

## Voice Search While Driving: Is It Safe?

Kent Wittenburg

TR2009-005 February 2009

### Abstract

PowerPoint presentation.

*Voice Search 2009*

This work may not be copied or reproduced in whole or in part for any commercial purpose. Permission to copy in whole or in part without payment of fee is granted for nonprofit educational and research purposes provided that all such whole or partial copies include the following: a notice that such copying is by permission of Mitsubishi Electric Research Laboratories, Inc.; an acknowledgment of the authors and individual contributions to the work; and all applicable portions of the copyright notice. Copying, reproduction, or republishing for any other purpose shall require a license with payment of fee to Mitsubishi Electric Research Laboratories, Inc. All rights reserved.





 **MITSUBISHI ELECTRIC RESEARCH LABORATORIES**  
Cambridge, Massachusetts

# **Voice Search While Driving Is it Safe??**

---

Kent Wittenburg, VP & Director

Mitsubishi Electric Research Laboratories  
Cambridge, MA USA

Voice Search 2009  
San Diego, California

# Innovative mobile applications



Courtesy of Bruce McCall

## Innovative mobile applications for the car

- Now 275 car models have iPod connectors  
5 years ago: 0 models\*
- Models with DVD entertainment systems have doubled in 5 years\*
- Nav systems, customizable environment settings, Bluetooth, satellite radio, messaging, web access,...
- Over \$12B will be spent on electronic enhancements for vehicles in 2008\*\*

**But, by the way, is this safe?**

\**NY Times* Cars Special Section, October 30, 2008

\*\*CEA Industry Forecast, November, 2008

# Eye movements operating an iPod while driving



Video courtesy of Donald Fisher, HPL, U. Mass. Amherst

# Speech interfaces to the rescue! Eyes free (mostly)! Hands free (mostly)!



- Command & control
- Music selection
- News & information control
- Voice call setup
- Destination entry
- Point of interest finding
- Dictation and voice output for email and text messaging
- ...

**But, are voice interfaces  
really safe?  
Are they all the same?**

## Areas of Concern

- **Stateful language dialogs**
  - Only a subset of commands available
  - Does the user know what to say?
  - What if the system fails to understand?
  - What if the system state doesn't correlate with the user's intentions?
- **System-paced dialogs**
  - The system prompts the user, waiting for a response
  - What if the user needs to attend to driving?
  - An additional distraction from the road?





