Designing Creativity Support Tools

Contact Information

	Lecture	**Instructor Office Hour**	**Lab 1**	**Lab 2**	**Lab 3**
Every week	Tuesday & Thursday 4:30-5:50pm Starting Jan 11	Tuesday 2-3pm or by appointment Starting Jan 11	Thursday 2:30-3:20 Starting Jan 20	Thursday 3:30-4:20 Starting Jan 20	Friday 1:30-2:20 Starting Jan 21
Room	Zoom until Jan 24 (use link posted below) After Jan 24 - ECS 124	Zoom (use link posted below)	ECS 366	ECS 366	ECS 366
Instructor	Sowmya Somanath, sowmyasomanath@uvic.ca http://celab.cs.uvic.ca/		Yichun Zhao, yichunzhao@uvic.ca	Yichun Zhao, yichunzhao@uvic.ca	Dibya Prokash Sarkar, dibyaprokash@uvic.ca

Course Zoom:

Per UVic's announcement, all courses are being offered online until Jan 24.
https://www.uvic.ca/news/topics/2021+notice-january-classes-update+notice

From Jan 11-24 period, the **lecture will be online**. After that period it is expected that we will meet in person per UVic's information.

The labs for this course are **tentatively scheduled to be in-person starting Jan 20** given the hands-on nature of this course, however, this will be confirmed in the first week of the course based on the information I learn from the department.

Zoom link: https://uvic.zoom.us/j/84312693194?pwd=a0dIWWpNQTBqcWhaSmtlbWZQdWsvUT09

Meeting ID: 843 1269 3194
Password: CST
You must sign in using your UVic email.

Course Slack:

Join the class slack to stay up to date with all the ongoing course-related conversations.
https://join.slack.com/t/cst-gbz2583/shared_invite/zt-1179hdsip-_f9ZDpNA~Ex2d9F6YvuEFA

When emailing:

1. Please use the appropriate course code (CSC 485E/ SENG 480C/ CSC 578C) in the email subject line so we can search for your emails easily and also to ensure it doesn't reach spam.
2. When you email Sowmya, you are welcome to address her as any of the following: Hi Sowmya; Hello Dr. Somanath; Hi Professor Somanath; or a variant of those. Please avoid addressing me with a 'hey' as our course-related conversations are most likely not informal chats.

Course Information

Designing Creativity Support Tools is a topics course that will explore designing user interfaces to support creative processes and activities. With Design and Human-Computer Interaction research as a lens, students will envision and create speculative, tangible, or provocative user interfaces to support creative tasks. Students will design such user interfaces keeping in mind specific end-user(s) and select to support specific creative tasks in domains such as food, fashion, music, content creation, DIY activities, programming and more. The course will engage students in thinking about ideas to develop such user interfaces through both foundational literature and hands-on studio culture.

To prototype user interfaces, students will develop fluency in incorporating physical materials (e.g., art and craft materials, 3D printed objects), electronics (e.g., Arduino and DIY sensors), software programming and interaction design ideas into practice. Class assignments and the final project will require hands-on work and typically involve programming, electronic circuitry, designing physical objects and basic digital fabrication. While tutorials and instruction will be provided in each of these areas, students will be expected to take initiative and explore additional information relevant for implementing their projects. There is no final exam for this course. The course will conclude with a final public show-and-tell of the projects (contingent to the evolving pandemic situation).

Why take this course?

- Tools and systems that enable people to engage in creative processes and activities can help people in many ways such as improving their problem-solving skills, providing them with an opportunity to express themselves or helping them improve their overall health and wellbeing.
- Much of what makes humans different -- language, values, artistic expression, scientific understanding and technology -- are results of an individual or collective ingenuity supported by learning new things. Every new generation of people has to learn the basics of such topics and creativity support tools can help facilitate such learning.
- We live in a digitally enriched era, but the commercial products we see around us are usually more of the same. For example, yet another app to solve a human problem. Instead, if we can harness and leverage the interplay between digital technologies and the physicality of humans

and the world around us to create different and expressive technologies, we could identify fresh products and process ideas that help diverse people and the broader society.

