Eyewear 2021 The Forth Workshop on Eyewear Computing – Augmenting Social Situations and Democratizing Tools

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Figure 1: Eyewear Prototypes and Use case examples. From facial gesture recognition, over somatosensory feedback in VR to large scale social sensing approaches, like the data set recordings during UbiComp 2019 and Theater performance recordings [8, 17, 18]

ABSTRACT

Head-worn sensing, especially embedded in augmented and virtual reality (AR/VR) head-mounted displays and smart glasses is currently increasingly moving away from niche applications and small-scale research prototypes to large-scale consumer adoption (e.g. Oculus Quest 2, Hololens 2, J!NS MEME, Bose Frames). Significant progress in sensing technologies and modalities have lead to a constant increase of commercially available products and unobtrusive, affordable research prototypes. These recent advances allow us to extend the Eyewear Community to enable large scale in-situ studies, as one of the favored research methodologies in Ubiquitous Computing. One manifestation of this can already be observed in large scale dataset recording, eyewear student competitions and programming seminars.

In this workshop we focus on supporting these large-scale uses of eyewear computing, discussing lessons learned from early deployment and how to empower the community with better hardware/software prototyping tools as well as the establishment of open data sets.

In addition, we will discuss long-term psychological and physical impacts and risks of the technology that become increasingly important with a wider distribution of devices to consumers. The proposed workshop will bring together researchers from a wide range of disciplines, such as mobile and ubiquitous computing, activity recognition eye tracking, optics, human vision and perception, usability, as well as systems engineering research. This year it will also bring in researchers from neuroscience, psychology and other fields that might want to apply or use the research systems. The workshop is a continuation from 2016/2018/2019 and will focus on discussing on how to democratizing tools for researchers who want to apply eyewear computing (sensing/interaction) in their fields, yet are no wearable computing experts or computer scientists.

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CCS CONCEPTS

• **Human-centered computing → Interaction design**; **Interaction design process and methods**.

KEYWORDS

datasets, eyewear computing, interactions, activity recognition

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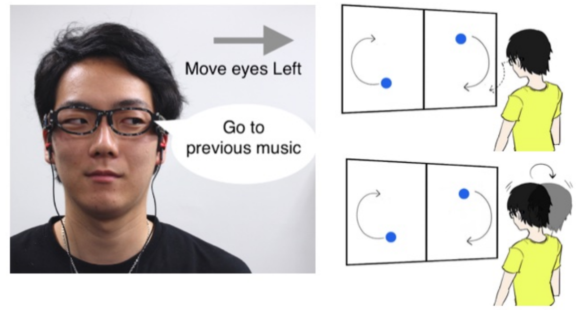

Figure 2: Demonstrators of eyewear interactions using different software prototyping tools. On the left an example for micro-gestures, on the right smooth pursuit systems [20, 22]

1 INTRODUCTION

Our head holds most of our senses - sight, hearing, taste, smell - and through nonverbal gestures, like facial affect and eye gaze, it allows us to communicate with others. Additionally, The face is the main way in which we express personality and character, and is crucial to our ability to interact socially. Consequently, head and face are an obvious choice to place sensors and actuators to track activities, enable new user interactions, and study social interactions [2, 15].

For a long time, head- and face-based wearables have been restricted to special purpose, niche applications. While hearing aids and mobile headsets are widely accepted as head-worn devices, users in public spaces often consider novel head-attached sensors and devices as uncomfortable, irritating, or stigmatizing. Yet, given a number of recent technological developments, we believe eyewear computing will soon transition into mainstream technology and become a prominent research field. In essence, because the face is so important to humans, under every day circumstances people are highly sensitive to ergonomic and social acceptance aspects of anything placed there. It is telling that in early wearable computing ergonomic studies the head was not even included [4]. Early egocentric vision devices were rather bulky, expensive, and their battery life severely limited their usage [7]. Building on existing work in wearable computing, recent commercial egocentric vision devices and mobile eye trackers, such as Google Glass, SMI ETG, and J!NS meme, pave the way for a new generation of "Smart Eyewear" that is light-weight, low-power, convenient to use, and increasingly looks like ordinary glasses adding to its unobtrusiveness [6, 14].