## Dialog-based Music Finding



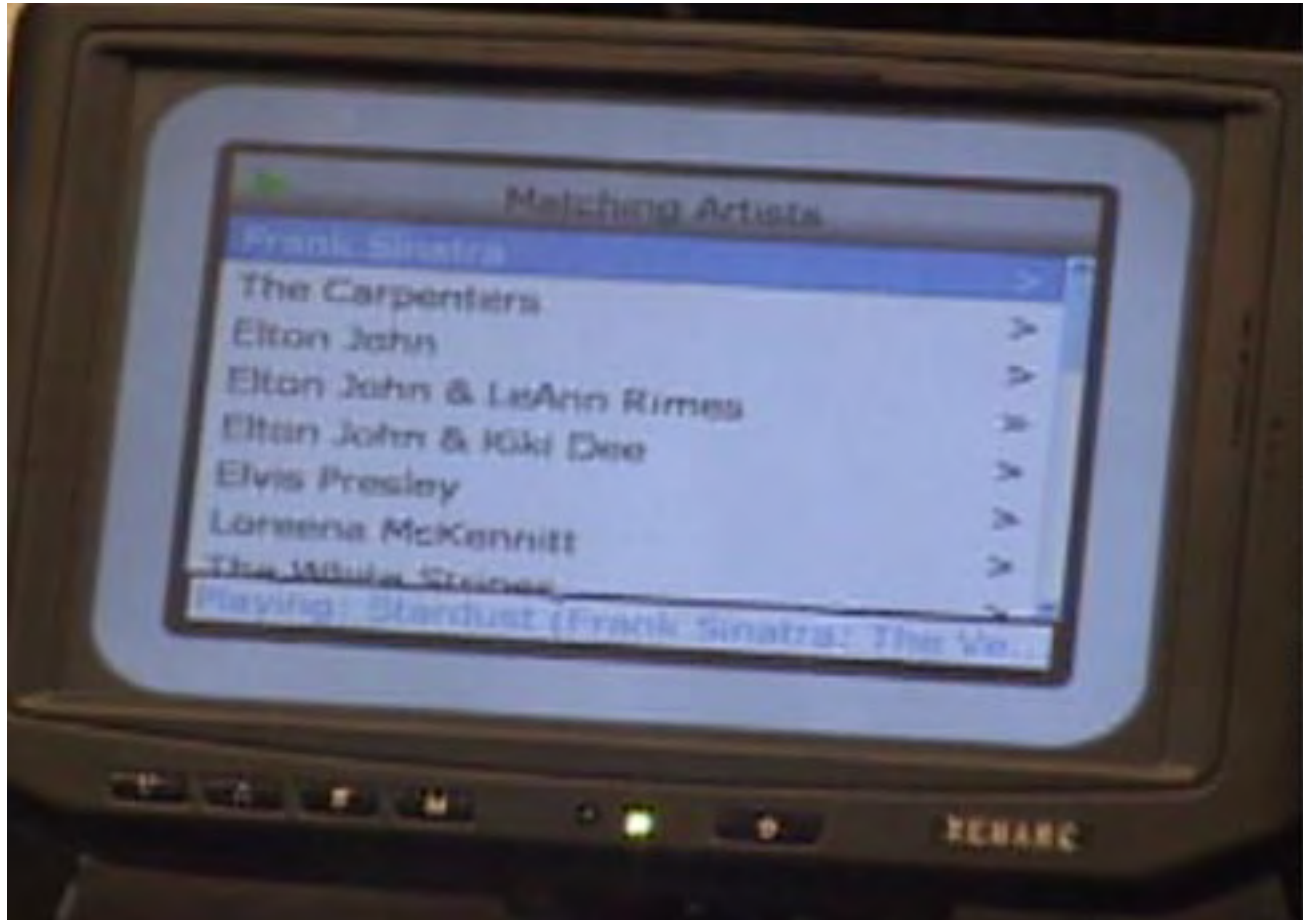
Commercially available system

## Voice search (Speech-in List-out) alternative

- Stateless language dialogs
  - All commands always available
  - User may say anything
  - Only failure is unsatisfactory result—try again
- User-paced
  - The system never prompts the user
- Speech used only when needed
  - Haptic input for list navigation, state selection, etc.



## Voice Search Music Finding



MERL's SpeakPod prototype

## Testing the hypothesis

- Collaboration with U. Massachusetts Human Performance Laboratory (D. Fisher, Director)
  - Driving simulator
  - Eye tracker



