CPSC 359 – Fall 2019
Assignment 1: Combibot: a sumobot strategy in combinatinal logic

due: 0900h 30-Sep-2019

Background

"Robot-sumo is a sport in which two robots attempt to push each other out of a circle (in a similar fashion to the sport of sumo). The robots used in this competition are called sumobots." (`https://en.wikipedia.org/wiki/Robot-sumo`) In this assignment, you will design a combinational logic circuit to implement a simple strategy for a hypothetical sumobot.

Combibot

Figure 1 describes the basic operation of the combibot and the sumo arena in which it competes.

Combibot balances on two wheels, controlling its motion with the motors that drive those wheels. It uses *differential steering*, i.e., steers by turn the wheels in different directions or at different rates. You have two motor controllers, one for each wheel, and each motor can do only one of three things at any point in time: stop, go forward, or go in reverse. Table 1 summarizes the binary inputs to the motor controllers. Note that the motor controllers do not respond continuously to their input – they sample the command input once every second, performing the commanded behaviour for a full second before getting the next command.

Combibot has four sensors, each of which produces a binary value depending on what it senses. M_0 and M_1 detect the edge (or *margin*) of the arena. M_0 looks forward while M_1 looks rearward. $M_0 = M_1 = 0$ means combibot is inside the arena, while $M_0 = 1$ or $M_1 = 1$ means the corresponding side of combibot is at the edge of the arena. E_0 and E_1 detect the opponent sumo (or *enemy*). E_0 looks to the left, and E_1 looks to the right. $E_0 = 0$ or $E_1 = 0$ means no opponent detected, while $E_0 = 1$ or $E_1 = 1$ means an opponent is detected on the corresponding side of combibot.

What you need to do

To design the circuit and complete the assignment, you need to do the following.

1. Identify all the inputs and outputs for your circuit. This step is fairly obvious, but it is a good habbit to write these down anyway.

$L_1(R_1)$	$L_0(R_0)$	**action**
0	0	stop
0	1	forward
1	0	reverse
1	1	not allowed

Table 1: Motor control commands. L_1/L_0 (left wheel) and R_1/R_0 (right wheel) are binary inputs. The controllers sample their input to get a commandevery second. They perform the last command received for a full second until they get the next command.

