Glass: A New Media for a New Era?

1. Introduction

This paper focuses on the mass storage technologies and proposes a technique that utilizes silica, commonly known as glass, to be a material encoded by a femtosecond laser. Due to silicas' cost, duration, and easily accessible, this idea could be an alternative approach to current mass storage technology.

2. Comparison

Discussion on the disadvantages of other storage techniques.

- Tape(Magnetic Storage): slow speed, low cost, high latency, bit rot, and environmental degradation.
- HDD (Magnetic Storage): slow speed, low cost, slow scaling down, not having a careful IO management.

Discussion on how reliable the silica storage is?

Quickly note: It is high reliable but its usefulness is skeptical.

- ▼ Some requirement
 - 1. Durable for extreme environment
 - 2. High density compact
 - 3. less power consumption
 - 4. fast reading/writing (low latency)
 - 5. no need for refresh or copying
- ▼ Silica project:
 - 1. Storage for long term period

- 2. Endurance (melting point: 1400 °C to 1600 °C)
- 3. Easily accessible to the materials (Glass SiO_2): second highest rate in the earth.
- 4. Recyclable: melt and then reproduce it.

3. Physical properties

Storage unit: voxel (nanostructures made (etched) by femtosecond)

1. How many bits can a voxel memorize? (Qishen Li)

 \rightarrow Depends on the resolution of retardance and polarization (*birefringence*).

2. Multiple-layer storage

 \rightarrow compared with HDDs, data can be stored in multiple layers due to the nature of glass.

- \rightarrow the resolution of encoding lasers determines how many layers can be used.
- 3. How to read data from silica? (Basu)
 - \rightarrow optical microscopy with different focus on each layer.

→ machine learning for what? error correction? quick diagnosis? noise elimination

4. how to process data from retardance and polarization? (Yash)

How much energy would be consumed?

1. how the femtosecond laser works? applications for biomedicine.

 \rightarrow This kind of laser with extreme high power density can produce extremely uniform periodic structures in nanoscale with scarce deficiencies.

2. Is it energy-efficiency? (Kurpur, Mark)

 \rightarrow the laser facilities need a large amount of energy to compress laser beam to pulse laser, and amplify the magnitude so as to encode data in silica, which is very hard and endurance. Therefore, the power source may consume lots of energy even though the silica devices require no energy for storage.

3. Can this system be incorporated in topological quantum system? (Kurpur)

System integration

- 1. How to incorporate the glass storage system into current storage system?
- 2. Whether it is useful although it possesses a huge storage space?
- 3. Machine learning plays a role in processing data.
- 4. Is reading data convenient? if a huge amount of data has been stored, is it easily accessible to obtain needed specific data? random accessible?

Summary

The silica storage technique proposed by this paper seems very promising to mass storage in the further. However, in our discussion, there are many questions and concerns that may compromise its usefulness, potential, and realizability.

The first concern is energy-consumption. The paper claims that the silica technology spends zero energy on data storage, which means that data stored in glass needs no extra energy to be refreshed or be copied for long-term storage. However, the energy of the encoding sources, femtosecond lasers, should be considered. When data is encoded in glass, the high energy consumption from the operation of femtosecond lasers in writing would elevate the total energy consumed.

The second one is data reading. Although the paper points out that machine learning can be utilized for enhancing decoding accuracy, does this extra process consumes more cost and more time than other mass storage techniques? In addition, how much time the reading process spends is not specifically mentioned by the paper. This period spent for reading should be overall evaluated as compared to the other ones.

The third concern is system compatibility. The silica storage owns many advantages that are able to overcome some drawbacks of current storage technique. However, the management of silica storage may be a significant problem for implementation since data encoded in glasses cannot be modified. Probably, it is a suitable way that invariable data, like historical events or records or something that should not be altered in storage, can be memorized in silica, but personal computers or clouds are not fitted with this way. It is worth noting that, with data stored more and more, a large volume of glasses can cause the difficulties of reading as data reading is carried out by optical methods, but lights cannot turn around so you have to bring a piece of glass with data to somewhere with microscopy for extraction, which may spend much more time than electrical reading.