GNG1103

Technical Report

Project 17- Deliverable D

Submitted by

Project 17. A3, TEAM 17

[Alec Edward, 300115955]

[Isabelle Tam, 300115159]

[Evangelina Schonfeldt, 0300111231]

[Rehana Lawrence, 300124577]

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University of Ottawa

Abstract

The users of CEED need a digital, interactive system in order to improve their experience and make their time more efficient. Project 17 has made solving this problem it's goal. Simply stated, the staff, students, and community that use the CEED space need an interactive system in order to manage time and inventory more efficiently. The design will focus on two main obstacles: time and inventory management. Based on user feedback and comments, the team was able to narrow down some criteria of a design that would solve the problems. Focusing in on these criteria and creating solutions to tackle the problems has brought about deliverable D.

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1 Introduction

After defining the design criteria, the main problems were grouped into four sections. Solutions addressing each specific problem were generated over the span of a week. Each team member was responsible for creating a solution to tackle each problem, all while following the design criteria defined in the last deliverable (C). All these potential solutions are outlined below. The individual solutions were combined to create three fully-functioning solutions which address our problem statement, which goes as follows; The staff, students, and community that use the CEED space need an interactive system in order to time and inventory manage more efficiently. Most importantly, the solutions have been examined against the design criteria and target specifications to ensure they all fit the user's vision of the design. The following report explores in detail the user needs, the problems and the solutions that have been proposed to solve these problems

Our design is revolutionary and will impact all users of CEED. The most important features of the project is the fact that it is interactive for the users. Interactive features are easier to use and personalize the CEED experience. This in turn, increases productivity for all. CEED's ultimate goal, paraphrased from their website, is to facilitate student learning through project based work. To reach their full potential, the user have mentioned the need for a system to help manage time and inventory. As of now, CEED has not come up with a system to accomplish this, as such, the space cannot reach its full potential.

2 Need Identification and Product Specification Process

Disclaimer: In this section, work from past deliverables is to be mentioned and referenced. Any works that were directly referenced from benchmarking can be found in the appendix of this report

The user needs for this design have already been recorded, analyzed and prioritized. In this section we compare our three fully functioning solutions to the criteria and specifications as described in the past deliverables.

Problem statement: **The staff, students, and community that use the CEED space need an interactive system in order to time and inventory manage more efficiently.**

3 Problems

Problem #1: Inventory Management

The users expressed an inconvenience in the current system of locating and returning items that belong to the space (e.g. SD cards and screwdrivers in the makerspace)

Problem #2: Machine Vacancy

The CEED users have mentioned the practicality of a system that monitors machine vacancy. If such a system existed, users would not show up to the makerspace when it was extremely busy or all the machines were in use.

Problem #3: Monitoring Maximum Capacity

The CEED staff need a system to track the maximum capacity of users in the lab. At times, the lab can get very crowded during busy times of the year. Additionally, there are not always enough CEED staff to accomodate to the number of users in the lab.

Problem #4: Keeping Track of Time

One common problem with the vast majority of CEED users is keeping track of time. As engineers, students are used to staying up late working on projects and managing their own schedule. Unfortunately, the makerspace is only open certain hours of the day. Users need a way to keep track of progress vs how much time is left in the day.

4 Conceptual Designs

Problem #1: Inventory Management

Solution 1A (Alec): An interactive map of the makerspace, available online, would show all the tools and equipment in the makerspace, and how many are supposed to be there. This would help the CEED users to find the tools they need, as well as an easy way for the staff to know if something was misplaced. At the end of the day, if there are only 3 screwdrivers left on the northwest bench (Purely an example) the staff could check the map and notice that there are supposed to be 4 over there, making an easy system to assure theft is reported.

Solution 1B (Isabelle Tam): This solution also includes an interactive map of the makerspace, however, it will focus more on an informative aspect of the lab. There will be information on each main aspect of the lab, for example; the 3D printers, the laser cutters. The design will consist of a map where you can click on that piece of machinery and information will pop up. This way users will know where all inventory is in the lab and ensure that everyone's time is being used efficiently.

