Université d’Ottawa University of Ottawa

uOttawa

L’Université canadienne
Canada’s university

GNG2101[D] - Introduction to Product Development and Management

Conceptual Design and Project Plan

Project Deliverable C

Group 2.4
January 30, 2022

Mike Sheppard, 300166172
Shambhavi Asthana, 300144663
Grace Buchardt, 300236838
Jacob Troop, 300186278

Table of Contents

1. Introduction

In Deliverable B, we concluded what we wanted our product to look like in terms of metrics and target specifications. We came up with values that seemed reasonable which will be confirmed in the next client meeting. This deliverable will highlight and emphasize what we want the physical design of our product to look like. To do this, each member of our team came up with 3 potential design solutions and as a team, we deliberated on them and picked the features that we would like to see in our final prototype.

2. Functional Decomposition and Analysis

In order to effectively and efficiently generate ideas in the brainstorming phase, we underwent functional analysis on the client's requested product. This consisted of splitting the design process into each and every necessary sub-function that would serve to create a working solution.

The first subfunction we had to consider was the storage of the tablet storage. The client had informed us that when it is not in use the tablet should not be visible and should not take up space on the tray while in its storage position. This then led us to create the second subfunction which would be the activation phase where the tablet would go from its stored state to being visible to the user. The client would prefer that this process is automatic and electrically powered to make access easier for users with mobility issues.

The next subfunction would be the ability to adjust the position in the X,Y and Z directions; this should also be done automatically and the user should have a large range of options for how they would like to position the tablet. Another degree of freedom must be added in the form of an additional subfunction that allows the user the ability to control the angle of the tablet face. Ideally this would also be an automatic function but it is less important than the previous two functions since it requires minor adjustments that would put less strain on the user if manual force was required.

The final subfunction allows the tablet to stay in place even when a substantial amount of force has been applied by the user. This prevents the user from having to constantly readjust the table while it is in use.

3. Brainstorming Stage

3.1 Jacob Troop

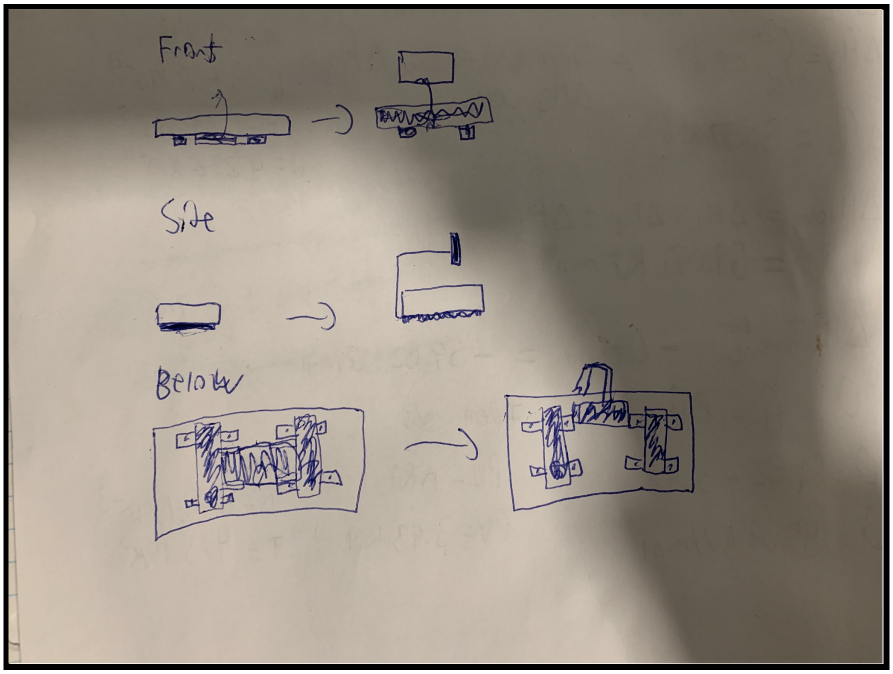


Figure 3.1 a) Retractable Arm on Rail System

This system would be permanently attached to the bottom of the tray using either bolts or an adhesive. The system will contain a retractable arm that is adjustable to suit the height or angle the user would require for the tablet. This arm would be attached to a track on the bottom of the tray and could retract and slide back along the tray when the tablet needs to be stored.

