Interactive Visualization of SILENCE Sensor Data

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Capstone Design Project under guidance of Prof. D. Pompili and PhD Student E.K. Lee

Objective

To create an interactive visualization tool for sensor data that will allow the user to view the sensor map, as well as:

•control the tradeoff between energy consumption and accuracy of the received sensor map by changing the parameters of the SILENCE algorithm

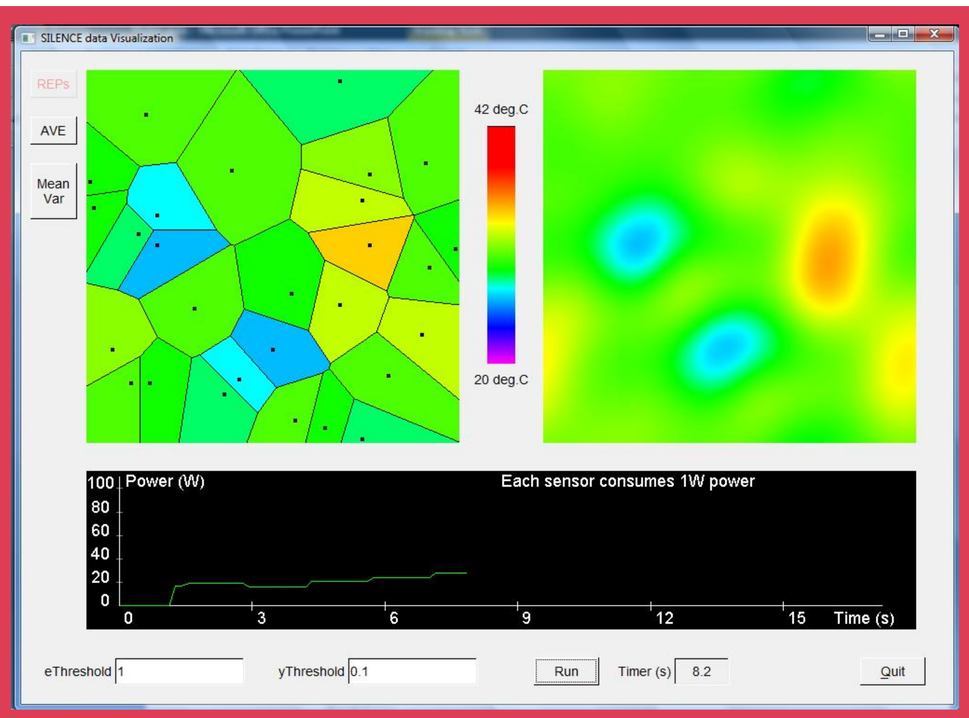
•monitor the energy consumption of the sensor system