Topics Covered

This course will introduce you to the basics of the following topics:

- Theory of Creativity
- Landscape of Creativity Support Tools
- Tangible User Interfaces
- Physical Computing
- Data Physicalization
- Making and HCI
- Speculative Design
- Design Methods

Expected Outcomes

In this course students will learn to:

- **Develop new design and research skills:** Ideate, prototype and build objects and interfaces that support people in accomplishing tasks in creative ways or ways that are different from the current options, and apply this skill to a variety of application domains.
- **Apply multi-disciplinary perspectives:** Identify and examine the relationship between design, technology, and other disciplines and proactively apply interdisciplinary and transdisciplinary perspectives to problem-solving.
- **Communicate effectively:** Learn to disseminate your ideas and prototypes through verbal presentations, writing papers and instruction documents, and video production.

Materials Required and Sources

- **Electronics** - Microcontroller and corresponding input, output and sensor components (e.g., buttons, servo motor, LED, DC motor, temperature sensor, tilt sensor). You may need additional or different components and sensors depending on your project requirements. If you already own and know how to use a specific microcontroller platform (e.g., Arduino, Raspberry Pi), you are welcome to use that for this course. However, if you are new to electronics the recommended kit to purchase is the below listed Elegoo kit. All labs in this course will use the Elegoo kit to introduce topics related to electronics circuitry.

- *UNO Elegoo Starter Kit:* this is a less expensive alternative to Arduino and works similarly to Arduinos. Available via UVic bookstore (https://www.uvicbookstore.ca/merch/search/3498) and Amazon (https://www.amazon.ca/ELEGOO-Project-Tutorial-Controller-Projects/dp/B01D8KOZF4)
- *UVic DSC:* You can borrow some hardware from the UVic DSC, see: https://onlineacademiccommunity.uvic.ca/dsc/toollibrary/
- *ECS 366* - The lab associated with this course also has some microcontroller boards and hardware available for borrowing, but access and availability may be limited.
- *Other stores for electronics* - Ardunio, Digikey, Adafruit, SparksFun and BC Robotics

- **Basic Prototyping Materials -** the assignments and projects in this course will require the use of some physical materials. Some commonly useful materials include paper, pen, pencil, sticky notes, pipe cleaners, glue, clay, and cardboard. You may need other materials per your project needs.

- *Amazon or dollar stores*: are usually the least expensive options to purchase prototyping materials. Also, look around your home and/or office to see what you can re-use or re-purpose.

Course Delivery

This course is being offered as an in-person course. All course activities (such as discussions, show-and-tell, tutorials, class activities and presentations) will expect in-class and lab participation.

Recordings from the lecture may be available however do not depend on them for learning because of the following reasons: a) the lecture will include class activities that cannot really be recorded using the resources currently available in the classrooms. These class activities are important for your learning; b) the quality of the recording device in the lecture room is quite poor; c) there can often be technical glitches or plain human error when recording lectures which often leads to no lecture recording being available for upload.

NOTE: delivery methods may change with short notice due to the ever-changing nature of the pandemic situation.

Expectations from Students

- **Purchasing or borrowing materials:** this is a hands-on course and students will be expected to engage in rapid prototype development. It is the responsibility of the students to purchase or borrow the required course materials in a timely manner so they can complete the assignments.
- **Lab attendance:** is required. Labs will take students through a number of mini-projects and introduce them to skills they can use for their own assignment development.

- **Class Attendance:** will not be monitored. However, missing class activities and lectures may mean you are not actually learning and this may impact how you perform in this course overall. It is your responsibility to take part in all graded activities and be aware of the course progress.
- **Reviewing Class Materials:** This is the responsibility of students. All course materials such as recorded lectures and assignment handouts will be posted on Brightspaces.
- **Assignment Submission**: must be completed per the set due dates. Late submissions will not be accepted unless there was an alternative arrangement agreed upon at least 1 week before the assignment is due. Please also note that extensions affect how much time one has available for the next assignment. Long-term extensions are not possible unless you apply for an academic concession: https://www.uvic.ca/students/academics/academic-concessions-accommodations/index.php
- **Grading:** For the sake of consistency and fairness, I do not alter individual grades per student request. For example, scenarios such as requesting the weight of an assignment be altered or increasing grades by a small percentage will not be accommodated. If students think they need a different grade, they can request a re-grading. In this case, the overall grade may change (increase or decrease) and that will be recorded as the final grade. If students want to get a good grade in this course, it is expected they perform well consistently.
- **Behave in a professional and inclusive manner:** at all times during the course and lab hours. Any form of cheating, plagiarism, bullying, disrespect, harassing or offensive communication in person or online via class Slack or email will not be tolerated. UVic policies will be followed in such cases. It is the responsibility of the student to review the policy to understand the expectations.

