data" in the present invention is a value specified according to experiments and experience; and for example, it can be 10% of the number of data in the magnetic data recorded in the magnetic card specified according to ISO standards.

[0018]

(5) The magnetic card reader; wherein magnetic data judged to be effective by the judgment section is transmitted to a higher-level device; and meanwhile magnetic data judged not to be effective by the judgment section is omitted.

[0019]

According to the present invention, the number of transmitting operations of transmitting erroneous magnetic data from the magnetic card reader to the

higher-level device can be reduced. As a result, the number of error handling operations in the higher-level device can be decreased, so that the environment resistance performance of the magnetic card reader such as resistance against radio-waves, resistance against noises, and the like can be improved.

[0020]

Incidentally, "omit" in this context means not only deleting magnetic data but also ignoring the magnetic data software-wise (not dealing with it as effective magnetic data) without deleting it.

[Effect of the invention]

[0021]

As described above; according to the present invention, magnetic data read and acquired by using the magnetic head is dealt with as effective magnetic data when the total number of data in the magnetic data is less than or equal to a prescribed threshold. Therefore, the number of error handling operations in the higher-level device can be decreased, wherein errors are caused due to problems of the environment in which the magnetic card reader is installed, so that the environment resistance performance of the magnetic card reader such as resistance against radio-waves, resistance against noises, and the like can be improved.

[Description of the Preferred Embodiments]

[0022]

Embodiments of the present invention are described below with reference to the accompanying drawings.

[0023]

FIG. 1 is a schematic view showing an overview of a magnetic card reader 1 according to an embodiment of the present invention.

[0024]

In FIG. 1, the magnetic card reader 1 includes: a frame 2, having its almost U-shaped cross section perpendicular to a swiping (manual transfer) direction and constituting a card transfer path; a datum surface for transfer motion 3 formed as a part (a bottom) of the frame 2; and a magnetic head 5 for reading magnetic data recorded in a magnetic stripe 41 on a surface of a card 4 (as an example of a card-like medium), or writing magnetic data into the card. As a two-direction arrow shows in the drawing, when the card 4 is swiped (transferred manually) along the datum surface for transfer motion 3 in the magnetic card reader 1, the magnetic data is read. Incidentally, though the magnetic head 5 of a read-only type is used in the present embodiment, a magnetic head provided with

both a reading function and a writing function may be used instead. "Swiping" in the present specification means an operation of quickly and manually moving a card-like recording medium along a guide (the card transfer path) of the magnetic card reader 1.

[0025]

The magnetic head 5 is so placed as to be present at the card transfer path. Then, the magnetic head 5 reproduces a signal according to the magnetic data of the card 4. Specifically to describe, when the magnetic stripe 41 on the surface of the card 4 contacts and slides over the magnetic head 5, the magnetic head 5 reads the magnetic data recorded in the magnetic stripe 41 and reproduces a regenerative signal according to the magnetic data.

[0026]

FIG. 2 is a block diagram showing an electrical structure of the magnetic card reader 1 according to the embodiment of the present invention.

[0027]

In FIG. 2, the magnetic card reader 1 according to the embodiment of the present invention chiefly includes: the magnetic head 5, a CPU 101, an AMP circuit 102, a demodulating circuit 103, and a RAM 104, and a ROM 105. Incidentally, the RAM 104 and the ROM 105 may be built in the CPU 101 (as a built-in ROM and the like). In general, the ROM 105 includes a base program supporting a basic function of the magnetic card reader 1, and meanwhile the RAM 104 functions as a working area for the CPU 101.

[0028]

Governing a central control core of the magnetic card reader 1, the CPU 101 integrally controls the magnetic card reader 1. The regenerative signal from the magnetic head 5 is amplified and waveform-shaped at the AMP (amplifying) circuit 102; demodulated at a demodulating circuit 103 (through binarizing the read signal); and then subsequently transmitted to the CPU 101.

[0029]

The CPU 101 communicates with a higher-level device 10 through an I/F circuit (not shown). In the higher-level device 10, a CPU 110 carries out demodulation processing on binary digital data by using a decoder 106. As a result, the higher-level device 10 can acquire contents of the magnetic data.

[0030]

In the magnetic card reader 1 according to the embodiment, electrical components, such as the CPU 101, the RAM 104, and the ROM 105, constitute a 'comparing section' and a 'judgment section'. More specifically to describe, the

ROM 105 stores a comparing program for comparing the total number of data in the magnetic data read and acquired by using the magnetic head 5 with a prescribed threshold, as well as a judgment program for judging that the magnetic data is effective data when the total number of data in the magnetic data is less than or equal to the prescribed threshold. Then, using the RAM 104 as a working area, the CPU 101 materializes the functions of the 'comparing section' and the 'judgment section' through executing these programs. Incidentally, in the embodiment, the prescribed threshold is stored in the RAM 104, but the threshold may as well be stored in a memory such as an EEPROM or the like prepared separately. Furthermore, in the embodiment, the prescribed threshold is specified with a value calculated by 10% increase of the number of data in the magnetic data recorded in the card 4 specified according to ISO standards.

