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# Green Computing - Future Trends in Data Storage

P. Amar Raja[1], S. S. Mukhilan[2], D.Shobana[3]
[1, 2]*Students,* [3]*Assistant Professor, Department of Information Technology, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India*

***Abstract:*** ***Modern data research and industrialize sectors adopting green computing methodology to control environment pollution and reduce cost for storing data and other aspects of information technology management over the future. Research is going on the future enhancement of data storing towards next level. In the stream of genetic engineering and optical data storage technology researchers found new dimensions in data storage. Data storage based on the introduction of genome and optical storage into enzyme and fused quartz using a bit of chemical process and femtosecond laser could ensure all that we have learned will not be forgotten.***

***Keywords: Quartz, Enzyme, Adenine, Thymine, Guaning, Cytosine, protein, nanostructures, Nano grating***

## I. INTRODUCTION

Data processing and storage can be done through any storage medium. Recording of information or data is accomplished by virtually any form of energy. Storing data is the core concept of any general purpose of computer Information Technology. Digital Data can be stored in many forms such as print, film, magnetic, optical and also numerous different formats.

Digital data storage is non-durable and intermittent. As such, securely storing large amounts of information over, even the relatively short timescale of 100 years comparable to the human memory span is a challenging problem. As such large amount of information storing in secured way over even in relatively short era.

### *A. Dna Digital Data Storage*

DNA digital data storage is the process of encrypting and decrypting binary data and stored in the synthesize DNA strands.

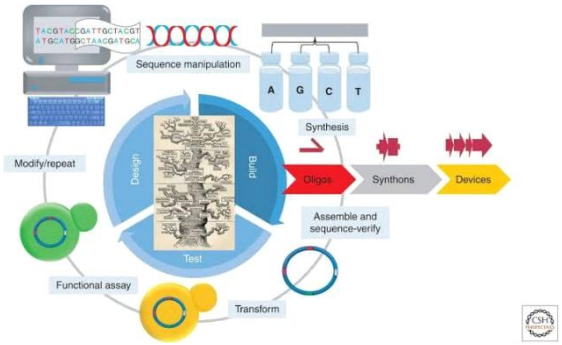



Fig: Synthesize DNA

1) *DNA:* DNA is basically a natural data base. Organisms are the result of a three dimensional computing process, written in tiny compounds wound up inside the nucleus of all your cells. It's a set of instruction, coded and saved that our bodies write and read to build proteins, construct cells, and perform thousands of other tasks.
2) *DNA Structure:* A single DNA molecule is shaped as a double helix made up of two strands of nucleotides that are bonded together. Each nucleotide consists of a nitrogen base, a sugar (ribose), and a phosphate group. The same 4 nitrogen bases are used as the genetic code for every strand of DNA, no matter which organism it comes from. The bases and their symbols are adenine (A), thymine (T), guanine (G), and cytosine (C). The bases on each strand of DNA are *complementary* to each other. Adenine always binds to thymine; guanine always binds to cytosine. These bases meet each other at the core of the DNA helix. The backbone of each strand is made of the deoxyribose and phosphate group of each nucleotide. The number 5 carbon of the ribose is covalently bonded to the phosphate group of the nucleotide. The phosphate group of one nucleotide binds to the number 3 carbon of the ribose of the next nucleotide. Hydrogen bonds stabilize the helix shape.[1]
3) *Genetic Engineering:* Genetic Engineering is basically researcher trying to hack human DNA (hard drives), and they are learning more about the possibilities of accomplishing this every day. But the way back in 1964, Soviet Physicist named Mikhail Neiman concocted the idea that we could use the compact, efficient, storage system of DNA to store not nature's code

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but whatever we wanted. So far, we have been able to decipher parts of nature DNA programming, a genome here few line of code there we have not decoded all of this yet, but scientists do understand how the storage system works now. We are real close to putting whatever pictures of files we want into DNA storage.

