Efficient Smart Room MAS

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Implemented using

SPADE

SMART PYTHON AGENT DEVELOPMENT ENVIRONMENT

Problem

- The climate conditions of a room are highly dynamic, changing constantly throughout the day. Modern rooms are equipped with various devices designed to adjust these conditions and create a comfortable living environment—for example, fans, air conditioners, light bulbs, and windows.
- *Given the natural conditions at any given moment, the challenge lies in determining the optimal combination of devices to activate in order to achieve the desired comfort level while minimizing power consumption.*
- This challenge is addressed in the proposed system through the implementation of a multi-agent system, which efficiently manages and coordinates the operation of these devices.

Why Multi Agent System

- The problem exists within a complex system characterized by high dynamism and uncertainty. The equipment involved is distributed across the environment and requires a high level of interconnectivity to communicate and collaboratively develop strategies to address the room's current conditions effectively.

- Thus, a MAS equipped with effective message passing is the perfect solution for this rather than using an algorithmic approach.

Why not a simple algorithmic approach

- An algorithmic approach can't properly model the complex system mentioned above.
- In addition, an algorithmic approach won't be able to
  - adapt to any unpredictable situation like a malfunctioning of an equipment.
  - express emergent properties
  - Handles uncertainty and treat it like an opportunity

Features of the task environment

- Dynamic – room climate might change while the agents are acting on it.
- Stochastic – next state of the room climate can't be predicted from the current state.
- Sequential – an action done now will massively affect the future.
- Multi-agent environment – multiple agents are acting on it.

Agents

3 Sensor Agents

1. Temperature sensor agent
2. Humidity sensor agent
3. Room brightness sensor agent

4 functional Agents

1. A/C agent
2. Light bulb agent
3. Fan agent
4. Window agent
5. Controller agent

Sensor agents

- Read relevant data from the environment and distribute them among the other agents.

A/C agent

- Uses Fuzzy Logic to identify the best power consumption it needs to get the room to a comfortable level. (usually performs better than fan when room temp is too high)

Fan agent

- Uses Fuzzy Logic to identify the best power consumption it needs to get the room to a comfortable level. (usually performs better than a/c when room temp is low)

Window agent

- Uses Fuzzy Logic to identify a score that represent how useful the opening of the windows will be for the room.

Light bulb agent

- Given the current conditions in the room, it identifies the brightness to be ignited.

