Designing Data Visualization and Crowdsourcing Systems in Community-based Citizen Science

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Abstract

Citizen science forges partnerships between experts and citizens through collaboration and has become a trend in public participation in scientific research over the past decade. While public participation has been applied to science education, researchers recently noticed that this strategy can contribute to participatory democracy, which empowers citizens to advocate for their local problems. Such strategy supports citizens to form a community, increase environmental monitoring, gather scientific evidence, and tell convincing stories. Researchers believe that this community-based citizen science strategy can contribute to the wellbeing of communities by giving them power to influence the general public and decision makers.

Community-based citizen science requires collecting, curating, visualizing, analyzing, and interpreting multiple types of data over a large spacetime scale. This is highly dependent on community engagement (i.e. the involvement of citizens in local neighborhoods). Such large-scale tasks require the assistance of innovative computational tools to give technology affordance to communities. However, existing tools often focus on only one type of data, and thus researchers need to develop tools from scratch. Moreover, there is a lack of design patterns for researchers to reference when developing such tools. Furthermore, existing tools are typically treated as products rather than ongoing infrastructures that sustain community engagement.

This research studies the methodology of developing computational tools by using visualization and crowdsourcing to support the entire community engagement life cycle, from initiation, maintenance, tracking, to evaluation. This research will make methodological and empirical contributions to community-based citizen science and human-computer interaction. Methodological contributions include detailed case studies with applied methodologies of information technology systems that are deployed in real-world contexts. Empirical contributions include generalizable empirical insights for developing visualization and crowdsourcing techniques that integrate multiple types of scientific data.

In this proposal, I first define community-based citizen science and explain corresponding design challenges. Then, I review existing computational tools related to this research. Next, I present two completed works: Time Engine and AirWatch Pittsburgh. Time Engine is a web-based timelapse editor for creating guided video tours and interactive slideshows from large-scale imagery datasets. AirWatch Pittsburgh is an air quality monitoring system which integrates heterogeneous data and computer vision to support forming scientific knowledge. In addition, I propose two works: Environmental Health Engine and Smell Pittsburgh. Environmental Health Engine is a visualization and exploratory analysis platform for creating environmental sensing and health data narratives. Smell Pittsburgh is a mobile crowdsourced application for reporting and visualizing pollution odors. I also propose conducting case studies to derive typology about using tools to support community engagement. Finally, I propose organizing insights from all four works and case studies into design patterns, which serve as rubrics for future researchers.