SCC: Smart Water Crowdsensing: Examining how innovative data analytics and citizen science can ensure safe drinking water in rural versus suburban communities

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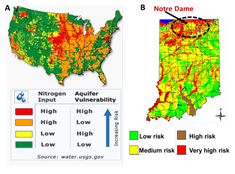
Project Vision:

- Develop a citizen science based Smart Water Crowdsensing (SWC) framework using interdisciplinary approaches
- Promote public health and increase the resident awareness of drinking water quality in private well dependent communities

Community-identified Problem:

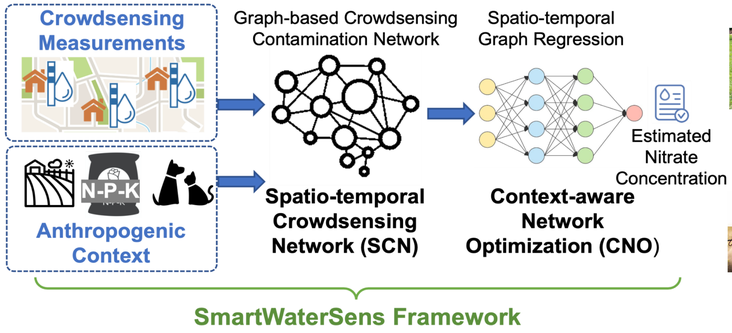
- Northern Indiana has been identified as a hotspot for groundwater nitrate contamination.
- Community Partners:
  - St. Joseph County Environmental Health Department
  - Penn-Harris-Madison School Corporation

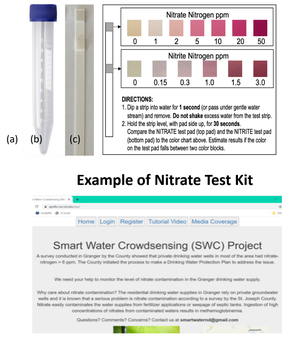


Intellectual Merit:

- Technological:
  - It is feasible to obtain reliable crowdsensing data on drinking water contamination using unreliable crowd sensors for community level well water monitoring.
- Social:
  - By comparing different community types (suburban, urban, and rural), it is found that the socio-demographic qualities may fluence crowdsensing participation and data quality.

Project Activities:





Lanyu Shang, Yang Zhang, Quanhui Ye, Na Wei, Dong Wang. SmartWaterSens: A Crowdsensing-based Approach to Groundwater Contamination Estimation, IEEE International Conference on Smart Computing (SMARTCOMP 22), Espoo, Finland, June, 2022. (Best Paper Candidate)

Method	MAE	MSE	RMSE	R^2
SmartWaterSens	**0.4875**	**0.4897**	**0.6997**	**0.3518**
NCE	0.9173	2.8777	1.6963	-0.2119
ELR	0.7496	1.6465	1.2831	-0.1533
NCRA	0.5451	0.6503	0.8064	0.2793
GWR	0.7703	1.0251	1.0125	0.1562
AVI	0.7118	0.7169	0.8467	-0.0864
BNN	0.7444	0.8655	0.9303	-0.1834

Table II: Nitrate Concentration Estimation Performance

Method	MAE	MSE	RMSE	R^2
SmartWaterSens	**0.4875**	**0.4897**	**0.6997**	**0.3518**
SmartWaterSens\S	0.5849	0.5273	0.7261	0.3301
SmartWaterSens\T	0.5315	0.5017	0.7071	0.3363
SmartWaterSens\C	0.5006	0.5078	0.7125	0.2809

Table III: Ablation Study

Results showed that our SmartWaterSens model outperforms all the baselines by achieving the least estimation error. The ablation study shows the incorporation of spatial and temporal correlations and context improves the performance of SmartWaterSens.

Broader Impact:

- **Community education on groundwater contamination and protection:** The team organized Family Science Night event that provided hands-on aquifer model exploring groundwater and contamination. Nearly 300 visitors attended the event.

Broader Impacts (cont'd):

- **The SWC project empowered the residents with knowledge to protect their own water and potential strategies to mitigate health risks.**

Pre- and post-surveys and focus group meetings with crowdsensing participants showed that participation in the SWC crowdsensing experiment could improve their knowledge on groundwater quality and protection.

Next Steps:

- The team will further improve the generality of the data analytic models and SWC framework and study the robustness of our models using both real-world and synthetic datasets.
- The team will study the sustainability of our SWC framework in our pilot study communities and discuss how to scale them into other communities with similar underground water contamination problem.
- The team will conduct surveys with participating school teachers to evaluate the educational impacts of the SWC projects and to understand factors to help engage participants through school systems.

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