Augmented Safety through Smart EnvironmenTs (ASSET)

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Overview

ASSET is a research project funded jointly by the Turkish (Tubitak) and UK (British Council) Governments. In this project, we investigate the use of computational methods to support regulators and employers in increasing Occupational Health and Safety (OHS) regulation compliance. We explore the use of low-cost devices in conjunction with automated reasoning models to understand how workplaces can be effectively instrumented. Such systems may collect information about the environment and activities through various sensors, reason about compliance with OHS regulations, and support coordination of responses to emergencies in order to mitigate damaging effects.

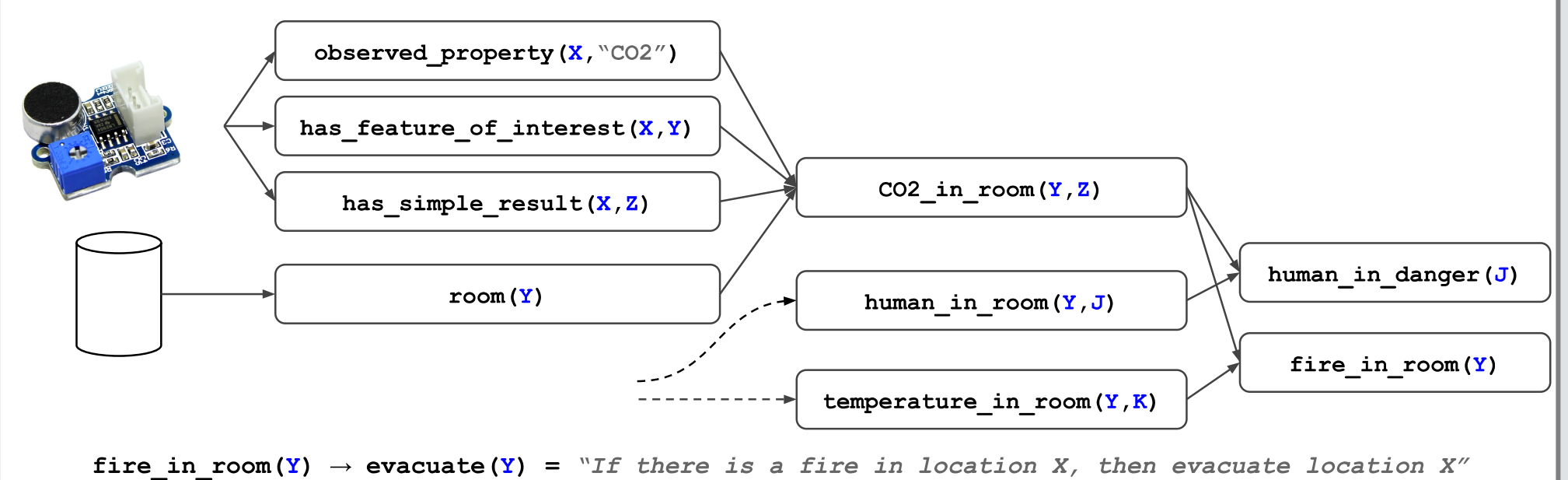## Policy-Aware Sensor Networks

Problem. Current monitoring systems interpret sensor data using ad hoc rules manually specified by experts. This approach makes systems expensive to build, and not easily adaptable to changes and unforeseen circumstances.
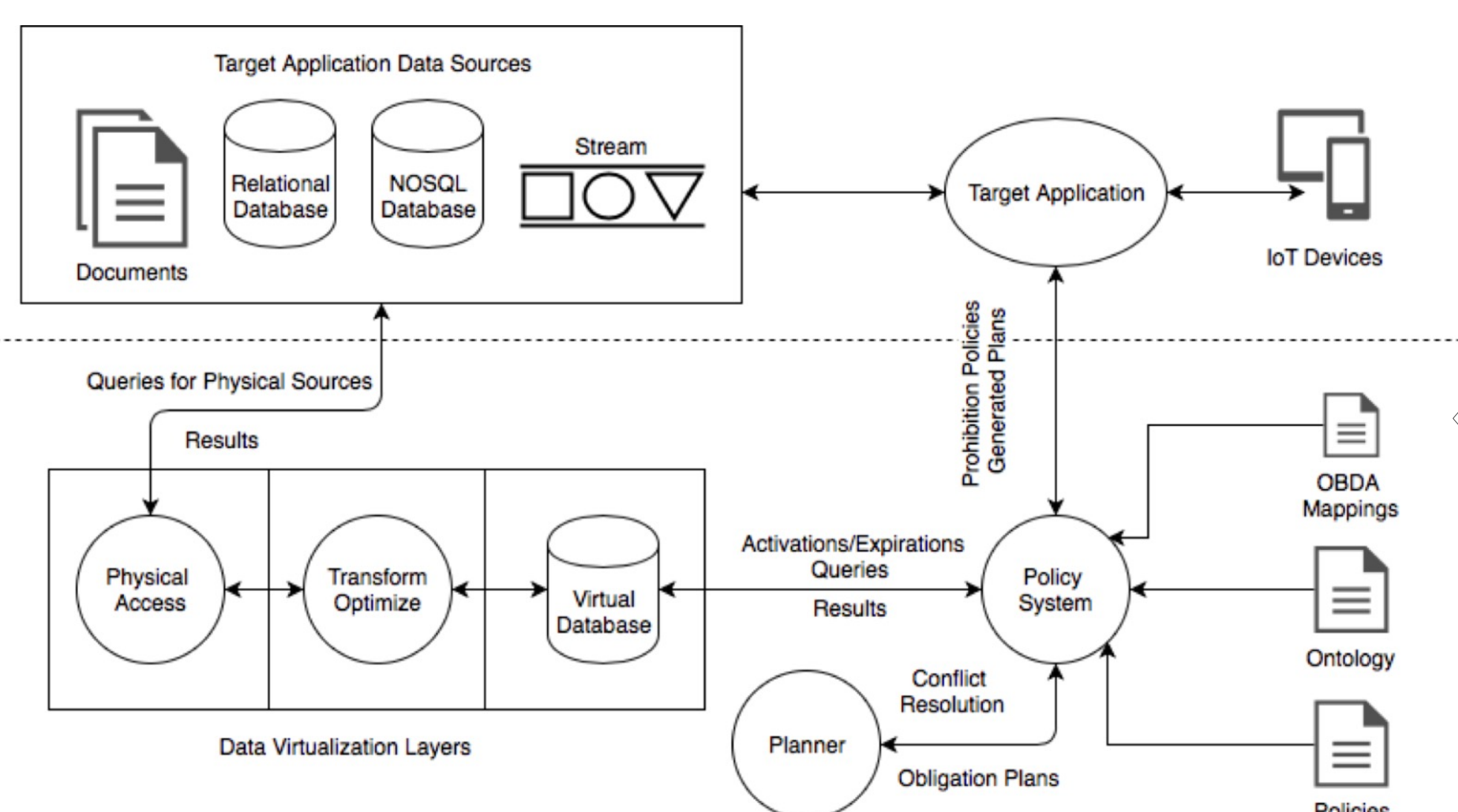

