Seeing with Sound:
Wearable Computing for the Blind

The vOICe

by

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OIC? Oh, I see!

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Wearable Computing for the Blind

Overview

- Introduction to seeing with sound
  - *How does it work?*
  - *User experiences*
- Special features and options
  - *Speech I/O, OCR, color, binocular (3D) vision, ...*
- Conclusions

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The vOICe: The Concept

Basic facts:

- Blind people cannot see... but usually they can hear
- Multimedia computing allows audio-visual transformations

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The vOICe concept

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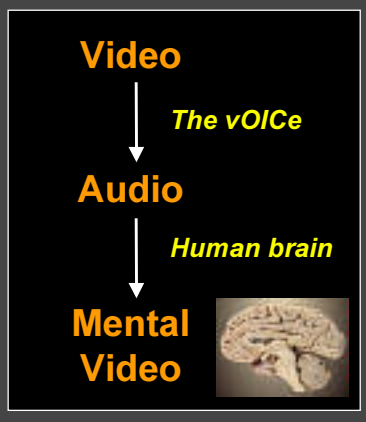
So translate video to audio!?



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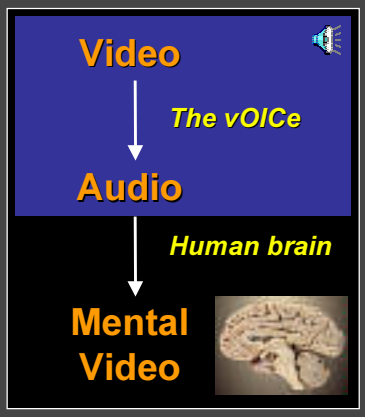
The vOICe Learning Edition software



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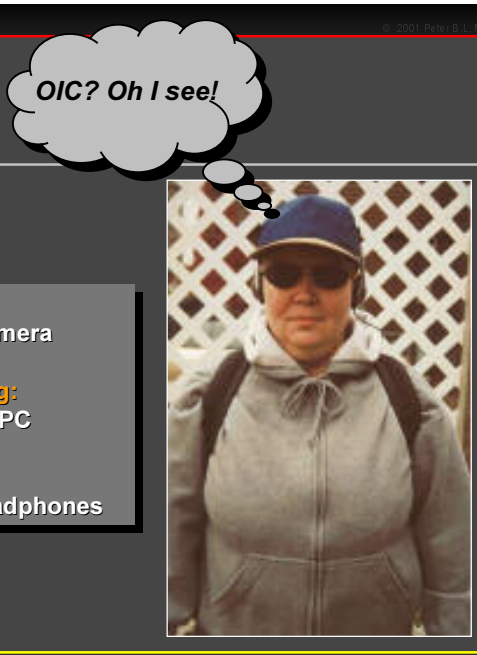
Wearing The vOICe



Video:
Hidden camera

Processing:
Notebook PC

Audio:
Stereo headphones

The fully immersive visual experience

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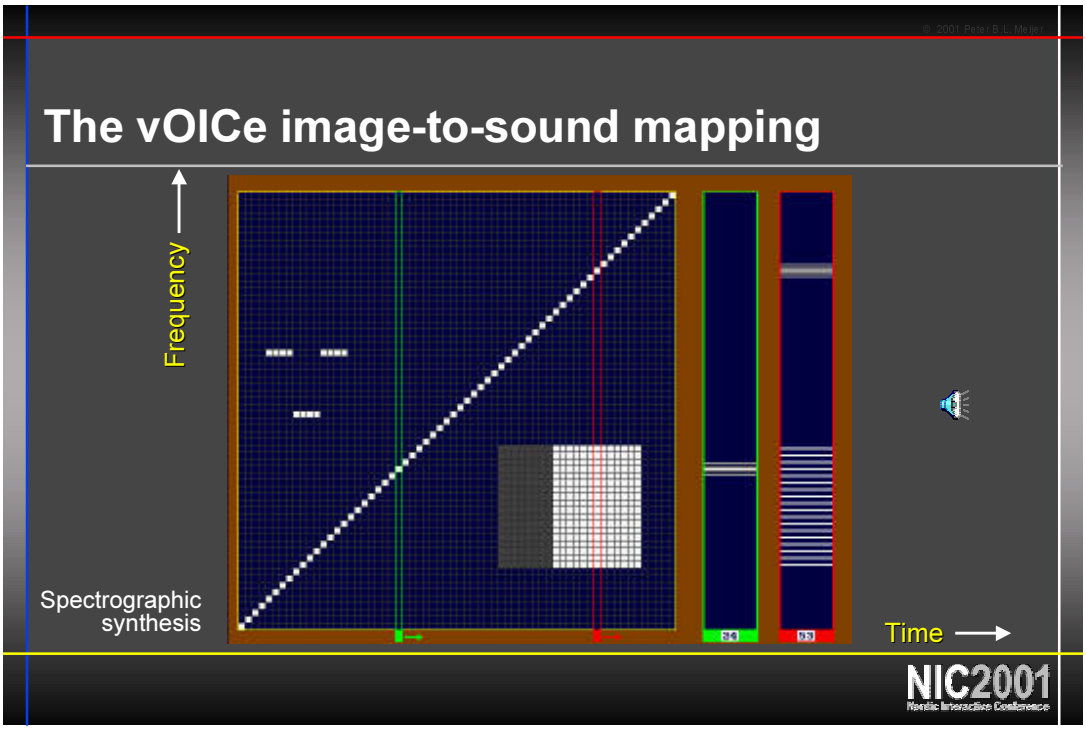

