Summary of the Sixth Edition of the International Workshop on Eye Movements in Programming

Janet Siegmund
University of Passau
Germany
janet.siegmund@uni-passau.de

Andrew Begel
Microsoft Research
USA
Andrew.Begel@microsoft.com

Norman Peitek
Leibniz Institute for Neurobiology
Germany
norman.peitek@lin-magdeburg.de

DOI: 10.1145/3356773.3356809
http://doi.acm.org/10.1145/3356773.3356809

ABSTRACT

The study of eye gaze data has great potential for research in computer programming, computing education, and software engineering practice. To highlight its role for the software engineering community, the Sixth Edition of the International Workshop on Eye Movements in Programming (EMIP 2019) was co-located with the 41st International Conference on Software Engineering. The goal of the workshop was to advance the methodology of using eye tracking for programming, both theoretically and in applications.

Categories and Subject Descriptors

D.3.2 [**Software Engineering**]

General Terms

Keywords

Eye tracking, programming, computing education, software engineering.

1. INTRODUCTION

Eye tracking in software engineering has a long history, beginning with Crosby's early studies of program comprehension in the 1990s[2,3,7]. The field grew slowly, hampered by the cost and difficulty of using eye tracking devices. However, in recent years, low-cost, widely available, and robust, mobile eye trackers have been introduced, providing an additional objective source of information about programmer behavior, and spurring a renaissance of research focused on programming and software engineering. The research has covered areas like social aspects, vision, education, affective modeling, cognitive modeling, readability, as well as looking at the traditional fields of program comprehension and debugging.

The workshop was organized by Andrew Begel and Janet Siegmund, and supported by Norman Peitek as Social Media Chair. For the first time, it was co-located with the International Conference on Software Engineering (ICSE) to move eye tracking more into the focus of the software engineering research community. The previous editions of EMIP have been co-located with eye-tracking or programming education conferences. This year's edition featured four full research papers, two short papers for presenting new ideas, and one demo paper, each of which was reviewed by two members of our program committee of 22 reviewers. 22 participants attended the workshop.

2. KEYNOTE ``EYE TRACKING AND PROGRAM COMPREHENSION''

We started the workshop with a keynote by Dror Feitelson from the Hebrew University of Jerusalem. In his talk entitled ``Eye Tracking and Program Comprehension,'' (Slides are available at: http://emipws.org/wp-content/uploads/2019/05/2019-emip-eye-comp.pdf) Prof. Feitelson gave an overview of how eye tracking can be used to observe program comprehension, which plays a major role during software-engineering development. In a nutshell, Prof Feitelson showed that to understand program comprehension, researchers need to define tasks, metrics, and variables, which form the basis to get an unbiased observation of how programmers work their way through code. Essentially, eye tracking can show that comprehension time is more appropriate to measure program comprehension than errors rates (which are driven by programmer expectation), that each code clone makes comprehension considerably easier, and that programmers select which code they understand in depth in which they understand superficially. These insights help us to understand the programmer, which is necessary because there are many things that we still do not know.

3. PAPER PRESENTATIONS

Dispersed throughout the day, six authors presented their papers, which we shortly summarize:

- Fabian Deitelhoff presented a paper on how area-of-interest models can affect how comprehension is analyzed and measured. As a take-away, checking with different area-of-interest models helps to improve data quality and overcome current limitations of eye tracking research, including eye-tracker imprecision and missing standards [4].
- Cole Peterson then showed his work on how students understand C++ code snippets. Specifically, boilerplate code was not often fixated on, a smaller number of lines get a large share of visual attention, and fixations were typically moved to close lines [8].
- Maike Ahrens presented a study on shared attention in software maintenance, indicating that highlighting code according to programmers' attention helps during software maintenance, especially for less experienced programmers [1].
- Toyomi Ishida summarized a combined EEG and eye tracking study, which allows researchers to understand which cognitive state is linked to what line of code. This might allow us to identify students who are struggling in classroom settings and provide tailored support to them [6].
- Yoshiharu Ikutani talked about how neural autonomous agents can simulate the gaze behavior of programmers, which is an important step toward automatically executing the tasks of programmers [5].
- Georg Simhandl showed that newly introduced language features are easily grasped by programmers familiar with the base language, but that abstraction of these features is difficult [10].

4. INTERACTIVE WORKSHOP

We structured EMIP to be highly interactive to foster discussion and community building. To this end, we had at-table discussions, for which we requested as set up round tables in the workshop rooms. This way, all attendees interested in a certain paper could have a seat at the according author's table and take part in the discussion. This considerably reduced the barrier for engaging, and attendees identified the most interesting question for each paper, which was then discussed with all workshop

attendees. This was a great success according to the attendees. We recommend this two-step discussion format for other workshops.

