CLW 2015: The Fifth Workshop on Cognitive Load and In-Vehicle Human-Machine Interaction

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ABSTRACT

Interactions with in-vehicle electronic devices can interfere with the primary task of driving and increase crash risk. Interactions with in-vehicle interfaces draw upon visual, auditory, psychomotor, and cognitive resources. Researchers often investigate how these resources interfere with performance through the use of different measurement techniques, particularly doing so in applied settings such as automotive scenarios. The goal of this workshop is to share knowledge with the community regarding the theoretical underpinnings, collection, and filtering of physiological data as a measure of cognitive load within the scope of automotive research. The workshop will describe and demonstrate the physiology, approaches and issues in regards to collection, and successful methodologies of filtering data from some of the more popular and supported physiological measures. The focus of the workshop will be on ensuring participants walk away with an understanding of the theoretical reasoning behind the measures shown in the workshop as well as practical knowledge of how to collect and filter data.

Categories and Subject Descriptors

H.5.2 Information interfaces and presentation: User Interfaces. H.5.1 Multimedia information systems.

General Terms

Design, Experimentation, Human Factors, Measurement.

Keywords

Cognitive load, estimation, management, driving, physiological measures.

1. INTRODUCTION

In-vehicle human-machine interaction (HMI) can interfere with the primary task of driving. The concept of cognitive load can help us understand the extent to which these interactions interfere with the driving task and how this interference can be mitigated. Research has progressed to the point at which some processes for collecting measurements for the estimation of cognitive load (but not analyzing them) has been standardized (i.e. [1]). However, as the popularity in measuring cognitive load increases within the in-vehicle HMI field, people are constantly exploring new options to gather this data. One increasingly popular way to measure cognitive load is the use of physiological measures. These physiological measures are being applied more often due to their objective nature, and the wider availability of the devices necessary for their collection. However, the successful use of these measures requires an understanding of the physiology behind the changes seen in the measures with a change in workload as well as knowledge regarding the best methods of data collection and filtering.

The purpose of this workshop, the fifth in the series [2], is to provide this theoretical knowledge behind the use of physiological measures and the practical experience of collection and filtering of this data. The workshop will focus in particular on the popular physiological measures of heart rate (HR), skin galvanic response (SGR), and pupil size (PS). The measures will be considered separately within the workshop but discussion of the integration of these measures and how they compare to DRT data will also be discussed.

WORKSHOP GOALS

The workshop has three goals:

1. **Explain the theoretical underpinnings of the physiology behind common physiological measures of cognitive load.** The first goal of the workshop is to ensure participants understand the physiological reasons behind the use of common physiological measures (e.g., HR, SGR, PS) and what some practical considerations are for each of the measures. A strong focus will be on why these measures change with differences in workload and what this means within the applied setting of automotive research. For each measure, there will be one or possibly two invited or submitted papers that will provide an overview of each measure.
2. **Demonstrate how measures of physiological workload are collected**. The attendees of the workshop will also want to leave understanding how to go about applying physiological measures of workload. The second goal of the workshop is to ensure participants receive a demonstration of how physiological measures are collected and hands-on experience towards this goal if possible. Again the focus here will be toward the practical considerations of using these measures

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within an automotive environment. Presenters may also provide DRT measures to compare against the physiological data collected so the audience can see the differences between the data collection and analysis techniques, issues and outcomes. The goal for the audience is to get hands-on experience to a level that they understand the basic working of the equipment.

3. **Present techniques of how the data from these measures are reduced and analyzed**: The last goal for the workshop and to allow attendees to walk away with applicable knowledge is ensure they understand how to go about filtering the data that they will collect. To some extent, this will involve summarizing existing practice codified in standards or discussed in previous studies within the space for the participants. However, we will be looking to go beyond what is in those documents, discussing practical problems of filtering and cleaning up the data, censoring, rules for determining and eliminating outliers, methods of quantifying lost data, identifying potential confounding factors and situations that arise with the use of a measure can bias interpretations of results and software that can help produce results.

The workshop organizers will bring together a number of experts from government, industry, and/or academia to address the above topics. In addition, position papers on these topics will also be solicited. In contrast to prior workshops on the topic of cognitive load, this workshop will focus on physiological measures, though other forms of measuring workload may also be included depending on the quality and applicableness of submissions. The focus will be on measures that are commonly used and somewhat easily accessible to researchers and will focus on discussions in detail about practical issues.