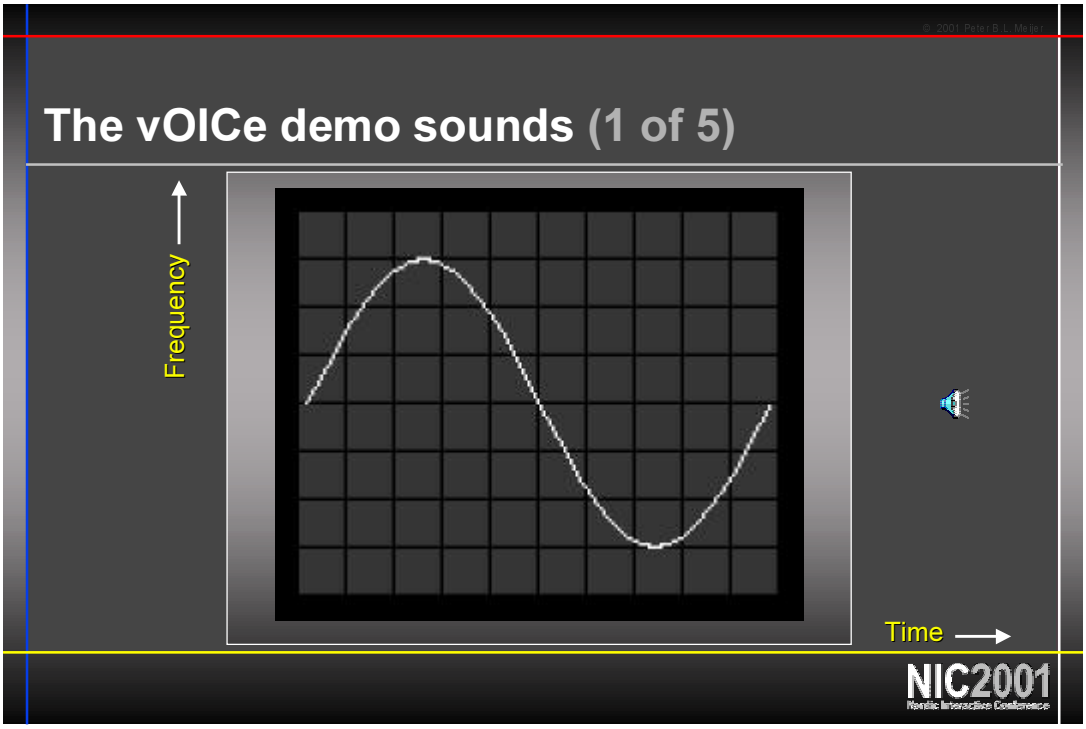

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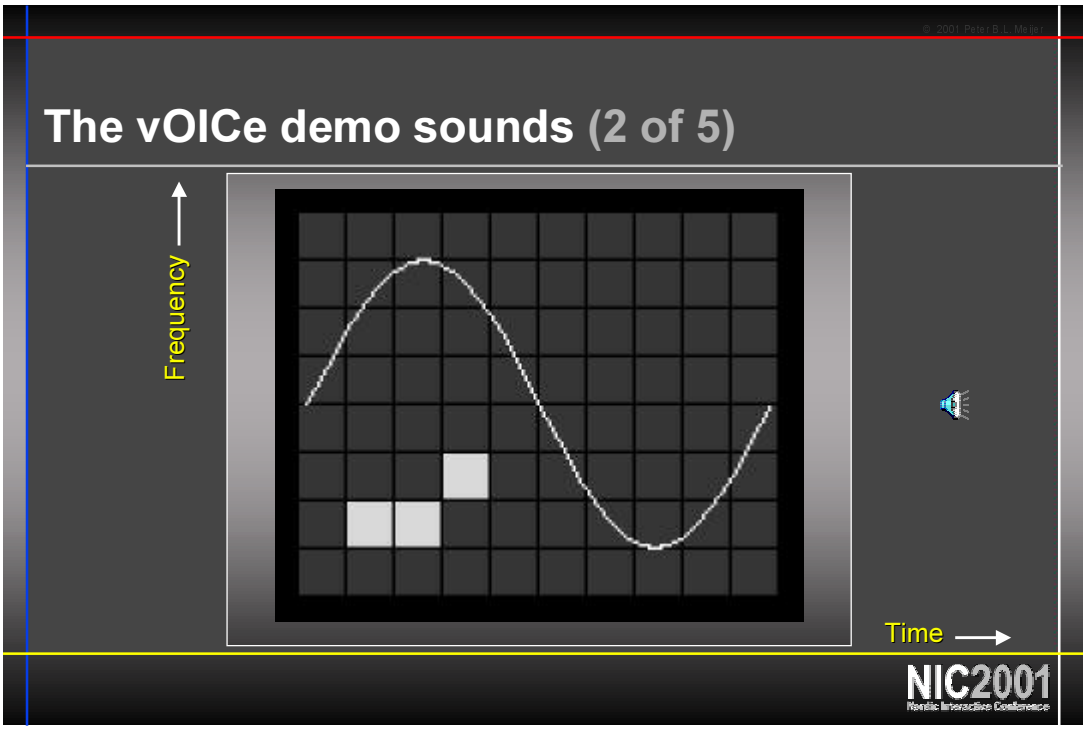

