

Goal-driven Management of IoT Indoor Environments

Supervisors:

Prof. Antonio Brogi

Dr. Stefano Forti

Candidate:

Giuseppe Bisicchia

Pervasive IoT



Domotics

Pervasive IoT

Robotics



Domotics



Pervasive IoT

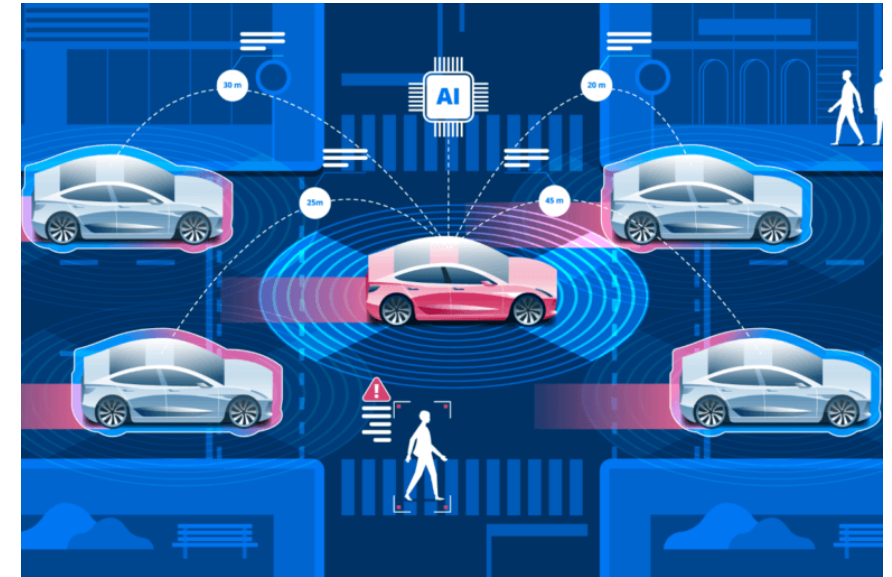


Domotics

Robotics

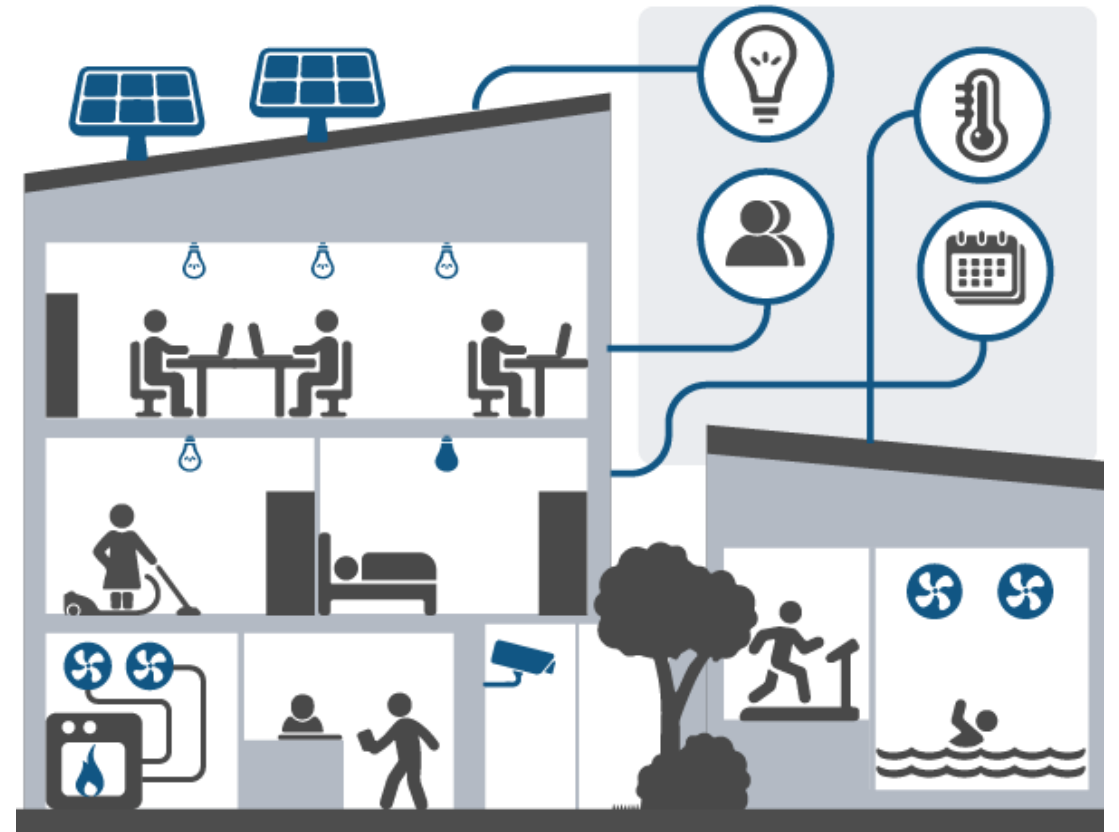
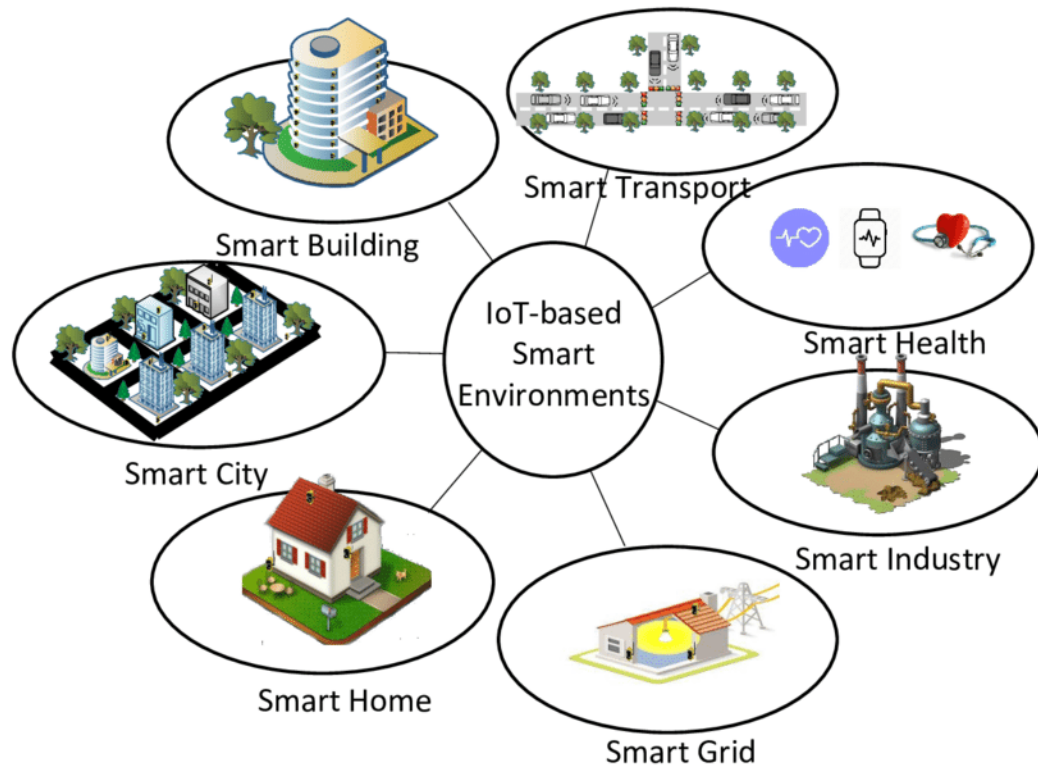


