CMPSC 497

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READ ME for Autonomous Mobile Robot System - Custom Built

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Autonomous Soda Selector

Overview

The Autonomous Soda Selector is a Python-based application that simulates an autonomous robot navigating a grocery store to find and identify specific soda cans selected by the user. Utilizing computer vision through a webcam and a trained YOLOv8 object detection model, the application allows users to create a virtual shopping cart of desired sodas. Upon initiating the "robot vision," the application processes the webcam feed, identifies the selected soda cans in view, and notifies the user when an item is found. While this version doesn't control a physical robot, it demonstrates the core functionality of automated item detection in a retail environment.

Features

- **Intuitive User Interface:** Built with customtkinter, providing a clean and user-friendly interface to select desired soda cans.
- **Real-time Object Detection:** Employs a trained YOLOv8 model (ultralytics) to detect soda cans in the webcam feed.
- **Virtual Shopping Cart:** Allows users to add and remove soda types from a virtual cart before initiating the detection process.
- **Visual Feedback:** Displays the processed webcam feed with bounding boxes and labels around detected soda cans.
- **Item Found Notification:** Provides a pop-up notification when a selected soda can is detected.
- **Cart Management:** Enables users to view and manage the items currently in their virtual cart.
- **Simulated Autonomous Navigation (Conceptual):** While not physically moving a robot, the "Start Robot Vision" button conceptually initiates the automated search process. The aisle information is currently simulated and would be integrated with actual robot navigation in a real-world implementation.

How to work our Autonomous Grocery Shopping Robot

Software

This guide will help you understand and operate the Autonomous Soda Selector code, even if you've never seen it before. This application uses a camera to detect sodas you've added to a virtual cart and tells you which aisle they are in.

Prerequisites

Before you can run or modify this code, you need to have the following installed:

1. **Python 3.x:** Make sure you have Python 3 installed on your system. You can download it from python.org.
2. **Required Python Libraries:** This code relies on several Python libraries. You'll need to install them using pip (Python's package installer).

How It Works

The CartUI is a basic user interface that allows the user to fill their shopping cart with 4 types of soda's: Coke, Pepsi, Fanta and Sprite. The user can select 1 of each or remove the ones they do not want by accessing the cart. Once they are happy with their selections, the user starts the "robot vision" and the cart goes off to search for the items. Using our attached camera, the robot is able to detect the entire soda can. This is done using our trained YOLOv8. As the robot finds the items, it will track what aisle the can is in and which can it was. Ex. Coke found, aisle 1. Once everything is found, the UI will have a final screen showing the cans and their corresponding aisle.

The **movement** is controlled by 3 files: pathing, Wheel_funcs, and and obstacle_detection.

Pathing.py:

The robot moves forward down an aisle, briefly stops if it detects a soda (can), and turns into the next aisle upon reaching a wall.

The robot stops completely once all sodas in the cart have been detected and removed.

- **Forward Movement:** Robot moves forward by default inside an aisle.

- **Soda Detection:** If a soda can is detected (using placeholder), the robot stops briefly for 2 seconds, then continues moving.
- **Wall Detection:** If a wall is detected (using ultrasonic sensors), the robot stops, turns left, and continues into the next aisle.
- **Completion:** When all sodas in the cart are found, the robot stops entirely.

Wheel_funcs.py:

This file basically controls the wheel movements, such as forward, and backward. This file coincides with the pathing file and obstacle detection file.

Obstacle_detection.py:

The obstacle detection file works with the Arduino in stopping the robot and turning it 90 degrees when it comes close to the end of the aisle, in the case the wall. Using the ultrasonic sensor, the robot is able to sense the distance from it and the wall and turn into the next aisle.

Hardware:

This guide will help you understand and operate the Autonomous Soda Selector hardware. It details what we used and how everything was connected.

Prerequisites:

Before you can get started on our autonous robot, you'll need the following:

1. **Robot Kit:** HelloMaker custom build robot kit
2. **Keystudio** 37 in 1 kit (Ultrasonic sensor, cables, breadboard)
3. Raspberry Pi 5
4. Arduino Uno
5. Camera
6. 5V battery pack
7. Portable charging pack

How It Works

Our custom-built autonomous grocery shopping robot utilize the microcontroller(Raspberry Pi 5) and the sensor input (Arduino Uno) to control the physical robot. From here, the robot is able to pickup movement signals from the Pi and sensor input from the Arduino to stop and go. The code wihin the ardunio controls the distance the robot needs to be from a wall before turning 90 degrees. The raspberry pi is in charge of holding the CartUI software and movement software (as mentioned above).