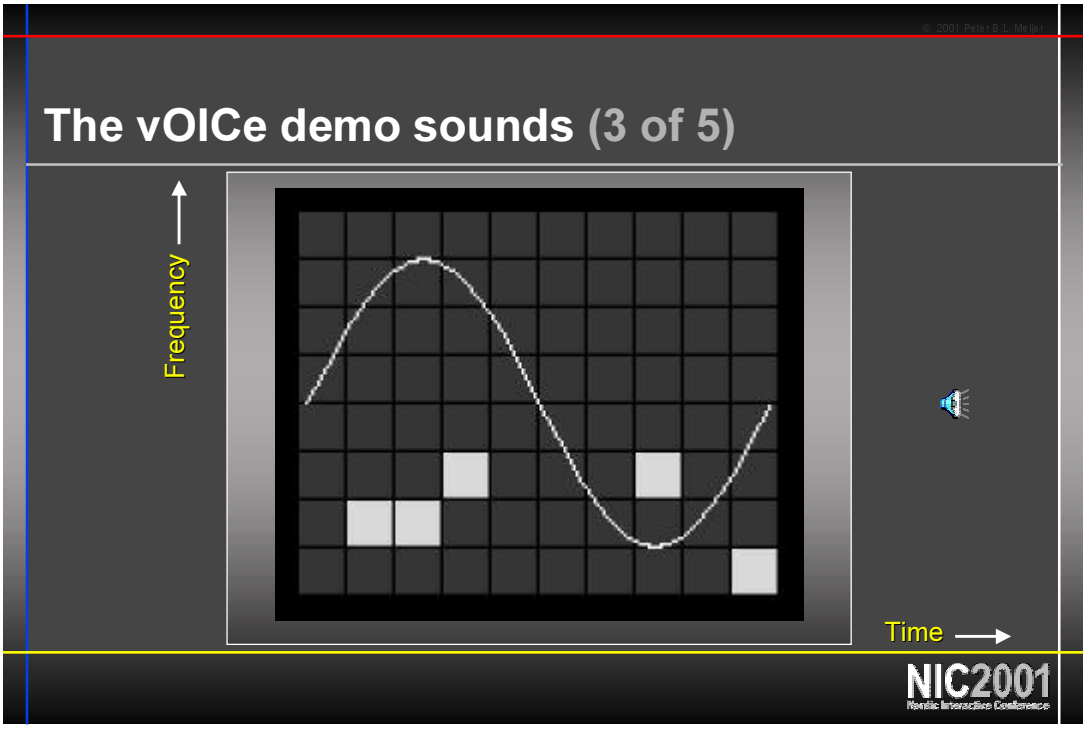

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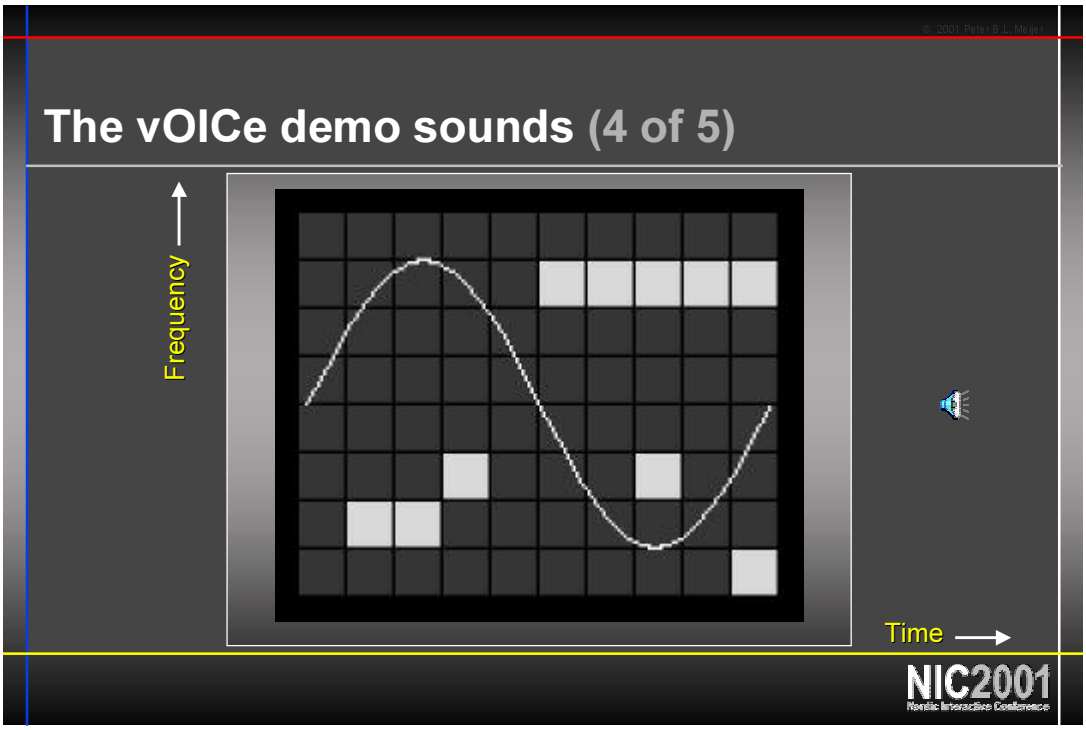

