UI Proposal for Shared Autonomous Vehicles: Focusing on Improving User's Trust

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Abstract. The automotive industry is rapidly evolving into automated vehicles by integrating cutting-edge technologies. This paper focuses on shared autonomous vehicles that are currently highly feasible in terms of commercialization and proposes a proper UX design that improves the factors that hinder the formation of trust in the user's shared autonomous vehicles experience. The research method is largely divided into three processes. The first is to review the literature to address the importance of trust-building in the user's autonomous vehicle experience and to derive sub-factors to evaluate it. The second is an empirical study, in which the participants are given an indirect experience of watching shared autonomous vehicles service video. This study has academic implications in that it has found that the formation of a user's trust is an important factor for a user to accept new technology and showed that the factors that form trust in autonomous vehicles must be identified from various angles. When people think of fully autonomous vehicles, they are still hesitant and not completely comfortable. This is a critical point of how important it is to gain user trust in developing and simulating autonomous vehicles. In this respect, this study has academic implications in that it has found that the formation of a user's trust is an important factor for a user to accept new technology and showed that the factors that form trust in autonomous vehicles must be identified from various angles.

Keywords: Automated vehicles · Shared autonomous vehicles · User trust · Design for user trust · User Interface

1 Introduction

1.1 Research Background and Goal

The automotive industry is rapidly evolving into a connected vehicle and an automated vehicle by integrating cutting-edge technologies such as ICT, sensors, and satellite navigation. As focusing on the realization of fully autonomous vehicles or fully shared autonomous vehicles, most of the previous studies have dealt with the development of driving technology and the infrastructure to which it can be applied. Yet the goal of this paper is to identify the cognitive and emotional responses experienced by the user in the process of shared autonomous vehicle experience from the perspective of trust

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formation and to present the UI design for enhancing the user's trust in the shared autonomous vehicle service.

1.2 Research Question

In order to achieve the research goal, the research questions are set as follows.

RQ 1. What are the factors that affect negatively the user's trust in the ride experience of shared autonomous vehicles?
RQ 2. How should the UI of shared autonomous vehicles be designed to mitigate the negative factors?

2 Theoretical Reviews

2.1 Autonomous Vehicles

Autonomous vehicles are cars that recognize the surrounding environment and determine the route and risk factors even if the driver does not directly control the steering wheel, brakes, or accelerator pedals. The role of the driver is replaced by sensors, semiconductors, and software. Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles [1] were released by Society of Automotive Engineers (SAE). Although it is not included in the SAE standard, "Autonomous Vehicles (AV)" is also frequently used in various research areas including media reports. Based on this fact, this paper adopts the term "Autonomous Vehicles (AV)" which focuses more on the concept and utilization rather than the technology of the system.

2.2 Trust

Trust has been considered as a major determinant of acceptance of new technology [2, 3]. A common description of trust in Lee and See [3] is that trust plays a key role in shaping the attitude toward trustee; the object of trust, which is new technology.

Sub Factors of Trust. There are many studies that derive trust-building factors regarding various services and technology. Lee and See [3] divided dimensions that describe the basis of trust which have been investigated differently by various researchers. The researchers categorized trust attributes derived from studies dealing with automation and organizational relations according to the three factors that constitute trust presented by Lee and Moray [4]. The key basis of trust is summarized by the three dimensions as follows (Table 1).

The dimensions of trust related to technology were divided into performance, process, and purpose. According to the researchers, the basis of performance was the competence, ability, and expertise of technology in various studies. The basis of the process was predictability, accessibility, understanding, availability, reducing uncertainty and confidentiality. Finally, the basis of purpose was intention and motives, benevolence, loyalty, and faith.

