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REMOVABLE COMPUTER DATA STORAGE MEDIUM WITH VISIBLE MUTABLE BULK PROPERTY INDICATION

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Abstract
[0001] A system and method is provided wherein a data storage medium, such as a magnetic tape cartridge, includes visual indicia that reflects a changeable property of the medium, such as whether and how much data has been written to the medium.

Background
[0002] Certain existing systems include visual indications on removable physical computer data storage media to indicate various unchanging properties, such as the volume serial number of the medium, or the capacity or technology of the medium. For instance, vendors may use dark red cases for LTO-5 tape cartridges and black cases for LTO-6 tape cartridges. Certain existing systems also include indicators (e.g., LEDs) on tape and disk drives that indicate changing properties of the drives (e.g., power, errors, activity, etc).
[0003] When operations personnel are dealing with large numbers of physical removable data storage media units (e.g., tape cartridges or disk packs), there may be confusion regarding dynamic properties of the unit. For instance, a set of empty tapes intended for insertion into a tape library for writing might be confused with a set of full tapes destined for remote vaulting, resulting in the empty tapes being put into a truck to the vault, and full tapes being inserted back into the library, resulting in wasted time and effort or data loss.

Example System And Method
Figure 1 illustrates a computer-data storage media with indicia having a visual characteristic that is based on a dynamic property of the media. For instance, the media may be a tape cartridge 100 that includes visual indicia 110 disposed on an outer surface of the cartridge’s housing.

Figure 2 illustrates a system that may be used in connection with the tape cartridge 100. A computing device, such as server 250, may include a processor 260 and memory 270. Server 250 may control a tape drive 200, which may include a processor 210, a read/write head 220 and an input/output interface 230 for communicating with a logic circuitry stored in the cartridge 100. The cartridge 100 itself may include magnetic tape 130, indicia 110 for indicating whether data has been written to the tape, a logic circuitry 280 such as a computer chip (as explained in more detail below), and an input/output interface to the chip 290.

Figure 3 illustrates one possible aspect of using visual indicia to provide information about a mutable property of computer-data storage media. A panel 330 may be disposed on or adjacent to the outer housing of the cartridge 100 (also visible in Figure 1). The panel may be further disposed in a groove or the like that allows the panel to slide parallel to the side of the housing to which it is adjacent. A spring may be connected at one end to the panel and at the other end to a bar that is fixed in place relative to the housing, such that the spring pulls the panel towards bar 340. The panel may be initially held in place in spite of the bias of the spring by a catch 360, which is attached to the panel 330 and hooked around leader pin 120. In its initial position, the panel may hide visual indicia 110 from view. For instance, indicia 110 may be
a brightly colored marking or sticker that is affixed to the housing and is disposed between the outer surface of the housing and the panel when the panel is in its initial position.

[0007] One possible operation of the cartridge 100 is shown in Figures 4-6. Figure 4 illustrates the leader pin 120 being pulled out of the cartridge by a tape drive (not shown) so that the tape drive can access the tape. As shown in Figure 5, when the leader pin 120 is pulled from the cartridge, the panel is no longer held in place by catch 360, thus allowing the spring 350 to slide the panel towards bar 340. As shown in Figure 6, the final position of the panel may leave the visual indicia exposed and conspicuous when the cartridge is removed from the tape drive.

[0008] In that regard, a user may readily determine whether the tape in cartridge 100 has ever been inserted into a data-access system by checking the state of the visual indicia. In the example shown in Figures 3-6, the states are hidden or exposed.

[0010] Figure 7 illustrates another possible aspect of using visual indicia to indicate a changeable property of computer-data storage media. Tape cartridge 700 may include logic circuitry 750 that is used by the tape drive to store and retrieve information specific to individual cartridges. For instance, the circuitry may comprise a chip containing a processor and memory (e.g., an ASIC). The drive may access the chip via electrical contacts 730 connected to the chip by wires. Although the chip interface is shown as electrical contacts in Figure 7 for ease of illustration, in many implementations the drive and cartridge chip may communicate with each other wirelessly.
Indicia 710 may be a material that changes its visual appearance in response to receiving an electrical signal. For instance, indicia 710 may be an electrochromic material that is capable of receiving an electrical signal from chip 750 via electrical connection 750, e.g., a wire that may be combined with other circuitry.

