

Empowering Environmental Justice Communities with Smart and Connected Technology: Air and Noise Pollution, Wellbeing, and Social Relations in Times of Disruption

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IRG-1 – FY2020

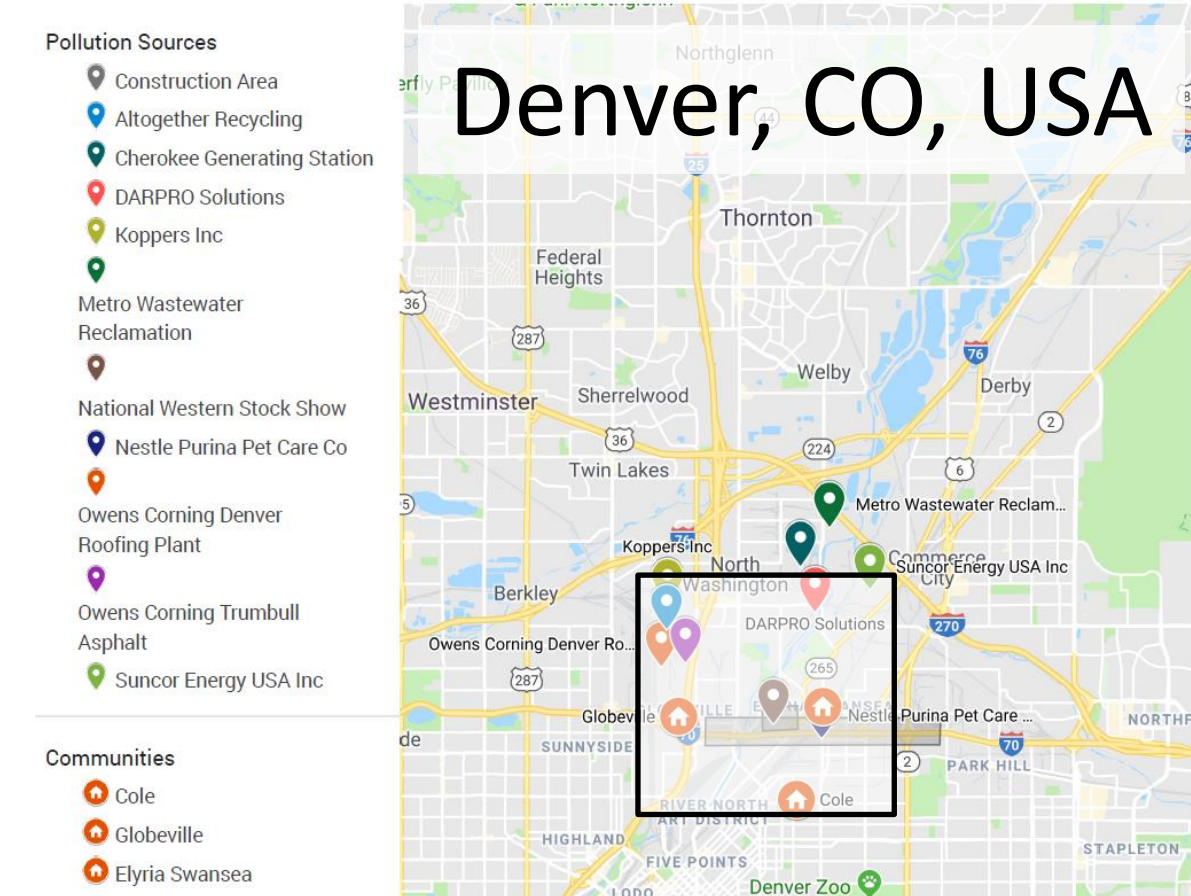
Motivation: Construction-related disruptions impact air and noise pollution and mobility in North Denver neighborhoods of **Globeville, Elyria-Swansea, Cole, and Clayton**

Air and Noise Pollution Sources

- Oil refinery
- Pet food manufacturing
- Asphalt production
- Vehicle traffic
- Industrial emissions

Construction Disruptions

- Central I-70 reconstruction
- National Western Complex redevelopment/expansion
- Neighborhood redevelopment



Multidisciplinary Community Engagement in Environmental Justice Research

Engineers, computer scientists, and social scientists collaborating to understand how to best engage with community organizations to:

- Provide value to the community through research;
- Educate the community through research and outreach;
- Conduct citizen science research;
- Inform future policy decisions to benefit the community.