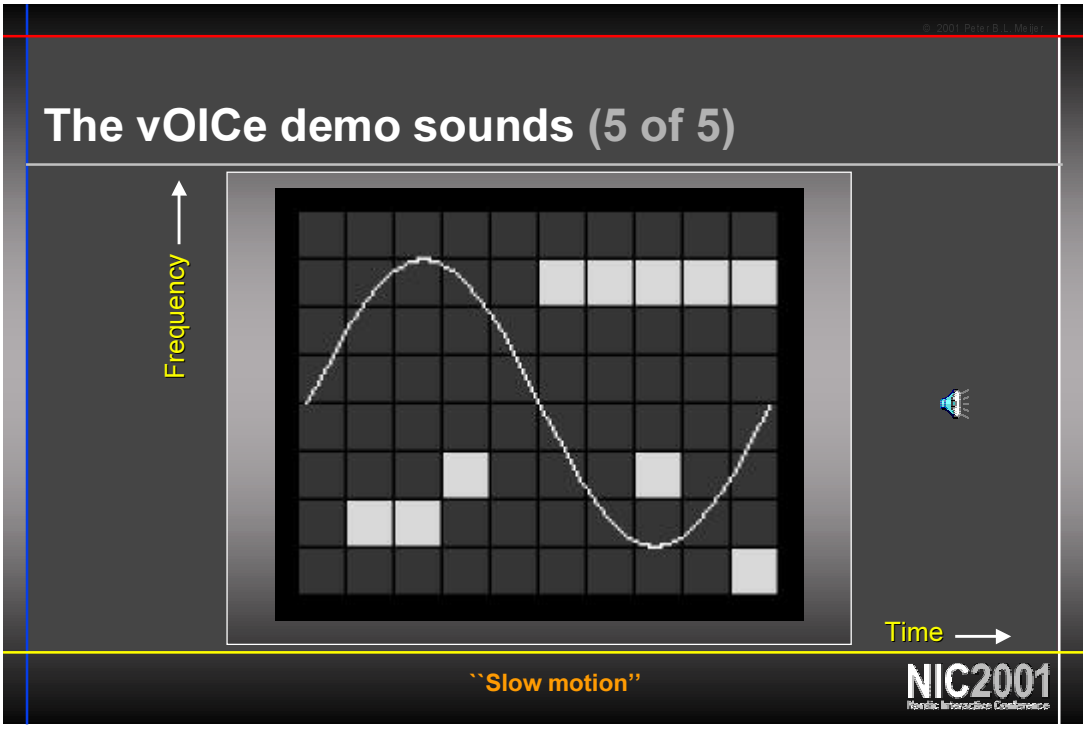

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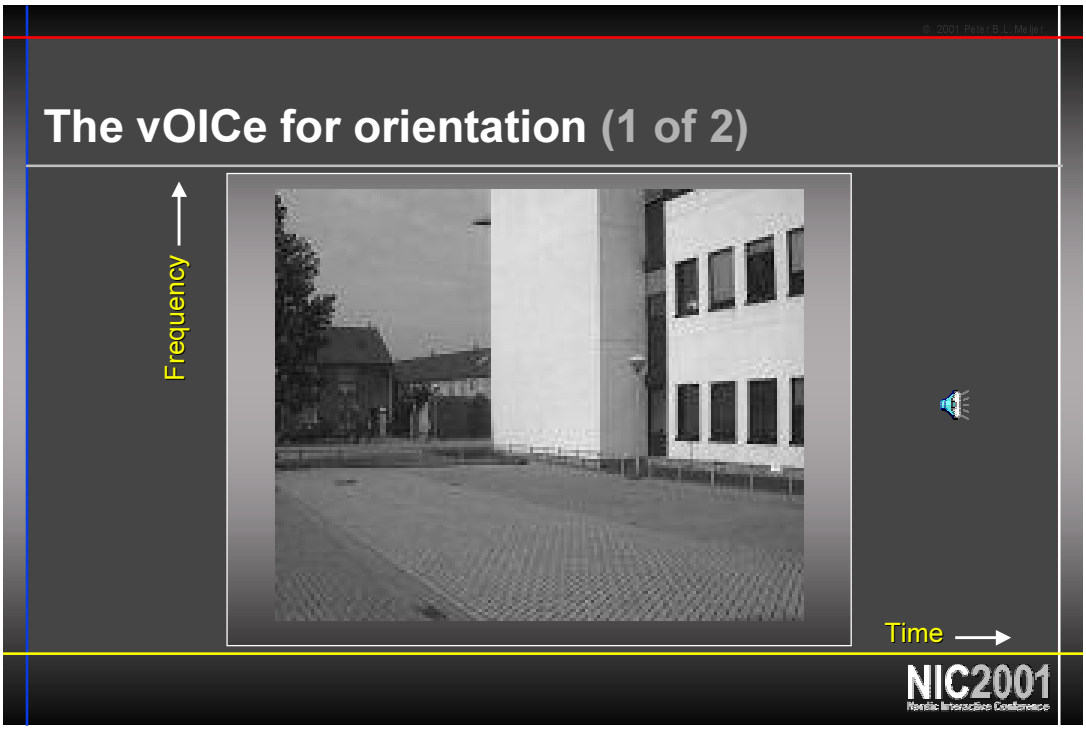

