Trends in Automotive User Interfaces

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Agenda

» Automotive speech technology
» Voice dialing
» Navigation control
» Embedded versus off-board
» Mobile device functionality
» What to expect in the future
Car Speech Technology

» What are the challenges?

» Meeting the driver’s expectations

» What should be speech enabled?

» Safety – minimizing driver distraction
Challenges that linger.....

» User adoption
  ▪ Analogous to pairing bluetooth phones - optional

» Knowing how to use speech in the car
  ▪ Is it really easy for most people?

» Accuracy
  ▪ Knowing what to say and how to manage results

» Dependency on vision and touch
  ▪ No exceptions even today
  ▪ Single button from steering wheel - ideal

» Mobile device usage influences
Latency, Accuracy & User Satisfaction

User Satisfaction vs. Accuracy

- "System understands nothing"
- "System is slow" >3 seconds
- "System is fast" <1 second
- "System understands everything"

System Latency and Accuracy are both critical for user satisfaction
Evolution of Speech in Automotive

Vehicle Communication

- SMS Reading, Traffic Messages
- Outbound texting

Satellite/MP3

- Radio Station Names
- Music selection by Voice (MP3)

Navigation

- Voice Destination Entry, TTS Route Guidance
- Full address entry, POI and Category

Radio/Climate Control

- Command & Control
- Natural Speech?

Mobile Phone Control

- Voice Activated Phone Dialing
- Bluetooth dialing

Introduction to the Market
Early Voice Dialing

» First embedded systems were prototyped in the 80’s

» First off-board automotive dialers were deployed in the early 90’s
  - Discrete digit dialing
  - Name dialing
  - Connect time was an issue

» Driver distraction acknowledgement

» Advent of DSP-based mobile phones
Portable Navigation: TomTom example

- Must initialize with tap
- Optional dialog mode
- Speech is very effective

- N-best lists are critical
- Confirm by tap or voice
Speech-enabled Navigation

- Basic control and destination entry
- User interface challenges
- Off-board advantages
  - Current map data and other dynamic content
  - Head unit versus off-board turn-by-turn
- PND market trends
  - Speech recognition has arrived and is well received
- Common to have speech-enabled destination entry
  - POI coverage
- Trends in speech capabilities
User Interfaces that depend on vision
RL Steering Wheel Control Buttons
Drivers Keep Their Eyes on the Road

- When controlling in-car systems manually car drivers focus their eyes on the devices instead of the traffic for 30 – 40% of the duration of the task.
- Music selection by voice almost eyes-free.
- Voice dialing or entering a destination by voice reduce distraction to less than 10%.

2008 Technical University of Braunschweig, Nuance
Speech Interfaces in the Vehicle

» Trends in mobile device usage while driving
  ▪ Increased need for speech-enabled text entry

» Multimodal interaction modes
  ▪ Speech, hearing, vision, and touch

» Next generation technology allows voice search

» Increases safety, productivity, and entertainment

• Mixing a vision with speech is complex while driving
• HMI principle: ability for vehicle driver to glance
• Latency and reliability are key to usability
Embedded Versus Off-board

» Embedded Technology
  ▪ Speech within the application environment
  ▪ Some limit on computing resources
  ▪ Limited usability and adaptation
  ▪ Direct audio input
  ▪ Push-to-talk: various methods for users to learn

» Off-board Technology
  ▪ Speech outside the application environment
  ▪ Unlimited computing resources
  ▪ Unlimited usability and adaptation
  ▪ Distorted audio input (over wireless voice channel)
  ▪ Push-and-wait-to-talk (essentially, an outbound call)
Speech in the cloud for the vehicle

Key Benefits:
- Controlled accuracy
- Technology agnostic
- Multimodal UI
- Multi-lingual

The Driver

Enterprise Data Center

Multi Modal Platform

Internet Protocol

Navigation Speech Recognition

Dictation Speech Recognition

Voice Search Speech Recognition

Human Assisted Speech Recognition

Dialog Controller
- Media Gateway

Multimodal Services
Entering text while driving

» Browse by voice
  ▪ Speak search phrase and see search results
  ▪ Limited value in the vehicle

» Text by voice
  ▪ Speak text message and send it

» Advanced destination entry
  ▪ Speak business name, category, or full address
  ▪ Local search leverages vehicle location

Speech in the cloud: advanced processing
HMI methodology for text input

Select Intent

Speak Phrase

Manage Results

TEXT
BROWSE
NAVIGATE
SOCIALIZE

MESSAGE
SEARCH INPUT
DESTINATION
ANNOUNCE

RECIPIENT
GLANCE
ENTER
GROUP

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CONCLUSION: Challenges and Trends

» Consistent accuracy and natural language
  ▪ Flexible dialogues, avoid voice menus

» Avoiding driver distraction
  ▪ Simplicity and “the right” applications

» Convergence of embedded and off-board
  ▪ Consistent user experience

» Voice browsing, text-by-voice, improved destination entry

» Mobile device HMI controlled by vehicle
  ▪ Key trend for future navigation and infotainment
Questions?