บทคัดย่อ

การใช้ Optical Disk Technology ในการจัดเก็บ และสืบค้นข้อมูล

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บทความนี้มุ่งศึกษาการใช้ Optical disk technology ในการจัดเก็บและสืบค้นข้อมูลโดยกล่าวถึงภูมิหลังโดยย่อของ Optical disk technology ชนิดของ Optical disk และการใช้ ตลอดจน Optical disk ที่นิยมใช้กันแพร่หลายในท้องตลาด ซึ่งได้แก่ Digital Optical Data Disk (ODD), Videodisc, และ CD ROM นอกจากนี้ยังได้พิจารณาถึงความสามารถในการบันทึกข้อมูล และการใช้ข้อมูลที่บันทึกไว้ใน disk โดยยกตัวอย่างการใช้เทคโนโลยีในห้องสมุดและศูนย์ข้อมูลทั้งในสหรัฐอเมริกาและยุโรป ท้ายที่สุด บทความนี้ยังได้รวบรวมข้อดีและข้อเสียของการใช้ Optical disk technology ตลอดจนแนวโน้มและการใช้เทคโนโลยีดังกล่าวด้วย

Optical Disk Technology in Information Storage and Retrieval

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Overview of Optical Disk Technology

In 1929, the first optical videodisc was invented by an American, Reginald F. Friebus, and the optical disk technology has been developed. In 1972, Philips demonstrated the first prototype using lasers for recording and playback. An optical disk recorder, and a compact disk were introduced in 1978, and 1979 respectively. Advances in this technology have occured in 1980's, including larger storage capacities and faster access time, a mass-produced read-only storage-exemplified by CD ROM, a digital version of the audio compact disk, and WORM (write once, read many) Erasable (or rewritable) optical storage, though commercially available, is still in experimental stages. This technology, from an application design viewpoint, is not particularly challenging since its function is identical with existing magnetic mass media, except that it someday may be much less expensive.

Types of Optical Disk

The followings are principle categorization of optical disks

1. digital/analog: digital disks employ digital encoding. Conceptually, the encodable spiral on the disk is a set of regularly spaced binary bits. Each of the regular spaces either contains a marking, or it does not, corresponding to binary 1 or 0. Markings and spaces between markings are in fact longer towards the circumference of the disk and shorter towards the center of the disk, Binary or bits may be used to represent information in eight bit bytes, or in an image (facsimile form).

Analogue disks employ pulse code modification (PCM) that represents a continueously variable (analog) FM-Signal encoded by variances in the laser marking length and spaces between markings. Analogue encoding is employed by consumer market disks designed for playbek of audio visual materials.

2. Optical/capacitance: An optical is recorded using light source, normally a lower-powered laser. Capacitance system, employing electrical capacitance writing and reading systems, are Capitance Electronic Disk (CED) and Video High Density (VHD).

3. Read-write; read only; write-once; erasable: Read-write systems can both read disks and write on them. Read-only systems can only read disks and write-once is a term used in contrast to erasable.

4. Direct read-after write (DRAW)/pressed: These terms refer to means of producing the disk. DRAW is a process in which information is written on a disk a track or track sector at a time. Immediately after writing, the information is read back and checked for errors. If there are errors, writing information is attempted in next track or sector. The process is repeated until a track or a sector is successfully written with no detected errors.

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Pressing is a process used to replicate disks from a suitable master. It is quick, cheap and used to mass-produce disks. Quantity produced pressed disks have a much lower unit cost than DRAW disks. Error correction techniques are used to achieve acceptable corrected BER (bit error rate) in both types.

5. Reflective/transmissive : Reflective disks have a mirror like finish. If the disk is encoded on both sides, it must be turned over for reading the second side. Transmissive disks do not need to be turned over since the reading laser can be refocussed to read the second side through the disks, which are made of translucent materials. But the majority of optical disks are reflective disks.

6. Diameter size : the most common disk diameter sizes are 4.72 inches (12 cm.) and 12 inches (30 cm.). The smaller size is used by the widely marketed Compact Digital Audio Disk (CDAD) system. The larger size is used by videodisc systems and a number of optical data disk systems.