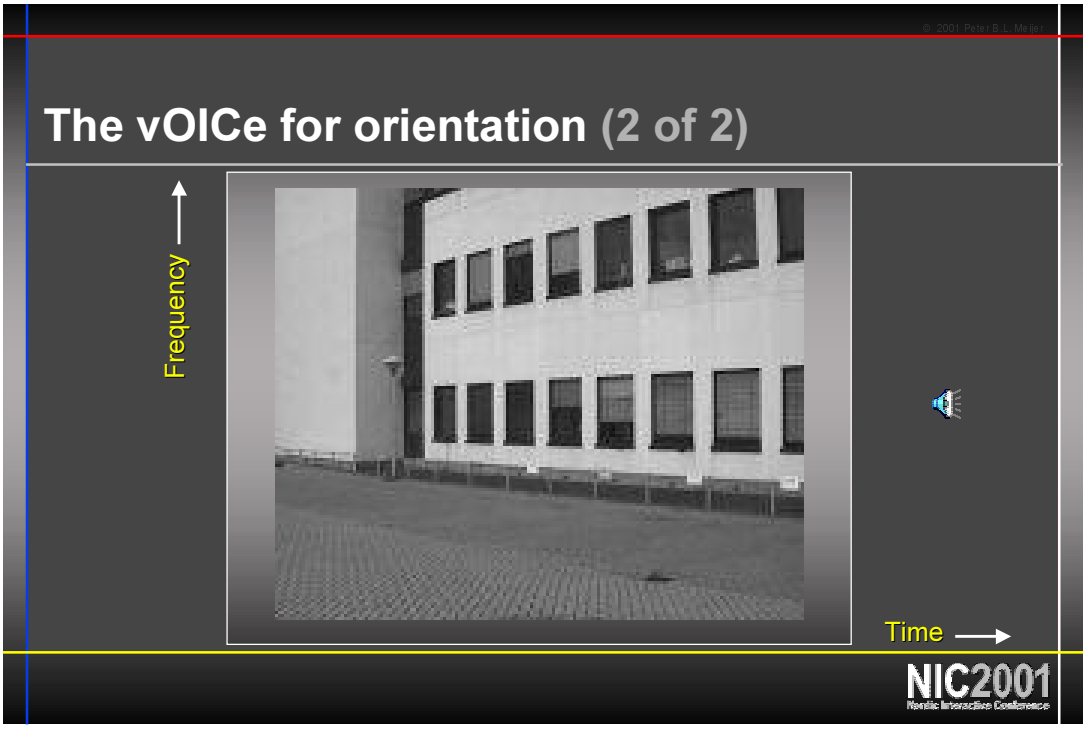

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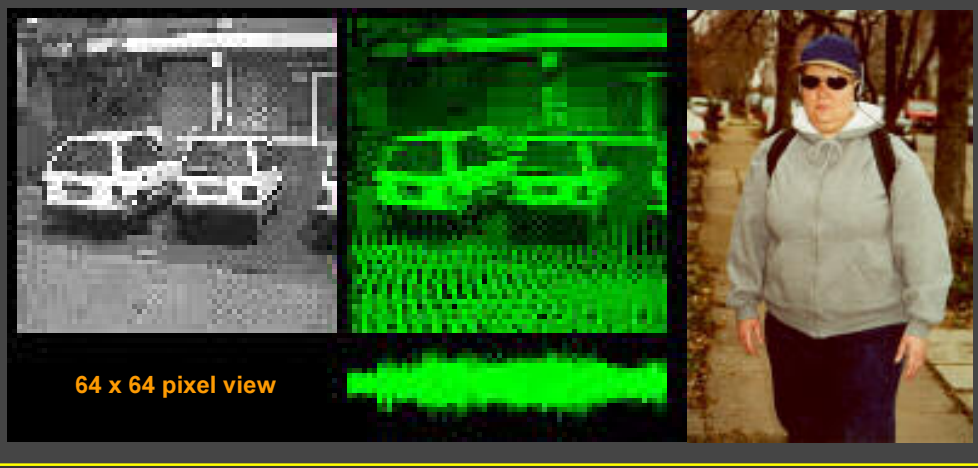
The vOICe image reconstruction



Original (left) and reconstruction from soundscapes (right)

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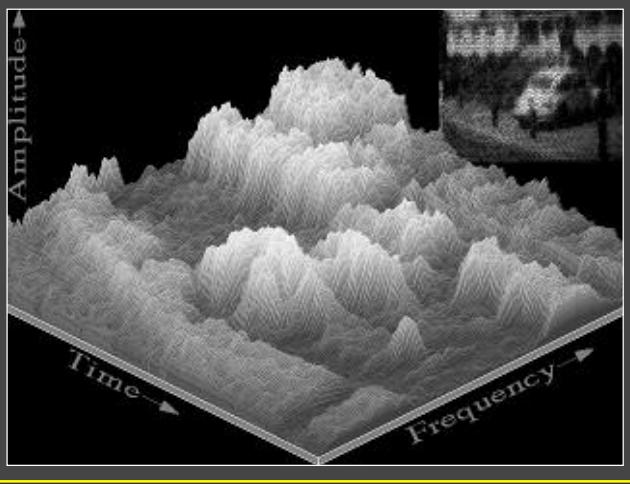
The vOICe mental imagery?

