

Exploring aesthetics factors of gesture interaction in vehicles: An empirical study of in-car music player

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ABSTRACT

This paper aimed at exploring the aesthetic factors of gesture interaction in vehicles through the descriptions of the aesthetic experience of drivers to provide reference for the further study of the aesthetic of in-car gesture interaction and gesture design. Based on the analysis of the collected descriptions, we finally present a set of aesthetic factors of in-car gesture interaction that can influence driver's aesthetic experience.

Categories and Subject Descriptors

B.5.1 [Design (e.g. Styles)]: Gesture interaction-Aesthetic factors.

General Terms

Design, Experimentation

Keywords

In vehicle, Gesture Interaction, Aesthetic Factors, Music player

1. INTRODUCTION

As the functions and infotainments in vehicles increasing, gesture interaction is a promising solution to reduce the visual attention while driving [1]. Designers and researchers have put much effort in designing more intuitive and natural gestures in vehicles [2, 3]. Based on previous research, we propose to integrate "aesthetic of interaction" into the design and research process of gesture because "aesthetics can be a powerful design driver that helps connect dynamic form, social and ethical aspects [4]". However, there is only a broad definition of the aesthetic of interaction as an area of research covering both the perspective of aesthetic experience and aesthetic expression [5]. Besides, there is no prior reference in the special scenario of in-vehicle.

In our point of view, to get the aesthetic factors that can influence driver's aesthetic experience is the first step to present a set of countable reference for the future definition of aesthetic of in-car gesture interaction and gesture design. Hence we plan to collect descriptions of drivers' aesthetic experience and qualitatively derive the aesthetic factors from the analyzed data. In the study, an elementary application of vehicle - music player was chosen to be the research object. A demo controlled with gesture (G-player) was developed. Using principles of aesthetic interaction as guideline, we derived drivers' semantic descriptions of aesthetic experiences in different aspects and finally conclude a set of aesthetic factors with the analysis methods.

2. METHODS

We adopted an empirical study by integrating methods of observation, interview, questionnaire, and participatory design. There were 18 Chinese participants in total consist of 9 male and

9 female, between the age of 20-49 ($\bar{M}=30.22$ $SD=8.77$). All of them are right-hander and have driver's license.

2.1.1 Data Collection Methods

We designed part of the controlling gestures (see Figure 1). The G-player built with Arduino was assembled besides a driving simulator in our lab. We did a pilot study to test the usability and revised the G-player's controlling parameter and position.



Figure1. The gestures of G-player

Firstly, drivers were asked to drive on the simulator and control the music player while driving. Then we encouraged drivers to design gestures for the functions and offered several optional gestures to choose. Researchers observed drivers' behaviors and recorded their words. Based on the observation, an interview was done to obtain further opinion of their experience of gesture controlling while driving. Questions in the interview were designed under the guidance of the aesthetic principles [4] to elicit participants' oral descriptions of their aesthetic experience, e.g. 'Where do you prefer to execute the gesture while driving?' is guided by 'maximal effect with minimal means', 'What attributes of this gesture attracts you' is guided by 'has satisfying dynamic form'.

2.1.2 Analysis Methods

Descriptions were given in a variety of perspectives and were about different aspects of gestures. The basic method of dealing with the data is affinity diagram [6]. After three rounds of affinity building we were able to categorized similar descriptions into a group. Besides, a qualitative method of coding scheme [7] was adopted to transform the original categories of descriptions into the separately aesthetic factors.

Table1. Part of description's coding table

NO.	Conversation/Notes	Category
07-05	"I don't want to looks like an idiot while I control the music"	Social Aspects
09-10	"I don't want to draw others' attention for the control."	

3. RESULTS

The collected data included transcripts, video recording in three views, a set of gestures designed by participants and their subjective sequencing of gestures we provided. From these data

we selected 142 Chinese descriptions of in-car gestures referring participants' aesthetic experience. With the analyzing methods, we summarized two categories of aesthetic factors that can influence the drivers' aesthetic experience of in-car gesture interaction. Physical factors are mainly about the physical attributes of gestures while mental factors concerns drivers' subjective aesthetic experiences and feelings.