Table 1. Factors describing the basis of trust

Performance	Process	Purpose
Competence	Persistence	Fiduciary responsibility
Ability	Integrity	Loyalty
Functional/specific competence	Consistency	Intention
Interpersonal competence	Openness	Motives
Business sense	Discreetness	Motivation to lie
Judgment	Predictability	Benevolence
Expertise	Accessibility	Concern
Reliability	Availability	Faith
Congeniality	Understanding	Generalized value congruence
Context-specific reliability	Willingness to reduce uncertainty	Leap of faith
Trial and error experience	Confidentiality	Fiduciary responsibility

3 Research Methods

This study consists of two processes; first, the process of deriving research questions through the Empathy map technique and second, the process of finding solutions through the co-creation workshop.

3.1 Empathy Map

Definition of Empathy map. Empathy Map (EM) means drawing the user's level of empathy for an object, product or service [5]. It starts with the premise that if an operator or service provider understands the consumer, even small design changes can have a big impact on the consumer. This method helps to design business models from the consumer's point of view, goes beyond demographics and gives a better understanding of the consumer's environment, behaviors, aspirations, and interests [6].

In the first version of EM, four different areas were addressed when creating an EM of a person; think & feel, hear, see, and say & do. Since then, it was improved including the Pain and Gain areas. As a result, EM consists of six areas as below [5] (Fig. 1).

See. what the user sees in their environment
Say & do. words and actions – the way the users say and act
Think & feel. thoughts and feelings – what happens to the user's mind
Hear. how the environment affects the user
Pain. frustration, pitfalls, and risks experienced by te user
Gain. what the user actually wants and can do to achieve the goal.

Experimental Procedure. In the experiment, participants indirectly experienced Waymo, a shared autonomous vehicle service by Google. At this time, the participants

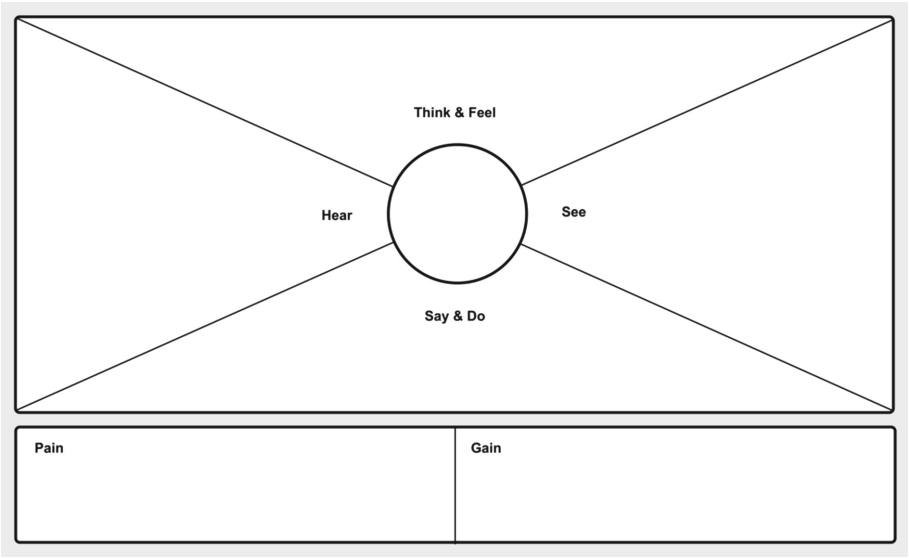

Fig. 1. Template of the EM [6]

encounter the shared autonomous vehicles for the first time, and this process aims to collect various responses of the participants to the shared autonomous vehicles service. The experimental procedure for developing an empathy map is as follows.

First: Watching a Video. Participants watch a video of a prototype service of shared autonomous vehicles in the first-person view. In order to derive the response of the participant related to trust, it was determined that the degree of sophistication and the quality of the prototype that the participant indirectly experienced would influence the outcome. As a result, the researcher adopted a prototype service video of a representative company, which is open to the public and actively develops shared autonomous vehicles services, without implementing a prototype (Fig. 2).

Second: Creating an Empathy Map. After viewing the video, the participant creates the first Empathy Map. This process is divided into five steps for the user to book and board a shared autonomous vehicle, and then create an empathy map according to each step. The five steps of using the shared autonomous vehicles service are as follows (Table 2).