•perform analytics on the received sensor data and visualize the analyzed data

Motivation

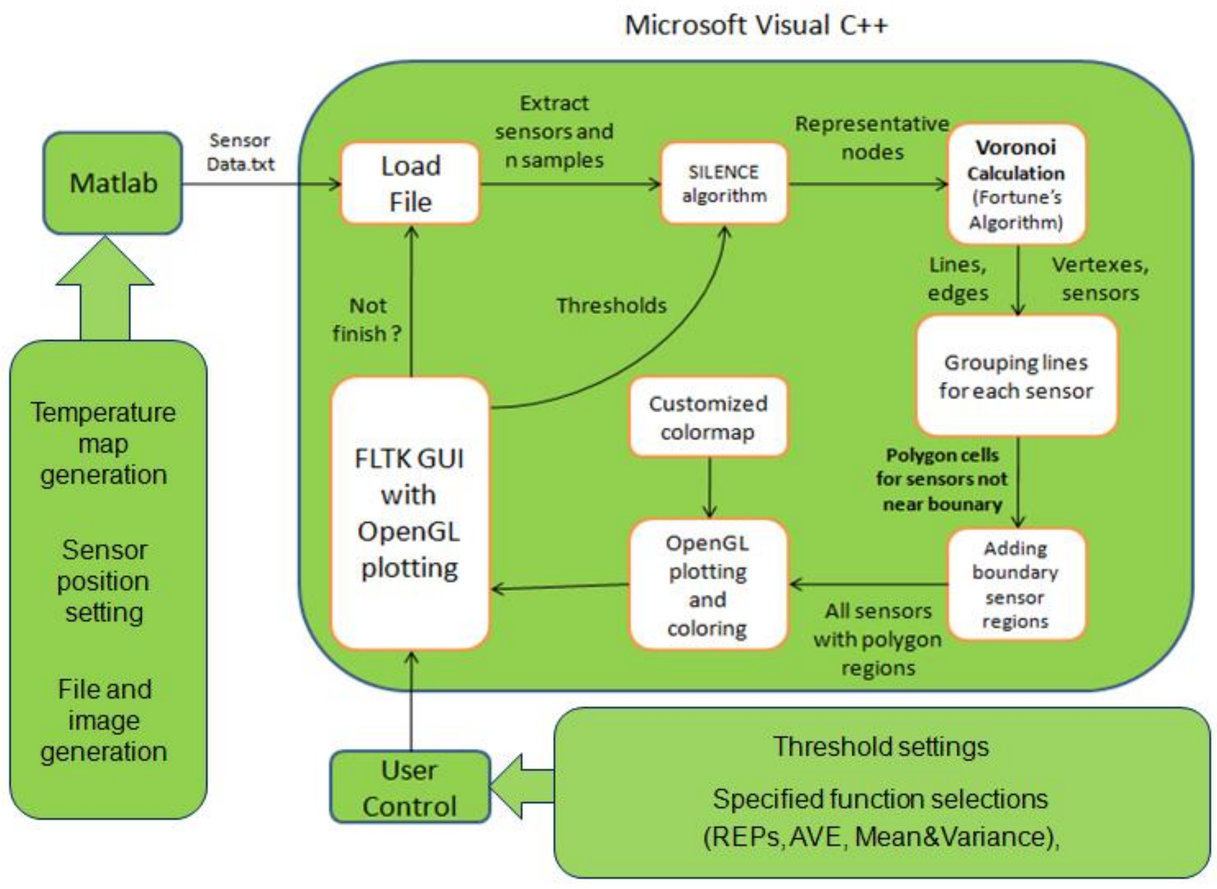
- Visualization of the sensor data allows a user to easily understand the useful information underlying the potentially large amount of values taken from the sensors
- It is also useful for one monitoring the sensor system to be able to control aspects of the sensors to optimize performance or meet criteria – with SILENCE, the tradeoff between power usage and map resolution may be controlled

Application



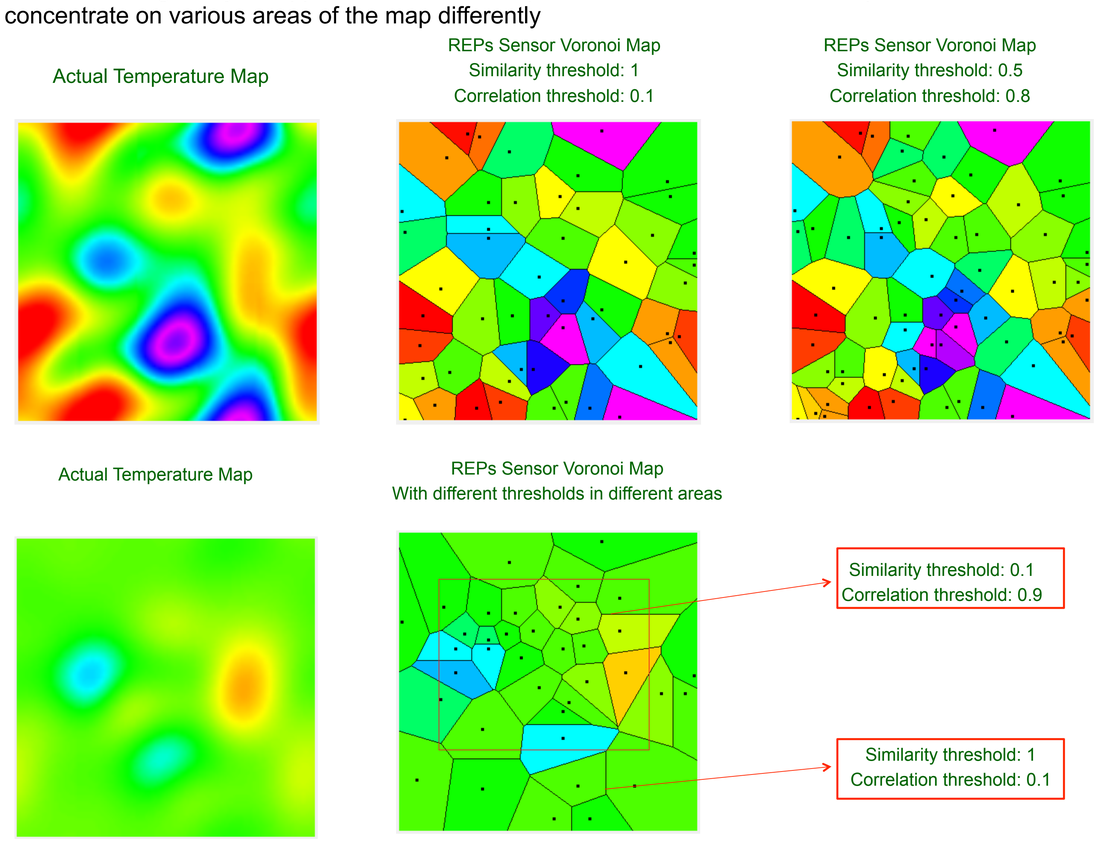
- On the left is the visualization of the received sensor map using a Voronoi Diagram
- On the right is the actual sensor map, for comparison with the received sensor map
- Energy consumption is tracked on the bottom over time
- Parameters of the SILENCE algorithm can be changed on the bottom