[0031]

Furthermore, the ROM 105 also stores a transmission program for transmitting the magnetic data, which the 'judgment section' has judged to be effective, to the higher-level device 10; a omitting program for omitting the magnetic data, which the 'judgment section' has judged not to be effective; and the like. Then, using the RAM 104 as a working area, the CPU 101 executes these programs.

[0032]

Moreover, the RAM 104 functions as a re-writable 'storage section' that stores the magnetic data read by using the magnetic head 5. Incidentally, in the present embodiment, the RAM 104 is a re-writable storage section and a part of the memory area of the RAM 104 is used as a 'data storage buffer', but for example, an entire part of the memory area of the RAM 104 may be used as a 'data storage buffer'.

[0033]

Furthermore, the CPU 101, the RAM 104, and the like also work as a counter for counting the total number of data in the magnetic data read and acquired by using the magnetic head 5, and counting the number of data in the magnetic data stored in the data storage buffer. Incidentally, being separately from the CPU 101, a counter may be prepared. Explained below in detail is an operation flow of a magnetic data reading method according to the electrical structure describe above.

[0034]

FIG. 3 is a flowchart showing an operation flow of a magnetic data reading method according to the embodiment of the present invention.

[0035]

In FIG. 3, it is judged at whether the magnetic data reading operation (reading the magnetic data) has already finished or not (Step S1). Specifically to describe, the CPU 101 of the magnetic card reader 1 judges whether reading the magnetic data by using the magnetic head 5 has already finished or not. If reading the magnetic data has not yet finished (Step S1: NO), the CPU 101 updates a total detection number counter (Step S2). Incidentally, as shown in FIG. 4, the 'total detection number counter' is used for counting up the number of data (the total number of data) in the detected magnetic data, being irrelevant to the size of the data storage buffer.

[0036]

Next, the CPU 101 judges whether the data storage buffer has an available space or not (Step S3). If it is judged that the buffer has an available space (Step S3: YES), the magnetic data is stored in the data storage buffer (Step S4). Then, at the same time, a stored data counter gets updated (Step S4). Incidentally, as shown in FIG. 4, the 'stored data counter' keeps on counting up until the data storage buffer becomes full. In the case of an example of FIG.4, the size "N" of the data storage buffer is the maximum value of the stored data counter. In the present embodiment, "N" shows the number of magnetic data that can be recorded in one line in a longitudinal direction of the card 4.

[0037]

As described above, the magnetic data of the card 4 is read by the magnetic card reader 1, and stored in the data storage buffer. The magnetic data is composed of bitwise serial data. Then, while reading bitwise serial data sequentially, the magnetic card reader 1 detects an interrupt signal for each bit. Namely, an interrupt signal is generated at each time of reading the serial data of each bit, and then the magnetic data of the card 4 is stored in the data storage buffer of the magnetic card reader 1, corresponding to each of 0-bit, 1-bit, - - - (N-1)-bit. Then, at the time when the magnetic data is stored in the data storage buffer, the stored data counter counts up according to the interrupt signal generated for each bit. The stored data counter keeps on counting up until the data storage buffer becomes full.

[0038]

In the meantime, according to the interrupt signal described above, the total detection number counter counts up the number of data (the total number of data) in the detected magnetic data, being irrelevant to the size of the data storage buffer. In other words; when the magnetic data is stored in the data

storage buffer, the total detection number counter also counts up according to the interrupt signal while the stored data counter counts up on the other hand. Furthermore, even after the data storage buffer has been filled with the magnetic data, i.e., even after the stored data counter has stopped counting up, the total detection number counter still counts up according to the interrupt signal read by the magnetic card reader 1. On this occasion, the read magnetic data is omitted, without being stored.

[0039]

Then, after the process of Step S4 finishes, operation returns to Step S1 to repeat the processes of Step S1 to Step S4 until reading the magnetic data finishes. Incidentally, even when there exists no space in the data storage buffer at the process of Step S3 (Step S3: NO), operation also returns to Step S1 in the same manner. Therefore, in this case, the stored data counter is not updated (Namely, the stored data counter does not count the part exceeding the data storage buffer).

