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Specification

Title of the Invention:

Method for processing defective sectors in a disk storage device, and a disk storage device

Detailed Description of the Invention:

[0001]

[Field of the invention]

The present invention relates to a disk storage device which searches for a defective sector on the disk and reassigns an alternate sector in advance, and a method for processing the defective sector in such a disk storage device.

[0002]

[Background art]

In recent years, as the capacity of the disk storage devise (disk storage) has been increased, in an AV (Audio Visual) application, dynamic image and sound are increasingly becoming stored in the disk storage device. In such an application, for real time input and output of the dynamic image and sound, it is required to define a lower limit value of the throughput of the storage, that is, to define a limit of its instantaneous performance degradation. However, in the conventional disk storage devices designed primarily to store static data, the average values of their throughput may be compared, but their instantaneous performance degradation is not taken into account. Therefore, when an error actually occurs, retries are executed as many times as possible to recover from the error. Then, when the number of retries reaches a predetermined number, it is decided that the sector is a defective sector, and reassignment of the defective sector is carried out.

[0003]

[Problems to be solved by the invention]

However, in the above described AV application, retries extending over a long time result in pause of the image and

dropout of the sound, and therefore cannot be accepted. Also, in the conventional disk storage devices, unless having access from a host, the devices are in the waiting state. Furthermore, because the reassignment of the defective sector is carried out when an error occurs during access from a host, depending on the number of retries, it may be a contributing factor of the instantaneous performance degradation. Furthermore, write errors are often associated with the servo system, and the occurrence of such errors in the servo system results in reassignments of the sector in which the error occurred and a plurality of subsequent sectors. Thus, many sectors are reassigned at a time, and this also greatly affects the instantaneous performance.

[0004]

An object of the present invention is to provide a disk storage device which can overcome the above described problems and avoid the instantaneous performance degradation as much as possible, and a method for processing a defective sector in such a disk storage device.

[0005]

[Summary of the invention]

A method for processing a defective sector in a disk storage device according to the present invention comprises the steps of: executing a predetermined check related to a function of the disk storage device, preferably at least one of a read test, write servo test and write test, when the disk storage device is in a waiting state where the disk storage device has no access from a host. Thereby, the read test and write servo test are to search for a defective sector on the disk and reassign the defective sector, and the write test is to indicate the abnormal condition of the head.

[0006]

According to the present invention, the waiting state of the disk storage device in which it has no access from a host is utilized to execute during that time the predetermined check, preferably the read test, write servo test, and write test, to reassign the defective sector and ascertain the status of the head in advance, thereby the probability that the reassignment will occur when the data is actually accessed by a host command can be reduced, and the performance degradation can be prevented.

[0007]

In the preferred embodiment of the present invention, it is contemplated that (1) if a host command is generated when each test is being executed, the test which is being executed is suspended, and the generated host command is given a priority and executed, (2) the disk storage device is provided with a register, in which the position of the sector which is accessed for the check currently being executed is stored, and the position is sequentially updated as the check proceeds, and wherein (a) the content of the register is stored in the disk when a predetermined time has elapsed after the supply of the command from the host stopped, so that the value of the accessed sector can be recovered even after the power is shut off and the content of the register is cleared, or (b) when a host command is provided during a check, the value of the accessed sector which is to be accessed to restart the check can be recovered by the content of the register, and that (3) the disk storage device is provided with a mode flag, in which the type of the test currently being executed is stored. In either case, the above described processing of the defective sector of the present invention may be executed.

[0008]

Furthermore, the disk storage device according to the present

invention comprises means for detecting that the disk storage device is in the waiting state, and means for executing a predetermined check related to a function of the disk storage device, preferably at least one of the read test, write servo test and write test, in response to the detecting means.