Grades

There are no tests and final exams in this course. The grades are distributed as follows:

Coursework	**Undergraduates (total 100%)**	**Graduates (total 100%)**
Readings and discussion		Total 10% [Individual] There will be a total of three reading and discussion assignments: R1 - 3% R2 - 3% R3 - 4%
Assignment 1	25% [Individual]	20% [Individual]
Assignment 2	25% [Group]	20% [Group]
Assignment 3	50% [Group or Individual]	50% [Individual]

Due Dates and Demo Schedule

Who	Activity	Due (all times in PT)	Discussion activity or Show-and-Tell during class time
Graduates	Reading 1	Jan 25 before 11:59pm for sharing papers Feb 1 before 1pm for submitting slide	Feb 1 and 3
Undergraduates and Graduates	Assignment 1	Feb 7 before 11:59pm	Feb 8 and 10
Graduates	Reading 2	Feb 20 before 11:59pm for sharing papers March 1 before 1pm for submitting the slide	March 1 and 3
Undergraduates and Graduates	Assignment 2	March 7 before 11:59pm	March 8 and 10
Graduates	Reading 3	March 22 before 11:59pm for sharing papers March 29 before 1pm for submitting the slide	March 29 and 31
Undergraduates and Graduates	Assignment 3	Part 1: April 4 before 11:59pm Part 2: April 4 before 11:59pm Part 3: April 9 before 1pm	April 5 - public demo April 6 -8 - final presentations (tentative schedule. These dates may change based on room availability at UVic)

Reading and Discussions (for graduate students)

Reading, understanding, synthesizing, constructively critiquing and presenting research is an important skill for graduate students. Engaging in reading and discussing is helpful for many reasons such as it helps you identify new research problems, prepares you for disseminating your own research in meaningful ways, and serves as an early teaching experience. In this course, graduate students will complete three reading and discussion activities.

All discussions in this course will take the form of hands-on activities in which everyone in the class must participate.

- Reading Activity 1: Examples of Physical and Tangible User Interfaces
- Reading Activity 2: Examples of Physical Visualization
- Reading Activity 3: Examples of CST

Reading and Discussion Requirements

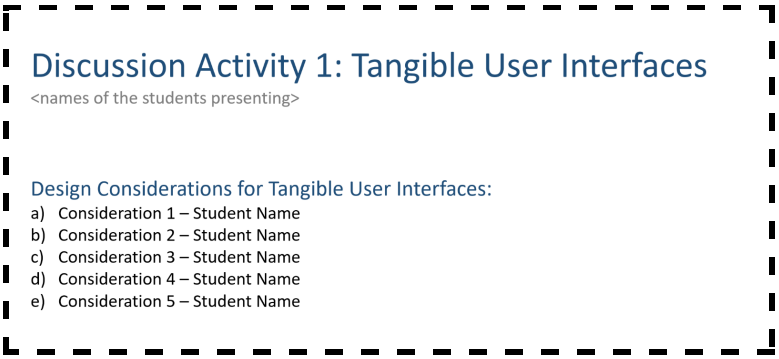
A. Reading Activity

1. Every graduate student will individually pick a full paper of their choice based on the topic of the reading activity listed above. Sources for searching papers include but are not limited to: ACM Creativity and Cognition, ACM CHI, ACM UIST, ACM TEI, ACM DIS, IEEE VIS .
2. Some suggestions for papers are available in the Google Sheet: https://docs.google.com/spreadsheets/d/192vFDpqmDllTPcDEaMBB75gIChkxc1yNEJC_bTZenXU/edit?usp=sharing
3. Share the paper you have selected with the rest of the class by the set deadline.
4. Read your paper with the purpose of identifying answers to the following three questions:
    a. What is this paper about? And what are the creative task(s) the paper explores?
    b. What is the one most interesting consideration for user interface design from this paper? (for example, this can be an interaction technique, an algorithm, or a physical product design)
    c. How might members in this class apply this technique for their projects? Discuss 1-2 ways of applying the technique.