Warning:

Representation may dramatically affect recognition!



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The vOICe limitations?

Issues:

✓ Frequency-Time uncertainty

- Physiology / Perception:
  - ✓ *just-noticeable difference (JND)*
  - ✓ *critical bands (human cochlea)*
  - ? *auditory streaming/segregation*
  - ? *neural pathways & bandwidth*
  - ? *neural processing & plasticity*
- Psychology / Education:
  - ? *sounds (too) unpleasant*
  - ? *minimum required results*
  - ? *acceptable training effort*
  - ? *motivation for learning*
  - ? *training programs*

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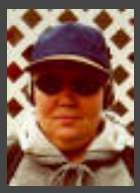
The vOICe user experiences

So, what do blind users say?



Some accounts from a late-blinded woman in the USA who has been wearing The vOICe daily from mid 2000

(No claims are made that this is representative!)

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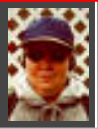
The vOICe user experiences



User quotes:

As a person who was blinded later in life I can say that the soundscapes seem to trigger a sense of vision for me.

At first you might say I noticed only the soundscapes as they indicated changing patterns. I was not at this time actually seeing as I feel I do now. Rather just experiencing the soundscapes as I walked around. **After a few months I was not concentrating on the changing sounds rather just accepting the input as background information and translating it into images.**

Vision is (and should be) a largely subconscious process

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The vOICe user experiences

User quotes:

What is significant to realize is The vOICe allows you to experience your surroundings in a 3-dimensional form. When I am not wearing the program my contact with the world is limited to sound and touch. When wearing the program you can extend these senses to include the sight the program provides. **I look across my study while using the program and see the scanning table then the small book case in back of the table with an image of the door opening on the left of the scene.** Take off the program and this full, rich environment of seeing different structures is lost and I am returned to perceiving the world in a flatten 2-dimensional form. **Wearing the Seeing With Sound program is like stepping from total darkness into light.**

www.seeingwithsound.com/users.htm

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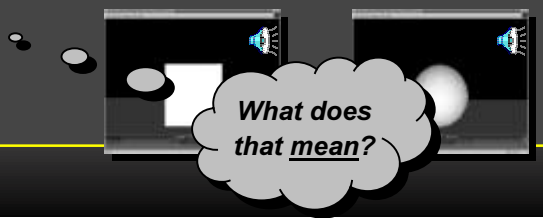
Philosophers and The vOICe

17th Century "Molyneux problem" revisited?

- Q: Would someone born blind, in case sight was restored, be able to tell a cube from a sphere by sight alone?
  A: "No" (*according to John Locke & William Molyneux*)
- Q: Would someone born blind, using "seeing-with-sound", be able to tell a cube from a sphere by "sight" alone?
  A: "Yes"



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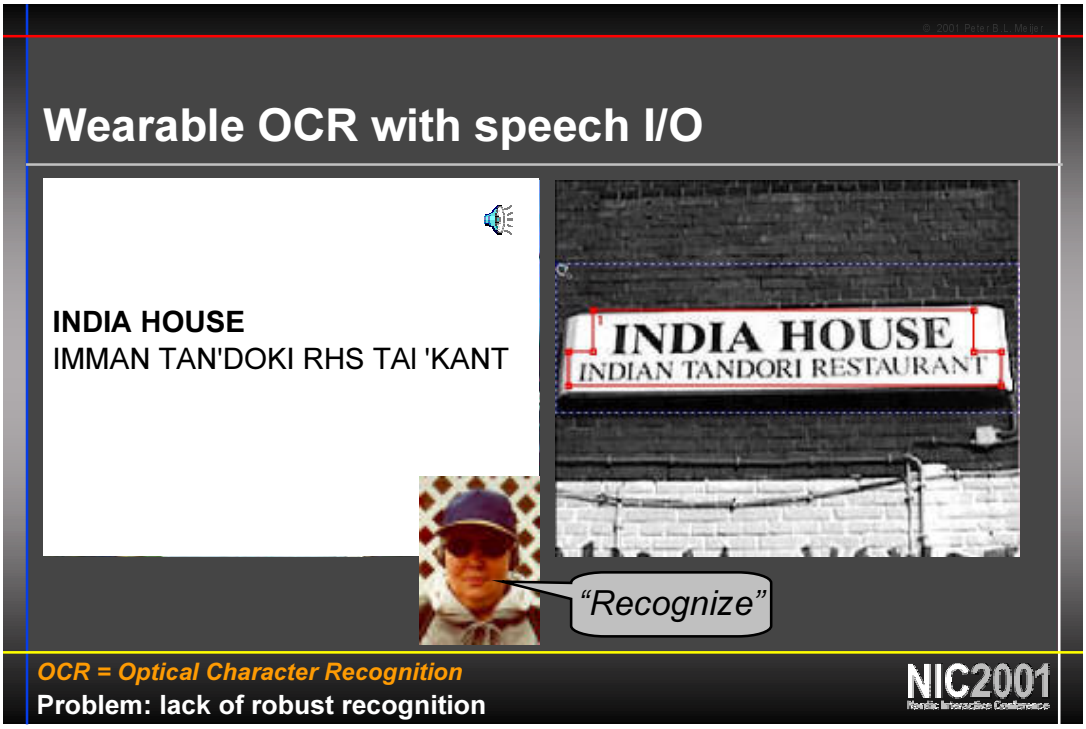