Third: Imaginary Technique. Imaginary techniques are used to induce participants a realistic commitment to shared autonomous vehicles services. Based on the indirect experience through the video provided above, the participants are asked to imagine a rainy situation in the city center of Korea where they currently reside. In order to materialize the situation and collect additional responses from the participants, the researcher lets the participant imagine a busy and complex road condition when using the shared autonomous vehicles service. Participants imagined the situation where the

Fig. 2. Images of shared autonomous vehicle in the video viewed by participants

Table 2. User journey of experiencing the shared autonomous vehicles

Step no.	Step division	Description
1	Calling a vehicle	User requests a car service from the app
2	Waiting	While the user is waiting, he or she can check the vehicle's movement on the map in real time. The shared car service app ensures that the requested vehicle is correct before boarding for safety
3	Boarding (Confirming and getting in the vehicle)	The user recognizes his or her face in the mobile app to confirm that he or she is a passenger in the assigned shared autonomous vehicles
4	Moving	–
5	Getting off	Upon arrival, the user pays with a credit card stored in the app account or with online cash

traffic jam occurred, and only the THINK & FEEL, PAIN & GAIN were written because the specificity of the situation was limited.

Last: Discussion. The researcher asks the participants to share their opinions freely. After gathering enough feedback, the experiment is completed.

Participants Information. There were 8 participants with an average age of 33 (SD = 1.05). In order to gather in-depth information, the mobile device UX designers were selected. Therefore, they know the definition of a technology called autonomous vehicles. All the participants have experienced driving. The preliminary test inquired whether the participants know and trust the company that provides shared autonomous vehicles services in the video presented in the experiment.

When asking participants opinions about the video in this experiment, the research topic of trust was not specifically mentioned. The reason for this is to confirm that trust is an important issue in the acceptance of participants' shared autonomous vehicles services. It is also to measure how much comments mentioning trust are submitted voluntarily (Table 3).

Table 3. Participants information

	Participants information
Age	• The average age of the 8 participants was 33
Job	• Title: Mobile UX designers • Career: the average years of career is 8.2
Prior knowledge on autonomous vehicles	• I know the definition of autonomous vehicles • I know how the stages of autonomous driving are distinguished • I know how far autonomous vehicles are currently being developed • I know an shared autonomous vehicle service is being developed * Recruited only those who answered yes to all of the above questions
Attitude on the company	• I know a company (Google and Alphabet) That offers a prototype of the shared autonomous vehicles service in this experiment • I have trust in the company presented in this experiment

3.2 Co-creation Workshop

In the 2nd step, a workshop is conducted by collecting participants with work experience in the field of autonomous vehicles. The second workshop focuses on collecting the participants' professional views. Based on their views and the industry trends, the goal of the second workshop is to create feasible UI of shared autonomous vehicles service that involves all participants.

The co-creation process means designing with others. Others here may mean experts in other fields or non-design experts [7]. Emerging issues on design practices more focus on 'designing for a purpose' rather than 'designing of products' [8]. The UX design of autonomous services also applies to the views described by Sanders and Stapper. From the point of view of the formation of consumer trust, the UX design of shared autonomous vehicles service needs to solve a problem through co-creation. Co-creation empowers the whole group of people, who are determined to participate in design together, to help designers in their creative activities through discussion.

4 Results

4.1 The Result of the 1st Experiment

Empathy Map Results. From the first experiment with 8 participants of mobile UX designers, an Empathy Map was drawn according to the six factors of EM. The results are presented as follows according to the sequence.

SEE. At the exterior of the vehicle, the participants carefully looked at LiDAR (radar), an element not found in existing vehicles. Inside the vehicle, they mainly saw operation buttons and display devices that can be operated by the user. The operation buttons consist of the functions that the user can use in an emergency situation. The participant thoroughly examined the configuration of the emergency button.

The display device provides different functions for each situation. When driving, the display device provides real-time modeling of navigation (maps, landmarks), surrounding vehicles, and pedestrians. It also shows traffic infrastructure including signs and real-time signal information and digitized blinking signals. This is more complicated and the amount of information to be delivered is much more than the navigation device of the existing vehicles. When not driving, the display provides interaction elements, such as announcements and buttons, for users' use of the service.

