# EyeSec: Eye-Gaze for Security Applications

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## ABSTRACT

We propose a half-day workshop on using eye gaze for security applications. Such applications include, but are not limited to, using eye gaze to design novel authentication schemes, building privacy protection mechanisms (e.g., hiding content on a screen as shoulder surfers peek at it), or understanding user state from gaze behavior in security-relevant situations (e.g., determining stress while reading an email as an indicator for being subject to a phishing email). This workshop is motivated by significant, technological advances of eye tracking in recent years, making it a powerful modality in secure applications. Our objective is to establish a forum for researchers and practitioners to exchange ideas, discuss fundamental challenges and opportunities of using eye gaze for security as well as to identify directions for future research.

## 1 INTRODUCTION

Eye tracking has developed in the past years from being a technology that can be used only in labs and controlled settings, to a pervasive technology that is gradually weaving into our everyday lives. Advances in visual computing as well as in sensors and processing power of ubiquitous devices allow accurate gaze estimation and a myriad of applications for desktop settings, mobile devices [11], public displays [17], head-mounted displays [5], wearables [4] and other ubicomp technologies. These advancements pave the way for eye tracking to deliver its promises on off-the-shelf devices. For example, the integration of depth cameras into off-the-shelf mobile devices such as iPhone X and Huawei P30 Pro is making eye tracking available to a wider range of users, leading to eye tracking applications being just an app installation away.

At the same time, eye movements are subtle and have been deemed attractive for security and privacy protection applications. For example, Kumar et al. [16] and De Luca et al. [3] introduced the use of eye gaze for authentication on desktop computers and public terminals. More recently, eye gaze was leveraged for authentication

on unmodified mobile devices [12, 14]. While these works made use of explicit gaze-based interaction for security, researchers leveraged eye gaze implicitly to improve authentication mechanisms. For example, Bulling et al. [2] used eye gaze to improve the choice of graphical passwords. Katsini et al. [9] studied gaze behavior when using and setting graphical passwords, and accordingly adapted the system to ensure users set stronger passwords.

A recent survey paper [6] established that eye tracking is a very promising tool for improving security and highlighted directions for future work. The aim of this workshop is to provide a forum for researchers and practitioners to exchange ideas, discuss the most important challenges and opportunities of using eye gaze for security, and to identify directions for future research.

Note that this workshop is complementary to the workshop "*Privacy and Ethics in Eye Tracking*". While our workshop focuses on using eye tracking as a tool for improving security (e.g., using eye tracking to build a secure gaze-based authentication method), the other workshop focuses on the privacy and ethics implications of eye tracking systems (e.g., making sure eye tracking data does not leak private information about the user).

## 2 OBJECTIVES

In particular, we will establish a community that investigates the following areas:

- Authentication: gaze is used for explicit, implicit, and multi-factor authentication;
- Improving security based on gaze behavior: by analyzing the gaze behavior, systems can uncover user states (e.g., nervousness when reading a phishing email, or carelessness when creating a password) and intervene accordingly to improve security;
- Understanding user state from gaze behavior in security-critical situations;
- Identify challenges that need to be addressed before adopting gaze-based security applications.

The workshop shall provide intellectual stimuli and build bridges for future collaborations among researcher and practitioners from the aforementioned fields.

## 3 TOPICS OF INTEREST

In this workshop we will solicit submissions that cover a broad range of topics related to the overall theme. Topics of interest include (but are not limited to):

- Novel Authentication Concepts;
- (Gaze) Biometrics;
- Privacy protection solutions;
- Threat models;
- UX of gaze-based security systems;
- Challenges of gaze interaction in security contexts;
- Novel methods;
- Long term data collection/deployments;
- Ethical and societal implication;
- Privacy implications of gaze systems.

## 4 PREVIOUS HISTORY

The idea of bringing together experts from eye tracking, HCI, and security emerged during a panel discussion on privacy implications of eye tracking, which took place in ETRA 2019. The event was part of the main conference with more than 70 attendees, including both researchers as well as people from industry (e.g., Tobii). Subsequently, participants of the panel decided to propose two back-to-back half-day workshops evolving around the topics of security and privacy in ETRA 2020.

## 5 ORGANIZER(S)

The workshop will be organized by five researchers who are actively involved in the research fields of eye tracking, HCI, as well as usable security and privacy. All organizers have prior experience in organizing and running workshops.

**Yasmeen Abdrabou** is a Ph.D. student at the Bundeswehr University Munich. Her research combines HCI and usable security. She focuses on the use of eye gaze to enhance security mechanisms, including but not limited to gaze behavior in security-related situations and personal identification. Yasmeen also has previously organized several students coding competitions and poster sessions.

