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CS 4635 Knowledge-Based AI

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<u>Assignment 3</u>

Introduction:

        I would like to design an agent to automate a rather particularly annoying activity that I am forced to partake in; taking out the trash. To be more specific, when I say, 'taking out the trash', I mean the weekly ritual of rolling the large, green, municipally issued garbage can down to the end of the driveway, where its contents will be collected the following morning by the garbage truck. Taking out the trash is a miserable chore: often needing to be performed in terrible weather. Additionally, once the garbage cans are out, they end up blocking the driveway, forcing you to put them away before you can even leave your home. Worst of all, the entire process relies on our fallible human memory, where forgetting results in trash piling up for an additional week as you wait to correct your mistake. Therefore, I would like to develop an agent that would leverage incremental concept learning and planning in order to automate and streamline the entire process.

Problem Description:

        Although 'taking out the trash' might appear to be a rather simplistic problem, I believe it a has a surprisingly large amount of depth that the agent would need to properly account for. First and foremost, the agent needs to be able to keep track of the date and time such that it can remember when it needs to wheel itself out onto and back off from the street. Secondly, the agent needs to be capable of navigating to the proper position at the end of the end of driveway. The agent will also need the be able to open, and then close, the garage doors that would otherwise block its path. While moving along its path the agent needs to able to recognize and respond to any unexpected obstacles. Penultimately, after reaching its destination, the agent needs to properly orient the can such that the garbage men can easily access its contents. Finally, after detecting that the trash has been properly emptied, the agent needs to navigate its way back into the garage.

Physical Agent Concept:

Shown below is an extremely rough conceptual design for the physical component of the system that would enable my agent to complete its task:
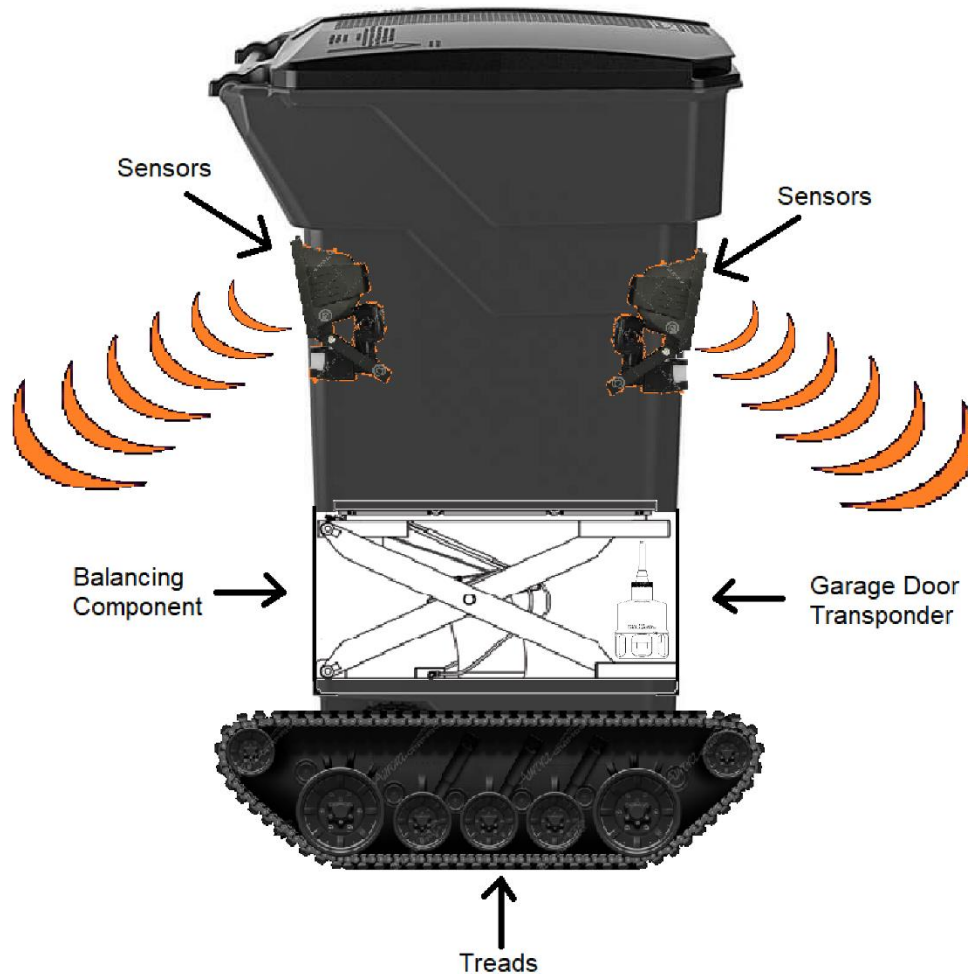
Looking at this picture you can see that my agent will use treads as its form of locomotion, allowing it to travel across rough surfaces like grass and ice. It will also have a balancing device to make sure the can stays at an upright angle to prevent tipping over when traveling across steep inclines. Shown adjacent to that device is also the built-in transponder which will allow the device to send a signal to open and close the garage door. Lastly the agent will possess and array of sensors across the device to provide it with information of its surroundings.

Digital Agent Concept:
        The way I envision my system operating successfully is through a combination of incremental concept learning and planning. My agent will use incremental concept learning to build and manage a traversable map of its surroundings; while planning will be used to create a sequence of actions that will deliver the agent to its destination. Initially my agent starts with no understanding of the world around it, requiring the agent's owner to perform a couple "test-runs" where they manually wheel out the trash can like normal. These test-runs play a pivotal role, as they allow the agent to build up an initial map and path to the destination. The map concept will be broken-up and variabilized into a grid like structure, with each grid being marked as obstructed or unobstructed. After completing a sufficient number of these test-runs, the agent will take then attempt to take over an autonomously deliver itself to the goal. It does this through a multistage planning process.

1. After performing a regular time/date check, the agent determines that this is the proper time to activate.
2. Using its conceptual modal of the traversable space, the agent will then use A* path-planning to map out a path to the destination.
3. The agent will then open the garage door.
4. The agent will then begin traversing the planned path. If it encounters an obstacle during its path; the agent will update its map of traversable space, by changing the values of the various grids from unobstructed to obstructed. The Agent will then re-use it's a* path planning algorithm to re-route a new path to the destination.
5. Once the agent arrives at the destination, the agent will then close the garage door and orient itself to the proper position.

My Agent's Strengths and Weaknesses:
        Although I went about designing my agent to tackle a rather personal problem of own, I believe my theoretical agent could work with many other households in solving their own waste removal problems. However, there are many cases were this is an impossibility, any home that might have a flight of stairs, or a manually operated door, between their garbage can and their garbage pick up would prevent my agent from operating successfully. I also never went into details about how my agent would be powered, or recharged. In an ideal would my agent would be able to plug itself in, while not in use; but in all likelihood due to the cumbersomely large nature of the agent, I doubt the feasibility of such a situation. The agent also has the capacity to drive through unwanted sections of someone's property, such as a flower bed, that were deemed unobstructed in order to more expediently reach its destination. As of the current design, there is no way for the agent's owner to prevent or curb the agent from traveling through certain areas.