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Car Information Assistant Report

Authors

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1. Background

Recent estimates suggest that adopting assistance systems and automated vehicle technology could reduce road crashes by 25% to 90% (European Commission, 2016; Litman, 2017). However, studies in user automation as well as recent investigations conducted on road accidents involving ADAS and partially-automated or SAE level-2 systems (SAE, 2018), indicate that lack of adequate understanding of these systems' functioning may escalate, rather than mitigate, the effect of human error on safety (Biondi et al., 2018; Biondi et al., 2018; Endsley, 2017; National Transportation Safety Board, 2017, 2018). In addition, a recent investigation by AAA Foundation for Traffic Safety showed that insufficient understanding of systems like Adaptive Cruise Control, Lane Keeping Assistance Systems and level-2 automation resulted in greater chance of speeding, drowsiness, and engaging in manually and visually distracting activities (Dunn et al., 2019).

Taken together, these data indicate that a better understanding of the capabilities and limitations of assistance and automated systems and their mode of operation may increase road safety.

2. iNAGO Car Information Assistant

iNAGO Car Information Assistant (CI) is designed to provide information about vehicle features and ADAS functionalities to the driver. By mean of its visual-vocal interaction, it is intended to act as an in-vehicle personal assistant.

3. Overview of Testing

This study was approved by the institutional board overseeing compliance with research ethics

3.1 Participants

- 20 participants (12 female, 8 male)
- Age Range 16-49, Mean Age = 27 years

3.2 Procedure

- The Car Information Assistant was tested in two formats, Text Input (TiA) and Voice Input (ViA). TiA requires visual-manual interaction via a computer keyboard + screen. ViA requires visual-verbal interaction with verbal inputs from users.
- Both TiA and ViA were used by each participant.
- TiA and ViA were programmed to have identical information available to the user with the only difference between them being the way the user inputs and receives information from the assistant.
- 10 functions tested per application: 4 ADAS, 4 Vehicle Features, and 2 Indicators ((see appendix for more details)
- 6-question survey after each function completed (see appendix for survey)
- Number of interaction steps recorded for each question asked.
- Additional survey was completed at the end of the experiment.

4. Testing Results

4.1 Text Input vs. Voice Input

- ViA answered user queries more successfully than the text input application and required less interaction steps
- ViA had a 93.5% success rate for answering user queries and took an average of 1.64 interaction steps per question
- TiA had a 91% success rate for answering user queries and took an average of 1.82 interaction steps per question

4.2 ADAS

- TiA performed better than ViA in user satisfaction and answer completeness for ADAS.
- Higher satisfaction rate was found for TiA (4/5) relative to ViA (3.86/5)
- Overall high answer completion rates were found for TiA (2.68/3) and ViA (2.56/3) (Note that a score of 3 indicates that the user felt the answer was complete and no information was missing)
- Both ViA and TiA provided sufficient amount of detail in their answers averaging a score of 1.94/2 and 1.98/2 respectively.

User considerations

- Users indicated that ViA speech pace was somewhat fast and hard to understand at times. This could have caused low satisfaction rate.
- Users often reported that they had no previous knowledge of ADAS.
- Given users limited previous knowledge of ADAS, the ViA fast speech pace may have hindered their overall user experience. They may have preferred reading the information at their own pace (self-paced vs. system-paced)

4.3 Vehicle Features

- TiA performed better than ViA in user satisfaction and answer completeness.
- Users reported similar satisfaction rates for TiA (3.74/5) compared to ViA (3.65/5)
- Users more often reported that information was missing or incomplete in their answers for the text input assistant (2.43/3) and the voice input assistant (2.39/3) compared to the ADAS.
- ViA and TiA scored similarly in the amount of detail provided (1.76/2 for both)

User considerations

- The lower scores recorded for the vehicle functions compared to the ADAS were likely related to the amount of detail provided on how to use the functions.
- Users consistently reported that they would like to know more about how the functions worked in their vehicle instead of just what they were.
- When a user asked about how to turn on the high beams, they were told to use the multifunction lever. This information would be helpful to them if they knew what the multifunction lever was and where it was in their vehicle but would not help them turn on the high beams if they did not have previous knowledge of the

different levers and their locations in the vehicle. Providing more specific information about these features would help increase user satisfaction for questions regarding vehicle functions.

4.4 Indicators

- ViA was more successful than TiA across all of the survey questions asked.
- Users consistently found the simulator used for the voice input assistant indicator questions much easier to use than trying to describe the symbols in text in the text input assistant.
- Users reported slightly higher satisfaction for ViA (3.88/5) relative to TiA (3.74/5).
- Users reported that they would like more information provided in the answers for both TiA (1.72/2) and ViA (1.84/2)
- Participants also felt that some information was missing or incomplete in both TiA (2.39/3) and ViA (2.56/3).

