Marshall Class Room for Disabilities

Midpoint Report 2017-2018

Abdullah Ali Almutairi
Mohammad Alkatan
Yousef Alkatan
Taha Alansari
Abdullah Abdulaziz Almutairi

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Project Sponsor: W. L. Gore
Faculty Advisor: Dr. Oman
Sponsor Mentor: Eva Herberger, Krista Branch

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EXECUTIVE SUMMARY

This report was generally concerned with the designing of the wheel chairs for the incapacitated individuals. It begins with the essential presentation about the wheelchair and its significance for the destitute individuals which experience the ill effects of specific incapacities. After the presentation, the undertaking format was quickly portrayed in the report. The structure, operation and execution of the first framework were portrayed under partitioned headings. After the best possible clarification of the item to be composed, extraordinary light was showered upon the clients' needs keeping in mind the end goal to make the holder as close with regards to the real prerequisites of its clients. The client prerequisites, the designing necessities and the place of value were explained in detail under this heading. At that point the current outline of Wheelchair was examined. Existing plans were clarified alongside their pictorial perspectives for better understanding. The practical disintegration of the gadget was likewise done in this report and a black box was made for recognizing certain information the hand-made figures of every one of these plans were additionally incorporated into their particular headings. Toward the finish of the report, the chose configuration was talked about in detail. The reasons of the determination of this outline were completely examined under the heading of the method of reasoning of the chose plan. Toward the finish of this report, our real outline was clarified. The plan computations of the spring instrument utilized as a part of the Wheel chair were likewise the piece of this report. The 3D model of the Wheel chair was appeared toward the finish of the report from various isometric perspectives for better comprehension of the chose outline.

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2 Background

2.1 Introduction

Children with disabilities face different kind of challenges in their life when they were in a school; as they need to perform certain tasks which require constant movement. Consequently, it tires them so quickly because they burn lot of energy during various manipulation exercises while using normal chairs and desks [1]. Consequently, they perform poorly in academics and thus denying them access to higher levels in the society. Children with disorders in sensory processing lead them to have a distorted sense of their localities, which at most times disturbs their exploration and learning of their world. Sensory incorporation was our brain's aptitude was to interpret, comprehend and respond to sensory information. Individuals with sensory processing disorder at most times have trouble assimilating and retorting to this information.

Using sensory incorporation products was one main way to assist children with sensory disorder observe and make sense of the world; moreover, these products were perfect for children who lacks sensory processing capabilities, and can aid kids in attaining important growing milestones. One of such sensory incorporation product was a sensory board. It has a task to model a unique device that will have all possible requirements of a disabled child contained in one place so as to minimize the movements. Precisely, we will design a sensory board that was going to be useful in teaching a disabled child several activities such as pulling, pushing, twisting, switching things on and off and so on. The device will also have a micro-phonic and speaker devices whereby an audio response will be generated for each activity done. For instance, if a child executes a certain task correctly, say pushing a button, the device will generate a sound saying, "well done" and so on. Several versions of a sensory board can be adopted but to best that was effective and meets the purpose, we have to consult with the relevant stake holders including the consumer and the manipulators. Basically, the sensory boards could be standalone boards, amalgamated in the walls or even on the desks.

The team pursues was to smear different skills and information in developing the new system. We have number of targets to achieve, including a better functioning model that was attractive and effective. The design will be comfortable, robust and eye-catching making the children yearn to learn. In addition, electrical engineering work will also so be added, so as to make the design function better.

2.2 Project Description

The goal of this project is teach children with disabilities how to write, read, stand, live their normal lives, and learn some basic life's skills. Normal people do not notice how hard for children with disabilities to learn skills. Children with disabilities need more attention to learn new materials and they can hardly store the new materials in their brain. Therefore, we are trying to create a device for them that can help them learn many things in our life. In addition to that, The device that will be built is educational as well as entertaining so that kids can enjoy the materials that they are learning.

The following is the project description given by the instructor:

"This project calls for a learning device for the classroom that helps one or more children with disabilities during a regular school day. The project is open-ended and calls for the student design team to visit the classroom, understand how the children learn and play

during the day in the room, and propose a project based off their observations and the classroom teacher's needs."

2.3 Original System

This project involved the design of a completely new disability aid product. There was no original system when this project began.

3 Requirements

By the end of the project the team will have ensured that both the customer and the engineering requirements were met. These requirements will be contained in the final design system to facilitate effective functioning and also guarantee that the customer necessities were met.

3.1 Customer Requirements (CRs)

Customer requirements include the requests which were given by both the consumer and the operators. In this case the client was Marshall Elementary Cross-Categorical Program while the users were the disabled students. These were the right people to give the requirements they want since they interact with the devices on a regular basis and hence they exactly know what will best suit them and the necessary adjustments which need to be done include operations which were needed to be added [2]. Their views on how they want the original device improved will be translated into customer requirements as shown in the Table 1 below.

Table 1: Customer Requirements

Customer Requirements	Description of customer requirement
Safe to Use	Device must be safe to use by the children
Flexible design	The design should be adjustable to fit people of various sizes, bulkiness and disabilities.
Sensory board	To guide students on various operations.
Containment	Include an entertainment teaching device
Device Strength	Strong materials should be used to ensure the device lasts longer.
Comfortable design	The sitting area should be easy and the writing board at the user's level.
Durable design	The material used should be durable
Economical	It must be economical

In the above table, customer requirements have been presented as per the specifications of the client. They will be followed by the team when they will be designing the device. The original system will be amended by ensuring that the board has an electrical component so it can produce lighting and sound. The design will be flexible to suit various sizes of the disabled students. This way, its location which was on the wall could be adjusted which solely depends on the height of the user. Strong plastic will be used to guarantee that the device was strong and durable. It will also have a containment so as to entertain the users while they were operating the device.

3.2 Engineering Requirements (ERs)

From the customer needs obtained from the specifications of the client in order to improve the original design, they were then rendered into various engineering requirements. This was very crucial since it ensures that the requirements were translated into aspects which were definite and determinate for later analysis and interpretation. The engineering requirements were as shown in Table 2 below.

Table 2: Engineering Requirements

Engineering Requirements	Targets
1.Flexible design	Adjustable to a length ranging from 5cm to 15cm
2.Strength of the device	Yield strength of at least 6Mpa.
3.Soft material	Low pulling force of below 5 Pascal
4.Adjustable length	5 cm length range
5.Containment	-
6.Sensory Board	-
7.Size	8 x 8 feet
8.Soft Edges	-
9.Height of Board	12 feet
10.Weight	15 lb.

