NORTHERN ARIZONA UNIVERSITY

Design for disability simulation

Final Proposal Report

(Team B2)

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EXECUTIVE SUMMARY

This project is about making the able-bodied persons to feel like person with disabilities and then they will realize the mysteries faced by persons with disabilities. For this purpose different sort of designs have been generated in this report and after using the Pugh Chart and decision matrix two designs have finalized which will be built in actual for this project. One of the design is neck belt which will cover the whole neck and shoulder and able-bodied person will not able to move the neck easily and the next one is black glasses which will be worn by able-bodied person to understand the feeling of blindness. Neck belt has made using the Aluminum Alloy 1060 and glasses has made using the plastic.

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1 BACKGROUND

1.1 Introduction

Disability was a problem which was affecting most people since they lack the awareness of how to tackle it so as to enable them to lead better lives just like able-bodied persons. The major aim of this project was to create a disability simulation display which will be used by able-bodied persons so as to make them feel like they were persons with disabilities. In this simulation new designs will be focused on making people learn what it feels to be person with disabilities as a result of ailments of accidents. Some of the disabilities the project seeks to focus on include arthritis, loss of fingers or hands, or lack of movement in an arm and lower body disabilities such as inability to walk and use of prosthetic.

The team seeks to apply a variety of skills and information in developing the new system. There are various requirements and targets the team seeks to attain, including determining the kind of disabilities the display will simulate to enable the users to understand certain disabilities in a clear and appropriate manner. The team will ensure that they create a perfect disability simulation which can be used as many times as possible and thus satisfy the needs of the clients. In addition, the team will ensure that they apply the knowledge they have acquired during the course so as to make sure that the design function appropriately. When those targets are attained, the team will have met all the needs that have been indicated by the client.

1.2 Project Description

Individuals who have lower and upper appendage muscles ineptitudes typically require assistive gadgets with the goal of having the capacity to complete their errands essentially. These designs which the team expects to think of should go about as reproductions that assist a man to comprehend being an individual with inabilities. Be that as it may, the designs will likewise be of incredible importance in instructing and presenting the clients to an assortment of incapacities related with the upper and the lower appendages. The designs chose ought to guarantee that the clients can utilize them in an agreeable way and furthermore empower them to use them proficiently. In such manner the design ought to be easy to work with the goal that the clients invest restricted energy when they were utilizing it. Basically in this project we were going to build such a product which will be used by able-bodied persons to be able to feel like people with disabilities as their motions will restricted by the use of product.

1.3 Original System

In this project we were going to build an original which was new and hasn’t been built before as well and neither were we improving on any system. We were going to build a disability aid product.

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

2 REQUIREMENTS

There were a variety of requirements that the team seeks to meet by the end of the project. These include the customer requirements, which will be taken into consideration while formulating the engineering requirements. The requirements will be included in the final design system to facilitate effectiveness in functioning in addition to meeting the customer requirements.

2.1 Customer Requirements (CRs)

Customer requirements were the different forms of requests in which the clients and the users have on how a design can be improved so as to suit their needs. Since they were the major users of the device, they have a lot of experience on how the device operates including its strengths and weaknesses [3]. The experience was of great significance since the clients and users may have views on how the device can be improved, which were then translated into customer requirements. Some of the customer requirements were as shown in the table below.

Customer requirements were presented below in table 1

Table 1: Customer Requirements

Customer Requirements	Description
Safe	Must be safe and must not hurt anyone
Durable	Life time should be longer
Reliable	Must be a reliable product to use at any instance.
Transportable	Easy to carry anywhere without facing any difficulty.
At least three disabilities simulated	Three different disabilities must be simulated with the product.
Easy to Use/ understand by children and adults	Easy to use by anyone and must not be a complicated product.
Requires users to perform certain tasks while simulating disability	Different sort of tasks will performed after wearing the disability simulation product.
Able-bodied persons will feel the true feelings of people with disabilities	People with disabilities feelings can only be realized by able-bodied persons if he or she was also in the same situation.

2.2 Engineering Requirements (ERs)

From the customer requirements the team was able to come up with engineering requirements which were to be used in improving the original design into a more appropriate and effective one. The engineering requirements were specific and measurable and this was very crucial as it makes work easy during later analysis and interpretation. The engineering requirements were as shown in Table 2 below.

Engineering requirements were presented below in the table

Table 2: Engineering Requirements

Engineering Requirements	**Target Values**
Angle of Movement	30 Degrees
Speed of Motion	20 cm/s
Material Strength	1200 Gpa
Range of Motion	2.5 feet
Allowable Stress	100 Gpa
On/off time	30 seconds
Maximum Force	20 N

Angle of Movement

Movement angle for the neck in the case where neck was covered with the belt. At that time maximum angle, the neck can make a turn of around 30 degrees.

Speed of Motion

Motion speed will reduce after wearing the product and the maximum speed will be around 20 cm/s that will be achievable after wearing it.

Material Strength

Capability of material to bear any stress was material strength and that will be around 120 GPA.

Range of Motion

Range for any body part will be reduced after wearing the belt and the maximum range was around 2.5 feet that a person will be able to achieve.

Allowable Stress

Stress that will be within the limits of material was around 100 GPA.

On/off time

The time that will be taken by the product to become active and inactive will be maximum of 30 seconds.

Maximum Force

Force that will be applied by the human body was 20 N that which he will apply after wearing the belt.

2.3 Testing Procedures

In this section it explains about the procedures through which each engineering requirement will test. Like through the machines, scales or anything.

Angle of Movement

It can test by moving the angle and determine the angle variation and see if the body is moving with consistent angle or not. Angle measuring scales are available easily at the stores.

Speed of Motion

Speed motion can test by determining the speed using the speedometer, in this way it can test. Speed measuring tool available which determine the velocity after attaching with the body.

Material Strength

Material strength can test by applying the stress over the materials. Material strength can test in mechanical lab.

Range of Motion

Range of motion can test by throwing some object and taking the object to test its range. Range of motion test through machine available in stores.

Allowable Stress

Stress can test by applying some external force and determine the change in shape. This can test in mechanical lab.

On/off time

On/off time can test using the watch and see how much time it takes to turn on and off. Watch is enough to test this.

Maximum Force

Maximum force can test by observing the force using force gauge.

2.4 House of Quality (HoQ)

House of Quality help will be used since it will help to analyze gadgets given various parameters. It will be used to investigate the plan that will be selected by the team to help them in settling on the most appropriate plan to use. In this regard, the team members will be required to remember all the prerequisites which have been investigated above [1]. The requirements include a device that was light in weight, simple to use, strong, flexible, durable and comfortable. By using the house of quality the team was able to make tremendous effort by improving the original design so as to meet the engineering requirements.