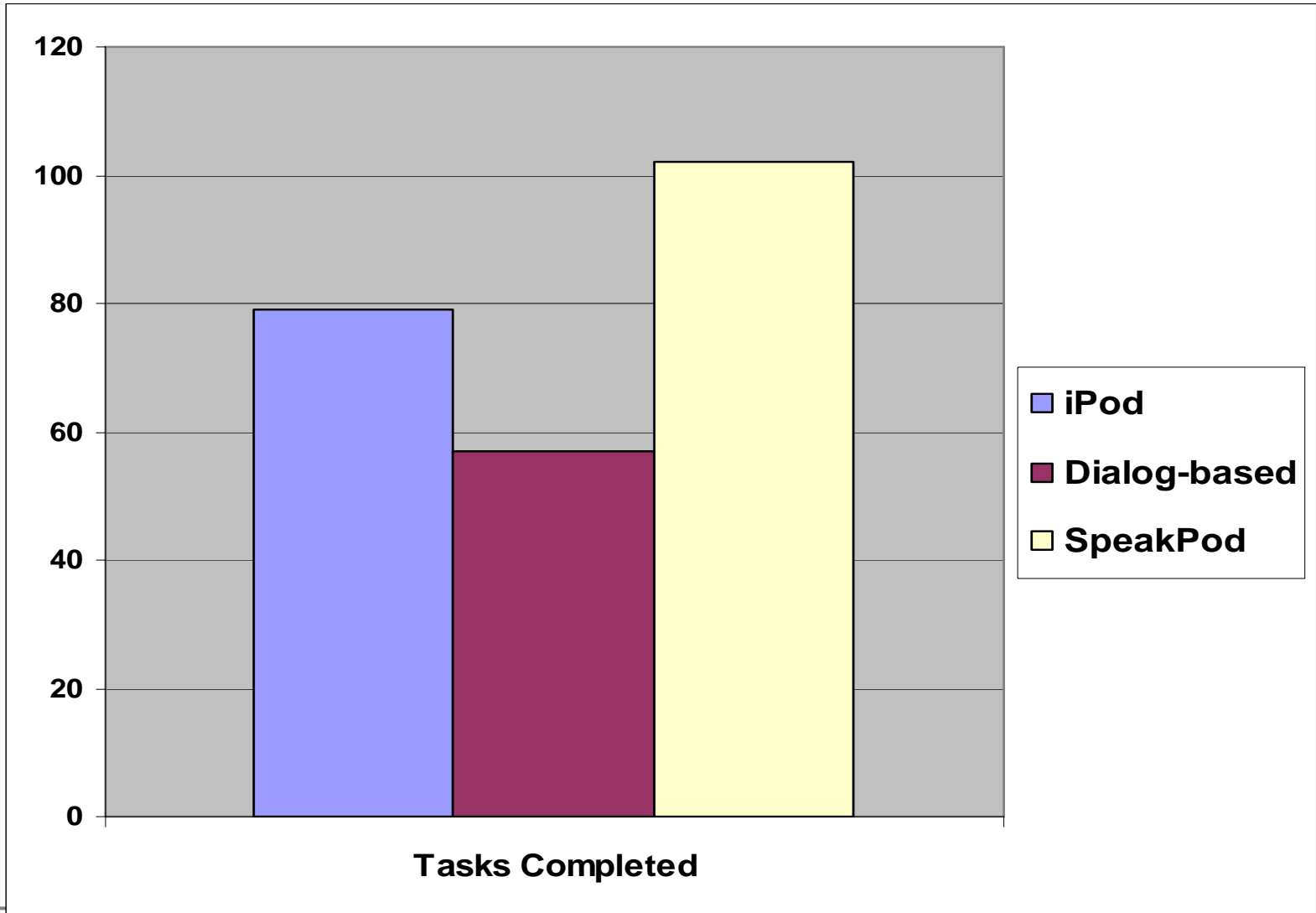
## Three conditions for finding music while driving

	<b>Display</b>	<b>Haptic Interface</b>	<b>Secondary Input Modality</b>
<b>A. iPod</b>	2.5-inch LCD	click-wheel	none
<b>B. Commercial aftermarket in-dash unit</b>	7-inch LCD	wheel-mounted remote	speech (dialog-based)
<b>C. MERL SpeakPod prototype</b>	7-inch LCD	wheel-mounted remote	speech (query-based)