One possible operation of the cartridge 700 is shown in Figures 8-10. As shown in Figure 8, when cartridge 700 is inserted into the drive (not shown), the drive initiates electrical communication with the cartridge’s electrical contacts 730 via its own contacts 770. As shown in Figure 9, the drive may then pull the leader pin 120 out of the cartridge and, as shown in Figure 10, start writing data to tape 130 via read/write head 1150. Upon writing data to tape 130, the drive may send a signal to chip 750. In response to receiving such indication, the chip may store information about the operation in its memory for later retrieval. The chip may also send an electrical signal to indicia 710 such that the resultant electrical charge may cause indicia 710 to change color. The color (e.g., hue, saturation, or value of the color of said area) of the indicia 710 may thus indicate that data has been written to the cartridge.

The extent of change in the appearance of the indicia may provide more additional information about the current state of a mutable property. For example, when the cartridge is new, the indicia 1110 may be relatively colorless as shown in Figure 11(a). After the data is first written to the tape, the chip may apply a moderate charge to the electrochromic indicia, causing a moderate change in color as shown in Figure 11(b). Once data has been written to all or nearly all of the tape, the
chip may apply a full charge to the indicia, causing a more
dramatic change in color. In this manner, the color of the
indications may be relate to the amount of data written to the tape.

[0014] The implementations described may be used with typical
system configurations without modification to such
configurations. For instance, cartridge 100 may be configured
to work with any tape system that uses a leader pin to access
tape. Cartridge 700 may be used may be configured to work in
any tape system that communicates with circuitry, such as chip,
in a cartridge. Other typical mechanical and electrical
interactions (wired and wireless) between a media and media
readers and/or writers may also be used for the purpose of
changing the indicia. For instance, although the foregoing
description used magnetic tape cartridges by way of example, the
system and operations may be applied to other removable data
storage medium, including removable disk packs and USB keys.

[0015] Moreover, the indicia indicated may reflect other
properties relating to the medium itself (e.g., how much has
been written to) or the nature of the data written to the medium
(e.g., a server may identify the type of data that is being
stored to tape drive, which may in turn instruct the cartridge
chip to change to a color that represents the type of data).

[0016] Other types of visual indicia may also be used. For
instance, an alphanumerical character or symbol on the visible
areas of the physical medium may appear, disappear or otherwise
change in response to a change in the mutable property. Indeed,
the indicia need not be limited to visual characteristics. The
indications may use audible, tactile or other human-perceptible
characteristics to indicate the current state of, or changes to
the state of, the indicia.
[0017] Figure 12 illustrates a flow chart of certain operations described above. At block 1210, the media (e.g., tape cartridge) is inserted in the drive. At block 1220, the drive establishes communication with circuitry capable of storing data, such as electronic memory on a chip. At block 1230, the drive accesses the media, such as by accessing the tape in a cartridge. At block 1240, the drive provides data to the circuitry, such as the amount of data that will be or has been written to the media. At block 1250, the media provides an electronic signal to the visual indicia. At block 1260, the visual characteristic of the indicia changes in response to the signal.

[0018] The operations described herein do not have to be performed in the precise order described above. Rather, various steps can be handled in reverse order or simultaneously.

[0019] The foregoing description should be taken by way of illustration rather than by way of limitation. It will also be understood that the provision of examples (as well as clauses phrased as "such as," "e.g.", "including" and the like) means "by way of example only, without limitation"; the examples are intended to illustrate only some of many possible aspects.
FIGURE 1

FIGURE 2

Computing Device (e.g., Server)
- Processor
- Memory

Tape Drive
- Processor
- Read/Write Head
- Cartridge Chip I/O

Tape Cartridge
- Tape
- Data-Written Indicia
- Chip
- Chip I/O
FIGURE 3
FIGURE 7

[Diagram of a removable computer data storage medium with visible mutable-bulk features]
FIGURE 10

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FIGURE 12

1210 Media inserted into drive

1220 Establish communication between drive and electronic memory in media

1230 Drive accesses media

1240 Drive provides data to memory regarding media access

1250 Media provides electronic signal to visual indicia

1260 Visual characteristic of visual indicia changes