TEXT2030 - Shaping Text Entry Research in 2030

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ABSTRACT

We propose a workshop on the theme of ubiquitous text entry research. Our aim is to address the methodological challenges arising from several decades of experience in this research community. We hope to solicit views, experiences and ideas from researchers across a range of backgrounds, with a view to formulate concrete action plans to move community practices into a strengthened position by 2030.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile devices**; **Ubiquitous and mobile computing design and evaluation methods**; **Empirical studies in ubiquitous and mobile computing**; **Text input**.

KEYWORDS

text entry, scientific practice, methodological challenges

1 BACKGROUND

1.1 Introduction and Rationale

Text entry remains a fundamental capability in mobile and ubiquitous computing systems, especially where such systems aim to support communication between remotely located users. Advances in machine learning and sensing equipment have enabled significant breakthroughs and exploration of promising new text entry paradigms (e.g., the "invisible keyboard" [18]), as well as affording deeper insights into behaviours, cognitive processes and motor actions of users during text entry [11]. With the proliferation of mobile computing devices, effortless text entry has become a badly supported requirement for a very wide diversity of population,

including those with disabilities and niche languages, or dialect speakers. However, even when considering support for large user populations, the community is still unearthing strong evidence that better text entry method design is still needed, for example in non-English speaking countries [2, 8]. Despite our best work though, mainstream text entry methods have remained unchanged for at least a decade and it appears that text entry research is having a smaller impact in society than anticipated.

At the same time, text entry research faces a range of methodological challenges. The laboratory-based phrase transcription task remains the dominant evaluation method for new text entry approaches [15], even though lab-based alternatives with better potential for ecological validity have been proposed [10]. Though potentially outdated, most research has used the same phrase-sets for many years, focusing on English-language based tasks, and therefore precluding research using non-English speaking populations [9]. Field studies remain few and far in between, or are still heavily based on transcription tasks, even if executed in contextually realistic settings [15]. Whether lab or field based, evaluations still mostly involve limited sample sizes and target specific user population groups, often through convenience sampling. Beyond standard performance measurements, such as speed and errors, studies also rarely look at other dimensions, such as action-level analysis [14] or emotional responses to text entry methods [1].

Further, the field is characterised by very limited data and code sharing practices, which prohibit replication or reproduction studies. The "replication crisis" is a longstanding and widely recognised problem in HCI [6, 7], but this problem is especially impactful for the text entry community. If materials and data could be made more widely available to other researchers, then replication or reproduction studies could significantly improve the generalisability of results.

The text entry research community is relatively small, with related papers representing only a small portion of publications in top-tier conferences and journals. Despite regular attempts in the past decade to bring the community closer, researchers remain mostly isolated and joint projects are uncommon. The small size of the community could represent a significant opportunity to collectively discuss how to shape the next decade of research, by considering paths towards addressing some of the methodological challenges in this field of research and consolidating views collaborative practices and resource sharing to improve the stature and societal impact of text entry research.

Text entry workshops have been organised in various conferences, e.g., at CHI and MobileHCI between 2012-2018 [3–5, 12, 13,

16, 17], though the main focus of these events has been community building, as well as technical, in terms of grand challenges, or thematic areas of exploration. We propose a workshop to decide a shared vision for the state of text entry research by 2030, focusing less on technical problems, but methodological and collaborative practices that will improve our effectiveness in tackling such issues. By bring the community together, in order to start a discussion around these common issues, we aim to conclude by deciding on collective steps towards implementing a joint action plan to solidify and improve our scientific practices, and ultimately achieve greater impacts in the digital society.