Major Marketed Types

1. Digital Optical Date Disk (ODD). Digital optical storage devices enable the storage of character and numeric information as well as digitized images. This type of disk is produced by a read after write process and may be read using a read-write unit or a read-only unit.

2. Videodisc : Analog videodisc has been used for the distribution of movies for several years. The disc is encoded in an analog format for replay on a TV and design to be read using either optical or electric capacitance detection system. Digitally encoded videodisc combines the best features of analog and digital products, taking advantage of low replication cost of analog videodisc and digital storage capacity of digital optical disk. The laser videodisc technology is based on laser optics and offers very high density, high quality video, random access, and a mixed storage format of both analog and digital.

3. CD ROM (Compact Disk Read-only Memory) : CD ROM are based on digital storage principles, the information can be retrieved by using microcomputer and desk top CD ROM drive. The information is stored permanently and cannot be altered or erased once pressed in the mastering and production process.

The Application of Optical Disk for Information Storage and Retrieval

The main features of optical disk that make it a potentially attractive medium for information storage and retrieval are high storage capacity and rapid random access.

Optical Disk Storage Capacity

Strage capacity of digital optical disk is very high. A 12 inches optical can hold one or two gigabytes of data or about 400,000 to 800,000 typed pages of text. Per surface basis, the capacity of an optical disk is 150 upto 200 times of magnetic disk. Ten million pages of text can be stored on 25 optical disks, the same amount of data may consume 500 tapes.

The use of "jukebox" helps in handling very large quantities of data. "Jukebox" is a robotic device for holding and automatically handling optical disk media for opticol disk drives. It is also called a "library" or "autochanger". This jukebox is an excellent way of storing images. This device can hold as many as 100 one-to-two gigabyte optical platters, thereby offering upto 200 gigabyte storage. As the optical technology develops, each disk will hold three to maybe five gigabytes. The result is the jukebox that store more than 800 gigabytes of information. The example of the application of optical disks and jukebox device is the Internal Revenue Service (IRS) testing project, using optical disk for archiving and retrieving images of two billion tax

return documents for each year This $4 million test project will use three optical disk jukeboxes to store several million documents.

A two-sided videodisc can store approximately 100,000 individual still frames or provide close to 2 hours of motion picture materials. The standard one-half hour per side has a storage capacity of about 2 billion characters (or 2 gigabytes)

A CD ROM disk holds about a half gigabyte of data, the same amout of information as would be on 275,000 typed pages.

Information Retrieval

The ability to provide rapid access to the information is one of significant characteristics of this medium. In the optical disk system, once indexed and stored, documents can be recalled. Images stored on disks are displayed in less than five seconds, and the information can be kept online for instant retrieval. It is acceptable that the major advantages of optical disk system is fast online retrieval from large databases.

Furthermore, the information can be viewed from several users simultaneously. The system can be expanded to allow multiple users real-time access to multiple disks, using jukebox. The jukebox will select the required disk and insert it into optical disk drive. The disk will spin up and pass the reguired image to the requestor. Anyway, the efficient use of the jukebox depends mostly on a function of accurate system design.

The optical disk technology offers the access to information store in the same graphic form as originated. The online computer search with video displays and illustrations stored on video optical disk can be seen in the system introduced by the Pergamon International, known as Video Patsearch tm, which provide online access to the 700,000 US patents issued since 1971, permitting retrieval of patent drawings and illustrations of chemical structures together with patent abstracts and other textual information. The original form of information is very important for application in banks, signature lists, and for the study of fingerprints.

There is also the modification of retrieval software, that provides the access graphics in databases, introduced by Laser Data in the BRS/search. The retrieval system uses a menu approach by subject searching, which is powerful and easy to use.

The optical disk technology provides the alternative access to information that can be purchased on disk instead of in printed format-The CD ROM, which expand optical market during the past two years. CD ROM offers a low-cost, relatively high speed, i.e., one can search, using sophisticated Boolean string and getting access in less than half a second to over half a gigabyte of information.

Applications of Optical Disk Systems

The basic applications of optical disks are storing and retrieving information.

The major potential of optical disk is the storage of original data. It can discriminately record all data : signatures, textual, or graphics. At present, the laser videodisc technology has a mixed storage format, utilizing both digital and analog data. These makes the use of videodisc flexible since both text (in digital format) and graphics (in analog format) can be stored in the same medium.