The design that our team intends to make should be flexible so that it was able to fit individuals of different heights. Therefore the device will have an adjustment knob so as to adjust the height accordingly. The device will also be strong such that it will yield strength of 6Mpa. It will also be soft and hence soft material will be used. In this instance, the soft material will be the one with a pulling force of less than 5 Pascal. The device will also have a containment so as to keep the student with disability busy and entertained as well as teaching at the same time like playing 40-50 educational songs. They will also have a sensory board to guide the students through various operations like 10-20 lights indications and/or a voice prompt.

3.3 Testing Procedures (TPs)

3.4 The following testing procedures highlight how each impute of the design was tested to ensure that they fell into the scope detailed in the engineering requirements. Testing standards were used where pertinent, while more clarity testing methods were used for all other tests.

- Flexible to a length ranging from 5cm to 15cm with tolerance limit of 0.5 cm.

  The adjustment mainly entails the writing board and the height of the seat. In this situation the seat and the writing board were accustomed to the lowest position possible and measurements taken. Then they were attuned to the highest position possible and measurements taken. This enabled the team to get the range of 5 to 15 cm.

- Yield strength of at least 6MPa ± 1KPa.

  To test material's yield strength, the team subjected it to a force. A clamp and several weights of about 50Mpa ± 5KPa were required. Using the clamp, the material was first clamped with the clamp and weight was then positioned over the material. After the test the material did not give in to the weight.

- Soft material.

  The measure for the softness of a material was the force vital to break a fiber. In order to measure the breaking force of the fiber, the material was tied on one end to a firm position while the other end was tied to a spring balance. Spring balance's end was pulled and readings made. Before a reading f 5N was attained the fiber snapped. A soft fabric should not exceed a toughness of 5 newton.

- Containment.

  A device which was to teach the students with disabilities on how to count

numbers and the months of the year was fixed and tested for its effectiveness.

- Sensory board.

  The sensory board was supposed to have instructional lights and voice prompts to guide the student with some ability on various operations.

- Size

  Size of the box can determine by the scale. By calculating the width and length of box.

- Weight

  Weight of box can measure through the weight scale and test if it lies within the range or not.

- Soft Edges

  This can test through by hand if there was any sharp edge present or not.

- Height of Board

  It can measure through the scale and find the height of box and test it if it was in within the range or not.

3.5 House of quality

HOQ will be applied so as to assist in analyzing gadgets given various parameters. Its major aim was to investigate the plan that the tea will select to assist them in settling on the most suitable plan. This will involve integration of the requirements which have been discussed above the requirements include, flexible device, strong, comfortable, light, durable, and simple to operate [2].The HOQ enabled the team to improve the original design to fit the engineering requirements.

Table 3: House of quality

Customer Requirement	Weight	Weight	Yield strength of at least 6Mpa	Adjustable to a length ranging 5cm to 15cm	Use soft fabric	Containment	Sensory board	Size	Soft Edges	Height of Board
Should be flexible	4			5	4	5	**6**		**3**	1
Should be strong and durable	5	3	4					**6**		
Comfortable design	4	1			5			**3**	**9**	2
Containment	5		4			8	**9**			
Sensory board	4	5	4			8	**9**	**9**	**9**	3
Absolute Technical Importance (ATI)		5	4	4	5	5	5	4	5	2
The Relative Technical Importance (RTI)		7	9	9	7	6	9	8	4	7
Target(s), with Tolerance(s)		15±1	6±1	5±2	30±5	-	-	8x8±1	-	12±*1*
The Testing Procedure (TP#)			1	2	3	6	6			

4 Existing Design

Variety of devices have been designed to assist the disabled in carrying out various day to day operations. In this regard, the team has made an extensive research so as to check and compare the various devices which were available to help the disabled. The key focus was on a device that will assist the disabled by meeting their proposed customer requirements. In order to recognize the various aspects required to improve the design's performance the team embarked on looking into a range of already existing designs.

4.1 Design Research

A range of designs have been created to help the disabled. However, the designs were normally improved as time goes on so as to suit the needs of the users. The team analyzed a wide range of existing designs in the market so as to come about with an appropriate design.

4.2 System Level

The assistive devices for the individuals with disabilities such as wheel chairs have evolved over the course of several years to suit the needs of the user. The changes were attributed to the technological advancements which have occurred over the years. In this project the proposal was a device which resembles a wheel chair but with a multiple of improvements to make it appropriate. The team will acquire some basic knowledge from the pros and cons of the already existing designs so as to make their design a success.

4.2.1 Existing Design #1: Walgreens Ultra Weight Transport Chair

Walgreens ultra-weight transport chair was a strong chair which can support up to 300lbs, it has remove able foot rests, a seat belt and wheel locks for extra safety. Also, it has angled armrests to enhance access to counters tables, and desks. In addition it has washable stain- resistant nylon fabric that was inherently and brakes lock for safety [3].

Figure 1: Walgreens Ultra Weight Transport Chair [7]

4.2.2 Existing Design #2: Viscco Wheel Chair

Viscco wheel chair comprises of a removable eating and writing board. Also it has a strong metal frame which was able to endure rough conditions. It has special sealed bearings used for smooth movement hence adding to the comfort of the user. In addition it has a seat made of double bonded Vinyl Fabric with upholstery for comfort and durability [3].

Figure 2: Viscco Wheel Chair [7]

4.2.3 Existing Design #3: Wheel Chair with a Lap Hugger

The lap hugger was very crucial since it enhances the security of the user by preventing him from falling forward. It was also crucial for appropriate support to the upper body. In addition, it makes the wheel chair stronger as it was made up of durable foam padding covered with vinyl.

Figure 3: Wheel Chair with a Lap Hugger

4.2.4 Existing Design #4: Wooden Sensory Board

This Sensory can teach kids the basic things in life such as, counting, adding, subtracting, zipping, stapling, etc. This was very vital since it makes them independent and can do maximum of the stuff themselves. In addition to that, the size of this kit was very small to facilitate the kid can spend some time figuring out some materials alone. Studies show that some kids need to spend some time alone when studying to avoid any distractions [4].

4.2.5 Existing Design #5: A Stand Sensory Board

The only difference between this design and the previous one was that this design has wooden legs. This design was significant because it enables instructors to teach a group of students at the same instance. It exactly works like a regular board. The instructor, then, can show each student how to use the materials and it can make them practice in front of all the others. When practicing in classroom settings, the student can barely forget what they learned [4]. This was because they saw their friends practicing the materials upon they started playing with the board.

4.3 Functional Decomposition

In this project, the major aim was to design device which can be used by the students with

disabilities while they were taking their studies in class. Our functional decomposition will be a device which was strong durable, light-weight and easily operate-able. Functional decomposition consist of two models one was black box model and second was functional model or hierarchical task analysis.

