Journal of Eye Movement Research
7(3):1, 1-2

Introduction to the PETMEI special issue

Andreas Bulling
Perceptual User Interfaces
Max Planck Institute for Informatics
bulling@mpi-inf.mpg.de

Roman Bednarik
School of Computing
University of Eastern Finland
roman.bednarik@uef.fi

Latest developments in remote and head-mounted eye tracking and automated eye movement analysis point the way toward unobtrusive eye-based human-computer interfaces that will become pervasively usable in everyday life. We call this new paradigm pervasive eye tracking – continuous eye monitoring and analysis 24/7. Pervasive Eye Tracking and Mobile Eye-Based Interaction (PETMEI) is a workshop series that revolves around the theme of pervasive eye-tracking as a trailblazer for pervasive eye-based human-computer interaction and eye-based context-awareness. This special issue is composed from extended versions of the top-scoring papers from the 3rd workshop in the PETMEI series held in 2013.

Keywords: pervasive eye tracking, mobile eye-based interaction, automated eye movement analysis, gaze-based human-computer interaction

Introduction

Despite considerable advances over the last decades, previous work on eye tracking and eye-based human-computer interfaces mainly developed use of the eyes in traditional ("desktop") settings that involved single user, single device and WIMP-style interactions. Latest developments in remote and head-mounted eye tracking equipment and automated eye movement analysis point the way toward unobtrusive eye-based human-computer interfaces that will become pervasively usable in everyday life. We call this new paradigm pervasive eye tracking – continuous eye monitoring and analysis 24/7 (Bulling & Gellersen, 2010). The potential applications for the ability to track and analyse eye movements anywhere and at any time call for interdisciplinary research to further understand and develop visual behaviour for pervasive eye-based human-computer interaction in daily life settings.

PETMEI is a workshop series that revolves around the theme of pervasive eye-tracking as a trailblazer for pervasive eye-based human-computer interaction and eye-based context-awareness. PETMEI provides a forum for researchers from human-computer interaction, context-aware computing, psychology, health, and eye tracking to discuss techniques and applications that go beyond classical eye tracking and stationary eye-based interactions in constrained settings. The workshop series aims to stimulate and explore the creativity of these communities with respect to the implications, key research challenges, and new applications for pervasive eye tracking in a ubiquitous computing world. The long-term goal is to create a strong interdisciplinary research community linking these fields together and to establish the workshop as the premier forum for research on pervasive eye tracking.

This special issue is composed from extended versions of the top-scoring papers from the 3rd workshop in the PETMEI series held in 2013. PETMEI 2013 was organised as a dedicated conference track at the 17th European Conference on Eye Movements (ECEM 2013) in Lund, Sweden, from 11-16 August 2013. All papers from the 2013 workshop can be downloaded from the workshop website: `http://2013.petmei.org/program/`.

The following is the list of papers selected for this special issue.

- Onur Ferhat, Fernando Vilariño and Francisco Javier Sánchez: *A Cheap Portable Eye-Tracker Solution for Common Setups*
- Jose Javier Bengoechea, Juan Jose Cerrolaza, Arantxa Villanueva and Rafael Cabeza: *Evaluation of accurate eye corner detection methods for gaze estimation*
- Kentaro Takemura, Tomohisa Yamakawa, Jun Akamatsu and Tsukasa Ogasawara: *Estimation of Focused Object using Corneal Surface Image for Eye-based Interaction*
- Yusuke Sugano, Yasunori Ozaki, Hiroshi Kasai, Keisuke Ogaki and Yoichi Sato: *Image Preference Estimation with a Data-driven Approach: A Comparative Study between Gaze and Image Features*

The topics span a range of areas nested under the pervasive eye-tracking field, from developing custom low-cost eye tracking solutions (Ferhat, Vilariño, & Sánchez, 2014) and improvements of eye detec-

DOI 10.16910/jemr.7.3.1

ISSN 1995-8692

tion algorithms (Bengoechea, Cerrolaza, Villanueva, & Cabeza, 2014), through novel ways of gaze direction detection (Takemura, Yamakawa, Akamatsu, & Ogasawara, 2014), to user preference estimation based on gaze data (Sugano, Ozaki, Kasai, Ogaki, & Sato, 2014).

Ferhat et al. introduce a cheap portable eye tracker for common setups. The system is able to track eye movements with sampling rate of up to 30Hz and with accuracies of around 1.5 degrees. The introduced setup with Raspberry Pi can track eye movements at 3Hz at the costs of about 70 EUR.

