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# ENGIN (Exploring Next Generation IN-vehicle INterfaces): Drawing a New Conceptual Framework through Iterative Participatory Processes

Myounghoon Jeon<sup>1</sup>, Jonathan Schuett<sup>1</sup>, Jung-Bin Yim<sup>2</sup>, Parameshwaran Raman<sup>2</sup> & Bruce N. Walker<sup>1,2</sup>

Sonification Lab, School of Psychology<sup>1</sup> & School of Interactive Computing<sup>2</sup>

Georgia Institute of Technology

654 Cherry Street Atlanta, GA 30332 USA

{mh.jeon, jschuett6, jyim, params.raman}@gatech.edu, bruce.walker@psych.gatech.edu

## ABSTRACT

This paper presents an initial stage of the ENGIN (Exploring Next Generation IN-vehicle INterfaces) project. In order to create next generation in-vehicle user interfaces, iterative participatory processes were used: brainstorming, drawing affinity diagrams, conducting focus groups, and hosting expert panel sessions. Through these various inputs, we tried to balance among technology trends and feasibility, users' needs, and experts' considerations. This explorative study approach is expected to provide a blueprint of the automotive user interfaces in the near future and to guide researchers in academia and industry.

## Categories and Subject Descriptors

H.5.2. [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces – interaction styles (e.g., commands, menus, forms, direct manipulation), user-centered design

## General Terms

Design, Human Factors

## Keywords

Next Generation In-vehicle Interfaces, Participatory Design

## 1. INTRODUCTION

During the last century, cars were merely thought of as a way of transportation or delivery. Currently, as cars are becoming more advanced machines, the design of in-vehicle technologies is more than simply the design of a space for the driving task alone. Often, cars can also be referred to as “offices-on-the-move” [6] or “personal communication centers” [5] with more complex functions. However, because academic research has focused on performance and safety issues, [e.g., 2, 3], it is hard to find literature that provides a perspective on the integration of upcoming new features (exceptions such as [1, 4]). The

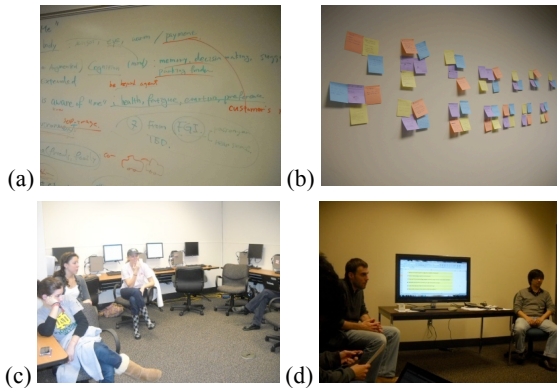
present study introduces iterative participatory processes on drawing a conceptual framework for the next generation in-vehicle interfaces. Most of the addressed concepts and technologies were ongoing research in 2010, but some of them have since appeared on the market.

## 2. CONCEPT-DRAWING PROCEDURE

We adopted various methodologies with multiple populations in order to obtain balanced data among technology trends and feasibility, users' wants and needs, and human factors experts' guidelines and considerations. The overall procedure was as follows: benchmarking – brainstorming sessions with drivers – affinity diagram session – human factors expert panel session 1 – focus group sessions with drivers – human factors expert panel session 2 – prototyping. Among these, we highlighted only a few sessions here.

### 2.1 Brainstorming & Affinity Diagram Sessions

First of all, we investigated current products and manuals in industry (e.g., Tomtom, Garmin, Benz, BMW, Ford, etc) as well as recent research in academia (e.g., journals and conference proceedings such as Automotive UI, Driver Distraction, Driving Assessment Conference, MIAA Workshop, Human Factors, CHI, etc). Moreover, researchers have their own brainstorming sessions with their own colleagues. In addition to benchmarking results and separate brainstorming results, we conducted an integrated brainstorming and affinity diagram session. In this session, four researchers brought up 10 ideas with titles and descriptions. At first, one researcher announced the title of the idea and then remaining participants wrote down their own new ideas on the post-it inspired by the title. After that, the researcher explained his own idea in full. In this way, we obtained more than 100 ideas at the end of this session. All the ideas on the post-its were classified according to their contents (Figure 1 (b)). We used top-down and bottom-up categorizations (e.g., top-down headings from general HCI trends, Automotive UI trends, and some conference session names and bottom-up categories from our ideas). After iterative discussions and classifications, we created five categories with a focus on the relation between a driver (referred to “me”) and a car, which is a unique story-telling about the future in-vehicle technologies (Figure 2): 1) Extended Body, 2) Augmented Cognition, 3) Link Me & Mine (co-driver, friends, and family), 4) Aware of Me, Learn about Me & Meaningfully Use My Info, and 5) Think about My Environment.