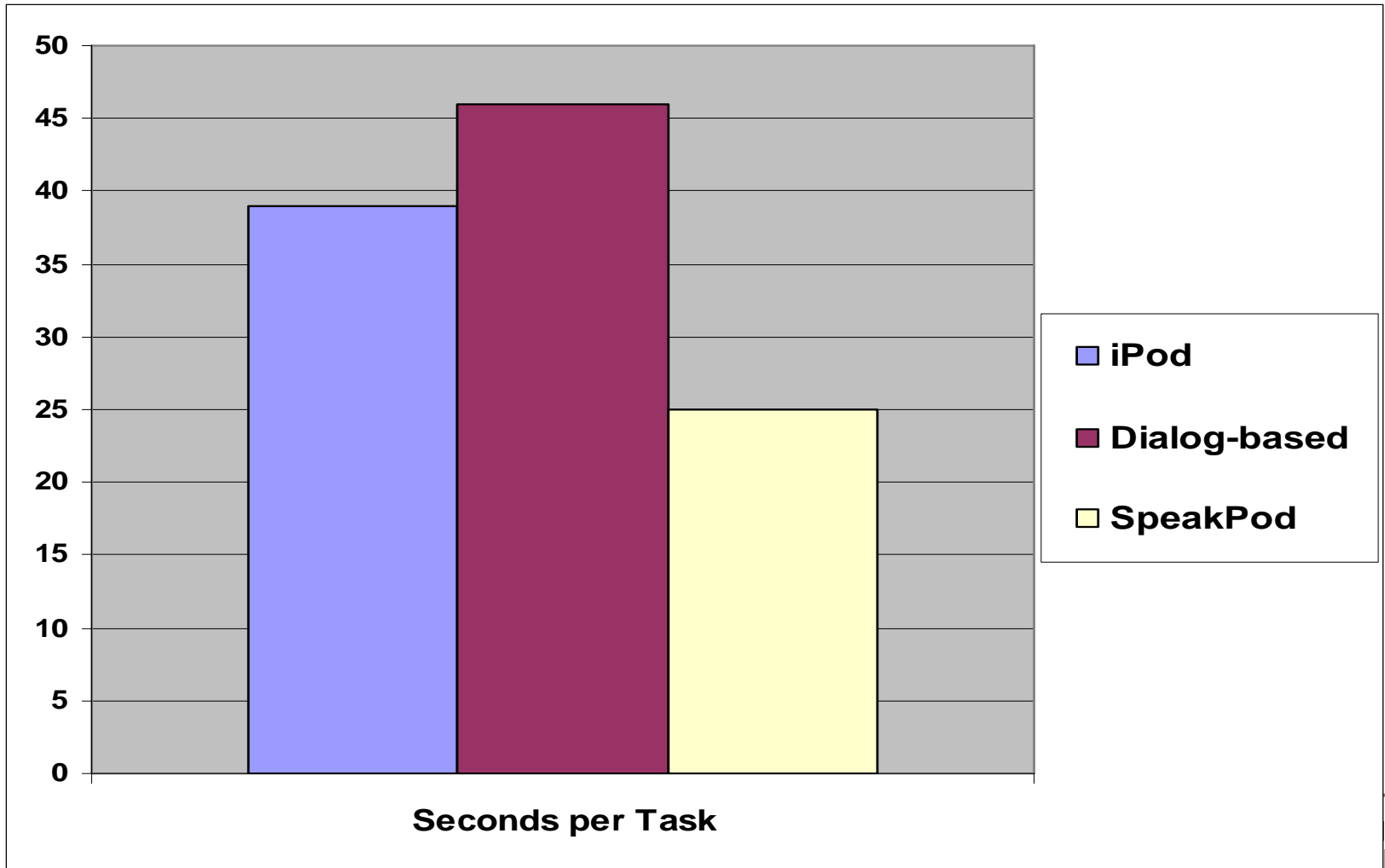
## Experimental procedure

- 17 native English speakers (12 men, 5 women) from students and staff of U. Mass.
  - Ages 18 to 30 (average 21. 5)
  - iPod experience
- Music retrieval task (finding a specified item)
  - Specified song
  - Any song from specified album
  - Any song from specified artist
- Simulated driving task (4 different blocks per user)
  - Eye movements monitored
  - Music retrieval tasks timed and marked successful or not

