GNG1103

Technical Report

Deliverable D - Conceptual Design

Submitted by

Project Group 19

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1 Introduction

This report will provide conceptual designs for the problem statement, based on benchmarking and list of prioritized design criteria. The problem is relevant because CEED representatives have addressed issues in the workspace and want them resolved. For example, the loss of SD cards for 3D printing and the difficulty in keeping inventory. Resolving these issues will make STEM an ideal space to work in for both users and CEED staff members.

The basic user requirements will ensure that the solution created will make working in Makerspace or the Brunsfield Centre much more efficient and more productive. The solution will benefit the space, users, or staff in some manner. Our designs are associated with anyone using Makerspace or the Brunsfield Centre.

The aspects that will make our design better is the fact that it will solve multiple problems at once. Not only will it please the user, it will make the workflow within the workspace much smoother and more efficient. Our design will be efficient and robust that the likely hood of it failing is very slim.

2 Problem Statement and Prioritized Design Criteria

We want to design a sign-in system and user interface that improves the current problems with signing into the STEM spaces while also automating the use of 3D printers to improve the user and staff experience with 3D printing, organizing, time management, and ease of use.

Table 1: List of Client Needs

#	Needs	Design criteria
1	Allowing for usage of tools (e.g. 3D printers) to be used in a more organized and faster manner	• Less time wasted when using Makerspace tools (mins) • Decreased time in vacancy of tools (mins)
2	A way to let students know what machines are being used before entering the Maker Space and Brunsfield Center.	• Decreased time in vacancy of tools mins)
3	Tracking system for signed out tools such as SD cards allowing for items to be returned and not lost.	• Decrease in amount of SD cards lost (# of sd cards lost)
4	A way to keep track of materials/tools in stock especially in the Brunsfield Center.	• Decrease in amount of questions pertaining to stock of materials/tools (# of questions) • Decrease in the amount of tools misplaced or lost (# of tools lost/misplaced)
5	A better way to help users navigate STEM	• Decrease in lost users (surveying users)
6	A tool or system indicate users to pack up/clean up before the rooms are closed	• Decrease in the time it takes to close up (mins)
7	A functional security system for makerspace. Makerspace currently doesn't have cameras set up for security.	• Decrease in theft and damage (# of things lost or damaged)

Table 2: List of Functional Requirements

#	Design Specifications	Relation (=,<,or >)	Value	Units	Verification Method
1	Increase the number of people using the 3D printers	>	5	People/ Day	Analysis
2	Time taken to set up the 3D printers	<	2	Minutes	Test
3	Decrease in the number of SD cards lost	<	10	SD Cards/Month	Analysis
4	Quick setup time	<	2	min	Test

Table 3: List of Non-functional Requirements

#	Design Specifications	Relation (=,<,or >)	Value	Units	Verification Method
1	Aesthetics	=	Yes	NA	Test
2	Product life	>	3	Years	Test
3	Ease of usage	=	Yes	NA	Test
4	Safety	=	Yes	NA	Test

Table 4: Constraints

#	Design Specifications	Relation (=,<,or >)	Value	Units	Verification Method
1	Cost	<	100	Dollars ($)	Budget
2	Size	=<	5 x 3(3/32) x 1(1/8)	Inches	Measure
3	Time to Build	<	2	Months	Trello (Gantt Chart)
4	Time to learn Ross Video	<	2	Months	Ability to incorporate Ross Video successfully into project

3 Conceptual Designs

Concept 1 (Tom Lin):

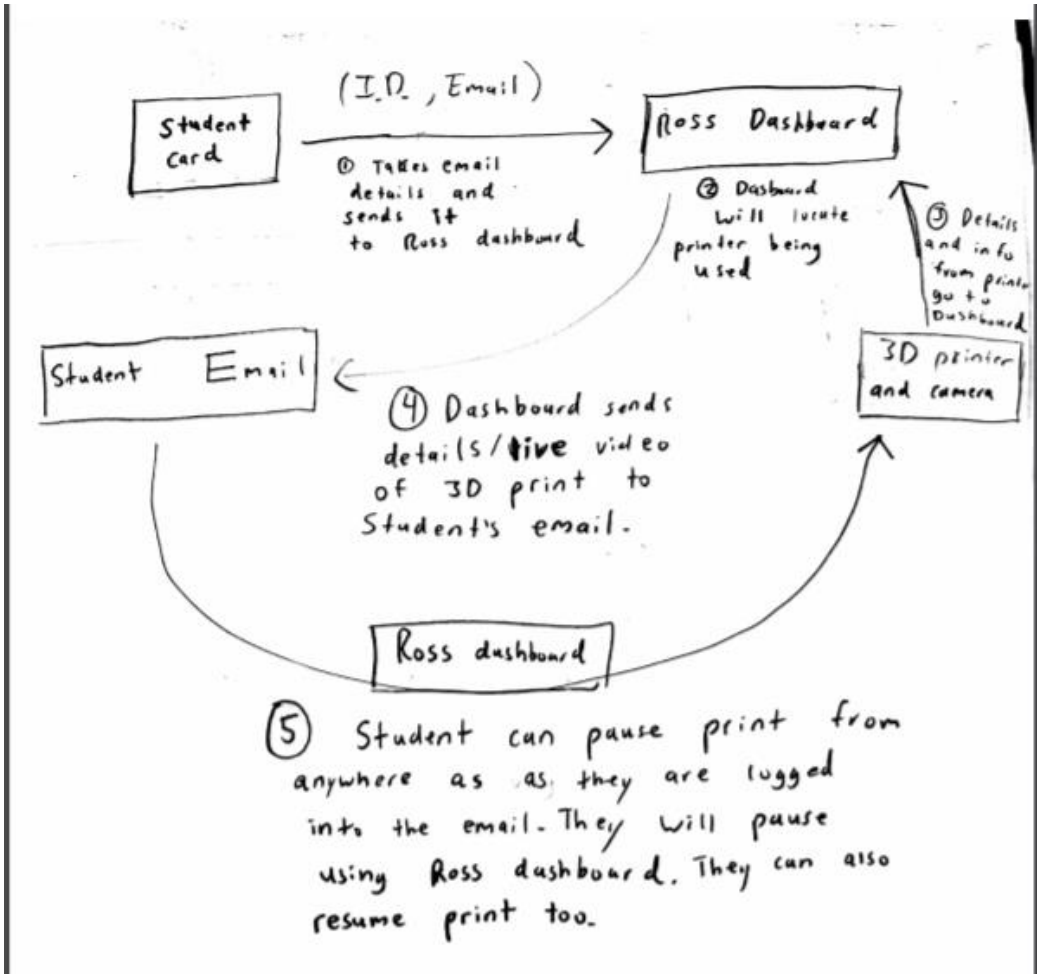

Figure 1 Flow Chart of Email Automation

This concept takes the user's email after they scan their student card and will send updates on their 3D print. A camera will also be incorporated in the 3D printer to monitor the print live from anywhere. Ross video will be used to collect the data for the printer and send the data to the