Research Organizations



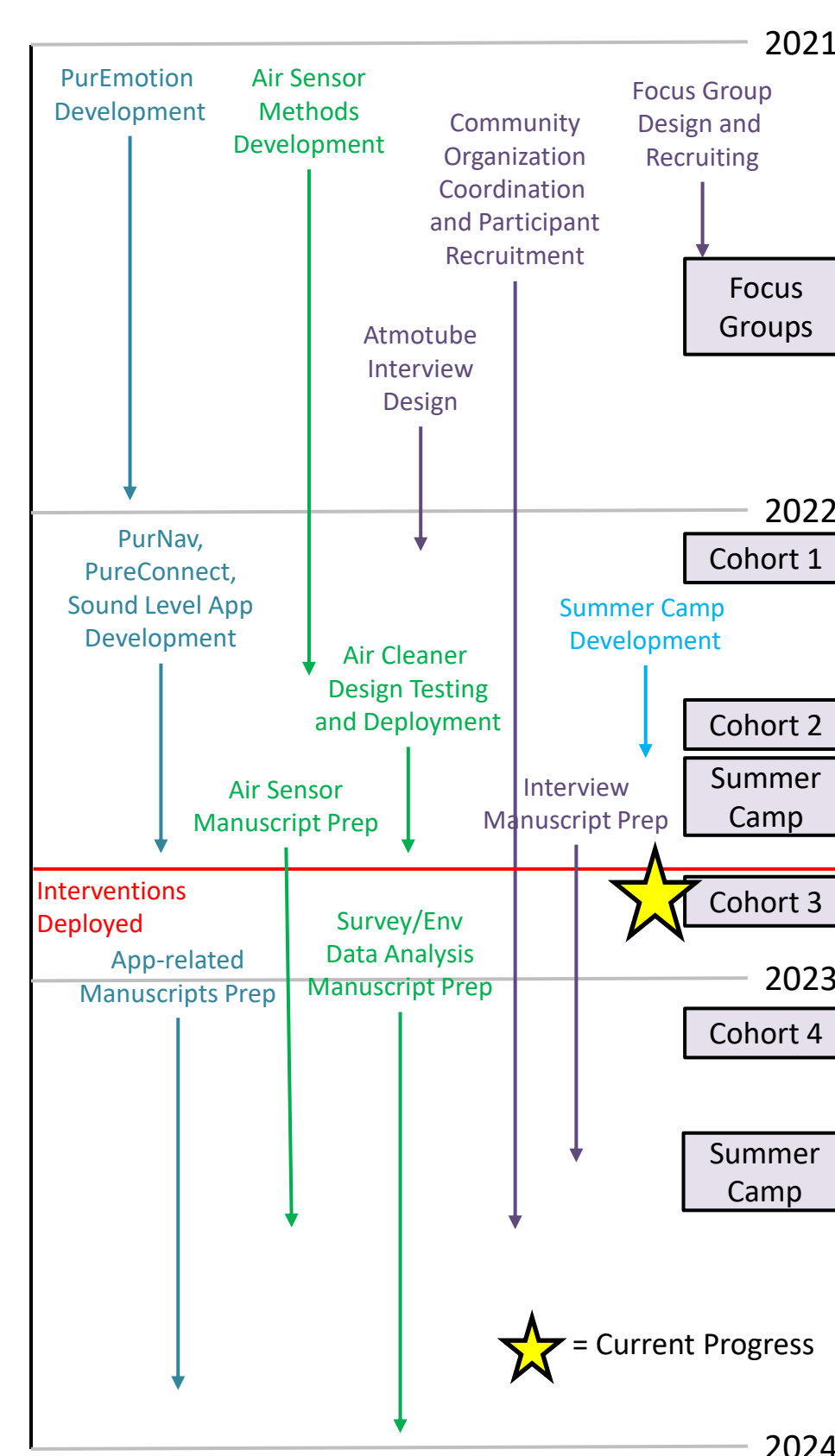
Community & Government Organizations



Research Study Design

Study Goals

1. Understand the impact of construction-related disruptions on the air and noise pollution exposure and mobility in an environmental justice community.
2. Mitigate the negative impacts of construction-related disruptions through introduction of: (a) **PureNav**, an app to help participants move around the community, (b) **PureConnect**, an app to connect participants on a common forum, and (c) **air cleaners** in residences.
3. Conduct outreach in the community, including regular dissemination of results and insights and running summer camps for middle school students.