Table 3: House of Quality

Engineering Requirements / Customer Requirements	Importance	Angle of Movement	Speed of Motion	Material Strength	Range of Motion	Allowable Stress	On/off time	Maximum Force	
Safe	9	3			1			3	
Durable	3	1	3	3	9	3	3	1	
Reliable	3	3			3			3	
Transportable	9		1	3		1	3		
At least three disabilities Simulated	9	1	1	1	1	3	1	1	
Easy to Understand	1		1	3	3	1	3		
Perform certain tasks	3	1	1	3	1	3	1	3	
Able-bodied persons can feel	9	3	9	3	9	3	9	1	
Technical Importance: Raw Score		78	112	84	141	82	132	66	
Technical Importance: Relative Weight		**11.2%**	**16.1%**	**12.1%**	**20.3%**	**11.8%**	**19.0%**	**9.5%**	
Techanical Target Value		30	20	1200	2.5	100	30	20	
Upper Target Limit		60	40	1300	5	200	60	30	
Lower Target Limit		20	10	1000	1	50	10	5	
Units		Deg	m/s	Gpa	m	Gpa	sec	N	

3 EXISTING DESIGNS

Over the years engineers have come up with various forms of simulation technologies aimed at teaching medical practitioners, students, people who assist the persons with disabilities and other interested stakeholders to understand what it feels to be a person with disabilities. The team has inquired about various gadgets that were intended to simulate in an appropriate way. While conducting their research on various sources, the team focused on designs which met the various customer requirements. They also focus on designs which had the ease of improving so as to satisfy the user's needs. In order to get the most appropriate designs the team carried a lot of research from the internet, interviewed the clients and the sponsors. Some of the already existing designs that the team embarked on focusing were as discussed below.

3.1 Design Research

Since the first design of assistive devices was invented, improvements have been made over the years so as to meet the upcoming customer requirements. This has been facilitated by the growth and development of technological innovations and inventions. Therefore the team was burdened with the task of analyzing the merits and demerits of each design so that they can use the shortest time possible and fewer resources in improving it [2]. The analysis was very crucial since it helped the team to have efficient ways of coming up with a design which meets the customer requirements. For this project we have searched online on various platforms to find out the best sources for our project. From the internet search we have found multiple existing designs which relates to our project. And these design were presented below as well.

3.2 System Level

Over the years the simulation devices for the person with disabilities have evolved so as to suit the needs of the user. The changes have been facilitated by technological advancements which have occurred over the years. In order to make their work effective the team members made an analysis of the merits and demerits of the various existing designs.

3.2.1 Existing Design #1: Artificial Hand Prosthetics

This design was an artificial hand which was manufactured using high grade materials hence it was durable. It also has advanced components and has a variety of sizes so as to fit people in various age brackets. It was also assembled from the finest quality components to enhance the amputee's needs [3]. The hand was also light weight, easy to wear and remove, has convenient design, has reliable performance and low maintenance. This design relate to our project in a way that this was a product which will restrict the motion of able-bodied persons and our project was also to come up with such design that will restrict the able-bodied person and feel the feeling of people with disabilities.

Figure 1: Artificial Hand Prosthetics [3]

3.2.2 Existing Design #2: Reciprocating Gait Orthosis

This design was light in weight and has enhanced durability since it was made up of high quality materials. The device was mostly used to assist people who have a spinal cord injury. The device also has a long working life, high performance and excellent finish. This product also restrict the motion of able-bodied persons so it was also related to our project. This product will restrain an able bodied person to move and it reduces the speed and bending angle of able-bodied person.

Figure 2: Artificial Hand Prosthetics [4]

3.2.3 Existing Design #3: Functional knee brace

The design was intended to assist those people who have knee defects due to anterior and/or posterior injury. It has streamlined frame design has ROM hinges with plug-in flex, hypoallergenic silicone-grip strap pads for anti-migration, breathable padding liner for shock-absorption and optimal heat exchange and tibia strap padding to improve suspension and customized fit. This product restrict the walking of a human being so it relates to our project as well.

Figure 3: Artificial Hand Prosthetics [5]

3.3 Functional Decomposition

In this project, the major aim was to design a device which will assist the client in carrying out simulations of people with upper and lower limb disabilities and hence enable them have an experience of a person with disabilities. The functional decomposition of the team will be a device which was easy to operate, durable, and light in weight. The functional decomposition was of great significance to this project since it will enable the team members to focus on the specific customer and engineering requirements.

3.3.1 Black Box Model

After a analyzing the original design, the team realized that there were problems with the general operations due to limited functionality. In this regard, the team made a decision of including a black box so as to improve on its performance. The black box will be used to store data. It will also help in coordinating other functions such as movement with minimal efforts. The major setback of the black box was that it was expensive and needs regular maintenance.

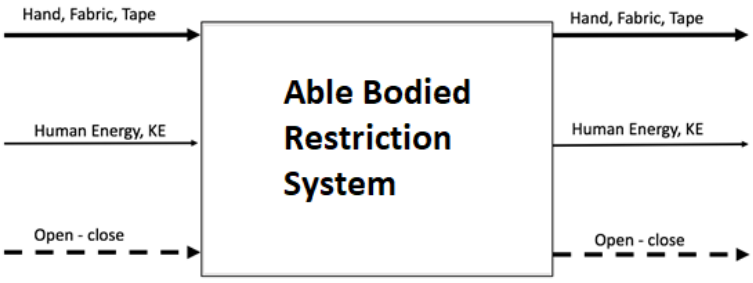


Figure 4: black box

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

In order to ensure that the team does not deviate from the objectives of the project, we

will make use of a functional model which will act as a guide. The model will have the engineering and customer requirements which will be fulfilled.

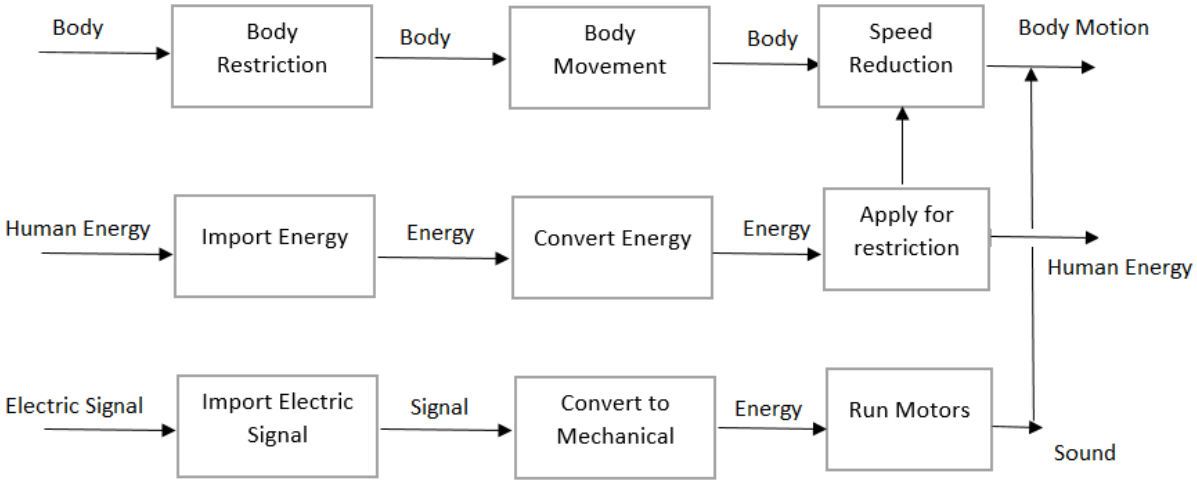


Figure 5: Functional Model

3.4 Subsystem Level

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

3.4.1 Subsystem 1: Hinges

There were different type of hinges already existed which include steel hinges, aluminum hinges and plastic hinges. Hinges were very important for our project because at every joint we have to use the hinge for making the moveable connection.

