Adasa: A Conversational In-Vehicle Digital Assistant for Advanced Driver Assistance Features

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Interacting with in-vehicle systems is evolving

- Improve usability and driving experience
- Various approaches proposed, yet remain unclear
- Required for more complicate systems
Advanced Driver Assistance System (ADAS)

• Assist and share the control with drivers while driving
• Warn and reduce the effects of human errors

Lane Keeping System (LKS)  Adaptive Cruise Control (ACC)
Gaps prevent drivers from utilizing ADAS

- Drivers have difficulty understanding ADAS
- Drivers are unsure how to activate and use ADAS

3.16% drivers actually read user manual [SIGDOC’06]

73% drivers have not even attempted to use ADAS features [McKinsey’16]
Interface for in-vehicle systems

• Visual and tactile interfaces
  • Complicate to understand symbols
  • Distract drivers from driving

• Constrained speech-based interfaces
  • Require higher cognitive demand
  • Designed for simple/intuitive features
Goals

• Build an intuitive interface to help drivers understand ADAS features and improve the usability.
Challenges

- Unclear what information drivers need
- Low cognitive demand for interaction
- Complex vehicle contexts involved
Insights learned from customer data

• Investigated over 9,000 customer verbatim data
• Collected from Ford Customer Service Division

Division of Driving Responsibility

Interface to activate ADAS features

Meaning of symbols

Others
Adasa

• A conversational speech-based interface for ADAS
• Natural language understanding
• Real-time processing
• Handle queries with complex vehicle contexts
  • Inquiry (FAQ)
  • System diagnosis
  • Command and control
Adasa: System Overview

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What does ACC do? Is my ACC ON?

ACC helps you … Your ACC is ON and the gap level is 3
Evaluation

• Real-system prototype
  • End-to-end implementation
  • Two ADAS features: LKS and ACC
• Production vehicle deployment
  • Integrated with button activation
• On-road driving study
  • 15 participants
  • 11.7 miles route
  • 9 tasks in relevant scenarios
Quantitative system analysis

• Query understanding
  • Queries categorized to the correct intent class
  • Adasa achieves an accuracy of 92.5%

• Response correctness
  • Queries answered by Adasa correctly
  • Adasa achieves overall 77.6% response correctness

• Processing latency
  • Merely 1.5 seconds end-to-end latency
Subjective user feedback

- Design standard 10-point Likert scale questionnaire[1][2]
- Evaluate the effectiveness of Adasa but not ADAS functions

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Insights learned from real-world driving study

• **Response length**
  
  • **Different length of responses** are expected in varying driving environments

• **Query completeness**
  
  • Questions asked by drivers are usually **incomplete** and **unstructured**
Summary

• Identify drivers’ primary needs
  • Division of driving responsibility; interface to activate features; meaning of symbols

• Adasa
  • A conversational speech-based interface for ADAS
  • Natural language understanding; real-time processing

• Prototyped and deployed in production vehicles
  • Quantitative and qualitative analysis
  • Real-world user driving study
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