In-situ Visualization in Motion for Mobile and Wearable Devices

Details

Advisor

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Internship Location

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Topic

Have you used a fitness tracker while running to check your performance? If so, you are one of the millions who use wearable and mobile devices such as fitness trackers and smartphones to record, analyze, and display personal data under motion. However, with varying speed, the movement of the body (e.g., the bouncing of the arm), and the change of environmental factors such as lighting, even a simple chart could become hard to read, particularly when both visualization (e.g., sports analytics) and observer (wearers such as you) are under motion.

To address this problem, the internship has one main objective:

Generate a first set of design guidelines for visualizations in motion with a focus on usage scenarios in which wearers read their trackers while walking.

And target one specific research question:

1) How do visualization design factors affect readability while walking?

This internship has the following steps:

- Investigate and classify reading performance on mobile and wearable devices under motion by literature reviewing.
- Categorize existing factors that have been shown to influence the readability of mobile and wearable devices while walking.
- Design an empirical study to explore the impact of 1-2 design factors (e.g., length of encoding, encoding color, representation type, or size) on the reading performance of visualization on a mobile device (e.g., smartphone, smartwatch) while walking.
- Implement the study and run a pilot.
- If time permits: Conduct the formal study.

The duration will be 6 months (graduated internship/stage fin d'étude), and the start time will not be later than the end of March 2023, preferably the beginning of March. We are looking for someone interested in this topic, with user experience in wearable and mobile devices such as smartwatches and a background in computer science / human-computer interaction. Coding skills (e.g., Java, JS, Swift…), some knowledge of embedded systems, and design knowledge (e.g., Adobe Illustrator, Figma) will be needed, and an interest in a future publication would be a plus.

Background

This research internship is related to three research directions in the visualization community: 1) situated visualization, 2) visualization in motion, and 3) mobile visualization. In situated data visualization, the data is directly visualized near the physical space, object, or person it originates from [Willett et al., 2017]. Visualization in motion is a new research topic in the visualization community, and there is no dedicated research on this topic yet beyond our paper published on TVCG [Yao et al., 2022]. Based on our paper, we defined visualization in motion as visual data representations used in contexts that exhibit relative motion between a viewer and an entire visualization. In sports activities such as running, a runner is the viewer who reads in-situ visualizations such as how many calories have been burned from their fitness tracker like a smartwatch while running. The relative movement exists between the runner's eyes and their bouncing arm. In the domain of mobile visualization, there is a set of past research on how to design visualizations for a limited screen size [Islam et al., Neshati et al.]. Nevertheless, it lacked a discussion when characteristics of motion were involved, except we proposed a first research agenda on visualizations in motion for fitness trackers [Yao et al., 2022]. Thus, our internship topic has a very high potential to contribute new knowledge in both visualizations in motion and mobile visualization and would lead to a scientific publication.

Related to our specific research question, the following are past works about reading performance under walking on mobile and wearable devices:

[1] Bastian Schildbach and Enrico Rukzio. 2010. Investigating selection and reading performance on a mobile phone while walking. In Proceedings of the 12th international conference on Human computer interaction with mobile devices and services (MobileHCI '10). Association for Computing Machinery, New York, NY, USA, 93–102. https://doi.org/10.1145/1851600.1851619

[2] Rufat Rzayev, Paweł W. Woźniak, Tilman Dingler, and Niels Henze. 2018. Reading on Smart Glasses: The Effect of Text Position, Presentation Type and Walking. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 45, 1–9. https://doi.org/10.1145/3173574.3173619

[3] Terhi Mustonen, Maria Olkkonen, and Jukka Hakkinen. 2004. Examining mobile phone text legibility while walking. In CHI '04 Extended Abstracts on Human Factors in Computing Systems (CHI EA '04). Association for Computing Machinery, New York, NY, USA, 1243–1246. https://doi.org/10.1145/985921.986034

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Alaul Islam, Anastasia Bezerianos, Bongshin Lee, Tanja Blascheck and Petra Isenberg, "Visualizing Information on Watch Faces: A Survey with Smartwatch Users," 2020 IEEE Visualization Conference (VIS), 2020, pp. 156-160, doi: 10.1109/VIS47514.2020.00038. https://hal.inria.fr/hal-03005319v2/document

Alaul Islam, Ranjini Aravind, Tanja Blascheck, Anastasia Bezerianos, Petra Isenberg. Preferences and Effectiveness of Sleep Data Visualizations for Smartwatches and Fitness Bands. CHI 2022 - Conference on Human Factors in Computing Systems, Apr 2022, New Orleans, LA, United States. ⟨10.1145/3491102.3501921⟩. https://hal.inria.fr/hal-03587029/document

Ali Neshati, Yumiko Sakamoto, Launa Leboe-Mcgowan, Jason Leboe-Mcgowan, Marcos Serrano, et al.. G-Sparks: Glanceable Sparklines on Smartwatches. 45th Conference on Graphics Interface (GI 2019), May 2019, Kingston, Ontario, Canada. pp.1-9, ⟨10.20380/GI2019.23⟩. https://graphicsinterface.org/wp-content/uploads/gi2019-23.pdf

Ali Neshati, Fouad Alallah, Bradley Rey, Yumiko Sakamoto, Marcos Serrano, and Pourang Irani. 2021. SF-LG: Space-Filling Line Graphs for Visualizing Interrelated Time-series Data on Smartwatches. In Proceedings of the 23rd International Conference on Mobile Human-Computer Interaction (MobileHCI '21). Association for Computing Machinery, New York, NY, USA, Article 5, 1–13. https://doi.org/10.1145/3447526.3472040