Smart Wearable



Autonomous Vehicle

Smart Environment



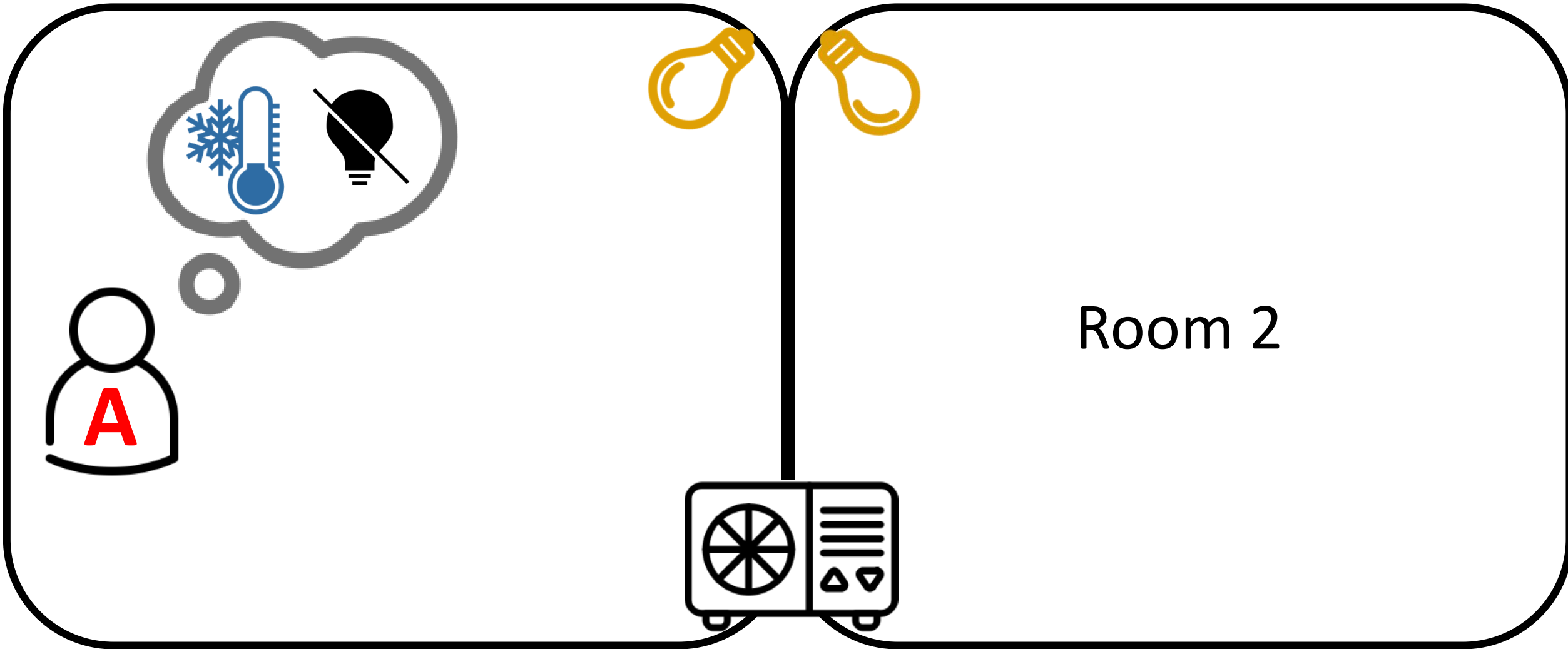
Scenario: The Environment

Room 1

Room 2

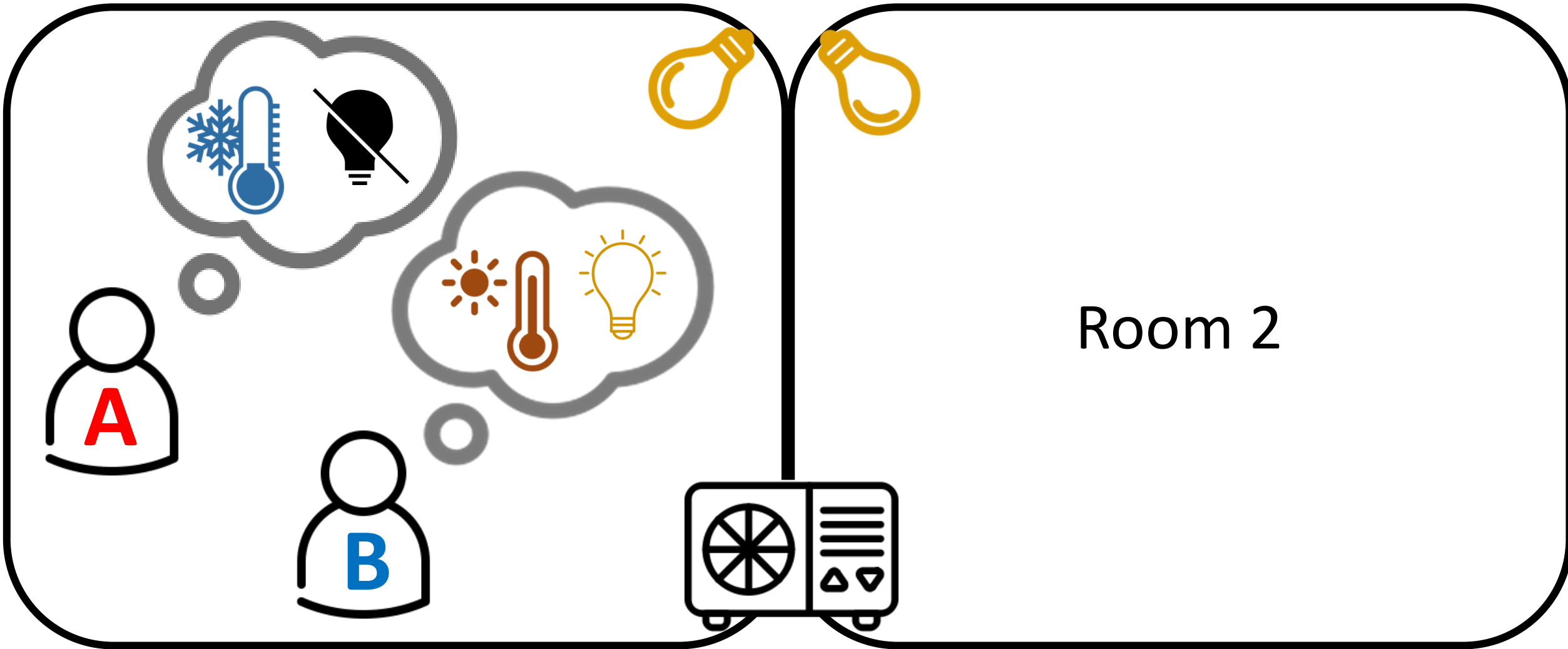


Scenario: Meet Alice



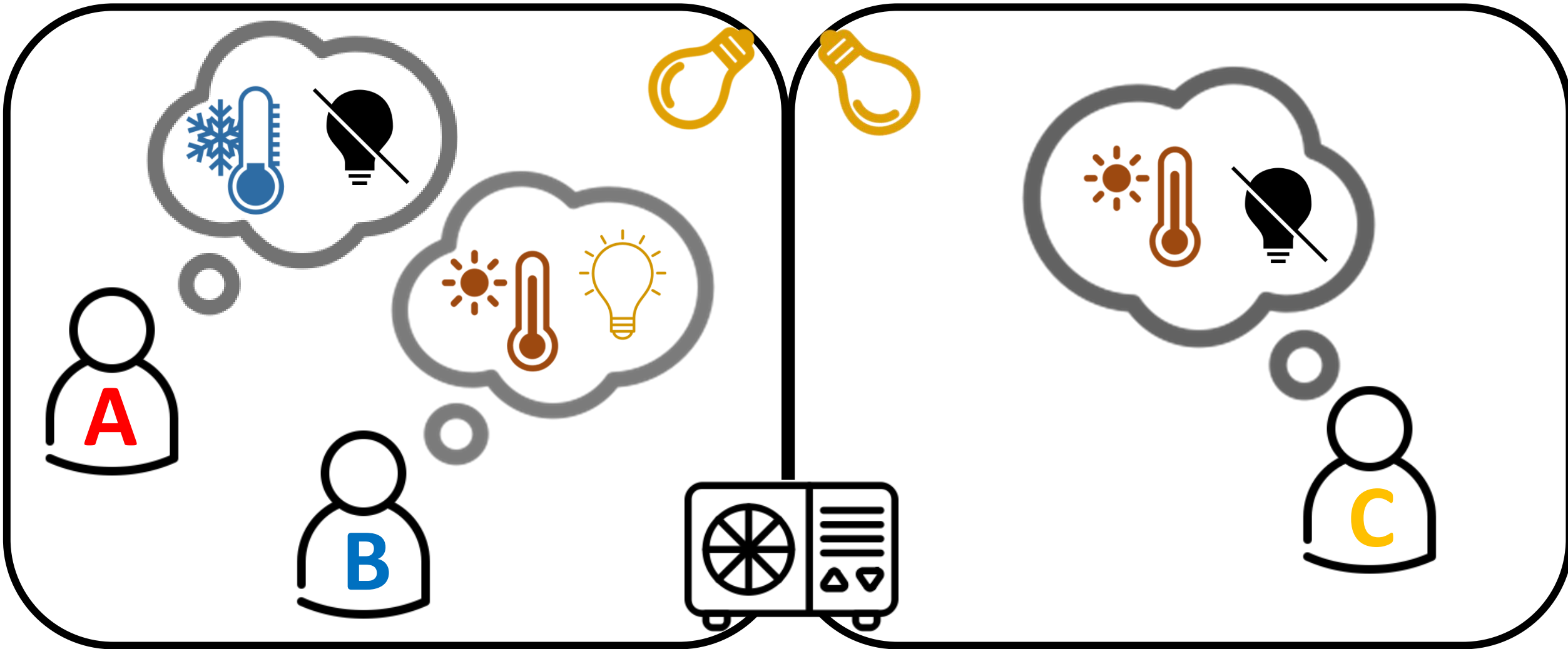
Room 2

Scenario: Meet Barbara



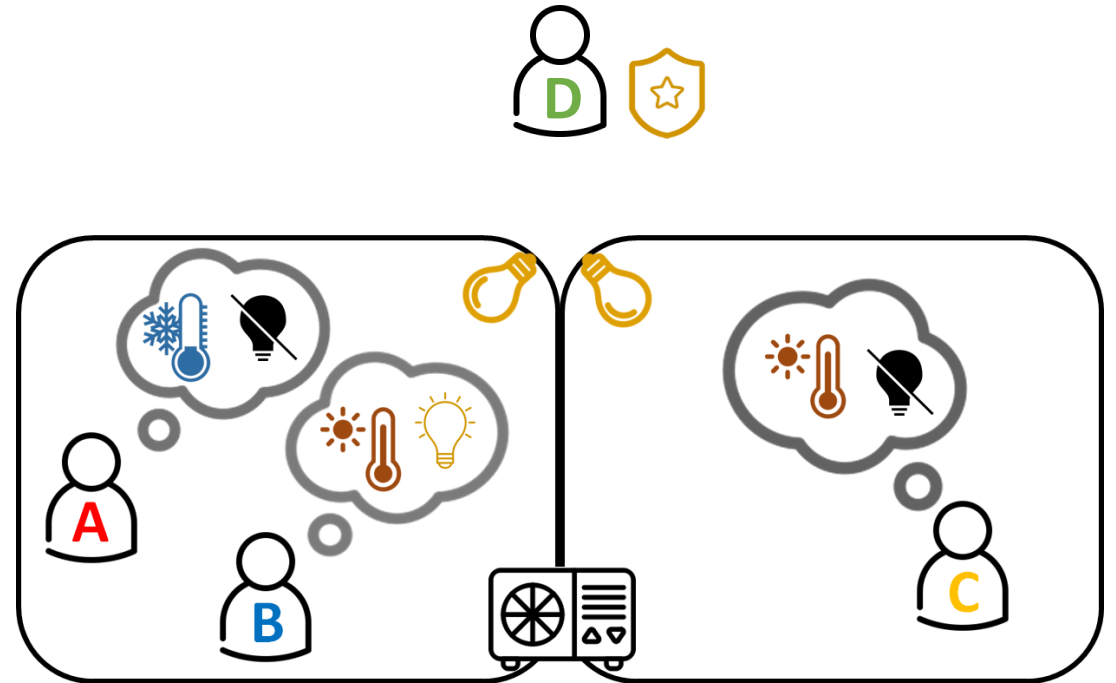
Room 2

Scenario: Meet Caterina




Smart Environment: Some Problems

- *How can we mediate all preferences to satisfy them in the best way possible?*
- *What happens if another user enters the second room, with different preferences?*
- *How can we mediate between the preferences of A, B, C and the energy saving objectives of the admin Diana?*

