Towards a Citizen Science Pb Monitoring Program

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Introduction

Lead contamination of drinking water is a potential issue for millions in the US. Current analytical approaches are resource intensive and most Pb testing is (very) infrequent. Some utilities lack full transparency, and results may not be available to public.

Pb testing strips are available to allow a consumer to test the lead levels coming from a tap. However, results may be difficult to interpret, are not publically available and only provide a binary level of information. We propose that results from these strips can be leveraged by using computer vision and the citizen science community (see Figure 1).

***Figure 1**: CitizenSpring Concept Diagram*

Methods

- DI and tap water matrices spiked with Pb(II). Concentrations confirmed via GFAA.
- Exposed Pb test strips to spiked samples following manufacture's directions. Strips then scanned.
- MATLAB algorithm developed to quantify pixel value across scanned strip lines
- Algorithm results compared to human-eye evaluation and actual Pb concentration.

Results

***Figure 2**: 5 ppb Test Strip*

***Figure 3**: 15 ppb Test Strip*

***Figure 4**: 100 ppb Test Strip*

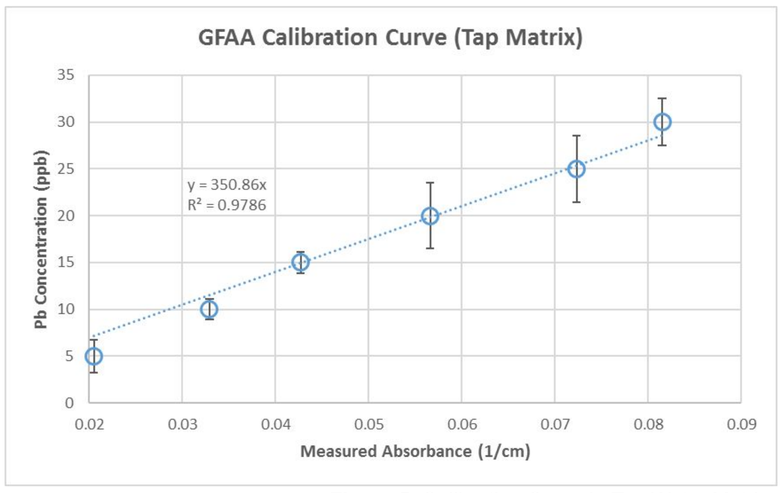
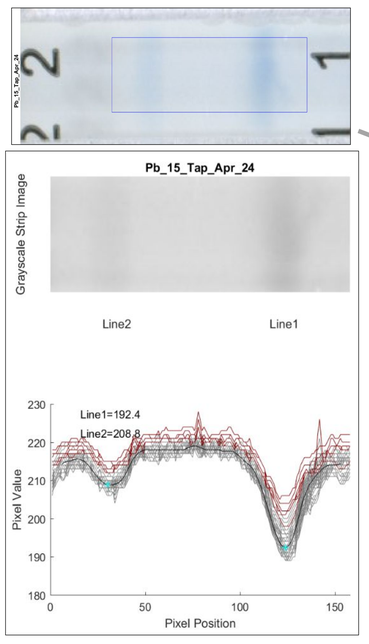


***Figure 5**: Calibration Curve in Tap Water Matrix*



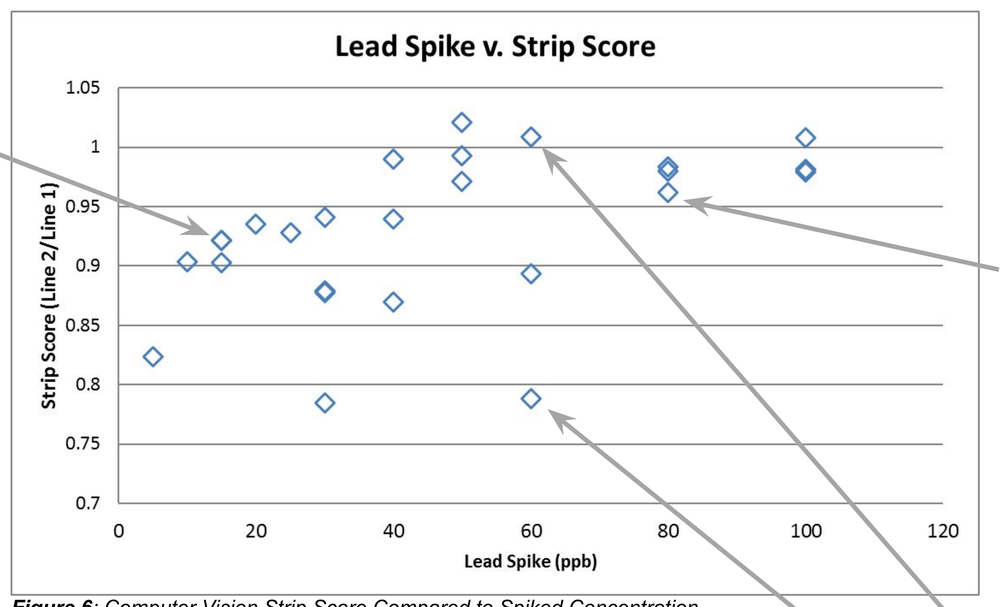
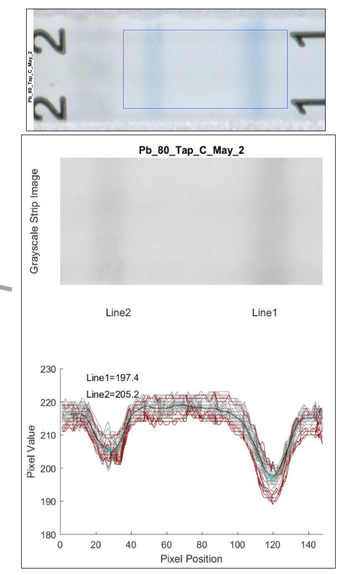