We motivate the continuation of this workshop series through significant progress in sensing technologies and modalities leading to a constant increase of commercially available products and unobtrusive, affordable research prototypes. These recent advances allow to extend the Eyewear Community to enable large scale in-situ studies, as one of the favored research methodologies in Ubiquitous Computing. One manifestation of this can already be observed in large scale dataset recording, eyewear student competitions and programming seminars(for example the MobileHCI 2019 competiton [1]).

Advances in real-life tracking of physical and cognitive activities and states (e.g. reading, walking, detection of fatigue, cognitive load) enable applications on areas like quantified self for the mind [16, 19]. And with increasing ubiquity of the technology, new opportunities arise for applications that track social behaviours and interactions between groups of people in real-world settings [3, 23]. The workshop is a continuation of the first three EyeWear workshops at UbiComp (2016 in Heidelberg, 2018 in Singapore, and 2019 in London). These three workshops focused mostly on enabling technology on activity recognition and interaction paradigms. We will still discuss enabling sensors and actuators, yet in contrast to 2016/2018/2019, we will focus more on open eyewear platform tools (hardware and software know-how) as well as the development and sharing of public datasets.

[1]https://mobilehci.acm.org/2019/call-for-student-competition/

2 TOPICS

Eyewear Sensing and Actuation Technologies: Driven by use cases, which sensing modalities are the most interesting to be integrated in Smart Eyewear? What are the important activities and measures to focus on (e.g. fatigue detection, concentration tracking)?

Eyewear Interactions: Best practices and explorations for interaction mechanisms and technologies related to smart eyewear control/input (see also Figure 2) For example eye-gaze based interactions, head movements, and facial micro-gestures.

Open Eyewear Tools and Dataset Best Practices: Introducing to several hardware /software tools used by the community and the co-organizers[2, 8]. Where does it make sense to integrate them? What are advantages, disadvantages of the tools and where are they still lacking. In addition we will discuss and share datasets(Fig **??**). A concrete result of the workshop will be a list of software tools and open datasets related to eyewear computing.

Novel Use Cases: Which activities are the most useful for application cases and how can we support them from the community. Potential directions include exploring social interactions in performances (interpersonal synchrony, entrainment) as well as medical applications (e.g. disease: Alzheimer, Parkinson monitoring) [1, 13].

Impact and Risks of Long-Term Sensing: How can we use these real life recordings of physical, physiological and cognitive signals on the head? What are potential negative effects of long term usage, ranging from perceptual issues regarding the use of wearable displays (binocular rivalry, vertical and horizontal gaze comfort, instrument myopia, eye strain, accommodation-convergence mismatch) over potential skin irritations during the deployment of electrodes or other sensors necessary to touch the skin to privacy issues and negative social impacts[11, 12].

Figure 3: Examples for publicly available data-sets and experimental setup instances utilizing smart eyewear [5, 8–10, 21]

3 ACTIVITIES

We propose a one-day workshop **on Saturday the 25th September** with presentation sessions in the morning, development of scenarios in the early afternoon, and group discussions on fundamental challenges in the late afternoon. In the following we describe pre-workshop preparations and the post-workshop follow up.

3.1 Pre-Workshop activities

Prior to the workshop all selected attendees will be asked to fill out the online form regarding their timezone preferences, platform restrictions and accessibility requirements, professional background, and interest in topics connected to smart eyewear. The call and other information (social network links, discord info) will be posted on http://eyewear.pro/eywear2021/. We will setup a discord server for all participants and will start exchanging software tools to work with during the workshop. This will start about 1-2 months before the workshop. We are also planning to stream some sensor data to the participants and let them interact with the eyewear data in real time.

3.2 Workshop activities

3.2.1 Welcome(10:00-11:30). The workshop will start with an introduction given by the workshop organizers in which they will summarize the workshop's motivation, goals, and outline (10:00-10:15). This will be followed by short introductory presentations of the workshop participants (in Pecha Kucha style) to get familiar with each other and to get to know the topics they are working on. The presentation session will be broken into two parts with a short break in between. This will allow enough time to discuss different ideas coming out from the presentations.

3.2.2 Keynote (11:30-12:30). The keynote will be given by Prof. Thad Starner (Georgia Tech, Google Glass Development Lead).

3.2.3 Demonstration Session. We encourage participants to demonstrate research prototypes related to their submissions. Depending on the number of demonstrations we will hold a separate session or do small show-and-tells in small breaks.