correct user via email. This data includes print time remaining and current progress of the print from video from the camera. Ross video will also be able to allow the user to pause the print and resume it later without being in Makerspace. This will be done with Octoprint. This will save time for the user as they don't need to constantly check the 3D print for errors and the user can arrive to pick up the print right when it finishes.

Concept 2 (Tom Lin):

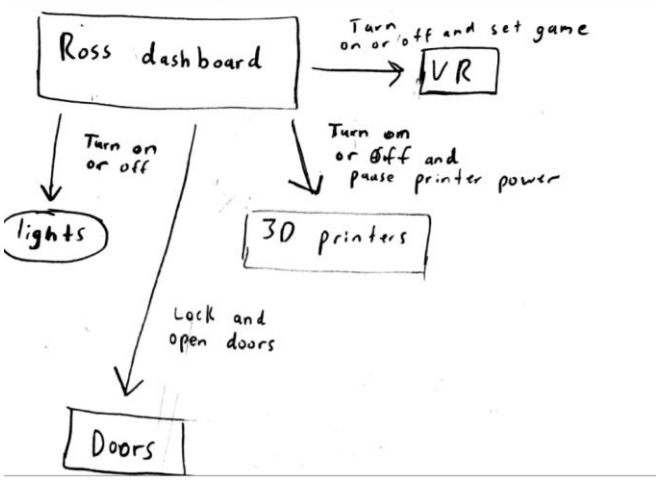

Figure 2 Flow Chart for Automated Power Switch

Ross dashboard can be used to turn on equipment/lights in the makerspace area and unlock or lock the doors in the makerspace area as well. Dashboard will relate to the equipment's control system allowing the user to turn on or off equipment without needing to physically do so. This will allow CEED employees to quickly check the equipment if anything has been left on in a more efficient way allowing for the pack up/cleanup process to be sped up.

Concept 3 (Tom Lin):

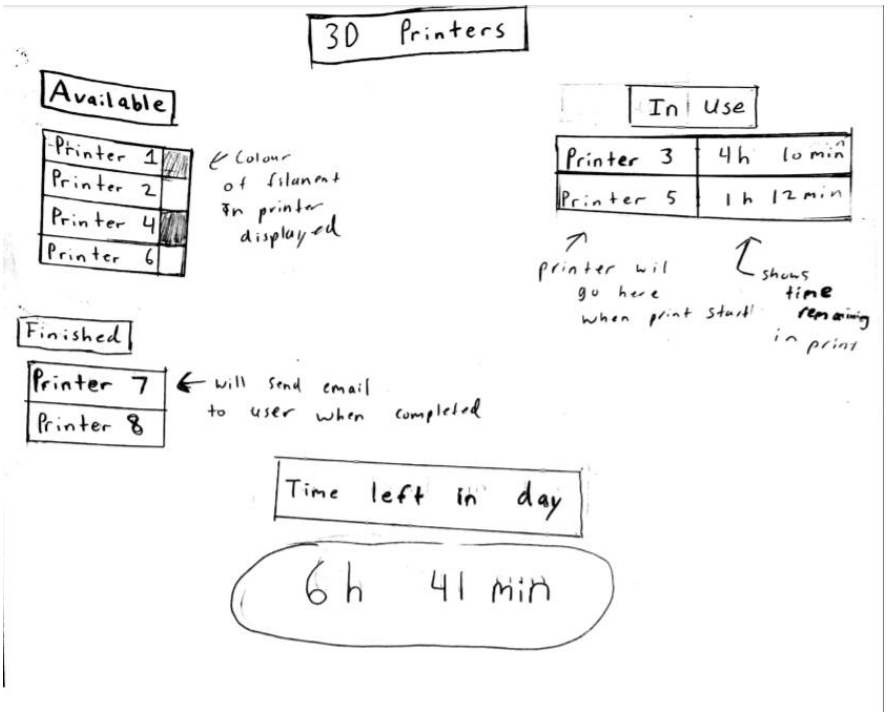

Figure 3 User Interface for Sign In/Out System

This concept requires the use of Ross Video to create a sign in/out system to sign out the 3D printers in makerspace. This allows students/guests to see which colored printers are vacant meaning they won't need to waste time checking themselves. A dashboard will be created by Ross dashboard which will connect to the 3D printers and update information to a website about the vacancies of printers. This info will then be passed to a website allowing for it to be displayed live.

Concept 4 (Senthura Yogarajan):