***Figure 6**: Computer Vision Strip Score Compared to Spiked Concentration*



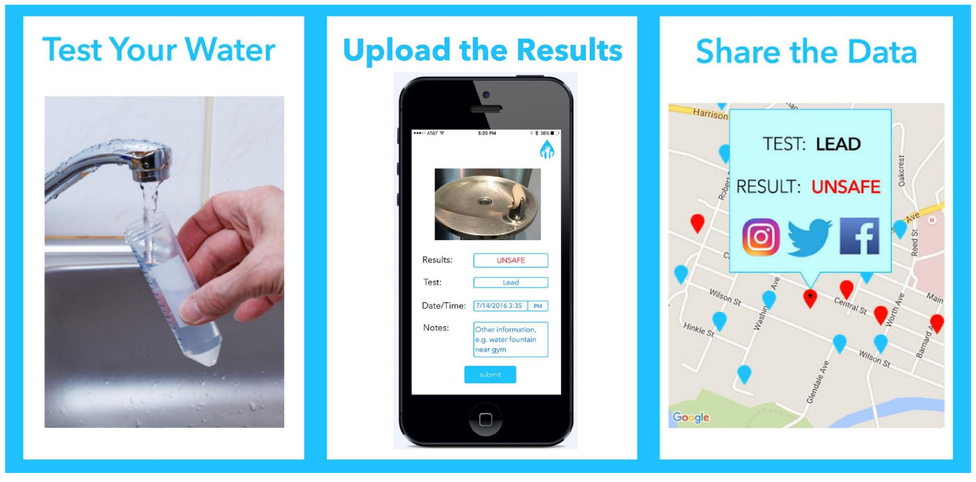
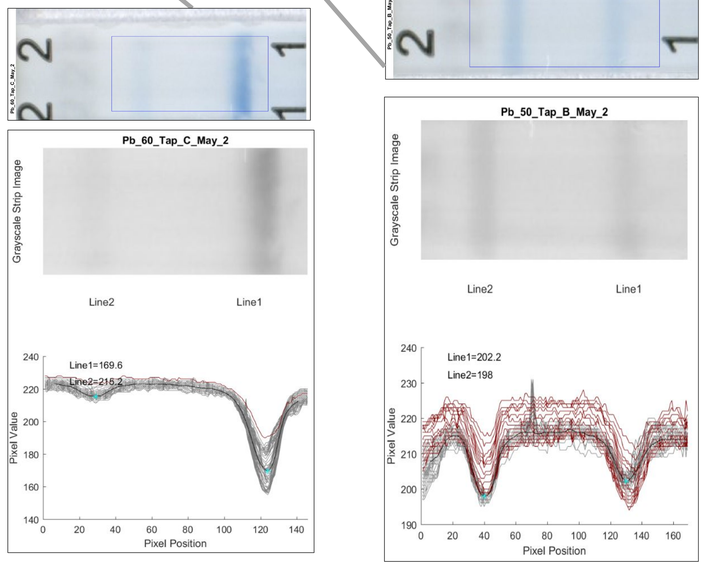


***Figure 7**: The CitizenSpring Mobile Application*



Conclusions

- MATLAB code successfully reads strip
- Computer vision much better than human eyes
- Strip results tend to under represent Pb level (for this specific study water). Also significant variability.
- Much more testing needed
- Other solutes impact strip performance (DI v. tap)
- Mobile application may substantially reduce testing cost and enable optimization of Pb analytical resource deployment

Future Directions

- Additional testing on varied water quality matrices
- Port MATLAB to OpenCV, and finish mobile application development
- Create backend database
- Surrogate parameters (iron, copper, etc.)
- Assess ways to overcome strip limitations

Study Tap Water Quality		
Parameter	Value	Units
pH	7.5	na
Temp.	21	Cel
Cond.	385	µS/cm
Manganese	0.02	mg/L
Iron	0.09	mg/L
Free Chlorine	0.2	mg/L
Alkalinity	127	mg/L $CaCO_3$

***Table 1:** Tap water quality parameters*