Automotive UI:
Multimodal Design Considerations

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Agenda

- Multimodal interactive modalities
- Best practices for UI design
- Model for interactive modalities
- Conclusions
Human Modalities for User Interfaces

- **Gesture**
- **Speech**
- **Touch**

**Communication to Device**

**Vision**
**Sound**
**Haptic**

**Communication to User**
Information is conveyed through motion, the location of the motion, and the temporal properties associated with the motion.

- Touchscreen
- Haptic controller knob
- Touchpad
- 3D gesture detector

Gesture is a user action.
Speech Recognition Requirements

- High accuracy
- Low latency
- Good OOV handling
Icons: Discovery and Task Selection

- Drivers are accustomed to Icons
  - Mobile device usage continues to grow
  - Touchscreens in cars is a trend

- Icons are easy to understand and remember

- Icons are easy to scan

- Text helps Speech UI
Haptic Controllers

- Haptic controllers are jog wheels with tactile notches
  - Some include 4-way control
  - Some include touch gesture
  - All include press function

- Easy to use, user actions translated on display

- Virtually all vehicles include haptic controllers

- Haptic feedback when used
HMI GUIDELINES
Guidelines for the Best Automotive UI

- Maximize simplicity
- Minimize number of task steps and menu layers
- Avoid voice menus
- Use speech for text entry and disallow typing
- Minimize incoming messages
- Maximize interruptibility
- Minimize verbosity
- Remove need for learning mode
- Minimize glance duration and frequency*
- Minimize task completion time
Achieving Simplicity

- Easy to understand or explain
- Naïve users welcome simplicity
- Sophisticated users also welcome simplicity
- But infotainment systems can be complex...
Minimize Task Steps and Menu Layers

- Limit number of user actions to complete a task
- The fewer, the better
- Avoid presenting long lists that require scrolling
- Use icons if possible
Avoid Voice Menus

• Voice menus in today’s car are unusable
  – Supported by JD Power data
• People often don’t know what to say
• Recognizers don’t handle the unexpected
  – Anything can happen, but something will happen
• Using voice adds to the task completion time

“Please say a command”
Use Speech Instead of Keyboard

- Destinations, dialing, and music selection
- Context is critical for reliability
- Users must speak a certain way
  - Structured, timed, and authoritatively
- Embedded speech recognition limitations
  - Accuracy needs improvement

“Please say a phone number”
Minimize Incoming Messages

• Messages can be visual, audible, or tactile
• Alerts, promotions, and social messaging
• Incoming messages originate from multiple sources
  – Diagnostic trouble code
  – Advertisement
  – Incoming text
  – V-to-V warning
• Difficult to limit and manage
• More driver distraction research is needed
Task Interruption

- All secondary tasks should be interruptible
- Easy and natural to focus only on driving
- Visual-manual tasks interruptible by user or car
- UI for resuming long tasks is not trivial
- Avoid multi-step speech sessions
Minimize Verbosity

- Excessive audio prompting can be irritating
- Audio prompts and messages take time to play
- Consider user configuration options
- Visual text is acceptable for short prompting
- Avoid competing with other sources of audio
Remove Need for Learning Mode

- New car owners need to focus on the task of driving
- Secondary tasks shouldn’t require a learning curve
- Accommodate naïve and sophisticated users
- Owner’s manuals are often ignored
  - Trouble codes may require owner’s manual
  - Speech command lists shouldn’t require owner’s manual
Minimize Glancing Requirements

- NHTSA has issued guidelines for glancing
- Very challenging to remove UI visual dependency
  - Smart phone UI designs are rich with visual dependencies
- Speech is critical....

Glance data from Virginia Tech Study
Minimize Task Completion Time

• NHTSA guidelines for visual/manual tasks
  – 15 seconds maximum
  – Does not apply to other interactive modalities
• Guidelines for speech input have been delayed
• Multimodal UI design is the key
• Task completion time is an excellent indicator of the level of driver distraction

The shorter the task completion time, the safer the task.....
Conclusions

• Overcoming infotainment complexities is a challenge
• Multimodal UI is needed and must be natural
• Speech in the car can mitigate complexity
  – Speech in the car needs to be improved
• Gesture mixed with other modalities has promise
Thank You