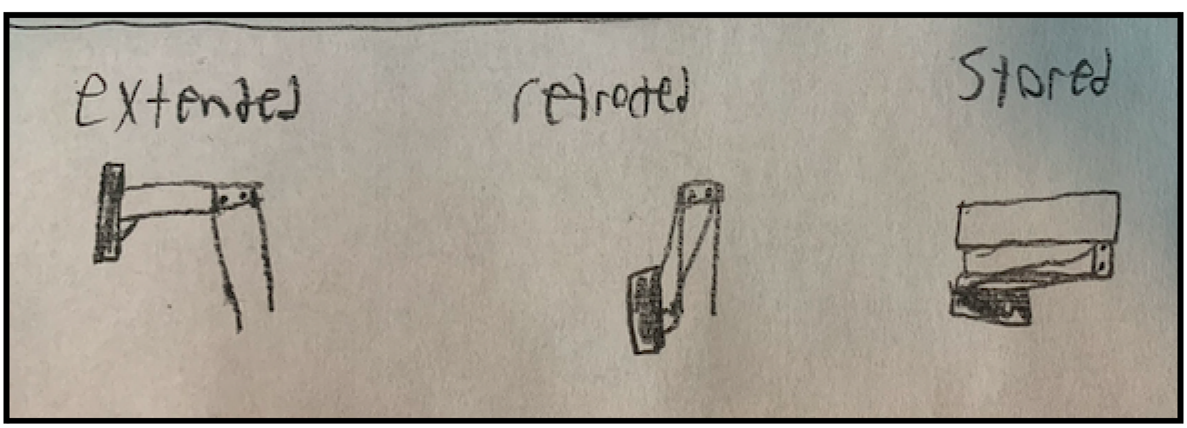


Figure 3.1 b) Retractable Arm Subsystem

The figure above shows the subsystem of a retractable arm with the tablet mounted at the end of the arm. This arm is able to adjust the location of the tablet in all three dimensions and can also change the tablet's angle. The arm would be capable of locking in specific positions in order to prevent unwanted adjustments during use. How the arm would get from the retracted position to the stored position would be dependent on the overall system that this subsystem is attached to.

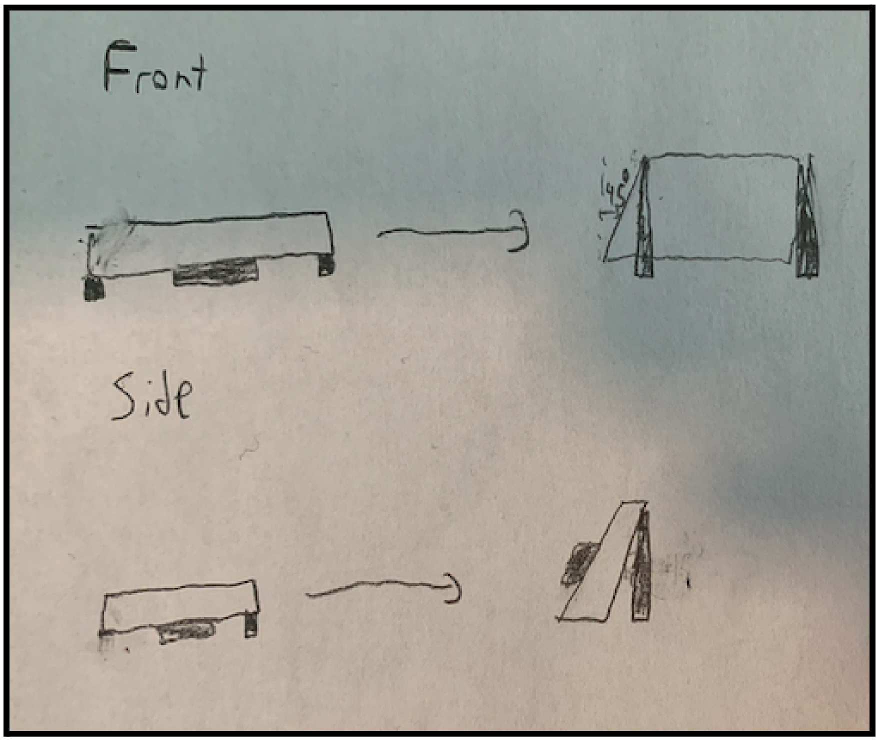


Figure 3.1c) Rotating Tray with Tablet Mounted on Bottom

This system involves a much more basic cost effective design that has a much more limited range of motion for the tablet. It would require the tablet itself to be securely mounted to the bottom of the tray. Then when the user requires the tablet the side of the tray away from the user would be forced upwards, rotating the tray and revealing the tablet stored below. In this design the tablet would only have 1 degree of freedom in its positioning and that would be its angle relative to the user.