4.3.1 Black Box Model

Black box model was the functional decomposition and it consists of only inputs and outputs. What was going inside the box was not matter in this case. Black box model basically explains the system working, by telling the inputs and outputs of the system. And at the start of any project, making the black box model was good to understand the system. Black box model for this project was showing in the figure 4.

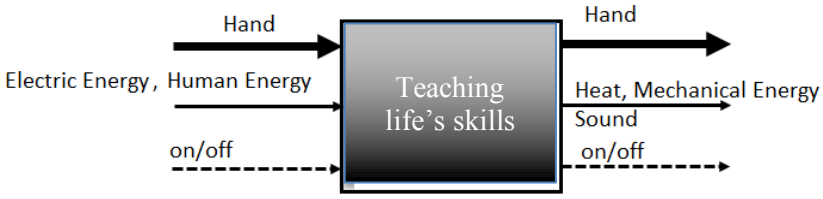


Figure 4: Black box

4.3.2 Functional Model/Work-Process Diagram/Hierarchical Task Analysis

Black box model has presented in the previous part, and in black box model only inputs and outputs of the system have defined, and what's going inside the system doesn't express in black box model. On the contrary functional model was the one which explains the system from inside. It tells the process takes by the system from input to reach the output. This model was also important to completely understand the system. Figure 5 was showing the functional model.

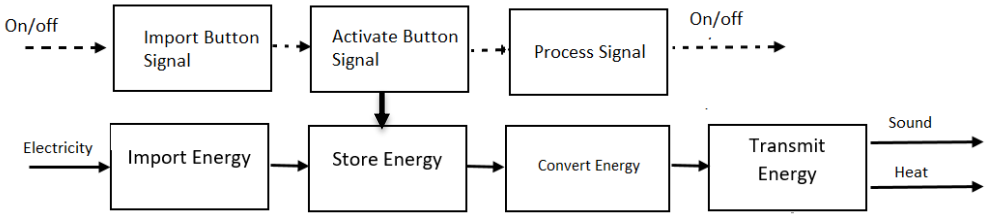


Figure 5: Functional Model

4.4 Subsystem Level

After carrying out an extensive research it was evident that when devices were designed in a better approach they were able to meet customer requirements. This was accomplished by using proper gadgets [5].

4.4.1 Subsystem #1:Enjoyable

Having a variety of containment such as numbers, texture board and pillows which makes the users to learn new things and feel entertained and comfortable.

4.4.1.1 Existing Design #1: Numbers Containment

The numbers improve the learner's knowledge by making them know how to count numbers and hence keep them busy and informed.

4.4.1.2 Existing Design #2: Texture Board Containment

It enables the students with severe disabilities such that they will be able to differentiate

between various textures feels.

4.4.1.3 Existing Design #3: Positioning Pillows Containment

It entails positioning pillows which were made from a strong and a washable fabric.

4.4.2 Subsystem #2: Sensory Boards

Since the device will be used for teaching the students with disabilities how to perform various activities such as how to pull, push, twist, switch etc. a wheel chair with an appropriate sensory board can be adopted.

4.4.2.1 Existing Design #1: Sensory Stimulation Tray

The design involves a sensory stimulation tray whose purpose was to entice the vision and sense of touch of the user.

4.4.2.2 Existing Design #2: Audio Sensory Board

The design entails a sensory board with digital controls and voice prompt to guide the user on various actions.

4.4.2.3 Existing Design #3: A Stand Sensory Board

The design has legs that can be used in regular classroom for teaching materials.

4.4.3 Subsystem #3: Safety

The device should ensure the safety of the user always.

4.4.3.1 Existing Design #1: Wheel Locks

They make sure that the device was steady when the student was stationary on a desk.

4.4.3.2 Existing Design #2: Angled Armrests

They enhance access to counters tables and desks.

4.4.3.3 Existing Design #3: Break Locks

They enhance safety of the operator by locking the braking system.

5 Designs Considered

The team produced a wide range of designs during the brainstorming process which were parallel with the various customer and engineering requirements. Various aspects of design were considered and improvements made on the already existing designs. Some designs which selected were as follows.

5.1 Design #1: Wheel Chair with a Desk

The device has a board which can be utilized for writing and eating purposes. This will ensure that students carry out their tasks of readings and writing tasks easily by placing books on this board. It also has wheels to facilitate motion from one place to another. The major challenge with the board was that it must be removed every tie the user was not using it.

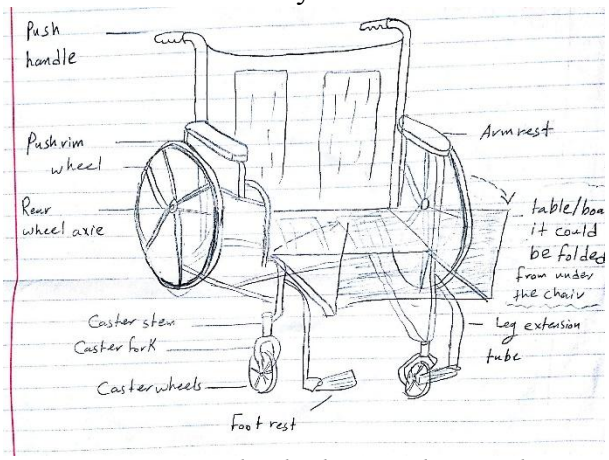


Figure 6: Wheel Chair with a Desk

5.2 Design #2: Lap Hugger

The lap hugger provides an appropriate upper body support and also prevents the user from leaning forward. The hugger was made up of durable foam padding covered with vinyl hence making it easy to clean. It also has a clear window for storing reading material.

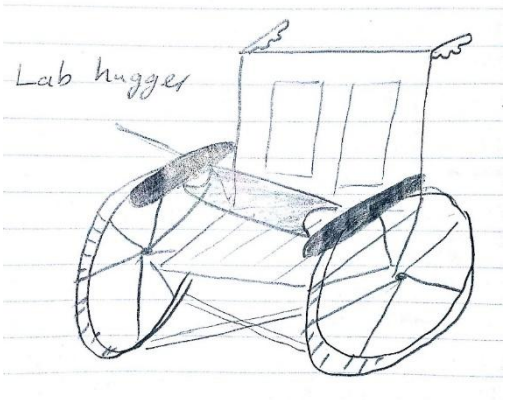


Figure 7: A Lap Hugger

5.3 Design #3: Wheel Chair with a Seat Belt

The design comprises of a safety belt which was fastened around the waist. This was beneficial in that it prevents falls, prevents forward sliding, it has a soft breathable foam to facilitate comfort. Also, the closer was capable to be positioned for self-releasing

or even more restrictions.