1.2 Issues to be Addressed

The key topics or challenges that we would like to invite contributions and discussion upon, can be outlined as follows:

- **Fostering open science**: The community rarely shares data and source code, both for input method functionality, as well as for data analyses. Ways to establish better open practices, e.g., through a shared scientific artefact repository and digital commons space, standards for data generation and data exchange, use of common evaluation tools and environments, common frameworks for data logging and analysis, could significantly improve the community's output. Such tools would enable more rapid prototype development, confidence in data quality and privacy, and would enable more replication/reproduction studies.
- **Improving collaboration**: Text entry result generalisability is often low, due to the lack of large and diverse participant populations. The community could discuss ways to carry out distributed/parallel studies in multiple countries and with different target groups, by setting up ways to communicate planned research, and find collaborators with access to various population groups.
- **Diversifying research methodology**: As a community, we should look towards leveraging the capabilities of novel technologies as a way to break out of the limitations imposed by the transcription evaluation method. We seek proposals on how to encourage, inspire, and appreciate new and/or more ecologically valid study protocols, such as using text composition instead of transcription, in-the-wild studies, autoethnography, or engagement with the open-source community (e.g., OpenBoard). We should also look at how we can best integrate novel sensing technology into our research protocols, to capture data other than touch/keystrokes (for example, eye, motion, EEG signals, other biosignals, or potentially even emotions) and discuss how these can be shared under a common framework for open science.
- **Addressing the needs of under-represented populations**: Our community needs to acknowledge text entry does not only mean letter entry and text prediction, and that much more focuses needed on number entry, symbol entry, error prediction and correction, emoji entry, and text editing. We also should seek to encourage more research on text entry for people with sensory, motor control and cognitive impairments. Further, work into supporting local dialects, niche

or disappearing languages through better typography, semiotics and intelligent entry support, must form a core target as we aim to culturally preserve, rather than help towards elimination, of this rich heritage.
- **Supporting the development of the text entry community**: Though text-entry related workshops have been regularly organised in the past decade, there seems to be a lack of progress on the base of mutually agreed action plans for the community. Proposals on how to establish a regular meeting of the community and frequent communications towards achieving commonly set goals, while accounting for pandemic situations and the need to lessen travel-related climate impacts, should be discussed. A further goal for the community would be to increase the attractiveness of our field, by encouraging outreach events within regular conferences, such as working with committees to organise a talk + demo combo presentation format for text entry research, so that others can check out novel techniques on their own. Finally, the community needs to discuss the development of a common corpus and curriculum of teaching material for students and graduates, so that training for undergraduate or postgraduate theses does not have to start from scratch every single time.

1.3 Workshop Goals

The workshop aims to conclude with a concrete set of actions and a clear plan for implementation for most, if not all, the challenges it aims to address. The issues of fostering open science and collaboration are key priorities, since they will be enablers for the success of other goals (e.g., addressing the needs of populations where participants are hard to recruit, or developing common training materials). We aim to produce a set of prioritised actions, assigned to volunteering members of the community, even if these actions are not conclusive, but precursors to further discussion that can be arranged after the workshop (e.g., setting up a monthly teleconferencing meeting with a defined agenda).

2 PRE-WORKSHOP PLANNING

The workshop will be publicised via a dedicated website set up for this purpose. Further, a Call for Papers (CfP) will be distributed using various established routes (e.g., main conference website, social network accounts of organisers and their institutions, emails to known members of the text entry community). To better address the community, we will scrape related paper author details from recent flagship SIGCHI sponsored conferences in the last 3 years and communicate the CfP to them via email. We aim to address a representative sample of researchers from all continents, while ensuring gender representation in communication is balanced as much as is inherent in the community. International and minority perspectives will be especially welcomed in the CfP.

3 TECHNICAL REQUIREMENTS

We aim for a hybrid delivery of the workshop. Given the relatively small participant number (15-20) we do not anticipate that remote participation will be a problem, and that the technical requirements

for delivering a hybrid workshop via a simple teleconferencing platform (such as Zoom) will be low. The workshop can be also delivered entirely online if needed. Prior to the workshop, we will make all papers available to the participants via our website. Presentations will also be pre-recorded and uploaded on a dedicate YouTube channel, using captioning, to assist remote participation (delivery and/or attendance). Finally, supporting materials for running the interactive workshop phase will be delivered both in printed, and digital form, to enable remote collaboration. To assist remote participation, we will set up appropriate digital collaboration tools (e.g. Trello, Miro, Slack, Jamboard, Google Drive) and provide instructions for where, when and how to use each.

