EEE 120

Capstone Project Answer Sheet (Online Class)

Name: Yengkong Sayaovong

Semester/Year/Session (A/B): Spring 2022 A Date: 2/27/22

**Task C-1: Planning the Synchronous Sequential Machines**

(5 pts) Interview your stakeholders (TAs, Instructors, family, friend, OR “Yourself”…etc.). Ask questions regarding the form, function, and features needed by potential customers for this design. Make sure to capture what the customer prefers from this type of solution, as well as what environment the customer plans to use this design. Summarize your findings here and document the names of who you interviewed.

**Stakeholder name: Chay S.**

**Question: What features are important to make the wheelchair convenient?**

**Stakeholder:** The wheelchair should be easily able to move left or right.

**Question: What is the most important to you when looking for a wheelchair?**

**Stakeholder:** The wheelchair should be light since we travel a lot as a family. It would be difficult to bring the wheelchair everywhere if it was heavy since we have four kids to watch out for already.

**Question: What safety features are important to you when choosing a wheelchair?**

**Stakeholder:** With my daughter being only 3 years old and because of her condition, I think having straps to hold her legs in place would really benefit the wheelchair.

(5 pts) Please include a comment on why your automation adds value from multiple perspectives (technological, societal, financial, environmental, etc.). (*What value does this add? What is the type of customer for whom this is designed? Where is this most needed? What couldn’t you do before?*) [2-3 sentences are sufficient]

This wheelchair will mainly be used for everyday use moving from crowds of people to the next crowd so the design must be easy to use and can get user safely from point A to point B.

(5 pts) It is allowable to continue to ask questions of stakeholders throughout the design process (and is preferred of a conscientious engineer). This can be done as you are designing, before you are designing if you need input and clarifications, or after you are done designing if you want feedback on improvements. Summarize any changes to your understanding or design based on the feedback you received during your initial interviews or continual interviews?

**Question: Where do you prefer the move forward, backward and stop buttons to be?**

**Stakeholder:** I would like a joystick instead in case my daughter accidently leans her hands on the buttons.

**Task C-2: Document the Synchronous Sequential Machines**

**Design #1:** **(2 pts) What assumptions did you make in the design of this machine? (Based on stakeholder’s requests)**

The assumptions that was made was that whenever the user was at the farthest right or left, the state would be reset to 0

**(3 pts) Create a state definition table here that describes in plain English what each state in your machine means and what binary values you have assigned to represent each state, inputs, and outputs.**

|  |  |  |
| --- | --- | --- |
| State | Binary | Definition |
| S0 | 000 | Center |
| S1 | 001 | First left |
| S2 | 010 | Second left |
| S3 | 011 | Third left |
| S4 | 100 | First right |
| S5 | 110 | Second right |
| S6 | 111 | Third right |
| S7 | 100 | unused |

**(12 pts) Show your state diagrams, state transition tables and your circuit planning work (Karnaugh maps/MUX/DEC/etc.) used in your design process. (You can do this by hand if you wish, do not show the full circuit schematic here.)**

See link for diagrams:

https://drive.google.com/file/d/15N-UstsNixsEKzKe-Fk4A0B-2pl0GimA/view?usp=sharing

(3 pts) List your final design equations and required logic gates (including types of Flip Flops) needed to complete this circuit. Do **not** show the full circuit schematic here. You will implement (i.e. build on Digital) only one design. This design will be chosen based on Tasks C-3 and C-4.

**Design 2:**

**Q2:** Q1Y’+Q1’X’+Q0X’+QZQ0X+Q1’Q0’XY+Q2’QZ’Q0XY

**Q1:** Q0’X’Q2 + Q2’Q1’Q0X + Q2’Q1Q0’Y’ + Q2’Q1Q0X’ + Q2Q1Q0Y’ +Q2Q1’Q0’Y

**Q0:** Q0X’Y’ + Q0XY + Q0’X’Y + Q0XY’

**A:** Q2Q1Q0

**B:** Q2’Q1Q0

**Task C-3: Determine Criteria and Weighting for Judging Your Designs**

(5 pts) Using the guidelines in the laboratory FAQ’s, list your 5 criteria and associated weights here used to help decide between the two design models (weights should add to 100%):

Criteria Weight

1. Minimal gates 15
2. Safety 30
3. Compact 20
4. User friendly 30

**Task C-4: Apply the Criteria to Pick the Best Design**

**(2 pts) Describe how you applied each of the criteria and weighting system in the above task to pick the best design. How did you choose these criteria (customer interviews, engineering preference)?**

I picked the criteria and weight based on what the customer preference was ranked the highest.

**(3 pts) Which design is better based on your criteria and weighting system and why? Please explain how the winning design scored in each category and why (the winning design does not need to score the highest in every category, but it does need to score higher overall when applying the criteria weights).**

Design 2 was a better fit for the criteria because it has the least amounts of gates to make the wheelchair functioning.