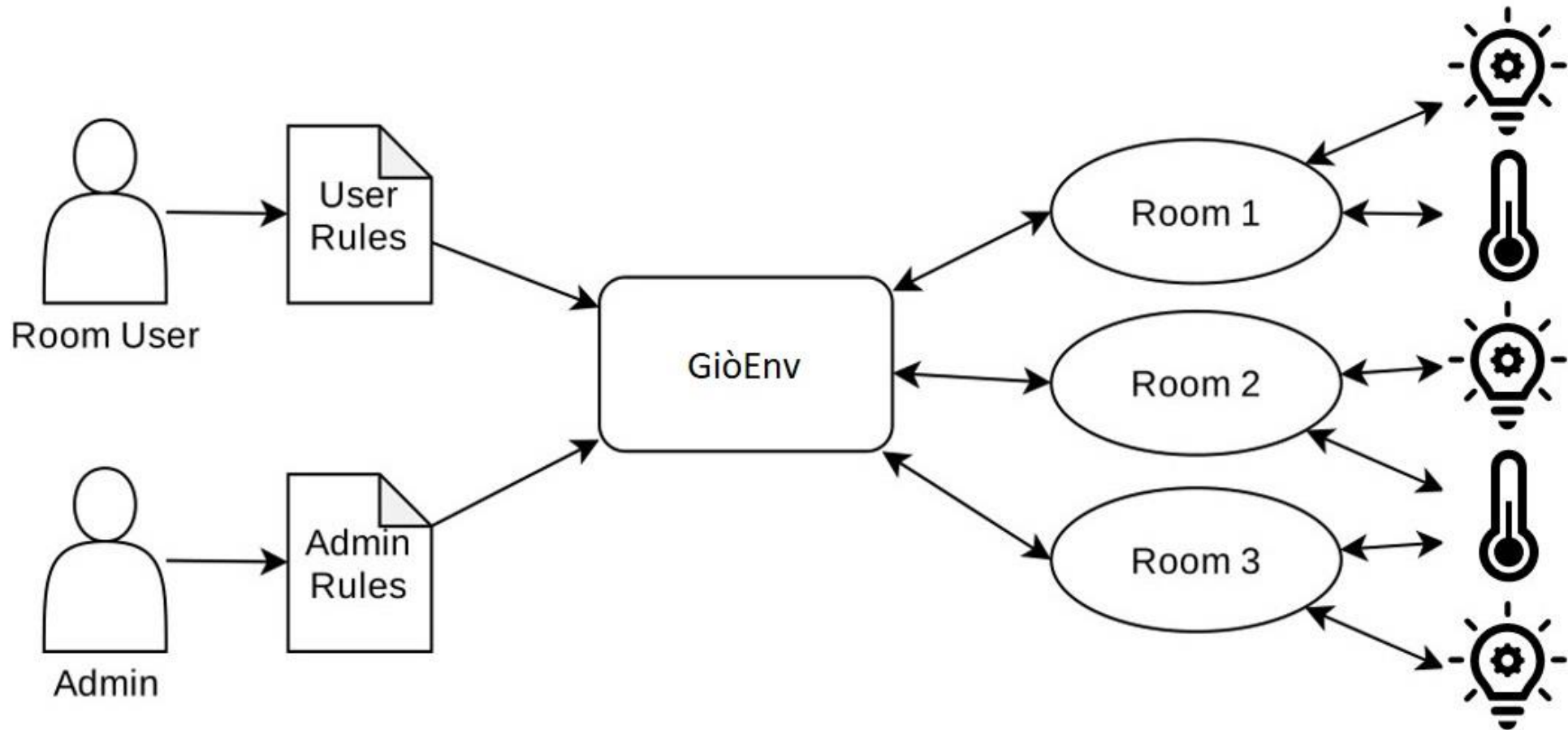


Objectives of the Thesis



Design and implement an IoT goal-driven system capable of monitoring and automatically managing interior natural lighting and temperature by mediating possibly conflicting goals set by users and system administrators.

GiòEnv: a Goal-driven system for managing Smart Environment



GiòEnv Rules

User

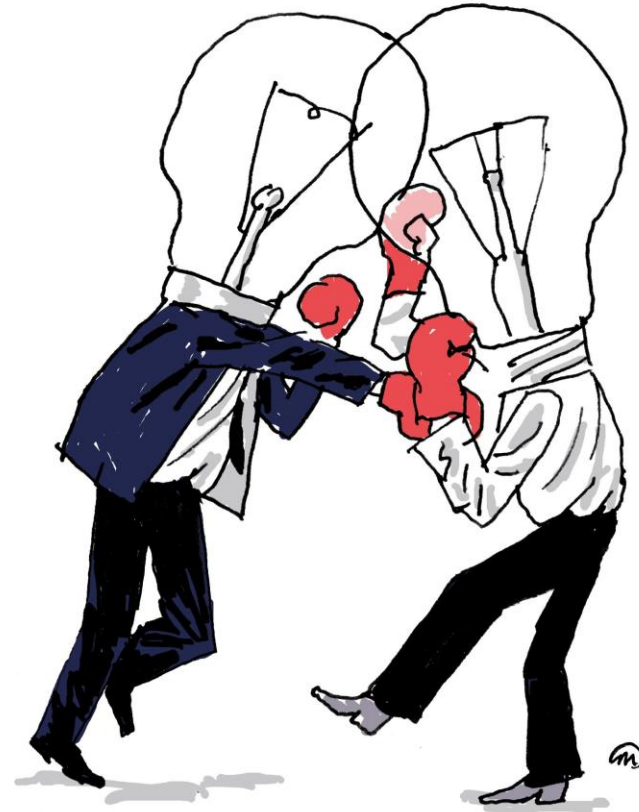
```
set(user, R, temperature, very_low) :-  
    inRoom(user, R),  
    (temperature(high, R)  
    ;  
    temperature(very_high, R)).
```

Admin

```
mediate(A, temperature, [X|Xs], todo(A, temperature, W)) :-  
    convert(temperature, [X|Xs], Ls),  
        (season(summer)  
    ;  
    season(spring)),  
    max_list(Ls, W).
```

GiòMediator

- GiòMediator is the service that performs the mediation process.
- It receives from the WoT Server the data for mediation (rooms status, users' preferences, administrator's policies) and returns the decisions which will then be sent to the GioButtons.