SAY & DO. Since the participants boarded alone in the shared autonomous vehicles, the behavior of Say never appeared. However, there was an expectation for voice interaction in later discussions (5 participants). Boarding-moving-getting off, which is directly related to autonomous vehicles, has been discussed as the key User Journey. Among the core tasks, "moving", many participants performed the following tasks.

Checked the display device information (8 participants)

Watched the outside scenery (8 participants)

Observed the internal elements such as emergency button, camera, steering wheel, etc. (8 participants).

It was shown that all - participants focused on driving-related information displayed on the display device. All of the participants answered that they were curious about the modeling of vehicles and pedestrians around them in real-time. Accordingly, the participants compared and confirmed in real-time whether the display information and the information outside the car are accurate (6 participants). Behaviors of the participants that find the emergency button and verify the function of the emergency button can be inferred as a prerequisite to knowing the response in a hazardous situation.

In the case of cameras, 3 participants said they wanted to verify that the camera was working, rather than simply verifying that the camera was in place.

HEAR. The voice announcement was recognized by 7 participants, but there was no further discussion because it was similar to the navigation application of the existing vehicles. As for the sound, many participants said that it was very quiet overall and small sounds were noticeable.

> "I would be sensitive to the sound from the car until I get used to the autonomous cars." (Participant 3)

"Because this car is very quiet, the blinking sounds are loud." (Participant 4)
"I can hear a small mechanical sound inside and outside." (Participant 5)

Interpretation of the vehicle sound differed from participant to participant. While one participant mentioned it as a characteristic of an electric vehicle (Participant 4), others expressed anxiety about having a louder mechanical sound than a normal engine vehicle (2 participants). While the participants did not respond very much to the information that they could infer, they had a tendency to feel anxious about the machine due to the differences from their existing experience. In addition, there was a discussion regarding the blinking sound, and all participants were aware of the blinking sound. Four said the blinking sound felt loud. Participant 5 said it was awkward to hear the blinking sound without lights being turned on. Three participants mentioned that no blinking is needed.

THINK & FEEL. In discussing the thoughts and feelings, many different opinions of the participants were expressed, but mostly negative thoughts or feelings. All participants judged that the driving of the shared autonomous vehicles was immature and incomplete.

The results of the participant's discussion by dividing the Think & Feel into negative feelings, positive feelings, curiosities, concerns about specific situations that did not occur, wishes, and others were as follows.

First, regarding negative feelings, although no abnormalities occurred during driving, all participants considered the driving ability of shared autonomous vehicles to be incomplete. Also, participants imagined various edge cases or specific situations that did not occur and were concerned about how shared autonomous vehicles would handle those kinds of imaginable dangerous situations. Many commented that it was too slow and frustrating (7 participants). In addition, the comments on self-moving steering wheels and flashing were negative. Some commented that the overall atmosphere or user environment was either quiet or dry. Some participants naturally recalled autonomous driving accidents encountered in the media (3 participants). Two participants said they wanted to sit in a seat with a steering wheel, which reveals their anxiety. Some female participants expressed fear of taking an unmanned shared autonomous vehicle alone on a dark night.

"I think it would be scary to ride alone at night."(Participant 3)
"When a car enters a dark and quiet road at night, it's scary to see me alone in the car through the glass."(Participant 5)

Second, regarding positive feelings, most of the participants felt safer and more comfortable with no vehicle driver (7 participants). This was mentioned by all female participants. At the same time, however, four female participants also spoke about the contradictory feeling of riding alone (mentioned above in negative feelings). Three participants mentioned the freedom of being "alone." Finally, four participants commented positively on proficiency in parking. All participants tended to mention negative emotions early in the journey but then decreased in frequency.

Third, regarding curiosities, although all participants knew the concept of autonomous driving, it was their first time experiencing it. They were curious about the first-ever devices they have seen (formally LiDAR on the top and Radar on the front)

(6 participants). In addition, there were questions in various contexts. This is due to the fact that there is no information other than the basic concept of a vehicle driving itself.

