EVIS 2013:
2nd Workshop on Electric Vehicle Information Systems

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ABSTRACT
Sustainability has become one of the key factors for car manufacturers worldwide. Electric mobility is clean, quiet, efficient and offers a great opportunity to keep our environment healthy. High effort has been put into new technologies, materials and infrastructure. Though, little research has been done on in-vehicle information systems (IVIS) to fit the needs of electric vehicle (EV) drivers. We argue that electric vehicle information systems (EVIS) are required to communicate EV specific information to all passengers in a positive and understandable way. This will be a key factor towards a better acceptance of EVs. With this workshop, we want to continue to bring together researchers, designers and practitioners of this design space in order to define a list of Grand Challenges of EVIS and work towards a bright future of EVs.

Categories and Subject Descriptors
H.5.2 [**Information Systems**]: User Interfaces – *Graphical User Interfaces, Input devices and strategies, User-centered design.*

Keywords
Electric Vehicle (EV), In-Vehicle Information Systems (IVIS), Electric Vehicle Information Systems (EVIS), E-Mobility, Workshop

1. INTRODUCTION
Range does not matter! Or, does it? A recent article in the New York Times [2] on a test ride with the Tesla Model S sedan and the detailed response by Tesla's CEO Elon Musk [7] showed that the confidence in the range of new electric vehicles (EVs) is still something to argue about. In this case, the test driver was not able to reach his destination despite Tesla's promoted maximum range of 300 miles. Should the manufacturer promise only realistic range numbers or should the driver be committed to follow exactly the suggested charging times and driving behavior?

This dispute exemplarily shows the reasons for the concerns of potential customers: EVs have high prices compared to regular cars with combustion engines, but the range might not be sufficient for their driving habits, raising the question of a sufficient number of available charging stations.

Apart from these concerns, EVs also offer new opportunities. First, they are clean and quiet, giving the driver the chance to show that he cares for the environment and the people around him. At the same time, EVs offer a new driving experience, including a strong acceleration and recuperation, i.e. regaining energy while slowing down the car. Furthermore, some elements of the power trains are not needed in EVs, which offers more room and new design spaces [4], e.g. the center console, in the interior of the car.

We can conclude that EV drivers have different needs compared to drivers of regular cars. A lot of work has been concentrating on this issue concerning new battery technology or a growing charging infrastructure in larger cities. Nevertheless, we argue that a major factor of gaining the trust of the drivers and therefore raise the acceptance for electric mobility is the meaningful and understandable communication of the EV's information by customized electric vehicle information systems (EVIS). This important issue has surprisingly not been in the main focus of researchers.

However, first explorations have been made: e.g. Strömberg et al. [11] state that "information that help [the drivers] comprehend the relationship between [state of charge], [distance to empty], driving conditions and behavior are important in creating a mental model […] and can lead to that EVs are utilized in a more efficient way", but did not find a solution to convey this information in an understandable manner.

Outside of electric mobility, Tulusan et al. [13] analyzed eco-feedback [11] types for drivers and concluded that "most preferable were unobtrusive feedback systems, able to convey clear and contextual information" and that "not serving drivers' specific preferences and situated needs is a disadvantage that next generation feedback technologies should address".

Conference'10, Month 1–2, 2010, City, State, Country.

Meschtscherjakov et al. [6] proposed five alternative pervasive feedback systems for regular cars. Included is the EcoPedal, a gas pedal trying to reduce fuel consumption by "pushing back against the driver's foot when it detects wasteful acceleration". However, "participants felt especially disturbed by systems with tactile and/or auditory feedback" [6].

The time is ripe to concentrate research on the special properties of EVs and the needs of the drivers. EVIS serve as the main communication channel between car and passengers and should therefore receive a suitable amount of attention by researchers and manufacturers. With this workshop, we want to continue to gather experts on the field and shift their attention towards the creation of meaningful and understandable EVIS.

2. AREAS OF INTEREST

The characteristics of electric vehicles are manifold and affect a wide range of different topics. To understand the requirements and needs of EV drivers, the following topics require special attention in the design and development process:

Driving Behavior. Driving EVs is different compared to regular cars with combustion engines. A strong acceleration without switching gears and regenerative breaking influence the driving experience. BMW proposes the "single-pedal control" related to their electric i3 Concept car. It allows driving with only the accelerator, regenerating energy when releasing the pedal, and lets the vehicle "coast without consuming power, driven by its own kinetic energy" [1].