3.4.1.1 Existing Design #1: Steel Hinges

Steel hinges were strong and lightweight to use for our project. This was a good option to use in the project because these were long lasting and strong as well. Following figure was showing

Figure 6: Steel Hinges [6]

3.4.1.2 Existing Design #2: Aluminum Hinges

Aluminum hinges were also a useful option for our project. Aluminum hinges have already available and these type of hinges were lightweight and strong. These hinges have good channel for movement as showing below.

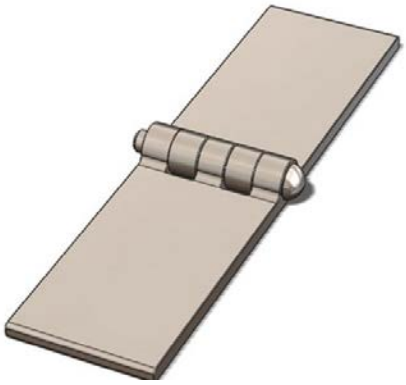


Figure 7: Aluminum Hinges [7]

3.4.1.3 Existing Design #3: Plastic Hinges

Plastic hinges were also already existed and these hinges were sharp and clean and easy to move. These can also use in our project as showing below in the figure.

Figure 8: Plastic Hinge [8]

3.4.2 Subsystem #2: Straps

Straps that will wrap around the body for holding it firmly. This was important in our project because without the straps the project was not possible to build and there already existing designs of straps were available.

3.4.2.1 Existing Design #1: Nylon Straps

Nylon straps were very common and useful existing product because these type of straps were strong and flexible to hold any sort of body firmly. This can be useful for our project to wrap the body tightly and able-bodied person will feel like the person with disabilities.

Figure 9: Nylon Straps [9]

3.4.2.2 Existing Design #2: Plastic Straps

Plastic straps were the one which were little hard and tough but they were flexible as well to hold the body. These straps were useful for our project to grip the body but this could hurt the body as well. Following figure was showing the plastic straps.

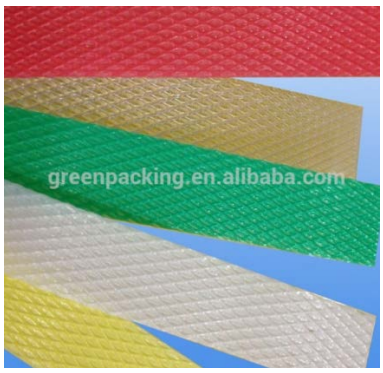


Figure 10: Plastic Straps [10]

3.4.2.3 Existing Design #3: Rubber Straps

Rubber straps were flexible and strong, these straps can also use in our project as these straps can hold the body easily without causing any pain to body.

Figure 12: Rubber Straps [11]

3.4.3 Subsystem #3: Standing Structure

For our project the product will build within a module and that module will be like a stand or the body of the product so that will be a strong and hard material like plastic, wood or aluminum structure. All these type of materials have been existing already as presented in the following sections.

3.4.3.1 Existing Design #1: Plastic Stand

An existing design was plastic stands which can use for our project as well to use because plastic stands were safe to use and hard as well for bearing the force and can able to stand up against the human force.

Figure 13: Plastic Stand [12]

3.4.3.2 Existing Design #2: Aluminum Stand

Aluminum stands were lightweight and strong so aluminum stand can use which will easily bear the human force as showing below.

Figure 14: Aluminum Stand [13]

3.4.3.3 Existing Design #3: Steel Stand

Steel stand was useful but steel stand could be heavy to carry it by human for long time but these were strong as showing below

Figure 15: Steel Stand [14]

4 DESIGNS CONSIDERED

During various meetings the team members came up with a variety of designs during the time given which were in line with both the customer and engineering requirements. Some of the designs selected were as discussed below.

4.1 Design #1: Ear Device

This was a device used by deaf persons and if such device will use by normal person he will realize that how bad it was to being a deaf person. He will not listen the voice clearly and he need to control the sound level in order to listen to someone then the normal person will realize the feelings of a deaf person.

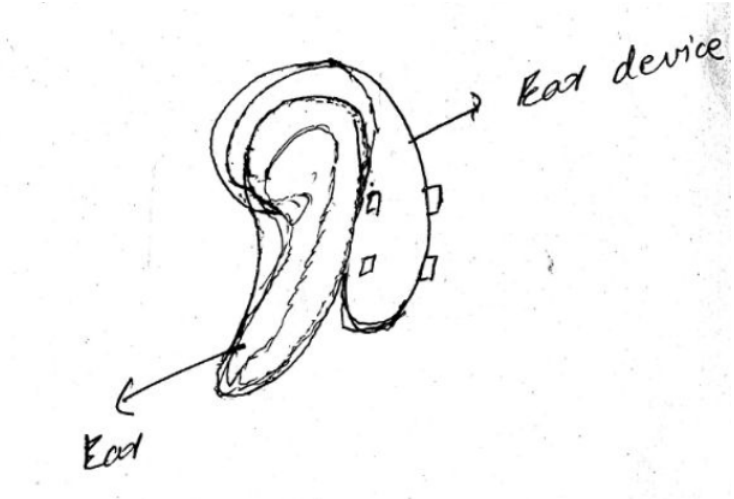


Figure 16: Ear device

4.2 Design #2: Black Glasses

A person with low vision can use these glasses to view some things from the picture and cannot see the whole world so if normal person will wear this device will not able to see other than the pictures and realize the difficulties of blind of person. The figure was showing as

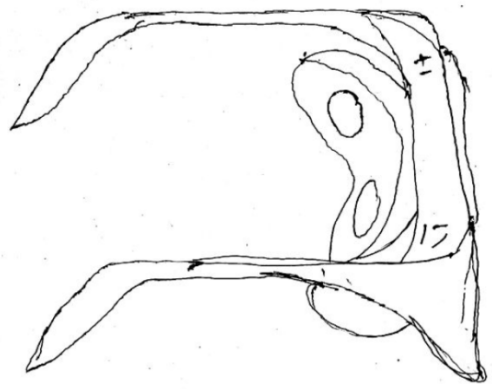


Figure 17: BLACK Glasses

4.3 Design #3: head belt

This design was showing in the figure in which a forehead belt connected with the shoulder bag

to make the neck straight and if any healthy person will wear such a belt, he will not able to rotate his neck properly and will understand the feelings of person with disabilities persons who cannot move their neck. As showing below in the figure

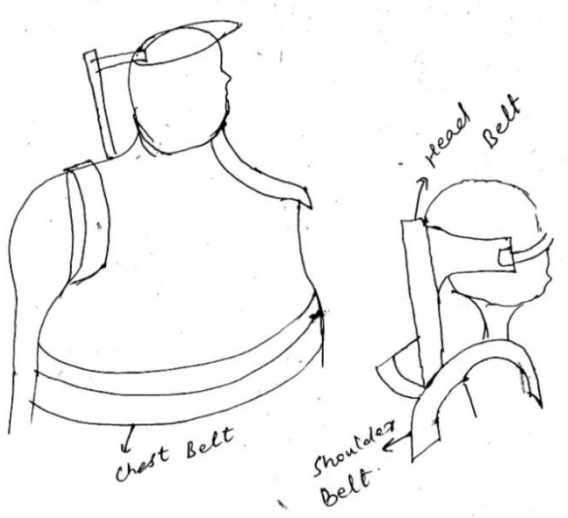


Figure 18: Head Belt

4.4 Design #4: Chest Belt

The design showing in the following figure was a support for neck, chest and shoulders. If a healthy person wear this belt he will realize that it's really difficult to survive with straight neck and chest pain then able-bodied person will realize the feeling of person with disabilities. And the design idea was showing in the following figure.