**Florian Alt** is a professor for Usable Security and Privacy at the Research Institute CODE of the Bundeswehr University, Munich. Florian looks at the role of humans in security critical systems, focusing on topics related to behavioral biometrics, physiological security, social engineering, and usable security in novel application areas, such as smart homes and VR. Florian is a subcommittee chair for CHI 2020, TPC chair of Mensch und Computer 2020 and was general chair of the 2018 Conference on Mobile and Ubiquitous Multimedia. He organized several workshops at CHI, MobileHCI and Ubicomp/Pervasive.

**Christina Katsini** is a Ph.D. Candidate at the University of Patras, Greece. Her interests lie in understanding the security implications of user-generated passwords and has used eye tracking to monitor user behavior and guide the design solutions for improving user behavior during security tasks [7, 9, 10]. She has also published work in gaze-based user modelling [8].

**Mohamed Khamis** is a Lecturer (Assistant Professor) at the University of Glasgow in the UK. His research is at the intersection of Ubiquitous Computing and User Privacy. He is interested in understanding the privacy implications of ubiquitous technologies,

as well as developing novel systems for protecting privacy and security. He has major contributions at the intersection of security and gaze [1, 6, 13, 15]. Mohamed organized workshops at UbiComp 2016, CHI 2018, and CHI 2019. He is a program committee member for CHI 2020, and was general chair for PerDis 2019.

**George E. Raptis** is a User Researcher in Human Opsis and a PhD candidate at the HCI Group, University of Patras, Greece. His research interests include studying user behavior from a cognitive theory perspective and cognitive modeling of users through computer-based methods based on eye-tracking technology on interactive systems that lie under the principles of usable security.

## 6 PARTICIPANTS

We will provide a website[1] and create social media accounts (e.g., Facebook) to advertise the workshop and to foster communication between participants prior to and after the workshop. We will encourage participants to write position papers and briefly present those at the workshop, though this will not be mandatory. The workshop will be open to all ETRA attendees, in particular those of the workshop "*Privacy-Aware Eye Tracking*", which will be held in the afternoon on the workshop day.

Furthermore, we will provide all important information on the website, including a link to the submission system as well as important references to allow participants to gain a mutual understanding of the workshop theme prior to the event. Papers will also be published on the website.

During the workshop we will create a shared document to collect all information generated throughout the workshop (minutes of discussions, presentations, mindmaps, etc.) and make it accessible to all participants after the workshop.

## 7 WORKSHOP FORMAT

The workshop will be a half-day workshop. It will emphasize discussion of new ideas. The planned format is:

- short introduction to the workshop theme by the organizers;
- presentations of novel ideas for using eye tracking in security in the form of talks / posters (depending on submissions);
- group discussions / break-out groups;
- presentation of outcomes of group activities and wrap up.

### 7.1 Pre-workshop plans

The call for papers will be distributed in popular mailing lists of the eye-tracking, usable security, HCI, and computer vision community. We will disseminate the call via social media and our website. We solicit position papers (up to 2-pages) that describe original ideas and challenges for using eye tracking in security applications. The paper selection process will be juried. Jury members will consist of the workshop organizers and experts from the field.

Each author will have the opportunity to present their positions paper at the workshop. Papers will be published as part of the ETRA 2020 Adjunct Proceedings in the ACM Digital Library.

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[1]Website will be created upon acceptance

## Table 1: Pre-workshop plans

| Action | Important Dates |
|---|---|
| Submission deadline | March 6, 2020 |
| Notification deadline | March 19, 2020 |
| Publication-ready deadline | April 2, 2020 |

## 7.2 During-the-workshop plans

The timeline for the workshop is shown in Table 2. First, the organizers will introduce themselves and talk briefly about the aim and scope of the workshop. The participants will then introduce themselves and their research interests (either in the form of posters or short talks).

After the coffee break, participants will be divided into groups and asked to discuss the core challenges and opportunities of using eye tracking for improving security. Each group will then present their outcomes and future research directions to the rest of the participants. We will conclude by collecting feedback from the participants on how to take the field forward and disseminate the outcomes of the workshop.

## Table 2: Proposed programme

| Time | Programme |
|---|---|
| 09:00-09:15 | Opening |
| 09:15-10:45 | Introductory Round |
| 10:45-11:00 | Coffee break |
| 11:00-12:15 | Group Activity |
| 12:15-12:45 | Groups Present Outcomes |
| 12:45-13:00 | Wrap up |

## 7.3 Post-workshop plans

We plan to disseminate the outcomes of the workshop in the form of an article in the ACM Interactions magazine. Furthermore, we will setup tools (mailing list, Slack, etc.) for supporting follow-up activities among participants (joint publications, proposals, future workshops, etc.) to establish and grow a community around the theme of the workshop.

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