The optical media seems to be useful quality alternative for archival storage, especially the write-once optical disks. The data will be stored in original form, and the life expentancy of the disk is over 10 years. The Plexus Computer announced that its disks has a life expectancy of 50 years. Optical storage also avoids wear resulting from continueous disk use, since only a beam of light touches the medium during playback Maxell Corporation of America advertises

the optical disk that has an operating life expectancy for more than 10 million passes. In addition, information on digital optical disk can be transferred to a new disk without any loss, if changes are detected in the original disk. It is valuable as a preservation material.

In business office aspect, write-once optical disk systems are significant in the filing system, especially file intigrity. Many files are simply lost or not available due to misfiling or out-of-file situation. The write-once disk fills the important role in this aspect in that the document cannot be misplaced or altered once stored.

Optical media also have great potential for the development of local specialized information. In library and information center setting, they may be able to store in-house indexes to newspapers, private files on disks. They can also develop specialized catalog or database management system, for example, a file of approximately 250,000 records can be placed in videodisc, which can provide online service to the database and can provide information exchange in or between libraries or information organizations.

In business setting, the optical disk is very useful for "business communication". When paper files are in digital form, stored, and indexed integrated with the corporate computer database, they provide the online access internally and externally. The digital paper file become a true management tool.

Review of Some Optical Disk Technology Applications in Libraries and Agencies Concerned with Information and Document Delivery

1. The use of videodiscs and compact disks as regular library materials made accessable to library patrons.

2. The use of digital optical data disk in a library catalog card storage, retrieval, and printing system, for example, in the Library of Congress Optical Disk Pilot Project, the Catalog Distribution Service used two Optimen Digital Optical Data Disk to store some 850,000 card images in 1984.

3. The use of digital optical data disk for document storage, retrieval, and printing as in PAPYRUS, a document storage system introduced by Thomson Gigadisc System, which was first used at the library of the Centre National de' e'tudes des te'le'communications, Issy-les-Moulineaux, France.

4. The use of videodisc as a public relations tool. The national Library of Canada provides a videodisc about the library, including a film and a narrated tour of the library.

5. Reference use : It is typically in the integrated system, using microcomputer and optical disks. Many vendors, now offer the CD ROM disk, containing indexes and other reference tools.

6. Document delivery service. One of the interesting service is the EURODOCTEL, beginning in February 1985. It is the online current awareness service supported by the Commission of the European Communities.

7. Archival Storage, for example, Digital Image Applications Group (DIAG) sponsered by the National Archive has activities in disemminating and exchanging information, which involved the conversion of human readable images to digital formats, storing and retrieving them.

Advantages and Disadvantages of Optical Disk Technology

The advantages and disadvantages of the application of this technology depend upon particular applications, specific types of optical disks, and comparative aspects of this system to other systems.

The advantages of the optical disk technology can be summarized as follows:-

- compactness and high storage capacity. This is a high priority to acquire such a system, especially for office-oriented aspect, where more costly office space increases.

- multi media. Optical disk can store and playback any form of image data, sound and computer-readable data.

- resistance to general wear, tear, handling, dust, magnatic fields and reasonable temperature ranges; and playback does not wear disks or reduce quality.

- lifetime storage integrity is likely to be at least 10 years.

- ability to remove disks and play multiple disks on single player; jukeboxes gives convenient access to considerable quantities of data on disks.

- suitability for computer-controlled operation, and as computer peripheral; using sophisticated software and powerful PC-AT computers, information can be access in seconds and print on site, which allows one to copy document immediately.

- falling hardware cost and continuing improvement of the technology; at present there are about 54-56 companies actively developing optical disk drives.

- repidly expanding volume of materials becoming available on optical disk, especially in CD ROM.

- locally accessible; CD ROM provides locally accessible device, sitting on the desktop, attached to microcomputer-available immediately.

- write-once or non erasable disk is appropriate to certain uses, especially to ensure data security. In some agencies the security of data is vary important. Nonerasable disks offer the security, that surpasses that of magnetic media, where a skill programmer might be able to access sensitive data. This disk allows intelligence and military installations to store data from satellite hooks-up Lockheed Electronics Co., is planning production of an optical disk system for use with fighter aircraft and other military platforms in early this year.