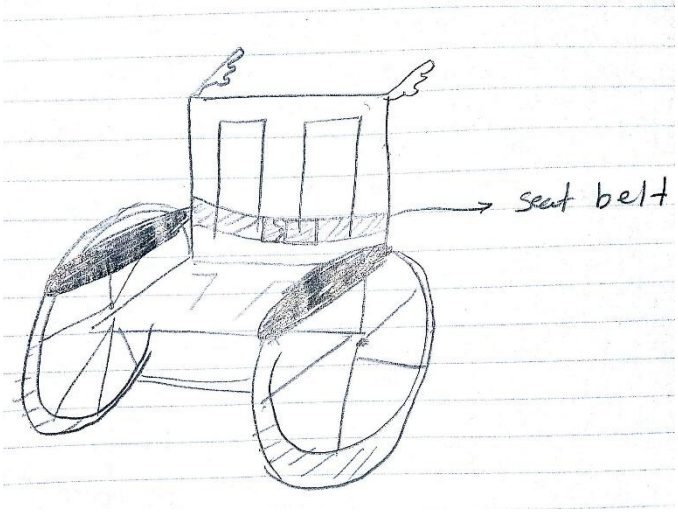


Figure 8: Wheel chair with Seat Belt

5.4 Design #4: A Hexagonal Containment

A hexagonal containment that has a door. Once the child was in, he can play around with a sensory board surrounding him.

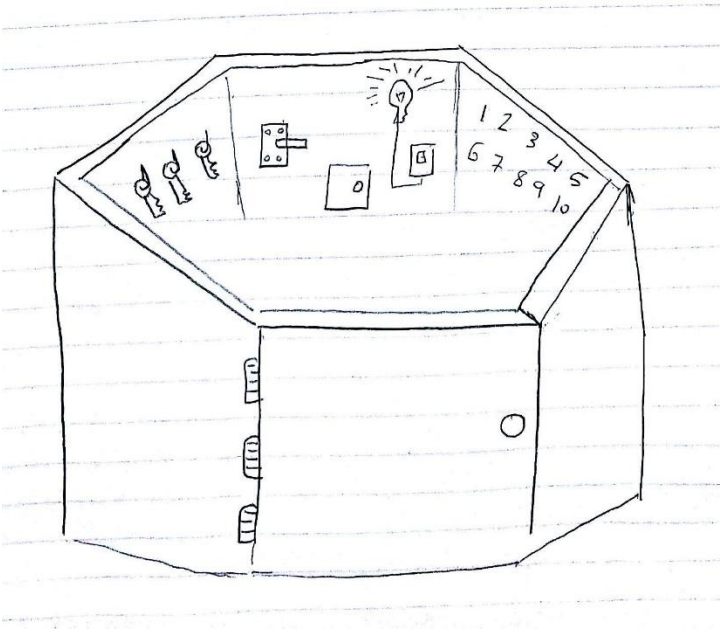


Figure 9: Hexagonal Containment

5.5 Design #5: A Hexagonal Containment Sensory Board with Wheels

A hexagonal containment made of word and it has door which enables the child to get in inside. Once the child touches the wall and play with the materials, the wheels will rotate. Consequently, energetic kids do not fell board because they move from one place to another but inside the hexagonal.

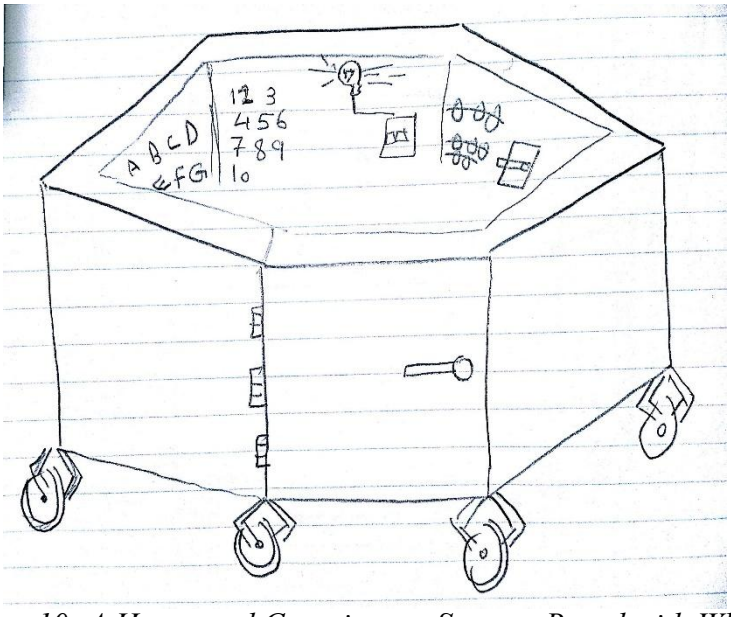


Figure 10: A Hexagonal Containment Sensory Board with Wheels

5.6 Design #6: Trampoline Containment Sensory Board

A hexagonal containment has a door and it was made of wood. The base of it was a trampoline shaped. This can entertain the child while he was learning the hexagonal.

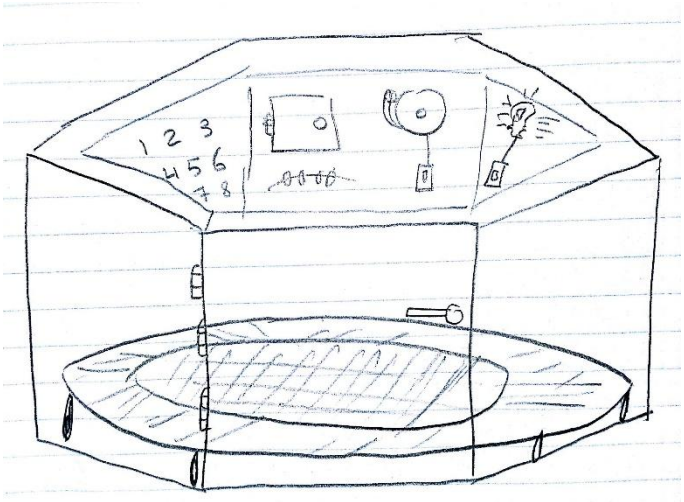


Figure 11: A Trampoline Containment Sensory Board

5.7 Design #7: Sensory Board to the Wall

Sensory board that was mounted to a wall. This design can enable all kids in the schoolroom use this available learning tools.