4) *Storing data in DNA:* In January 2013 researcher from European Bioinformatics Institute (EBI) proved that they could write computer data into synthetic DNA with 0 errors. The ideology of scientist to work with DNAstorage they found a new way of methodology to encrypted data from non-natural data source to genetic data using machine code to be converted into DNA code for better understanding of data storing in DNA that Machine code binary is to transformed to DNA code. While DNA is A, T, G, and C. Several genetic algorithms can be used to create binary to DNA code. Even though DNA only pairs A with T and G with C these latter can also be reversed, A T and T A are different this means the data is more dense, more data can be stored in less space. The algorithm does all the translation required. Then scientists had to create a piece of DNA that reflect the computer data. It holds the same DNA that the human has in their cells, but they made it in a lab. Peck described it as "Similar to stacking four colors to Lego bricks into segments," To get the data back out of the DNA, scientists decrypted the DNA code where the data is stored in the DNA using genetic engineering techniques And the whole reason that they want to archive lot of data into a tiny space with a bit of chemistry. IN genetic engineering synthetic DNA can store long term Stretched out DNA molecules. It can be three meters long and wound up, but it's tiny.
5) *Benefits:* On top of that, hard drives, compact disk, flash drives or tape backups commonly used in data centres need special climate-controlled facilities, with constant maintenance. Meanwhile DNA can survive with minimal effort under a rock for millennia. Scientist prove that a single gram of DNA can store 215 petabytes of data
6) *Issues:* DNA storage is too expensive, and complicated to work on. In 2013, they could encode a few hundred kilobytes, now in 2017 we're talking zettabytes. Someday, the molecules that make up all life as we know it, could be storing backups of videos and photos.

### *B. 5d Optical Storage*

5D data storage technology was discovered by scientists at the University of Southampton's Optoelectronics Research Centre. They developed a five dimensional recording and retrieval process on fused quartz using femtosecond laser writing.

1) *Storage Technique:* A conventional optical media like a compact disk, stores by burning tiny bumps on one or more layers of plastic disc. It is stored as bumps using three spatial dimension height, length and width. When the data on a compactdisk is read, a laser light is bounced off the disc, registering a when the light bounces off a bump and a 0 when there is no bump, with those 1s and 0s, it can store anything from books to music to image. But this new technology of recording data using a femtosecond laser in a fused quartz dis, it is not a bump like a compact disk or A pit like a vinyl record, instead it is creating self-assembled nanostructures, which are basically layers of 3D dots called Nano grating.

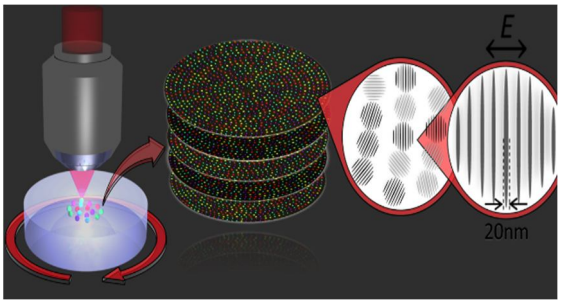



Fig 2:5D optical data storage, written in fused quartz using a femtosecond laser.

This Nano grating produces birefringence in the quartz, bringing out optical properties rooted in its refractive index. The scientists have taken advantage of this birefringence to access two "new" optical dimensions. When data is read from a five dimensional quartz, the light being bounced back and read depending on the Nano grating's orientation is the fourth dimension, the varied strength of the laser's light refracted by the structure is the fifth dimension. Add these to the traditional three-axes of height, length, and width, we get five dimension. By taking advantage of multiple dimensions, each spot in the glass can store three different bits of information. One file is written in three layers of nanostructured dots each separated by five micrometres, which is less than 0.0002inches, it is incredibly densely packed. And with so much data stores in such a tiny way, the implication are huge. This storage method 360 Terabytes of data can be stored in one small crystal.

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Fig 3: This is a crystal with the whole of the King James Bible stored on it.

### *C. Benefits Of 5d Optical Storage*

On other hand the information on a compactdisk is superficial and can be scratched off, the data stored in quartz is safe within the structure of the extremely resilient. It can withstand temperatures as high as 1,832F (1,000C) and will last virtually forever stored at room teacher. This kind of technology could change the way we should and read data. No more worrying about degrading a video tape or scratching a disk. The whole of human history could really be saved in a form that could well outlive the human race.

