GUEST EDITORS' INTRODUCTION

Data Physicalization—Part II

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This is a continuation of the *IEEE Computer Graphics and Applications* (CG&A) November Special Issue on Data Physicalization[1]. As we noted in our previous introduction "The practise of representing data in physical form has existed for thousands of years, yet it has only become an area of investigation and exploration for scientists, designers, and artists much more recently.[2] Advances in areas such as digital fabrication, actuated tangible interfaces, and shape-changing displays have spurred an emerging area of research now called Data Physicalization.[3]"

In the previous CG&A Special Issue on Data Physicalization (November/December 2020), we presented four articles that discussed the role of data as part of physical data-driven representations,[4] the use of physicalizations to materialize qualitative data related to human experiences and knowledge domains,[5] the design and construction of Data Badges—customizable physical conference badges,[6] and "Move&Find" a multisensory data representation where people pedaled on a bicycle to exert the energy required to conduct a search.[7]

IN THIS ISSUE

In this issue, we continue discussions through three further papers. First, describing a set of data physicalizations that represent aspects of the history of slavery in Brazil—"Slave Voyages: Reflections on Data Sculptures" illustrates how designerly and artistic concepts and material characteristics are deeply intertwined in the process of data physicalization. The article reflects on the agency of materiality that influences pragmatic production and construction choices and discusses the interrelations between the maker and the material during the physicalization creation process.

Second, "Narrative Physicalization: Supporting Interactive Engagement With Personal Data" introduces the concept of narrative physicalizations as everyday objects modified to support self-reflection through embodied engagement with personal data. The article reports on a two-part study which suggests people develop meaningful narratives around data and personal experience and designers and developers can leverage on the affordances and familiarity of everyday objects to reveal insights with users/viewers that may not otherwise come to mind.

Finally, "Data Clothing and BigBarChart: Designing Physical Data Reports on Indoor Pollutants for Individuals and Communities" brought data physicalizations into the field by using physical data representations to communicate data about in-door pollutants to the participants in the Green Housing Study. Their article reports on how the physicalizations were received by diverse audiences.

Together these two special issues show the diversity of contributions that arise from the area of Data Physicalization. These include theoretical discussions and applied case studies that span the domains of art, design, humanities, and science. We therefore encourage the community to further explore this style of data representation, analysis, and exploration to broaden the horizons of the emerging and growing field of data physicalization.

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REFERENCES

1. T. Hogan, U. Hinrichs, S. Huron, J. Alexander, and Y. Jansen, "Data physicalization" *IEEE Comput. Graph. Appl.*, vol. 40, no. 6, pp. 21–24, Nov./Dec. 2020, doi: 10.1109/MCG.2020.3027223
2. P. Dragicevic and Y. Jansen, "List of physical visualizations," 2012. [Online]. Available: http://www.dataphys.org/list/gallery

3. Y. Jansen *et al.*, "Opportunities and challenges for data physicalization," in *Proc. 33rd Annu. ACM Conf. Hum. Factors Comput. Syst.*, 2015, pp. 3227–3236.
4. D. Offenhuber, "What we talk about when we talk about data physicality," *IEEE Comput. Graph. Appl.*, vol. 40, no. 6, pp. 25–37, Nov./Dec. 2020.
5. D. Lockton, L. Forlano, J. Fass, and L. Brawley, "Thinking with Things: Landscapes, connections, and performances as modes of building shared understanding," *IEEE Comput. Graph. Appl.*, vol. 40, no. 6, pp. 38–50, 2020, doi: 10.1109/MCG.2020.3027591.
6. G. Panagiotidou, S. Görücü, and A. Vande Moere, "Data Badges: Making an academic profile through a DIY wearable physicalization," *IEEE Comput. Graph. Appl.*, vol. 40, no. 6, pp. 51–60, Nov./Dec. 2020.
7. J. Hurtienne, F. Maas, A. Carolus, D. Reinhardt, C. Baur, and C. Wienrich, "Move&Find: The value of kinaesthetic experience in a casual data representation," *IEEE Comput. Graph. Appl.*, vol. 40, no. 6, pp. 61–75, Nov./Dec. 2020.

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