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Assignment: Project 2

Project 2

I. Robot Design

Similar to our design for Project 1, we followed the [Medium Motor Driving Base](#) assembly instructions found on the ev3 website. We chose to do this for similar reasons to Project 1:

- Copying a known configuration reduces time spent on robot design and construction
- Copying a manufacturer-recommended configuration potentially reduces time spent adjusting robot design
- Two wheels simplifies kinematics of the robot
- Three points of contact with the ground nigh-guarantee stability

Beyond the above design and reasoning, we of course had to add sensors.

For wall following, we used a **color sensor** pointed at the ground to the left of the left front wheel of the robot. We chose this position so that as the robot wandered in a clockwise spiral then followed walls clockwise, this color sensor's efforts to stay off the blue tape would keep the center of the robot as far from the tape as possible.

For goal detection, we used an **ultrasonic sensor** pointed forward from the robot, mounted low to the ground. We chose this forward position so that the robot would not have to reorient itself upon goal detection, and we chose this low position so that it would not miss any narrow-bodied goals - and because it was the easiest mounting point available.

We also extended the forward arms of the robot to each side to increase the area in front of the robot that would be affected by the clearing behavior, as the ultrasonic sensor can detect objects off-bore by a somewhat significant amount. These longer arms allow the robot to engage those off-bore targets.

II. Control System Components

Wandering Behavior: `wander()`

Our robot starts out by entering the wandering mode, which makes the robot move in an expanding clockwise spiral from its starting point, checking for walls and the goal all the while. It continues its spiral movement until it either finds a wall, in which case it enters wall following mode, or detects the goal, in which case it enters clearing mode.

Wall Following Behavior: `follow_wall()`

In wall following mode, which can be entered from wandering mode or from clearing mode, so long as a goal is not detected (which it checks continuously), the robot will follow the wall it has encountered.

It does this by running the left motor when the color detector sees blue (the wall) followed by reversing the right motor until the color sensor is off the wall. If the color sensor does not detect a wall while in wall following mode, it will run the right motor until the color sensor does detect the wall.

In this behavior, the robot essentially hits the wall, angles away, then angles back towards the wall in a sort of staggered scooting fashion.

This behavior continues until a goal is detected, in which case the robot enters clearing mode, or until 80 seconds has passed, in which case the robot reenters wander mode.

Goal Finding Behavior: `goal_found()`

This boolean function is continuously called by the while loops within `follow_wall()` and `wander()`. The resulting behavior is that the robot will enter clearing mode from within `follow_wall()` and `wander()` whenever it detects the goal.

This function calls the `.distance()` method of the ultrasonic sensor and returns true if the detected distance-to-object is less than 330 mm, and false otherwise. 330 mm roughly translates to 13 inches, 1 more than spec, which is due to the inaccuracies observed in the ultrasonic sensor.

Clearing Behavior: `clear()`

In clearing mode, which can be entered from wall following or wandering mode, the robot enters a pseudo do-while loop, where it moves forward by a small amount once, then continues moving forward by that amount so long as there is not a wall in the way and it has not gone too far forward (determined by a movement counter). If a wall is found, it reenters wall following mode in an attempt to get around the wall to later vanquish the goal. If the movement counter limit is reached, it announces that it has achieved the goal, assuming that it has successfully moved the object from its original location.

As stated earlier, adding extended arms to the front of our robot ensures that simply moving forward when the ultrasonic sensor finds the goal, whatever the angle off-bore is.

Stopping Helper Function: `stop_robot()`

This function calls `.stop()` and `.hold()` on both motors, effectively pausing movement in such a way that allows the movement to continue as if it hadn't been interrupted. This is useful because without the stopping helper function, the robot would continue behavior like wandering for a time before entering another behavior.

Wall Detection Helper Function: `wall_found()`

This boolean function returns True if blue, i.e., a wall, is detected by the color sensor, and False if not. It is called continuously by while loops in `follow_wall()`, `wander()`, and `clear()` to control when different behaviors happen.

III. During the Demo

During our demonstration, our robot had trouble detecting colors properly, due both to differently-shaded tape and the sensor not being high enough off the ground to detect properly. Allison fixed this by pulling the sensor ever so slightly up with two rubber bands.

IV. Robot Name

We named our robot Rehoboam, after the heir of Solomon, the name of our Project 1 Robot.