4 RUNNING THE WORKSHOP

In total, we expect to invite 8 full paper submissions (up to 8 pages) for presentation, and 8 short paper submissions (up to 4 pages) to be presented as posters. Full papers should address the stated key themes of the workshop, while poster papers can present late-breaking work, works in progress, or research proposal ideas.

The workshop will run a full-day schedule, starting with presentations of experiences, proposals and position statements, and followed by an ideation session in the afternoon, before concluding with group discussion of key issues and plans to move forward. The workshop will begin with an invited talk reflecting on the experience of text entry research in the last decade. Two presentation sessions will afford speakers 15' + 5-10' for questions and discussion. We envisage two coffee breaks and a lunch break, during which authors of posters will be able to present their work to participants. The afternoon will include an ideation session where participants will be divided into smaller groups and asked to reflect on the key themes of the workshop. The workshop will conclude with a discussion of ideas generated by the groups, and a set of proposed actions to carry the workshop momentum forward. The proposed schedule follows.

- 09:00 - 09:15: Welcome and introduction
- 09:15 - 10:00: Invited talk
- 10:00 - 10:30: Coffee Break + Posters
- 10:30 - 12:30: Presentations (4)
- 12:30 - 13:30: Lunch break
- 13:30 - 15:30: Presentations (4)
- 15:30 - 16:00: Coffee Break + Posters
- 16:00 - 17:00: Ideation
- 17:00 - 18:00: Discussion and conclusions

5 DIVERSITY AND INCLUSION

While many diversity and inclusion provisions (e.g., badges, signage, catering etc) are expected to be handled by the relevant Mobile-HCI chairs, we will take concrete steps to ensure our workshop is strongly focused on these topics.

- **Representation:** We will ensure that the organising and program committee include diverse representation across gender identities, racial backgrounds and geographic regions. We will also strive to balance our program (speakers and poster presenters), while actively soliciting submissions and reviews from under-represented groups, since this is a key theme for our workshop. Further, a plan of actions fostering

text entry research with diversity and equity considerations will be a prioritised topic of discussion in our afternoon activities.
- **Participation:** We aim to deliver the workshop in hybrid form, allowing remote participation and streaming the event online. We will make materials available prior to, and after the workshop on our website, for the benefit of all participants. Presentations will be delivered live and also pre-recorded with captioning. Through the digital platforms used for hybrid participation, we will allow the interactive participation in Q&A sessions and ideation activities through voice or text entry.

6 EXPECTED OUTCOMES

The workshop is expected to provide several outcomes. First, the workshop proceedings will be published as an online volume through CEUR-WS. We aim to collaboratively produce a guest edited issue in a relevant journal (e.g., TOCHI) by inviting extended versions of the three best submissions in the workshop, an editorial article based on the outcomes of the workshop and key findings, and also opening up the guest issue to submissions from other researchers. Additionally, and more importantly, our workshop aims to deliver a plan of actions towards achieving the goals set out in the workshop theme description. We aim to frame the attainment of these goals as an international collaborative project, with assigned sub-projects, milestones and key personnel under each project role. Our desire is to leave the workshop with a strong momentum towards achieving these goals, while reviewing progress regularly and conferring at least yearly, under MobileHCI or other related conferences, in order to ensure continuity.

7 ORGANISERS

Conference organisers are presented in this proposal after random ordering [1]. The main contact person for this workshop is Andreas Komninos (akomninos@ceid.upatras.gr). All organisers will be reachable through the website that will be set up for the workshop. Short biographical statements for each of the co-organisers are presented below.