B. Discussion Activity

The course instructor will divide the graduate students into two smaller groups for the in-class discussion activity. In this in-class activity, the graduate students will lead a design activity involving all the students present in the class. To lead such an activity, graduate students are required to do the following:

a. Within your assigned groups, put together a single slide that lists that one interesting consideration you identified from your paper. Feel free to add a video or image in addition to text to demonstrate the design consideration. Submit this slide in PDF format to Brightspace. An example format for the slide:



b. In a lightning talk format explain the most interesting design consideration you identified and provide some brief context related to the goals of the paper. Each student will have exactly 2-minutes to present.
c. Lead a design session as a group, wherein you run the class through a design activity by asking students to sketch a user interface idea by combining or using the identified techniques. For example, for Reading Assignment 1, the design prompt can be: "Create a tangible user interface that can be used within homes by families and uses or combines the following five design considerations".
d. The graduate students will facilitate this activity by doing the following:
    - Create an activity plan - explain what is required to happen in the activity session (e.g., form small groups, sketch and discuss) and how long the different aspects of activity are (e.g., 10-minutes for sketching)
    - Answer any questions the students have
    - Keep the class engaged
    - Encourage discussion

Some general tips:

- Make the presentation engaging. One way to do this is to show things (such as videos and diagrams) instead of simply reading content from your slides.
- Your peers can read the paper in detail, so focus on sharing the key points only and your views.
- When presenting your views you should be critical but also respectful - remember that these papers have gone through competitive peer review systems and were accepted for publication from a large pool of submissions.
- Make an effort to rehearse multiple times. Poor presentations will reflect on your grades. Refer to the rubric carefully.

Assignment Handouts (for all students)

Designing a creativity support tool similar to a typical user interface design consists of three major considerations: how will people provide input and receive outputs, how will information pertinent to the user interface be represented and interacted with by people and lastly, how would people complete specific tasks with the user interface. In this course, students will complete three assignments/mini-projects that correspond to these considerations.

Assignment 1: Alternative Inputs or Outputs

The goal of this assignment is to help students rethink how people can provide inputs to computers and receive outputs from computers in ways that are different from the standard desktop paradigm wherein people use a mouse, keyboards and computer displays.

Here students are required to create a provocative system using hardware, software and physical materials to reimagine how an existing example of input and output can be changed. For example, can someone write software code using an interface that is not desktop-based? Or can a musician create music without using the standard musical instrument?

Students are expected to understand and apply concepts from tangible user interface literature to creat such input/output interfaces.

This is an **individual assignment** for both undergraduates and graduate students.

Inspirations:

- https://tangible.media.mit.edu/projects/
- https://www2.ocadu.ca/research/socialbody/project/diy-superhero-communicator-cuffs
- https://www.instructables.com/How-to-Make-a-Porcupine-Vest/
- http://www.hybrid-ecologies.org/projects

Requirements:

a) The assignment requires you to use:
   i) Electronics
   ii) Physical materials
   iii) Programming
b) Think about the overall design - it should not simply be some electronics on a breadboard or paper pasted on electronics for the sake of using physical materials
c) The system must be provocative or push our thinking forward. Remember your system design does not have to be applicable for today, it can be based on a future use scenario. However, the design must still be meaningful and critically considered.
d) Carefully select the scope of what you want to create. For example, if your vision is to reimagine how someone can program, you do not have to create an exhaustive SDK for this assignment. Instead, demonstrating one very specific example such as how someone creates a for-loop is enough for this assignment. Also, remember the input/output mechanism has to work, so think about how much time you will need to implement something.
e) You can use any material available on the Internet (e.g., existing software code) but you must cite the source and not falsely claim it as your own. Do not simply replicate an example from

Instructables or elsewhere. You must make at least some changes and articulate the changes made.