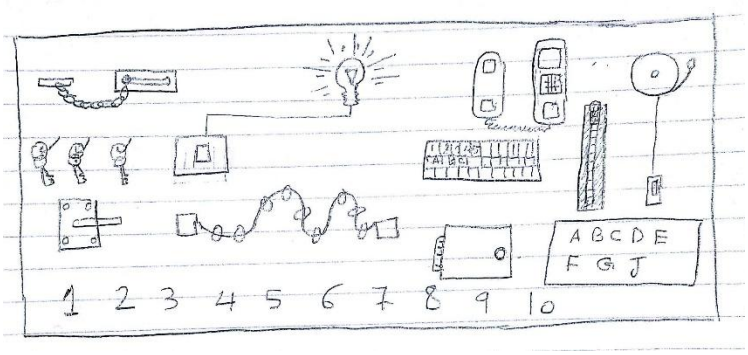


Figure 12: Sensory Board to the Wall

5.8 Design #8: Rectangular Sensory Board

The design comprises of a sensory board which has digitized controls. The board has a wide variety of buttons, door knobs, and some puzzles. Also, the sensory board has different lights which blink followed by a voice prompt either to caution or assuring the user of the correctness of performing a particular action. The unique about this design was that it has wheels which facilitate moving it around the class without exerting any efforts. In addition to that, we were incorporating in this design a stand that can help a disabled child to get used to stand up and play with the board because of some of the kids we observed struggle when getting up. The cubic sensory board will attract them, and therefore, help them strengthen their knees.

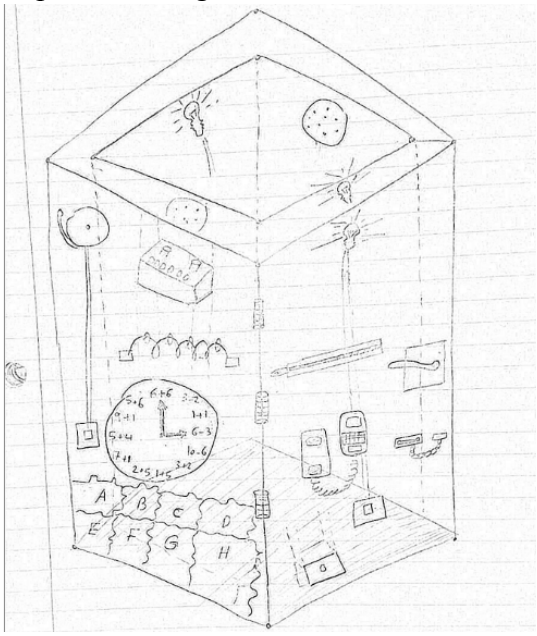


Figure 13: Rectangular Sensory Board

5.9 Design #9: Rotating Circular Sensory Board

This design comprises of different kinds of audios that can teach disabled children how to read letters, numbers, days, and months. Kids, in general, don't like to be forced when learning, so we can make this more attractive by making the circular sensory board flashing while rotating. In this situation, the disabled kids were more into learning because it was a game for them.

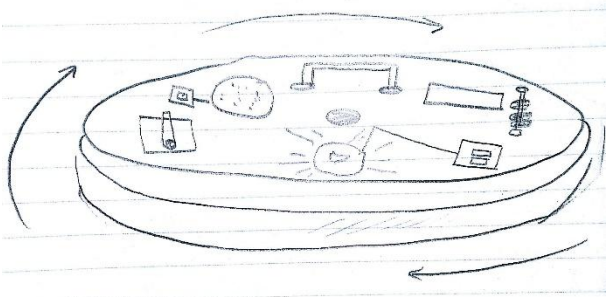


Figure 14: A Circular Rotating Sensory Board

5.10 Design #10: A Folded Sensory Board

The purpose of this design was also to teach disable children life's skills such as, pulling with some resistance, pushing, twisting, switching lights on/off, and zipping. However, the significant thing about this design was that it can be folded and taken away using a handle so that kids do not play with it without their instructors' permission. Also, this folded sensory board can be turned to a desk. The unique about this device was that it can serve many several things at the same instant.

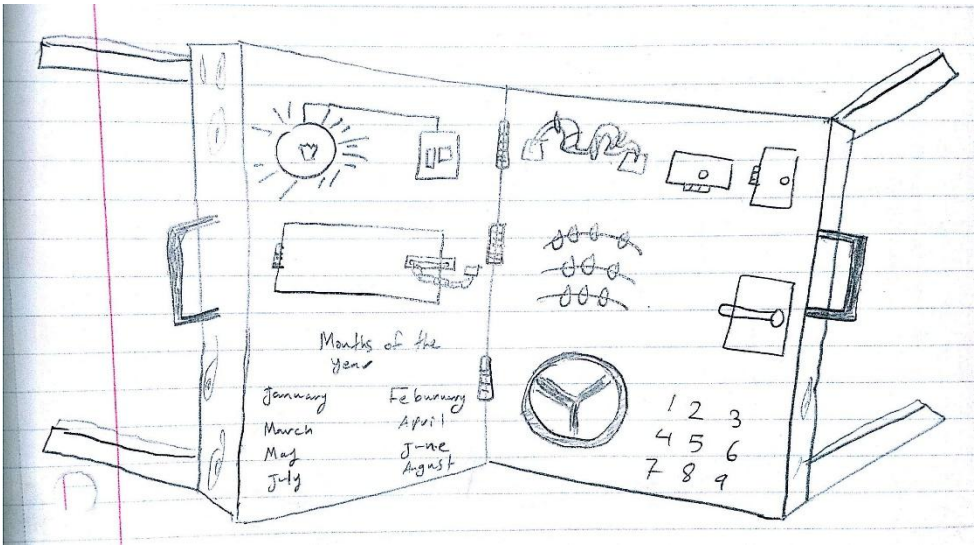


Figure 15: A Foldable Sensory Board

6 Design Selected

This design was ought to be taken after what the client needs and connected our building prerequisites. As we did in configuration considered for the 10 outlines. Everyone has distinctive thought and diverse approach to utilize. So we have to make sense of which one was better and can take after our client needs. Therefore we have decided to select the design on the basis of Pugh chart and decision matrix. Pugh chart will narrow down the results to final three designs and decision matrix will narrow down the result to final design.