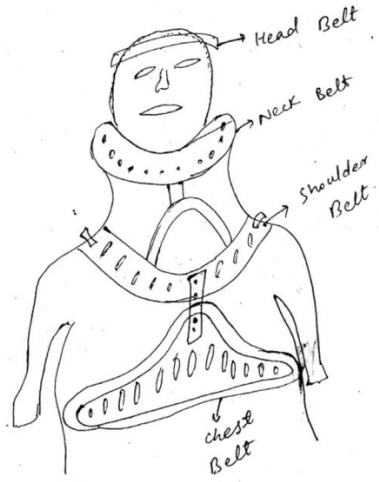


Figure 19: chest belt

4.5 Design #5: Arm belt

A moveable arm was useful for person with disabilities persons but if any healthy person wear such a product and he will not able to move his hand properly then he will understand the miseries of person with disabilities person who has to wear such a belt as the figure was showing below.

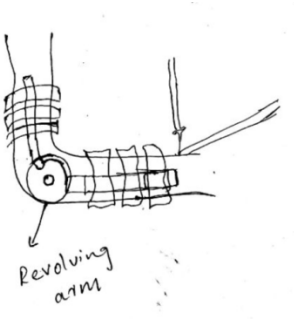


Figure 20: Arm Belt

4.6 Design #6: Leg skeleton

A leg skeleton was useful thing for person with disabilities persons, it gives the capability to those persons whose legs were week and don't have enough capability to walk. If a normal person use this skeleton he will understand the difficulties of person with disabilities and will feel the misery for not having the leg working properly. Design was showing below in the figure.

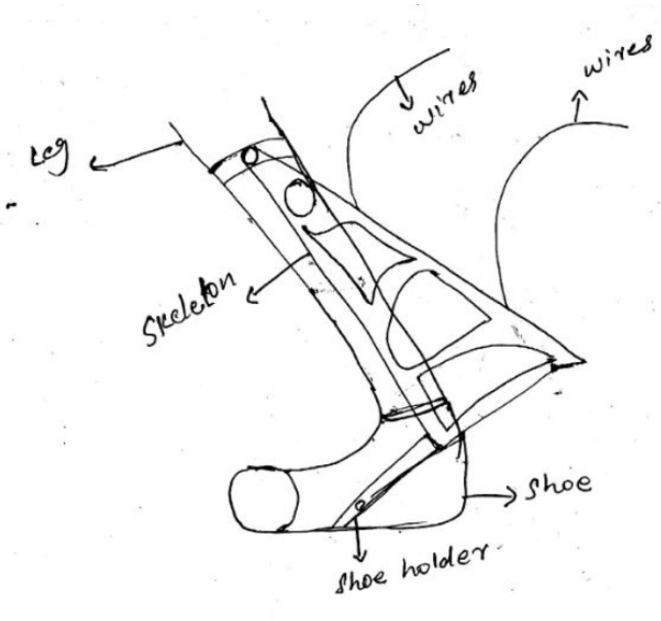


Figure 21: leg skeleton

4.7 Design #7: Legged robot bag

This design was basically a legged robot bag and if the normal person wear this belt he will feel that legs were important part of human body and it's really difficult for person with disabilities persons with legs to survive. This idea was showing below in the figure.

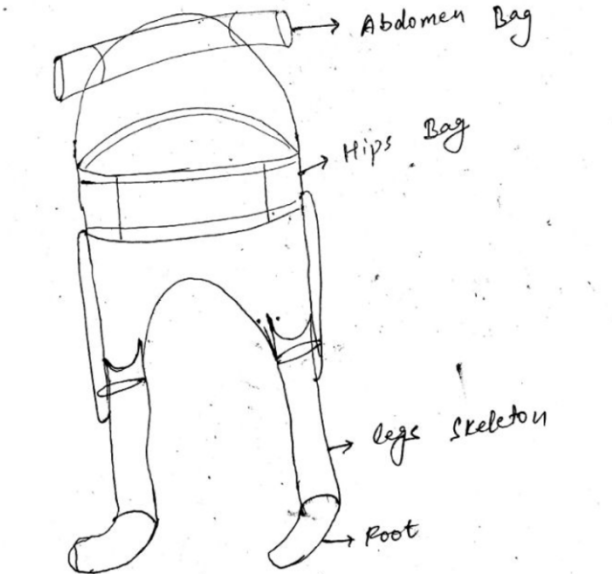


Figure 22: legged robot bag

4.8 Design #8: Nose Catcher

A device that uses for nose to hold it tight for those who have problem with the dust or anything similar. In that case if a normal person will use such catcher he will face lot of difficult in taking breadth and it will be hard for him to be within this catcher and then the person will understand the miseries of disabled person.

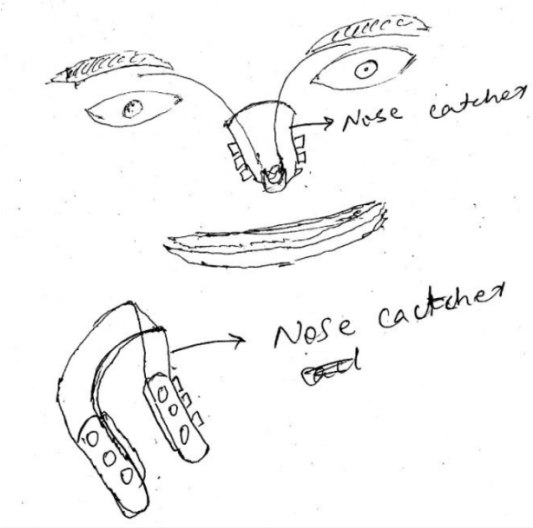


Figure 23: Nose Catcher

4.9 Design #9: Chest Bag

A bag for chest and back was a good idea to support for backbone but when such bag wear by a healthy person it will give him the feel of person with disabilities persons as it will hold the complete backbone and chest so the person will realize the pain of backbone. As the figure was showing below

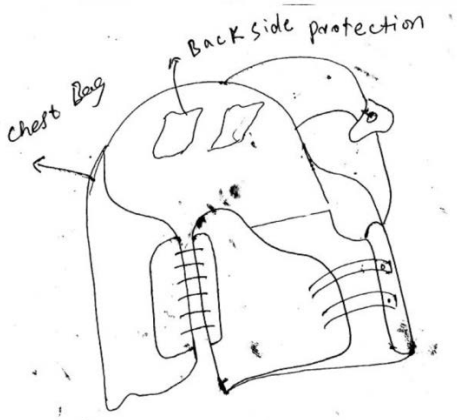


Figure 24: chest bag

4.10 Design #10: Arm cover

Some person with disabilities persons cannot fold their hand and rotate, but if a healthy person wear such a belt he will realize the missing of folding hands for person with disabilities persons. As showing below in the figure.

