
A Human-Data Design Approach to Physically Experiencing Data

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Abstract

We are in the midst of a data revolution where masses of data are being collected about our behavior, our bodies and aspects of the environment. However, much of the data is 'black box' in nature, meaning users often do not know (i) how data were derived, (ii) how accurate data are, (iii) and how to interpret data. As a result, it is often difficult for users to grasp the significance, impact and importance of these data on their daily lives. We propose a '*human-data design*' approach that bridges the gap between users and their data. Creating better suited understandable physical visualizations that elicit, represent and combine different data streams to evoke new understandings can lead to public engagement based on an understanding of what people are interested in and expect from such data. We argue that designing tangible ways to both elicit and represent data can encourage the general public to discover more about what lies behind it and in doing so, decide for themselves how best to use and act upon it

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

We are in the midst of a data revolution where masses of data are being collected about our behavior, bodies, social life and aspects of the environment. Councils, organizations, and community groups are starting to use a variety of sensing kits, from webcams to CO2 monitors, to discover more about things that were previously difficult to track, including local pollution levels, animal movements and crowd density; individuals are also increasingly tracking their health and wellbeing through an assortment of off-the-shelf, self-monitoring devices and apps. However, despite the ubiquity of data, much of the collected data is 'black box' in nature, meaning that users have to take what is presented at face value. They typically do not know how the data are derived, how accurate the data are or what is actually measured.

Furthermore, many of the representational formats used to show the data are either a simple snapshot view or an overly complex information visualization. Existing data formats are often repurposed to make 'busy' dashboards without much thought going into their usability or usefulness. While statisticians and experts in data analytics can understand the graphics, they often fail to communicate what they mean effectively and efficiently to other users, especially the general public [1,2]. As a result, they can be difficult to draw inferences from and understand their significance. What is needed are better informed designs that are easy for the wider population of non-specialists to understand and make sense of in analyzing data or reading information visualizations.

We propose a Human-Data design approach, in which information visualization is better suited to match data

formats that align with the expectations, needs and understanding of the public. Empowering the public to create, elicit, represent and combine different data streams will enable them to better experience and understand the data and invoke new engagement and discoveries about themselves, their social circle and the environment. To achieve this vision of a new shared understanding of data, based on input, experience and engagement of the public, we work on designing novel physical forms of interactive representations that depict and juxtapose data streams that are intended to be placed in public places, such as foyers, libraries, parks, squares and reception areas in public buildings.

Previous research has shown that the affordances and physicality of real physical artifacts, such as seen in **Figure 2**, can influence and affect the intention, engagement and experience in public interactive setups [3,4]. By designing tangible curiosity invoking reactive ways to elicit and represent data, we can encourage the public to interact and discover the meaning and implications of the data, thus, empowering them to make decisions on how to use and leverage the data to improve their lives and environment.

The fundamental question in this, is *how* we can design and deploy these physical representations of data so that they can be interacted with, shared, compared and blended in meaningful and insightful ways. In our proposed work, physical forms of multiple data streams will be combined to experience and interact with different combinations of input/output. In our work, we aim to:

1. lower the bar for more people to take part in sensing and making sense of data;



Figure 1: Curiosity objects uses their physical appearance and affordances to invoke curiosity and elicit interaction with public installations [2].



Figure 2: VoxBox provides tangible interfaces that allow users to input data through physical interaction [3].

2. increase people's creativity by making the data more suggestive of what can be done with it; and
3. allow for new ways of sharing environmental and other data in public spaces.

Ongoing Research

The human-data design approach revolves around supporting end users in (i) creating, (ii) curating and combining, and (iii) visualizing data through ephemeral interfaces and physical interaction.



Creating and Inputting Data

In prior work [3], we explored how users can express their opinion on a wide range of topics in situ at an event through playful and engaging interaction with a tangible system. This approach demonstrates how tangible physical interfaces can elicit user engagement and provide users with a playful interface to input data. We are currently exploring how these type of approaches can be extended to combine subjective perceptions of users with readily available data sources from the many sensors available nowadays that measure aspects of the environment. This approach aims to juxtapose objective data, such as CO₂, noise, temperature, oxygen levels, or animal sounds, with subjective data, such as perceived warmth, happiness, physical activity, emotions and social activity. This juxtaposition will help users understand what is happening and how these events influence their lives, social activity and environment.

Curating and Combining Data

Once data sources are available, we aim to provide users with physical interfaces that allow them to combine, curate, discuss and organize data themselves to build a better understanding of what the data means, and how data change and react when interacting and integrating with other data sources. Current interfaces designed for this type of end user interaction with complex data sets are mostly not understandable or useable. Again, we aim to provide users with public physical interfaces that allows them to use their own mobile devices in a public installation to collaboratively combine, build and understand data visualizations.

Visualizing and Physicalizing Data

Direct sensory experiences are often a better and more explicit way to translate information. Citizens of Beijing, for example, are physically exposed to smog and smell on a daily basis, which dramatically amplifies their understanding of the severe impact of air pollution on their daily lives. We can leverage the fact that human sensory experiences are a powerful medium to translate and externalize data to create a direct experiential understanding. Physicalizations can employ volatile temporally constraint mechanisms to visualize data sources and support users in creating an understanding about data and their impact, based on social experiences in public settings. These type of Ephemeral interfaces [5] use digitally augmented transient, physical and natural materials such as water, smoke, sand, vibrations, air and others sources to create tangible, sonic, and haptic input and outputs to explore and experience data. These interfaces allow users to shape and transform data through physical interaction.

Challenges

Enticing the public interest: how can we design public installations that entice users to interact with physical representations of data? How can we evoke curiosity with users and convince them to participate in the collection and curating of data sources?

Designing Ephemeral interfaces: how can we design ephemeral user interfaces and physical artifacts that employ transient materials and digital augmented shape changing properties to provide users with experiences that help translate data into a better and shared understanding? How can users interact with, shape and influence these ephemeral interfaces through bodily and natural interactions?

"In the wild": how can we deploy, test and evaluate these physical interactions with data in real "in the wild" to get a better understanding on how these interfaces would be used in real world settings? How do we engage a community or group to explore, use and share the interaction with these public installations?

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