[0040]

If the reading operation of the magnetic data (reading the magnetic data) is already finished at the process of Step S1 (Step S1: YES), the CPU 101 judges whether the total detection number is greater than the prescribed threshold or not (Step S5). More specifically to describe, executing the programs described above; such as the comparing program, the judgment program, and the transmission program; as required, the CPU 101 transmits the data as effective magnetic data to the higher-level device 10 (Step S6) if the value indicated by the total detection number counter (the total number of data in the magnetic data) is less than or equal to the prescribed threshold (Step S5: NO).

[0041]

On the other hand, if the value indicated by the total detection number counter (the total number of data in the magnetic data) is greater than the prescribed threshold (Step S5: YES), the CPU101 executes the omitting program described above to omit the data (without the process of Step S6), and then executes the process of Step S7 (clearing the buffer). At the process of clearing the buffer, the counters may be cleared arbitrarily, as required.

[0042]

Thus, through making a comparison between the total number of data in the magnetic data and the prescribed threshold (Step S5), it becomes possible to transmit only the data, which is judged to be effective magnetic data, to the higher-level device 10. As a result, it becomes possible to eliminate false

recognition on data receiving caused by radio waves, and to improve the environment resistance performance such as resistance against radio-waves, resistance against noises, and the like. Although, in the embodiment, the process of Step S5 is necessarily carried out after completion of the reading operation of the magnetic data (reading the magnetic data), conditions for carrying out the process of Step S5 may be specified, for example, as shown in FIG. 5.

[0043]

FIG. 5 is a flowchart showing an operation flow of a magnetic data reading method according to a modification of the embodiment of the present invention.

[0044]

In FIG. 5, processes of Step S11 to Step S14 are the same as the processes of Step S1 to Step S4 in FIG. 3. Furthermore, processes of Step S16 to Step S18 are the same as the processes of Step S5 to Step S7 in FIG. 3. Therefore, one and only difference is a process of Step S15.

[0045]

Concretely to describe, due to presence of Step S15, a process of Step S16 by the 'comparing section' is carried out only when the total number of data in the magnetic data (a counter value of the total detection number counter = the total detection number) is greater than the number of data in the magnetic data stored in the data storage buffer (a counter value of the stored data counter = the number of data in the stored data) (Step S15: YES). This is because; if the total number of data in the magnetic data is greater than the number of data in the magnetic data stored in the data storage buffer, the detected magnetic data is highly likely ill-affected by radio disturbance so as not to be effective magnetic data, and therefore it is needed to carry out a comparison process using the threshold (Step S16).

[0046]

On the other hand, if the total number of data in the magnetic data is less than or equal to the number of data in the magnetic data stored in the data storage buffer (Step S15: NO), it is assumed that the stored magnetic data is effective, and then the data is transmitted to the higher-level device 10 (Step S17). When the total number of data in the magnetic data is less than or equal to the number of data in the magnetic data stored in the data storage buffer, a relationship described below is generally achieved: i.e., "the total number of data in the magnetic data is equal to the number of data in the magnetic data stored in

the data storage buffer.”

[0047]

If the comparison process is carried out only when an overflow is observed at the data storage buffer, it is not required to always fulfill a function of the comparing section. Accordingly, a software-wise processing load can be reduced.

[Advantageous effect of the embodiment]

[0048]

As described above, the magnetic card reader 1 according to the embodiment has a function of counting the number of data detected during the operation to the end (the total number of data in the magnetic data); i.e., the magnetic card reader 1 has a counter for counting the number of data stored in the data storage buffer, as well as a counter for counting the total detection number of the magnetic data. Therefore, it becomes possible to make a judgment software-wise by using a threshold in order to decrease a frequency of erroneous notifications to the higher-level device 10. For example, even in the case having effect of radio disturbance, it is possible to decrease a chance of transmitting an erroneous notification to the higher-level device 10. As a result, the environment resistance performance of the magnetic card reader 1, such as resistance against radio-waves, resistance against noises, and the like can be improved.

[0049]

Furthermore, wherein meaningless magnetic data, i.e., ineffective magnetic data is generated due to problems of the environment in which the magnetic card reader 1 according to the embodiment is installed (being attributed to a fact that the magnetic card reader 1 is installed under a poor environment in which, for example, radio-waves of a certain frequency range are continually transmitted); if such frequent transmission of meaningless magnetic data, i.e., ineffective magnetic data to the higher-level device 10, and frequent error handling operations for the data in the higher-level device 10 can be avoided, the operation stability of the system can be improved.

[0050]

Moreover, as already explained by using FIG. 5; if the comparison process (Step S16 in FIG. 5) is carried out only when the certain condition is fulfilled (Step S15: YES in FIG. 5), it is not required to always fulfill the function of the comparing section, and therefore, a software processing load can be reduced.

