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3D Optical Data Storage System: A Survey

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***Abstract*: An important function is being done in our regular e-life storage data, this technique has an unrestricted history in the form of floppy disks, magnetic tape, gramophone records, optical storage disks, flash cards etc. So this change is in the amount of data size and can occupy the disk space. For this 3D optical type is going to be a top alternative. 3D optical data storage is the word given to any form of optical data storage in which data can be recorded and/or read with three dimensional resolutions.**
***Keywords*: Optical data storage, Two- photon absorption, Multicolour Absorption, Holographic data storage, Hologram**.

I. INTRODUCTION

In 3D optical data storage data can be record and/or read with 3D resolution. This 3D optical data is the word indicated to some method of optical data storage. The 3D optical data storage innovation has potential to provide petabyte-level mass storage on DVD-sized disks.

Data recording and read back are completed by focusing lasers within the medium. As data structure has a volumetric nature because of it, the laser light necessary to travel over other data points before it touches the point where reading or recording is very important. Therefore, some kind of nonlinearity is essential to confirm that these other data points do not affect with the lecturing of the desired point. No profitable items are produced on 3D optical data storage has yet extended on the form market several corporations are dynamically developing the technology.

In 3D optical data storage system there are two types:-

A. Using Multicolour Absorption
B. Holographic data storage

II. 3D OPTICAL DATA STORAGE

In traditional storage systems, magnetism and semiconductor techniques are used for storing in CDs and DVDs. The optical data storage system is very different from the traditional storage system, before talking about how three-dimensional data storage works, giving a brief overview to optical data storage. Storage is done on an optically readable medium. An optical drive writes on the optical readable medium i.e. storage disk. It uses laser ray to burn pits (or dams) in special material on the disc. This data stream is placed in the spiral path, in this case the data interval starts with the track and its work towards the side of the disk an optical drive computer has a device that can read CD-ROM or other optical discs. To store optical storage information, it represents 27% of the world's technical capability.

A. 3D data

In 3D data, information can be recorded and / or read with 3D resolution. 3D optical data storage is an investigational storage technology, today has been predicted to provide more storage capacity faster than data storage technologies. Because of the design issue, this technology is not yet commercially available; Researchers have worked with 3D optical data storage devices.

B. Difference of 3D optical Data Storage Device From Other Data Storage Device

This innovation has the ability to provide large-scale storage of petabyte-level (1024 TB) on DVD-sized disks. Current optical data storage media are CD and DVD. They store data on a disk's interior surface as a series of reflective digits. For raising the storage capacity, two or more of these data layers can also be added. But their number is severely limited. The laser contacts each layer, which passes through that address and the addressed layer. In these interactions noise which limits technology to approximately 10 layers.3D optical data storage methods group this problem by using those procedures where only precisely the addressed voxel (volumetric pixel) addresses communicate with light to a great extent. This requires methods of reading and writing non-axial data, especially in non-axial optics. Here also the laser light should travel through other data points, as long as it does not touch the point where reading or recording is preferred. Nonlinearity confirms that these other data points do not obstruct with the address of the preferred point.

III. CONSTRUCTION

A model 3D optical data storage looks like a transparent DVD as it's construction can use a disk. There are several layers of data in the disk, each of which is in a dissimilar depth in the media, and each has a DVD-like spiral track. The distance between the layers can be 5 to 100 micro meters. Information about 100 layers may be stored. Therefore, the average thickness of a disc can be estimated at about 100 times 50 micro meters. It's equal to 5 millimeters. Clearly these discs are going to be heavier than CDs and DVDs[1]. The reading and writing of data using multicolor absorption is as shown in fig1.

A. By Writing Procedures by Multicolour Absorption

To record data on the disc, the laser is brought to focus on any particular depth in the media. Depth is related to a particular data layer. When the laser is turned on, there is a photochemical change in the media. As the disc rotates and read/write moves with radius, the layer is written as if a DVD-R is written. The severity of the focus can then change. It recruits another completely different layer of data written on the disc.