# Task success rate

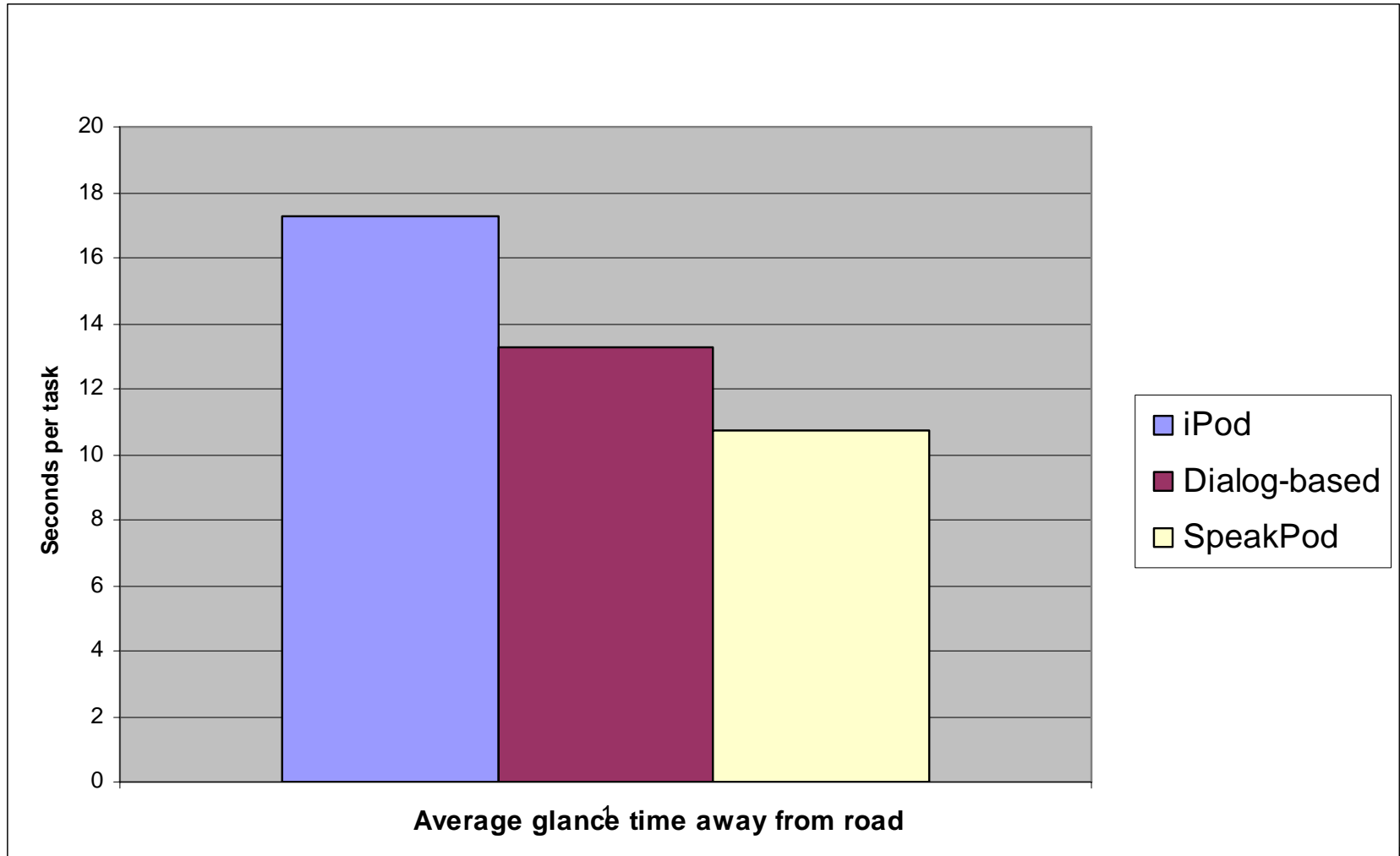


# Task time completion





# Average glance time away from the road



## Conclusions

- Myriad of new features and gadgets compete for driver's attention
- Ultimate user experience must include safety!
- Speech interfaces are a good direction
- However, different UI dialog models may influence safe driving
  - Stateful dialogs, system pacing
  - Stateless dialogs, user pacing
- Initial experiment
  - Some support for hypothesis
  - Need for further testing and research



## Acknowledgements

- Contributors to SpokenQuery
  - Evandro Gouvea, Bret Harsham, Bhiksha Raj, Bent Schmidt-Nielsen, Hugh Secker-Walker, Garrett Weinberg, Joe Woelfel, Peter Wolf
- Contributors to driving simulation studies
  - U. Mass.: Lisandra Garay-Vega, Anuj Pradhan, Yan Shen, Gautam Divekar, Marrhew Romoser, Michael Knodler, Donald Fisher
  - MERL: Garrett Weinberg, Bent Schmidt-Nielsen, Bret Harsham, Cliff Forlines

## Further Information

- <http://www.merl.com/projects/SpokenQuery>