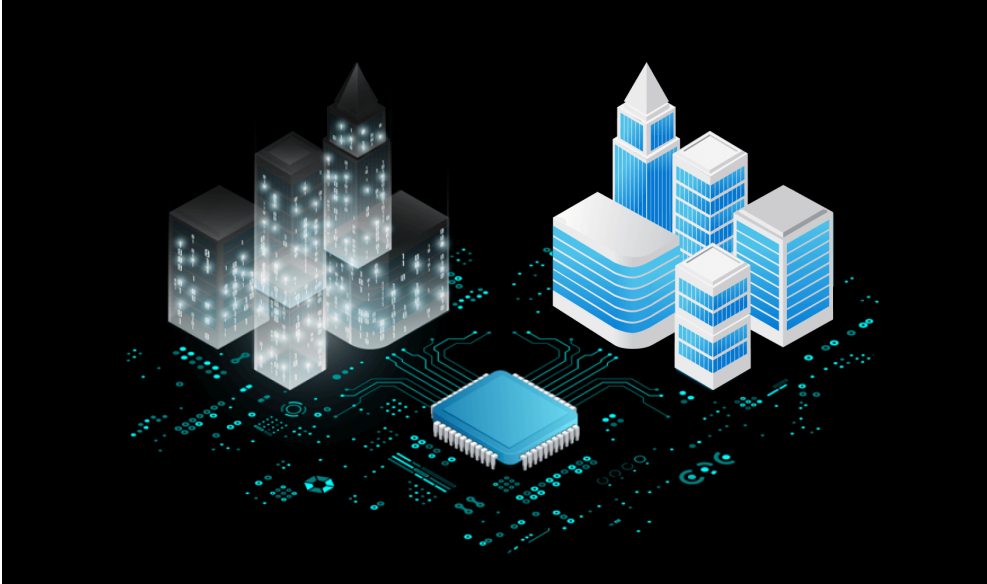
Digital Twin



- A Digital Twin is a digital replica of a physical entity.
- In GiòEnv each IoT device and each room has its own Digital Twin.

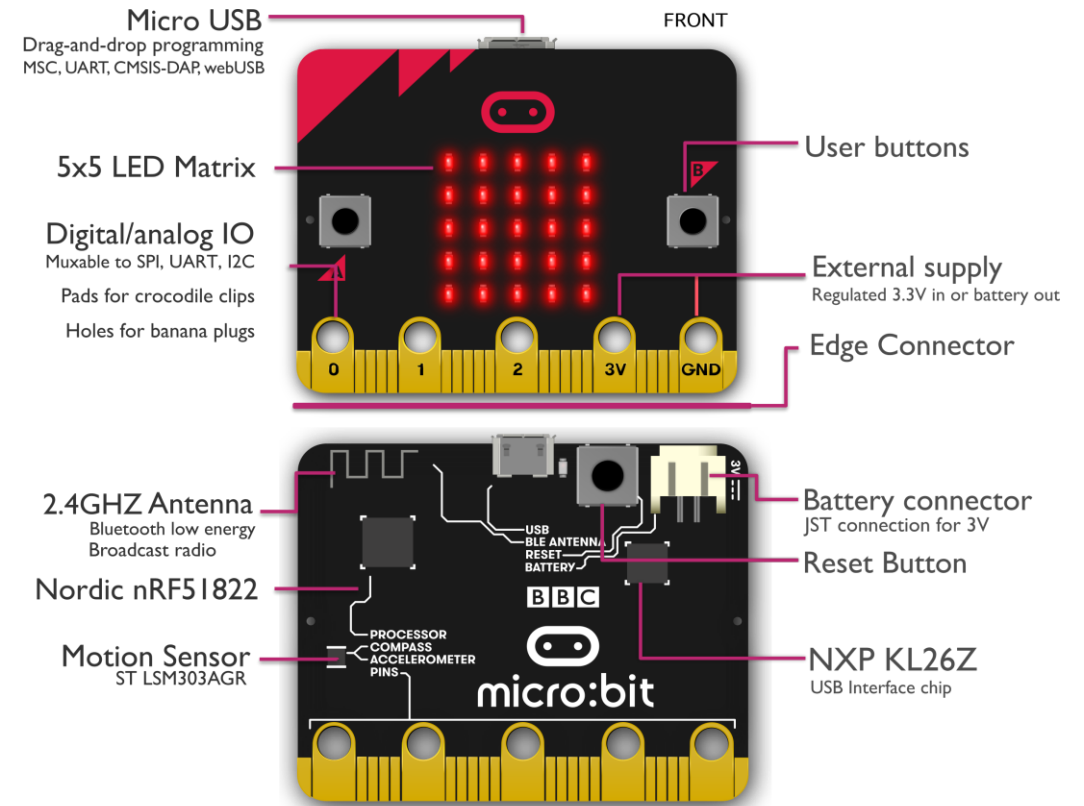
The Web of Things

- The Web of Things is a set of W3C standard to create a uniform and interoperable way to interact with devices and applications of the Internet of Things.
- In GiòEnv Digital Twins are implemented through the WoT.

