A Seminar on Optical Computer

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Content:

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Introduction:

Optical Computers perform computations, operate, store and transmit data using only light.

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Electronic To Photonic Converter

Fiber optic cables
An optical computer is a device that uses the photons in visible light or infrared (IR) beams, rather than electric current, to perform digital computations.
Real Optical Computer:
Why Optical Computer:

- Light travel 10 time faster than electron. So using light the data transmission rate can be increased.
- In electronic computer the solid state transmission media limits both the speed and volume of signal.
- Optical data processing can be done in parallel process
- Parallelism is the capability of the system to execute more than one operation simultaneously.
- Optical materials have a superior storage density and accessibility over magnetic materials.
How it works ?????????

- Light(Photon) in the place of electron.

- Uses optical components like Optical Transistor, Optical Gate and Switch, Holographic Memory, Input Output Devices etc.

- Transistors, logical gates etc are simulated using optics.

- There are switches that are activated by beams of light rather than by pulse of electricity.

- All-optical components require a high level of laser power to function as required.
Components:

1. **VCSEL** (vertical cavity surface emitting micro laser)
   - it emits light in a cylindrical beam vertically from the surface of a fabricated wafer
Cont.....

2. Photonic crystal:

- Photonic crystals designed to replace transistors in optical computers.
- Photonic crystals is also known as photonic band gap material and similar to semiconductors, only that the electrons are replaced by photons.
- Photonic crystals reflect light of different wavelengths selectively depending on their band gaps.
Cont....

3. SLM (spatial light modulators)

- SLM modulates the intensity and phase of the light beam.
- SLMs are used extensively in holographic data storage setups to encode information into a laser beam.
Cont....

4. Logical Gates:

- Logic gates are the building blocks of any digital system. An optical logic gate is a switch that controls one light beam with another. It is "on" when the device transmits light, and "off" when it blocks the light.

![Diagram of a Nanosecond All-Optical AND-Logic Gate](image)
Cont......

5. Smart Pixels:
- Smart pixels is the union of optics and electronics.
- the electronic circuitry provides complex functionality and programmability while the optoelectronic devices provide high-speed switching.
Use of optics in Memory storage:

- The holographic optical data storage technologies have higher storage capacities and faster read-out rates.

- In conventional memory data are store bit to bit but in a holographic memory data are store in the form of a hologram within a crystal.

- It offer to store 1 tera GB in a sugar cube size crystal.
Advantages...

- Increase in the speed of computation.
- Immune to electromagnetic interference.
- Free from electrical short circuits.
- Have low-loss transmission and large bandwidth.
- Capable of communicating several channels in parallel without interference.
- Possess superior storage density and accessibility.
- No power loss due to excess of heating.
- Life of the hardware of optical computer is more.
Challenges...

- Computation is a nonlinear process in which multiple signals must interact to compute the answer.
- Making photonic crystals is a difficult process.
- Putting optical switches on computer chips is a difficult task.
- It is bulky in size and not movable.
Some Current Research:

- A group of researchers from the university of southern California, jointly with a team from the university of California, los angles, have developed an organic polymer with a switching frequency of 60 Ghz.

- Another groupe at brown university and the IBM, Almaden research center has used ultrafast laser pulses to build ultra fast data storage devices.
Conclusion:

- Research in optical computing has opened up new possibilities in several fields related to high performance computing, high-speed communications.
Any Queries
Thank You!