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# The 6th International Workshop on Pervasive Eye Tracking and Mobile Eye-Based Interaction

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## Abstract

Previous work on eye tracking and eye-based human-computer interfaces mainly concentrated on making use of the eyes in traditional desktop settings. With the recent growth of interest in wearable computers, such as smartwatches, smart eyewears and low-cost mobile eye trackers, eye-based interaction techniques for mobile computing are becoming increasingly important. PETMEI 2016 focuses on the pervasive eye tracking paradigm as a trailblazer for mobile eye-based interaction to take eye tracking out into the wild, to mobile and pervasive settings. We want 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 ubiquitous computing. 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.

## Author Keywords

Eye tracking; gaze-based interaction; wearable and mobile

## Introduction

Eye tracking technology has considerably matured in recent years and eye-based interaction is gaining attention in various application areas. While early work focused on gaze for input in desktop settings, eye tracking is now mov-

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09.30 - 09.35 Opening  
 09.35 - 09.50 Introductory Round  
 09.50 - 10.40 Keynote  
 10.40 - 11.00 *Coffee break*  
 11.00 - 12.00 Talks (3 papers) I  
 12.00 - 13.00 Lunch & exhibition  
 13.00 - 14.00 Talks (3 papers) II  
 14.00 - 14.20 *Coffee break*  
 14.20 - 15.20 Talks (3 papers) III  
 15.20 - 16.45 *Coffee break*  
 16.45 - 18.45 Plenum Discussion  
 18.45 - 19.00 Wrap-up

**Table 1:** Preliminary workshop schedule of PETMEI 2016

ing into pervasive and mobile settings. In everyday life, how and where we look provide rich information for understanding human interactions with real-world environments. Our gaze behaviors are closely related with human attention and are good indicators of visual interest. A growing number of researchers study eye-based interaction in pervasive daily-life settings, for example, eye tracking is used to assist life logging [10], pervasive display interactions [4, 11], user authentication [5] and distributed communication in mobile settings [8].

We call this new paradigm pervasive eye tracking - continuous eye monitoring and eye-based interaction 24/7 [1]. The potential applications for the capability to track and analyze eye movements anywhere and any time call for new research to further develop and understand visual behavior and eye-based interaction in mobile daily-life settings. Pervasive eye tracking opens up new research across a number of disciplines including ubiquitous computing, eye-tracking research, ego-centric vision, cognitive psychology, and design. Identifying the implications and addressing challenges of pervasive eye tracking and mobile eye-based interaction require an interdisciplinary approach at the crossroads of these fields.

### The PETMEI workshop series

PETMEI has been taking place annually since 2011. Except for year 2013, PETMEI always took place in conjunction with UbiComp. PETMEI 2011, 2012, 2014, and 2015 attracted approximately 30 participants each, who enjoyed 11, 9, 9 and 6 oral presentations respectively as well as demos of latest mobile eye trackers [6]. PETMEI 2013 [2] was held as a conference track at the 17<sup>th</sup> European Conference on Eye Movements (ECM 2013), in which 60 participants attended 12 oral presentations.

### Objectives

The main objective of the workshop is to bring together researchers and practitioners working in HCI, UbiComp, Eye tracking, context-aware computing, and computer vision. The workshop will create a forum for these researchers to gather, present their ideas, and to discuss techniques and applications that go beyond classical eye tracking and stationary eye-based interaction. Specifically, we want to encourage these communities to think about the implications of pervasive eye tracking for context-aware computing, i.e. the ability to track eye movements continuously for long term. The workshop aims to identify key research challenges in pervasive eye tracking and mobile eye-based interaction and to discuss the technological and algorithmic methods required to address them. The workshop shall provide intellectual stimuli and build bridges for future collaborations between these communities. The long-term goal is to create a strong interdisciplinary research community linking the different research fields and to establish the workshop as the premier forum for research on pervasive eye tracking in context-aware computing.

### Topics of Interest

Topics of interest cover computational methods, new applications and use cases, as well as eye tracking technologies for pervasive eye tracking and mobile eye-based interaction.

Previous research in HCI and eye tracking has resulted in a large variety of methods, e.g. for eye detection and tracking [3], automated eye movement analysis [9], or evaluation of eye movement classification algorithms [7]. We invite participants to reflect on the specific characteristics of pervasive eye tracking systems and post-WIMP user interfaces and to contrast them with classical methods for eye tracking, eye movement analysis, eye-based interaction, and evaluation. We solicit contributions reporting on methodological and



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technological advances on all components of mobile eye tracking systems. This includes computer vision techniques for face and eye detection, tracking, pupil localization, calibration, gaze estimation, pattern recognition and machine learning techniques for automated eye movement analysis, as well as methods and user studies to evaluate interaction techniques. PETMEI also covers latest advances in mobile eye tracking equipment including creative use of existing measurement techniques as well as potentially new types of tracking hardware. In summary, submissions addressing innovative pervasive eye tracking methods could cover:

- Tools for detecting, tracking, and analyzing the face, pupil, and eye movements
- Gaze-supported multimodal interaction techniques
- Methods and devices for eye tracking on wearables (e.g. smart watches and smart glasses) and mobile devices (e.g. smart phones and tablets)
- Integration of pervasive eye tracking and context-aware computing
- Robust eye tracking for indoor/outdoor environments

In addition to contributions reporting on methodological advances we also attract submissions that explore innovative applications. By inviting researchers from different disciplines, we aim to identify particularly promising applications (the “killer applications”) for pervasive eye tracking and mobile eye-based interaction.