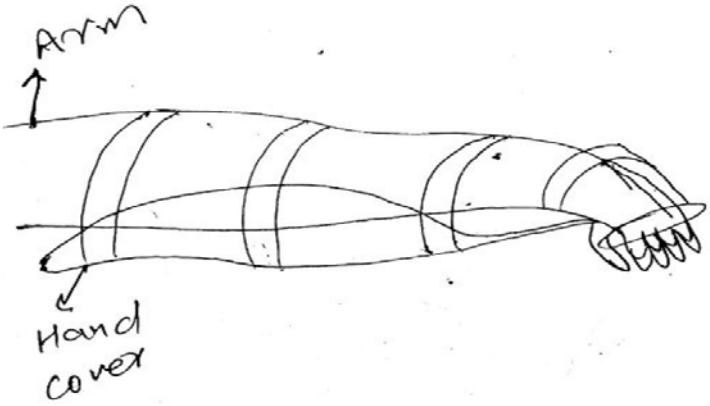


Figure 25: Arm cover

5 DESIGN SELECTED

In this chapter the rationale which was used by the team to come up with a final design has been discussed. The chapter stated about the design process and plans that can use to implement for any project. First of all it has explained about the planning of any project. Planning was very important for any project. Then it told about building any prototype model or proof of concept so that it can be clear whether the design will work or not. Then it told about the task management using bar chart and Gantt chart. And it's very important to do the documentation for each project that will make the project easy to build as well. Now move on the section to select the final design.

5.1 Rationale for Design Selection

After carrying out their analysis the team came up with an appropriate design that met both the engineering and customer requirements. In order to come up with the best design the various components constituting various designs were looked into. This was very crucial since it ensured that the final product was efficient and will meet the client's tastes and preferences. First of all going towards the Pugh Chart and narrow down the results on the basis of client requirements as

Table 4: Pugh Chart

10 Designs	**Weight**	**Design # 1**	**Design # 2**	**Design # 3**	**Design # 4**	**Design # 5**	**Design # 6**	**Design # 7**	**Design # 8**	**Design # 9**	**Design # 10**
Safe	8	+	+	D	+	-	-	-	+	+	-
Durable	7		+		-	+		+	+	+	+
Reliable	6	-	+	A	+	-	-		+	-	-
Portable	5	+	+		+	-		-	-	-	
Three disabilities	4	+	+	T	S	-	+	-	+		
Easy to Use	3	+	+		-	+	-		+	-	+
Perform Certain Tasks	2	-	+	U	+	-	-	-	+		-
Able-Bodied Person feel	1	-	+	M	-	+	-	-	+	+	-
Pluses		4	8	n/a	4	3	1	2	7	2	2
Minus		3	0	n/a	3	5	5	4	1	4	3

From Pugh Chart we have got three design as the top leading designs which were design 2, design 3 and deign 8. Now move on to the next section to finalize the design.

Table 5: Decision Matrix

Decision Matrix	**Safe**	**Durable**	**Reliable**	**Portable**	**Easy to Use**	**Perform Certain Tasks**	**Able-bodied Person Feel**	**Total**
Weight	8	7	6	5	4	3	2	
Design # 2	6x8=40	6x7=42	2x6=12	7x5=35	7x4=28	5x3=15	5x2=10	152
Design # 3	6x8=40	6x7=42	2x6=12	7x5=35	7x4=28	5x3=15	5x2=10	152
Design # 8	4x8=32	4x7=28	3x6=18	4x5=20	4x4=16	3x3=9	3x2=6	129

Result obtained from the decision matrix showed that the best design were the two designs, design 2 and design 3. In this regard, the team agreed with the design 2 and 3since both had the highest score as presented in the decision matrix.

5.2 Design Description

Design selected for this project were two designs, first design was showing below.

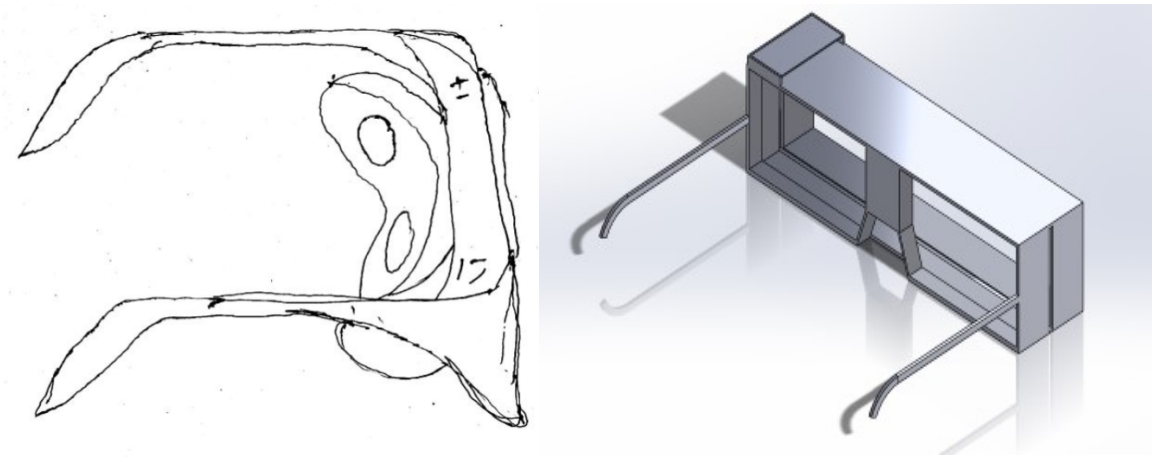


Figure 26: BLACK Glasses and CAD model

This design was about the blindness and low vision. So when the able-bodied person will wear this glass he will unable to see anything and he will act like a blind man then he will realize the miseries of person with disabilities. And the next design was