**Task C-5: Build and Simulate Winning Design in Digital**

(10 pts) Insert a copy of your chosen Digital Schematic here. Please make sure that you have outputs or tunnels connected to each flip flop so that you can easily monitor your states. Make sure that the logic and equations match the final equations presented in either Design 1 or Design 2.

![Diagram, schematic

Description automatically generated]()

(20 pts) Testing: Demonstrate that your “best” circuit meets the completed design specification. You only need to test one design, the one you chose according to your criteria in Task C-4. Use the table below for testing your circuit. Note the following:

* First write the names of the inputs and outputs. The names should match the manual’s convention. Do not use A and B, or X and Y. Graders do not understand what those are.
* Fill-in the table with values you tested. Ideally, you need to test all arrows on the state diagram. If it is tedious, you need to come up with a sufficient testing plan.
* Modify the table as needed.
* If your expected output does not match the actual output, answer the questions at the end of this task.

|  |  |  |
| --- | --- | --- |
| **Inputs**  **[Input names go here]** | **Expected Outputs According to Diagram**  **[Output names go here]** | **Actual Outputs According to Waveform**  **[Output names go here]** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

If your circuit does not work, answer the following questions:

* Where do you think the mistake is coming from? The design? The table? The kmaps? The circuit? Something else?  
  **Answer:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* How would you correct this mistake if you were given more time?  
  **Answer:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Task C-6: Record a Video Demonstration of the Winning Design (Optional)**

(partial credit) If your circuit is not working and want to get partial credit, you can record a video demonstration showing at least 16 clock cycles being simulated through your Digital schematic. This could be a detailed explanation for the last two questions in Task C-5.

For every clock cycle, explain the inputs, what current state you are in, and point out any outputs that should be noted. Be sure to show what happens for different input combinations when the wheelchair is 3 positions to the left and right of center. Your demonstration should be able to showcase all possible states and transitions required to get there. If you include any asynchronous inputs, make sure to show those features as well. Add a link to your video here: <https://drive.google.com/file/d/15H8jfuBTLDqxgqFDmr7mVBF7AFf58xWR/view?usp=sharing>

# Capstone Design Project: Lab Report Grade Sheet

**Name: Yengkong Sayaovong**

| **Grading Criteria** | **Max Points** | **Points lost** |
| --- | --- | --- |
| **Template** |  |  |
| Neatness, Clarity, and Concision | 5 |  |
| **Description of Assigned Tasks, Work Performed & Outcomes Met** |  |  |
| Task C-1: Planning the Synchronous Sequential Machines | 15 |  |
| Task C-2: Document the Synchronous Sequential Machines | 40 |  |
| Task C-3: Determine Criteria and Weighting for Judging Your Designs | 5 |  |
| Task C-4: Apply the Criteria to Pick the Best Design | 5 |  |
| Task C-5: Build and Simulate Winning Design in Digital | 30 |  |
| Task C-6: Record a Video Demonstration of the Winning Design |  |  |
| **Self-Assessment Worksheet** (The content of the self-assessment worksheet will not be graded. Full credit is given for including the completed worksheet.) | (2 extra points) |  |
|  | **Points Lost** |  |
| **Lab Score** | **Late Lab** |  |
|  | **Lab Score** |  |

# Self-Assessment Worksheet

Put an ‘X’ in the table below indicating how strongly you agree or disagree that the outcomes of the assigned tasks were achieved. Use ‘5’ to indicate that you ‘strongly agree’ and ‘1’ to indicate that you ‘strongly disagree’. Use ‘NA’, Not Applicable, when the tasks you performed did not elicit this outcome. Credit will be given for including this worksheet with your lab report. However, your **responses will not be graded**, they are for your instructor’s information only.

**Table 1: Self-Assessment of Outcomes for the Capstone Design Project Lab.**

| **After completing the assigned tasks and report I am able to:** | **5** | **4** | **3** | **2** | **1** | **NA** |
| --- | --- | --- | --- | --- | --- | --- |
| Initiate a design process based on a value proposition and feedback from various stakeholders. |  |  |  | x |  |  |
| Make assumptions to complete an incomplete functional specification. |  |  |  | x |  |  |
| Use classical design techniques (i.e., state diagrams, state transition tables, and Karnaugh Maps), to design a synchronous sequential machine starting with a functional specification. |  |  |  | x |  |  |
| Build, and debug a synchronous sequential machine. |  |  |  | x |  |  |
| Develop reasonable engineering criteria for comparing different designs. |  |  |  | x |  |  |
| Apply engineering criteria to select a ‘best’ design. |  |  |  | x |  |  |

Write below any suggestions you have for improving this laboratory exercise so that the stated learning outcomes are achieved.

I believe the class should be a little slower pace. Probably offer a Session A, B and C? With working a 40-hour work week and having 3 children under 4 years old, I stayed up most nights trying keep up with lectures, labs and assignments. I would have benefited from the class more if I took this in a slower pace C section and developed a more understanding of the materials.