

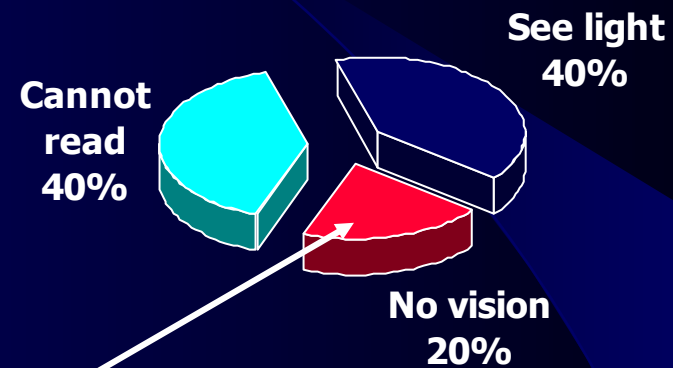
Revolutionary Assistive Technology for the Blind

Blind Navigator: using object recognition to enhance blind mobility

David Grossman	dgrossman@cdr.stanford.edu
Becky Currano	bcurrano@stanford.edu
Larry Leifer	leifer@cdr.stanford.edu
Naseem Hakim	naseem@stanford.edu
Chris Yap	cayap@stanford.edu
Boonping Lau	

1.35M “Legally Blind” in USA

- Covered by
 - Insurance
 - Medicare
 - Legislation
 - The ADA (1990)
 - The ATA (1998)
- 270,000 with no vision
- Huge impediment
 - Jobs
 - Education
 - Training



Challenge: Mobility

- Real physical world
 - Complex environment: outdoors & indoors
 - 100 BC - 2003 AD: canes and dogs
 - Various mobility aids on the market
 - Technology hasn't helped very much
- Object recognition a revolutionary advance
 - Reduce the cognitive workload

