Zero-Waste Data

Creating a Sustainable Data Physicalization Workshop Kit

SARAH HAYES, Munster Technological University, Ireland

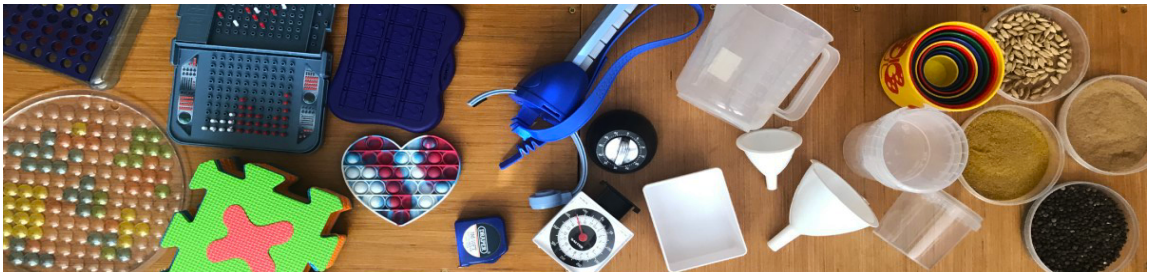

Fig. 1. The Zero-Waste Data Physicalization Kit will include (1) reusable materials, e.g. board games and toys, (2) measurement tools (3) biodegradable materials, and (3) containers and labels for grouping and annotation.

Workshops are often used to introduce new practitioners to data physicalization concepts and methods. However, the environmental impact of the materials and methods used in these types of workshops is often at odds with the short lifespan of the generated artefacts. I propose the development of a Zero-Waste Data Physicalization Kit, comprised of a mix of reusable, repurposed, and biodegradable materials and tools. I discuss the motivation and conception of this toolkit, including a set of criteria developed for material selection. I conclude by offering thoughts on future work that I intend to conduct in this area, including a planned research study to evaluate the Kit's capabilities for supporting the introduction of data physicalization to novice practitioners.

CCS Concepts: • **Human-centered computing** → **Visualization toolkits**; *User interface toolkits*;

Additional Key Words and Phrases: data physicalization, sustainable HCI, toolkits, zero-waste prototyping

ACM Reference Format:

Sarah Hayes. 2023. Zero-Waste Data: Creating a Sustainable Data Physicalization Workshop Kit. In *CHI'23: ACM Conference on Human Factors in Computing Systems, April 23-28, 2023, Hamburg, Germany*. ACM, New York, NY, USA, 3 pages. https://doi.org/XXXXXXX.XXXXXXX

1 INTRODUCTION

Data physicalization refers to the practice of giving physical form to data (cf. [9], [1]). Although there has been a relatively recent surge in interest in this discipline, the practice remains mostly unknown amongst the general public. Prototyping workshops in which participants create their own physicalizations are an established method of facilitating the introduction of the concepts and practices related to this space to new groups of creators (e.g. [4], [7], [10]). The artefacts generated in these workshops are often, by their nature, short-lived and transitory. They exist to facilitate learning and exploration, rather than to persist and be reused. However, the materials and methods selected for use in

Manuscript submitted to ACM

these workshops are typically not considered with this short lifespan in mind. Moreover, the environmental impact of these activities in terms of waste generation and resource usage has not been investigated. While biodegradable materials, such as food [10], and reusable materials, such as building blocks [7] have been used in past physicalization workshops, the approach of selecting workshop materials based on their environmental impact has not been explored in this context. I propose to address this gap through an exploration of sustainable prototyping techniques for introducing data physicalization, through the development of a sustainable workshop kit.

2 BACKGROUND

This research can be situated within a wider body of Sustainable HCI (SHCI) work that seeks to address the environmental impact of human activities within HCI through an exploration of materiality, practice, and frameworks for design - what DiSalvo and colleagues [3] called sustainability *in* design (e.g. [13], [12], [2]). In the context of Data Physicalization, the topic of sustainability has been primarily addressed thus far through data topic selection (e.g. [14], [11], [15]). However, the wider environmental impact of physicalization, as a research area and practice, remains under-explored. Given that the process of making data physical requires the practitioner to engage in activities that consume energy and materials, and produce waste in a way that diverges widely from traditional information visualization, I suggest that this is a key area of exploration for Data Physicalization researchers. Other key strands of Data Physicalization literature that influenced the work presented here are documented examples of past physicalization workshops (e.g. [5], [7], [10], [4]), as well as existing physicalization kits (e.g. [8], [7]).

3 THE ZERO-WASTE PHYSICALIZATION KIT

I am in the process of designing the *Zero-Waste Physicalization Kit*, which will be used to conduct workshops that allow people to explore data physicalization creation whilst minimising the environmental impact of these activities. The Zero-Waste Physicalization Kit is being designed with the following criteria in mind:

(1) Materials should be reusable and, where possible, repurposed or found.
(2) Waste from the workshops should be kept to an absolute minimum. Any waste that is generated should be biodegradable.
(3) Any consumable materials should be natural and biodegradable, easy to replenish, and ethically sourced.

See fig. 1 above for examples of proposed materials. My purpose in creating this tool kit is twofold: (1) to explore materials and methods for sustainable prototyping and exploration activities in introductory data physicalization workshops, and (2) to explore the opportunities and boundaries of zero-waste materials for supporting the design of data physicalizations. For instance, I am interested in investigating how various physical variables (e.g. weight, scale, position) can be introduced to people using this constrained set of materials and tools.

