Applications of the Internet of Things (IoT) in Real-Time Monitoring of Contaminants in Air, Water, and Soil

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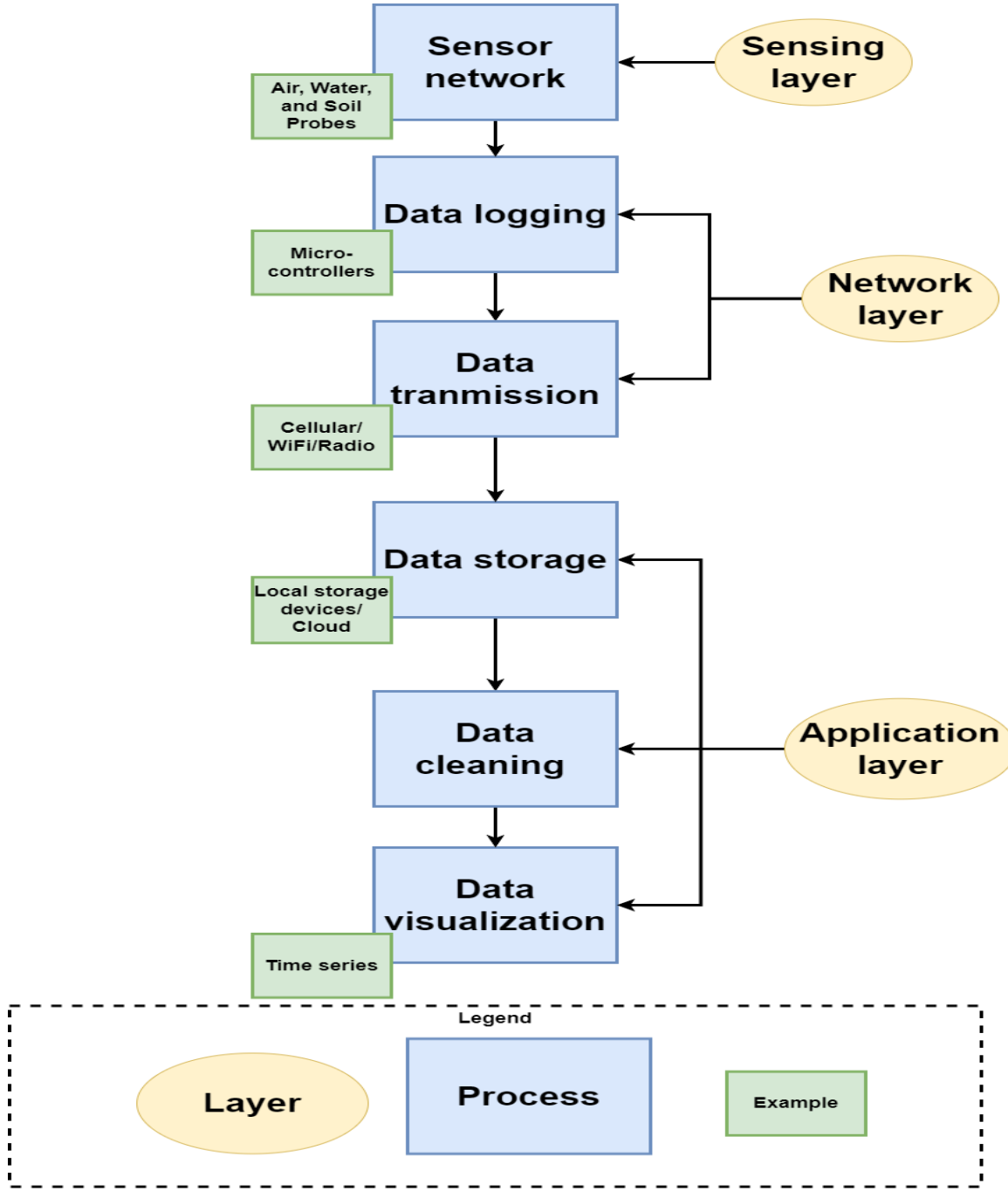
Introduction

- Excess production and manufacturing
- Maintaining natural resources for sustainable development is crucial
- Smart monitoring of Air, Water, and Soil is possible using IoT systems