2. WORKSHOP ORGANIZATION

2.1 Before the Workshop

2.1.1 Program Committee Recruitment

The program committee will be recruited from the extensive list of academic and industry contacts of the organizers, in the HCI, speech, ubiquitous computing, and human factors and ergonomics communities. We will primarily target our colleagues who were part of the PC in 2011, 2012, 2013, and 2014.

2.1.2 Publicity and Soliciting Papers

The workshop will be publicized using a dedicated website hosted by the University of New Hampshire. The Call for Papers will be distributed via the following channels:

- ACM CHI mailing list,
- Ubicomp mailing list,
- WikiCFP,
- HFES Surface Transportation Technical Group Newsletter,
- Driving Assessment conference email list,
- Contacts of program committee members in their fields.

2.1.3 Paper Submission, Review and Selection

We will invite papers by experts on physiological measures of cognitive load. We will work with the authors on any necessary edits and improvements.

Position papers will be submitted and reviewed using the EasyChair conference management system [3]. This will allow for online paper submission and simple management of reviewer assignments and feedback. The organizers will make the final paper selection based on reviewer recommendations. Note that EasyChair is a free service hosted by the University of Manchester CS Department; therefore no funding will have to be secured for its operation.

2.1.4 Final Pre-Workshop Activities

The list of accepted and invited papers will be posted on the workshop website in early September. The organizers will create a mailing list to distribute accepted papers to workshop participants prior to the workshop. Participants will also be encouraged to use the mailing list to initiate interactions before the workshop.

2.2 During the Workshop

2.2.1 Sessions

The workshop will start with an introduction by a leader in the automotive user interface research community to discuss the overall impact of measuring cognitive demand and how the use of physiological measures can help towards this goal. This introduction will be followed by three sessions:

Session 1: Discussion of the reasons behind the use of physiological measures – Invited presenters will discuss theoretical reasoning behind the use of popular physiological measures and practical considerations that can come along with the collection of this data. The presentations during this session will provide the audience with the theoretical understanding of why physiological differences are seen, so that in the following sessions they are able to understand the implications of the data being collected and filtered. The goal for the audience is get basic affinity with physiological measures as well as a deeper understanding of practical issues in applying these measures within the automotive settings. These presentations will be aimed toward goal 1 of this workshop.

Session 2: Demonstrations of measure collection – Presenters will provide an opportunity during the second session to get either a hands on experience with the collection of certain physiological measures if the hardware is available or at the least a very in depth presentation on the process. Those attending the meeting will be invited to bring hardware and software or recordings of the use of these systems to demonstrate the physiological measures in question. This includes hardware and software for the measures (i.e. HR monitors, SGR detection equipment, and eye trackers), as well as a driving simulator or driving video game to show how the data are collected in a real study. As with the whole workshop this will focus on issues that can appear during the process that are stumbling blocks for researchers within automotive research. This session is aimed at goal 2 of this workshop, in providing experience of actually using the physiological measures in a study.

Session 3: Discussion of techniques to measure reduction and analysis – The third session will focus on papers and invited speakers presenting on the topic of reduction and analysis of physiological measures. This process can be very long and tedious so it will not be as hands-on as other sessions but should still be informative to participants and give participants more applicable knowledge of the process of analysis in this space. This session will be particularly focused on "tricks-of-the-trade" within the automotive field and looking at different approaches and tools people use in the analysis of physiological data. This session aims to fulfill the 3rd goal of the workshop.

None of the sessions should be viewed as an opportunity to present a paper describing results. Instead, the goal is that attendees get a deeper understanding of how to analyze physiological data in automotive settings.

2.3 Feedback

As in 2011, 2012, 2013, and 2014, at the end of the workshop organizers will solicit feedback from participants in anonymous written form. Participants will be asked to evaluate the relevance and ultimate value of the workshop using responses on a Likert scale. Suggestions for improvements will also be solicited.

2.4 After the Workshop

2.4.1 Online Report

Based on the notes taken during the workshop, the organizers will create a journal article summarizing some of the practical issues that seem to be common and solutions to them. If not appropriate for a journal, then a proceedings paper will be written.

2.4.2 Workshop at AutomotiveUI 2016?

Assuming that participant feedback indicates that the workshop was successful, the organizers will contact participants for suggestions for a workshop to be held at AutomotiveUI 2016.

3. ACKNOWLEDGMENTS

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4. REFERENCES

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