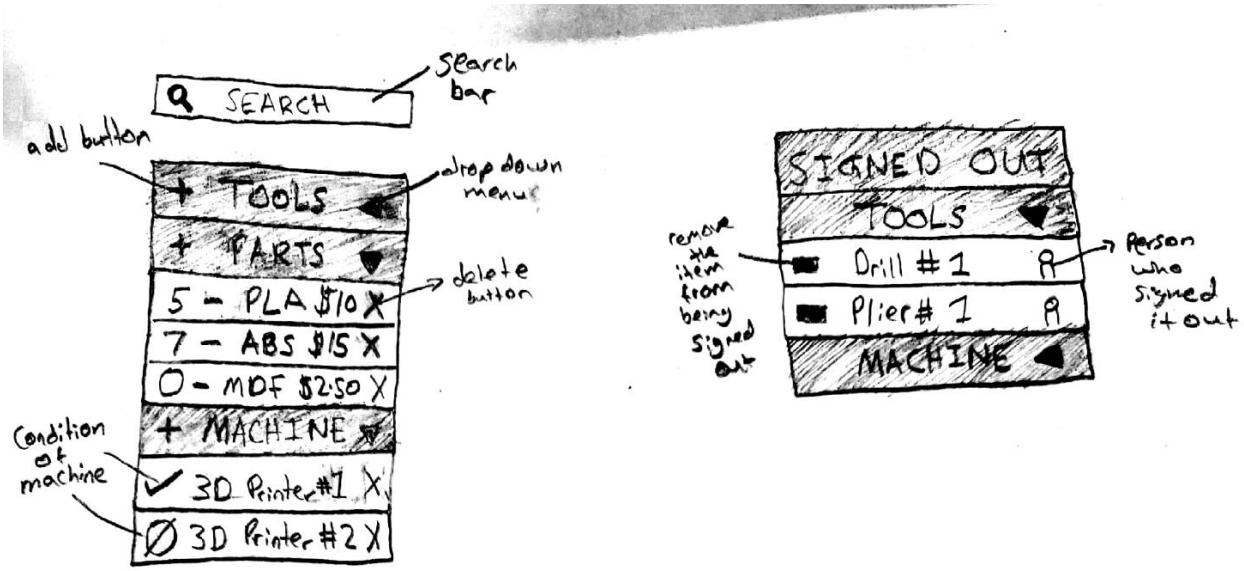

Figure 4 User Interface for Sign In/Out System for Tools, Parts, and Machinery

Ross Video can be used to create a user interface which can keep track of inventory of all parts/tools/machinery etc. There will have to be initial inputs for what parts/tools/machinery exist in these spaces and at what quantity. These will then be categorized into what space they belong to. The user interface will be a sign in/out system in which users can be registered when utilizing a tool/machinery in Makespace or the Brunsfield Centre when tapping their card to connect to Maker Repo. This will allow CEED staff members to hold people accountable for what they have signed out. Not only that, it will be visible to the user as to what machinery is available to use and what is not. To add, there will be a way to view the history of what tools/machinery have been used to assist CEED staff members with the maintenance of the tools/machinery.

Concept 5 (Senthura Yogarajan):

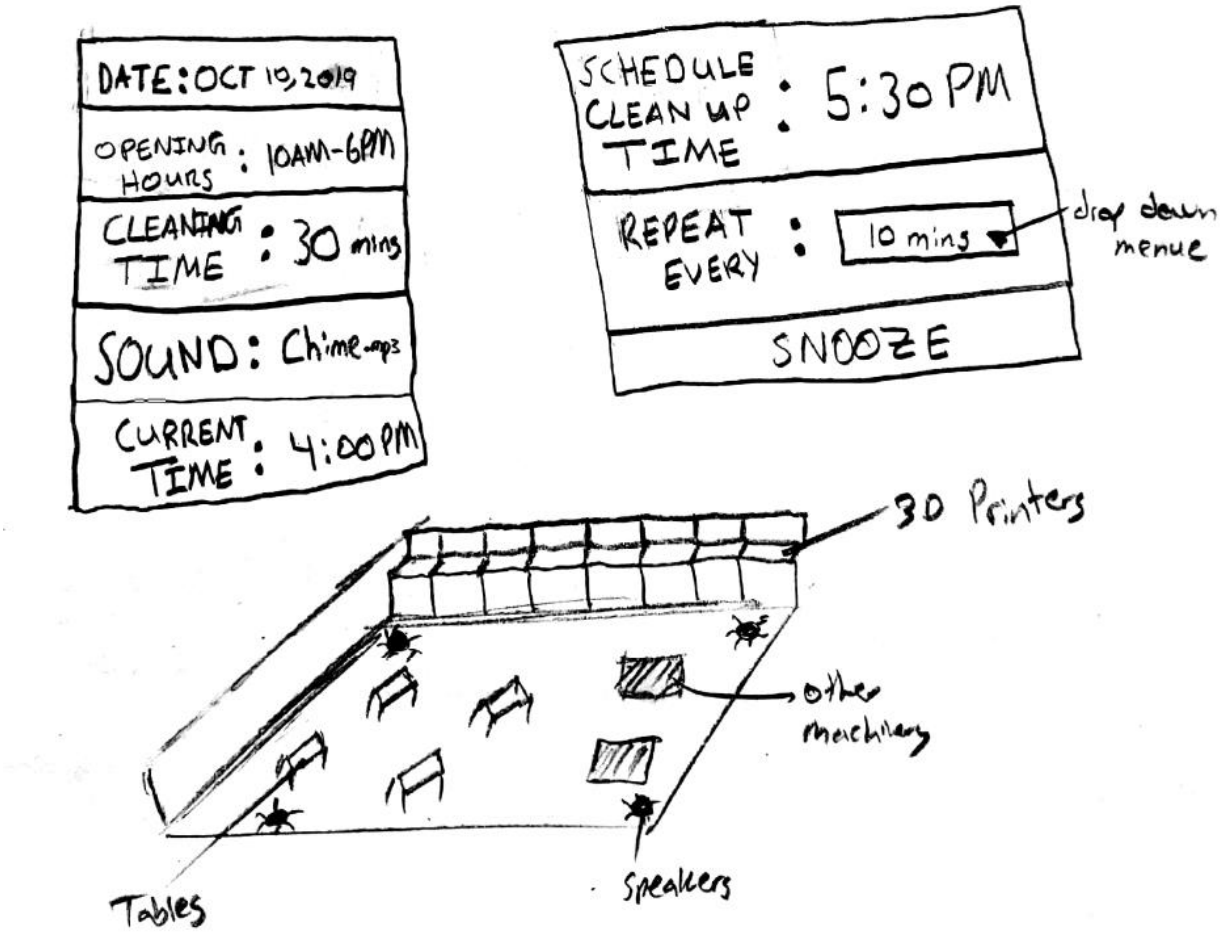

Figure 5 User Interface and Diagram Describing Clean Up Sound System

Another way to incorporate Ross Video is to create a user interface which alerts the users of Makerspace or the Brunsfield Centre when it is time to pack up. The user interface will be connected to wireless speakers which are placed around Makerspace or the Brunsfield Centre. Whatever amount of time is required to clean up will entered into the system. A sound/song will be initiated x number of mins before Makerspace or the Brunsfield Centre closes to indicate to

users that it is time to clean. Every few mins that a user specifies, the sound/song will play again to remind the users that there is x number of mins left before Makerspace or the Brunsfied closes. The user interface will also connect to the lights in Makerspace or the Brunsfield Centre to turn them on and off for the specified working hours.

