THE ROBOTICS INSTITUTE

THESIS DEFENSE

Designing Interactive Systems for Community Citizen Science

Monday, June 4, 2018

4405 Gates Hillman Center

1:00 p.m.

Thesis Committee:

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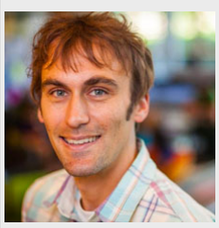

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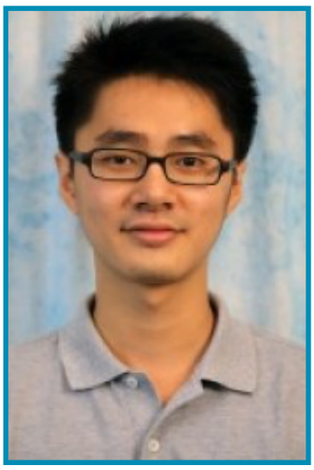

Yen-Chia Hsu

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. Besides this trend, public participation can also contribute to participatory democracy, which empowers citizens to advocate for their local problems. This strategy supports citizens to form a community, increase environmental monitoring, gather evidence, and tell convincing stories. Researchers believe that this "community citizen science" strategy can contribute to the well-being of communities by giving them the power to influence the general public and decision makers.

Community 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 data visualization, crowdsourcing, and machine learning techniques to support the entire community engagement lifecycle, from initiation, maintenance, to evaluation. This research will make methodological and empirical contributions to community citizen science and human-computer interaction. Methodological contributions include detailed case studies with applied techniques from information technology systems that are deployed in real-world contexts. Empirical contributions include generalizable empirical insights for developing interactive systems that integrate multiple types of scientific data.

In this thesis, I first define "community citizen science" and explain corresponding design challenges. Then, I review existing computational tools and techniques that are related to this research. Next, I present four interactive systems centered around the research scope: (1) a timelapse editor that supports building evidence-based narratives, (2) an air quality monitoring system that integrates heterogeneous data and computer vision to support the formation of scientific knowledge, (3) a visualization tool that reveals the impact of oil and gas development, and (4) a mobile crowdsourced application for reporting and visualizing pollution odors. Finally, I synthesize findings from all four works into generalizable design implications for future researchers and developers.