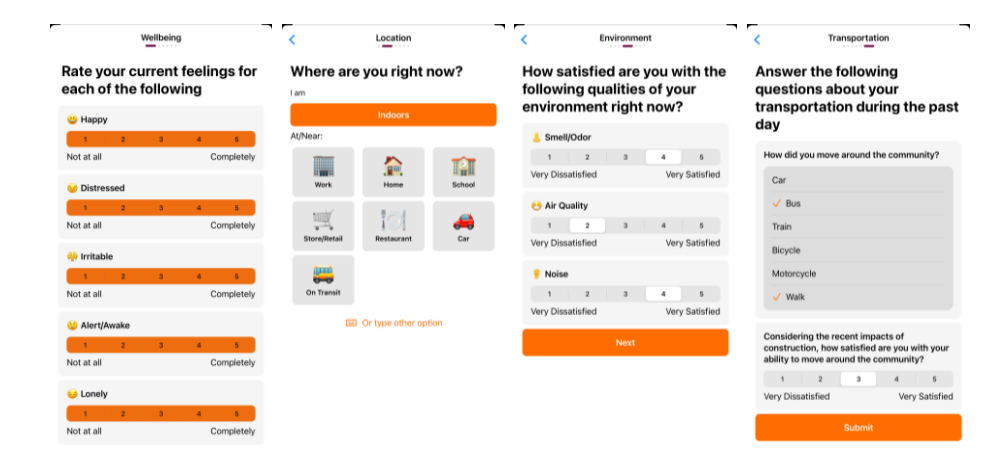


Research Methods

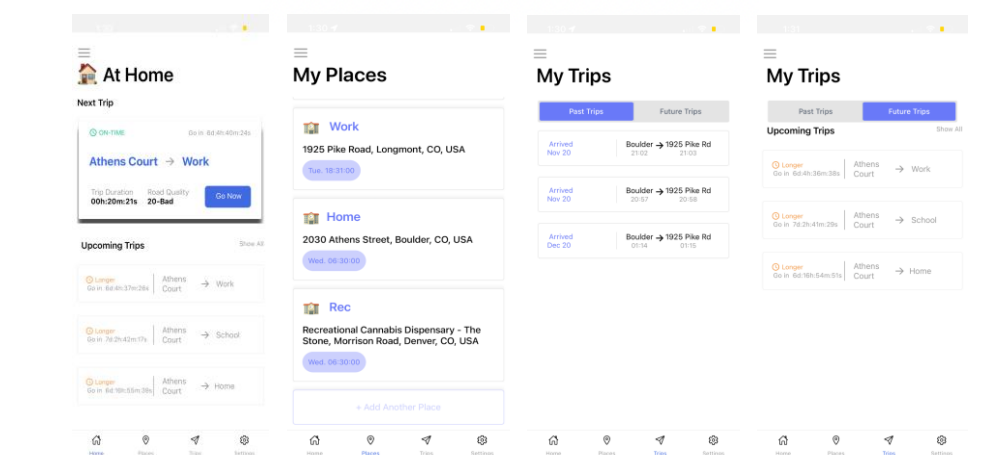
- **Focus Groups:** 32 participants, summer 2021
 - Goal: To understand the community's local knowledge and concerns regarding the interstate reconstruction and neighborhood development projects
- **Field Study:** 120+ participants/cohort, 4 cohorts each a month long, started summer 2021 and running 1.5 years until spring 2023, interventions deployed for last 2 cohorts
 - **120+ Participants:** Long-form survey of health and well-being, PurEmotion app for daily ecological momentary assessments on well-being, environmental quality, and transportation acceptability
 - **Subset of 50 Participants:** Wear a personal air pollution sensor (Atmotube Pro) daily and install a carbon monoxide sensor in their home
 - Atmotubes are calibrated at monitoring sites in the community
 - Interviews are conducted after each cohort to understand experience of Atmotube users
 - **Subset of 5 Participants (cohorts 3 and 4):** Noise monitor installed in their home
 - **Intervention, cohorts 3 and 4:** PureNav and PureConnect apps introduced to all participants and DIY air cleaners provided for all participants' residences



