



University of British Columbia
CPSC 414 Computer Graphics

Displays, Devices II

Week 12, Wed 19 Nov 2003

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News

- extra office hours in lab
– 5:15-6:15 today
- project 3 **draft** out

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Display Technologies recap

- CRT: Cathode Ray Tubes
- LCD: Liquid Crystal Displays
- plasma display panels
- DMD/DLP: micromirror array projectors
- display walls: tiled projector array

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Display Wall Discussion

- pros
 - commodity technology
 - can be seamless (theoretically)
- cons
 - geometric alignment solvable
 - colorimetric alignment difficult
 - large space footprint

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Future: Plentiful Pixels?

- digital wallpaper
 - 300dpi, ubiquitous
 - cheap as paint/wallpaper
- projectors as lightbulbs, flashlights
- challenges
 - rendering
 - physical delivery of pixels to displays
 - would need **lots** of wires

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Mobile Displays

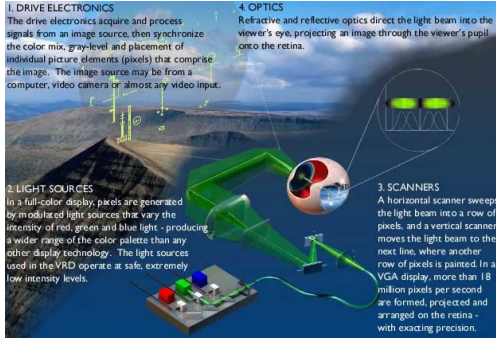


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Mobile Displays



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Stereo Displays

- active glasses or active screen
 - autostereoscopic also possible



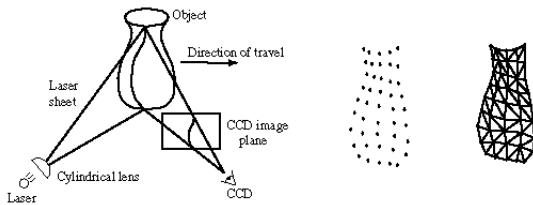
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Laser Stripe Range Scanners

- camera records laser stripe
 - second camera records texture image



[graphics.stanford.edu/papers/volrange]

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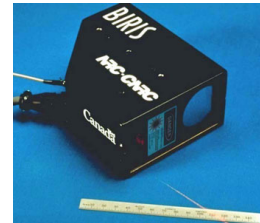
Laser Stripe Range Scanners

Cyberware



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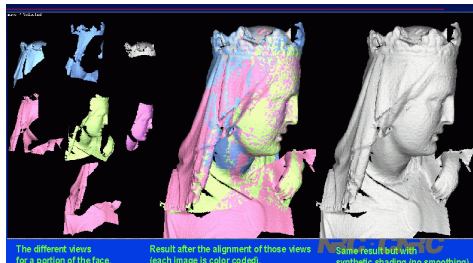
BIRIS



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Laser Stripe Range Scanners



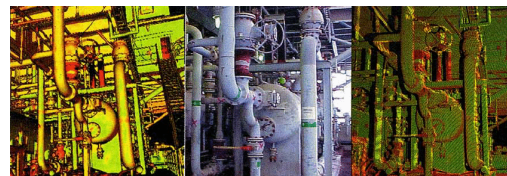
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Laser Time-of-Flight Scanners

- Cyra
 - picosecond clock rates

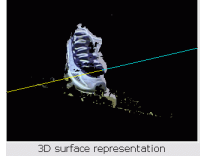


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Depth from Stereo



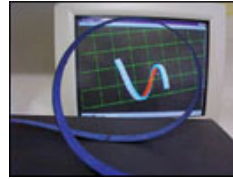
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Shape Tape

- fiber-optic based bend-and-twist sensor



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Haptics



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3D Printers

- spread layer of powder
- print binder solution
- vacuum away loose powder



4.5 hrs printing,
\$100 printing cost
electroplated



[Z Corp]

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3D Printers



printing telephones?
etc.

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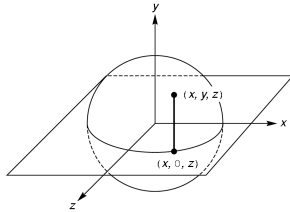
Virtual Trackball

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Virtual Trackball

- imagine a trackball embedded in screen
 - cs.calvin.edu/CS/352/02Graphics/lectures/primer-demo.exe
- if I click on screen, what point on trackball am I touching?



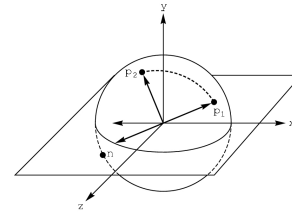
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Trackball Rotation Axis

- If I move the mouse from \mathbf{p}_1 to \mathbf{p}_2 , what rotation does that correspond to?



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Virtual Trackball Rotations

- Rotation about the axis $\mathbf{n} = \mathbf{p}_1 \times \mathbf{p}_2$
- Angle of rotation: use
 - $\mathbf{p}_1 \cdot \mathbf{p}_2 = |\mathbf{p}_1| |\mathbf{p}_2| \cos \theta$
- Fixed point: if you use the $[-1, 1]$ cube, it is the origin

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Virtual Trackball

- can we use the mouse to control the 2-D rotation of a viewing volume?
- imagine a track ball
 - user moves point on ball from (x, y, z) to (a, b, c)
- imagine the points projected onto the ground
 - user moves point on ground from $(x, 0, z)$ to $(a, 0, c)$

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Trackball

- movement of points on track ball can be inferred from mouse drags on screen
- inverse problem
 - where on trackball does $(a, 0, c)$ hit?
 - ball is unit sphere, so $\|x, y, z\| = 1.0$
 - $x = a, z = c, y =$ solve for it

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Trackball

- user defines two points
 - place where first clicked $X = (x, y, z)$
 - place where released $A = (a, b, c)$
- ball rotates along axis perp to line defined by these two points
 - compute cross product of lines to origin: $(X - O) \times (A - O)$
- ball rotates by amount proportional to distance between lines
 - magnitude of cross product tells us angle between lines
 - (dot product too)
 - $|\sin \theta| = \|\text{cross product}\|$
- compute rotation matrix and use it to rotate world

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