Chapter 7 - Group 04

7.3.1 Design and implement the Line finder

Simplified FSM

Input: Sensor(l,m,r) w = white = 1, b = black = 0
Ouput: motor_l_reset, motor_l_direction, motor_r_reset, motor_r_direction
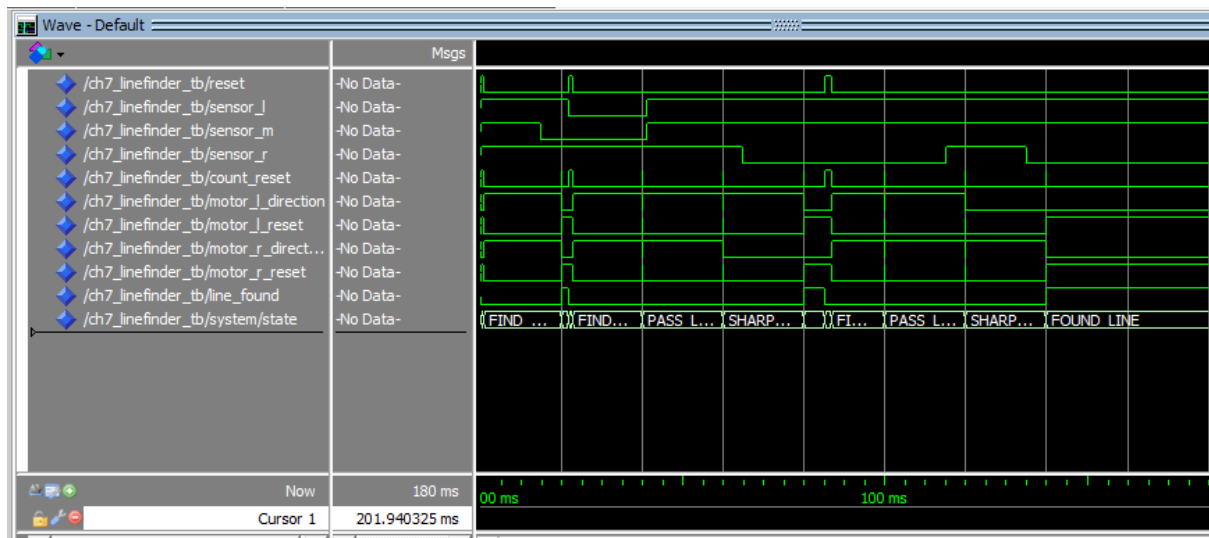

FSM of the line finder:

Testbench of the line_finder controller

We have designed the line finder in such a way that it will traverse all the paths to the line found state.

First by going directly from find_line to Found_LINE if the sensors are (wbw). Then by following the path to pass line, turn sharp right and then line found at 80ms, and finally find_line, pass_line, turn sharp left, line found at 140ms.

Explanation of chosen method

We choose to use multiple separate controllers. These controllers are the line_finder controller, line_tracker controller and a main controller which controls the output of the mux. The main controller switches the output of the mux whenever the reset is hit or whenever the line_finder gets to the line found. This method allows for easy addition of functionality. The separate controllers also allow for easy testing and debugging.

We are aware of the fact that the motors are mirrored and hence the forward/backward function is flipped. In our case, the right motor works in the opposite way. A pulse width of 2 ms for the right motor will result in a backward rotation and a pulse width of 1 ms will result in a forward rotation. To implement this, we used a NOT function in front of the motor direction to the right motor. This means that when a '1' is sent from the controller, a '0' is received at the right PWM generator.

Testbench of entire system

This is a table of the sensor values we use in the testbench. The last row shows the expected next state at the end of the pwm period. So the first column says that the sensors are 111 at 0 ms and the state is find line until 20 ms.

time (ms)	0	15	35	55	75	95	115	135	155	175
sensor_l	1	0	0	1	1	1	1	1	0	0
sensor_m	1	1	0	1	1	1	0	0	1	0
sensor_r	1	1	1	0	1	0	0	1	1	1
Next State (multiples 20 ms)	find line	pass line	pass line	pass line	sharp right	sharp right	turn right	forward	sharp left	turn left

We used the following sensor values to simulate the track. Notice that the main controller should change from using the line finder to using the line tracker between 95 and 115 ms.