Bengoechea et al. focus on improving the eye corner detection methods for normal lighting conditions in which active IR illumination is not available. The authors present a series of exhaustive tests in which they evaluate five new methods for eye corner detection.

Takemura and others present a novel approach to estimate the object in user's focus, rather than gaze direction as implemented in modern head-mounted eye-trackers. The novel approach could, for example, be used for wearable head-mounted technologies, such as Google Glass.

Sugano et al. investigate a hot topic in applied eye tracking, namely, the analysis of user states and preferences in interactive environments. The contribution of the paper is a comparison of the performance of user preferences estimation from gaze and from explicit ranking of preference labels.

Review process

Based on the scores from the workshop review process, we invited authors of four of the best papers to submit a significantly extended versions of the original papers for the special issue. The solicited submissions were carefully reviewed, partly by the original PETMEI 2013 reviewers, and in part by the editors. Each of the four papers received at least three reviews. The first round of decisions sent to the authors contained detailed instructions on how to improve the manuscripts to guarantee readability, replicability, and accessibility of the work to the wider eye tracking community. The authors were invited to respond to the reviews and an additional round of reviews ensured all concerns raised were properly addressed before publication.

Reviewers

This issue would not exist without the dedicated work and expertise of our external reviewers. We would like to thank all of them for their assistance and timely reviews. In particular, Ralf Biedert, Shahram Eivazi, Catharine Oertel, and Hana Vrzakova contributed significantly to this special issue.

Special Issue Editors

Andreas Bulling (http://www.andreas-bulling.de/) is an independent research group leader (W2) at the Max Planck Institute for Informatics and the Cluster of Excellence on Multimodal Computing and Interaction, Germany, where he leads the Perceptual User Interfaces Group (http://perceptual.mpi-inf.mpg.de/). He was previously a Feodor Lynen Research Fellow and a Marie Curie Research Fellow in the Computer Laboratory at the University of Cambridge, a postdoctoral research associate in the School of Computing and Communications at Lancaster University, as well as a Junior Research Fellow of Wolfson College, Cambridge. He received his PhD in information technology and electrical engineering from the Swiss Federal Institute of Technology (ETH) Zurich, Switzerland, in 2010. Andreas initiated the PETMEI workshop series in 2011 together with Andrew Duchowski and Päivi Majaranta. He coined the term "pervasive eye tracking" and pioneered the use of automatic eye movement analysis for context-aware computing. His further research interests include activity and context recognition, multimodal sensing and inference, and cognition-aware systems with applications in ubiquitous computing, human-computer interaction, and personal health monitoring.

Roman Bednarik (http://cs.uef.fi/ rbednari/) is a senior researcher at the School of Computing, University of Eastern Finland (UEF). Since 2012 he is an adjunct professor (docent) of interactive technologies at UEF. In 2011 he was a visiting scholar at the School of Information Sciences, University of Pittsburgh. In 2007-2010 he was an assistant professor at the University of Joensuu. Roman is interested in human behaviour, cognition, learning, and interaction with computers in general. His particular interests lie in applying eye tracking to study and support usability, thinking and interaction. In his PhD work Roman investigated and used eye movement recording as a measure of visual attention of computer programmers during program comprehension and debugging.

References

Bengoechea, J. J., Cerrolaza, J. J., Villanueva, A., & Cabeza, R. (2014). Evaluation of accurate eye corner detection methods for gaze estimation. *Journal of Eye Movement Research*, *7*(3), 3:1-8.

Bulling, A., & Gellersen, H. (2010). Toward Mobile Eye-Based Human-Computer Interaction. *IEEE Pervasive Computing*, *9*(4), 8–12. doi: 10.1109/MPRV.2010.86

Ferhat, O., Vilariño, F., & Sánchez, F. J. (2014). A cheap portable eye-tracker solution for common setups. *Journal of Eye Movement Research*, *7*(3), 2:1-10.

Sugano, Y., Ozaki, Y., Kasai, H., Ogaki, K., & Sato, Y. (2014). Image preference estimation with a data-driven approach: A comparative study between gaze and image features. *Journal of Eye Movement Research*, *7*(3), 5:1-9.

Takemura, K., Yamakawa, T., Akamatsu, J., & Ogasawara, T. (2014). Estimation of a focused object using a corneal surface image for eye-based interaction. *Journal of Eye Movement Research*, *7*(3), 4:1-9.

DOI 10.16910/jemr.7.3.1

ISSN 1995-8692