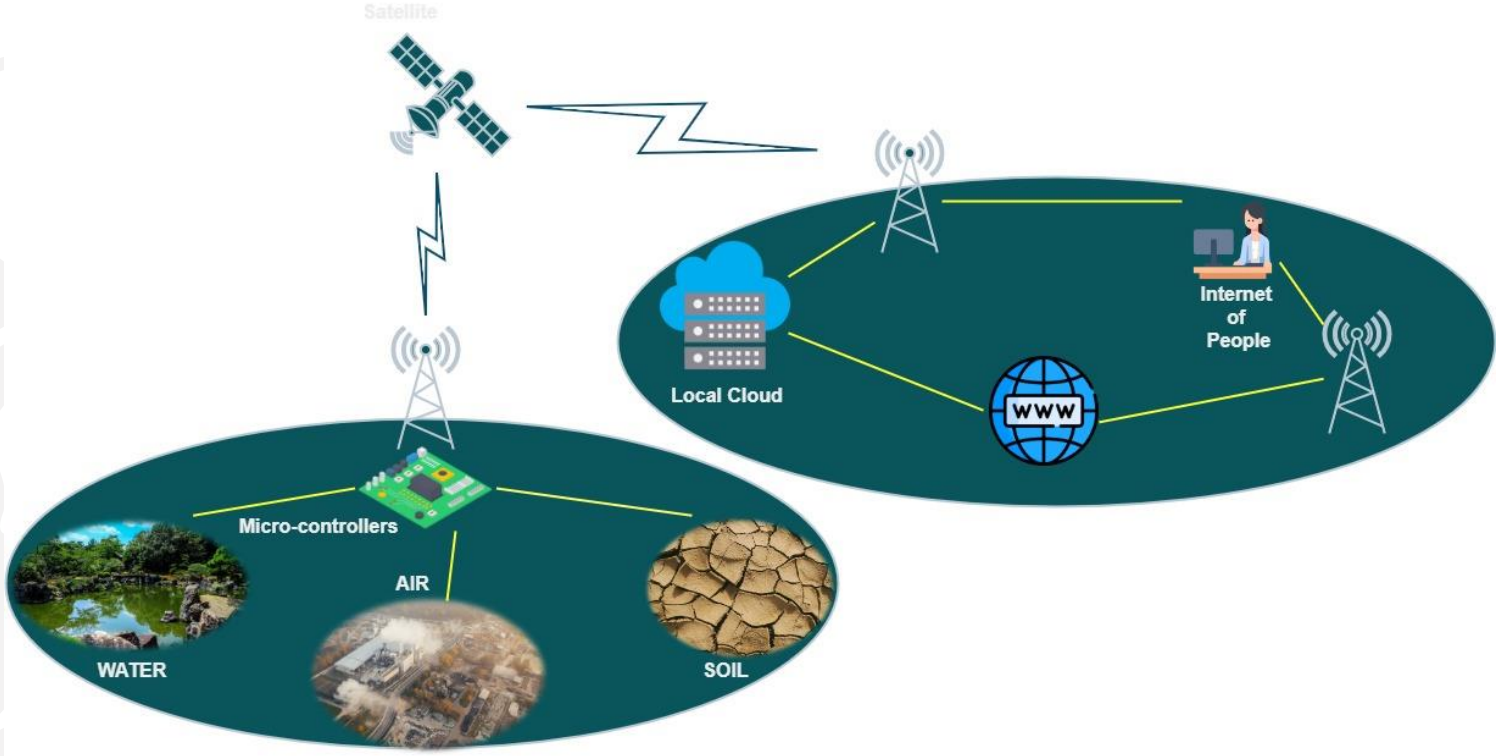
IoT architecture

- Framework
- Smart monitoring systems using IoTs
- Smart monitoring of Air, Water, and Soil



IoT systems for environmental monitoring

- Smart monitoring for reliable data collection
- Challenges in smart monitoring technologies
- Quality index for quick comparison



Smart monitoring environment for quick comparison of air, water, and soil quality using IoT networks

Environmental sensors for IoT applications

- Sensors that detect heavy metals and PFAS
- Air quality sensors detect pollutants
- Quality index for quick comparison

