

A Futuristic Kitchen Assistant – Powered by Artificial Intelligence and Robotics

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Abstract

My project is about building a prototype of a futuristic kitchen assistant that is powered by Artificial Intelligence and Robotics. Using Cozmo (an AI-powered robot made by Anki) and Calypso (a language developed by Professor David Touretzky at Carnegie Mellon University for programming intelligent robots), I have built a proof-of-concept futuristic kitchen assistant that shows how the food identification and serving process can be automated.

I accomplished this by learning Calypso's rule-based language and its five fundamental laws of computation. Using Calypso's various programming features such as perception, teleoperation, pursue and consume, conflict resolution, speech and hearing, landmark-based navigation, and path planning, I learned how to make Cozmo move around and do intelligent activities, which are demonstrated in my prototype.

I designed a model kitchen using a cardboard box. I used the wall templates that had special symbols called "ArUco markers" to help Cozmo recognize kitchen walls and door openings and plan his path accordingly. Once I had the physical model of the kitchen ready, I created a new Calypso program that simulated the model kitchen along with the walls, door openings, the Cozmo robot, and three cubes that represented three different types of food. The program enabled Cozmo to recognize my voice instructions to get a particular food, go to the kitchen through the door opening, pick

up the cube that represented the correct food, bring it to the dining room, and then drop it on a plate in front of me.

I faced several challenges such as how to make Cozmo recognize my voice, identify the door openings correctly, and move around without hitting obstacles. Eventually, after a lot of testing and debugging, I was able to get the kitchen assistant working and was able to prove that using a robot programming language such as Calypso, a robot can be programmed to perform highly complicated tasks such as listening to voice commands from human beings, navigate from one room to another (i.e., from the dining room to the kitchen), pick up an object (i.e., food), and then navigate and bring the object to another room (i.e., from the kitchen back to the dining room).

In the future, I plan to add more intelligence to the kitchen assistant such as providing the ability for a person to select a dish/recipe on a smartphone app, making the kitchen assistant go to the kitchen, find the right ingredients, follow the instructions in the recipe, make the food, and then serve it to the person.

Introduction

I got the idea for building a futuristic kitchen assistant while I was learning how to program Cozmo (a small robot powered by AI) using Calypso, a robot programming language developed by Professor David Touretzky at Carnegie Mellon University. At that time, I was assisting Professor Touretzky test a new version of Calypso software that he had released that included instructions on how to build a shack and use landmark-based navigation to make Cozmo (Figure 1) navigate the shack. Once I learned how to do this, I thought perhaps I can use the concept to build a kitchen assistant that is powered by AI and Robotics.



Figure 1. Cozmo robot

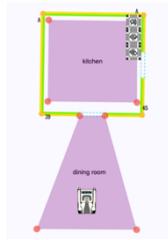


Figure 2. Calypso world map



Figure 3. Robot in the kitchen

Background

I have been learning Calypso robot programming language for the past couple of months and how to use it to program Cozmo to do various tasks. I learned that Calypso is a rule-based language, which is very different from a procedural language such as Python, and that it follows five fundamental laws of computation:

First Law: Each rule picks the closest matching object

Second Law: Any rule that can run, will run

Third Law: When actions conflict, the earliest wins

Fourth Law: An indented rule can run only if its parent's action succeeds

Fifth Law: On every cycle, earlier actions affect later rules

I then learned how to use Calypso's various programming features such as perception, teleoperation, pursue and consume, conflict resolution, speech and hearing, landmark-based navigation, and path planning to make Cozmo move around and do intelligent activities.

Process

I designed and developed a model kitchen using a cardboard box, scissors, box cutter, adhesive tape, and glue stick. I cut the sides of the cardboard box to create door openings. I used the wall templates provided by Professor Touretzky that had special symbols called "ArUco markers" to help Cozmo recognize kitchen

walls and doorways and plan his path accordingly. Inside the model kitchen, I placed different small pieces of kitchenware to simulate an actual kitchen. I labeled the three cubes that came with Cozmo as three different food types and placed them inside the kitchen. Once I had the physical model of the kitchen ready, I created a new Calypso program that simulated the model kitchen along with the walls, door openings, the Cozmo robot, and the cubes that represented different types of food (Figure 2). I then wrote the programming required to make Cozmo act as an artificially intelligent kitchen assistant.

I tested the program by making Cozmo listen to my voice instruction to get a particular food, go to the kitchen through the door opening, pick up the cube that represented the correct food, bring it to the dining room, and then drop it on a plate in front of me.

Results

I was able to prove that using a robot programming language such as Calypso, a robot can be programmed to perform highly complicated tasks such as listening to voice commands from human beings, navigate from one room to another (i.e., from the dining room to the kitchen), pick up an object (i.e., food), and then navigate and bring the object back to another room (i.e., Figure 3 - taking the food from the kitchen and bringing it to the dining room).

Future work

In the future, I would like to add more intelligence to the kitchen assistant. For example, when a person selects a dish/recipe on a smartphone app, the kitchen assistant will go to the kitchen, find the right ingredients, follow the instructions in the recipe, make the food, and then serve it to the person.

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