3.2 Grace Buchardt

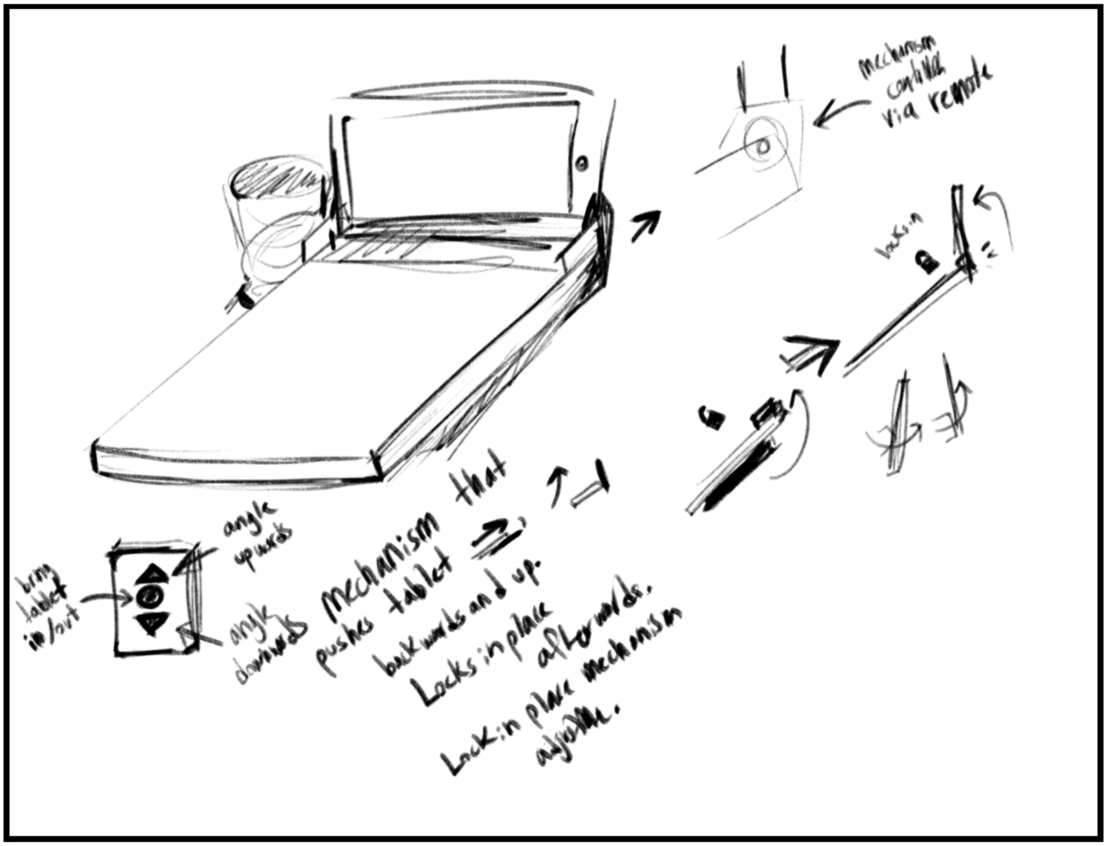


Figure 3.2 a) Rail and Lock with Angle Manipulator

This design consists of a rail system which transports the tablet to the back of the tray, which then manipulates it to be above and then loc in place. The lock in place mechanism would then allow for the angle of the tablet to be manipulated while also remaining secure. The remote control's center button can summon the tablet to the top, and the up and down buttons can adjust the angle or distance.