[0051]

Furthermore, used as the prescribed threshold is a value calculated by adding the prescribed number of data (10% in the embodiment) to the number of data in the magnetic data recorded in the magnetic card specified according to ISO standards. Thus, when the card 4 conforming to ISO standards is swiped (transferred manually), it can be precisely judged whether the magnetic data acquired by using the magnetic head 5 is effective data or not.

[0052]

Incidentally, at the time of precisely judging whether the magnetic data acquired by using the magnetic head 5 is effective data or not, a judgment is made software-wise by using a threshold. Therefore, adjusting the threshold at any timing arbitrarily enables coping flexibly with change of the environment, and improving the flexibility.

[0053]

In the embodiment described above, when the magnetic card reader 1 is provided with a learning function, it also becomes possible to optimize the thresholds autonomously. More specifically to describe; at an initial stage when the magnetic card reader 1 is installed in a prescribed spot, a judgment is made with initially-specified thresholds. However, the condition of the installation environment is not uniform, and sometimes the initially-specified thresholds are not optimum for the installation spot. Then, at the time of having detected an error, the objective number of data is stored, and it is compared with the threshold specified at the time. If the difference is less, the threshold are set to be greater step by step. The threshold are provided with their uppermost limits. The magnetic card reader may have a notifying function; such as flashing an LED, etc., or sending a command to the higher-level device, and the like; in order to give notice when either threshold reaches its uppermost limit, for prompting improvement of the condition of the installation environment.

[0054]

Furthermore, for changing the threshold, any one of a static method and a dynamic method may be applied. For example, a static method may be applied to specify the threshold by using dipswitches, etc. at the time of initially setting the magnetic card reader; or a dynamic method using a command, etc. may be applied as well to enable changing the threshold even while the magnetic card reader is in operation. By applying any such a method, a flexible action can be taken for dealing with a sudden change in the condition of the environment. Moreover, used in the embodiment is magnetic card reader of a swiping operation

type. However, the magnetic card readers are not limited to that type of device, and any other type of manual card reader, or a motor-driven card reader other than a manual-type device may be used as well.

[Industrial Applicability]

[0055]

The magnetic card reader according to the present invention is useful, for improving the environment resistance performance of the magnetic card reader such as resistance against radio-waves, resistance against noises, and the like.

[Brief Description of the Drawings]

[0056]

FIG. 1 is a schematic view showing an overview of a magnetic card reader according to the embodiment of the present invention.

FIG. 2 is a block diagram showing an electrical structure of the magnetic card reader according to the embodiment of the present invention.

FIG. 3 is a flowchart showing an operation flow of a magnetic data reading method according to the embodiment of the present invention.

FIG. 4 is an explanatory drawing for explaining a concept of a total detection number counter and a stored data counter.

FIG. 5 is a flowchart showing an operation flow of a magnetic data reading method according to a modification of the embodiment of the present invention.

[Reference Numerals]

[0057]

1. Magnetic card reader
2. Frame
3. Datum surface for transfer motion
4. Card
5. Magnetic head
101. CPU of the magnetic card reader
102. Amplifying (AMP) circuit
103. Demodulating circuit
104. RAM
105. ROM
106. Decoder
110. CPU of the higher-level device

CLAIMS

What is claimed is:

[Claim 1] A magnetic card reader, for reading magnetic data recorded in a card-like medium by using a magnetic head, comprising:

a storage section for storing the magnetic data read and acquired by using the magnetic head;

a comparing section for comparing the total number of data in the magnetic data with a prescribed threshold; and

a judgment section for judging that the magnetic data is effective data when the total number of data in the magnetic data is less than or equal to the prescribed threshold in the comparing section.

[Claim 2] The magnetic card reader according to Claim 1;

wherein the comparing section compares the total number of data in the magnetic data with the prescribed threshold, if the total number of data in the magnetic data is greater than the number of data in magnetic data stored in the storage section.

[Claim 3] The magnetic card reader according to either of Claim 1 or Claim 2;

wherein the magnetic card reader further comprises a counter for counting the total number of data in the magnetic data and the number of the data in magnetic data stored in the storage section.

[Claim 4] The magnetic card reader according to any one of Claim 1 to Claim 3;

wherein the prescribed threshold is a value calculated by adding a prescribed number of data to the number of data in the magnetic data recorded in the magnetic card specified according to ISO standards.

[Claim 5] The magnetic card reader according to any one of Claim 1 to Claim 4;

wherein magnetic data judged to be effective by the judgment section is transmitted to a higher-level device; and

meanwhile magnetic data judged not to be effective by the judgment section is omitted.