Using eye tracking as tool to develop and evaluate human-machine systems

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ABSTRACT
This is our application for conducting a full day course about using eye tracking as tool to develop and evaluate human-machine systems at the IHM 2009. The course is conducted by the Chair of Human-Machine Systems (Technische Universität Berlin) in cooperation with SensoMotoric Instruments. The application contains the requested personal data of the moderators, a short description of the course and a detailed agenda including contents, time schedules and technical requirements.

GENERAL TERMS: Course application.

KEYWORDS: eye movements, eye tracking, usability research, applied research.

TITLE OF COURSE
Using eye tracking as tool to develop and evaluate human-machine systems.

DURATION
Full day course.

MODERATORS
The course will be moderated by Sandra Trösterer and Magali Gouy.

Main moderator

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Curriculum Vitae. Sandra Trösterer is psychologist and works as a research co-worker at the Chair of Human-Machine Systems at the Technische Universität Berlin (TU Berlin). She is a member of the research group "Team mEyeInt" (multimodal Eye Interaction) and is currently working on her doctoral thesis regarding the design of assisted gaze-based interaction. She has special experience in usability research, eye tracking, and multimodal gaze-based interaction. During her work, she has conducted eye tracking studies in the area of human-machine interaction for different industrial partners (e.g. Volkswagen AG, Deutsche Telekom Laboratories), investigating different kind of research questions and using different kind of eye tracking equipment. Currently, she teaches a course on "Eye movements in human-machine-systems" at the TU Berlin.

Supporting moderator

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Curriculum Vitae. Magali Gouy is a graduate student of Human Factors (Ergonomics) at TU Berlin. She graduated with a Bachelor of Psychology from Paris V University where she specialized in Ergonomics. She currently works for the eye tracking systems producer SensoMotoric Instruments (SMI).

SHORT COURSE DESCRIPTION
Eye tracking is a technique where eye movements of an individual are recorded in a way that the researcher knows at any given time where the person is looking at and in which sequence the eyes are shifting from one location to another. This method is of increasingly importance in the area of human-machine interaction, as eye movements provide an insight into cognitive processes of information perception and processing while interacting with a machine. The analysis of eye movement data allows drawing conclusions about the visibility, meaningfulness, or placement of interface elements, which information is relevant, and which sequence was used to extract task-relevant features. Such conclusions can hardly be drawn from common usability measures like error rates or reaction times. Therefore, eye movement data provides an additional source of objective evaluation criterion. With the help of the data, human-machine systems can be developed and improved.

The aim of the course is to communicate the basic theoretical and practical aspects of eye movement and eye tracking and its applicability in the area of human-machine interaction. A theoretical part will give insight into the types of eye movements, the most relevant eye movement parameters used in usability research, different eye tracking systems, and requirements for conducting eye tracking studies. In a practical part, participants will work with different state-of-the-art eye tracking systems and analysis software provided by SensoMotoric Instruments (SMI). Data collection and analysis will be demonstrated conducting a website evaluation as well as a driver distraction study.

DETAILED AGENDA

Audience

The course is addressed to all people who are interested in using eye tracking for their research and want to find out more about the possibilities of this method. Additionally, people are welcomed who have already been using eye tracking in their research and want to extend their knowledge and discuss current research questions.

Theoretical part

Contents and schedule. The theoretical part of the course takes place from 9:30 am to 1:00 pm. The session begins with a short introduction of each participant, where each participant introduces him/herself, why she/he is here, what are his/her expectations for the course and what experiences with eye tracking she/he has so far.

The content of the theoretical presentation includes:

- Basics of eye movements
- Why should we use eye tracking in human-machine interaction (HMI) research?
- What are the basic steps and requirements for conducting eye movement studies?
- What kind of parameters of eye movements does exist, and what is their informative value in usability research?
- Which kind of eye-trackers do exist, and what are their features?
- Which application areas do exist, and where are eye tracking studies helpful?
- Summary: What are the advantages and problems of eye movement research in the area of human-machine interaction?

As the course is designed as a workshop, the theoretical part is a mixture of informative presentation parts and prepared discussion parts. The participants have the opportunity to contribute their own questions and experiences.

Table 1 gives an overview of the preliminary time schedule. Times for breaks can be changed if there are any predefined time slots reserved for breaks during the conference.

Presentation content	Time
Basics of eye movements Eye tracking in HMI Basic steps and requirements	9:30 am – 10:30 am
Break	10:30 am – 10:45 am
Parameters	10:45 am – 11:45 am
Break	11:45 am – 12:00 pm
Eye-Trackers Application areas Summary	12:00 pm – 1:00 pm

Table 1: Preliminary time schedule for the theoretical part of the course.

Technical requirements. For the theoretical part a beamer and an additional power plug for a laptop are needed.

Practical part

Contents and schedule. The practical part takes place in the afternoon (2:30 pm to 6:00 pm). This part aims to demonstrate different eye-trackers and analysis software using two exemplarily showcases. Approximately 90 minutes will be spent on each use case (see Table 2). The procedure for each case is as follows: First, a short introduction of the particular topic is given. Then the used eye-tracker (provided by SMI) is presented and shortly explained. The participants have then the possibility to explore the eye-trackers by recording eye movement data. After collecting data, a short introduction into the data analysis software BeGaze (SMI) is given and the participants can do a short data analysis with prepared gaze-data. The goal of this part is to confirm the knowledge gained in the theoretical part and to provide concrete examples of eye movement data analysis.

Content	Time
First use case	2:30 pm – 4:00 pm
Break	4:00 pm – 4:15 pm
Second use case	4:15 pm – 6:00 pm

Table 2: Preliminary time schedule for the practical part of the course.

Use Cases. The first use case incorporates a common area of eye movement data analysis: website evaluation. In this case the participants have the opportunity to learn how to handle a state-of-the-art remote eye-tracker (i-View X RED, SMI). During this task a predefined web page is displayed on the computer screen and data of up to 3 participants is collected using the remote eye-tracker while doing a search task on the web page (e.g.

search for the contact information). For the data analysis part prepared gaze-data is used. The participants are guided through the software BeGaze, defining Areas of Interest (AOIs) and doing data analysis regarding e.g. fixation frequencies, fixation duration, scan paths, or attention maps.

The second is a special case of eye tracking studies: visual distraction during a driving task. An experimental setting is build, where a secondary task (e.g. using a navigation system) has to be performed while driving. The driving task (i.e. Lane Change Task) is presented on a computer display and is performed with a steering wheel for computer games. A head-based eye-tracker (i-View X HED, SMI) is used to collect data. The difference to the first case, apart from the different kind of eye-tracker, lies in the gained data. In this case, the data is based on dynamic and moving situations. Therefore, the focus of the analysis lies on video data analysis and the use of dynamic AOIs.

Technical requirements. For the presentation part a beamer is needed and an additional power plug for a laptop should be available. 4 extension cables and power plug splitters are needed for the different eye tracking systems and laptops used during the hands-on part of this course.

In order to work on the use cases more intensely it would be preferable to have two separated rooms. The participants would then be split up in two groups and will work on the cases in parallel, supervised by a moderator respectively.

Both eye tracking systems and necessary computer components are provided by SMI. SMI also provides up to 10 laptops with the BeGaze software installed for the data analysis.

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