Fourth, regarding concerns about specific situations, all participants imagined various anxious situations. Basically, all the participants had a doubt about, "Can the autonomous vehicle skillfully respond to various unexpected situations?". In addition, specific issues that were previously recognized in other technical fields, such as hacking, personal information leakage, limitations of digital devices, and incompleteness of AI and machine learning, were specifically mentioned.

Fifth, regarding expectations and other else, expectations for voice interaction were high (5 participants), but there was also an opinion that it was unlikely to use voice interaction because a display device was provided (1 participant). Two participants mentioned expectation for precise rider's location tracking. Some participants expected to improve their driving guidance.

PAIN. In discussing the thoughts and feelings, many different opinions of the participants were expressed, but mostly negative thoughts or feelings. All participants judged that the driving of the shared autonomous vehicles was immature and incomplete.

The pain point was selected from all the PARTICIPANTS' anxiety and constant curiosity. Many participants pointed out the feeling that the shared autonomous vehicles were too stable.

"The door opens too late and frustrating." (Participant 2)
"I'll arrive later than in a non-autonomous car." (Participant 5)
"For Elderly people, it will be difficult to maneuver." (Participant 8)

GAIN. Riding comfortably alone was selected as the main advantage (4 participants). Two participants answered that they could do - other tasks instead of driving in a shared autonomous vehicle. The comfort factor for the inexperienced driver such as children and the elderly are also mentioned as an advantage.

Imaginary Technique Results. In the imaginary technique, as in the Empathy map, participants' opinions were collected on the requirements of Seoul's complex urban environment on a rainy night with heavy traffic jams. Participants recorded feelings centered on THINK & FEEL.

As a result of the analysis, all the participants had distrust about driving stability. In particular, there was a high level of concern about failing to board with the identical-looking cars waiting on the side of the road. All eight participants commented that seamless riding would be difficult. The distinction between vehicles was also perceived as difficult (7 participants).

There were also negative comments about the sophisticated operation of autonomous driving systems. All of the test participants expressed trust in the company Google, and even though they are engaged in the IT industry, they expressed anxiety about the sophistication and quality of driving.

Analysis of 1st Experiment at Touchpoints Aspect. Based on the SEE, SAY & DO, and HEAR results of the Empathy Map, the hindering factors of trust for each touchpoint were analyzed (Table 4).

Table 4. Touchpoints of Autonomous Vehicle that affect trust

Touchpoint	Number of participants who perceived	Contents hindering trust formation	Categorization
Mobile app	6	–	Mobile
Door	2	Button typed door	Unlocking, security
Display device	8	The sophistication of real-time modeling	Technology of autonomous vehicles
Handle	8	Moving by itself in the air	Design of Steering wheel
Camera	7	Whether it shoots me	Personal information, security
Speaker	2	Personalization and sentiment of voice messages	Voice Interaction
Digital blinker	7	Sound and design of blinker	Interior design
Emergency button	8	Existence of emergency buttons and its functions	Button in case of emergency

The Mobile Application. All the participants did not feel special emotions because it is similar to the experience of using the app of the existing shared vehicle service or the shared vehicle service.

Door. It is necessary to examine whether the button typed automatic door is a good method in terms of security and safety. Subsequent paragraphs, however, are indented.

Display Device. All participants focused on this device. However, real-time modeling of surrounding objects, traffic signals, and flickering features added with navigation looked too complicated to interfere with the participant's understanding.

Handle. Operating alone in the air gave most participants a sense of rejection. Research is necessary for terms of formative aspects and movements.

Camera. There was a negative opinion in terms of personal information leakage. Participants also expected emotional voice interaction instead of touch displays.

Digital Blinker. There were negative opinions about the operation principle, sound, and design. Further research is needed to optimize interaction.