Methodology



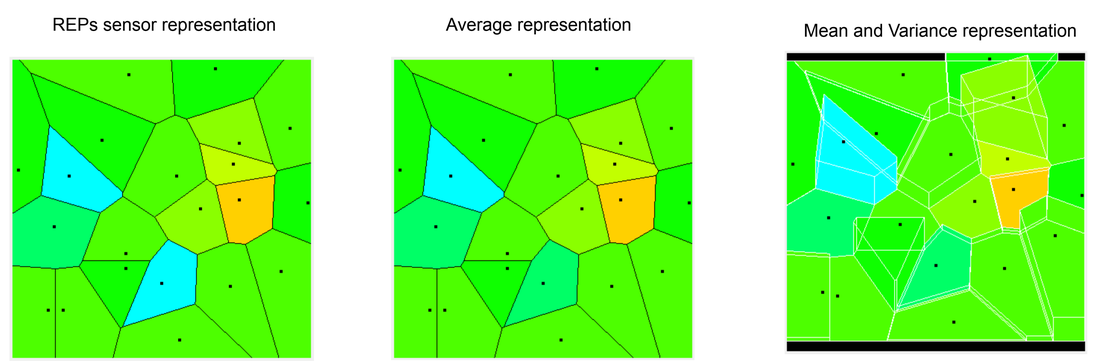
Controlling the Tradeoff between Map Resolution and Power Usage

- The simplified SILENCE algorithm used in this project selects representative sensors (REPs) to transmit data on behalf of surrounding sensors that have similar and correlated data (ASSOCs)
- With SILENCE, power is saved by reducing the amount of redundant data transmitted. However, the accuracy of the map constructed from received sensor data is decreased
- The user can optimize power conservation and map resolution to desired levels by adjusting the SILENCE parameters
- A threshold change may be applied to the entire map or to selected areas of the map to meet a user's need to concentrate on various areas of the map differently



Statistical Analysis

- REPs sensor representation: Map shows the temperature values of REPs sensors
- Average representation: Map shows the average values of REP sensor and its ASSOC sensors
- Mean and Variance representation: Map shows the mean and variance of REP sensor and its ASSOC sensors (color represents the mean value, and height represents the variance)



Future Work

- More statistical and quantitative analytical options
- Connect with actual sensor system in real time
- Automatic determination of proper thresholds for average power consumption
- Options for displaying the raw data for each REP cell

References

•E.K. Lee, H. Viswanathan, and D. Pompili, "SILENCE: Distributed Adaptive Sampling for Sensor-based Autonomic Systems," in Proc. of *IEEE/ACM International Conference on Autonomic Computing (ICAC)*, Karlsruhe, Germany, Jun. 2011

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