4 CONCLUSION AND FUTURE WORK

In this paper, I have briefly presented my work and motivation for developing the Zero-Waste Data Physicalization Kit. I am in the process of organising a series of introductory physicalization workshops with fine art and digital media students using the Kit. My aim in conducting these workshops is to investigate the usefulness of the Kit for introducing physicalization practices. Additionally, I will investigate the boundaries and constraints this approach to prototyping places on designers. Furthermore, I intend to explore how sustainability intersects with prototyping practices for data physicalization beyond introductory workshops.

REFERENCES

[1] S. Sandra Bae, Clement Zheng, Mary Etta West, Ellen Yi-Luen Do, Samuel Huron, and Danielle Albers Szafir. 2022. Making Data Tangible: A Cross-Disciplinary Design Space for Data Physicalization. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 81, 18 pages. https://doi.org/10.1145/3491102.3501939

[2] Eli Blevis. 2007. Sustainable Interaction Design: Invention & Disposal, Renewal & Reuse. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '07)*. Association for Computing Machinery, New York, NY, USA, 503–512. https://doi.org/10.1145/1240624.1240705

[3] Carl DiSalvo, Phoebe Sengers, and Hrönn Brynjarsdóttir. 2010. Mapping the Landscape of Sustainable HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Atlanta, Georgia, USA) *(CHI '10)*. Association for Computing Machinery, New York, NY, USA, 1975–1984. https://doi.org/10.1145/1753326.1753625

[4] Trevor Hogan, Uta Hinrichs, Yvonne Jansen, Samuel Huron, Pauline Gourlet, Eva Hornecker, and Bettina Nissen. 2017. Pedagogy & Physicalization: Designing Learning Activities around Physical Data Representations. In *Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems* (Edinburgh, United Kingdom) *(DIS '17 Companion)*. Association for Computing Machinery, New York, NY, USA, 345–347. https://doi.org/10.1145/3064857.3064859

[5] Trevor Hogan, Uta Hinrichs, Bettina Nissen, and Samuel Huron. 2018. Considering Physical Variables for Data Physicalization. https://data-physicalisation.github.io/drs2018.html#planning

[6] Trevor Hogan, Eva Hornecker, Simon Stusak, Yvonne Jansen, Jason Alexander, Andrew Vande Moere, Uta Hinrichs, and Kieran Nolan. 2016. Tangible Data, Explorations in Data Physicalization. In *Proceedings of the TEI '16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction* (Eindhoven, Netherlands) *(TEI '16)*. Association for Computing Machinery, New York, NY, USA, 753–756. https://doi.org/10.1145/2839462.2854112

[7] Samuel Huron, Pauline Gourlet, Uta Hinrichs, Trevor Hogan, and Yvonne Jansen. 2017. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (Edinburgh, United Kingdom) *(DIS '17)*. Association for Computing Machinery, New York, NY, USA, 1409–1422. https://doi.org/10.1145/3064663.3064798

[8] Samuel Huron, Yvonne Jansen, and Sheelagh Carpendale. 2014. Constructing Visual Representations: Investigating the Use of Tangible Tokens. *IEEE Transactions on Visualization and Computer Graphics* 20, 12 (2014), 2102–2111. https://doi.org/10.1109/TVCG.2014.2346292

[9] Yvonne Jansen, Pierre Dragicevic, Petra Isenberg, Jason Alexander, Abhijit Karnik, Johan Kildal, Sriram Subramanian, and Kasper Hornbæk. 2015. Opportunities and Challenges for Data Physicalization. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 3227–3236. https://doi.org/10.1145/2702123.2702180

[10] Carine Lallemand and Maud Oomen. 2022. The Candy Workshop: Supporting Rich Sensory Modalities in Constructive Data Physicalization. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, Article 404, 7 pages. https://doi.org/10.1145/3491101.3519648

[11] Luiz Morais, Lívia Sampaio, Gibran Yásser, and Andrey Brito. 2021. Lumiphys: Designing a Long-Term Energy Physicalization to Democratize Smart Campus Data. In *Proceedings of the Twelfth ACM International Conference on Future Energy Systems* (Virtual Event, Italy) *(e-Energy '21)*. Association for Computing Machinery, New York, NY, USA, 362–366. https://doi.org/10.1145/3447555.3466596

[12] James Pierce. 2012. Undesigning Technology: Considering the Negation of Design by Design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Austin, Texas, USA) *(CHI '12)*. Association for Computing Machinery, New York, NY, USA, 957–966. https://doi.org/10.1145/2207676.2208540

[13] Chris Preist, Daniel Schien, and Paul Shabajee. 2019. Evaluating Sustainable Interaction Design of Digital Services: The Case of YouTube. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3290605.3300627

[14] Rick van Loenhout, Champika Ranasinghe, Auriol Degbelo, and Nacir Bouali. 2022. Physicalizing Sustainable Development Goals Data: An Example with SDG 7 (Affordable and Clean Energy). In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, Article 346, 7 pages. https://doi.org/10.1145/3491101.3519638

[15] Karin von Ompteda. 2019. Data Manifestation: Merging the Human World & Global Climate Change. In *2019 IEEE VIS Arts Program (VISAP)*. 1–8. https://doi.org/10.1109/VISAP.2019.8900829