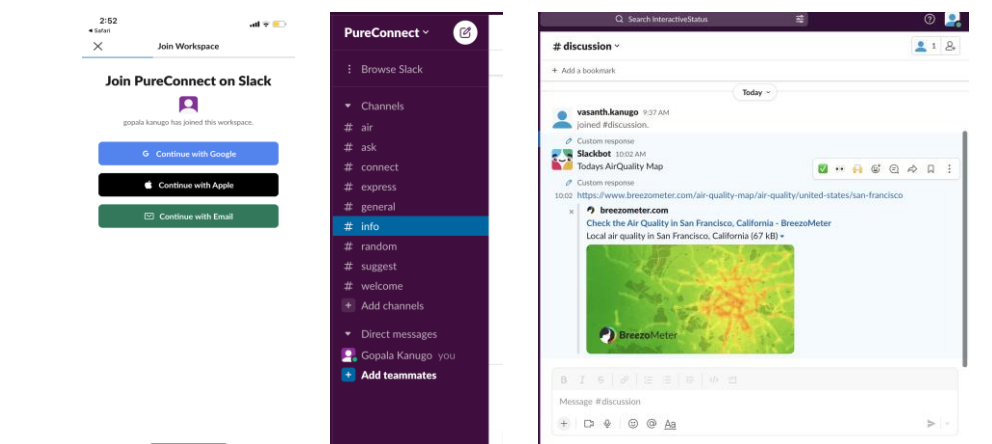
Puremotion



PURENAV



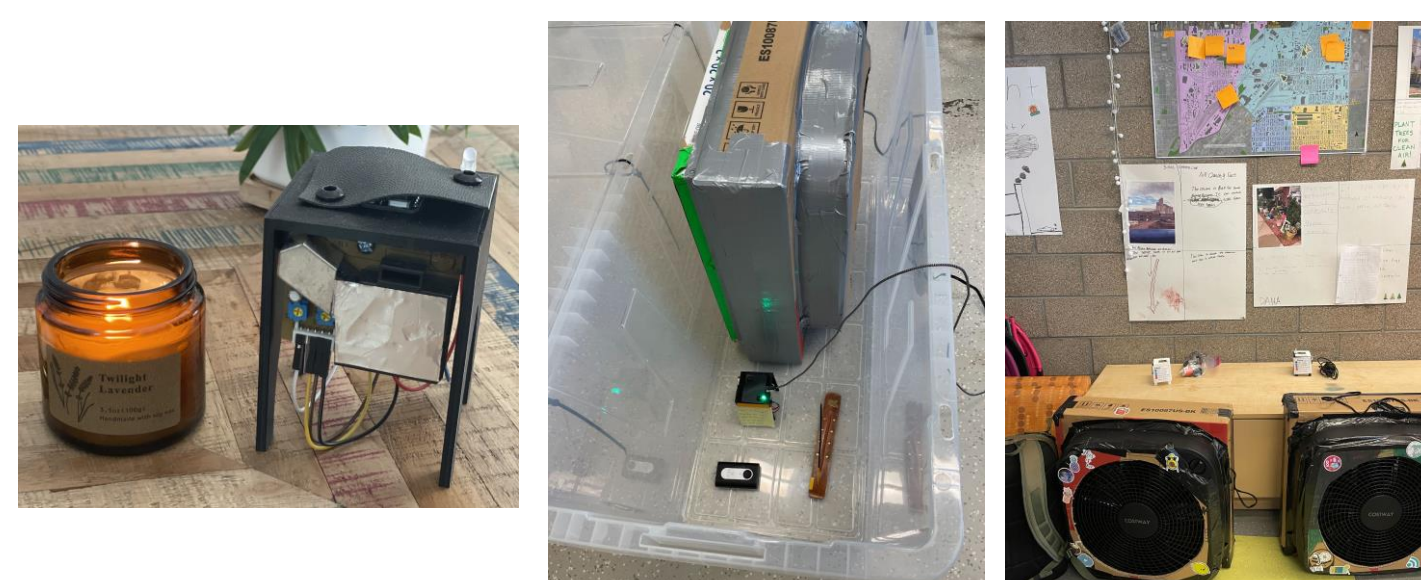
PureConnect



Broader Impacts

Community Engagement

- **Groundwork Denver:** Hired two community connectors to assist with outreach, recruiting, and field study deployments.
- **GES Coalition, GrowHaus, EOC Colorado, and many others:** Assisting with community outreach, recruiting, and sharing 1-page study summaries.
- **Research Advisory Board:** Met in June 2022, includes professors from computer science, public health, and engineering



Summer Camp Educational Outreach

- 10 middle school students from North Denver neighborhoods enrolled in 2022 summer camp
- Topics included: environmental justice, air pollution, mapping, and policymaking
- Students each built and tested their own air sensor and air cleaner

Project Progress and Next Steps

Focus Groups: Completed in Summer 2021, manuscript is in prep, presented a AAAR2021 conference

Field Study:

- **Puremotion App Development:** Completed in summer 2021, conference paper submitted to CHI2022