Sound. When starting an EV, the familiar sound and movement of the engine are missing. Consequently, drivers have trouble knowing "whether the vehicle is ready to drive or not" which was confirmed in an experiment conducted by Strömberg and colleagues [11]. While driving, EVs are hardly hearable for outside traffic participants, which can be blessing in a quiet neighborhood but a curse for bicyclists or the visually impaired. Therefore, the U.S. Department of Transportation recently proposed minimum sound requirements for electric vehicles [8].

Range prediction. To communicate the available range to the driver, it might not be sufficient to know the State of Charge of the battery. Other factors such as current destination, weather conditions, the traffic situation, available charging stations or the current consumption of the infotainment system have a strong influence on range prediction. Lundström [5] identifies even more, such as the relevance of an energy source being private or public, which might affect the trust in the infrastructure.

Energy management. As energy is the limiting factor for electric vehicles, on board energy management becomes important to save resources in the case of a "last mile situation". In this case, e.g. the air condition might take away resources for heating or cooling that would have been enough to allow a driver to reach its destination. Thus, intelligent controlling mechanisms are required and the driver needs to be informed why the AC stopped working.

E-Mobility Concepts. Not all EVs might be used in stereotypic usage scenarios like a three-person household with a garage. Novel mobility concepts such as car sharing or connecting vehicles to create a larger vehicle might affect how we see and use electric vehicles. EVIS are required to address the challenges of varying drivers that maybe never used an EV before [10].

3. OBJECTIVES & EXPECTED OUTCOME

In the first EVIS workshop [9], we identified characteristic properties of EVs, which have an influence on future interfaces and interactions (e.g. range and battery properties, safety of and trust in the new technology, user experience while interacting with EVIS, driving behavior of EVs, etc.) With this second workshop, we further extend the network of researchers, designers or practitioners of the design space. We invite participants to share their approaches to overcome the barriers that still keep the adoption of electric vehicles on a low level. We will work towards a meaningful research agenda, showing the Grand Challenges of EVIS.

With the help of this agenda, we hope to encourage the community to discuss the need to move away from simply adopting state of the art vehicles with combustion engines towards new EVIS concepts with their forms of interactions considering the special needs of EV drivers. The workshop will deal with but is not limited the following questions:

- What are properties of EVs that lead to the need of new interfaces and novel forms of interactions?
- Who are future EV drivers and what are their needs?
- How can we design EVIS to meet these needs?
- Which transportation concepts influence the design of EVIS?
- Do we need entirely new concepts for the interior of EVs or can we adopt regular combustion engine cars to meet the needs of EV drivers?
- How can we involve the other passengers in EV critical activities like trip planning and in-car interactions?

4. ORGANIZATION

4.1 Before the Workshop

The organizers will commit to publicize their workshop. The call for participation for this workshop will be distributed via related mailing lists as well as specialized ones (e.g. CHI announcement list, AUI list, TUM CREATE List) and will be distributed at several HCI- and E-Mobility related research groups and companies such as car manufacturers. We will use social media such as Facebook and Twitter as well to publicize the workshop. The website of the workshop will provide information about the workshop preparations, the CfP, and links to related material, so that people interested can become familiar with the scope of the subject and the goals of the workshop. Each submitted paper will be reviewed by at least two organizers. Authors will then get the chance to submit a revised version. Accepted position papers and other materials will be made available on the website in time before the workshop.

4.2 During the Workshop

Due to the experience of the first EVIS workshop at AutomotiveUI 2012, we expect about 15 participants. Therefore, we suggest a full day workshop that starts with an introduction to

the topic followed by Pecha Kucha presentations[1] of the submitted papers. We chose this presentation method due to earlier experience in AUI workshops and think that presenting 20 images, each for 20 seconds, will give a valuable insight into the key ideas of the work presented. Hereby we avoid long and detailed presentations, foster compact presentations and leave enough room for discussions and group exercises. The presentations will be accompanied by discussions with the audience to clear details after presenting and interrupted by a coffee break. After a joined lunch, we will spend the afternoon with a first summary of what we so far know about the challenges of e-mobility and with the breakout sessions. These will focus on challenges discovered during the workshop and discuss different aspects of interacting with information systems of electric vehicles. Workshop participants will work together in small groups and finally present their ideas of how to encounter particular challenges. At the end we will discuss topics that remained open and encourage a get together for dinner after the workshop. Table 1 contains a detailed schedule for the workshop.