Deliverables:

a) **Project Document:** must include the following information:
   i) What is the aim or purpose of the input/output you created?
   ii) What is the motivation for creating the input/output you designed? This should be explained from an end-user perspective e.g., help people to <do something>
   iii) Explain the system in full detail. Write the details at a level that someone else can replicate the project. For example, explain what materials and tools you used for creating your project. List the steps someone would need to follow to make the project work. Use photos to supplement your textual instructions. Provide a link to the software code and instructions for using the code.

   The textual description must not exceed 2500 words. Images and references are not included in the word count. You must edit and proofread your document with a view to brevity and clarity.

b) **Video**: submit a 2-3 minute video demonstrating your prototype. Use voice-over or subtitles to explain what is happening in the video. The video must include a title that lists the project name, student name and V number, and must be encoded as MP4. If your TA and I cannot play the video, you will be asked to reproduce the video.

What and Where to Upload:

a) **Project website -** Post all of the above-listed information on your project website
b) **Brightspaces** - Upload a PDF of the project document and the MP4 video file.

How to create a project website:

a) Create a project website (https://onlineacademiccommunity.uvic.ca/what-is-the-oac/). You will use the website to document your assignments throughout the term.
b) Give the site a descriptive name so we can identify you uniquely. Do not use a generic course name title
c) Select the "E-portfolio" option for creating your website
d) Set Privacy to: Visible only to registered users of this network
e) Add your team members and your TA to the website as administrators.
f) If you have questions, contact for help: https://www.uvic.ca/systems/services/contact/index.php

Class Show-and-Tell:

a) Prepare for a maximum 3-minute show-and-tell for your assignment. This will be a live demo but keep the video as a backup in case the demo does not work. Also, prepare to answer 1-2 questions from the class and discuss your project. Every student is expected to participate in the Q&A.
b) To ensure the demo session goes off smoothly, you must come to class on time and set up everything you need for your demo.

Assignment 2: Data Representation

The goal of this assignment is to help students rethink how data or information can be represented in different ways compared to the standard monitor display option.

In this assignment, students will collect data or use an existing small dataset for any activity of their choosing and represent it in a tangible format using 3D printed objects. The data visualization created from the 3D printed objects should be interactable and end-users of such visualizations should be able to answer some data-related questions such as: is it possible to find a specific value from the data visualization? Is it possible to identify a range given some constraints? Is it possible to identify the minimum and maximum values? Can people compare two or more data points?

The created visualizations should not simply replicate a digital visualization style (e.g., a simple bar chart). Carefully think about how the physicality of the 3D printed objects can benefit data representation. Students are expected to understand and apply concepts from data physicalization and tangible user interface literature to creating user interfaces.

This is a **group** assignment for both undergraduates and graduate students and **is to be completed in pairs**. You are free to select your team member. Due to the grade differences between undergraduate and graduate students, undergraduate students must pair up with another undergraduate and similarly for graduates.

Inspirations:

- http://dataphys.org/list/gallery/
- https://www.tabard.fr/data/publications/PhysicalVariables.pdf

Requirements:

a. Create a CAD model of your data visualization using the following requirements:
    i. The model must not exceed 20x20x20 cm in size

ii. The model can be a single piece or consist of modular parts that can be assembled. If it consists of modular parts ensure that it fits on the plate. In other words, it must be possible to print in one job and not require multiple rounds of printing.

iii. Test the model before printing using the Cura slicer. https://ultimaker.com/software/ultimaker-cura. If the print job exceeds 7-hours, you must modify your print to make printing time reasonable. Some ways to do this are by creating hollow objects, not having too many very-fine grained details that require slower printing speeds and avoiding having too many dense parts.

b. Print model:

i. When happy with the model, send the model for printing to UVic DSC in ".3mf" format: https://onlineacademiccommunity.uvic.ca/dsc/how-to-3d-print/ **NOTE:** printing models takes time and your wait time will depend on where you are in the cue. The sooner you can submit the model, the better. Keep in mind the assignment due date.

ii. In the comments section, mention "SENG 480C/CSC 485E/CSC 578C" to not be charged for the printing job. **NOTE:** The course will cover the cost of only one print job.