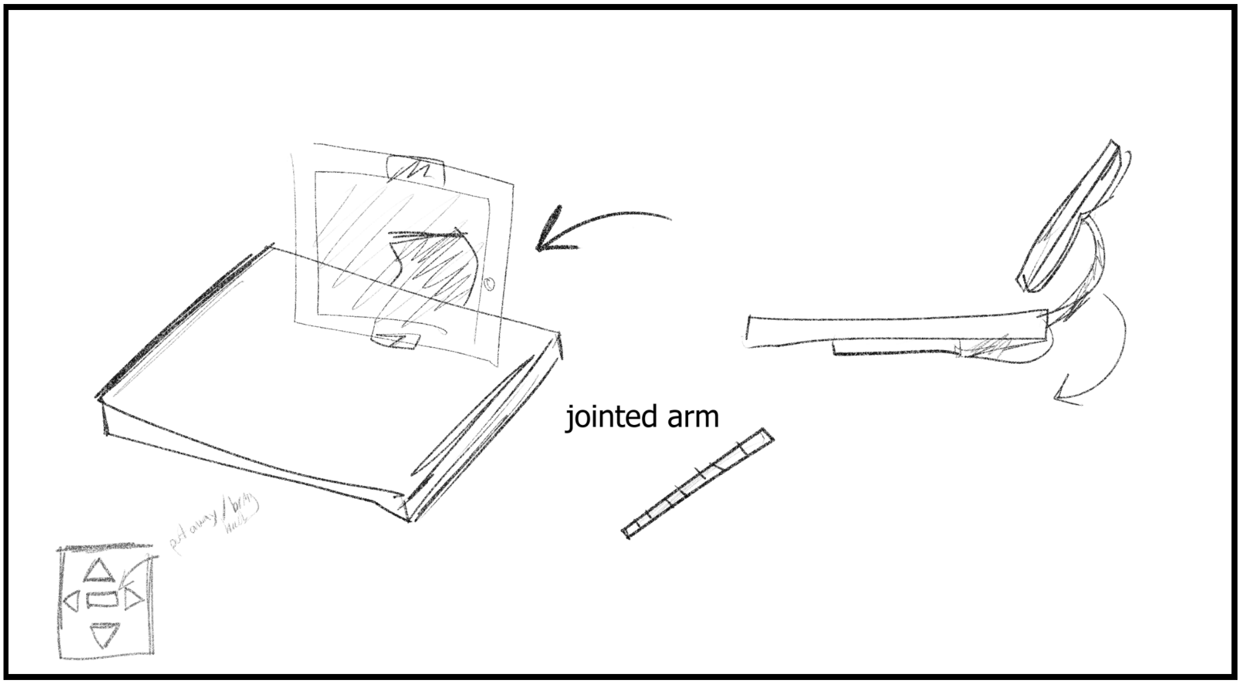


Figure 3.2 b) Jointed arm and Holder

A jointed arm piece can manipulate the tablet while being attached to the back of the tray. Most of the budget and money would go into making the jointed arm be able to function and be able to support the weight of the tablet. With some sort of adjustable grip it can grab onto a variety of tablet shapes and sizes, and depending on the type of joints used in the arm it could be made to not just be adjustable at a vertical angle, but horizontal. This design also includes a remote, with a center button bringing the tablet forwards and backwards tucked underneath.

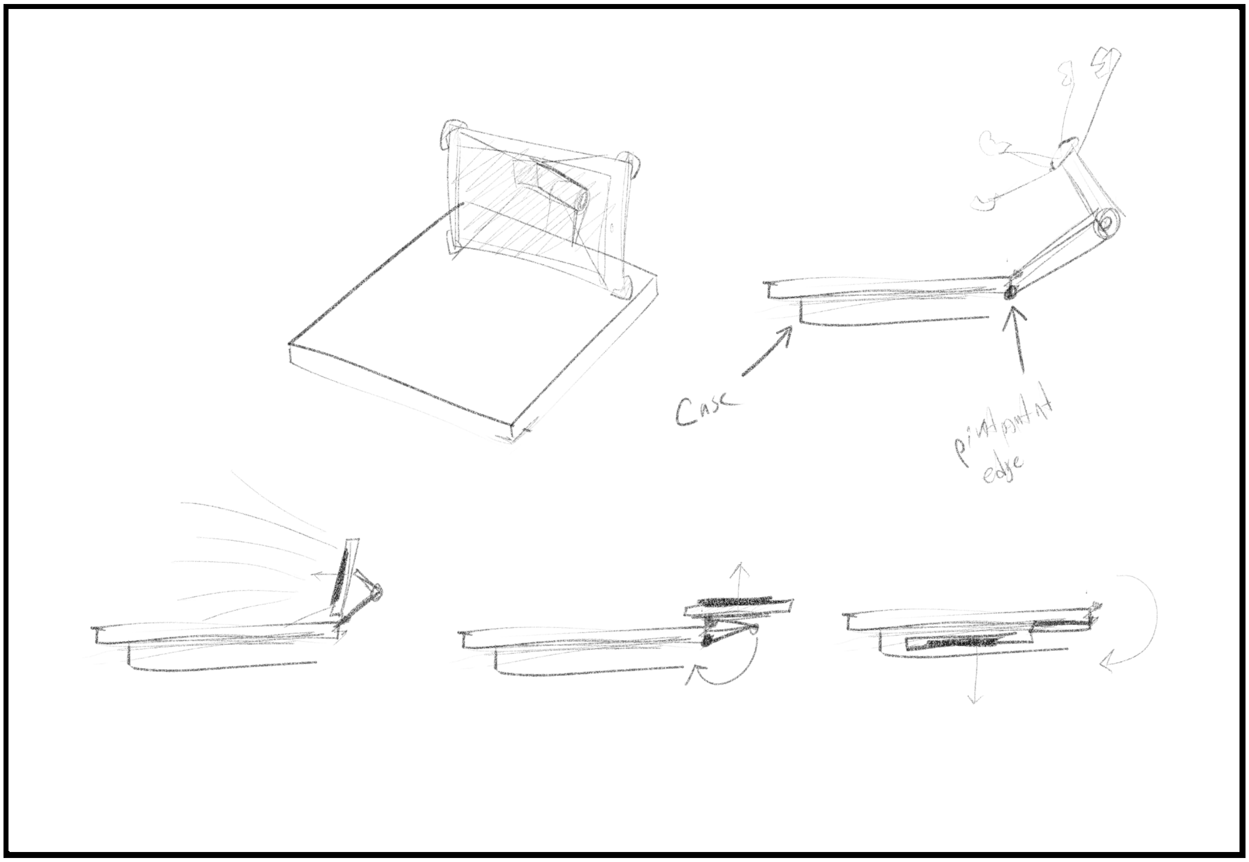


Figure 3.2 c) 2-Joint Elbow arm and Holder with Case

A jointed arm piece can manipulate the tablet while being attached to the back of the tray. Arm consists of two joints, allowing limited movement for tablet however easier construction. Arm would have four individual sections to grasp onto the corners of the tablet, keeping it secure. The grasping sections would have plastic ends to not scratch the tablet, and would have a lock-in mechanic to keep the tablet secured.