Concept 6 (Senthura Yogarajan):

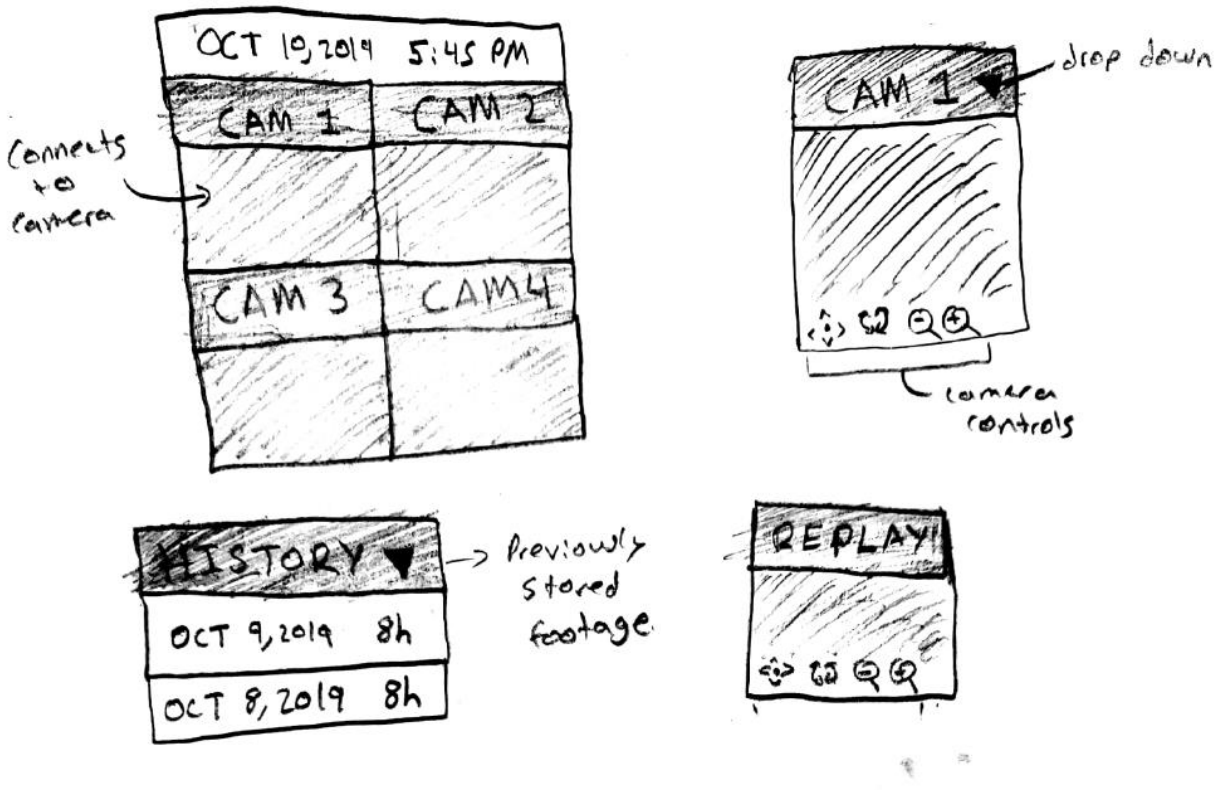

Figure 6 User Interface Describing Security System

Ross Video can also be used to create security system. The user interface will connect to cameras placed around Makerspace or the Brunsfield Centre. The user interface will allow CEED

staff members to monitor the users in these spaces to reduce theft and damage. There will be capabilities of replaying footage up to a week back in time. The system will not keep footage that is more than a week old to make room for new footage. Not only that, there will be features to allow for the maneuverability (pan, zoom, rotate, etc.) of specific cameras in both live and replay modes.

Concept 7 (Kian Mozafarian):

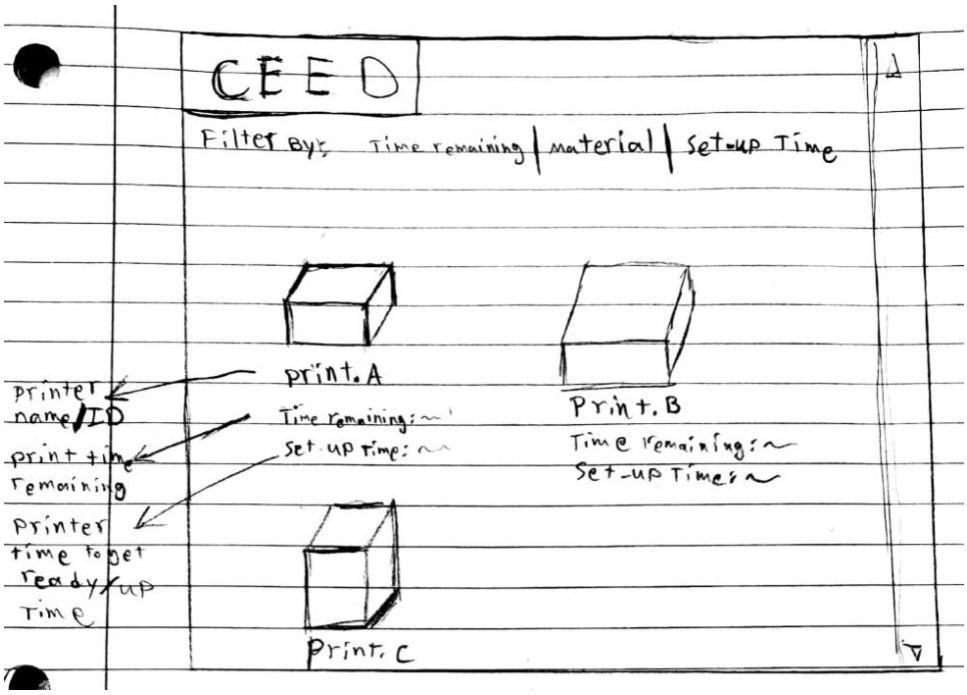

Figure 7 User Intrface of Printer Status

An user interface can be created via Ross Video that shows the user information about different 3D printers. This information includes, but is not limited to, the name of the printer, time remaining on the print, and show the up time for the printer. This gives the user feedback as to what device they can or want to use. With this in mind, a filtering system could be made, where the user can pick to display the printers in the order they request.