1) We have to see how much the process of writing is. As mentioned, non-axial optics are used. Although there are many non-axial optical phenomena, only multi-photon absorption is able to stimulate the molecular masses to the media and energy due to provide vital chemical reactions. example of a conference paper in [1] Two-photon absorption is by far the most powerful multipoint absorption. But still this is a very weak phenomenon. It I weak because it is a third order non-liner absorption event, i.e. three orders less than linear absorption.

2) Two-photon absorption (TPA) is instantaneous absorption of two photons of the similar or dissimilar frequencies. Energy difference among the lower and upper states of the molecule and the sum of the energy of both photons are permanently identical. It has less media sensitivity so; highly research has been focused to provide two two-photon absorption cross-section chromophores. Chromophore is an area in the molecule where energy difference among two different molecular orbitals originates within the visible spectrum limit. A chromophore is liable for its colour. Example of a conference paper in[1]

Writing through 2-photon absorption is achieved by focusing on the writing laser at the point where photochemical writing is required. Writing laser wavelength is chosen that it is not absorbed linear through medium. Therefore, it does not interfere with medium except for focal point. The focal point is very high in intensity and the effect of the nonlinear comes in the picture. The 2-photon absorption becomes important because it depends on the square of laser flux.

Both of these photons should come together because the single photon will not be absorbed as it is not resonant with molecular energy levels. Solution using resonant photons, allows some freedom of the second photon in the coming time. But then, it is now a non-axial phenomenon. It compromises the resolution of the data in all layers.

B. Reading the Data

Similar process is used to read data. Due to a light chemical change in the media, laser causes fluorescence, except this time. This example is obtained, depending on the wavelength of fluorescence, using less laser power or differently, the media is written at that point. Have or have not. Data is read by calculating the radiated light.

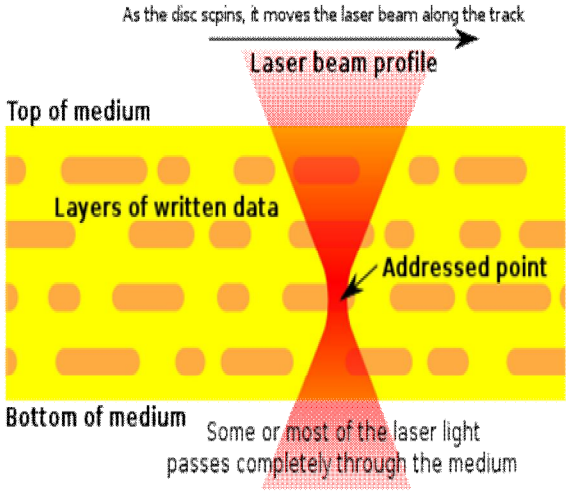

Fig.1 Schematic representation of a cross-section through a 3D optical storage disc (yellow) along a data track (orange).

IV. OPTICAL RECORDING TECHNOLOGY

Optical storage systems consist of many units, some of them are a drive unit and storage medium in rotating disk format. Normally, discs are pre-constructed using grooves and lands (tracks) to allow optical pick-up and recording head position to access information on disk. In the influence of a concentrated laser beam radiating from the optical head, data on the media is recorded as a difference in physical characteristics. Disk media and pick-up heads have been rotated and positioned by the drive motors directing the position of the head in relation to the data tracks on the disk. Extra peripheral electronics are used for regulate and data acquisition and encoding/decoding. The optical recording system is as follows in fig2.