**Figure 1.** Concept-drawing processes included (a) Brainstorming, (b) Affinity Diagram (c) Focus Groups, and (d) H/F Expert Sessions.

## 2.2 Focus Group Sessions

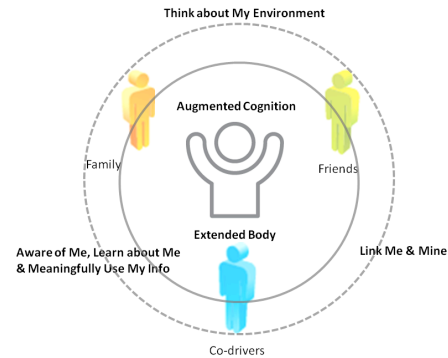
Through the Brainstorming and Affinity Diagram Session, we developed 21 detailed concepts within the five categories mentioned in the previous section. With these concepts, we conducted five focus group sessions with licensed young drivers (10 female and 8 male; mean age = 20.5, mean driving = 5 years). The session consisted of two parts. In the first part, participants discussed several topics that we prepared: purpose of using their car, necessary information while driving, bad experiences in car, the use and possible needs of rear seats, activities with passengers, plausible near future in-vehicle technologies, etc. In the second part, researchers demonstrated 21 concepts in a low-fidelity prototype (Microsoft Power Point) with detailed usage scenarios while gathering participants' comments on each idea. Finally, participants provided their preference on each concept selecting their 'top three choices' and using a 'seven-point Likert Scale rating'. Based on participants' choices and ratings, we attained top five concepts as follows:

- **Free Parking Spot/ Parked Car Finder** (Best choice N = 9/18, Rating score: 6/7): Drivers get information from the central server to locate vacant parking spots and guidance to navigate to them.
- **Drive-by-Payments** (7/18, 5.4/7): Drivers can pay for fast food, meter parking, gas, and more through their vehicle's interface.
- **Fatigue Meter** (6/18, 5.05/7): Drivers' fatigue state is kept track of and some adaptive user interfaces are provided.
- **HomeNet** (5/18, 5.5/7): Drivers monitor, control, and manage their home appliances in car.
- **Temperature / Proximity Sensor** (5/18, 6.1/7): In-vehicle interfaces alert the driver to external temperature outside as well as alerting about near or approaching objects.

Besides, highly ranked concepts included 'Entertainment on Demand' (5.6), 'Global Profile of Driver' (direct custom infomercial intended to suit drivers' situations) (5.16), 'Route Buddy' (the in-vehicle agent remembers the drivers' data and suggests information) (5.05), 'Steering Wheel Alerts' (5), 'Green Speedometer' (the speedometer indicates an economical driving), and 'Peripheral Auditory Display' (4.94).

## 2.3 Expert Panel Sessions

We conducted two expert panel sessions: one was administered after the Affinity Diagram Session and another was done after



**Figure 2.** A new conceptual framework for the future in-vehicle technologies with a focus on a the relations between technologies and a driver (referred to "me")

the Focus Group Sessions. In total, five Human Factors or HCI experts (H/F & HCI experience > 5 years; two holding PhD and three holding MS) participated in sessions. Similarly to the FG sessions, researchers demonstrated 21 concepts and experts were allowed to discuss, comment, and advise on each concept through the session. Their main concerns including safety, security, privacy, and allocation of modalities enabled us to make our ideas more concretely.

## 3. CONCLUSION & FUTURE WORKS

This paper presented iterative processes to create a new framework and detailed concepts of the next generation in-vehicle user interfaces. Via multiple iterations of the sessions including drivers, researchers, and experts, we attained feasible idea sets and the results are expected to provide a new perspective on automotive user interfaces. Although several concepts obtained good feedback from drivers and experts, it is still necessary to identify remaining detailed user experience issues. Our next step is to design some of these concepts as higher-fidelity prototypes and validate them in a driving context.

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