

A Secure, Trustworthy, and Reliable Air Quality Monitoring System with Low-cost Sensors for Smart and Connected Communities

Haofei Yu¹; Xinwen Fu^{2,1}; Deliang Fan^{3,4}; Kelly Stevens¹; Thomas Bryer¹

¹University of Central Florida; ²University of Massachusetts Lowell; ³Arizona State University; ⁴Johns Hopkins University

Project URL: <https://cece.ucf.edu/AirQualityProject/> Network: <http://www.stairnetwork.org/>

Introduction

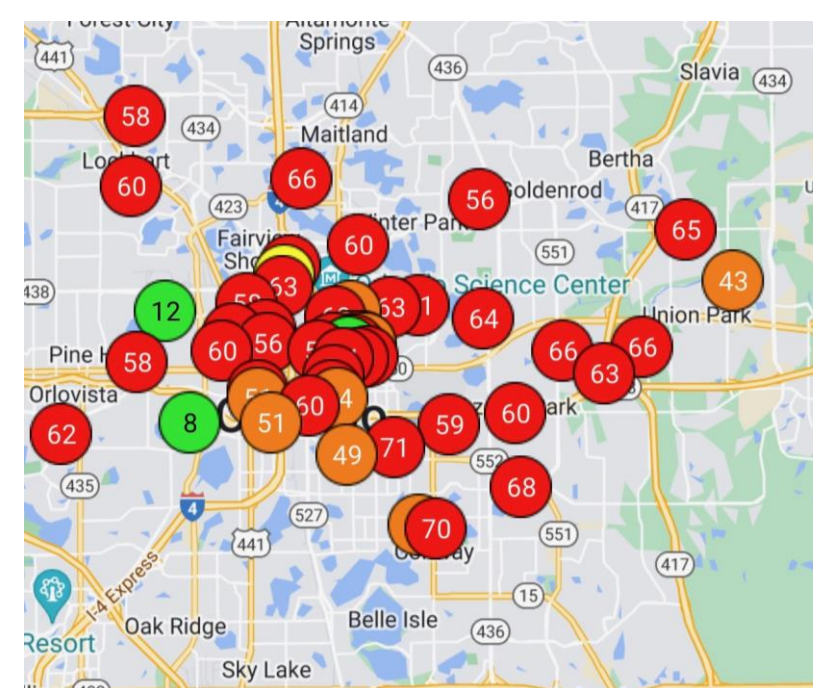
- Public administrators and researchers need to incorporate evidence and data into environmental decision-making
- We are establishing a secure, trustworthy and reliable air quality monitoring network in Orlando to better inform air pollution management strategies

Key Challenges

- **Sensing quality.** Unpredictable performance of low-cost sensors
- **IoT security.** Cyber security rarely considered
- **Data quality.** Noisy, mixed-labelled, or even compromised data
- **Citizen efficacy & trust in governance.** Disadvantaged citizens are often impacted the most by air pollution, but often feel neglected

Scientific Impact

- Generalizable approach for improving sensing quality of low-cost sensor
- Secured environmental IoT
- Sensor big data & machine learning based environmental prediction
- Further understanding and improve governance



Fire impact on air quality



Sensor at one home



Sensor testing at community center



Community meeting



Air quality slogan contest winner at local high school

Technical Approach and Intellectual Merits

- **Sensing quality**
 - Air quality models + multi-sensor system for remote sensor calibration, drift correction and malfunction detection.
- **IoT security**
 - Trustworthy monitoring devices based on Arm TrustZone
- **Data quality.** Air quality prediction model based on a two-stage semi-supervised deep learning framework over noisy data
- **Citizen efficacy & trust in governance.** A four-stage data accessibility framework to measure inclusion and trust of local government

Broader Impact

Education & Outreach

- Incorporated outcomes into courses across multiple disciplines
- Provide research & educational opportunities for college and K-12 students
- Train cybersecurity workforce for critical cyber infrastructures and environment

Assessment

- Increased participation of women and URMs in computing related majors and existing computing related K-12 outreach programs
- Recruitment of women and URM undergraduate students in this research project.

Society

- Help reduce exposures of sensitive population
- Provide key resources for local regulators to design mitigation plans on air pollution
- Assist with tracking the effectiveness of the City's current sustainability practices
- Educate public on the City's sustainability efforts