Design Architecture

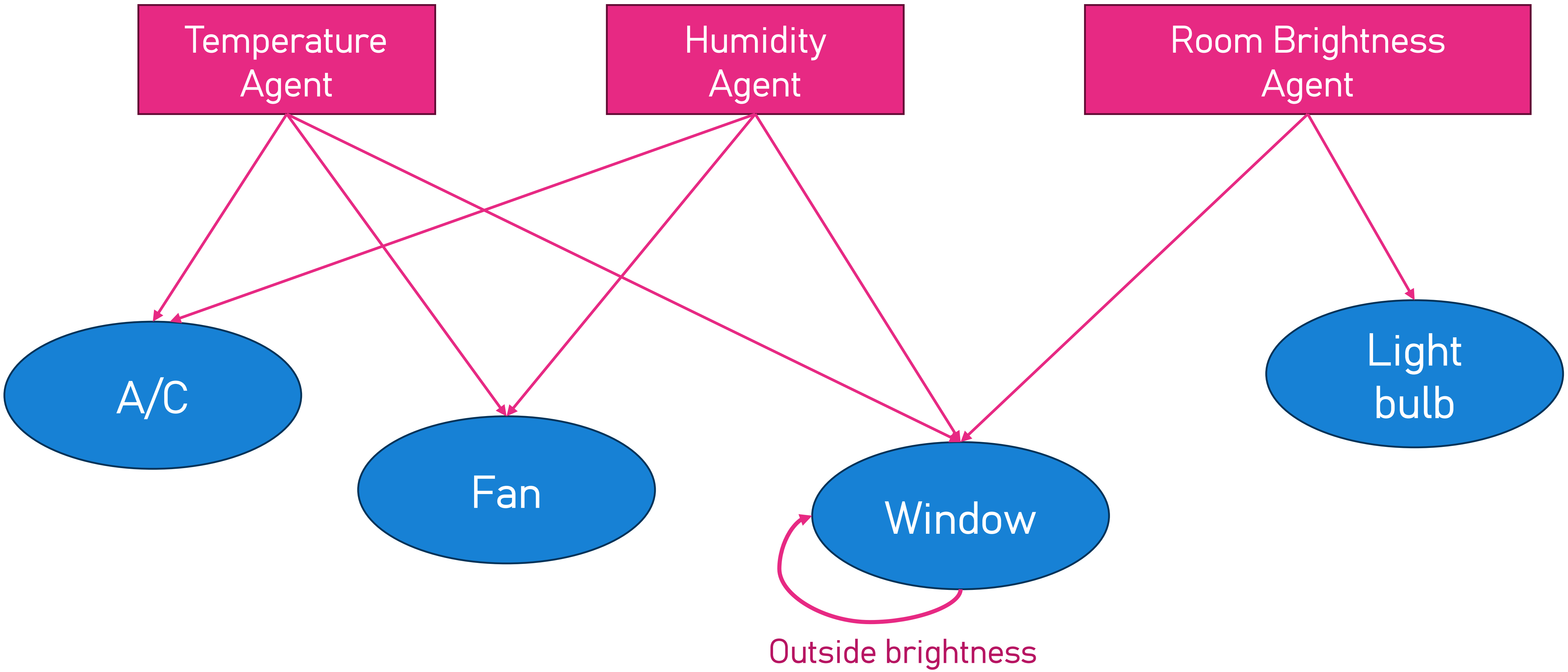
- Ontology based

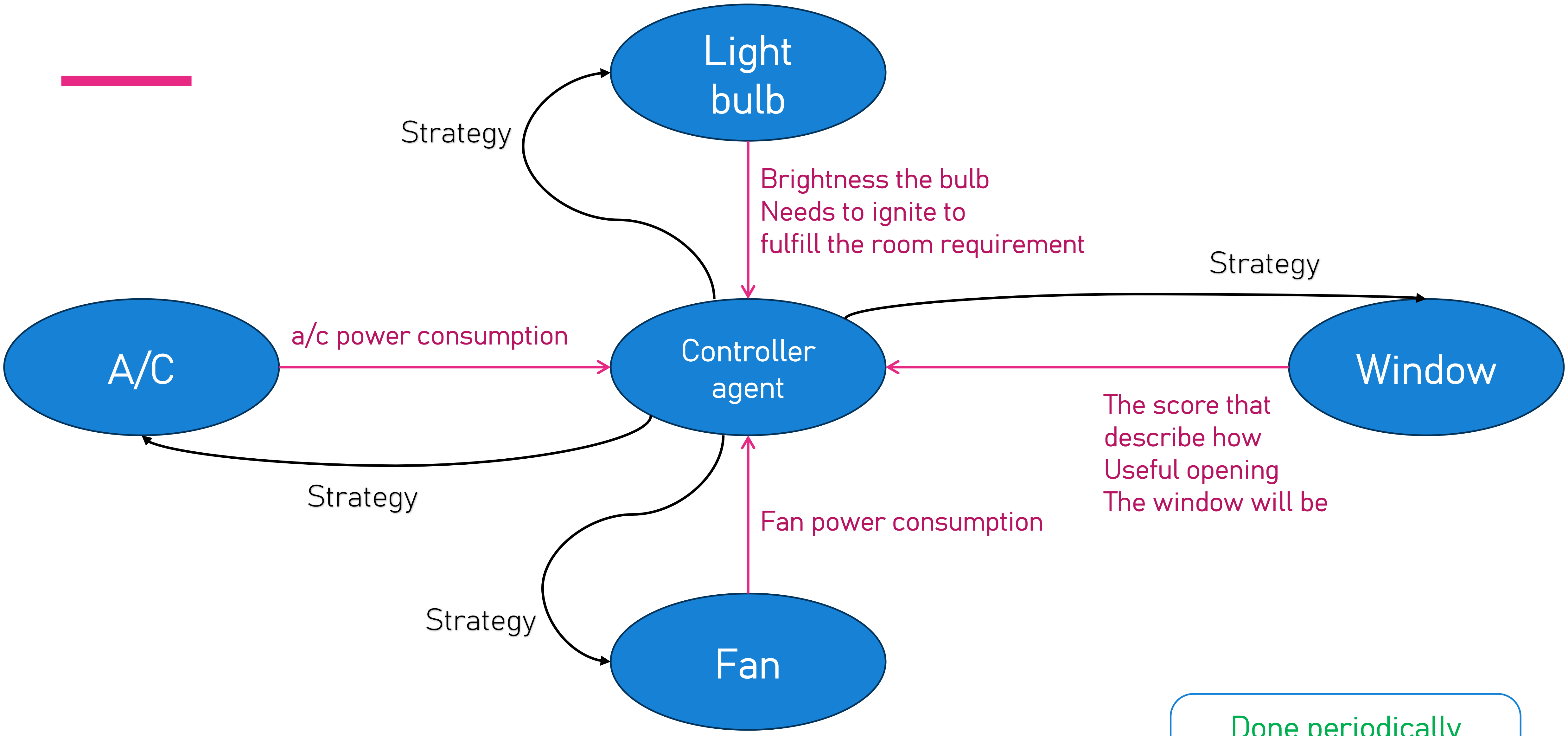
Communication

- Peer-to-peer

Coordination

- Contracting


Temperature Agent
Humidity Agent
Room Brightness Agent
A/C
Fan
Window
Light bulb
Outside brightness