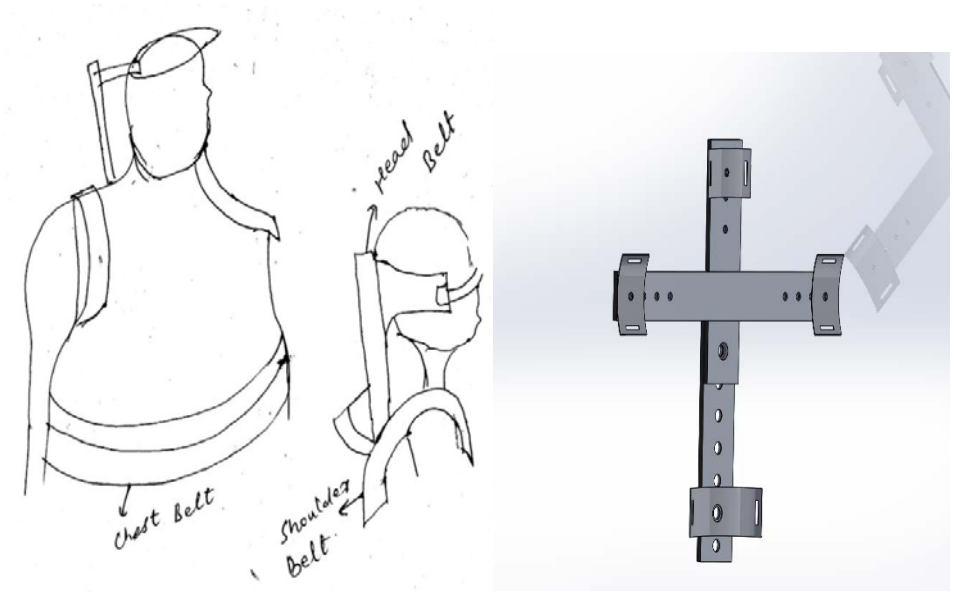


Figure 27: Head Belt and CAD model

Above design will cover the neck and shoulder and able-bodied person will not able to move around the neck properly and cannot move the shoulder as well. Cad model of this design has built as well showing below.

6 PROPOSED DESIGN

Our design has selected and the CAD model as presented as well in the previous section. As we have selected two designs one was the glasses to make the able-bodied person like blind so the able-bodied person will wear the glasses and will feel the emotions of people with disabilities. In the same way the other design we have finalized was the belt to wear around, neck and shoulder. After wearing this belt by the able bodied person he will not able to move the neck and shoulder easily. He will have to apply more force and still will able to move shoulder and neck to some extent. After wearing this belt able-bodied person will realize the difficulties and mysteries of person with disability. Here is the proposed design final model.

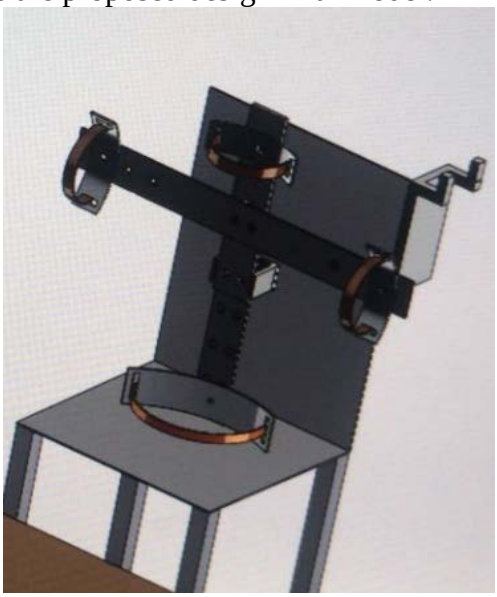


Figure 30: Final Design

The proposed design will implement in the next semester.

7 IMPLEMENTATION

Implementation of this project has done after lot of hard work. We have started from scratch with no idea what we will going to build in this project. We started researching and find out of lot of options. From those options we have decided to make the head neck belt but few members were saying this is quite simple to implement. After the discussion we have decided to make two things one is glasses and second head neck belt. 3D cad model has built and then we have decided to use the aluminum for making belt and for glasses plastic has chosen. These both materials have selected after the first individual analysis. After that we have ordered aluminum bars and plastic material which have delivered quickly. We took the aluminum bars at the workshop and sliced it, mold it and holes in it. Then using the screw and screw installer to join these parts and belt has ready. In the same glasses has made by molding it and giving the shape to it.

7.1 Manufacturing

For the details about implementation first of all is the bill of materials describing the materials that will use for manufacturing.

7.1.1 Bill of Materials

Bill of materials is a table which describes each part of a product in details, with the description

of its use and the function in the product. Furthermore it also explains the manufacturing process of the part and the material that uses to make that part. As we have two designs to implement so we will have two bill of materials one for each design. In Appendix a bill of materials for neck shoulder belt is present and in Appendix B bill of materials for glass is present.

7.1.2 Budget and Cost

Total budget for this project that we will use can see in the table as

Table 6: Budget Expense

Total Budget	$2000
Actual Expense	**$445.54**
Materials	**20%**
Manufacturing	**50%**
Prototyping	**5%**

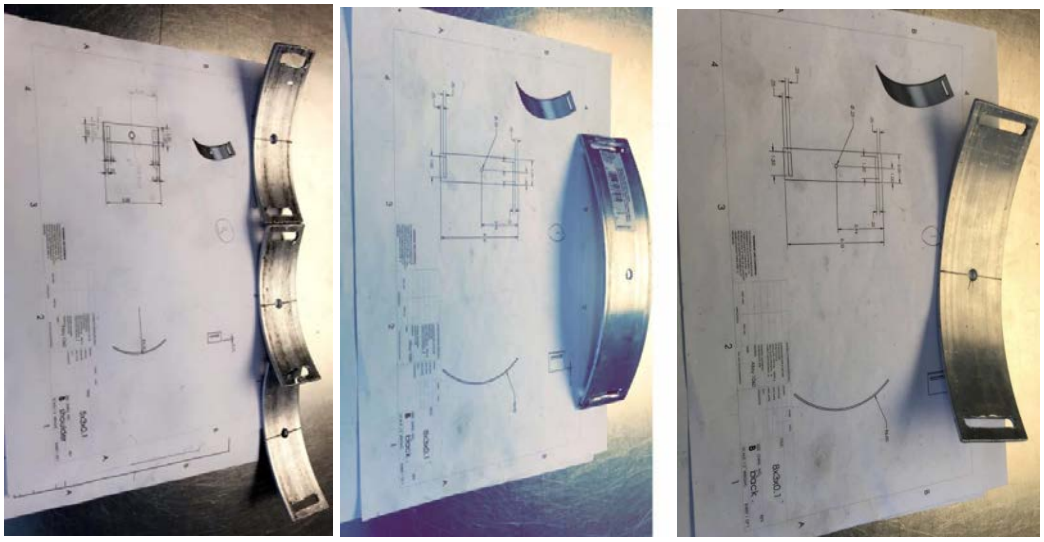
For the implementing two designs we have two different tables for the cost of each item. Budget cost for the items of neck wear belt has shown as

Table 7: Cost

	Material	Quantity	Price	Total Price	Location
1	Aluminum 1060 and 6061T	3	6.83$	20.49$	Home depot ,Flagstaff
2	glasses	3	9.97$	29.91$	Home depot ,Flagstaff
3	belt	4	4.56$	18.24$	REI ,Flagstaff
4	spring	2	1.1$	2.2$	Homco,Flagstaff
5	Screw	7	1.36$	9.52$	Homco,Flagstaff
6	Spry paint	3	6.50$	19.5$	Home depot ,Flagstaff
7	Machine shop	9		346$	Mayorga's Welding
			Total Price	445.54$	

7.1.3 Implementation Schedule

Gantt chart which explains the time frame for doing this project is showing below in Appendix C. Following pictures are showing the manufacturing of each part



First part is showing the bended parts three in a line, second image is showing the upper side of round shape part and third image is showing the lower side of round shape part.