If you own a 3D printer or have access to another, you are welcome to print using those.

Deliverables:

a. **Project Document:** must include the following information:

i. What is the aim or purpose of the data visualization created?

ii. How was the mapping created? That is, how is the data represented in the 3D model and what was your design rationale? Use images when necessary to explain the specifics.

iii. What types of data-related queries can people complete with your data visualization and how is the interaction supported? Use images when necessary to explain the specifics.

The textual description must not exceed 2500 words. Images and references are not included in the word count. You must edit and proofread your document with a view to brevity and clarity.

b. **Dataset:** Provide a copy of the data file you used to create the model

c. **Video:** Create a 2-3 minute screen-capture video that provides a 360 view of the object and demonstrates relevant animations created using Fusion 360. Use voice-over or subtitles to explain what is happening in the video. The video must include a title that lists the project name, student name and V number, and must be encoded as MP4. If your TA and I cannot play the video, you will be asked to reproduce the video.

What and Where to Upload:

a. **Project website -** Post all of the above-listed information on your project website

b. **Brightspaces** - Upload a PDF of the project document and the MP4 video file.

Class Show-and-Tell:

- Prepare for a maximum 3-minute show-and-tell for your assignment. This will be a live demo but keep the video as a backup in case printing is delayed despite early submission (i.e., you submitted the model at least 10 days in advance of the demo date). Also, prepare to answer 1-2 questions from the class and discuss your project. Every student is expected to participate in the Q&A.
- To ensure the demo session goes off smoothly, you must come to class on time and set up everything you need for your demo.

Assignment 3: CST Application Design and Development

The goal of this assignment is to develop one specific prototype system of a creativity support tool (CST) that will support people accomplish a creative task. Informed by the previous two assignments, students are required to rethink how a person can accomplish specific creative tasks (e.g., creating music, DIY activities such as making furniture, craft activities such as knitting or sewing, software programming etc.) Students are required to create a physical and tangible system using hardware, software and physical materials. The expectation is that the user interface design goes beyond the standard and envisions a possible future.

In this assignment, students are expected to apply the lessons learned from the previous assignments, course readings and discussions, and the class lectures to develop and execute a small-scale final project focused on designing a simple tool or system to support a specific end-user to accomplish a creative task.

For this assignment, **undergraduates** have the **choice to work in groups of 2 or individually** depending on the nature of your project. **Group work is highly encouraged** but given the pandemic situation, it is understandable if issues with executing the project (e.g., sharing of materials such as electronics) make it difficult to work in pairs.

Graduate students will work individually on their projects.

Requirements:

a. Identify an application area, a single creative task and an end-user for the CST you will develop in this assignment. For the purposes of this course, the focus of the project must be human-computer interaction i.e., carefully think about why will people want to use your interface, and how will people use the interface.

   Carefully think about the task the CST will support. A single task is a specific objective a user can accomplish (e.g., writing an email is a single specific task for email client systems such as Gmail).

   Identify 2-3 academic references (conference and journal papers or book chapters) that will help you learn about the application area, the creative task you want to support and the end-user you want to design for. Ideally, you will not be designing the interface for yourself and you must be

willing to challenge any biases or stereotypes you might have about others (e.g., grandmothers cannot use technology is a very stereotypical view).

You are free to work on a project of your choosing or select from a project idea listed below.

b. Your implementation of the CST must use all of the three: physical materials, electronics and software. **Note:** The focus is not on demonstrating software engineering excellence. You do not have to optimize code for example. The interface is a prototype and it is expected more work would be needed to make it better.
c. Lastly, this assignment requires you to complete a peer-review evaluation for one other project that will be assigned to you.

Deliverables:

This is a three-part assignment and has the following deliverables.