Emergency Button. The emergency button was the touchpoint that passengers wanted to check first. Participants wanted to know the location and function of the emergency button to ensure their safety. Therefore, in order to resolve the user's anxiety, further discussions will be conducted in the 2nd workshop considering the improvement.

Analysis of 1st Experiment at User Context Aspect. Based on the THINK & FEEL, PAIN & GAIN results and IMAGINARY TECHNIQUE results, User contexts that undermine trust were derived (Table 5).

Table 5. User context of autonomous vehicles affecting trust

Type of user context	Number of participants who perceived
Doubts about sophisticated driving skills	8
Lack of information on how to handle an emergency situation	8
Whether a response scenario exists for a corner case	8
Unable to understand some parts of the system, curiosity	8
Driver's absence	5

Participants were all suspicious of the driving ability optimized for the context of shared autonomous vehicles. In addition, there was no detailed information on the basic driving ability (visual, reaction speed) of the vehicle, and thus participants feared an accident. In other words, since no data on actual performance was provided, trust factors related to performance could not be formed.

In terms of process, participants also questioned a lot of principles and situations that they faced for the first time. This made it impossible for the participants to fully understand the system and hindered the formation of predictability. Subsequent paragraphs, however, are indented.

In terms of purpose, participants were anxious because they could not know any information about the vehicle's ability to respond in the event of an accident.

Collectively, the above factors were hindering the building of trust in the service of shared autonomous vehicles (Table 6).

Table 6. Sub factors of trust which is not formed via 1st experiment

Performance	Process	Purpose
Competence	Predictability	Fiduciary responsibility
Ability	Understanding	Leap of faith
Functional/specific competence	Confidentiality	
Interpersonal competence		
Reliability		
Congeniality		
Trial and error experience		

4.2 The Result of the 2nd Experiment

Regarding contents derived as the main issues affecting user trust formation through the first experiment, people indirectly related fields such as autonomous driving, digital cockpit for the connected car, mobile, project owner, project manager, software engineer, hardware engineer were selected for the second process of this study.

The workshop was conducted in two groups with four people in one group. After discussing the contents that emerged as the main discussion points in the first experiment, future scenarios were prepared. The workshop for the first group took place from 18:00 to 20:00 on November 1, 2019, and the workshop for the second group took place from 18:00 to 20:00 on November 8, 2019. Information on the workshop participants is as follows (Table 7).

Table 7. Information of the workshop participants

	Group	Field of job	Position	Company
P1	A	Autonomous Driving Simulation S/W	Project owner	Automotive Artificial Intelligence GmbH, Germany
P2	A	Connected Car	UX Designer	Samsung Electronics, Korea
P3	A	Connected Car	UX Designer	Samsung Electronics, Korea
P4	A	Mobile	UX Designer	Samsung Electronics, Korea
P5	B	V2X (Vehicle to Everything) Communication	Project Manager	Samsung Electronics, Korea
P6	B	V2X (Vehicle to Everything) Communication	H/W Engineer	Samsung Electronics, Korea
P7	B	V2X (Vehicle to Everything) Communication	S/W Engineer	Samsung Electronics, Korea
P8	B	Connected Car	S/W Engineer	Samsung Electronics, Korea

Co-created Scenarios. Voting and discussion were conducted for participants in the 2nd Workshop on the factors that hinder trust formation in each touchpoint and contexts derived in Experiment 1. The discussions of the semi-professional groups who participated in the 2nd workshop on each element are as follows.

Touchpoint 1. Handle. Six out of eight participants agreed that if the handle is out, the user could feel the burden of driving and confusion about whether it could be driven. So they agreed to the internal mounting of the handle of shared autonomous vehicles.

Touchpoint 2. Emergency Button. All participants agreed that the emergency button is the focus of the users' attention and that the optimal location is important. In particular, the location of the button should be in consideration of the children or patients. 5 out of

8 agreed on the central position. All participants agreed that pressing the button should lead directly to troubleshooting.

Touchpoint 3. Display Device. Generation Z, the main customer of shared autonomous vehicles, is expected to be familiar with complex digital information, so most participants agreed to keep the current state of the display device.