Solution 1C: (Rehana): Use a website to help track keep track of inventory in the space. The website should be interactive. The system must be able to track all equipment in the space to help minimize and prevent theft and lost items. Within the website there should be a section where staff is able to click on the certain item and information about the item should pop up as well as how much there is in storage. Items can be monitored through

Solution 1D: (Evan): This solution is to use load sensors to shelves which hold the tools that are most commonly left lying around. The load sensors would be controlled by Ross Video Dashboard in order to control how much weight it should be registering (allowing for change and reorganization of the space) and when a notification should sound (in order to adjust for tools which generally take a longer or shorter time to use).

Problem #2: Machine Vacancy

Solution 2A (Alec): Using the interactive map as mentioned in solution #1, the machine vacancy information could be made available on the internet. This way, users can check how busy it is before they leave home, influencing them to come at another time if it is very busy. This would also help split up peak times, making it less crowded at very busy times of the day and more busy during the quiet times of the day.

Solution 2B (Isabelle Tam): There will be a website where users sign in with their email and if they wish to use machinery, they must sign up online to inform everyone that the machine they are currently using is unavailable. Once done with the machine, the user will go back onto the website to confirm that they are done using that machine.

Solution 2C (Rehana): Using the website, all information about the machine should pop up. This includes monitoring the usage and as well the times in the day where the machine is primarily at use. Something could be set on the machine where it is able to send some sort of transmission to dashboard then dashboard could transmit stuff to the website showing the machine vacancy

Solution 2D: (Evan): A screen in the CEED space capable of being used by the users of the space at any time. Screen displays a Ross Video Dashboard with information all about the machines. A signal from motion sensors on the machine will notify Ross Video Dashboard when a 3D printer is moving (ie. in use). Therefore marking it is unavailable.

Problem #3: Monitoring Maximum Capacity

Solution 3A (Alec); Current system of tracking students, (the tap in and out boxes) already records the amounts of students that come in the lab, when, and for how long they stay. This information could be uploaded to dashboard, and data such as peak times, maximum capacities etc. can be tabulated.

Solution 3B (Isabelle Tam): To track the number of users in the lab, users will need to sign in using a website. Once users are done at the lab, they will sign out with the same email. This allows the system to know how many users are in the lab at once. Knowing the number of CEED staff, inventory, number of machines, and size of the lab, a maximum capacity can be calculated. Once the capacity has hit, an alert will be sent on the website to let users be informed.

Solution 3C(Rehana): To monitor maximum capacity, there will need to be a way to monitor movement within the lab. Any type of sensor that has the ability to detect movement would be suitable. Another idea would be a scanning system through the use of some type of membership card. Lastly, another idea could be a login for all users when entering the lab.

Solution 3D: (Evan): Cardstock cards printed for everyone using the space. We can adapt the scan boxes to scan these barcodes as well as ottawaU cards to get a more accurate data set. The data of sign in would then be uploaded and could be visible to the management/ employees of CEED space in order to use the data via Ross Video Dashboard

Problem #4: Keeping Track of Time

One common problem with the vast majority of CEED users is keeping track of time. As engineers, students are used to staying up late working on projects and managing their own schedule. Unfortunately, the makerspace is only open certain hours of the day. Users need a way to keep track of progress vs how much time is left in the day.

Solution 4A(Alec): As simple and sarcastic as it may sound, a very effective method of keeping track of time is a clock. More specifically, a digital clock visible to everyone that displays how long until the end of the day. As a common analogy, think of a timer for an online assignment; if the timer is running in the top corner, your productivity will increase as you can visually see how much time is left until the assignment is done. It will also allow you to constantly compare your goals for the day (how much you wanted to get done) to your progress (how much you have done so far) to how much time remains to achieve your goals.

Solution 4B (Isabelle Tam): Similar to Solution A, there will be a timer that displays the amount of time remaining until the lab closes for the day. However, this timer will be displayed outside of the lab, right above the entrance. This way, students can see how much time there is left before they even enter the lab. An even more efficient way to display this time could be through a website that displays this remaining time. This way, users don't even have to leave the comfort of their home, and thus saves them time. Ultimately, users will avoid wasting their time by showing up to the lab only to realize that it is closed or only open for another 10 minutes.