Sensors → DB → SSNO-Annotated DB → Composite Predicates → Formalised Policies → Policies
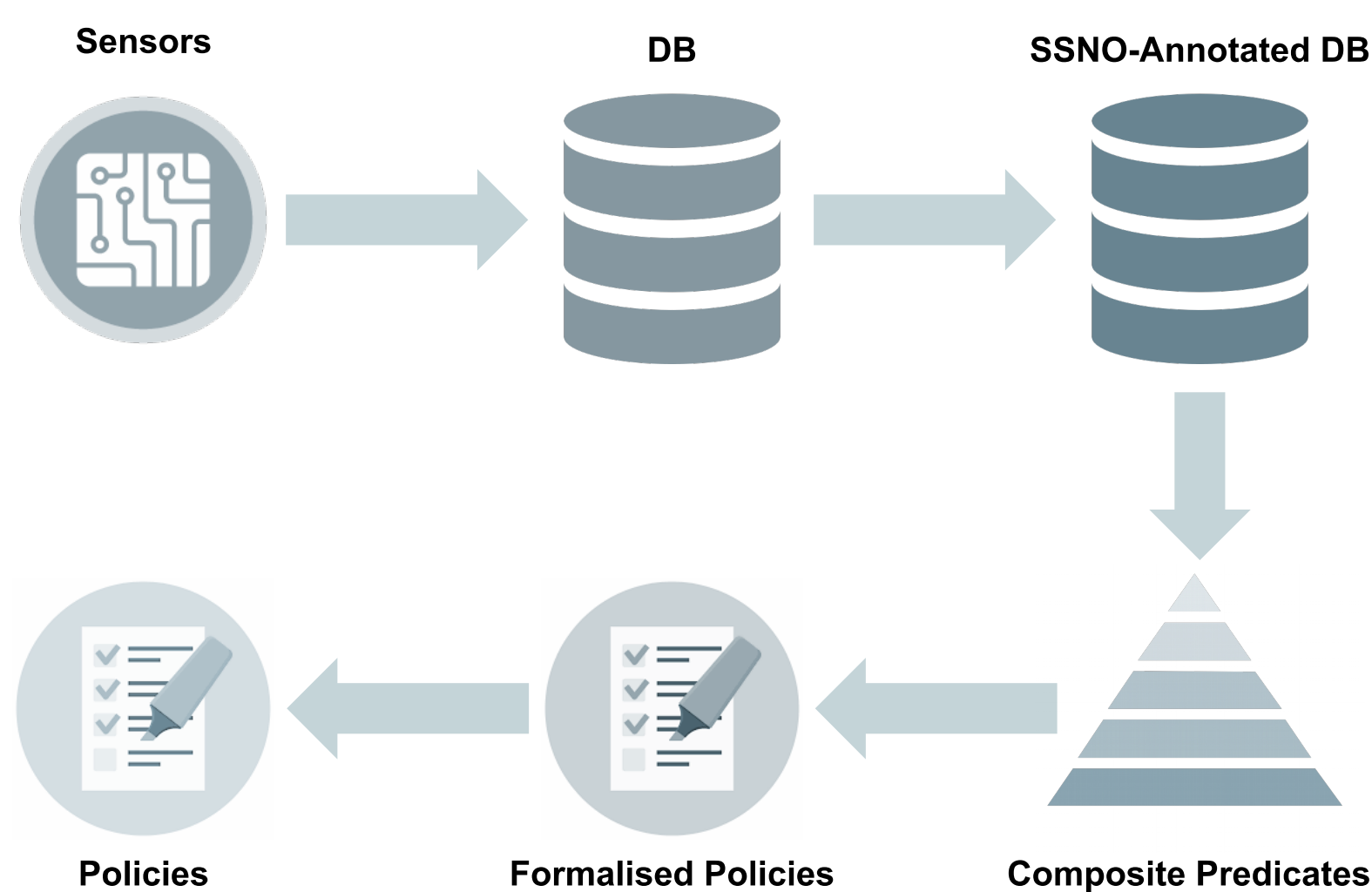
Linking Sensor Data to Policies

Solution. We allow machines to bridge the gap between sensor data and the policies that they monitor:

• We make sensor networks data more meaningful using the Semantic Sensor Network Ontology (SSNO).

• We use inference rules to automatically discover possible ways to aggregate sensor data into complex abstractions.

• We use these abstractions as building blocks to represent health and safety policies.

observed_property(X,"CO2")
has_feature_of_interest(X,Y)
has_simple_result(X,Z)
room(Y)
CO2_in_room(Y,Z)
human_in_room(Y,J)
temperature_in_room(Y,K)
human_in_danger(J)
fire_in_room(Y)

fire_in_room(Y) → evacuate(Y) = *"If there is a fire in location X, then evacuate location X"*

A Semantic Policy Framework for IoT

Target Application Data Sources
Documents
Relational Database
NOSQL Database
Stream
Target Application
IoT Devices
Queries for Physical Sources
Results
Physical Access
Transform Optimize
Virtual Database
Data Virtualization Layers
Activations/Expirations Queries
Results
Policy System
Conflict Resolution
Planner
Obligation Plans
Prohibition Policies
Generated Plans
OBDA Mappings
Ontology
Policies

Automatic Reasoning about Policies

• We introduce a policy language that provides efficient mechanisms with enough expressivity to describe and reason about policies. The approach allows to detect conflicts at design time and to use high-level concepts to refine policies to individual devices or services.

• We provide a conflict resolution strategy which utilizes a general purpose AI planner. The planner determines the best course of action (avoiding or minimizing policy violations) by making use of available services at run time. The planner can also be used as a conflict detection mechanism and to maximize the gains from regular mine operations.

• We describe how ontology based data access and data federation methods can be adopted to implement the policy framework and to consolidate in-use IoT applications that use multiple diverse data sources.