Part 1 Deliverables

a. **Project Report:** Submit a 5 page concisely written academic paper as a PDF. The paper should be written in the SIGCHI format: https://www.acm.org/publications/taps/word-template-workflow. The paper should consist of the following sections:
    i. Introduction - Must clearly explain the goal of the CST and motivation for the CST (i.e., what human problem(s) does it solve or what types of new opportunities does it provide for people?)
    ii. Related Work - What are some other commercial or academic projects that are similar to your CST?
    iii. Design Fiction - Develop a design fiction narrative for the CST's use. For example, see https://dl.acm.org/doi/pdf/10.1145/3027063.3052763 . This paper includes multiple chapters for a single design fiction. For this course 1-2 scenarios are sufficient.
    iv. Prototype design and implementation - Explain what the CST is about, how it was implemented and the design considerations you made. Explain how the user can accomplish the task you identified and developed. Include images when relevant.
    v. Critique - self-evaluate the developed prototype to identify the main strengths and limitations.
    vi. [Graduate students] Contributions - explain how you move the literature forward and what is the novel contribution in your project.
    vii. Future work - identify some directions for how the project could be improved and extended further.
    viii. References - list the necessary articles, websites, and products you referenced. References do not count towards the page count.

NOTE: any content outside the 5-page limit will not be read or marked.

b. **Video:** Submit a 2-3 minute video demonstrating your prototype system. Use voice-over or subtitles to explain what is happening in the video. The video must include a title that lists the project name, student name and V number, and must be encoded as MP4. If your TA and I cannot play the video, you will be asked to reproduce the video.
c. **Undergraduates:** If you work as a team, submit a short (half a page) contributions document explaining how the workload was distributed**.** Clearly list the tasks accomplished by the individual team members. If there are any issues with workload distribution, it should be made clear what the issues are so you can be graded accordingly. It is your responsibility to manage task distribution amongst team members.

Part 2 Deliverables

a. Presentation: Prepare for an 8-minute project presentation and the slides must explain the following:

i. Goal for the project - what is this project about?
ii. Motivation - whom might the CST help or be useful for and why?
iii. Design fiction narrative - explain the scenario within which the CST is intended to be used
iv. CST design - explain the design considerations you made for the CST to be appropriate for the design fiction narrative
v. CST implementation - explain how you implemented the system and show its individual features
vi. Future Work - how might you improve the CST if you had more time and resources?
vii. [For graduate students only] Contribution - what are some of the novel aspects in your CST design relative to the literature you referenced? Is the contribution a radical change or an incremental change?

Part 3 Deliverables

a. You will be assigned one other project and you must complete a peer review for that project by attending their presentation and by reading the materials posted on their project website.
b. The peer-review document will be one page long (11 point Calibri and 2.54cm margin all around) and must include the following:
   - Two strengths of the project
   - Two weaknesses or areas of improvement
   - Your overall assessment of the project i.e., Is the project idea clear? Is the project critically designed according to you and why? Is it meaningful and why do you think so?

April 5 Public Show-and-Tell:

For this final show-and-tell faculty and students from the Computer Science department will be invited (dependent on the ever-changing nature of the pandemic).

- Prepare for a maximum 3-minute show-and-tell for your assignment. This will be a live demo but keep the video. Also, prepare to answer 1-2 questions from the class/other members who visit the show-and-tell and discuss your project. Every student is expected to participate in the Q&A.
- To ensure the demo session goes off smoothly, you must come to class on time and set up everything you need for your demo.

April 6-8 Final Presentations (dates may change):

- You will present your project to the instructor and TAs
- Prepare to answer 2-3 questions from the instructor, TAs and students in the class

What and Where to Upload:

a. **Project website -** Post all of the above-listed information on your project website
b. **Brightspaces** - Upload a PDF of the project document, slides and the MP4 video file.

Example Project Ideas

Below are some project ideas for the CST assignment:

1. **Wearables Designer**: A CST that helps people create a custom interactable wearable such as a fitness tracker, jewellery or piece of clothing. Imagine a scenario wherein a person is able to create an interactable wearable design in software by modifying some existing pre-defined templates of wearable designs. When the user is happy with the design, the system automatically generates instructions for creating such a wearable (e.g., provides a list of materials required to create the wearable, circuit diagrams for assembling electronics and predeveloped code for the electronics behaviour). Lastly, the person can follow the instructions to assemble the wearable using the necessary materials.