Solution 4C (Rehana): To keep track time a large clock or timer needs to be used. Any type of system that has the ability to keep track of time is suitable. This can probably be set up using ROSS Dashboard.

Solution 4D: (Evan): A large clock face programmed to play alarms through speakers throughout the day (ie. 2hrs left in space or 30min left in space). The time of day that the alarm would play would be dependent on the time set through the Ross Dashboard.

5 Solution Analysis

After going through all the solution ideas, we picked our favourite aspects that we can use to form into a final solution.

In regards to problem 1; inventory management, the highlights of the solutions include the availability of online usage and interactive map from solution 1A and 1B. This allows users to access information from the comfort of their home, as well as easily access that information with an easy to read interactive map. Solution 1B has a main focus on information, this is an important aspect because users need to know how to properly and safely use machinery. By

providing this information prior to entering the lab, CEED staff have one less thing to worry about, and all users of the Makerspace can use their time efficiently. Also, Solution D includes load sensors which would be very helpful for users to know if inventory is properly put away and how many are in stock.

Furthermore, the best components of the solutions for problem 2; machine vacancy, in solution 2B is to include a physical button next to a machine that sends a signal to inform users that the machine is currently being used. This relates to solution 2C and how there could be a display of the live machine use on an interactive map. Additionally, solution 2D has a sensor aspect which can be used to detect when the 3D printer is in use.

Moreover, the highlights of the solutions for problem 3; monitoring maximum capacity include more physical aspects in the lab. For instance, in solution 3D, there is a button the CEED staff can press to send an alert to a website and notify the users of the makerspace that they are currently at maximum capacity. Solution C has a sensor at the door to detect how many students enter and leave the lab, which is a good way to keep a headcount of people in the lab. Solution 3D uses barcodes on the back of cards, cards which will be used to sign in and out of the lab. An app can be downloaded on a CEED staff's phone and will be able to scan these barcodes.

Lastly, the best aspects of solutions for problem 4; keeping track of time, is to have a display of time and the ability for that timer to automatically reset by itself. These aspects were from solutions 4A and 4D, respectively.

6 Final Solutions

Final Solution #1:

The first solution will be a website that focuses on resolving the issues of monitoring a maximum capacity. Ross Video will be used to create a Dashboard that will be displayed on the website. Once users enter the lab, there will be a button near the entrance of the lab where users can press it. This will send a signal to the dashboard and add another body to the headcount in the lab. Similarly, there will be another button to press when exiting the lab, thus sending a signal to remove a body from the headcount. Once the maximum capacity of the lab has been reached, it will send an alert to the Dashboard to inform users that the lab is busy. As a side note, a maximum capacity can be established after discussing with CEED staff. Although this solves a problem, it is low on the user needs priority list. However, it could possibly be adapted to fix a more urgent need.

Final Solution #2:

The second solutions will be more of an interactive website for the users of the Makerspace. The website will display a dashboard, created by Ross Video, which will include an

interactive map with lots of information. The interactive map will show a map of the Makerspace area and where all the inventory is. When a user would like to know more information about certain inventory in the lab, they can click on it and information will pop up. This information will include what this machine does and how to safely use it. Furthermore, the bigger machines in the lab, such as 3D printers, will have their vacancy displayed. If a user is using a machine, then they must press a button to notify the Dashboard that it unavailable. Once done with the machine, there will be another button to press and inform that is vacant again. An additional feature could be to have a timer that displays the remaining time that the Makerspace is open for. This will allow users to know how much time they have left to work on their projects.

This solution seems the most appropriate due to the fact that it meets many needs of the users while allowing the most time efficiency for the CEED staff. It meets more of the higher ranked design criteria we came up with than any other design we have.

