CSCE-452-500 Project#3

Tropical Storm Ofo:
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Project Summary

For project 3, our team created a program that simulates modular robots. These robots can be programmed to interact with light sources in various ways. The project was created using a HTML5, Javascript, and dat.GUI.

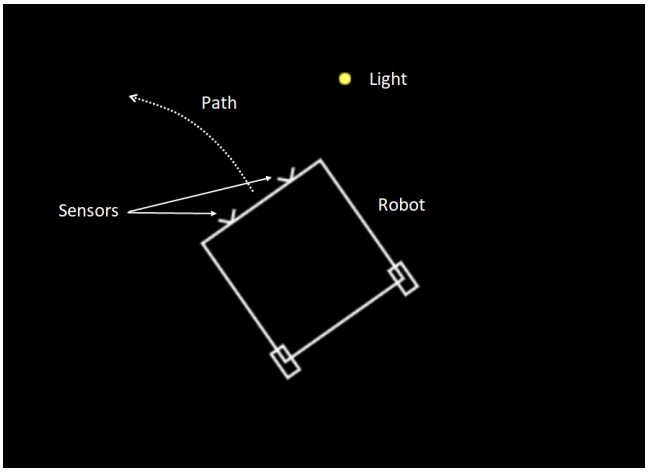

Figure 1: Screenshot of our project with annotations.

Robot Overview

Each robot has two wheels, and two light sensors (see figure above). Each light sensor is connected to both wheels with weights. These weights, along with the sensor input determine each wheel's velocity. In total, there are four weights for each robot, and by adjusting these weights, the robot can be "programmed" to seek light sources, avoid light sources, and much more.

Robot Mechanics

To calculate wheel speed, the following equation is used:

$$\begin{bmatrix} V_L \\ V_R \end{bmatrix} = \begin{bmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{bmatrix} \begin{bmatrix} S_L \\ S_R \end{bmatrix} = K \begin{bmatrix} S_L \\ S_R \end{bmatrix}$$

Where V_L, V_R are the velocities for the robot's two wheels, S_L, S_R are the sensor inputs, and $K_{11}, \cdots, K_{22}$ are the weights referred to in the previous section. By adjusting these weights, various robot behaviours can be achieved. For example, the matrix

$$K = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

will result in a robot that follows light sources.

Robot Kinematics

To calculate movement speed and rotation, we used the following equations:

$$\begin{aligned} x(t) &= \int V(t) \cos(\theta(t))\, dt \\ y(t) &= \int V(t) \sin(\theta(t))\, dt \\ \theta(t) &= \int \omega(t)\, dt \end{aligned}$$

where x, y are the coordinates of the robot and θ the angle over time t. Also,

$$\begin{aligned} \omega &= \frac{V_R - V_L}{2d} \\ R &= \frac{d(V_R + V_L)}{V_R - V_L} \\ V &= \omega R = \frac{V_R + V_L}{2} \end{aligned}$$

where d is the distance between either wheel and the center of the axel and V_R, V_L are the results of multiplying K by the sensor input vector.