Table 4: Pugh Chart

10 Concepts	Weightage	Wheel Chair with a Desk	Laphugger	Wheelchair with a desk	A Hexagonal Containment	A Hexagonal Containment Sensory Board with Wheel	Trampoline Containment Sensor Board	Sensory Board to the Wall	Rectangular Sensory Board	Datum Design	Rotating Circular Sensory Board	A Folded Sensory Board
Safe to Use	8	+	+	+	+	+	-	-	+	D	+	-
Flexible Design	7	S	S	+	-	-	S	+	+	D	+	+
Sensory Board	6	-	+	+	+	-	-	S	+	D	-	-
Containment	5	+	+	+	+	+	S	-	+	D	-	S
Device Strength	4	+	S	+	S	+	+	-	-	D	S	S
Comfortable Design	3	+	+	+	-	-	-	S	+	D	-	+

Durable Design	2	-	+	+	+	-	-	-	+	D	S	-
Economical	1	-	+	-	-	-	-	+	+	D	-	
Pluses		4	6	7	4	3	1	2	8	-	2	2
Minus		3	0	1	3	5	5	4	0	-	4	3

From the table, it has cleared that the top three designs which got the maximum points and these three designs were fulfilling the customer requirement at their best. So now move towards the decision matrix to get the final result.

Table 5: Decision Matrix

DECISION MATRIX	Safe to Use	Flexible Design	Sensory Board	Containment	Device Strength	Comfortable Design	Durable Design	Economical	Total
Weightage	8	7	6	5	4	3	2	1	
Rectangular Sensory Board	6x8=48	7x7=49	4x6=24	5x5=25	6x4=24	6x3=18	4x2=8	2x1=2	198
Wheel Chair with a desk	5x8=40	5x7=35	4x6=24	2x5=10	3x4=12	3x3=9	3x2=6	3x1=3	139
Lap Hugger	3x8=24	4x7=28	3x6=18	1x5=5	4x4=16	4x3=12	2x2=4	2x1=3	110

Decision matrix gave the final result in which the highest marks have obtained by the rectangular sensory board and rectangular sensory board

6.1 Rationale for Design Selection

These Standing Boxes were remotely controlled that give full help to clients while standing who were trying to remain standing after a long time. Spring locks on the entryway make the Standing Boxes additional protected and secure, and the entryway swings open to 180 degrees for simple passage and exit. The base outline keeps the stander from tipping, keep the client securely standing.

Figure 16: Selected Design [8]

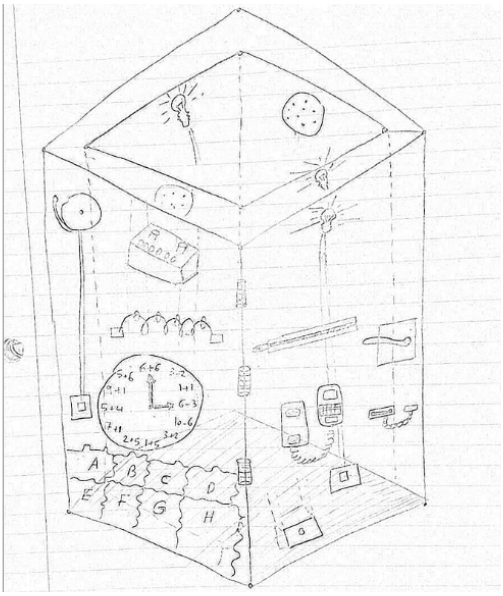


Figure 17: Sketch of Selected Design

Benefits of this design:

- Entryway swings 180 degrees
- Whole unit was set on a base intended to avert tipping
- Highlights an elastic secured, in a flash flexible foot stage
- Assists with a patient's initially attempt at working in a standing position
- Spring lock furnishes greatest security with one simple change

This was a fundamental cut out table for the patient's initially attempt at working in a standing position. The standing box includes an elastic secured, in a split second customizable foot stage.

The elite Bailey outlined spring lock furnishes most extreme security with one simple modification. The whole unit was set on a base intended to avoid tipping. Entryway swings 180 degrees.

Table 6: Features of the Selected Design

Individual Child Standing Box	Individual Adult Standing Box
Top Measurements: 61 cm x 76.2 cm	**Top Measurements:** 76.2 cm x 76.2 cm
Height from Floor: 85 cm	**Height from Floor:** 137.2 cm
Foot Platform Adjusts: 3.8 cm to 29.2cm from floor	**Foot Platform Adjusts:** 3.8 cm to 29.2 cm from floor
Cut Out Size: 17.8 cm x 25.4 cm	**Cut Out Size:** 30.5 cm x 38.1 cm
Box Dimensions: 35.6 cm wide x 35.6 cm deep and 81.3 cm high	**Box Dimensions:** 40.6 cm wide x 35.6 cm deep and 137.2 cm high

Figure 18: Final Design

6 Proposed Design

Final design has presented before in the previous section and in this section we were presenting that it will going to implement. Final design was semi cubic sensory board in which multiple items will hang and provide the learning to the children with disabilities. It will be moveable and easy to use it. Final design CAD model and a prototype is shown below:

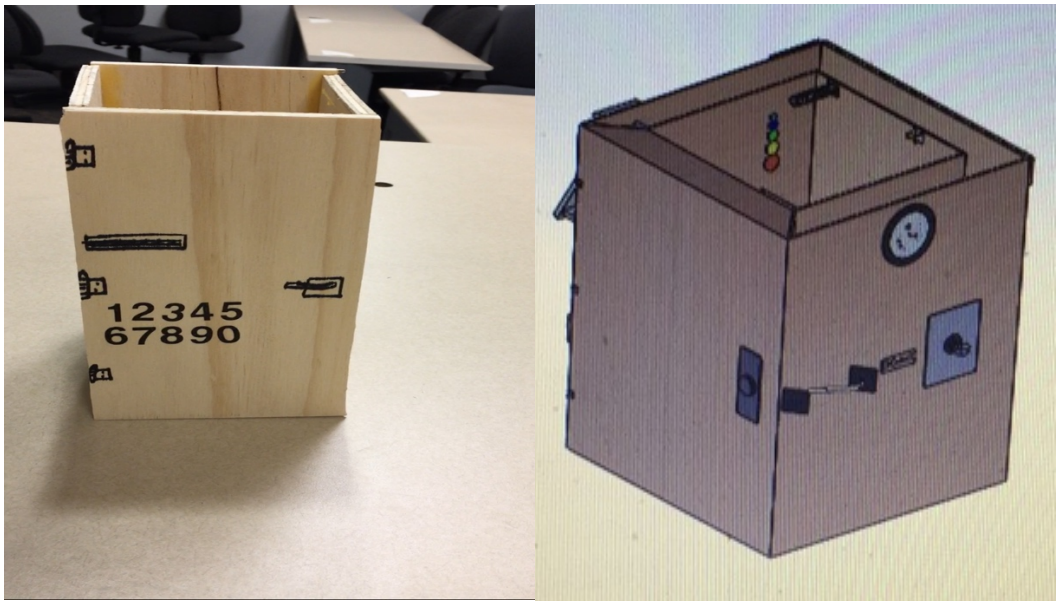


Figure 19: Primary design CAD model and the prototype.