Final Solution #3:

The third solution will be heavily focusing on inventory management. Again, Ross Video will be used to create a Dashboard that will be displayed on a website This solution will require load sensors. The load sensors will be put under inventory so that it can be detected when it is there or not. This information will be sent to the Dashboard so that CEED staff can easily track inventory from a screen. This idea may be unattainable due to the expense of load sensors and the inability to put them on every shelf. They would also need to be very sensitive load sensors. Even with load sensors that are sensitive, they do not guarantee the right tools will be placed in the right section only that the weight will match. This could cause the misplacement of tools.

Solution #1:

Metrics:

Maximum capacity	**to be discussed with CEED staff**

Relevance to user needs:

Solution #1 relates primarily to the staff's needs of tracking, monitoring and tabulating data based on when, and for how long students are using the lab. It also plays a role in keeping records of who is entering the lab, through a sign-in/sign-out system. This feature was proposed by the staff users as a method to minimize and report theft. These were two big concerns especially for the CEED staff. In this way, solution #1 responds mostly to the problems of the staff users and less so to the students.

Solution #2:

Metrics:

Machine Vacancy	Capable of monitoring Up to 13 individual devices (from one arduino), more if they are grouped

Relevance to user needs:

Solution #2 touches on many of the different needs of the users of the CEED space in one solution. The user needs solved by this solution are the CEED space worker shortage, end of day time display to keep people on track, and machine vacancy. The CEED space workers identified the problem of sometimes not being able to give their attention equally to users in the space. Much of their time is taken up teaching new users how to use machines. With the interactive and informational map, their time could be more efficiently used (solving a problem in our problem statement). The resetting clock would keep people on task and remind them about time left to work on a project.

Solution #3:

Metrics:

Inventory monitoring	Can monitor up to 13 tools from one arduino board
Weight	No more than 5 kg

Relevance to user needs: A problem mentioned by various staff was tool theft. Solution #3 was proposed to overcome this problem. Solution #3 responds to the user needs of finding things more efficiently, returning things to their correct locations and preventing tool theft. The concept of monitoring tools allows users to see where the tools are located, helping them to find things quickly. It also ensures tools are returned to their correct places, as if they are not, the dashboard will alert the staff. This in turn also prevents tool theft and the staff can check when the tools were taken from their spot.

7 Conclusions and Outlook for the Future

In sum, three fully functioning solutions were described above, combining different potential responses to our problems. Keeping in mind the problem statement and user needs outlined in previous deliverables, the team must converge and decide which elements of those solutions are to be kept, and which ones discarded. Features may be discarded either because of their functionality or the ease of implementation, which is an important factor since the team is on a very short deadline.

APPENDICES

APPENDIX I: List of User needs and criterion derived from said needs (done in delieverible C) Included for reference.

Table 1:

Criterion or User Need	Example	Description
Headcount system and Interactive from afar	SEED Management Services	SEED management is a software designed for managing employees of a company. (i.e. when they arrive, when the leave, how many employees are in a certain 'zone' at once). The system uses interactive keypads where employees can swipe their card to gain access to a certain room. It also keeps track of peak times, busiest days etc. The software updates in real time and all the data and information can be made available to managers and employers on their computer screens .
Machine monitoring	ProShop	ProShop is a software system for tracking and managing equipment, machines and tools in industrial machine shops. The system will monitor production rates, inventory and stock as well as managing various schedules (i.e. of employees, target deadlines etc.)
Display of peak times	Visit Data: (with Google)	Visit data uses data collected from users to provide a reading on a company. It displays popular times, wait times, and visit duration are shown for a business. It also includes, popular times graph; how busy a location is during different times of the day, live visit data; how

		active your location is right now, visit duration; how much time customers typically spend at a location, and wait time estimates: how long a customer waits before receiving service during different times of the day also the peak wait time for each day of the week
Showing the time	Alternative To	Alternative To is a software that you can download on your desktop . It can be used as a countdown clock, reminder, clock, alarm clock, tray clock, stopwatch, timer, sticker, auction watch, work days/hours countdown clock, and synchronization utility
Self resetting clock	Loop Countdown	Loop Countdown is an easy to use looping/repeating countdown timer. It allows the user to enter an amount of time to pause between each loop. The amount of time the countdown is on for can also be changed by the user. The versatility is good for when the labs have different open hours for different days of the week
Keeps track of inventory in the space	Vend App	Vend app allows users to create personalized barcodes that can be printed and placed on items. They can then be scanned by a phone in the app in order to display how many items are in the back, where the items should be stored, and other critical details to be used in inventory analysis and reordering.
Keep inventory in their place	Load sensors	Load sensors are used to detect when a weight has been added or taken away. Load sensors for