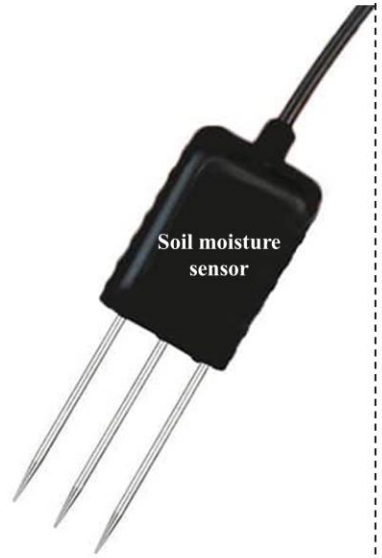
Water quality sensors

Sensors measure Conductivity, Temperature, Depth, and Turbidity

Air quality sensors

Sensor measures Particulate Matter

Soil quality sensors



Sensor measures Soil Moisture

Stream monitoring stations in the United States

- USGS has 13,500 stream monitoring stations around the United States
- EnviroDIY is a community that is exploring the ideas of environmental science for environmental monitoring
- Different pins represent the geospatial locations of stream monitoring sites

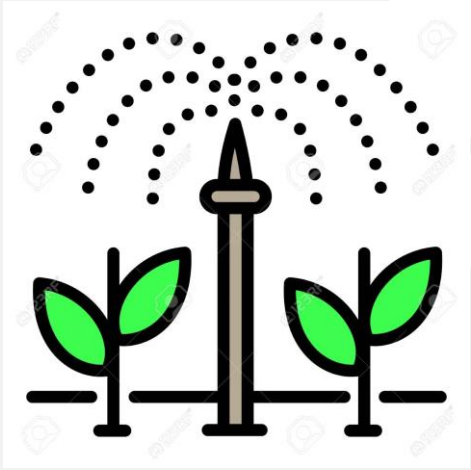
Source: https://monitormywatershed.org/browse/

Sample monitoring station used

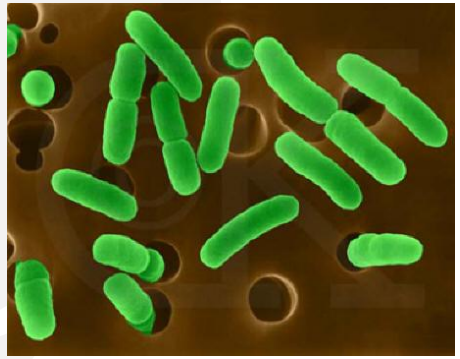
- Considered a sampling location that is draining water into Bear Lake
- North creek is currently being observed and monitored to assess both water quantity and quality
- Frequent monitoring of streams helps to build stream simulation models to understand contaminant transport

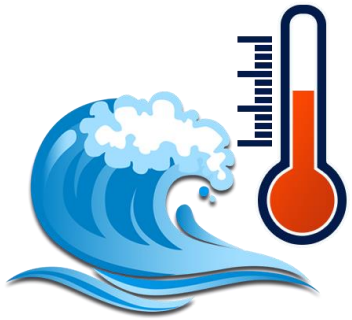
Source: https://monitormywatershed.org/browse/