3.2.4 Scenario Development (13:00-15:30). After the presentations, grouped participants will develop new scenarios. All participants will write notes, which will posted on a virtual whiteboard. In order to sort out the challenges and opportunities for an Open Eyewear Platform, we will create an affinity diagram analysis of the gathered ideas. Group analysis will start at 15:00 and will end at 15:30.

3.2.5 Group Discussion (15:30-17:30). After the group analysis, we will have a longer coffee break (15:30-16:00) followed by a discussion round on identified challenges and opportunities (16:00-17:00). Organizers will actively engage with the audience to stimulate discussions. We will summarize the key experiences from the workshop and will plan follow up activities (17:00-17:30).

3.3 Post-Workshop Follow Up

Organizers will document the outcome of the above analysis, and make this information available to the all participants through a shared Google Drive folder. Participants will be invited to an existing Slack channel where they can share papers relevant to the workshop themes. We will start a Data-set directory on http://eyewear.pro/ based on the participants submissions during the workshop to make it easier to access useful datasets and tools.

4 ORGANIZERS

Kirill Ragozin is a postdoctoral researcher at Keio University Graduate School of Media Design. His major research contributions are in mixed reality thermal interactions. His research interests include eye tracking and interaction design with smart glasses.

Kai Kunze is a Professor at Keio University Graduate School of Media Design. His major research contributions are in pervasive computing with a focus on augmenting human abilities.

Teresa Hirzle is a fourth-year Ph.D. student at Ulm University. Her research interests lie in analysing the impact of head-worn technology (in particular VR) on user comfort and developing suitable measurement tools thereof.

Benjamin Tag is a postdoctoral researcher and associate lecturer at the School of Computing and Information Systems at the University of Melbourne. His research focuses on the conceptualisation of digital emotion regulation, and investigation of human cognition using biometric sensors and psychological test methods.

Yuji Uema is a researcher at JINS Inc., where he develops smart eyewear and conducts feasibility studies with special focus on HCI, education and medical application. His Ph.D. research at The University of Tokyo includes the analysis and estimation of cognitive load based on eye blinks and eye movement.

Enrico Rukzio is a Professor of Media Informatics at Ulm University. His research focuses on mobile and wearable interaction, computerized eyewear and automotive user interfaces

Jamie A Ward is a lecturer at Goldsmiths, University of London. He works on wearable computing, with contributions to topics like social neuroscience, activity recognition, performance evaluation, and applications to real-world problems in health, industry, and the arts.

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A CALL FOR PARTICIPATION

The human face, holding the majority of human senses, provides versatile information about a person's cognitive and affective states. Using head-worn technology, user states, such as reading, walking, detection of fatigue or cognitive load, can be recognized and enable new application scenarios, such as quantified self for the mind. Besides, significant progress in sensing technologies and modalities have led to a constant increase in unobtrusive and affordable head-worn sensing devices, such as smart glasses like Google Glass or J!NS meme. With the resulting increasing ubiquity of the technology, new opportunities arise for applications that track social behaviours and interactions between groups pf people in real-world settings.

This workshop aims to identify key factors in large-scale uses of eyewear computing. More precisely, we are going to summarize lessons learned from early deployment, focus on ways to empower the community with high-quality hardware and software prototyping tools, and will specifically discuss the establishment of open source datasets. With the wider distribution of head-worn sensing technology to the public, long-term impacts of the technology become increasingly important. Therefore, we also welcome topics that are concerned with physical or psychological aspects of head-worn sensing devices. We invite submissions of position papers (2-4 pages in the ACM sigconf format, excluding references) that cover topics such as, but are not limited to:

- Open Eyewear Tools and Datasets
- Eyewear sensing and actuation technologies
- Smart Eyewear interactions
- Application scenarios of head-worn sensing/interaction devices
- Impact and Risks of long-term sensing
- Smart Eyewear User Experience Designs

Submissions will go through a single-phase review process with at least 2 reviewers. They will be assessed based on their relevance, originality, and their potential of initiating a fruitful discussion at the workshop. Note, that position papers are not expected to present finished research projects. We rather ask for thought-provoking ideas or initial explorations of a topic. Position papers will be reviewed by two of the workshop organizers. At the workshop, accepted submissions will be presented in a 5-min prerecorded video, following the Pecha Kucha style. At least one author of an accepted submission must attend the workshop.