EEE/CSE 120

Capstone Design Project

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Instructor: Alicia Baumann

Class Time: T & Th: 10:30 – 11:45 AM

Date: 4/13/21

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

(5 pts) Interview at least 1 stakeholder, but 3 is preferred. 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.

Wheelchairs, in their nature, are a product which need to be tailored to the user very closely. Questions addressed factors of price, specific discomforts, the build of the chair, fail safes, and features.

**Stakeholder 1: Matthew** (Roommate)

Matthew had a large emphasis on safety and reliability with the wheelchair design, and he plans to use it in an everyday setting in his life.

Price was not as much of a factor in his opinion, and he would rather not compromise features in exchange for a higher price. In addition, he also stressed that quality is a major factor, and having a robust system with basic functions is better than one with too many gimmicks. Matthew also requested that the system not register movements or simply brake completely when reaching an edge, opting for safety over most optimal automatic function.

**Stakeholder 2: Richard** (Peer)

Richard’s main concern in choosing a wheelchair was the price being affordable while maintaining functionality and a few specific features for long-term use and reliability.

As opposed to Matthew’s answers, Richard prefers a lightweight design that is easy to move to accommodate him in many different places. He also believes that not registering a movement is the safest option when at a ledge. When asked about extra accommodations, Richard requested a nicer back rest, as he has existing problems with finding a nice back rest.

**Stakeholder 3: Trevor** (Family member)

Trevor requested more of an all-in-one machine, including more features and movement considerations than my other two stakeholders. He would be using this wheelchair in all facets of his daily life over many terrains, so it makes sense that he requests one more personalized.

In terms of finances, Trevor is comfortable with paying more if it includes all the features he sees fit. He prefers a portable design as well, which would better accommodate his busy daily schedule. Arm rests are an area of discomfort for Trevor, and he hopes to add some comfort to those areas as a writer by trade. Much like the other two stakeholders, Trevor would like to not register any movements if stuck at an edge. He would appreciate a speedometer, a cup holder, and a heated seat in his design for personal comfort.

All three stakeholders, although they each prefer different features and designs, largely agree on most of the safety elements and how the wheelchair should function. They believe that when the chair gets to an edge, the chair should simply not register any movements to be as safe as possible.

(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?*)

The wheelchair which we are designing, with automatic danger detection, can benefit a large number of disabled persons in their everyday life by adding reliability and security whenever they are used. Being able to detect ledges and lock the input can provide the user a greater sense of security. In terms of other factors.

(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?

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

**Design #1:** (2 pts) What assumptions did you make in the design of this machine?

(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.

(12 pts) Show your state diagrams, state transition tables and your circuit planning work (Karnaugh maps/equations/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.)

(3 pts) List your final design equations and required logic gates (including types of Flip Flops) needed to complete this circuit.

**Design #2:** (2 pts) What assumptions did you make in the design of this machine?

(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.

(12 pts) Show your state diagrams, state transition tables and your circuit planning work (Karnaugh maps/equations/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.)

(3 pts) List your final design equations and required logic gates (including types of Flip Flops) needed to complete this circuit.

**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

**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)?

(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).

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

(15 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.

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

(15 pts) Record a video demonstration showing at least 16 clock cycles being simulated through your Digital schematic. 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:

# Capstone Design Project: Lab Report Grade Sheet

**Name:**

| **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 | 15 |  |
| Task C-6: Record a Video Demonstration of the Winning Design | 15 |  |
| **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. |  |  |  |  |  |  |
| Make assumptions to complete an incomplete functional specification. |  |  |  |  |  |  |
| 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. |  |  |  |  |  |  |
| Build, and debug a synchronous sequential machine. |  |  |  |  |  |  |
| Develop reasonable engineering criteria for comparing different designs. |  |  |  |  |  |  |
| Apply engineering criteria to select a ‘best’ design. |  |  |  |  |  |  |

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