CPSC 359 – Fall 2020
Assignment 1: Joystick Encoder – use a joystick for numerical entry
Revised 16-Sep-2020

due: 0900h 28-Sep-2020

Background

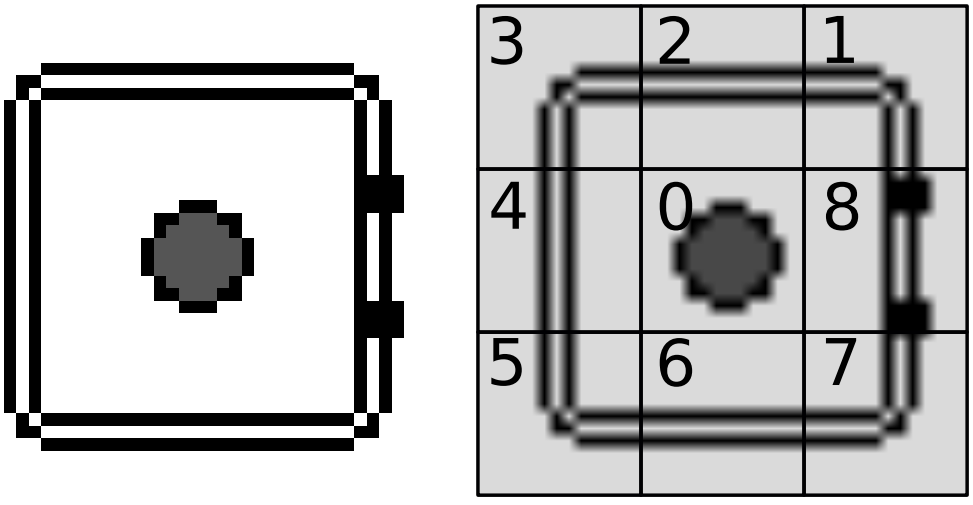
The goal of this assignment is to take the output of a joystick (simulated in Logisim) and turn it a digital number that represents an enumeration of a set of directions. You will use methods for combinational logic circuit design.

In assignment 2, your circuit will provide the numerical input to a digital combination lock that you activate by moving the joystick in a specific sequence of directions.

Logisim Joystick

Figure 1(a) shows your *joystick* as represented in Logisim. You can move the joystick with the *poke* tool (the one that looks like a hand with its index finger extended). The attributes of the joystick allow you to select the number of bits used to represent its position. Use two bits for this assignment.

Note that the joystick has an odd number of positions (center plus the left/right positions duplicated). Regardless of the number of bits used, the binary representation can enumerate an even number of positions. Logisim handles this by never using postion zero. Therefore, with two bits, the positions for x or y can be in $\{01, 10, 11\}$. When doing your design, any joystick output with 00 on either axis can be treated as a *don't care* state (typically denoted with an '*X*').



(a) (b)

Figure 1: The Logisim joystick: (a) the joystick as it appears in Logisim, and (b) an enumeration of the 9 unique joystick positions that are possible with 2-bit encoding.

You are provided with a Logisim template to help you get started with your solution. Using probes from the wiring menu in Logisim will help you to debug your design. Note that the joystick output is a 2-bit signal. To separate this into two 1-bit signals you can use a splitter (in the wiring menu). Splitters combine/break-up multibit signals.

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.
2. Write out the truth table for each of our outputs.
3. Use techniques from the course, inlcuding Karnaugh maps to to design circuits that implement output functions.
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 the steps listed above. You should include truth tables, Karnaugh maps, and functions in minimized disjunctive normal form (OR of ANDs, binary sum of products).
2. All files for your Logisim implementation of your design (probably just one).

Evaluation

1	Identification of input/output.	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.