Concept 8 (Kian Mozafarian):

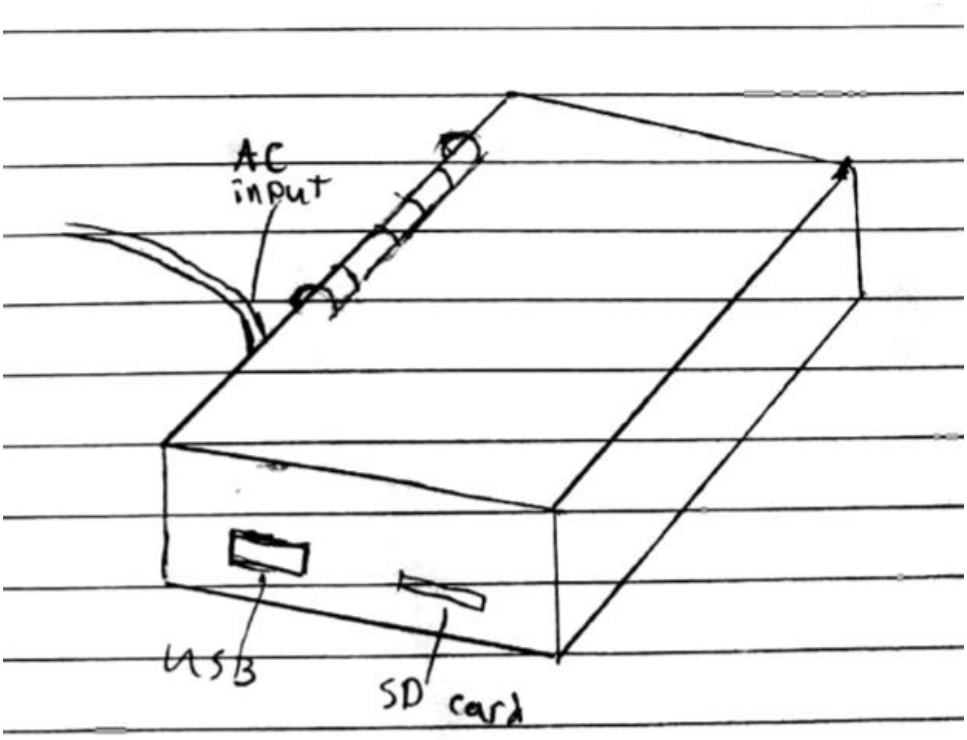

Figure 8 User Interface for Printer State

Create a container/box for the computer (Raspberry pi). It will contain a hinge that lets the lid of the container be opened at a wide angle which allows for easy accessibility to the computer. The container's IO consists of a usb port, SD card port, and an AC power input. The container would be made from wood or plastic so it's cheap and durable. The raspberry pi will connect to the printers to indicate which one's are malfunctioned, and which ones are not. Ross Video will be used by the user to indicate the vacancy of the tools. This will ensure that more people are using the 3D printers effectively.

Concept 9 (Kian Mozafarian):

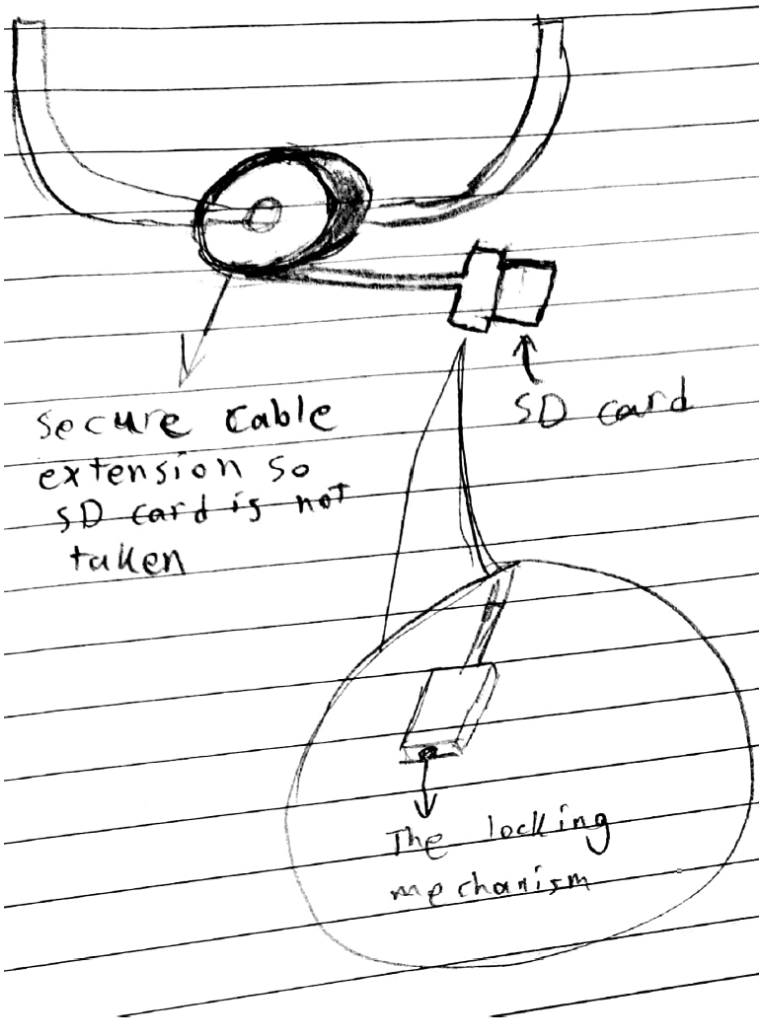

Figure 9 Security Measure for SD Cards

By using retractable cables and a SD card socket, SD cards could be locked into the socket that is connected to the retractable cable. The SD cards could be locked and unlocked for interchangeability by using an allen/hex key shaped key to loosen the SD card or lock it in. This is for the case that the online system fails, and the user will want to print manually. The good thing

about the cable is that it extends to be able to be inserted into the user's computer or into the 3D printers.