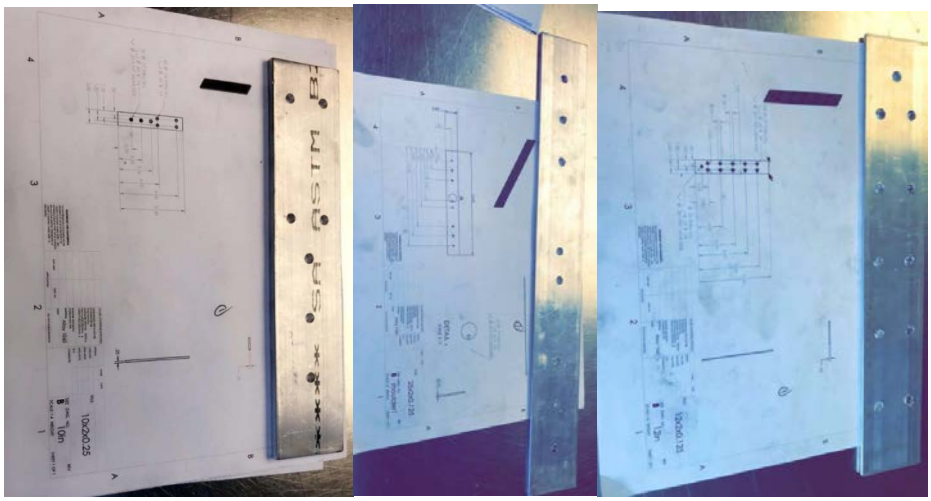


Figure 31: Implementation Parts

First part is showing the straight bar at the above of vertial bar, second image is shoiwng the vertical bar and third image is showing the horizontal bar.

Rounded three parts are the left shoulder round, neck round and right shoulder round. These three parts have connected at the edges. As it can be seen from the following figure in which the three round shaped edges have connected. They have connected on the horizontal and vertical bars.

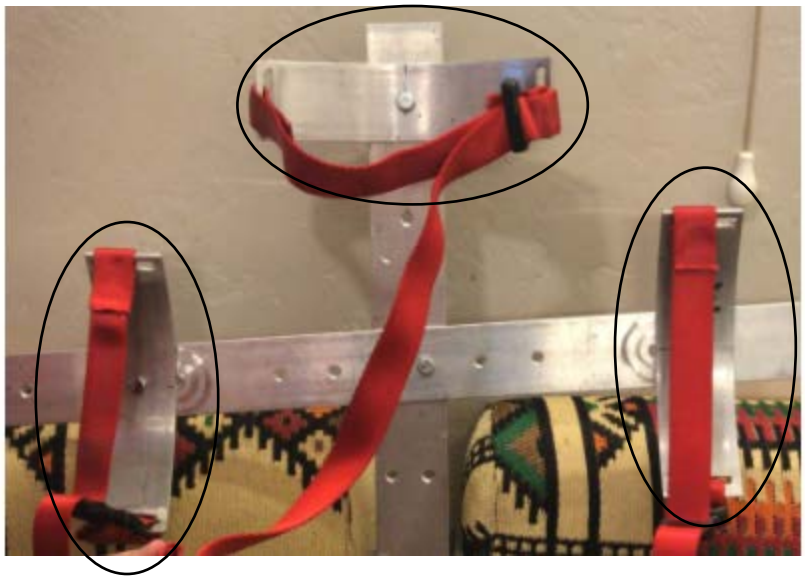


Figure 31: Assembling items.

In the above figure three black circles are showing the connected round shape edges which have already shown in figure 29.
Vertical bars and horizontal bars have connected by making the cross just like the christians cross. All the aluminum parts have connected with each other using the aluminum screws. And in this way the project has formed after that strips of nylon have inserted into neck edge, and both shulders edge. There is a spring holderd at the center of long bar in vertical position. That spring holder has spring in it which pusshes the body and provide the flexibility as well. So the final product we have obtained for neck belt is

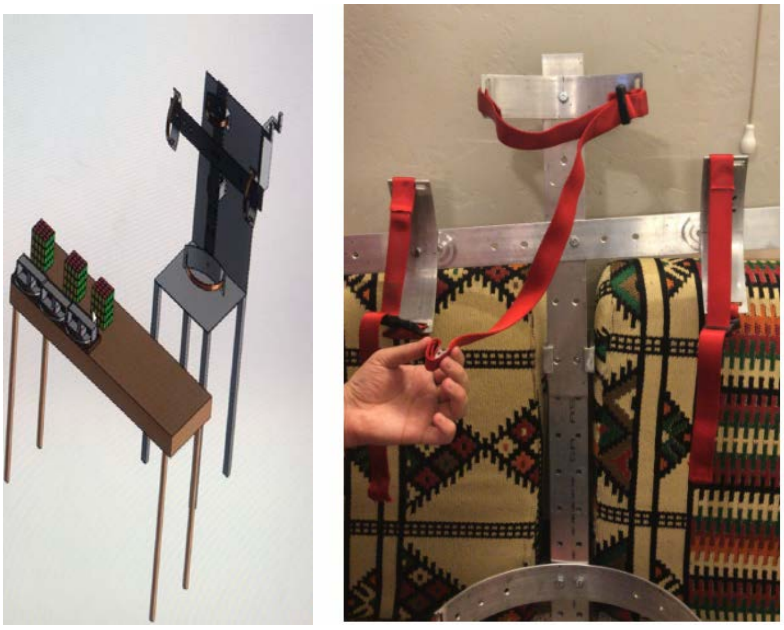


Figure 32: Final Product

A close look for showing the strips connections.

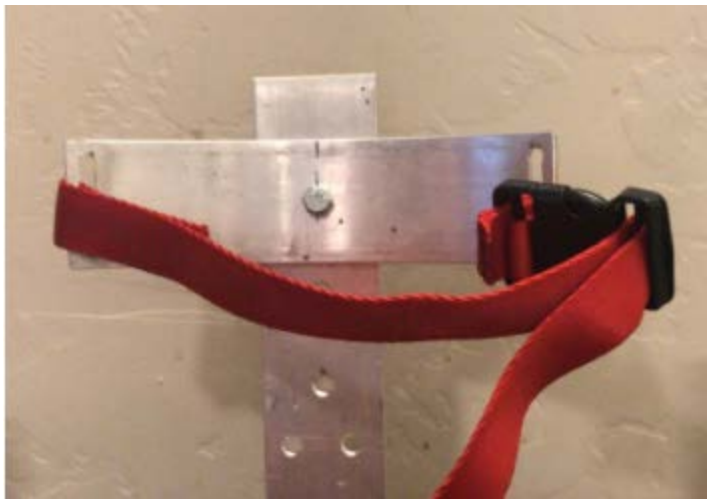


Figure 33: Close look

In the above figure strips have connected from both sides and these strips are felxible in size as well so every type of person can wear this belt.
After wearing this belt people will unable to move around the neck and unable to move the head as well and not able to rotate the shoulder. So it will totally cover the upper portion of human and make him feel like persons with disbailities.

Next is the implementation of glasses which have implemeted using plastic and the final form of glasses is showing below as

Figure 34: Final glasses

When the glasses have weared persom become blind and unable to see anything around and in this way he is feeling himself a blind person.

