Divided Attention On-the-Go: How to Stay Focussed while Moving

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Abstract

The increasing availability of lightweight augmented reality devices raises new opportunities for performing everyday digital tasks while on the go. While limitations with hardware and the expressivity and functionality of controller-less interactions remain key challenges for mobile interaction, a third key challenge lies in addressing the division of attention between virtual content and the physical world. Unaddressed, walking and navigational task demands interrupt and distract user attention, while a system that alleviates these demands would allow users to focus on their tasks or the world around them as they choose. This paper discusses this challenge space, and the understanding of human attention needed to progress the field of mobile interaction towards interfaces that work alongside our natural perceptual and locomotor processes.

CCS Concepts

• **Human-centered computing → Mobile computing**.

Keywords

Attention, Interaction On-the-Go, Mobile Interaction

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1 Dividing attention between walking and virtual tasks

The ability to perform our daily digital tasks while on-the-go offers an opportunity to improve the posture [7], creativity [12] and happiness [21] of our increasingly isolated population [5]. While augmented reality glasses and headsets continue to become lighter and more powerful [20], several hurdles remain. The primary problem is that many interactions that can be performed while stationary simply cannot be performed while mobile due to limitations in input expressivity and functionality. In my Master's thesis I sought to address this problem through the extension of a popular controller-less input method, Gaze+Pinch, with additional thumb-to-finger micro-gestures that dynamically map to functionality defined by the application at the user's gaze. Mapping gestures to application-specific shortcuts supported rapid, transient interactions suitable for mobile input, while mapping gestures to the three buttons and scroll-wheel of the mouse enabled full, unencumbered mouse emulation while on-the-go. Aside from selection-based inputs [3, 15], other works continue to explore controller-free and mobile typing solutions [1, 10].

However, even if we were able to design perfect input strategies, we still cannot perform tasks on-the-go as well as we can while stationary. That is because when we walk, our attention and focus becomes divided between the virtual task, and the task of walking and navigating the environment around us [13]. At times, either task can demand attention, taking away from the other. When the walking task demands attention, users' flow and focus is interrupted to navigate obstacles, re-orient, or change directions. When virtual tasks demand attention, users must either stop walking, or allocate less attention to the walking task, potentially risking their safety as they walk glued to their content [16]. With virtual and walking tasks imposing competing demands on attention, little attention is spare to allocate to the environment around the user. This stands to take away from the happiness and creativity benefits afforded by being outside, as focus is instead directed primarily to the path and virtual task. This paper takes the position that the future of mobile interaction lies in interfaces that reduce the cognitive load and attention requirements associated with walking and navigation, subtly allowing users to dictate for themselves the balance of focus between the virtual task, and the world around them. This may manifest as interfaces that subtly guide users to avoid obstacles, and navigate on behalf of users, or interfaces that shift and adapt to work alongside people's natural capability to notice obstacles, supporting the user in guiding themselves. This is juxtaposed to current approaches, many of which have a focus on overt alerts in advance of potential collisions [6, 14]. While these systems are critical to ensure user safety, exclusive reliance on alerts and notifications greaten the divide of attention between virtual and navigation tasks. The design of subtle interventions and guidance that work alongside users' natural capabilities offer a future where users can perform focussed, concentrated tasks while also able to absorb the beauty and benefits of being outside. To pursue this future, we must first understand how humans naturally allocate their attention while on-the-go, and how this is impacted with the introduction of mobile user interfaces.

2 The Natural Walking Process

When naturally walking, people typically focus their gaze ahead of them and direct their gaze towards their immediate goals [19]. Then, people will either initiate a cognitively-driven, top-down scan for obstacles, or an obstacle that appears in the peripheral vision will trigger a bottom-up saccade towards the object [8]. This object will then be encoded in spatial memory [2]. Once the user is closer to the object, they look away from it to plan for the path ahead [11], navigating around the object using several bodily mechanisms, including: spatial memory [2], proprioception [17], peripheral vision [18], optical flow [9], and reference landmarks and borders in the surrounding environment [4]. However, it is unclear how these stages and mechanisms of object recognition and avoidance are impacted with the introduction of mobile user interfaces—for example: how does visual scanning change across interface placements and task demands; how does the recognition of objects in the peripherals vary with object size and eccentricity; how does spatial memory degrade across different virtual task loads; and how does this impact visual scanning behaviour? A better understanding of the specific influences on natural walking processes would allow us to design interfaces with targetted support, or automate specific processes on behalf of the user.

This paper takes the position that mobile interactions need to be made more than portable, but must also work alongside the users' natural perceptual and locomotion processes to reduce the cognitive load associated with walking and navigating. Rather than being driven by the demands of the environment, this paper foresees a future where users choose how to allocate their attention between the world and virtual tasks, with virtual interfaces subtly directing and supporting them as they move. Realising this vision requires a deeper understanding of the impact mobile interfaces have on the natural processes we use to navigate and identify obstacles.

References

[1] Liwei Chan, Rong-Hao Liang, Ming-Chang Tsai, Kai-Yin Cheng, Chao-Huai Su, Mike Y. Chen, Wen-Huang Cheng, and Bing-Yu Chen. 2013. FingerPad: Private and Subtle Interaction Using Fingertips. In *Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology (UIST '13)*. Association for Computing Machinery, New York, NY, USA, 255–260. doi:10.1145/2501988.2502016

[2] Elizabeth R. Chrastil and William H. Warren. 2012. Active and Passive Contributions to Spatial Learning. *Psychonomic Bulletin & Review* 19, 1 (Feb. 2012), 1–23. doi:10.3758/s13423-011-0182-x

[3] Kurtis Danyluk, Simon Klueber, Aditya Shekhar Nittala, and Wesley Willett. 2024. Understanding Gesture and Microgesture Inputs for Augmented Reality Maps. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference (DIS '24)*. Association for Computing Machinery, New York, NY, USA, 409–423. doi:10.1145/3643834.3661630

[4] Christian F. Doeller and Neil Burgess. 2008. Distinct Error-Correcting and Incidental Learning of Location Relative to Landmarks and Boundaries. *Proceedings of the National Academy of Sciences* 105, 15 (April 2008), 5909–5914. doi:10.1073/pnas.0711433105

[5] Gallup. 2019. *Gallup Global Emotions Report*. Technical Report. Gallup.