- **Cohorts 1 and 2:** Completed in Jan/Feb and June/July 2022, manuscripts in prep on air pollution sensor calibration and exposure data and air pollution sensor interviews, air sensor data presented at Indoor Air 2022 and AAAR2022 conferences
- **PureNav and Pure Connect Development:** Completed summer 2022
- **DIY Air Cleaner Design Optimization:** Testing completed summer 2022, manuscript is in prep
- **Cohorts 3 and 4:** Planned for Oct/Nov 2022 and Feb/Mar 2023, intervention apps and air cleaners will be provided to all participants

Outreach:

- **Summer Camp #2:** Planned for summer 2023, will incorporate assessment feedback
- **Community Engagement:** Continue to grow connections with local organizations and provide study results in the form of 1-page study summaries: focus group results, prior odor studies, air sensor results



Project Team

- CU Boulder, Mechanical Engineering**
- Prof. Shelly Miller
 - Dr. Nick Clements
 - Aniya Khalili + Undergrad Team
- CU Boulder, Computer Science**
- Prof. Shivakant Mishra
 - Omar Hammad + MS/Undergrad Team
- CU Denver, Sociology/Health & Behavioral Sciences**
- Prof. Esther Sullivan
 - Marisa Westbrook + MS/Undergrad Team
- Groundwork Denver**
- Cindy Chang, Erika Delzell, and Rey Gallegos