When the tablet is not in use, the arm pivots using the bottom corner of the back of the tray. Using this pivot point, it retracts, folds, and then in a controlled swing brings the tablet into the carrying case below. The carrying case would be plastic, and have a soft lining inside to not scratch the tablet and to keep it secure. The case would have rounded corners and perhaps a soft texture as it might be in contact with the user.

3.3 Mike Sheppard

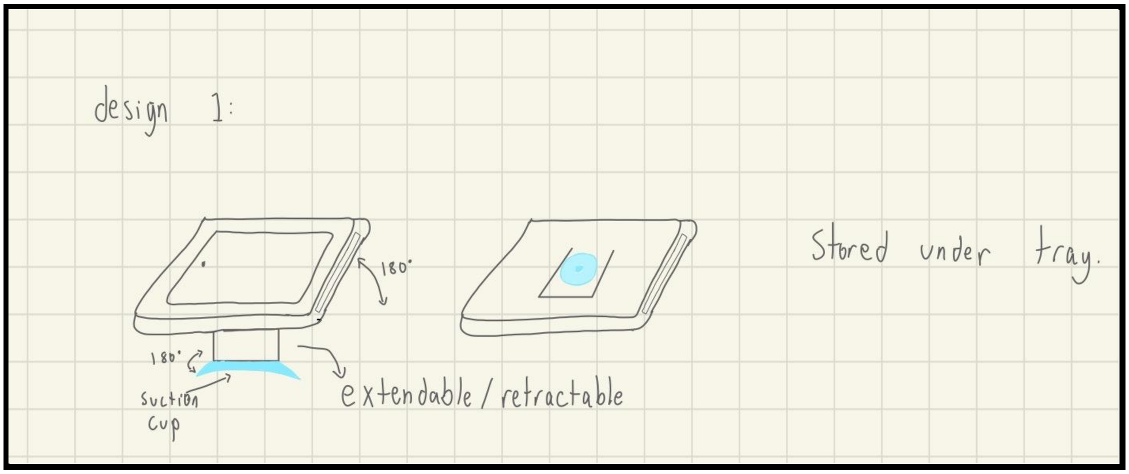


Figure 3.3 a) Suction Cup Design

This design uses a suction cup to secure the tablet holder onto the table when in use, and under the table when not in use. The tablet holder is capable of rotating 180 degrees along the x and z planes. The holder is made of a durable plastic material that withstands damage from falls, scratches and weather conditions. The tablet holder is powered by an 88 Wh power source. The power source allows the tablet holder to move up and down. It is operated by a remote. This holder is compatible with any type of wheelchair or tray.

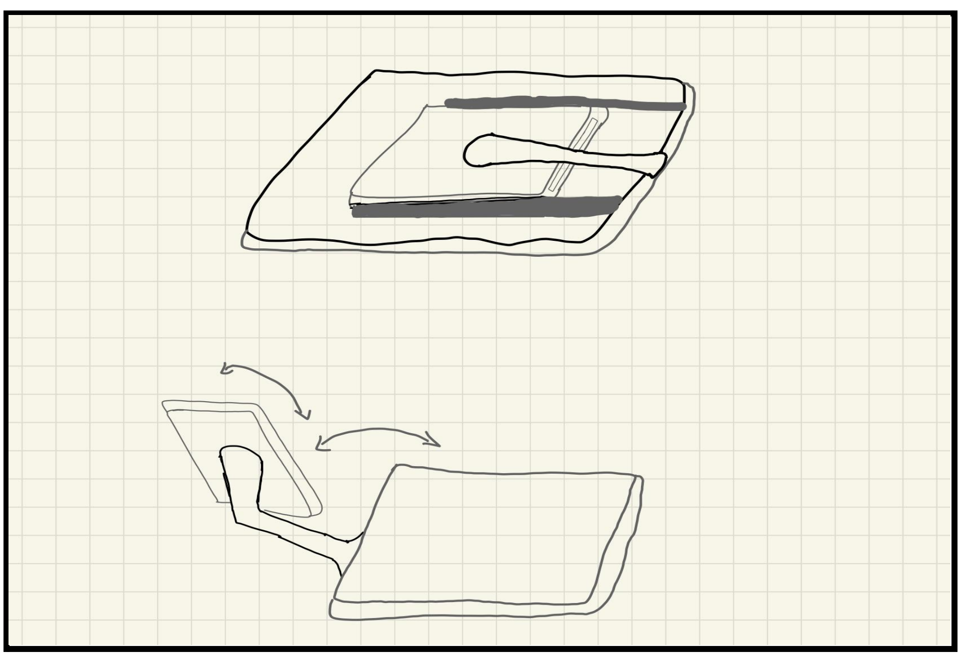


Figure 3.3 b) Rail and arm design

This design uses a rail mechanism on the bottom to hold the tablet in place. It is also connected to an arm which is strong enough to support the ipad. It is able to tilt forwards and backwards and side to side. The ipad is secured in a case. It is operated by a button which moves the holder. The buttons are powered by a 88 Wh source. This holder is compatible with any type of wheelchair or tray.