[6] Juan David Hincapié-Ramos and Pourang Irani. 2013. CrashAlert: Enhancing Peripheral Alertness for Eyes-Busy Mobile Interaction While Walking. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. Association for Computing Machinery, New York, NY, USA, 3385–3388. doi:10.1145/2470654.2466463

[7] Sang In Jung, Na Kyung Lee, Kyung Woo Kang, Kyoung Kim, and Do Youn Lee. 2016. The Effect of Smartphone Usage Time on Posture and Respiratory Function. *Journal of Physical Therapy Science* 28, 1 (Jan. 2016), 186–189. doi:10.1589/jpts.28.186

[8] Fumi Katsuki and Christos Constantinidis. 2014. Bottom-Up and Top-Down Attention: Different Processes and Overlapping Neural Systems. *The Neuroscientist* 20, 5 (Oct. 2014), 509–521. doi:10.1177/1073858413514136

[9] Melissa J Kearns, William H Warren, Andrew P Duchon, and Michael J Tarr. 2002. Path Integration from Optic Flow and Body Senses in a Homing Task. *Perception* 31, 3 (March 2002), 349–374. doi:10.1068/p3311

[10] Xueshi Lu, Difeng Yu, Hai-Ning Liang, and Jorge Goncalves. 2021. iText: Hands-free Text Entry on an Imaginary Keyboard for Augmented Reality Systems. In *The 34th Annual ACM Symposium on User Interface Software and Technology (UIST '21)*. Association for Computing Machinery, New York, NY, USA, 815–825. doi:10.1145/3472749.3474788

[11] Jonathan Samir Matthis, Jacob L. Yates, and Mary M. Hayhoe. 2018. Gaze and the Control of Foot Placement When Walking in Natural Terrain. *Current Biology* 28, 8 (April 2018), 1224–1233.e5. doi:10.1016/j.cub.2018.03.008

[12] Marily Oppezzo and Daniel L. Schwartz. 2014. Give Your Ideas Some Legs: The Positive Effect of Walking on Creative Thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 40, 4 (2014), 1142–1152. doi:10.1037/a0036577

[13] Antti Oulasvirta, Sakari Tamminen, Virpi Roto, and Jaana Kuorelahti. 2005. Interaction in 4-Second Bursts: The Fragmented Nature of Attentional Resources in Mobile HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '05)*. Association for Computing Machinery, New York, NY, USA, 919–928. doi:10.1145/1054972.1055101

[14] Yunqiang Pei, Renming Huang, Mingfeng Zha, Guoqing Wang, Peng Wang, Qiao Kang, Yang Yang, and Heng Tao Shen. 2025. AttentionAR: AR Adaptation and Warning for Real-World Safety via Attention Modeling and MLLM Reasoning. In *Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25)*. Association for Computing Machinery, New York, NY, USA, 1–19. doi:10.1145/3746059.3747674

[15] Francisco Perella-Holfeld, Shariff AM Faleel, and Pourang Irani. 2023. Evaluating Design Guidelines for Hand Proximate User Interfaces. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1159–1173. doi:10.1145/3563657.3596117

[16] Prudence Plummer, Sarah Apple, Colleen Dowd, and Eliza Keith. 2015. Texting and Walking: Effect of Environmental Setting and Task Prioritization on Dual-Task Interference in Healthy Young Adults. *Gait & Posture* 41, 1 (Jan. 2015), 46–51. doi:10.1016/j.gaitpost.2014.08.007

[17] Lili Tcheang, Heinrich H. Bülthoff, and Neil Burgess. 2011. Visual Influence on Path Integration in Darkness Indicates a Multimodal Representation of Large-Scale Space. *Proceedings of the National Academy of Sciences* 108, 3 (Jan. 2011), 1152–1157. doi:10.1073/pnas.1011843108

[18] Christian Vater, Benjamin Wolfe, and Ruth Rosenholtz. 2022. Peripheral Vision in Real-World Tasks: A Systematic Review. *Psychonomic Bulletin & Review* 29, 5 (2022), 1531–1557. doi:10.3758/s13423-022-02117-w

[19] Dimitris Voudouris and Eli Brenner. 2025. Gaze When Walking to Grasp an Object in the Presence of Obstacles. *Journal of Vision* 25, 11 (Sept. 2025), 12. doi:10.1167/jov.25.11.12

[20] VRcompare. 2024. Comparison of Augmented Reality (AR) Glasses and Headsets Worldwide in 2024, by Weight (in Grams). https://www.statista.com/statistics/1337293/ar-glasses-comparison-by-weight/.

[21] Feng Wang, Heather M. Orpana, Howard Morrison, Margaret de Groh, Sulan Dai, and Wei Luo. 2012. Long-Term Association Between Leisure-time Physical Activity and Changes in Happiness: Analysis of the Prospective National Population Health Survey. *American Journal of Epidemiology* 176, 12 (Dec. 2012), 1095–1100. doi:10.1093/aje/kws199