Seminar On Optical Computing

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Introduction

• What is Optical Computing?

Optical computing is the science of making computing work better using optics and related technologies.
Why Do We Need Optical Computers?

- Rapid growth of the Internet
- Network speeds currently limited by electronic circuits
- Terabit speeds are required
- Traditional silicon circuits have a physical limit
- High Data Storage
Development of Optical Computing

- Optical technology promises massive upgrades in the efficiency and speed of computers, as well as significant shrinkage in their size and cost.
- An optical desktop computer could be capable of processing data up to 100,000 times faster than current models because multiple operations can be performed simultaneously.
Problems to be faced in building optical computers

- Finding materials that can be mass-produced yet consume little power; for this reason, optical computers may not hit the consumer market for 10 to 15 years.

- The digital optical devices have practical limits of eight to eleven bits of accuracy in basic operations due to, e.g., intensity fluctuations. Recent research has shown ways around this difficulty
Some Key Optical Components for Computing

- Vertical Cavity Surface Emitting Laser (VCSEL)
- Spatial Light Modulators (SLMs)
Vertical Cavity Surface Emitting Laser (VCSEL)
Spatial Light Modulators (SLMs)
Uses of Optics in Computing

- Optical Materials are Superior than Magnetic Materials
- Rapid Progress of optical computing
- Optical computing can solve the Problems Faced by Electronic Computers
- Holographic Storage Systems Allows to Store Data at Much Higher Density
Optical Materials are Superior than Magnetic Materials

- Since photons are uncharged and do not interact with one another as readily as electrons, light beams may pass through one another in full-duplex operation.
- Electronics loops usually generate noise voltage spikes whenever the electromagnetic fields through the loop changes.
Rapid Progress of optical computing

- The field of optical computing is progressing rapidly and shows many dramatic opportunities for overcoming the limitations described earlier for current electronic computers
Optical computing can solve the Problems Faced by Electronic Computers

- Light beams can travel very close to each other, and even intersect, without observable or measurable generation of unwanted signals
- Dense arrays of interconnects can be built using optical systems. In addition, risk of noise is further reduced, as light is immune to electromagnetic interferences
- As light travels fast and it has extremely large spatial bandwidth and physical channel density, it appears to be an excellent media for information transport and hence can be harnessed for data processing
Holographic Storage Systems

Holographic data storage has 4 components
• Holographic material; thin film on which data is to be stored
• Spatial Light Modulator (SLM); 2D array of pixels, each of which is a simple switch to either block or pass light
• Detector array; 2D array of detector pixels, either as Charge-coupled device (CCD) camera or CMOS detector pixels to detect existence of light
• Reference arm; arm carrying the laser source to produce the reference beam
Applications of Optics in optical computing

- Data storage: - CDs, DVDs, Holographic Storage Units
- Optical Interconnections
- Optical fibre cables and data transmission
- Optical networking technologies
- Fiber channel and storage area networks
- Chip level optical interconnections
- Data processing and specialized devices
- Processing of continuous data streams
Advantages of Optical Computing

- They are immune to electromagnetic interference, and free from electrical short circuits.
- They have low-loss transmission and provide large bandwidth.
- They are capable of propagating signals within the same or adjacent fibres with essentially no interference or cross-talk.
- They are compact, lightweight, and inexpensive to manufacture.
Future Benefits vs. Current Limitations

**Future Benefits**
- No conversion of data
- Faster than today’s machines
- Increased computational power
- Optimized storage
- Increased bandwidth
- Super-fast database searches

**Current Limitations**
- Photonic circuit accuracy
- Requirement of power
THANK YOU

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Final Year (VIII Sem)
CSE-2