		items have been used in many cases to detect when something has left its place and notifies the user that the weight that should be there is no longer. We could potentially use this with commonly removed items by notifying the user that the designated tool has not been replaced (hopefully reminding them to return the item to it's spot).
Sign in and Out	Current scan box system	The CEED space currently has a student sign in only. It is a tap system which scans a barcode on the card and registers who is entering the space (recording the data). There is no real security to make sure this sign in happens and with other members of the community using the space, the data collected is not a true representation.
Security/ keeping things in the space	Tile	Tile is a new app and device which signals to each other. The tile is attached to an item and with the push of a button on a phone, the tile will ring, vibrate, and send out a GPS signal. Placing these on the most commonly taken items would encourage users to put them back and allow CEED managers to locate taken items.
Flexibility and Adaptability	Architecture	Though not having to do with software, we can use architecture as inspiration. When a structure is being built, architecture's main goal is to make the structure multi-purposeful. They know that evolutionary and dynamic helps to create a longer lasting structure and helps reduce cost.

Identification	iBeacons	This is a system that stores use to identify the customers. A mobile app is used to track the exact movements of customers. There are high resolution cameras at the purchasing tils that have the ability to scan the customers faces and a facial recognition software is able to identify all customers.
Easy to use/ very accessible	Microsoft Windows {Graphic User Interface (GUI) }	Computers use software that is very user friendly. Many computers use Microsoft Windows which is a type of GUI. It uses a variety of icons and visual indicators that help customers use the electronic device with ease.

APPENDIX II: List of prioritized user needs (From Deliverable B)- included for reference

Need	**Priority and Description:**
<u>INVENTORY MANAGEMENT</u>	----------
Keeping things in their space	**4 -** The clients mentioned a problem with keeping inventory in the space. Keeping things in the CEED space is beneficial for the users because when they go to use something it will not be missing. The clients stated that a better way to stay organized and keep tools in the space would be more cost, time, and human resource efficient.
Correctly returning items	**5 -** Correctly returning tools to their place was identified as a need by the managers. It is more time and human resource efficient. As there are limited staff in the space and limited time in a day, it wastes the time of the staff and the user when a tool must be found.
Finding things	**5 -** Students and users of the space identified locating items when they first begin using the space is a need. They found they were competing for the attention of the staff member for questions about location. A staff member identified familiarizing themselves with the space and the location of all of the tools can be difficult to get used to.
Efficiency in restocking/ordering	**3 -** A manager of the CEED space mentioned the difficulties had when reordering tools. Due to the lack of inventory management and the problems stated above, they are having a hard time reordering efficiently cost, and time wise.
<u>TIME MANAGEMENT</u>	----------
Machine vacancy	**5 -** Machine Vacancy is a top priority. We heard it mentioned several times during the client meeting. The users of the CEED space want to know if equipment is available. They do not want to show up to the lab and find the machinery they were hoping to use, already in use.
Monitoring max capacity/peak times	**4 -** The CEED staff need a system to monitor the max capacity and keep track of the peak times to ensure there are enough staff on hand, and that it is not too crowded . A student or community member using the space does not want it overcrowded as this is a hindrance to

	their ability to work.
Sign-in/out process	**4 -** In conjunction with the last point, the staff need a way to manage the people coming in and out of the CEED space. They want to be able to track who is coming in and how long they are staying.
End of day clock	**3 -** The end-of-day clock was mentioned at the client meeting as a general solution to the time management problem in the CEED space. Doing more research and talking to users of the CEED space, a clock wasn't a 'top priority' in their opinions. As such, it has been lowered on the list to accommodate other needs.