7.2 Design Changes

For the manufacturing of these products nothing has changed yet. All the details which has mentioned are same as during the implementation process. Glasses have changed little bit, as the model is showing straight square box shape glasses and the current which have developed are round shape glasses. Reason for making round shape is that the square shape was causing problem with the nose and it was hurting therefore the final design has changed to round shape.
For the cost of aluminum it has changed, before that it was considering to be the price of $51.65. But complete Aluminum has bought at the price of $90. We have used 3 parts of aluminum and each part cost us $30 so the total is $90.

APPENDIX

APPENDIX A: Bill of Materials for Neck Shoulder Belt

Table 9: BOM for Neck shoulder belt

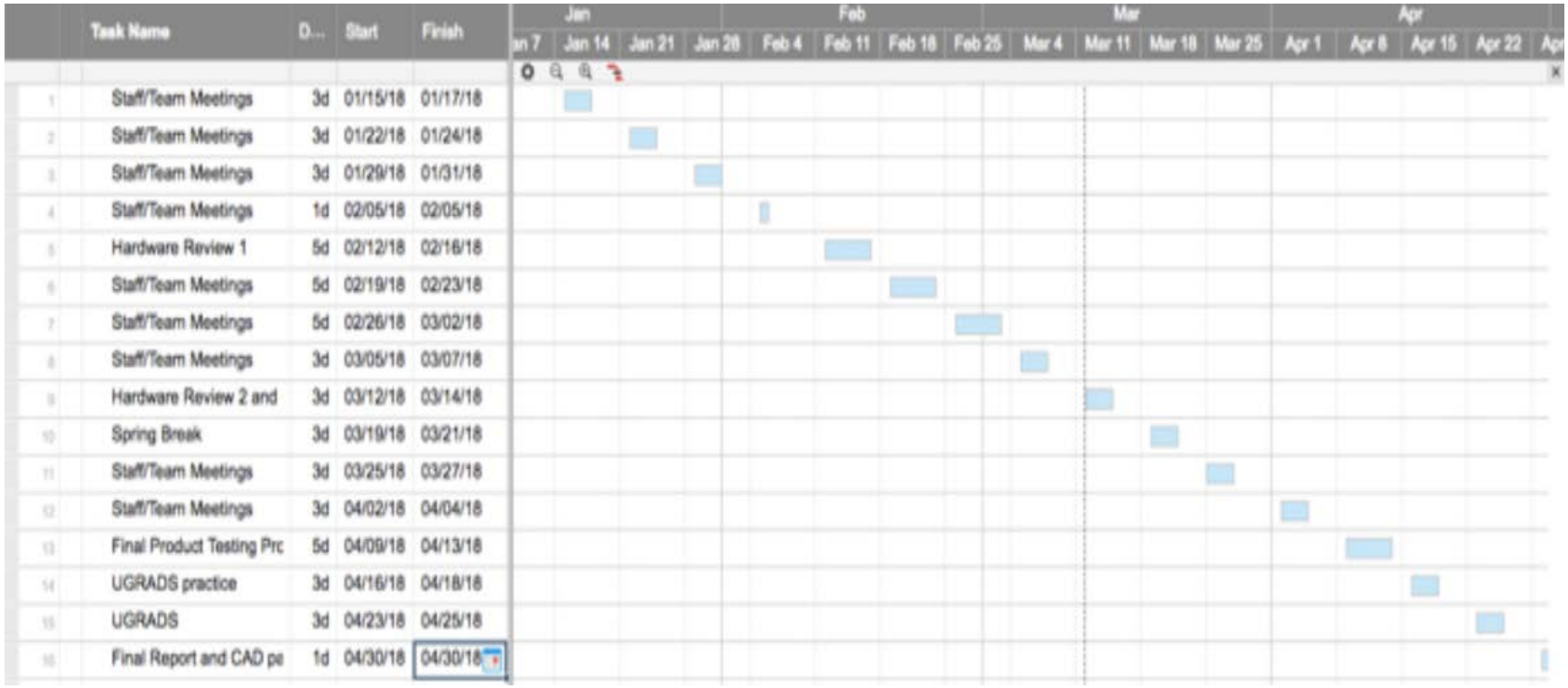
Bill of Materials: Neck Shoulder Belt							
#	Part Name	Quantity.	Decryption	Function	Material	Manufacturing Process	Dimension
1	Chest Holder	1	Holding Chest	Hold the chest using the belt	Aluminum	Aluminum Processing	5x1.5 in
2	Back	1	Back side of belt	Hold the backside with belt	Aluminum	Aluminum Processing	8 x 3 in
3	Aluminum Bar	1	Bar to stand straight	Belt will wrap around this bar to make proper straight shape	Aluminum	Aluminum Molding Process	12 x 2 in
4	Aluminum Bar 2	1	Bar to stand straight	Place at the shoulder for holding straight	Aluminum	Aluminum Molding Process	10 x 2 in
5	Spring	1	Compression and Expansion	Provide the flexibility	Aluminum	Aluminum Molding Process	1.9 x 1.5 in
6	Spring Holder	1	Hold the item	Hold the spring in straight form for expansion	Aluminum	Aluminum Molding Process	3 x 2.1 in
7	Shoulder straight Bar	1	Make the shoulder straight	Hold the shoulder in straight form	Aluminum	Aluminum Molding Process	25 x 2 in
8	Shoulder Round Bar	2	Cover the shoulder	Hold the belt with the shoulder	Aluminum	Aluminum Molding Process	5 x 3 in
9	Back Holder	1	Hold the backside	Cover the backside with belt	Aluminum	Aluminum Molding Process	8 x 2 in

APPENDIX B: Bill of Materials for Glasses

Table 10: BOM for Glasses

Bill of Materials: Black Glasses								
#	Part Name	Quantity.	Decryption	Function	Material	Manufacturing Process	Dimension	Price
1	Glasses	3	Wear on eyes	1-Different blocking will place in the mirror to make the person blind 2-make the person has half visibility 3-make a person has normal visibility	Plastic	Plastic Deformation	6 in x 3 in	$29.91

APPENDIX C: GANTT CHART



	Task Name	D...	Start	Finish
1	Staff/Team Meetings	3d	01/15/18	01/17/18
2	Staff/Team Meetings	3d	01/22/18	01/24/18
3	Staff/Team Meetings	3d	01/29/18	01/31/18
4	Staff/Team Meetings	1d	02/05/18	02/05/18
5	Hardware Review 1	5d	02/12/18	02/16/18
6	Staff/Team Meetings	5d	02/19/18	02/23/18
7	Staff/Team Meetings	5d	02/26/18	03/02/18
8	Staff/Team Meetings	3d	03/05/18	03/07/18
9	Hardware Review 2 and	3d	03/12/18	03/14/18
10	Spring Break	3d	03/19/18	03/21/18
11	Staff/Team Meetings	3d	03/25/18	03/27/18
12	Staff/Team Meetings	3d	04/02/18	04/04/18
13	Final Product Testing Prc	5d	04/09/18	04/13/18
14	UGRADS practice	3d	04/16/18	04/18/18
15	UGRADS	3d	04/23/18	04/25/18
16	Final Report and CAD pe	1d	04/30/18	04/30/18

Figure 30: Gantt chart

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