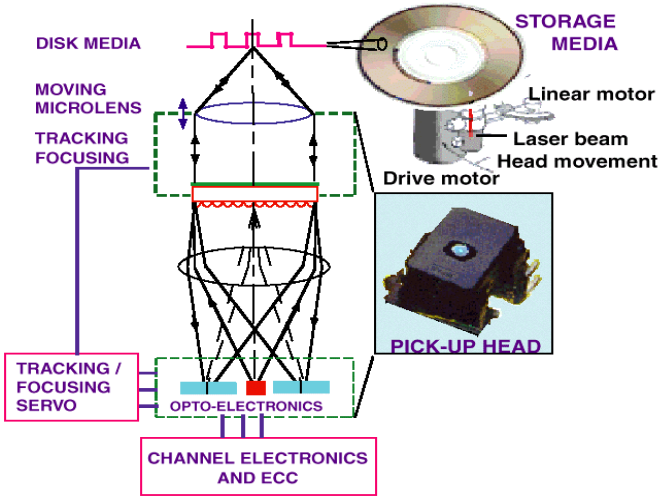

Fig.2 Optical recording system.

V. HOLOGRAPHIC DATA STORAGE

Holographic data storage is a likely additional technology which is in the area of high-capacity data storage that presently controls magnetic and conventional optical data storage. Magnetic and optical data storage devices faith on singular bits stored, which is on the surface of the recording medium as separate magnetic or optical changes. Holographic data storage accepts this limit by recording information in all measures of the medium and is able to record various pictures in the same area via light at different angles. Also, information on magnetic and optical data collection records in linear fashion is capable of recording and reading millions of bits in parallel, which enables data transfer rates achieved from conventional optical storage.

A. Recording Data

Holographic data storage captures information via an optical interference pattern in a heavy, photosensitive optical content. Light with a laser beam is distributed into two different optical patterns of dark and light pixels. Adjusting the reference beam angle, or media position, wavelength, a multitude of holograms (theoretically, several thousand) can be stored in a single volume.

B. Reading Data

Stored data is read through the reproduction of the same reference beam used to make the hologram. The light of the reference beam is focused on photosensitized material, illuminating the appropriate interference pattern, the light spreads on interference patterns and projects the pattern on a detector. The detector is able to read data in parallel, more than 1 million bits at a time, resulting in faster data transfer rates. Files can reach less than 200 milliseconds on the holographic drive.

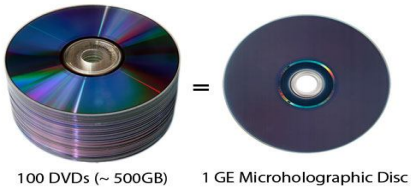

Fig.3 Comparison between DVD Microholographic discs.

VI. CURRENT CHALLENGES

A. Especially when 2-photon absorption is used, high-power lasers may be required which can be heavy, difficult to cool, and can cause safety concerns

B. Since both reading and data are written with laser beam, so the process of reading has the ability to write a small amount. In this case, reading the repeated data can eventually erase it. Although an attempt has been made to resolve the problem using different bands of absorption to read and write this issue.

VII.FUTURE WORKS

Holographic storage is a strong contender for future storage options. Research is being done by various companies to further increase the storage capacity if the cost of construction matches the available storage options at present, then a strong role for 3D data collection can be considered. There may be possible configurations in the future:

A. Pre-recorded 3D disks support over 100Gbytes and over 188Mbits/sec rated out rate are distributing computing, movies, and multimedia to the appropriate applications.

B. Volatile write-once, read-many drives support terabytes of storage, 1Gbit/second readout rate. Demand in appropriate applications and videos on large web servers are included

C. With 500-Mbits/sec readable rates, after writing each other supporting more than 100Gbytes, use time for 100Mbyte blocks of 10-100 milliseconds to use data. In fitting applications includes storage which requires permanent storage, but still quick access, such as health care data and satellite images.

VIII. CONCLUSIONS

The 3D optical data storage system is very useful for storing large amount of data. 3D optical data storage is the form of optical data storage which is really a good alternative for the data storage required in now-a-days life which is having a lot of data to store.
Holographic storage technology has the ability to offer up to 100 GB or more storage that can be used not only to store applications, but also to the distribution of physical content (if cost of production can be lower).