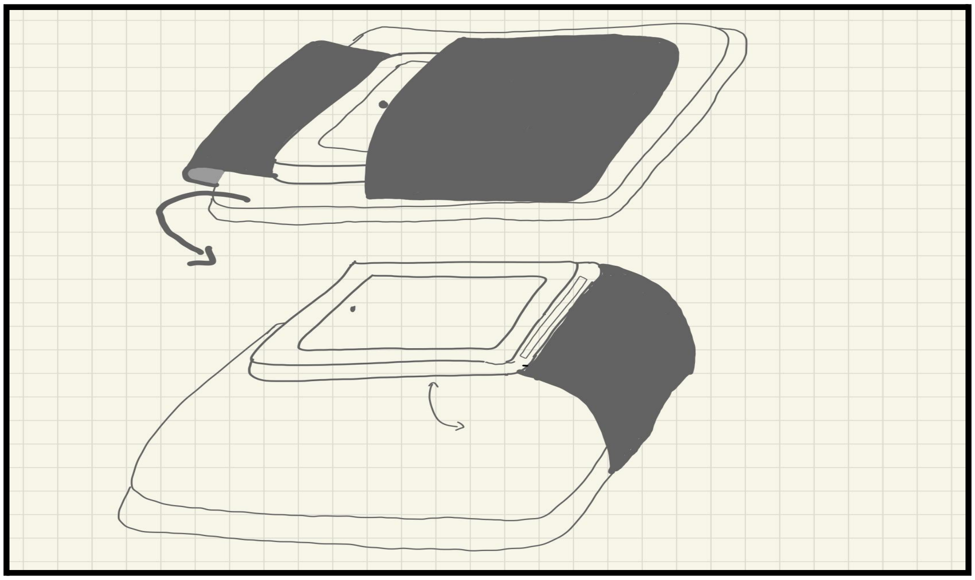


Figure 3.3 c) Holder + flexible arm

This design uses a sleeve on the bottom of the tray in order to hold the ipad while not in use. The ipad is connected to a flexible but sturdy material that is able to rotate and bend. The arm moves from a controller. The power source is 88 Wh. This holder is compatible with any type of wheelchair or tray.

3.4 Shambhavi Asthana

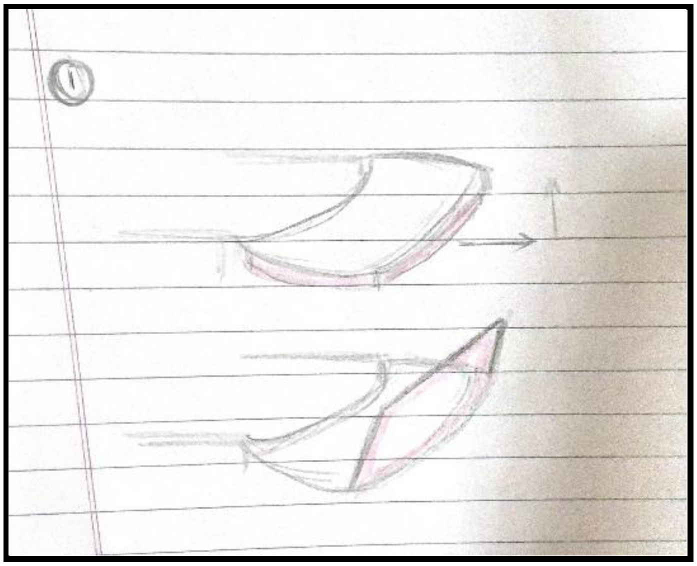


Figure 3.4a) Sliding Design

- Tablet would be stored under the tray in an unused position. When in use, it will slide out from underneath the tray (side away from the user) and move itself upwards. The angle would be adjustable.