3.1.1 Physical Factors

Kinematic impulse. The kinematic impulse consists of gesture's weight and speed. Drivers suggest the gesture have proper weight and speed as gestures too strong or fast may impact the other hand holding the steering wheel and gestures too light or slow need more time to conduct and may distract them from driving.

Complexity. Complexity is related to the gesture's dimensionality and track. Some drivers don't like vertical gestures because it requires much more efforts by raising arm than gestures in other dimensions. Besides, most drivers prefer gestures with easier track.

Position. The position to conduct gesture in vehicle is vital for driver's experience because the available space for driver is limited. Their favorite position is the right and upper space of steering wheel. They mentioned this area is the most accessible and safest one to conduct gestures when driving.

Size. Size refers the range of gesture, which is closely related to the effort of conducting. Most drivers mentioned smaller gesture is better because it can be conducted with only wrist or forearm. Thus, it will save much effort.

3.1.2 Mental Factors

Social aspects. Social aspect refers to socio-cultural factors including descriptions about normality and trustworthy. Drivers care about how the gesture looks like by passengers and people outside of the vehicle. They want be normal and not draw others' attention while performing the task. Besides, the gesture should be reliable without any possible misoperation.

Gesture mapping. Gesture mapping means gesture should be coherent with function in the aspects of meaning, user's knowledge and experience, e.g. the previous experience of using a computer. Moreover, the gesture's meaning should also be coherent with the corresponding function.

Beauty. Beauty concerns driver's direct feelings of aesthetic gestures, which are related to the descriptions involving natural, elegant, fluency and gesture track. However, there is no agreement on the specific style of an aesthetic gesture for the various subjective perspectives. The distinction between male and female is huge, for a gesture considered to be elegant by female participants creates the opposite feelings to male. The track also affects the experience of gesture beauty. Generally, a smooth and fluent track without any sharp turn is thought to be beautiful while a decisive track is regarded to be ugly.

Mental workload. Mental workload is the efforts a driver put to understand, remember, recall and conduct a gesture while driving. It is related to the descriptions about track, comprehension, memory, and inaccuracy. As a gesture being more comprehensible, less accurate, easier to remember and recall, driver will put much less attention resources on controlling. Thus they will feel more relaxed and safer with gesture control in vehicle, which may greatly increase drivers' aesthetic experience.

4. DISCUSSION & FUTURE WORKS

In this paper we conducted an empirical study to collected drivers' aesthetic descriptions of their experience with aesthetic principles as guideline, and finally presented a set of aesthetic factors that can affect the aesthetic experiences of in-car gesture interaction. Our ultimate research goal is to get a definition of the aesthetic of in-car gesture interaction. The current work is the very first step to explore the theme.

The initial challenge for our work is whether the aesthetic factors can be derived from the descriptions of aesthetic experience. As the experience is the outcome of interaction design, we believe descriptions of aesthetic experience implied the factors that shape the final aesthetic experience, which can be a reference for further research and design. Another challenge is whether this can be a countable reference for designing gestures. The results are in a macro view and lack of specific details to help solving practical and complex design problems. What we proposed are only a small part of the whole. Besides, the relationship between physical factors and mental factors remains to be discussed as we did notice there are connections between them.

The future work is to enrich, revise and verify these aesthetics factors. To explore more aesthetic factors, we plan to conduct a larger scale of study on collecting gesture behaviors involved aesthetics. In order to verify and revise the credibility of these factors, we will adopt them as a design guide in a practical project to test their effect as references. Moreover, the present experiment was done with only Chinese participants and in a lab environment. We'll conduct a universal experiment involving people from other cultures in natural scenarios of driving to explore more countable aesthetic factors.

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