6.1 Implementation Plan

The complete implementation plan of the Stick holder has been described with the help of the Gantt chart.

Table 7: Implementation Plan

Assignment	Beginning	Ending	Period
Design period			
Abstract	03-Nov-17	10-Nov-17	7
Detailed Design	11-Nov-17	18-Nov-17	7
Third party Validation of Design	19-Nov-17	24-Nov-17	5
Manufacturing Period			
Manufacturing of first sample	25-Nov-17	21-Dec-17	26
Purchase of Bought-out Part	21-Dec-17	10-Jan-17	16
Development of First Complete Set	11-Jan-17	25-Jan-17	5
Qualification of Sample	25-Jan-17	30-Jan-17	5
Planning Period			
Study of Market Strategy	30-Jan-17	05-Feb-17	5
Business Plan	05-Feb-17	10-Feb-17	5
Product Presentation/Demo	06-Feb-17	27-Feb-17	21
Pricing Strategy	27-Feb-17	28-Feb-17	1

6.2 Resources

The assets required to build up the task from its idea to its full development level incorporate the labor, starting capital cost to start the venture, Conventional machines to make the parts, throwing setups, materials to influence the parts and a get together to line if the parts will be made in extensive number of units. For manufacturing of parts we need access to Machine shop.

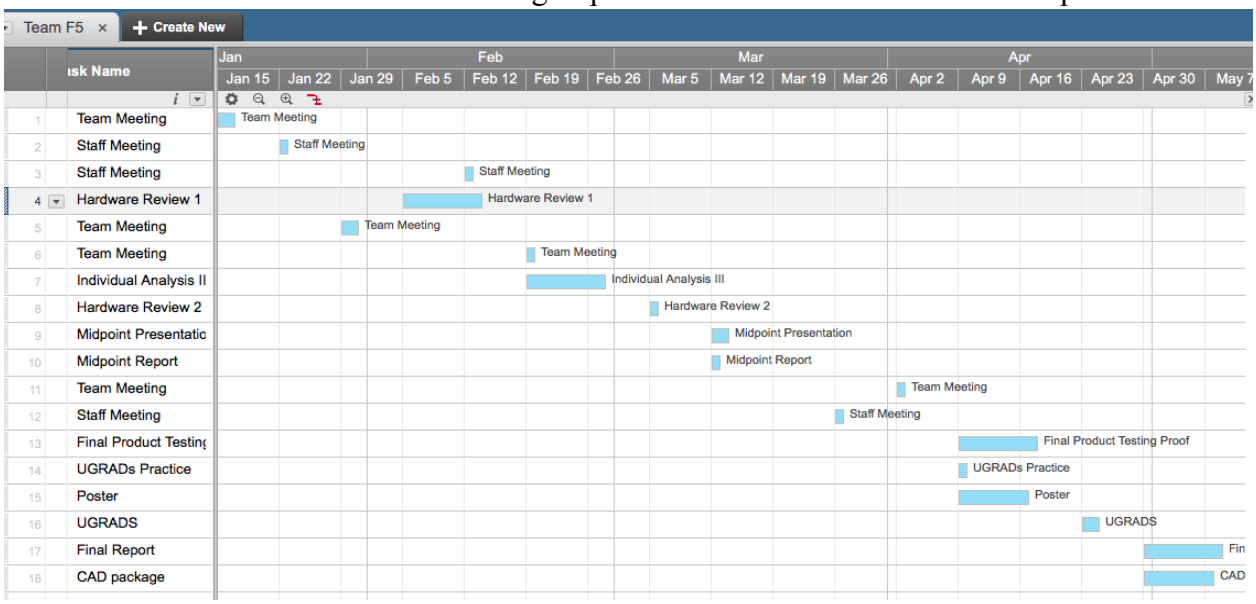


Figure 20: Gantt chart For Product Implementation

7 IMPLEMENTATION

In implementation process, the manufacturing is the main concept which needs to be done. For the manufacturing of a rectangular box following the bill of material in order to see the materials that will use in manufacturing.

7.1 Manufacturing

In the process of building the device, we began by building the rectangle box, before actual assembling. Then, we measured all the pieces of materials and ensured that they were enough according to the Bill of Materials. After that, we proceeded with assembling of materials, all we were very cooperative to ensure that the device is built as it was planned.

After modelling we did the following inspections:

*checked the strength of the corners

*we ensured that there is one side that can move to the door side

*ensured that all places that required tightening are well tighten.

In addition to that, we had bought heavy duty wood to ensure that the device does not tip over if anyone leans on it. Also, we are still working on safety measures so that the device is safe enough to be used. Thus we built three thick supports surrounded the device so that we ensure it does not tip over if someone else leans on it. This way, we ensured the safety of our device instead of keeping the think wood stands alone. Also, we installed the hinges for the door and we made sure the door is a little bit elevated from the ground so that we do not face any trouble when opening and closing the door. In regards of the

stuff that we are putting inside, we attached a wall clock that can help disabled children to know the time by adding and subtracting. For example, if the time is 12 then the kid sees in the clock 6+6 so they have to think and do some calculations in order to know the time and in this way education and entertainment both will happen at the same time. Following are the items that we added to the box. In regards of attaching parts to the wall, some sensory parts are glued, some are fastened, and others are fixed using Velcro depending on the materials we are using.

Figure 21: Item that are adding in the box

7.2 Design Changes

There are many changes in our design that occurred during testing and implementation. There are three main changes in the final. First, parts attached to the wall of the sensory board have been decreased from about 30 parts to 20 parts which results in size change of the design. The device was 5*6*6 ft to 3*4*3 ft according to the client's requirements. Secondly, trampoline has been removed from inside the device due safety issues. It has been looked it from different perspectives and it has been concluded that it is safe at all and it has to be removed and replaced by something else. We thought to use soft balls inside the design instead of the trampoline; however, it has been considered as it is not safe because it might hurt kids' ankles. Lastly, we will not use car battery as a source of power due to its size, cost, and safety reasons. Instead, we bought sensory parts which have their own batteries. Both bill of materials from last semester and this semester is shown below to highlight the differences between old design and new design:

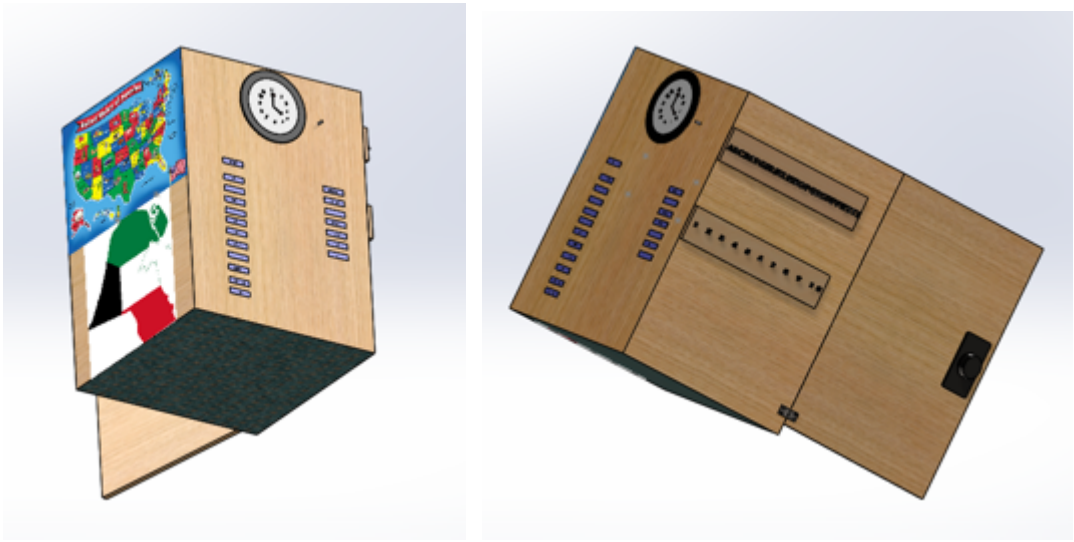
Table 8: Last semester BOM

	Materials	Cost in $	Quantity	Total cost
1	Door Knobs	$3.47	5	$17.35
2	Light bulb	$2.17	4	$8.68
3	Light switch	$2.97	4	$11.88
4	Car Battery	$49.88	1	$49.88
5	Drawer	$31.98	1	$31.98
6	Bell	$5.88	2	$11.76
7	Door hinges	$1.56	3	$4.68
8	Zip	Owned	2	N/a
9	Speaker	$9.49	1	$9.49
10	Wood	$19.95	8	$159.60
11	Telephone	$5.98	2	$11.96
12	Alphabet Puzzle	$4.82	1	$4.82
13	Learning clock	$6.97	1	$6.97
14	Bead Maze	$8.29	2	$16.58
				$345.63

Table 9: New BOM

	Materials	Cost in $	Quantity	Total Cost $
1	Alphabet and number puzzle	$29.99	2	$59.98
2	Bell	$5.85	2	$11.70
3	Zippers	$7.50	1	$7.50
4	Buzzers set of 4	$18.97	1	$18.97
5	Tax	$1.70	N/A	$1.70
6	Days cards	$6.99	1	$6.99
7	Monthly calendar cards	$5.99	1	$5.99
8	US map chart	$3.49	1	$3.49
9	Shapes Sound Puzzle	$12.99	1	$12.99
10	Tax	$2.64	N/A	$2.64
11	Wall clock	$3.88	1	$3.88
12	BP DOOR CHN	$3.97	1	$3.97
13	NK RD DR HNG	$2.97	1	$2.97
14	3 BRRL BOLT	$2.67	1	$2.67
15	2 WD SCRW	$0.97	1	$0.97
16	TAX	$1.29	N/A	$1.29
17	CASTER SWVL	$2.94	4	$11.76
18	DRLCK HALLCL	$7.87	1	$7.87
19	Wall clock	$3.88	1	$3.88
20	TAX	$2.10	N/A	$2.10
21	WORLD MAP	$3.49	1	$3.49
22	MAGNETIC CHALKBOARD	$19.99	1	$19.99
23	TAX	$2.11	N/A	$2.11
24	DOOR HANDLE	$12.05	1	$12.05
25	MAGNETIC TAPE	$3.88	4	$15.52
26	TAX	$1.39	N/A	$1.39
27	WOOD 0.725IN *48IN * 96 IN	$49.98	3	$149.94
28	WOOD 1.5IN *3.5IN * 96IN	$9.77	8	$78.16
29	SCREWS	$8.38	1	$8.38
30	HINGS	$3.67	3	$11.01
31	TAX	$22.15	N/A	$22.15
32	WOOD CEDR .216IN*23.75IN*47.75IN	$16.92	2	$33.84
33	TRIM BOARD	$3.22	3	$9.66
34	TAX	$3.88	N/A	$3.88
35	TAPE FOR THE IPAD	$6.97	1	$6.97
36	AAA BATTERY	$11.78	1	$11.78
37	AA BATTERY	$6.94	1	$6.94
38	TAX	$2.30	N/A	$2.30
39	IPAD Mini	Owned	N/A	Owned
TOTAL COST: $572.87				

The final cad package as well as the final design we built as is in the following pictures:



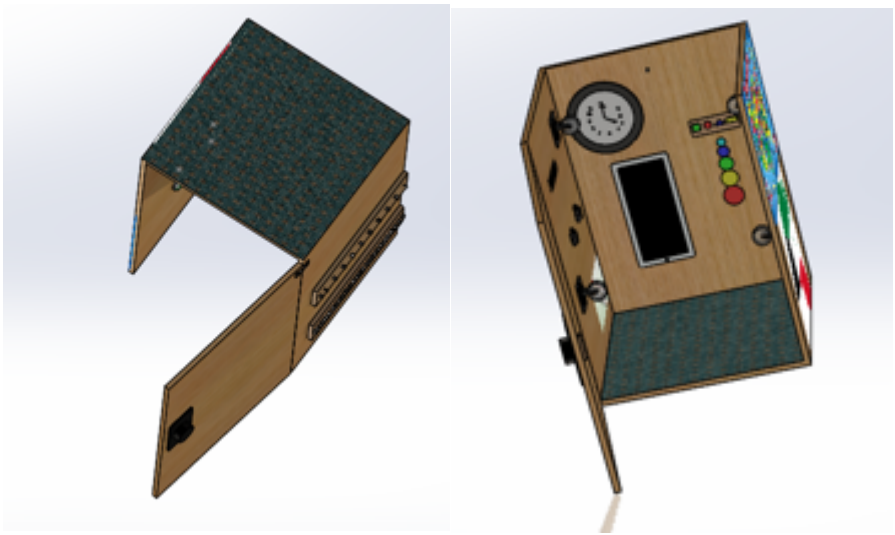


Figure 22: Final Cad model

Figure 23: Outside view of the design

Figure 24: Inside View of the design

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