[0009]

[Preferred embodiment]

Figure 1 is a flowchart for describing an embodiment of a general concept of the method for processing the defective sector in the disk storage device of the present invention. In the description according to Figure 1, first, it is decided whether the disk storage device is in the waiting state (step S1). Referring to whether in the waiting state or not, if the device has no access from a host after a lapse of a predetermined time, it is decided that it is in the waiting state, and if the device has an access from a host within the predetermined time, it is decided that it is not in the waiting state. And, if the device is not in the waiting state, a host command which is currently executed, or generated within the above described predetermined time after the execution is finished, is executed (step S2).

[0010]

Next, if it is decided that the device is in the waiting state, first, a read test, a write servo test, and a write test are sequentially executed. That is, for searching for a defective sector, the read test is executed by serial reading, and the write servo test is executed by positioning the head to a writing position, and for deciding whether there is an abnormal condition in the head, the write test is executed by writing data to a particular sector. As a result, if a defective sector is found by the read test or write servo test, the defective sector is reassigned to an alternate sector formed in a spare area on the disk, and if the abnormal condition of the

head is found by the write test, the user is informed of it (step S3). Incidentally, the present invention can be achieved by executing at least one of these tests. This step S3 is repeated sequentially as long as the waiting state persists. If a command is provided by a host during each test, this command is given a high priority, and the test which is being executed is suspended, and the host command is executed.

[0011]

Each of the above described steps will be described below in more detail. In the following description, an embodiment will be described, in which a controller of the disk storage device is provided with a mode flag for indicating actually executed one of the read test, write servo test, and write test, and a register which stores an address value for indicating the sector currently being accessed.

[0012]

1. Decision on whether in the waiting state or not (step S1)

In step S1, in conjunction with POR (Power On Reset), the register is initialized. At this time, the content of the register may be restored to the state of the register during the previous activation, which is stored in the disk of the disk storage device. Next, when a predetermined time is elapsed after the supply of the command from the host stopped, it is decided that the device is in the waiting state by the MPU in the disk storage device, and the content of the register as of that point in time is written to the disk. This is preferred, because at the time of next execution, reference to the content allows the head to be moved directly to the sector at the position where the test is to be executed. The content of the register is sequentially updated as the address of the sector which is accessed during execution moves.

2. Execution of the host command (step S2)

In step S2, in the condition that the host commands are continuously provided to the disk storage device, in other words, in the condition that the next host command is generated within a predetermined time after the supply of a host command stopped, it is decided that the disk storage device is not in the waiting state, and it executes the host commands.

[0014]

3. Performing of the test and reassignment (step S3)

In step S3, the MPU in the disk storage device complies with the microcode to test the function of the disk storage device, for example, in the order of the read test, write servo test, and write test. Then, if a defective sector is found by the read test or write servo test, the defective sector is reassigned by allocating it to a sector in the area for reassignment of the disk. If a failure of the head is found by the write test, the user is informed of it, for example, by means of indicating the presence of defect in this disk storage device on the display. The content of the mode flag is sequentially updated according to the content of the test which is actually being executed.

[0015]

Here, the read test is to sequentially execute reading on all the tracks, and decide that the sector in the tracks which cannot be read is the defective sector. This read test is executed on all the tracks, that is, regardless of whether the data-recorded areas or data-unrecorded areas, and if a defective sector is found, reassigns it. The write servo test is to offset the head to the writing position in each track, and measure the precision of the positioning in each servo

sector. If it is decided that the precision of the positioning is low in a sector, it is decided that the sector is a defective sector, and the defective sector and a plurality of subsequent sectors are reassigned. The write servo test is sequentially executed on all tracks, and it is enough to measure the dispersion and average value of about 10 laps of each track. The write test is to write data to the area for the write test identified on each disk face in advance, read this area, and to ascertain whether the data is written. If the data is not properly written, it is decided that the head has an abnormal condition, and the user is informed of it.

[0016]

If a host command is provided during a test, this host command is given a high priority and executed. When the execution of the host command is finished, then the previously suspended test is executed according to the type of the test suspended and the sector address value obtained from the content of the mode flag and the content of the register. During the test, the content of the register is preferably saved in the disk at appropriate time intervals, or once in an appropriate number of accesses. Then, when the test has been completed, the test is executed again from the start. Alternatively, the next test may be started after a certain time.

