Rainwater Ontology

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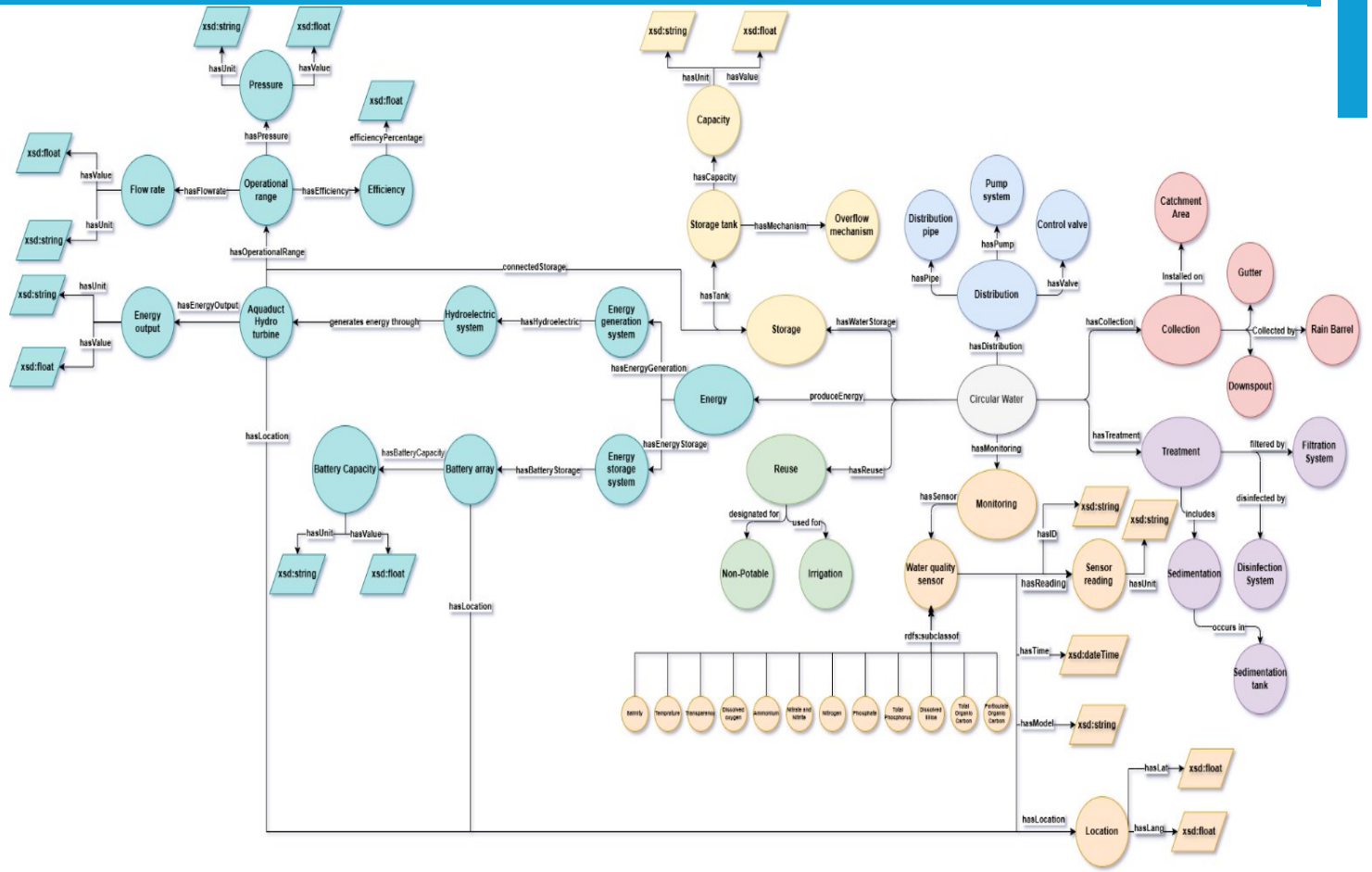
Overview

The Rainwater Ontology models the various components and processes involved in rainwater collection, storage, treatment, distribution, monitoring, and reuse.

It provides a structured framework for representing knowledge about rainwater management systems.



1. Main Classes

1. Collection System: Captures rainwater from surfaces using structures like gutters, downspouts, and barrels.
2. Storage System: Stores collected rainwater in tanks and handles overflow through mechanisms.
3. Treatment System: Processes rainwater through sedimentation, filtration, and disinfection for safe reuse.
4. Distribution System: Transports treated water via pipes, pumps, and control valves.
5. Reuse System: Utilizes treated rainwater for applications like irrigation and non-potable uses.
6. Monitoring System: Continuously checks water quality using sensors and logs readings with timestamps and locations.
7. Specific Sensor Types: Includes sensors measuring parameters like salinity, temperature, nutrients, and organic carbon to assess water quality.

2. Relationships

1. Rainwater Relationships: Link rainwater to key system components like collection, storage, treatment, monitoring, distribution, and reuse.
2. Distribution System Relationships: Define connections within the distribution system including pipes, pumps, and valves.
3. Storage System Relationships: Specify links between storage tanks and their overflow mechanisms.
4. Monitoring System Relationships: Associate sensors with their readings and geographic locations.
5. Reuse System Relationships: Describe designated uses of treated water, such as for irrigation or non-potable purposes.
6. Collection System Relationships: Identify how and where rainwater is collected from catchment areas and by specific structures.
7. Treatment System Relationships: Detail processes like sedimentation, filtration, and disinfection within the treatment flow.