Concept 10 (Dayu Liu):

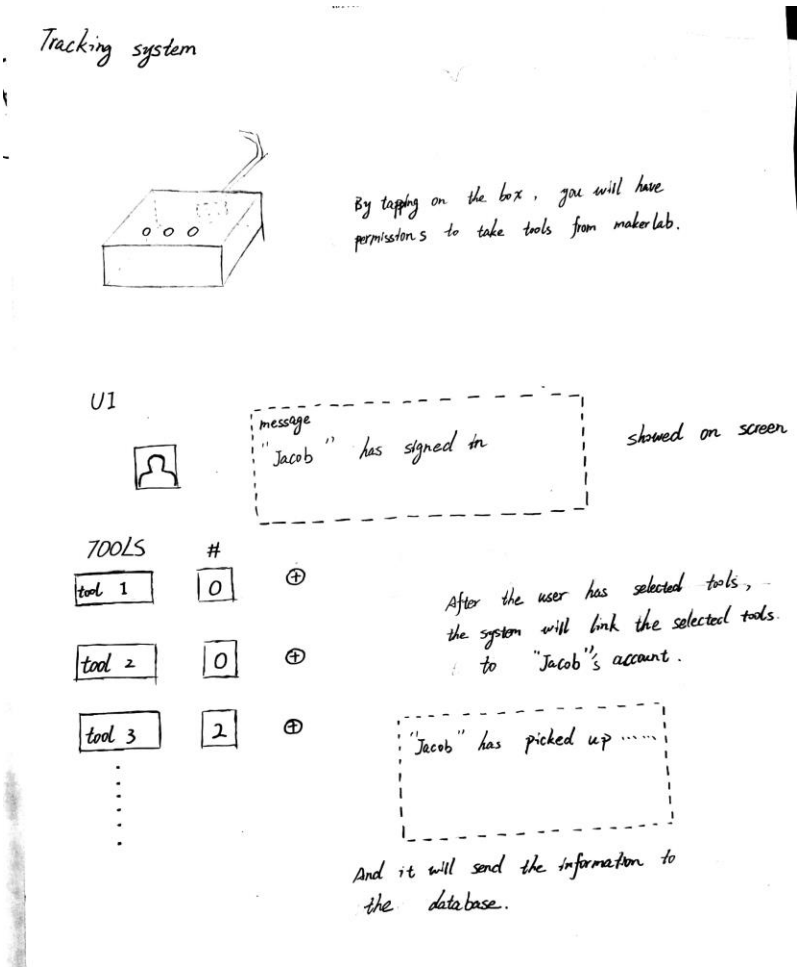

Figure 10 Tracking Tools and Users

Ross video can be used as a tracking system. It will record tools signed out by users and the user's information when they sign in and sign out of the system. This tracking system will ensure that the tools will be returned on time because the users will be held accountable for tools

that are not returned. This would reduce the responsibility of the CEED staff members because there is an online tracking system.

Concept 11 (Dayu Liu):

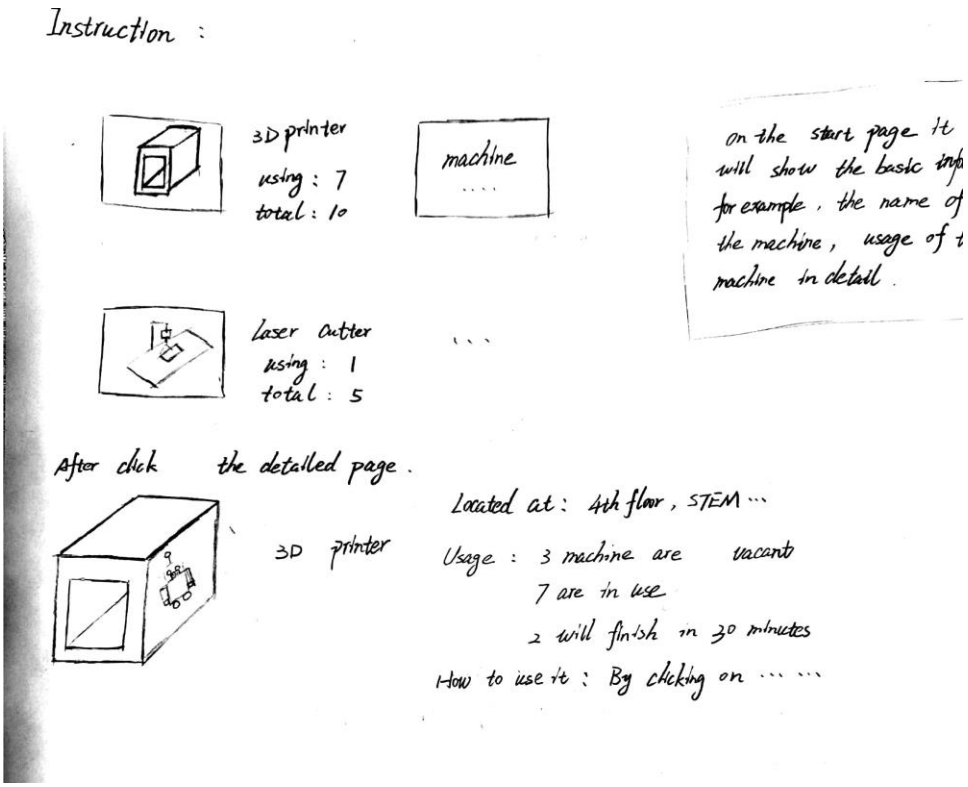

Figure 11 Instruction system and Machine Detail

Ross video can also be used to give instructions to users who are using Makerspace for the first time. There will be a user interface which will show the location of each machine and detailed instructions on how to use the machine. Not only that, there will be a section on the user interface which will display the certifications that the user has completed. The user interface will then show the user what machines are available to be used based on the completed certifications.