Time	Topic
09:00-09:15	Introduction
09:15-10:30	Pecha Kucha presentations (I)
10:30-11:00	Coffee Break
11:00-11:45	Pecha Kucha presentations (II)
11:45-12:30	Highlights, session grouping, preparation for break out session
12:30-13:30	Lunch
13:30-15:00	Break-out session
15:00-15:30	Coffee Break
15:30-16:30	Group discussions to define the Grand Challenges for EVIS
16:30-17:00	Wrap-up

Table 1. Proposed schedule for the one-day EVIS workshop

4.3 After the Workshop

A short report presenting impressions, pictures and first results will be published on the website shortly after the workshop. To retain the outcome of the workshop in a meaningful way, an overall whitepaper presenting the Grand Challenges of EVIS is envisaged to be published on the website as well. To frame the field of research towards EVIS, we envisage a publication of the submitted papers as a technical report.

5. THE PRESENTER

The organizers of this workshop form an interdisciplinary team with experts from Human Computer Interaction, Human Factors and automotive practice and research. Due to organizational reasons, the workshop itself will be presented by Sebastian Loehmann, who already ran the first EVIS workshop at AutomotiveUI 2012.

Sebastian Loehmann is a member of the HCI Group at the University of Munich as a PhD student and research assistant. He is involved in the interdisciplinary "CAR@TUM User Experience" project, which is a cooperation of BMW AG, Technische Universität Muenchen (TUM) and the University of Munich (LMU). The project focuses on the emotional aspects of e-mobility. Sebastian concentrates on the interaction with EVIS and explores the introduction of gestural interfaces into the automotive context.

6. REFERENCES

[1] BMW i3 Concept. The Megacity Vehicle. Last accessed 17.07.2013 http://www.bmw-i-usa.com/en_us/bmw-i3/

[2] Broder, J. The New York Times: Stalled Out on Tesla's Electric Highway. Last accessed 17.07.2013 http://www.nytimes.com/2013/02/10/automobiles/stalled-on-the-ev-highway.html

[3] Gyimesi, K. and Viswanathan, R. The shift to electric vehicles. Putting consumers in the driver's seat, IBM Cooperation (2011).

[4] Kern, D., and Schmidt, A. Design space for driver-based automotive user interfaces. In Proc. of AutomotiveUI 2009 (Essen, Germany), ACM, pp. 3-10.

[5] Lundström, A., Bogdan, C., Kis, F., Olsson, I., and Fahlén, L. Enough Power to Move: Dimensions for Representing Energy Availability. In Prof. of MobileHCI 2012 (San Francisco, CA, USA), ACM, pp. 201-210.

[6] Meschtscherjakov, A., Wilfinger, D., Scherndl, T., and Tscheligi, M. Acceptance of future persuasive in-car interfaces towards a more economic driving behaviour. In Proc. of AutomotiveUI 2009 (Essen, Germany), ACM, pp. 81–88.

[7] Musk, E. A Most Peculiar Test Drive. Last accessed 17.07.2013 http://www.teslamotors.com/blog/most-peculiar-test-drive

[8] National Highway Traffic Safety Administration: U.S. Department of Transportation Proposes New Minimum Sound Requirements for Hybrid and Electric Vehicles. Last accessed 17.07.2013 http://www.nhtsa.gov/About+NHTSA/Press+Releases/DOT+Proposes+New+Minimum+Sound+Requirements+for+Hybrid+and+Electric+Vehicles

[9] Osswald, S., Loehmann, S., Gleyzes, D., Butz, A., and Tscheligi, M. Electric vehicle information systems: The challenges of e-mobility. In Adj. Proc. of AutomotiveUI 2012 (Portsmouth, NH, USA), pp. 103-105.

[10] Osswald, S., Pratik S., and Tscheligi, M. "Hardware-in-the-Loop-Based Evaluation Platform for Automotive Instrument Cluster Development (EPIC)." In Proc. of EICS 2013 (London, UK), ACM, pp 323–332.

[11] Spagnolli, A., Corradi, N., Gamberini, L., Hoggan, E., Jacucci, G., Katzeff, C., Broms, L., and Jönsson, L. Eco-feedback on the go: Motivating energy awareness. Computer, 44(5), 38-45 (2011).

[12] Strömberg, H., Andersson, P., Almgreen, S., Ericsson, J., Karlsson, M., and Nabo, A. Driver interfaces for electric vehicles. In Proc. of AutomotiveUI 2011 (Salzburg, Austria), ACM, pp. 177-184.

[13] Tulusan, J., Soi, L., Paefgen, J., Brogle, M., and Staake, T. Eco-efficient feedback technologies: Which eco-feedback types prefer drivers most? In Proc. of WoWMoM 2011 (Lucca, Italy), IEEE.

[1] http://www.pechakucha.org