[0017]

Figure 2 shows an embodiment of the configuration of the disk, on which the method for processing a defective sector in a disk storage device of the present invention is executed. The disk shown in Figure 2 is provided with an area for the write test R1, a data-recorded area R2, a data-unrecorded area R3, and an area for reassignment R4, from the outer peripheral to the inner peripheral on it. Here, the area for the write test R1 is the area which is written in the write test. The area for reassignment R4 is the area in which the reassignment is executed when the defective sector is found in the read test or

write servo test. In the method for processing the defective sector in a disk storage device of the present invention, whenever the device is in the waiting state, the test is executed so that the defective sector is reassigned and the abnormal condition of the head is ascertained. Therefore, even if it is temporarily decided that a sector is the defective sector due to refuse and dust, when the test is executed again under the condition of refuse and dust being removed, it is decided that sector is not the defective sector, thus the optimal disk access may be provided at all times. And as shown in Figure 2, if there is a data-unrecorded area R3 on the disk, the temporal performance degradation during recording of data to the data-unrecorded area R3 can be conveniently prevented.

[0018]

[Advantages of the invention]

As will be obvious from the above described description, according to the present invention, by executing the test for the defective sector and the abnormal condition of the head at all times during the waiting state, the defective sector and the abnormal condition of the head may be found independently of an access from a host, and then the defective sector may be reassigned, or the abnormal condition of the head may be informed to the user, thus the instantaneous performance degradation associated with the recovery can be prevented.

4. Brief Description of the Drawings:

Figure 1 is a flowchart for describing an embodiment of a general concept of the method for processing the defective sector in the disk storage device of the present invention; and

Figure 2 shows an embodiment of the configuration of the disk, on which the method for processing a defective sector in a disk storage device of the present invention is executed.

[Description of symbols]

R1 ... Area for the write test
R2 ... Data-recorded area
R3 ... Data-unrecorded area
R4 ... Area for reassignment



Claims:

(1) A method for processing defective sectors in a disk storage device, comprising the step of:

executing a predetermined check related to a function of the disk storage device when the disk storage device is in a waiting state where the disk storage device has no access from a host.

(2) The method for processing defective sectors in a disk storage device according to Claim 1, wherein said predetermined check comprises at least one of a read test, write servo test and write test, the read test and write servo test are used to search for the defective sectors on disks and reassign the defective sectors, and the write test is used to indicate an abnormal condition of heads.

(3) The method for processing defective sectors in a disk storage device according to Claim 1, wherein, in the case where a host command is generated while said predetermined check is being executed, the check which is being executed is suspended, and the generated host command is given priority and executed.

(4) The method for processing defective sectors in a disk storage device according to Claim 1, wherein the disk storage device is provided with a register, in which the position of the sector which is accessed for the check

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currently being executed is stored, and the position is sequentially updated as the check proceeds, and wherein (a) the content of the register is stored in the disk when a predetermined time has elapsed after the supply of the command from the host stopped, so that the value of the accessed sector can be recovered even after the power is shut off and the content of the register is cleared, or (b) when a host command is provided during the check, the value of the accessed sector which is to be accessed to restart the check can be recovered by the content of the register.

(5) The method for processing defective sectors in a disk storage device according to Claim 4, wherein the content of said register is stored in the disk at regular time intervals, or once in a certain number of accesses.

(6) The method for processing defective sectors in a disk storage device according to Claim 1, wherein the disk storage device is provided with a mode flag, in which the type of the test currently being executed is stored.

(7) A disk storage device, comprising:

means for detecting that the disk storage device is in a waiting state; and

means for executing a predetermined check related to a function of the disk storage device in response to said detecting means.

(8) The disk storage device according to Claim 7, wherein said predetermined check comprises at least one of the read test, write servo test and write test.