Mark Dunlop is a senior lecturer at the University of Strathclyde, UK. His research focuses on usability of mobile systems including mobile text entry, sensor driven interaction and evaluation of mobiles. He is a member of the MobileHCI conference steering committee and co-organiser in most of the previous decade's CHI workshops on text entry. His bio and publications can be found at https://personal.cis.strath.ac.uk/mark.dunlop/

Wolfgang Stuerzlinger is a Professor at Simon Fraser University, Canada and leads the VVISE research lab. His research interests include human-computer interaction, occasionally failing systems, human error behaviours, virtual reality and augmented reality, where he has often explored interactions with text entry methods. He has been a co-organiser for several of the previous decade's CHI workshops on text entry. His bio and publications can be found at https://vvise.iat.sfu.ca/people/wolfgang-stuerzlinger

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[1] https://www.aeaweb.org/journals/policies/random-author-order/search?RandomAuthorsSearch%5Bsearch%5D=4eLdimSrSBsb

Ahmed Sabbir Arif is an Assistant Professor at the University of California, Merced, USA, where he leads the Inclusive Interaction Lab. His research program is interdisciplinary, spanning multiple areas, including computer science, cognitive science, human factors, virtual reality, accessibility, and applied artificial intelligence, having frequently focused on text entry research. He has co-organised several of the previous decade's CHI workshops on text entry. His bio and publications can be found at https://www.asarif.com

Andreas Komninos is an Assistant Professor at the University of Patras, Greece. He has previously worked on text entry methods for smartphones and smart watches, focusing on visual and multi-modal feedback for error detection and correction. He has served in the OC and PC of multiple international workshops and conferences. His bio and publications can be found at http://www.komninos.info

Ohoud Alharbi is an Ph.D from Simon Fraser University in Computing Science and has a Master of science from University of California Irvine in Computer Engineering. Currently, she is a faculty member at King Saud University. She has worked in Multi-disciplinary Design Program (MDP) at The California Institute for Telecommunications and Information Technology at University of California Irvine in USA for two years. Her bio and publications can be found at http://www.ohoudalharbi.com

REFERENCES

[1] Ohoud Alharbi and Wolfgang Stuerzlinger. 2022. Auto-Cucumber: The Impact of Autocorrection Failures on Users' Frustration. In *Graphics Interface (GI '22)*. 10 pages. To appear.

[2] Ahmed Sabbir Arif, Sarah Fardeen, and Ali Mazalek. 2017. Mobile Text Entry Challenges Among Low-Income Users in a Developing Country. In *2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*. IEEE, Banff, AB, 624–629. https://doi.org/10.1109/SMC.2017.8122676

[3] Ahmed Sabbir Arif, Wolfgang Stuerzlinger, Mark D. Dunlop, Xin Yi, and Caitlyn Seim. 2018. *TEXT 2018 MobileHCI 2018 Workshop on Socio-Technical Aspects of Text Entry*. CEUR Workshop Proceedings, Vol. 2183. http://ceur-ws.org/Vol-2183/

[4] James Clawson, Ahmed Sabbir Arif, Stephen Brewster, Mark Dunlop, Per Ola Kristensson, and Antti Oulasvirta. 2015. Text Entry on the Edge. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15)*. Association for Computing Machinery, New York, NY, USA, 2381–2384. https://doi.org/10.1145/2702613.2702660

[5] James Clawson, Stephen A. Brewster, Mark D. Dunlop, Per Ola Kristensson, Poika M. Isokoski, Antti Oulasvirta, Keith Vertanen, and Annalu Waller. 2014. The Usability of Text Entry Systems Now and in the Future. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems (CHI EA '14)*. Association for Computing Machinery, New York, NY, USA, 1139–1142. https://doi.org/10.1145/2559206.2559217

[6] Florian Echtler and Maximilian Häußler. 2018. Open Source, Open Science, and the Replication Crisis in HCI. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3170427.3188395

