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ECE 101
Title: Group Robot Assignment

Link to the demo video: <Click here>

Introduction:

Our group's objectives were to solve a maze, to record the information about the correct turns (left or right), to transmit the information to a second robot, and to have the second robot solve the maze without going into a dead end.

Originally, our group planned to make a maze out of lines and to use the robot's line sensors in order to stay within the maze and to find the way to the end. However, we found that the robot often missed the lines or sensed lines that were not there. This unreliability of the sensors made us decide to create a maze out of cardboard and have the robot sense obstacles instead using the getObstacle() function. This approach was much more accurate as it reduced the number of 'wrong readings' that the robot had and increased the accuracy of the list produced.

To solve the maze, we designed a function to make the robot turn left whenever it senses an obstacle. Each movement of the robot was added to a list which we stored in a particular location first. Then, we wrote code to eliminate forwards in places where there were multiple forwards in a row so that the robot would not wrongly bash into walls unexpectedly. This made the dead ends easier to identify so that they could be replaced with the right turns. If the robot turned left, went forward, then turned left twice in a row ('left', 'forward' , 'left' , 'left') as shown in the list, we knew the robot had reached a dead end. We wrote code that removed this set of instructions from the list and replaced them all with a single ('right') as shown in the list. Afterwards, we removed all "forward" movements from the list so it only included turns and the second robot would move forward until it senses an obstacle after which it would pull from the list and use the instruction stored at a particular position.

The first robot transmitted the list through the light sensors of the second robot. We attached a flashlight to the first robot and placed it sideways behind the second robot. The

flashlight was in line with the middle light sensor. The second robot picked up the sounds from the first robot's movements by using its microphone, then started to receive the correct list of movements by using the light sensors. Before using the microphone, we tried to control each robot with a separate laptop and coordinate when we started each function, but this proved to cause inaccuracy. The second robot added the correct turns it picked up from the first robot to its own list, a new blank list which was then populated with directions from the list of correct turns. At first, we noticed that the first item in the second robot's list was not sent to the robot via the flashlight. To solve the problem, we used the sounds of the robot's movements as a signal instead of adding a beep sound to the start of the function. This removed the problem of a delay between the second robot starting to sense the light and the first robot starting to move. The first robot would move back and forth to send the direction-- forward to send "right" and back to send "left." Since the position of the robot depended on the previous item in the list, we had to create several cases in order to make the robot travel to the correct sensor.

After the communication of the information was complete, the second robot would sense the sound of the user's order and start solving the maze. Whenever the second robot senses an obstacle, it can turn left or right according to the information in the final list, and not go into the dead end. Once the robot completes the turn in the list, it deletes it from the list so the next turn is always the first element in the list.

If it finishes solving the maze, it plays a celebration song while rotating. The direction of the rotation changes halfway through the song.

Conclusion:

There are many strengths to our project. In our maze the number of dead ends could be unlimited, and no matter how long the maze is, the robot will find a way and send a list without mistakes to the second robot. Since the list only contains the right direction at crossroads, the robot can transmit the reduced amount of information, which causes less errors. Also, using sound to activate the function makes it easier for the user to initialize the movement of the robot by clapping for instance.

However, the maze needs to meet certain conditions: the dead ends should be on the left side to the robot, and the maze must have the corners to its left. We programed the robot to turn left when it sees an obstacle, which made having a dead end on the right of the robot inefficient and might trap the robot. There are some problems related to the accuracy of the motion. The angle of the turn is dependent on the battery power and isn't always a perfect 90 degree angle. The robot doesn't always move in a straight line and sometimes it runs into the cardboard when it doesn't detect an obstacle. The transmission is sometimes affected by any light, so it was the best in the dark.

With more time, we could have expanded the number of mazes that the robot could successfully complete. We also could have found a better flashlight with adequate size and mass which we can control the angle to light the sensor of the second robot.