Concept 12 (Dayu Liu):

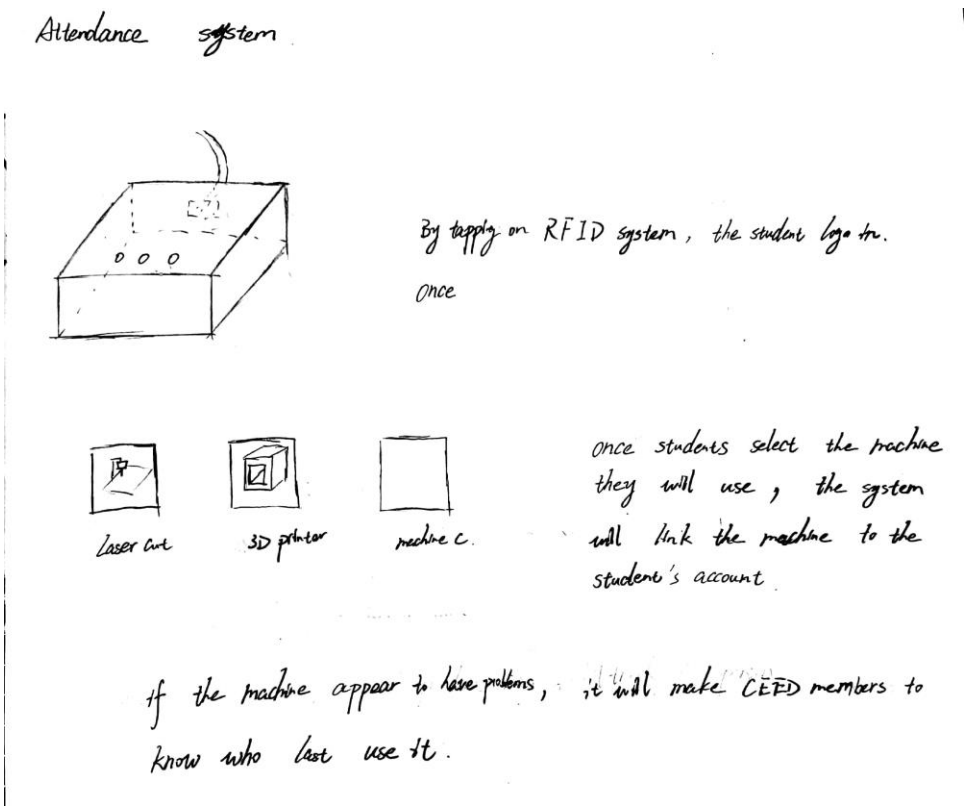

Figure 12 Attendance and Tracking System

Ross video can also work as an attendance system. When the user signs in and out by tapping their student ID's on an RFID system, it will automatically record and save the data on a database. This will show CEED staff members data on which user used which machine. This will help with the maintenance of the machine and it will help identify who damaged the machines.

Concept 13 (Alexander Steeves):

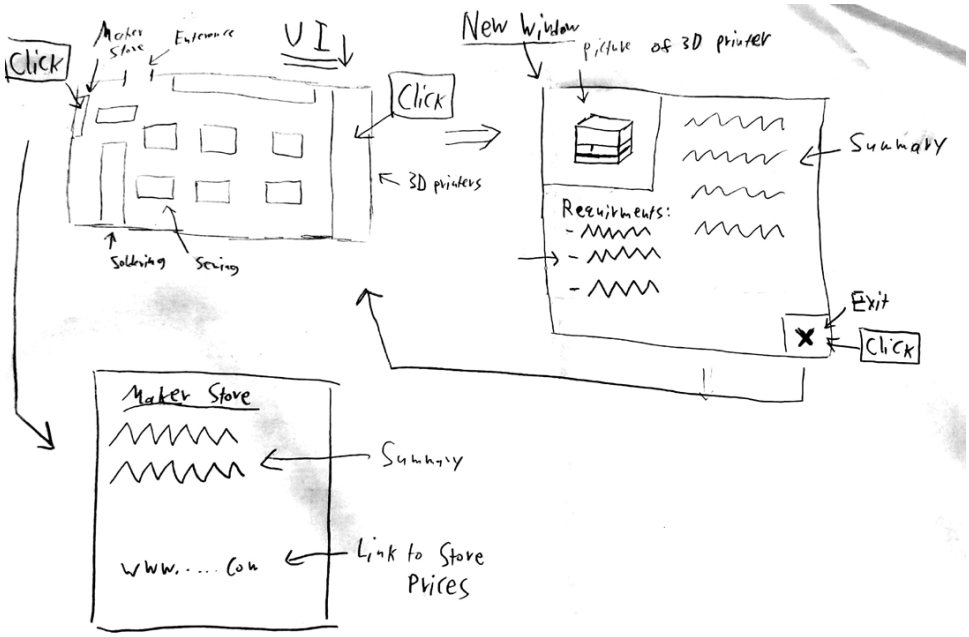

Figure 13 Sketch of Maker Space Interactive Map

By using Ross Videos user interface capabilities, it can be used to make a user interface that shows the user an aerial view of the Makerspace lab as well as the general location of each machine. Individual machines can then be selected by the user and a new user interface will open up, giving them information about the machine and if it requires previous training to use. This can be seen in Figure 13 where the 3D printer is selected and then a new user interface will open up with a description. This idea is especially relevant to first year students or people that come to Makerspace for the first time and are unsure what they can do with the machines.

Concept 14 (Alexander Steeves):

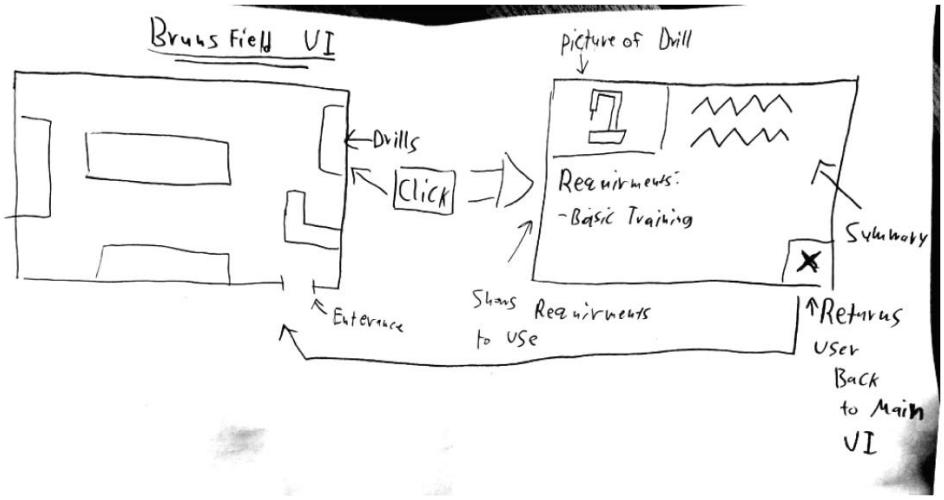

Figure 14 Sketch of Brunsfield Interactive Map

A Ross Video user interface can also be used to give users an aerial image of the different spaces within Brunsfield. By clicking on the different machines available the user is taken to a new interface that displays a summary of the machine, its general capabilities and what training is required to use it. In Figure 14 an example is given when the drills are selected. A picture and summary are presented as well as a requirement which is basic training. This is targeted towards student who have never entered Brunsfield and are interested in creating something but do not know what training is required.