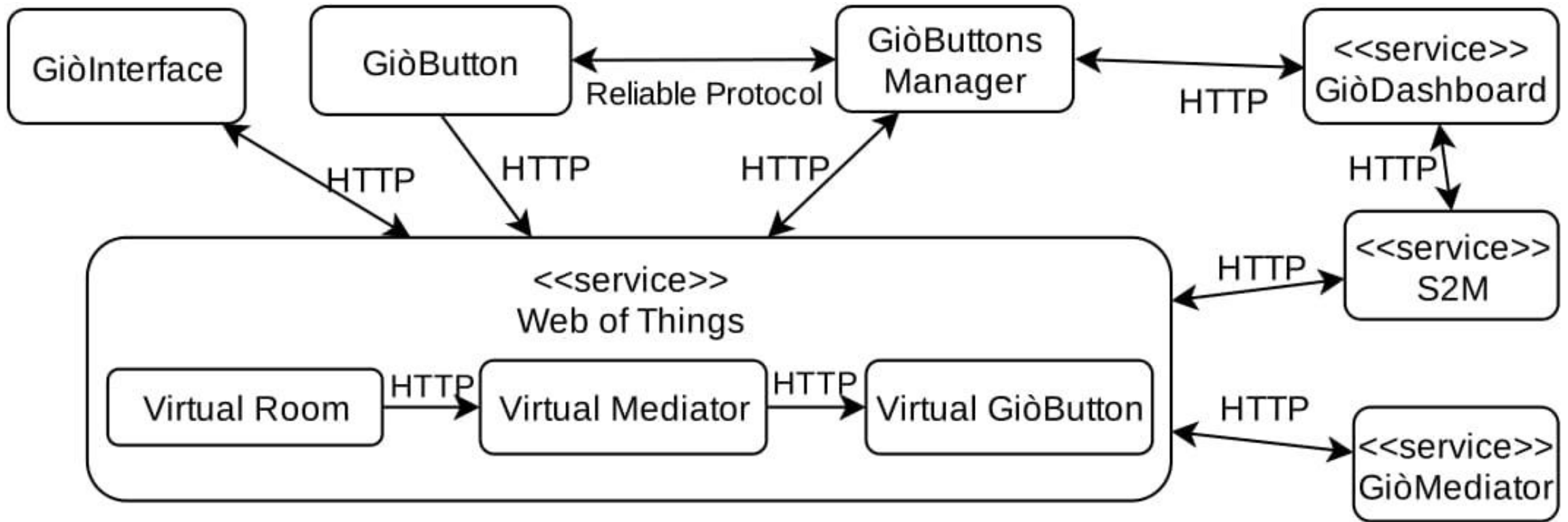


GiòButton

- *Sense*, which can collect environment data through the sensors
- *Actuate*, which can receive commands from the system, so to trigger suitable IoT actuators



GiòEnv: Boxology



Results

- Designed and implemented an IoT goal-driven system capable of monitoring and automatically managing smart environment mediating possibly conflicting goals set by users and system administrators.
- Implemented an extension of the Web of Things.
- Implemented a conflict resolution process based on a LPaaS.