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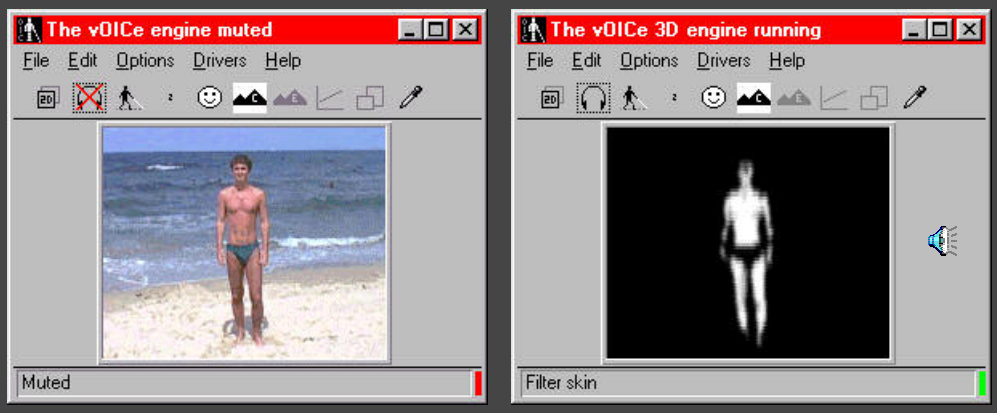
Wearable skin color detection



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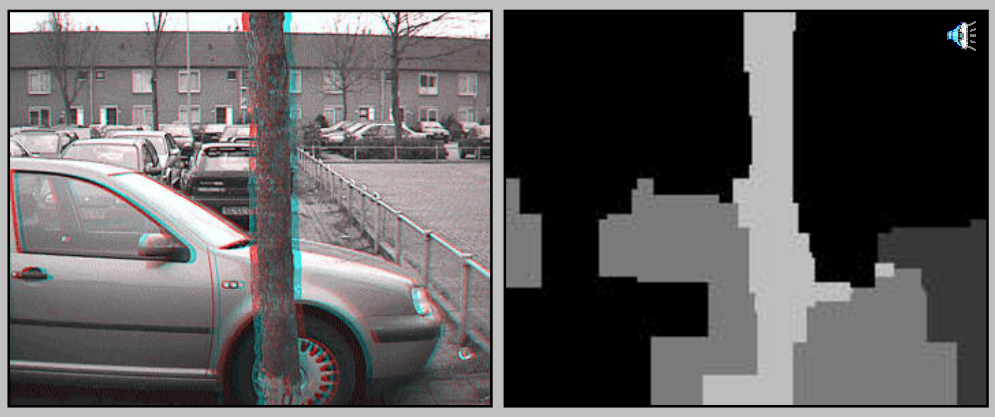
Stereoscopic vision for obstacle detection



From binocular disparity to distance map using anaglyph video input

www.seeingwithsound.com/binocular.htm

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Conclusions

Seeing with Sound

- ✓ Needs more research
- ✓ Is affordable technology
- ✓ Is non-invasive
- ✓ Is available ***Now!***

Free
evaluation software at
http://www.seeingwithsound.com

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