- Pervasive eye-based interaction with displays, real and virtual environments
- Eye interaction with robots and virtual characters
- Mobile attentive user interfaces
- Eye-based activity and context recognition
- Cognition-aware systems and user interfaces
- Security & privacy for pervasive eye-tracking systems
- Eye tracking and gaze interaction in healthcare

## Format

PETMEI 2016 is a full-day workshop. We expect around 30 participants with backgrounds in eye tracking, context-aware computing, HCI, and computer vision. As the workshop covers a new area of research at the crossroads of these fields, we aim to attract domain experts and also newcomers with an interest in the field.

## Before the workshop & CFP

The Call for Papers will be distributed in multiple research communities, including those of ubiquitous and pervasive computing, eye tracking, computer vision, and HCI. We have set up a webpage<sup>1</sup>, and used online media to disseminate the call. We solicit submissions of up to 10 pages that describe original research related to pervasive eye tracking research. All submissions have been peer-reviewed via an international program committee. Demos of latest development of pervasive eye tracking have been encouraged from all participants.

## During the workshop

The timeline for the workshop is shown in Table 1. After the keynote, participants will briefly introduce themselves and their research interests (30 seconds each). Each paper accepted for presentation will be given 15 minutes incl. questions, which is subject to change in case of accepting more than 8 papers.

## After the Workshop & Publication

Papers accepted for oral presentations will be included in the ACM Digital Library and in the supplemental UbiComp 2016 proceedings. Submissions accepted as a poster, presentation slides, and demo-related material will be made available on the workshop website.

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<sup>1</sup><http://2016.petmei.org/>



**Mohamed Khamis** is a PhD student at the University of Munich (LMU), Germany. His research focuses on seamless gaze-based interaction with pervasive displays, by developing usable methods for interacting with public displays and mobile devices using gaze.



**Päivi Majaranta** (PhD in Interactive Technology) is a researcher and lecturer at University of Tampere, Finland. She gives courses on usability and interaction design. Her research interests include gaze interaction, multimodal interfaces, accessibility, UX and HCI.

## Organizers and Steering Committee

The workshop will be organized by four researchers who are actively involved in the research fields of eye tracking, human computer interaction, and ubiquitous computing. Additionally, the PETMEI workshop series is supported by a steering committee of international eye tracking experts:

**Andreas Bulling**, MPI Informatics, Germany

**Dan Witzner Hansen**, IT University of Copenhagen, Denmark

**Paivi Majaranta**, University of Tampere, Finland

**Carlos Hitoshi Morimoto**, University of São Paulo, Brasil

**Pernilla Qvarfordt**, FX Palo Alto Laboratory, U.S.

## REFERENCES

1. 2011. *PETMEI '11: Proceedings of the 1st International Workshop on Pervasive Eye Tracking & Mobile Eye-based Interaction*. ACM, New York, USA.
2. Andreas Bulling and Roman Bednarik. 2013. 3rd International Workshop on Pervasive Eye Tracking and Mobile Eye-Based Interaction. In *Proc. of ECEM'13*.
3. Dan Witzner Hansen and Qiang Ji. 2010. In the eye of the beholder: A survey of models for eyes and gaze. *Pattern Analysis and Machine Intelligence, IEEE Transactions on* 32, 3 (2010), 478–500.
4. Shahram Jalaliniya and Diako Mardanbegi. 2016. Seamless interaction with scrolling contents on eyewear computers using optokinetic nystagmus eye movements. In *Proc. of ETRA '16*. ACM, New York, USA.
5. Mohamed Khamis, Florian Alt, Mariam Hassib, Emanuel von Zezschwitz, Regina Hasholzner, and Andreas Bulling. 2016. GazeTouchPass: Multimodal Authentication Using Gaze and Touch on Mobile Devices. In *Proc. CHI EA'16*. ACM, New York, USA.
6. Peter Kiefer, Yanxia Zhang, and Andreas Bulling. 2015. The 5th international workshop on pervasive eye tracking and mobile eye-based interaction. In *Adjunct Proc. UbiComp'15*. ACM, 825–828.
7. Oleg V Komogortsev, Sampath Jayarathna, Do Hyong Koh, and Sandeep Munikrishne Gowda. 2010. Qualitative and quantitative scoring and evaluation of the eye movement classification algorithms. In *Proc. ETRA'10*. ACM, 65–68.
8. Diako Mardenbegi and Pernilla Qvarfordt. 2015. Creating gaze annotations in head mounted displays. In *Proceedings of the 2015 ACM International Symposium on Wearable Computers*. ACM, 161–162.
9. Dario D Salvucci and John R Anderson. 2001. Automated eye-movement protocol analysis. *Human-Computer Interaction* 16, 1 (2001), 39–86.
10. Julian Steil and Andreas Bulling. 2015. Discovery of Everyday Human Activities From Long-Term Visual Behaviour Using Topic Models. In *Proc. UbiComp'15*.
11. Yanxia Zhang, Ming Ki Chong, Jǎǎǎǎ Mǎǎǎǎ, Andreas Bulling, and Hans Gellersen. 2015. Eye Tracking for Public Displays in the Wild. *Personal and Ubiquitous Computing* 19, 5 (2015), 967–981.