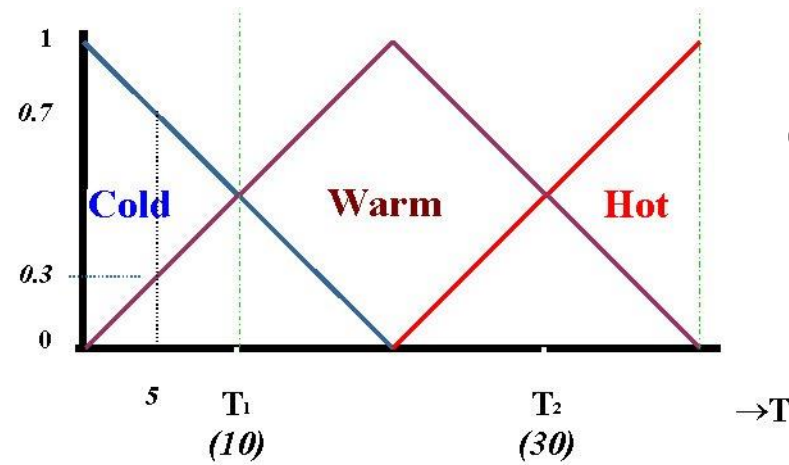


Related Work

Multi-Agent Systems



Fuzzy Logic



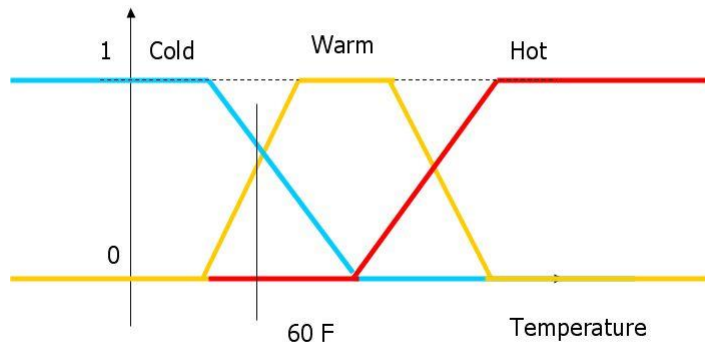
Goal-Driven Management



Neural Networks

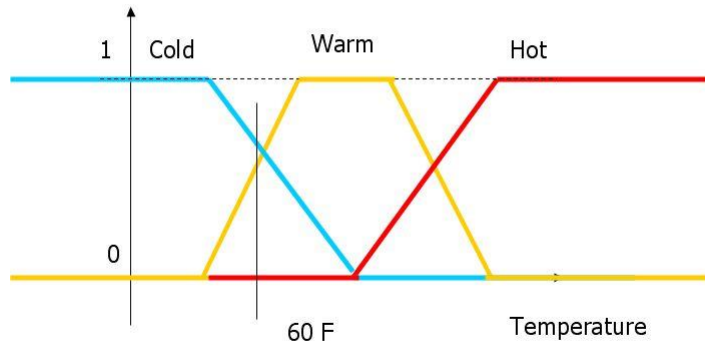
Future Work

Fuzzy Logic

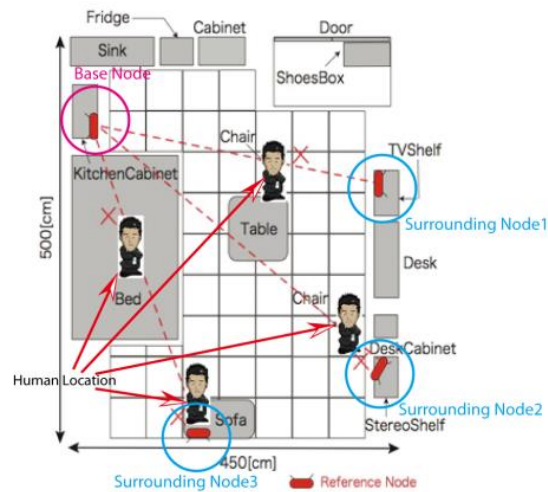


Future Work

Fuzzy Logic

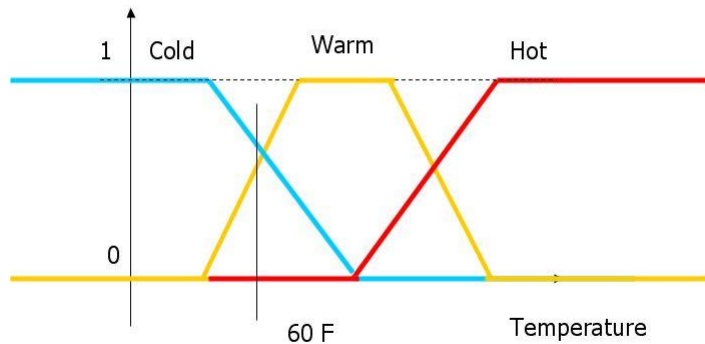


Automatic Recognition of Users