- erasable disk systems are developing and will become commercially available in limited quantities this year.

- write-once optical disk can be use as backup system for magnetic media in data processing system.

The disadvantages of the application of this technology are in three areas: cost, technical standardization, and legal issue

- cost: The optical disk system required in its basic configuration to record and maintain upto 128 gigabytes, will likely cost about $ 300,000, and system price of over $ 500,000 is not uncommon. It is expensive to create disk, given all preparation, indexing, premastering, check disk, replication, and computer programming.

However, the reseach of Firm Venture Development Corporation indicate that lower priced optical systems become available. Currently, a low cost optical disk system can cost $ 70,000 or more.

A two-year study of potential value of videodisc technology for use by libraries and archives by Smithsonian Institution concluded that the technology is too expensive.

But for profit organization, it seems that though the cost of this technology is high, it provides almost unbelievable return-on-investment.

When comparing the optical disk cost justification to that of magnetic tape, considering the storage capacity, it offers a cost-per-bit storage comparable to the magnetic tape. The optical disk can reduced associate costs, for example, when the agency use optical Disks, it need no longer duplicate each magnetic tape every few years to ensure data integrity, nor pay for operator.

Another weakness of optical disk related to cost is that the duplication of optical disk records is expensive unless a gigabyte or more of information must be sent to one location, and the cost would likely be unacceptable.

- Lack of technical standardization. There are many areas where technical standards do not exist. Storage of data on 12 inches videodiscs, either in digital or analog formats has no standards. There are number of different interfaces (hardware connection between the optical disk players and microcomputer) available in the market.

There are also no standards for system software to search, retrieval, and manipulate information on optical disks. Some system uses DIALOG or BRS searching system as well as support downloading of retrieval search. Other use progressive approximation search proves reminescent of early CLSI touch screen systems, that require software in the disc itself while other store theirs on floppy disks for the microcomputer.

The area that has some progress towards standard is the compact disc, interms of size, information storage, and laser reader, which existed by the joint effort of their developers-Song and NV Philips.

In the optical disk consultant opinion, the setting of standard is a long process. The optical disk standard process began in 1983. The National Information Standards Organization Committees are working on optical disk technolgy standards, for example, Committee G is working on common command language for online systems that can be applied to optical disks.

- Copyright problems: There are a number of legal concerns, aspects and issues on the application of optical disks, especially in libraries, when copying information onto disks. The attempts have been made to overcome this problem: in The Optical Disk Pilot Program at Library of Congress, copyright permissions were sought and granted from publishers to scan their journals onto optical disks. These publishers will be kept informed of how the public response to technology.

Marketing and Application Trends

Optical disk technology have devoloped and expanded rapidly. In 1985, 6,000 optical drives were produced in addition to those of 1984. the most popular among the optical disks is the write-once disk. Though it has been criticized for its inability to accept changes to its data once written, it proves itself perfectly usable in a wide range of large system application,

The expansion of write-once application included the application in Library of Congress; Internal Reveue Service; National Archive and Record Administration: U.S. Patent and Trademark Office, etc. Many manufacturers offer write-once optical disk system, whose software permits integration to standard computer system, including IBM; Digital Equipment. It is predicted that the write-once optical memory will be the dominent storage technology within the next decade, even the erasable optical disk are available commercially, since there still will be a need for much information to be written on permanent, write-once media. The CD ROM market seems stall in 1986 because of the lack of data format standard. There is also new product introduced by Philips called CD PROM (Compact Disk Programmable Read-only Memory), a writable CD ROM As far as products concern, in two or three years there will be a higher performance but lower capacity read-only optical storage device available called Data ROM, the 5-1/4 inches, multifunction, write-once, read-only and erasable disk.

In term of applications, there was a national survey of major organizations with micrographic equipments by Venture Development Corporation. The study revealed a high level of awareness of new optical disk technology, a fair level of interest, but only limited near-term purchase expectations The results also indicate the opinion that the availability of the new optical disk system will not drastically alter the pace of old equipments. One of the interesting attitudinal response is that many micrographic equipment owners thought that "whatever document storage system they choose, it will be outmoded in 10 years anyway".

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