Concept 15 (Alexander Steeves):

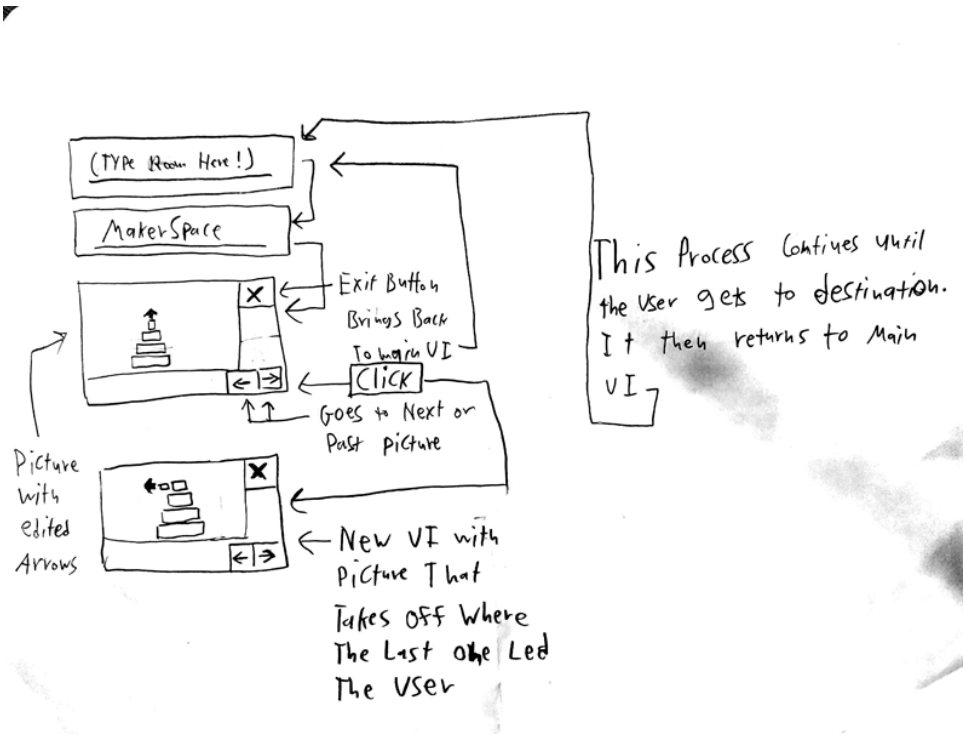

Figure 15 Sketch of Class Finding System

A Ross video user interface can be used to guide student throughout the STEM building. The user can enter a classroom within STEM and a series of pictures will come onto the user interface with arrows leading the user to the classroom as seen in Figure 15. This is targeted towards first year students who are confused where their classroom is.

4 Analysis:

Table 5: Analysis of Conceptual Design for Functional Requirements

Concept #	Criteria Met	# Of Criteria Met
1	• Increase the amount of people using the 3D printers • Time taken to set up the 3D printers • Decrease in the number of SD cards lost • Quick setup time	4
2	• Increase the amount of people using the 3D printers • Time taken to set up the 3D printers • Decrease in the number of SD cards lost • Quick setup time	4
3	• Increase the amount of people using the 3D printers • Time taken to set up the 3D printers • Decrease in the number of SD cards lost • Quick setup time	4
4	• Increase the number of people using the 3D printers • Decrease in the number of SD cards lost	2
5	• N/A	0
6	• Decrease in the number of SD cards lost	1
7	• Tell users how to schedule their time before coming in for a print • Give status update to user	1
8	• Give ease of use to the user's through Ross videos but manually connect to the computer when network is down	1

9	• Less chance of SD cards going missing due to any reason	3
10	• Increase the tools usage • Reduce responsibility for staff	2
11	• Increase the person safety when using • Reduce the vacancy of machine	2
12	• Reduce the damage on the machine • Record students on machine	2
13	• Increase 3D printer usage	1
14	• N/A	0
15	• N/A	0

Concept one, two, and three are all tied for the criteria met in the functional requirements, Table 2, at four criteria met. Looking at non-functional requirements to break the tie, concept one and two meet the criteria of non-functional requirements from Table 3. These concepts are aesthetics, product life, ease of usage, and safety. Concept three is not as aesthetic as the other two concepts. Concept one and two are fascinating compared to the third one. Therefore, the third one will be eliminated. Looking at the final Table 4, concept one will include and pass all four constraints. With concept two, this concept will not pass the time restraint. Although it would be an impressive idea, it would be extremely difficult to create within the time limit because there are too many programs and programing languages to learn.

5 Final Solution

We have chosen to go with concept one. This decision has been made after analyzing the similarities in the functional as well as non-functional requirements. The final decision was made after analyzing the constraints.

6 Conclusions and Recommendations for Future Work

Throughout this report our group has conceptualized 15 different ideas relating to the betterment of the STEM building and incorporating the use of Ross Video. With each idea we have examined their relatability to the functional requirements created for the list of client needs and gave them a score for each requirement met to see which idea has the best fit for our client. We have decided that our best idea is concept one. This is because it has met the most functional requirements and has met more non-functional requirements and constraints than concept designs two and three.

By conceptualizing so many ideas our group found it difficult to create ideas that can be related to Ross Video. This taught us that even though we felt fondly of certain ideas, the main requirement is to satisfy our client’s needs and not our own. In the future we will stay focused on what our client wants and not lean into ideas that we, as the creator, want.