Done periodically
(ex: per each 15 mins)

Contracting

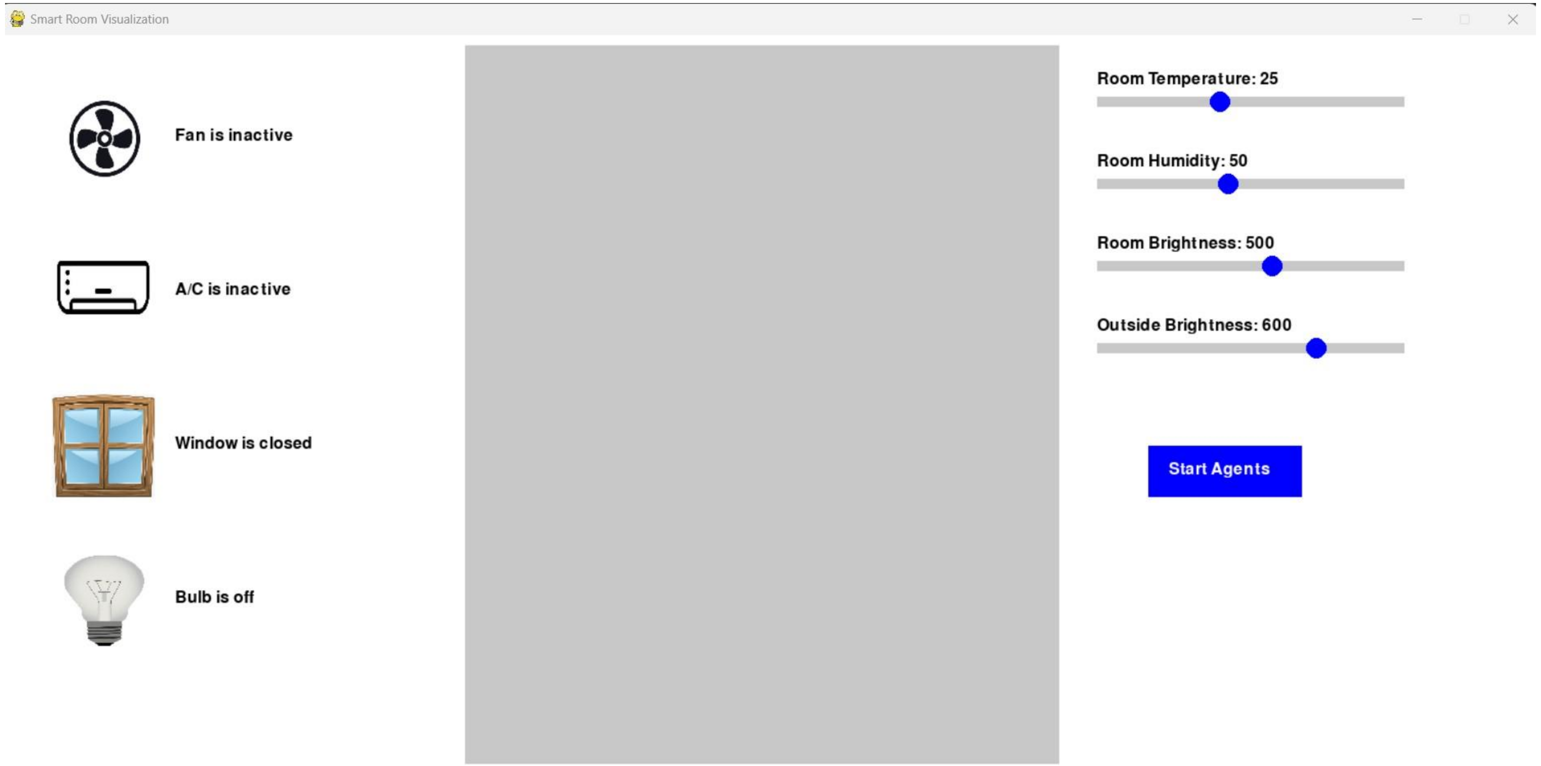
- Controller agent is taking proposal from all the other functional agents on how they will address the current room situation. Based, those tenders the controller agent will develop the best strategy and give the contracts to the relevant chosen agents to carry out the room handling until the next round.

Possible strategies

- W – window only
- A – A/C only
- F – fan only
- WF – windows and fan both
- BF – bulb and fan both
- BA – bulb and A/C both
- WB – window and bulb
- WFB – window, fan and bulb

Strategy with the least power consumption is chosen

UI


Smart Room Visualization
Fan is inactive
A/C is inactive
Window is closed
Bulb is off
Room Temperature: 25
Room Humidity: 50
Room Brightness: 500
Outside Brightness: 600
Start Agents

The end.