

Three Dimensional Data Storage

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Abstract— This paper or topic gives the details of the “THREE DIMENSIONAL DATA STORAGE”.

There are two types of 3-D storage technology

- 1) Holographic Storage Technology
- 2) Multi –layer Storage Technology

Both technologies are currently in developing phase. In the Holographic Storage technology there is a description about it which can show how it is superior from the other recent technologies, such as CD/DVD. Paper also includes the mechanism for reading and writing the data in the storage media and also the requirement for the storage material that used for storage the data. Also include the description of the some of the institutes. While in the Fluorescent material multi-layer technology, paper include that how the production of the storage media is done in this storage technology and the current development status of the storage technology.

Index Terms— 3D Data Storage, Three Dimensional data Storage.



INTRODUCTION

How do you increase data storage capacity? This is a question for all large companies, associated with developing and manufacturing Data storage devices and technologies. Data storage is the primary area of research because of unprecedented hike in data worldwide. Companies such as IBM, Hitachi, Seagate, are actively engaged in innovating and implementing new ways to store maximum data in minimum space.

In the process of finding new technologies, different innovations have been discovered to solve the problem of increased data storage capacity. In may this year, the tech giant proved that 1 terabyte-1trillion bytes of data –to a linear digital tape cartridge also can be managed. That figure, according to company is nearly 10 times the storage of any other tape cartridge currently available.

Tape storage is less susceptible to hacking and data theft problem. The latest technology puts high data storage in a form that makes it easily portable. It is expected, to reduce overall costs for storage.

Holographic storage is a breakthrough technology that stores information within its volume. Current generation storage media store digital information on layers of platters either magnetically or

optically. Holographic storage utilizes the space within special types of crystals with optical characteristics, which are very similar those used to create 3D holograms. Holographic storage incorporates the use of laser, optics, images sensors and special crystals that respond to laser light.

I. THREE DIMENSIONAL DATA STORAGE

It has long been recognized within the data storage scientific community that two –dimensional carriers are insufficient for future generations of memory devices. Research efforts have therefore focused on ways to develop three-dimensional storage including holographic technology and multi-layer storage technology.

Now we know that the currently available data storage technology such as CD/DVD and floppy are not capable of storing large amount of the data. They all are called the one dimensional devices or two-dimensional devices. Floppy and CD are called one dimensional storage devices because there is only one head which can read/write only on the one surface of the storage medium .While the DVD is called the two dimensional device. Because it head can read/write in the storage on the two layer of its. In the 3-D storage devices, the

storage of the data can be done on the more than two layers of the single storage media.

Now, at this moment the Question that arise in your mind that why we can't tell the hard disc the three dimensional data storage ? And Your argument is that hard disc can also store data on the different surfaces simultaneously. But your thinking is wrong. Because the storage material used in hard disc and 3-D storage devices are different. In case of hard disc there are several cylindrical surfaces of the magnetic fields which are physically separated from each other and also available separated head for each surface for read/write. But in case of 3-D storage material only one head for read and write in the different layers of the storage media. These layers are not physically separated from each other.

There are two 3-D storage technologies describe

- 1) Holographic storage technology
- 2) Fluorescent multi-layer storage technology

II. HOLOGRAPHIC TECHNIQUES

Consider the maximum data storage limits we have reached today 15.9G.B on a double-layer, doubled sided DVD. Think about a system that can store about a terabyte of information (that's over 15,000 CDs!) on the crystal the size of a sugar cube! Holographic storage is a breakthrough technology that literally goes beneath the surface of media and store information within its volume. Current generation storage media store digital information on layers of platters either magnetically or optically. Holographic storage utilizes the space within special types of crystals with optical characteristics, which are very similar those used to create 3D holograms. Holographic storage incorporates the use of laser, optics, images sensors and special crystals that respond to laser light.

The main advantage of this technology is the speed of retrieving the data such systems will able to retrieve data in tens of microseconds as compared to a data access time of almost 10 milliseconds offered by the fastest hard disk today. Scientists say holographic system could transfer an entire DVD movie in under 30 seconds! Another very important advantage is that of information search and retrieval. Consider the case of large databases that are stored on hard discs today. To retrieve a piece of information, you first provide some

reference data the data is then search by its address, track, sector and so on ,after which it is compared with the reference data. In holographic storage, entire pages can be retrieved where the contents of two or more pages can be compared optically without having to retrieve the information contained in them.

The success of holographic storage lies in the ability to accurately focus the reference laser on the exact position within the crystal to retrieve that page of information. You would be able to locate the data if there is an error of even a thousand of inch. The good news is that scientists indicate that holographic storage system should be available in next five years and have ability to store vast amount of information in the form of light.

Holographic storage is an optical technology that allows 1 million bits of data to be written or read in a single flash of light. Thousand of holograms can be stored in the same location throughout the entire depth of the medium. Unlike other technologies that record one data bit at a time, holography allows a million bits of data to be written and read in parallel with single flash of light. This enables transfer rate significantly higher than current optical storage devices. Imagine 2GB of data on a postage stamp, 20GB on a credit card, or 200 GB on a disk. And that is just beginning.