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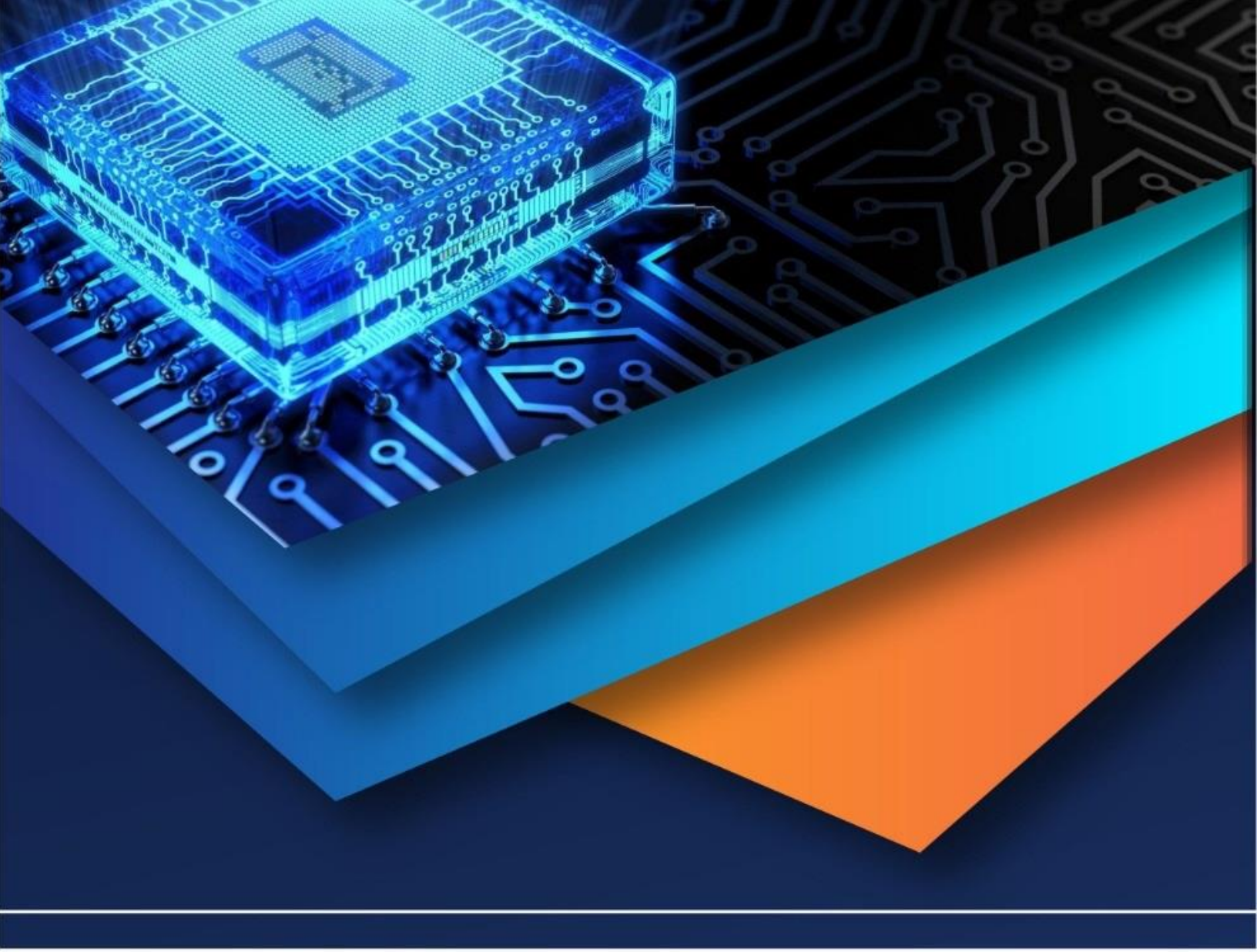

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