Pollutant sources



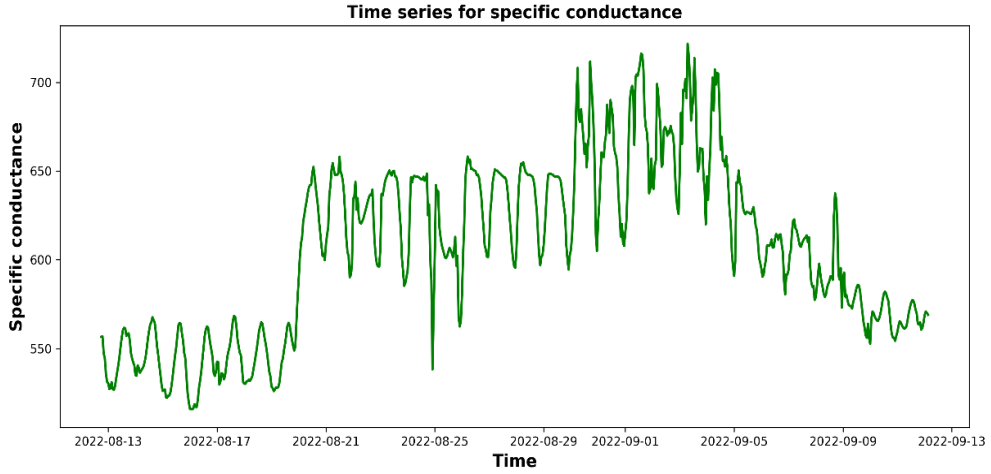
Water quality issues

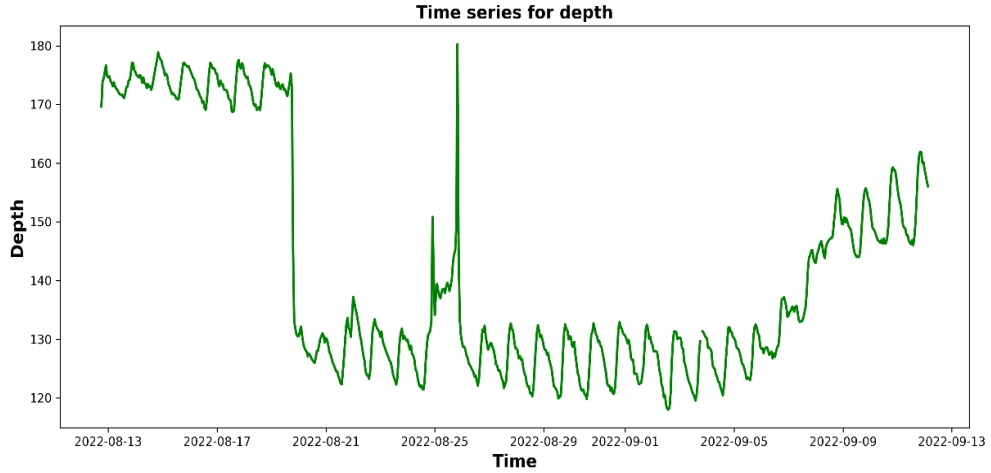


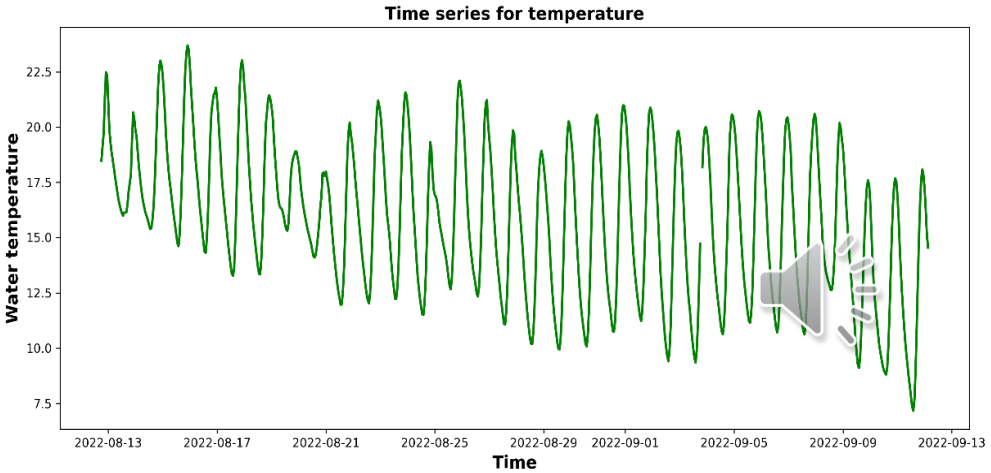


Water quality time series

- A time series helps in assessing the trends of variable affected by environmental factors over time
- The stream monitoring data combined with weather data can help in simulating the stream flows
- Estimating stream flows are important for better management of water resource







Implications for environmental monitoring

- State of the art sensors for air, water, and soil monitoring sensors are expensive

- IoT systems with faster wireless and cellular networks provide high resolution data that are providing solutions to improve the efficiency of contaminant transport models

Conclusions

- Challenges with unreliable data and solutions with machine learning
- Focus on Modeling applications to simulate contaminant fate and transport
- Future scope to improve environmental modeling aspects