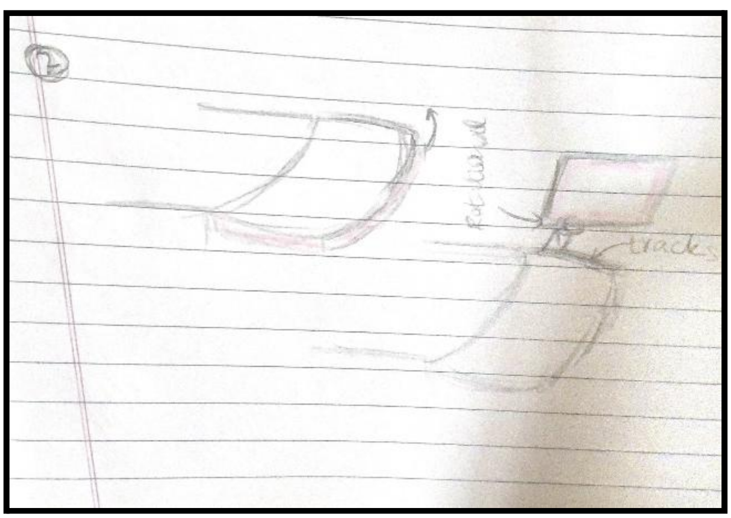


Figure 3.4b) Mechanical Arm Design

- Tablet is stored under the tray, slides out through the side and then a mechanical arm would bend in the middle and move the tablet to an upright position. Tablet would be placed in a case which would be attached to the mechanical arm through some type of rotational mechanism which would allow for 360° rotation

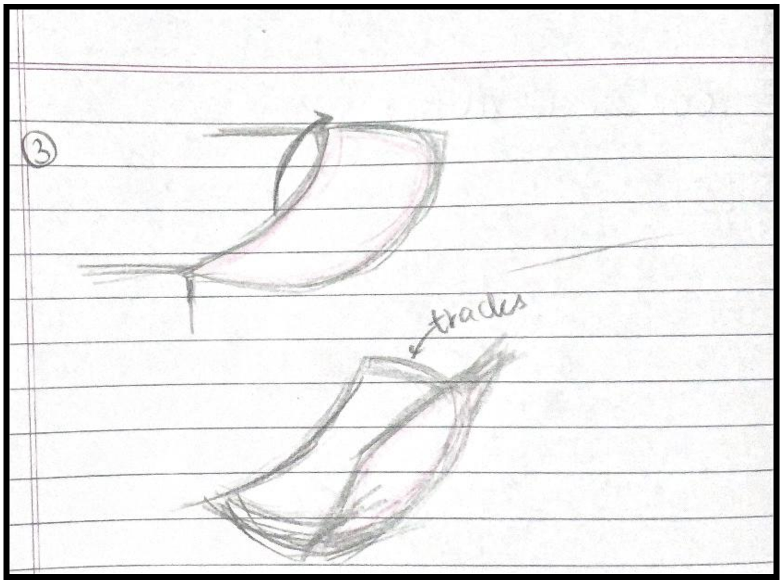


Figure 3.4c) Opening Tray Design

- Opens up like a laptop. The tray would essentially have another layer on it which would contain the tablet, this layer would be the tray portion when the tablet is not in use. When in use, the tray would open up (from the side closer to the user, upwards) and display the tablet on a flat surface

4. Design Analysis & Evaluation

Each group member's individual designs were considered and evaluated before we reached a conclusion on what our final design should look like. This was done first through comparison of all the designs, and then a more detailed broken down comparison based on their features.

*Table 4.1.1: Design Evaluation**

Design	Feasibility	Accessibility	Technology readiness	Total value
3.1 a)	3	4.5	2	9.5
3.1 b)	3	4	2	9
3.1 c)	4	1	4.5	9.5
3.2 a)	3.5	2	3	8.5
3.2 b)	2.5	4	2	8.5
3.2 c)	4	5	2	11
3.3 a)	4	4.5	2	10.5
3.3 b)	3.5	4	2	9.5
3.3 c)	3	3	3	9
3.4 a)	2.5	4	2	8.5
3.4 b)	3.5	4.5	2	10
3.4 c)	4.5	4	3	11.5

*Graded on a scale of [1 - 5], where 1 is the lowest and 5 is the highest

*Table 4.1.2: Design Analysis***

Redefined Subsystems	**Weight**	**Design 1 (3.2 c)**	**Design 2 (3.3 a)**	**Design 3 (3.4 c)**
Wide variety of user	5	5	2	5
Mobility (height, distance)	5	5	4	3.5
Easy to access	5	5	1	5
Hidden wires	4	5	5	5
Ability to be adjusted (angle)	4	4	3	4
Power source	5	5	5	5
Storage	4	4	4	5
User tray space	5	5	3	5
Total weight	185	177	128	178.5

**Graded on a scale of [1 - 5], where 1 is the lowest and 5 is the highest

Based on *Table 4.1.1* and *Table 4.1.2*, the conceptual design that we decided upon resembles Design 3.4c. This was done based on the initial comparison of all the designs, the criteria of which was based on the group's requirements, and the second comparison, the criteria of which was based on the client's requirements.