We also held an ad-hoc poster session, in which attendees created a simple poster on-site (for which we planned some time) and then discussed it during the poster session. This led to fruitful discussions and also initiated new collaborations. To make this successful, it is important to have enough space to display each poster individually at the same time.

5. DEMO SESSION

In the afternoon demo session, researchers presented their tools, discussed ideas, and collected feedback from the community. Attendees got first-hand experience on how eye tracking works, from the perspective of study participants as well as from the perspective of researchers analyzing the data.

Drew Guarner presented the current status of the iTrace plugin, which allows researchers to conduct eye tracking studies with minimal effort [9]. Furthermore, iTrace now provides a direct integration into Visual Studio and Eclipse. Participants were able to quickly set up and collect data with iTrace.

Cole Peterson demonstrated an interactive and beautiful visualization of transitions and scan paths. His tool enables researchers to dive into a programmer's eye gaze on multiple abstraction levels.

Norman Peitek presented his idea on a multi-modal data exploration tool CODERSMUSE. His demo showed how we can observe programmers from many perspectives besides eye tracking, including neuroimaging, physiological, and behavioral measures, and how CODERSMUSE allows researchers to explore all data streams simultaneously in one tool.

6. EXPERT PANEL

Bonita Sharif, Dror Feitelson, and Hidetake Uwano were invited to participate in a panel of experts, sharing their experience with the workshop attendees. One interesting insight is the answer to the attendees' question: ``Which research question you thought was super easy but turned out to be really difficult?" The answer of the experts was ``All of them." Thus, using eye tracking to observe programmers requires lots of preparation and also might include setbacks, but given the success and positive feedback of the workshop attendees, it is nevertheless worth it.

7. CONCLUSION

We closed the workshop with a reflection, collecting feedback from all participants to incorporate for future editions of EMIP. The attendees enjoyed the workshop and would attend again. They liked the collocation with ICSE, but were also amenable to a collocation with the ACM Symposium on Eye Tracking Research & Applications (ETRA)). Plans for the next edition of EMIP are underway.

8. ACKNOWLEDGMENTS

Many thanks to all workshop attendees, Dror Feitelson as keynote speaker and expert, as well as Bonita Sharif and Hidetake Uwano as experts. Furthermore, we thank all members of the program committee and the organizing committee of ICSE, including the workshop chairs.

9. REFERENCES

[1] Ahrens, K. Schneider, and M. Busch. Attention in Software Maintenance: An Eye Tracking Study. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages2–9. IEEE Press, 2019.

[2] M. E. Crosby and W. W. Peterson. Using Eye Movements to Classify Search Strategies. *Proceedings of the Human Factors Society Annual Meeting*, 35(20):1476–1480, 1991.

[3] M. E. Crosby and J. Stelovsky. How Do We Read Algorithms? A Case Study. *Computer*, 23(1):25–35, Jan. 1990

[4] F. Deitelhoff, A. Harrer, and A. Kienle. The Influence of Different AOIModels in Source Code Comprehension Analysis. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages 10–17. IEEE Press, 2019.

[5] Y. Ikutani, N. Koganti, H. Hata, T. Kubo, and K. Matsumoto. TowardImitating Visual Attention of Experts in Software Development Tasks. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages 33–36. IEEE Press, 2019.

[6] T. Ishida and H. Uwano. Synchronized Analysis of Eye Movementand EEG During Program Comprehension. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages26–32. IEEE Press, 2019.

[7] J. C. Nordbotten and M. E. Crosby. The Effect of Graphic Style on Data Model Interpretation. *Information Systems Journal*, 9(2):139–155, 1999..

[8] C. S. Peterson, J. A. Saddler, T. Blascheck, and B. Sharif. Visually Analyzing Students' Gaze on C++ Code Snippets. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages 18–25. IEEE Press, 2019.

[9] B. Sharif, C. S. Peterson, D. T. Guarnera, C. A. Bryant, Z. Buchanan,V. Zyrianov, and J. I. Maletic. Practical eye tracking with itrace. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages 41–42. IEEE Press, 2019.

[10] G. Simhandl, P. Paulweber, and U. Zdun. Design of an Executable Specification Language Using Eye Tracking. *Proceedings of the 6th International Workshop on Eye Movements in Programming*, pages37–40. IEEE Press, 2019