

Smart Home Lighting Planner

Abstract

This project presents a Smart Home Lighting Planner implemented using Prolog and Artificial Intelligence planning techniques.

The system models a smart home environment and automatically generates a sequence of actions to control room lighting based on predefined goal scenarios such as Morning, Night, Movie, and Party modes.

The planner starts from an initial state and applies logical reasoning and STRIPS-based actions to reach the desired goal state efficiently.

1. Introduction

Smart homes rely on intelligent systems to automate daily activities and improve user comfort. One of the most common automation tasks is lighting control.

In this project, Prolog is used to implement an AI planning system that determines the required sequence of actions to reach specific lighting configurations based on user-defined goals.

2. System Overview

The system consists of:

- A set of rooms
 - An initial state
 - Multiple goal states (scenarios)
 - Defined actions (turn on / turn off)
 - A planner that generates action sequences automatically
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3. Environment Representation

3.1 Rooms

The smart home contains the following rooms:

- Living Room
- Bedroom
- Kitchen
- Bathroom
- Children's Room

Each room is represented as a Prolog fact.

3.2 State Representation

The state of the system is represented using the predicate:

`light_status(Room, Status)`

Where:

- Room refers to a specific room
 - Status can be on or off
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3.3 Initial State

The initial state assumes that all lights are turned off.

4. Goal Scenarios

The system supports four predefined goal scenarios:

4.1 Morning Mode

- Living Room: ON
- Kitchen: ON
- Children's Room: ON
- Bedroom: OFF
- Bathroom: OFF

4.2 Night Mode

- All lights OFF

4.3 Movie Mode

- Living Room ON
- All other rooms OFF

4.4 Party Mode

- All lights ON

Each scenario is represented as a goal state in Prolog.

5. Actions Model

The planner supports two actions:

5.1 Turn On Action

Turns on the light in a specific room if it is currently off.

5.2 Turn Off Action

Turns off the light in a specific room if it is currently on.

Each action is defined using:

- Preconditions
- Add list
- Delete list

This follows the STRIPS planning model.

6. Planning Mechanism

The planning algorithm works as follows:

1. Check if the current state satisfies the goal
2. If not, select a valid action
3. Apply the action to generate a new state
4. Store visited states to avoid loops
5. Repeat until the goal is satisfied

Depth-first search is used with loop prevention.

7. Solve Plan Predicate

The solve_plan/2 predicate:

- Loads the initial state
- Selects the required goal scenario
- Generates a valid action plan
- Stops after finding the first valid solution

8. Output Representation

The system provides:

- Initial state display
- Generated plan (sequence of actions)
- Goal state display

This makes the planner easy to test and understand.

9. Example Queries

solve_plan(morning, Plan).

solve_plan(night, Plan).

solve_plan(movie, Plan).

solve_plan(party, Plan).

run_smart_home.

10. Results and Discussion

The planner successfully generates valid action sequences for all goal scenarios.

The use of Prolog enables clear logical reasoning and flexible extension of the system.

11. Conclusion

This project demonstrates how AI planning techniques can be applied to real-world smart home systems using Prolog.

The system is modular, extensible, and supports multiple user scenarios efficiently.