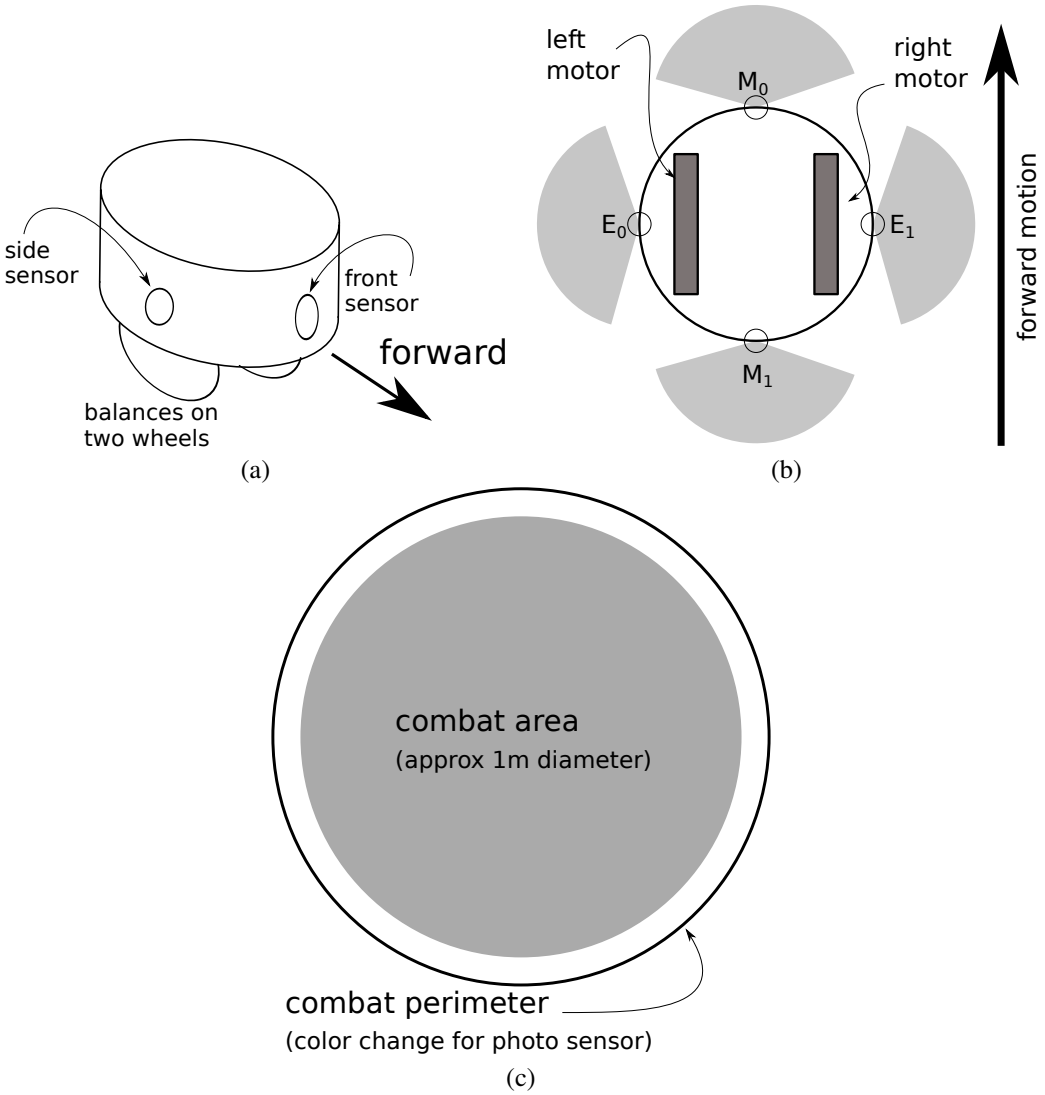

Figure 1: Combibot and the sumo combat arena: (a) a sketch of a combibot, (b) a top view showing sensor and motor layout, and (c) the arena.

2. Use the combibot strategy sheet provided to develop your strategy for combinational control of combibot. You are free to create your own strategy, but it must be reasonable. I.e., your strategy should look like it could possibly win a Robo-sumo competition against a weak opponent. Strategies that the marker deems overly simple (in order to trivialize the circuit design) will receive low grades.
3. Design the combinational circuits to implement your strategy.
4. Implement your design in Logisim using the provided template.

Deliverables

Turn in the following items for evaluation.

1. Documents (and code) to show the steps in your analysis and design for items 1, 2 and 3 above. You can scan your combibot strategy sheet, or annotate the pdf electronically. You should also include truth tables, Karnaugh maps, and functions in minimized disjunctive normal form (OR of ANDs).

2. All files for your Logisim implementation of your design (probably just one).

Evaluation

1	Identification of input/output/state variables.	2pts
2	Karnaugh maps for each output.	6pts
3	Design of combinational logic for each output.	5pts
4	Logisim implementation - runs correctly.	5pts
5	Logisim implementation - inputs/outputs labelled.	2pts
	Total	20pts

There is no team work. Each student should submit their own solution.

Late work

After the deadline and up to 24hrs late: -5pts. After 24hrs and up to 48hrs late: -10pts. Over 48hrs late: -20pts, i.e., no assignment will be accepted beyond 48hrs after the deadline.

Plagiarism

Submitted solutions must be your own work, and only your own work.

You may find that the design task for this assignment is similar to other well known circuits. Nevertheless, you should go through the design process yourself, and submit your own work. If you do borrow from other sources, cite the source and clearly indicate what you have borrowed, keeping in mind the design must be substantially your own. If you cite your sources, worst case you may receive a reduced grade for borrowing too much. If you borrow, but do not cite, that is plagiarism and academic misconduct. Plagiarism carries severe penalties as determined by the Faculty of Science.

As a guideline, consider the 20-minute rule. Talk with your colleagues and consult other sources (cite them please). Wait at least 20 minutes, then do your work to be sure that it is your own. Less then 20 minutes usually means that you are merely copying work from the original source.