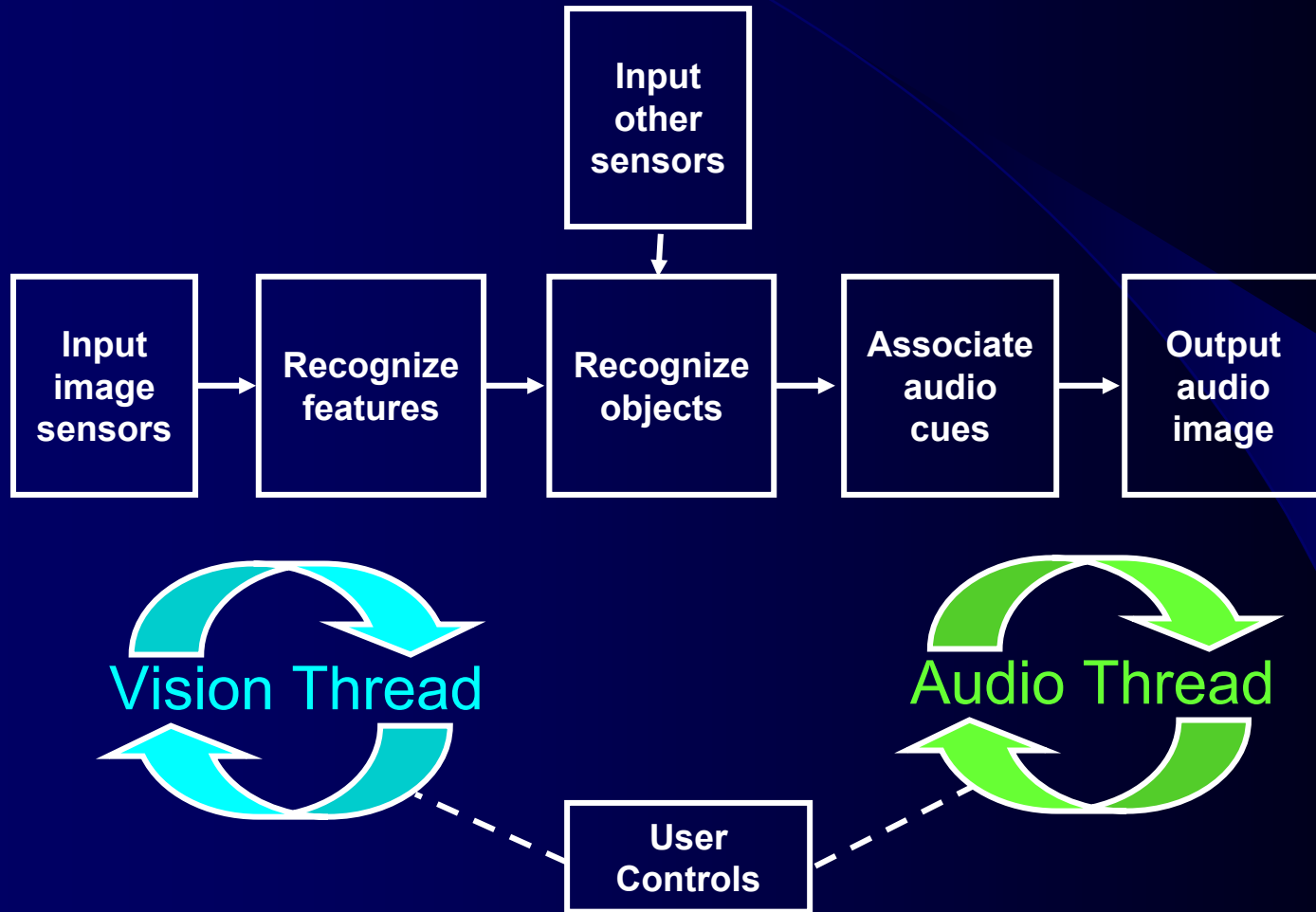
Concept

- Wearable computer & headset
 - Input: stereo video, 2-axis tilt, compass, GPS
 - Object recognition
 - Output: spatial audio emanating from objects
 - User controls
- Audio cues: speech and sound effects

Video ➡ **Recognition** ➡ **Audio**

Passive sensing: not ultrasound or laser ranging

Technology



Object Recognition

- Hazards

- Street, drop-off, post, tree

- Obstacles

- Walls, doors, windows vs Safe forward direction

- Common Objects

- Tables, chairs, people, cane

- Landmarks

- Buildings, mountains, sun

- Symbolic Information

- “Starbucks”, street name, directories
- Red and green traffic lights, Danger!

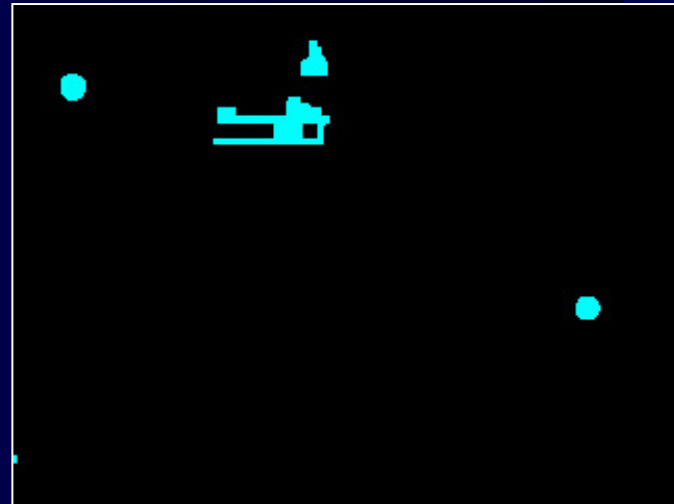
Media X Project: 9/02 – 9/03

- Funded by Omron Corporation, Kyoto
- Built a development environment
 - Laptop computer: 2 GHz Pentium 4
 - Windows (started with Linux)
 - C++ multithread application
 - vision, audio, model, control
 - OpenCV for computer vision (Intel)
 - DirectX for spatial audio output
 - 320 x 240 pixel webcams
 - Ordinary headphones
- Built a prototype system

Prototype System

- Recognizes red and green traffic lights
 - Input image \Rightarrow HSV planes
 - Threshold, boolean, morphic processing
 - Connected region analysis
 - Select circular features
 - Ignore: higher level object structure, stereo correlation, & geometric calibration
- Demo

Prototype System



Future Trend

- 2 MHz Pentium 4
 - 2003: 1,250 cm³, 2 kg, \$1,500
 - 2013: 250 cm³, 0.4 kg, \$200
- This project rides the technology wave
- Object recognition is the right approach
- Success is inevitable

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Conclusion

- Project still at its earliest stages
- Long term goals
 - Comprehensive solution
 - Widespread acceptance
 - Not just a technological success
- Unique & innovative
- “Social ROI”
- Looking for more funding for the future

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