User considerations

- Lower scores for TiA were expected for the indicator questions because the user had to describe the symbol in words to the application
- The results of the ViA being only slightly higher could be caused by difficulties some users had with the simulator.
- If a user used the word “dash”, “dashboard”, “car”, or “vehicle” when asking what the light was for the simulator questions, the application would not provide a correct answer. This led to some users requiring multiple attempts and rephrasing their questions to receive a correct answer which could have lowered the scores for the voice input assistant

5. Overall User Experience

- 90% of users said they would feel more knowledgeable about the features in their vehicle after using this application.
- 70% of users said they would feel safer with this application implemented in their vehicle
- 70% of users said that they would like to see this application implemented into vehicles

- 90% of users said that they would use this application compared to a written car manual

6. Conclusions and Next Steps

- ViA was preferred by users over TiA when asked which they would rather use after testing both versions of the CI.
- Users found the system helpful when learning about features that they did not have any previous knowledge of such as ADAS and indicators.
- Features in the vehicle such use fog lights, high beams and other questions about how to use a specific component of the vehicle should include more relevant information about where to find the specific lever or button that will activate the feature asked about.
- Users positively responded to the CI and thought it would be a helpful feature to include in vehicles in the future and an important application that could increase driver safety.
- Furthering the development of the CI to better answer “how” and “where” questions while still keeping the answers short and only including relevant information to the question asked will address the common concerns that users had when using the CI.

7. References

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8. Appendix

QUESTIONS

WHEN INTERACTING WITH THE CAR INFORMATION ASSISTANT USE THESE QUESTIONS AS GUIDELINES BUT ASK IT QUESTIONS AS YOU WOULD A PERSON

1. Ask about adaptive cruise control
2. You are driving your car and this indicator turns on. Ask the CI about this indicator

3. Ask about lane assist/lane keeping
4. Ask about interior lighting
5. Ask about pre-collision prevention/forward collision prevention
6. Ask about climate controls
7. Ask about the blind spot monitor
8. Ask about Anti-lock brakes
9. You are driving your car and this indicator turns on. Ask the CI about this indicator

10. Ask about the fog light

QUESTIONS

WHEN INTERACTING WITH THE CAR INFORMATION ASSISTANT USE THESE QUESTIONS AS GUIDELINES BUT ASK IT QUESTIONS AS YOU WOULD A PERSON

1. Ask about cross traffic alert
2. You are driving your car and this indicator turns on. Ask the CI about this indicator 
3. Ask about park assist
4. Ask about keyless entry
5. Ask about mirror adjustment
6. Ask about grade assist
7. Ask about the driver alert system
8. You are driving your car and this indicator turns on. Ask the CI about this indicator

9. Ask about windshield wipers
10. Ask about the high beams

Questions and Table Information

Question 1: Were you satisfied with the last Car Information Assistant interaction?
Very Satisfied – 5
Satisfied – 4
Neither Unsatisfied nor Satisfied – 3
Unsatisfied – 2
Very Unsatisfied – 1

Question 2: How easy was conversation with the Car Information Assistant to understand?
Very Easy to Understand – 5
Easy to Understand – 4
Neither Difficulty nor Easy to Understand – 3
Difficult to Understand – 2
Very Difficult to Understand – 1

Question 3: Were you satisfied with the answer provided?
Very Satisfied – 5
Satisfied – 4
Neither Unsatisfied nor Satisfied – 3
Unsatisfied – 2
Very Unsatisfied – 1

Question 4: Were you satisfied with the amount of detail for the answer provided?
Too much Detail Provided – 3
Appropriate Amount of Detail Provided – 2
Too Little Detail Provided – 1

Question 5: Was there any information that was missing or incomplete in your opinion?
No – 3
Some – 2
Yes – 1

Table 1:
ADAS

Were you satisfied with the last Car Information Assistant interaction?	How easy was conversation with the Car Information Assistant to understand?	Were you satisfied with the answer provided?	Were you satisfied with the amount of detail for the answer provided?	Was there any information that was missing or incomplete in your opinion?
TEXT INPUT				
4	4.0125	4.0125	1.9375	2.675
VOICE INPUT				
3.8375	3.925	3.8625	1.975	2.575

Table 2:
Vehicle Functions

Were you satisfied with the last Car Information Assistant interaction?	How easy was conversation with the Car Information Assistant to understand?	Were you satisfied with the answer provided?	Were you satisfied with the amount of detail for the answer provided?	Was there any information that was missing or incomplete in your opinion?
TEXT INPUT				
3.6875	3.925	3.7375	1.7625	2.425
VOICE INPUT				
3.675	3.9625	3.65	1.75949367	2.3875

Table 3:
Indicators

Were you satisfied with the last Car Information Assistant interaction?	How easy was conversation with the Car Information Assistant to understand?	Were you satisfied with the answer provided?	Were you satisfied with the amount of detail for the answer provided?	Was there any information that was missing or incomplete in your opinion?
TEXT INPUT				
3.69230769	3.84615385	3.74358974	1.71794872	2.38461538
VOICE INPUT				
3.85365854	3.97560976	3.87804878	1.85365854	2.56097561