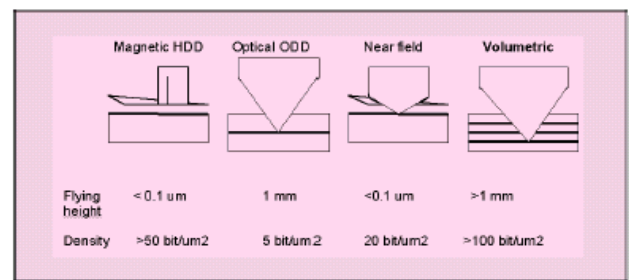


Figure1. Basic Component of Different Recording Technique

III. HOW IS DATA RECORDED?

Light from a single laser beam is split into two beams, the signal which carries the data and the reference beam. The hologram is formed where these two beams intersect in the recording medium. The process for

encoding data onto the signal beam is accomplished by a device called a spatial light modulator (SLM). The SLM translate the electronics data of 0's and 1's into an optical "checkerboard" pattern of light and dark pixels. The data is arranged in an array or page of around a million bits. The exact number of bits is determined by the pixel count of the SLM. At the point of intersection of the reference beam and the data carrying signal beam, the hologram is recorded in the light sensitive storage medium. A chemical reaction occurs in the medium when the bright elements of the signal beam intersect the reference beam, causing the hologram stored. By varying the reference beam angle, wavelength, or media position many different holograms can be recorded in the same volume of material.

IV. DEMONSTRATION SYSTEMS

The holographic 3-D disc being developed at the California Institute of Technology is example of such a system. The 3-D disc has a 100-micron -thick photopolymer laminated onto a glass disc substrate. By superimposing 32 holograms each hologram consisting of 590,000 bits-in area 1.77 mm², an areal density greater than 10bit/mm² has been demonstrated. No errors were detected in the reconstruction.

Holographic data-storage systems use devices that are currently being refined by displaying and electronic imaging applications so cost reductions

V. FLUORESCENT MULTILAYER

The concept of multi-layer, fluorescent cards/discs (FMD/C) is a unique break through, solving the problems of signal degradation. The storage layer is coated with a fluorescent material. When the laser beam hits the layer, fluorescent light is emitted. This emitted light has a different wavelength from the incident laser light—slightly shifted towards the red end of the light spectrum and is in coherent in nature, in contrast to the reflected light in current optical devices.

VI. CONCLUSIONS

Thus the Three Dimensional Data Storage Technology is the fast evolving and in the feature generation it is the most important for the large amount of the data

and performance improvement can be expected in markets. Some of the key component, such as the spatial light modulator and the electronic detector array which converts the holographic data reconstruction into an electrical signal.

The application for the 'FE' semiconductor optical read/write head is evolving more data storage. Thomas has many future concepts on holographic storage peripheral products. The FE semiconductor read/write head for ferroelectric molecular electrostatic field can be used for many more application than data storage, example might be, high speed imaging and offset printing, lithography, copiers and printers. Future integrated

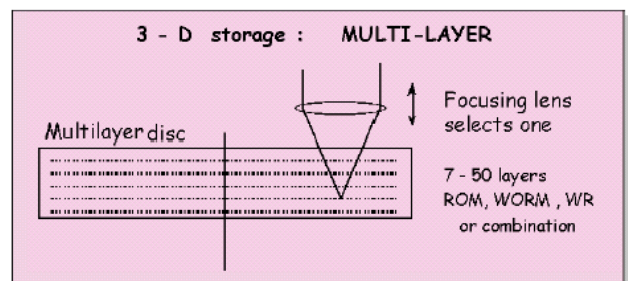


Figure 2 Multi-layer storage

circuits could be made and verified that have ferroelectric wiring molecule with the ability to polarize the wire for new switching.

The emitted light is not affected by data or other marks, and adjacent layers remain undisturbed. In the read-out system of the drive the light is filtered, so that only the fluorescent light is detected, thus reducing the effect of stray light and interferences. In that media containing up to a hundred layers are currently feasible, thereby increasing the potential capacity of a single card or disk to hundreds of Gigabytes. Use of blue lasers would increase the capacities to over 1 Terabyte.

storage. It is the technology that out form the latest and currently used technology such as CD and DVD.

Constellation 3D's fluorescent multi layer optical data storage technology can be utilised to produce compact, removable, inexpensive, rugged, ultra-high

capacity data storage devices, having data transfer speeds in excess of 1 G bit/s. The company wishes to maintain its focus on research and development in the field of Fluorescent multi-layer optical storage, with the intention of continually expanding the limits and capabilities of this technology. Having successfully demonstrated prototype multi layer cards and discs incorporating FMC/D technology, the way is now open, through joint ventures with industry leaders, to commence industrial production of these devices and take them into the mainstream.

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