[7] Sebastian S. Feger, Sünje Dallmeier-Tiessen, Paweł W. Woźniak, and Albrecht Schmidt. 2019. The Role of HCI in Reproducible Science: Understanding, Supporting and Motivating Core Practices. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (CHI EA '19)*. Association for Computing Machinery, New York, NY, USA, 1–6. https://doi.org/10.1145/3290607.3312905

[8] Anna Maria Feit, Mathieu Nancel, Maximilian John, Andreas Karrenbauer, Daryl Weir, and Antti Oulasvirta. 2021. AZERTY AméLioré: Computational Design on a National Scale. *Commun. ACM* 64, 2 (Jan. 2021), 48–58. https://doi.org/10.1145/3382035

[9] Marc Franco-Salvador and Luis A. Leiva. 2018. Multilingual Phrase Sampling for Text Entry Evaluations. *International Journal of Human-Computer Studies* 113 (May 2018), 15–31. https://doi.org/10.1016/j.ijhcs.2018.01.006

[10] Dylan Gaines, Per Ola Kristensson, and Keith Vertanen. 2021. Enhancing the Composition Task in Text Entry Studies: Eliciting Difficult Text and Improving Error Rate Calculation. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3411764.3445199

[11] Xinhui Jiang, Yang Li, Jussi P.P. Jokinen, Viet Ba Hirvola, Antti Oulasvirta, and Xiangshi Ren. 2020. How We Type: Eye and Finger Movement Strategies in Mobile Typing. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376711

[12] Per Ola Kristensson, Stephen Brewster, James Clawson, Mark Dunlop, Leah Findlater, Poika Isokoski, Benoît Martin, Antti Oulasvirta, Keith Vertanen, and Annalu Waller. 2013. Grand Challenges in Text Entry. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI '13)*. Association for Computing Machinery, New York, NY, USA, 3315–3318. https://doi.org/10.1145/2468356.2479675

[13] Per Ola Kristensson, James Clawson, Mark Dunlop, Poika Isokoski, Brian Roark, Keith Vertanen, Annalu Waller, and Jacob Wobbrock. 2012. Designing and Evaluating Text Entry Methods. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems (CHI EA '12)*. Association for Computing Machinery, New York, NY, USA, 2747–2750. https://doi.org/10.1145/2212776.2212711

[14] Gulnar Rakhmetulla, Ahmed Sabbir Arif, Steven J. Castellucci, I. Scott MacKenzie, and Caitlyn E. Seim. 2021. Using Action-Level Metrics to Report the Performance of Multi-Step Keyboards. In *Proceedings of Graphics Interface 2021 (GI 2021)*. Canadian Information Processing Society, 127 – 137. https://doi.org/10.20380/GI2021.15 ISSN: 0713-5424 event-place: Virtual Event.

[15] André Rodrigues, André R.B. Santos, Kyle Montague, Hugo Nicolau, and Tiago Guerreiro. 2021. WildKey: A Privacy-Aware Keyboard Toolkit for Data Collection In-The-Wild. In *Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers*. Association for Computing Machinery, New York, NY, USA, 542–545. https://doi.org/10.1145/3460418.3482872

[16] Keith Vertanen, Mark Dunlop, James Clawson, Per Ola Kristensson, and Ahmed Sabbir Arif. 2016. Inviscid Text Entry and Beyond. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*. Association for Computing Machinery, New York, NY, USA, 3469–3476. https://doi.org/10.1145/2851581.2856472

[17] Keith Vertanen, Kyle Montague, Mark Dunlop, Ahmed Sabbir Arif, Xiaojun Bi, and Shiri Azenkot. 2017. Ubiquitous Text Interaction. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. Association for Computing Machinery, New York, NY, USA, 566–573. https://doi.org/10.1145/3027063.3027066

[18] Suwen Zhu, Tianyao Luo, Xiaojun Bi, and Shumin Zhai. 2018. Typing on an Invisible Keyboard. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3173574.3174013