Crowd Sourced Environmental Monitoring

SenSIP Algorithms and Devices REU

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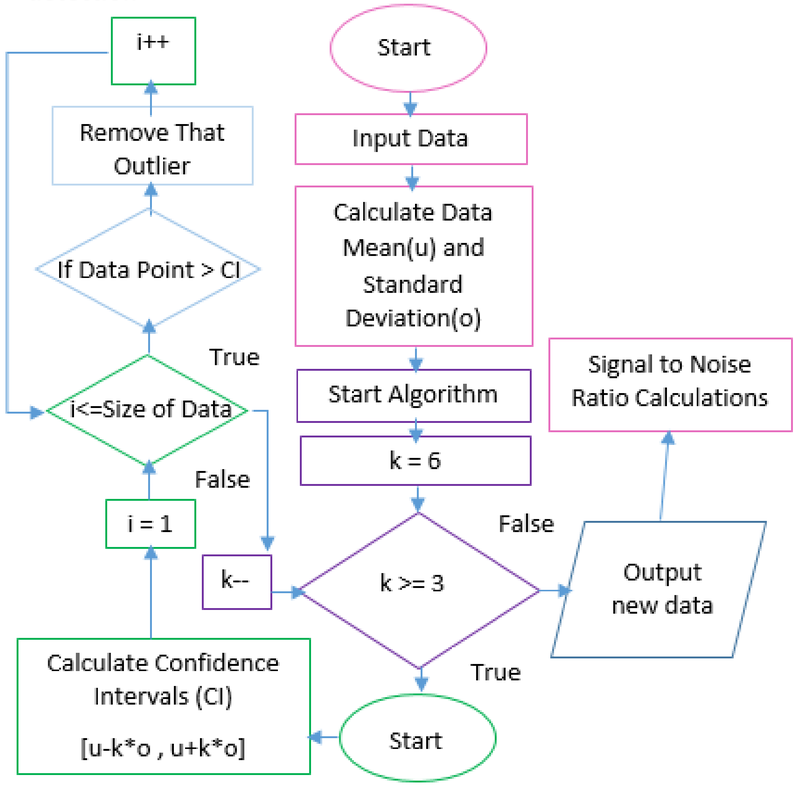
ABSTRACT

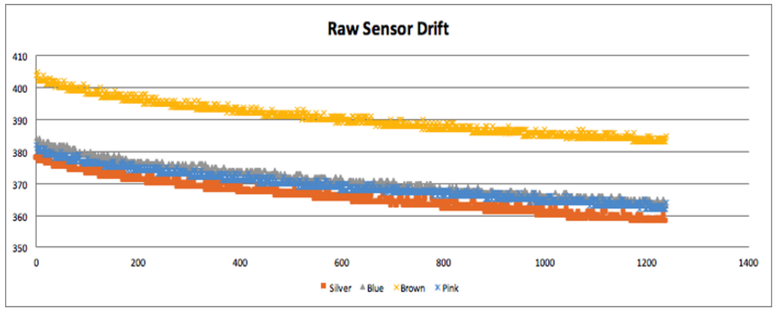
- Create a fine-grained pollutant map from crowd-sourced data using cheap wearable sensors
- Constantly collect/process sizable amounts of environment data
- Achieve reliability using a large number of sensors
- Mobile devices perform most computations
- Proposes an algorithm to increase SNR by averaging and outlier detection



Flow Chart : It explains the initial approach to removing outliers before going into Signal to Noise (SNR) Calculations. k is the confidence level. The algorithm will iterate through each k*o or k-sigma from the mean to make removals. k can be adjusted but no wider than 12 and no less than 3. Matlab is used during this process.

MOTIVATION

- Efficient algorithm: low computation power for affordability
- Accuracy and efficiency
- Public Pollutant Map



Ozone Graph: Roughly displays 4 ozone sensor drift. When developing an algorithm taking into account other factors of outliers are important. Eventually, the algorithm can determine if a node needs to calibrate or replacement.

PROBLEM STATEMENT

- Use cheap and inherently unreliable sensors, collect data from many nodes, and ensure reliability through post-processing.
- Challenges:
  - Lack of control over nodes.
  - Data fusion for pollutant mapping
  - Inaccuracy and sensor drift
  - Correlating with spatiotemporal awareness

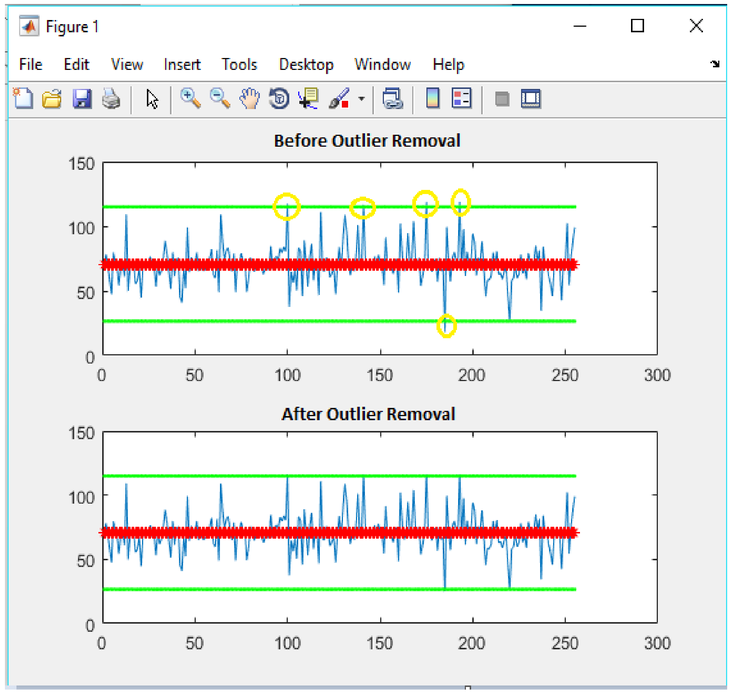
METHODS

- Understanding and Adjusting Arduino Code/Calculations
- Data Acquisition (Ozone and Particulate Sensors)
- Interpret Values and Discern Outliers
- Create Confidence Interval Iteration to Remove Outliers
- Calibrate Matlab Code to Ensure Accuracy
- Calculate Signal-to-Noise Ratio

RESULTS

Confidence Interval Approach

- Initial Removal of Sensor Warm-Up Value
- Removal of Obvious/Unobvious Outliers
- Understanding Signal to Noise Ratio
- Found a Reasonable Sample Size of Large Data



Outlier Removal Graph: Randomly created data shown in blue, red is the mean of initial data, and green are CIs. Circled in yellow (before graph) are outliers. Graphed in Matlab.

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