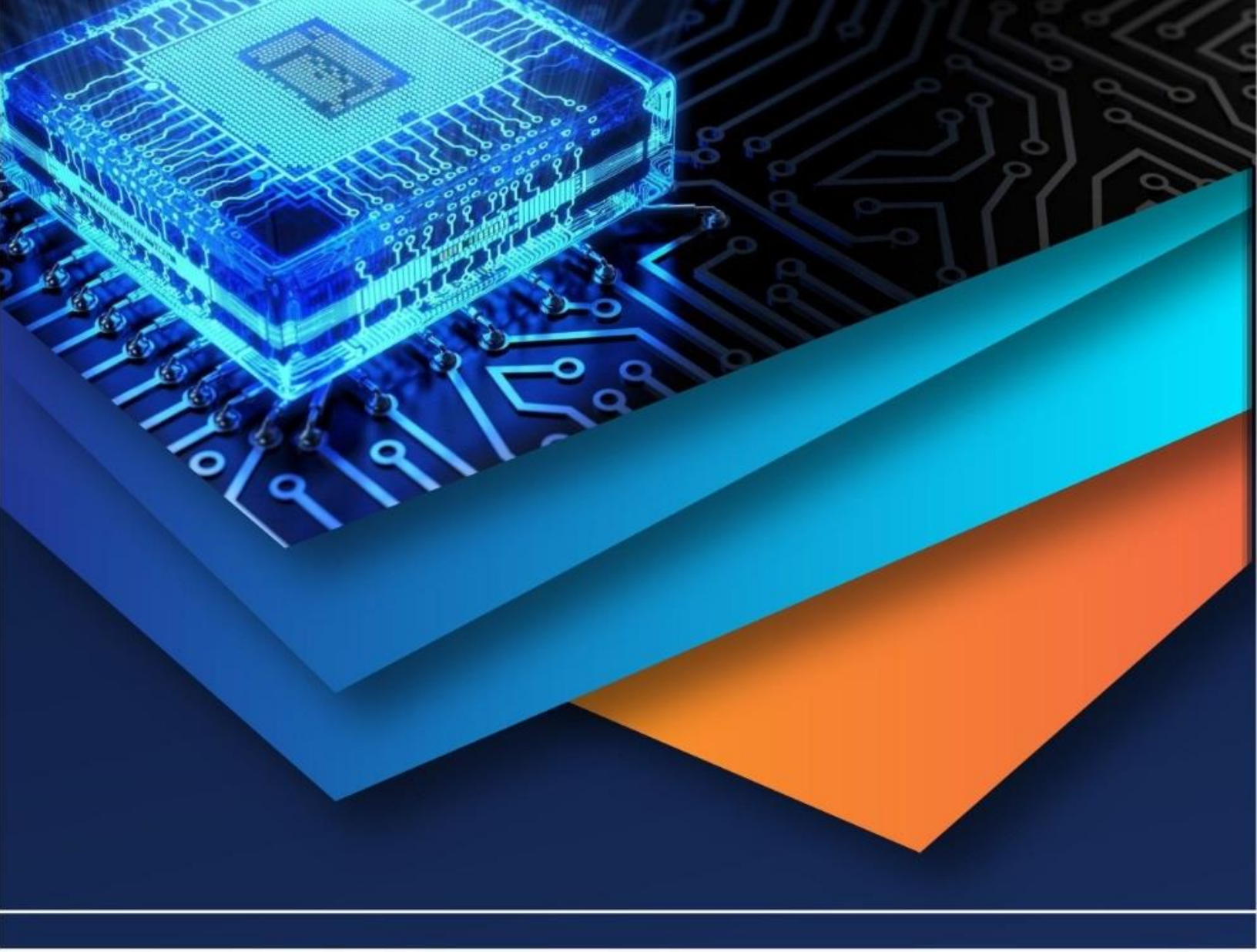
## II. CONCLUSION

This paper discusses about the future technology that can be used to store large amount of data in a tiny space. In future Organic and non organic material can be used to replace silicon based storage devices. This type of storage device have lot of complicated process to encrypt and decrypt data on it. So it's very hard to implement in real-time active storage dives like normal silicon based storage that available in the commercial market. A lot of research work is required to make it as a commercial product.

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