   For the purposes of this course, if you work on this project do not try to make the system exhaustive. Pick one specific example of wearable and make it work for that one specific example only.

   See this paper for reference and inspiration:
   https://dl.acm.org/doi/pdf/10.1145/2807442.2807483?casa_token=RirXfT5AGuEAAAAA:J5mHxYRPiOREroiO5Qff9FOZLErp1knKNHgszn4q6AuyHIyVt7N6jUNpRh7gm6OYO10A7UX3JHy9Pg

2. **Physical Programming System:** A CST that helps high school students learn programming concepts using readily found objects found in their homes. Imagine a scenario wherein a concept such as for-loop can be learned by interacting with a cardboard-based mechanical device such as the Jansen walking mechanism:
   http://www.papermech.net/walking-jansen-mechanism/ .

For this project think about how learning can be scaffolded. For example, how do the student's program? Can they provide some specific keyboard-based inputs for the for-loop variables or perhaps adjust some sliders for providing input? You could also think about how they learn from what they program? Do the individual attempts get recorded so they can play them back at a later time to reflect upon?

3. **Data Physicalization Creator:** A CST that helps people create a physical data representation based on the input data. Imagine a scenario wherein an employee tracks their work hours and at the end of the year wants to create a physical representation of that data for personal use as well as an artifact to decorate their office. A system to support such a task would typically include the following: enable the person to input the data, create specific mappings and then finally create the physicalization by assigning the mapping to the visual representation.

   For the purposes of this course, if you decide to work on this project then it might be better to have one specific pre-defined physicalization system whose behaviour can be altered based on the person's mapping.

   Some examples of systems that could inspire you to create the visualization system:
   https://experiments.withgoogle.com/tiny-sorter/view - for a visualization system the mapping here could correspond to time tracking categories instead of food cereal. Think also about how the person provides input/data and creates the mapping.

   http://www.papermech.net/up-down-rack-pinion/ - a series of these could be used to create an interactive bar-chart

4. **Hybrid Prototyping Tools:** A CST that helps with code and design tinkering of tangible and physical systems using a combination of physical and digital resources. Imagine a scenario wherein designers want to create an interactive physical object for the home such as a colour-changing vase. In order to create something like that they may want to first experiment with the physical design of the vase, electronics placement and the code functionality. A CST can help with these various tasks by leveraging existing physical objects and by augmenting them with digital information. For example, the designer may have created a number of paper prototypes of the vase which can then be augmented with an electronics circuit and colour-changing functionality before the designer commits to purchasing the electronics and/or building out the final project.
   See the following references for inspiration:
   - http://celab.cs.uvic.ca/files/FabLearn_CameraReady.pdf
   - https://dl.acm.org/doi/pdf/10.1145/1166253.1166300?casa_token=ZTF8guZiIy0AAAAA:49emKw_C0N3z4idk4Z6E3OXOWgwBDIc7KdDIqIPzjNmwN-jDEMyMsXsrLHq92TX8YbiiUDzNwdjl8g

List of Tools and Resources

For this course you might find the following tools and resources helpful:

1. Processing - https://processing.org/ This is a good tool for creating user interfaces and you connect the program to receive or send information to an Arduino
2. Unity - https://unity.com/ Also a helpful tool for building user interfaces and can communicate with an Arduino. Particularly helpful if you need predefined physics simulations and want to build AR/VR apps
3. Tinkercad - https://www.tinkercad.com/ . A helpful tool to test out electronics circuits before building them out physically. Also includes support for 3D modelling and Apple iPad-based AR app creation.
4. Instructables - https://www.instructables.com/howto/. Lots of ideas and step-by-step instructions for learning to build Arduino-related projects and to get ideas for integrating physical materials
5. Mechanism Building tutorials - http://www.papermech.net/learn/. Many simple and achievable mechanical movement ideas
6. Thingiverse - https://www.thingiverse.com/. Many ideas for 3D printing