Touchpoint 4. Door. The door lock should be opened after the identity verification is completed. This is a shared car, so it is impossible to apply the biometrics of each customer. Most of the participants agreed to be able to reliably complete the self-authentication with a mobile device owned by the individual.

Touchpoint 5. Camera. All workshop participants agreed to partial filming and limited streaming of users. In other words, if the guardian or the users ask to turn on streaming and turn on streaming in an emergency, but the users should be well informed.

Touchpoint 6. Voice Interaction. Since the voice guidance is awkward in the absence of the driver, most participants agreed to convey the friendly personality to the user through the personification of the service through voice guidance.

Touchpoint 7. Digital Blinker. The sound of the digital blinker is unnecessary but must be visible to the user and the outside.

User Context 1–3. Concerns. Participants in experiment 1 expressed doubt about the sophisticated driving capabilities of the shared autonomous vehicles. In addition, they were concerned about whether there was a corresponding scenario for the corner case. The workshop participant P1 said, "This anxiety was caused by the participants' lack of understanding of based technology of autonomous driving. "The response speed, judgment speed, and vision of the autonomous car are much better than those of humans."

Participant P8 said, "Even though they all trusted the company Google and all work in the IT field, everyone expressed anxiety because they had some knowledge of autonomous driving. Because it is a life-threatening task, they think the shared autonomous vehicle service should reflect the latest technology, and the complexity of the transportation system should be perfectly internalized.

User Context 4. Unable to Understand Some Parts of the System, Curiosity. Participants had at the same time comfort from the absence of the driver and anxiety that they were in a self-driving vehicle that was locked alone. Users should be familiar with the fact that they will eventually be provided with a complete response to emergency situations, which, like conventional aircraft, can be accessed such as guidance at the start of boarding.

User Context 5. Absence of a Driver. Participants felt comfortable in the absence of a driver but simultaneously were anxious to be alone in a locked autonomous car. Users should be aware that they can cope with emergencies perfectly. The solution to this problem can be approached by referring to the announcement before boarding the plane.

5 Conclusions

5.1 Research Summary and Implications

This paper focused on the process of user's trust formation in the design of autonomous vehicles and aimed to derive critical points of trust formation that enables users to accept and continue to use autonomous vehicles. In detail, focusing on shared autonomous vehicles that are currently highly feasible in terms of commercialization, a whole process of booking, boarding and getting off of shared autonomous vehicle is defined and trust formation points in each process were derived. Through this process, UI design scenarios were suggested that improved the factors that hinder the formation of trust in the user's autonomous vehicles experience.

When people think of fully autonomous cars, they are still hesitant and not completely comfortable. This is a critical point on how important it is to gain user trust in developing and simulating autonomous vehicles. In this respect, this study has academic implications in that it has found that the formation of a user's trust is an important factor for users to accept new technology and showed that the factors that form trust in autonomous vehicles must be identified from various angles.

5.2 Limitations and Suggestion for Future Research

This study has limitations in that it does not directly use the completed actual shared autonomous vehicles service and indirectly conducted the experiment through video in the first-person view. Future work needs to experiment with user experience in technologically advanced environments.

Previous studies mention that virtual experience testing has often been used as a practical approach to measuring confidence levels in new technologies. However, simulation tests alone cannot answer all consumer questions, such as software failures, bugs, and abnormal behavior, and inevitably face gaps in the actual driving environment. For example, in a simulated test, the driver can not be sleepy, but during long drives, the human driver can be sleepy [9].

In addition, there is a limitation in that it is not possible to derive trust formation according to various user environments in that the passenger condition is not classified in detail. The user has various differences in the degree of involvement in driving, driving ability and understanding of the traffic system. In future studies, various conditions of passengers can be subdivided into the study.

For citations of references, we prefer the use of square brackets and consecutive numbers. Citations using labels or the author/year convention are also acceptable. The following bibliography provides a sample reference list with entries for journal articles [1], an LNCS chapter [2], a book [3], proceedings without editors [4], as well as a URL [5].

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