ME 456 Mechatronics

Workshop Assignment #3: Triangulation with two sensors

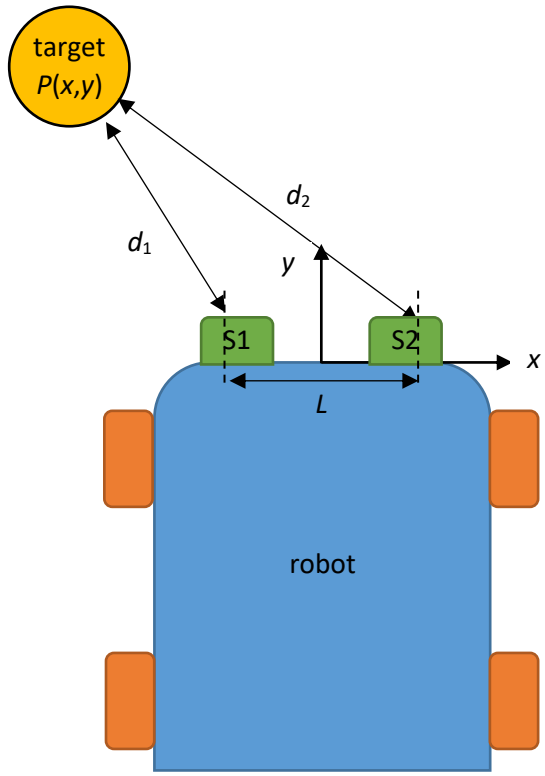
15.04.2025

Goal:

This assignment is about using two ultrasonic sensors to detect the planar position of the target object (triangulation) in front of the sumo robot (see Figure below).

Prelab [+5 pts]:

- Obtain a second ultrasonic distance sensor and connect to your Arduino controller. Fix your two sensors in front of your robot by leaving a fixed spacing in between the sensors, for example L = 12 cm. You can fix the sensors to the robot's chassis or a separate rail part can be used. In any case, make sure the spacing in between the centerlines of two sensors (L) is a known and fixed dimension.
- Write an Arduino program that can provide you with distance measurement from both sensors d_1 and d_2.
- Two sensors S1 and S2 will provide you with distances d_1 and d_2. Using geometry, derive a formula that relates d_1 and d_2 to the position of the target (x, y), relative to the coordinate system, as shown in the figure.



Lab Tasks [+5 pts]:

- Write a program that will continuously measure d_1 and d_2 distances and then using your formula to compute the position of the target (x, y).
- Your program must be capable of displaying the (x, y) using the serial monitor.

Homework and Reporting [+10 pts]:

- Now, extend your target position detection program to identify target velocity (for a moving target). Velocity of the target can be computed using a numerical scheme such as:

$$V_x(k) = \frac{x(k) - x(k-1)}{\Delta T}$$

$$V_y(k) = \frac{y(k) - y(k-1)}{\Delta T}$$

Here, k indicates the current time index, $k-1$ indicates the previous time index and ΔT is the time step in between repeated measurements. Your program must store the current and previous measurements and there must be a fixed time step between successsive measurements. Your program must display V_x and V_y velocities continuously and in proper units such as m/s or cm/s.

- Prepare a short report (2-4 pages) with your codes and results. Give a short discussion on robot's performance. Show a video of your robot.