5. Conceptual Design

The following is a CAD model of the team's current conceptual design:

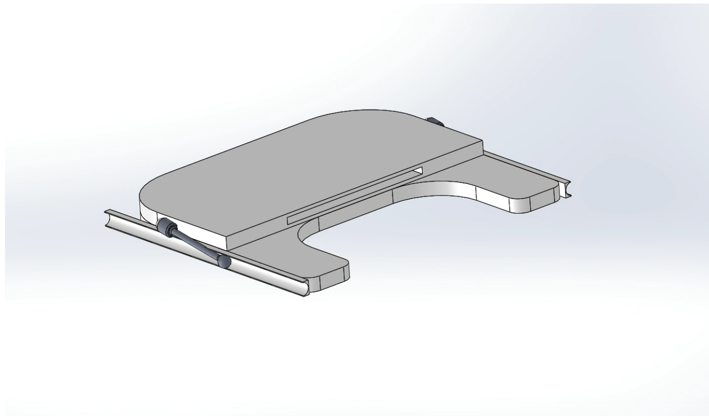


Figure 5.1: Tray when tablet is not in use

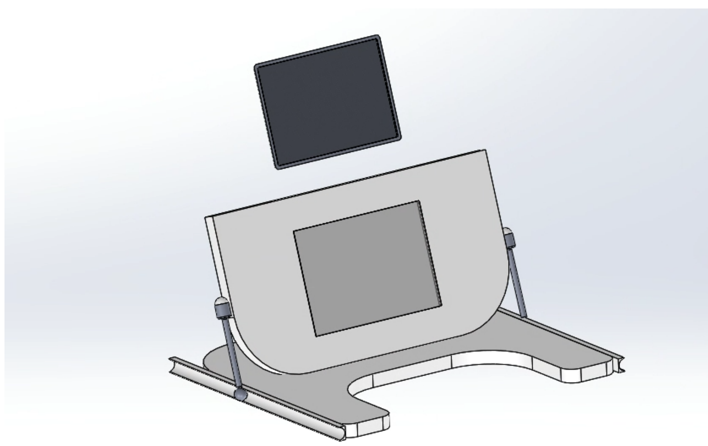
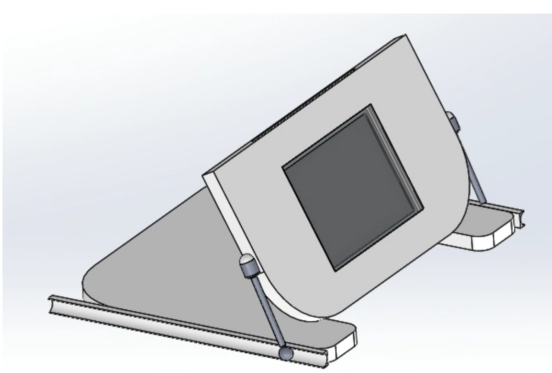
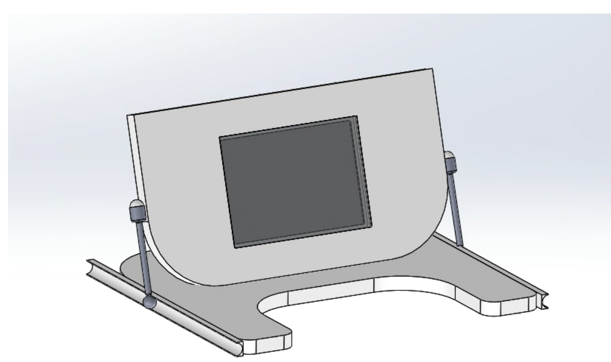


Figure 5.2: Tablet inserted into the top portion of the tray





Figures 5.3 & 5.4: Adjustable distance from the user

Figure 5.1 depicts what the tray would look like when the tablet holder is not in use (i.e, it would simply be the tray for the user). *Figure 5.2* shows how the tray mechanism opens up and how the tablet would be inserted into the top portion of the tray. *Figure 5.3 & 5.4* show how the distance of the tablet from the user is adjustable - this is implemented through tracks attached to the sides of the tray. Ideally, our design would be completely electronically controlled to make it as easy to use and accessible as possible for the user.

6. Conclusion

We ultimately decided to go with a design resembling *Figure 3.4c*. We chose this design after careful deliberation and discussion based on what the client requested. With this design, the two major drawbacks are that the height of the tablet is not adjustable and the tablet (when not in use) is not stored underneath the tray, as per the client's request. Since the tablet does not take up any space beneath the tray, any electronic components required could be stored there instead, ensuring that nothing will be sticking out or external. Adjustable height can be potentially implemented through an extra mechanism but any modifications to this design will be made after the next client meeting.

7. Gantt Chart (C.2)

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=xqjoPkeWUaI1O8LCiP1FZLibPqWsL5Rn%7CIE2DSNZVHA2DELSTGIYA