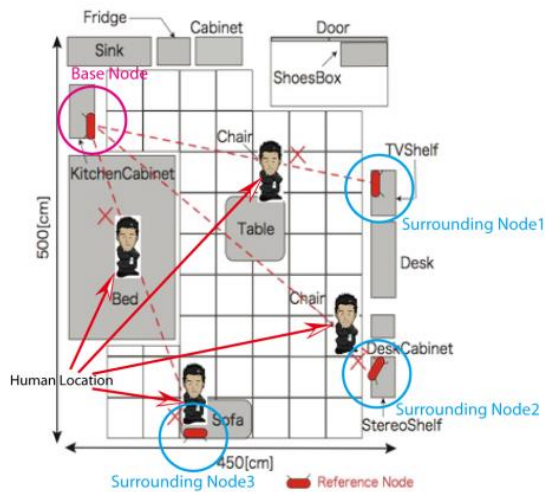


Future Work

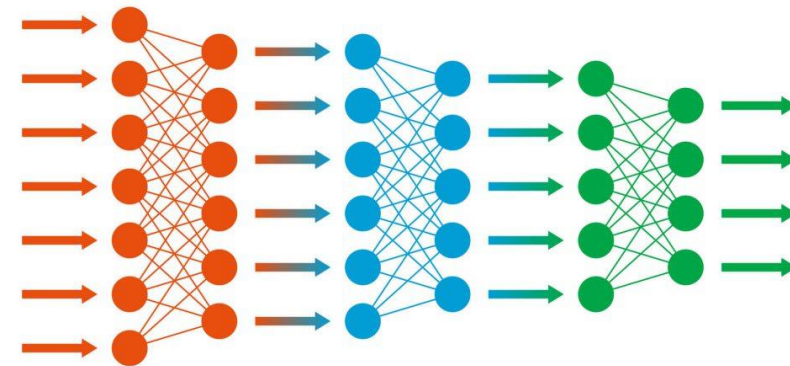
Fuzzy Logic



Automatic Recognition of Users

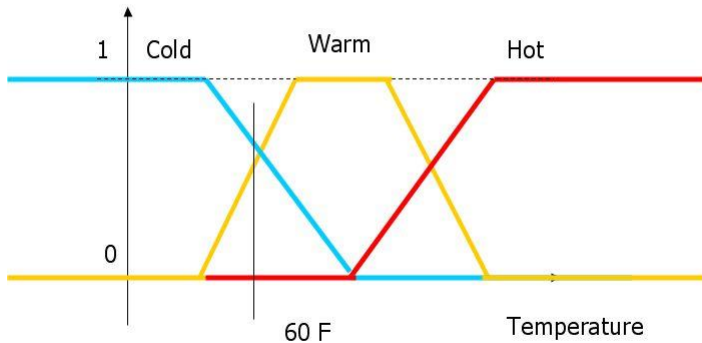


Deep Learning

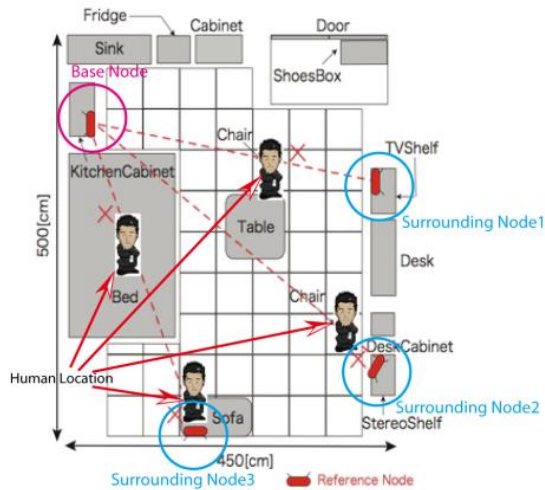


Future Work

Fuzzy Logic



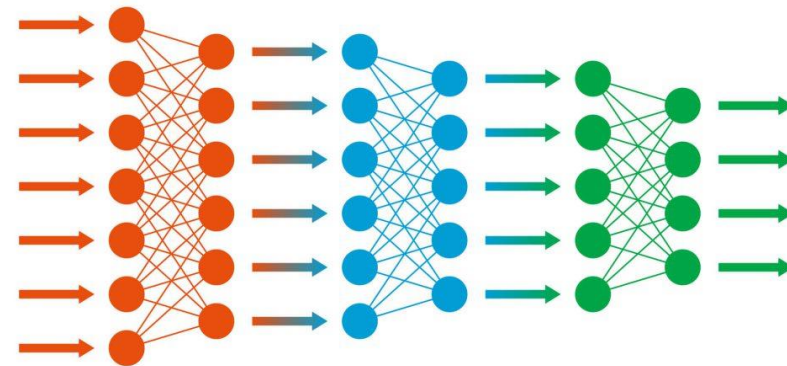
Automatic Recognition of Users



Questionnaires



Deep Learning



Thank You