3. Datatype Properties

1. Sensor Properties: Define attributes of sensors such as ID, model, and measurement time.
2. Reading Properties: Indicate units associated with sensor readings.
3. Location Properties: Provide geographic coordinates (latitude and longitude) of sensors.

Data generator

Due to the lack of real-world data, a data generator was designed to produce sample rainwater harvesting system with all components defined in the ontology.

```
ex:system_1a2b3c4d a ex:RainWater ;
    ex:hasCollection ex:catchment_5e6f7g8h ;
    ex:hasDistribution ex:distribution_9i0j1k2l ;
    ex:hasMonitoring ex:monitoring_3m4n5o6p ;
    ex:hasReuse ex:reuse_7q8r9s0t ;
    ex:hasStorage ex:storage_u1v2w3x4 ;
    ex:hasTreatment ex:treatment_y5z6a7b8 .

```

Shapes & Constraints

The rules and constraints that the data must adhere to are written in SHACL (Shapes Constraint Language). Key components in the SHACL are:

- sh:NodeShape: Defines constraints for a specific class
- sh:targetClass: Specifies which class the shape applies to
- sh:property: Defines constraints on properties
- sh:path: Indicates which property is being constrained
- sh:minCount: Requires at least N values for a property
- sh:class: Restricts property values to specific classes
- sh:or: Allows alternative valid classes/properties
- sh:message: Custom error messages for violations

Validator

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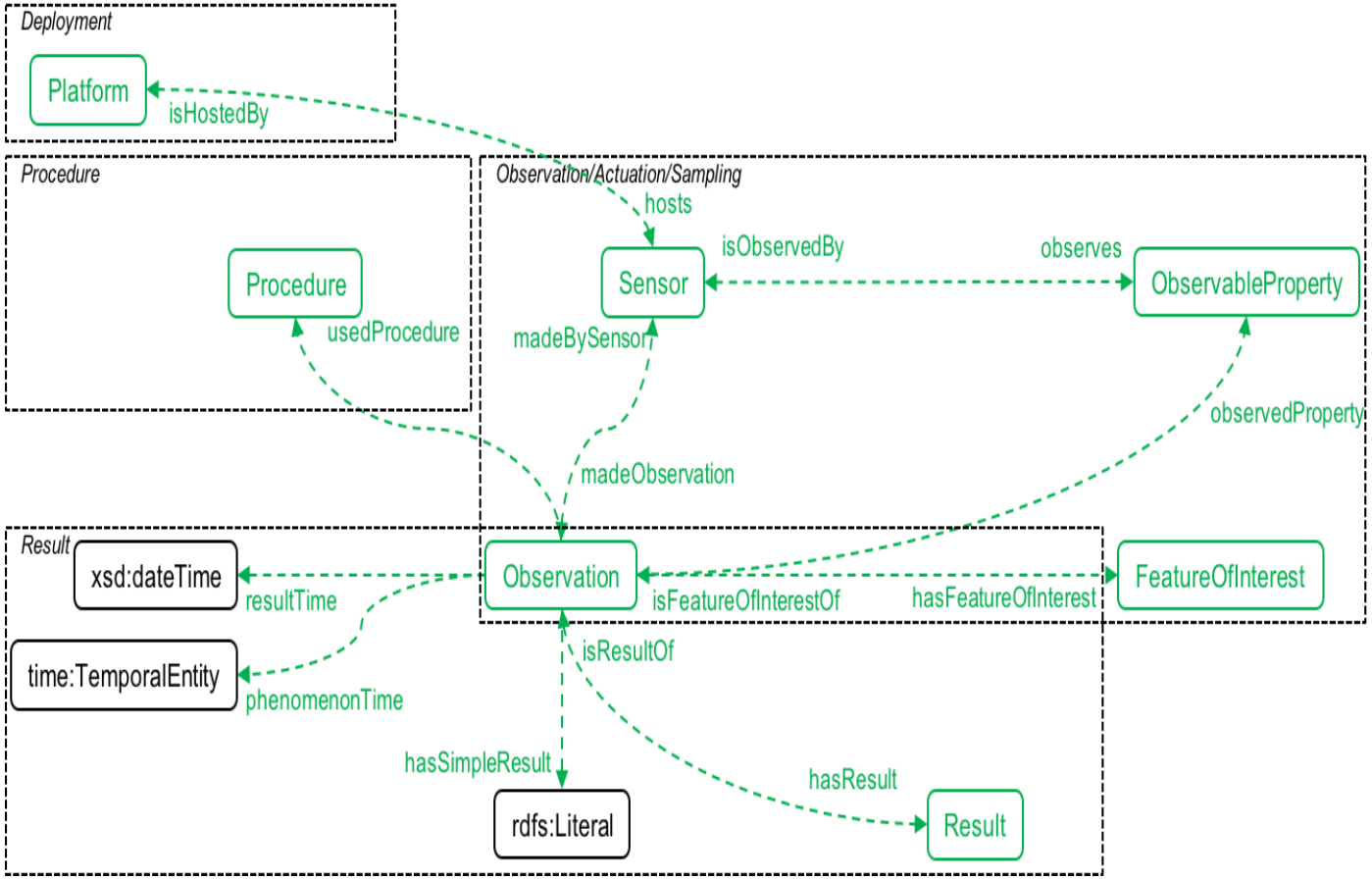
Future Work

In the future, the model will be extended to accommodate existing ontologies in order to avoid duplicate work. The starting point would be integrating “SSN SOSA” with the “Water Quality Sensor”.



Link to Repository