

Assistive Device for the art Studio

Final Proposal

Team 27

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DISCLAIMER

Students prepared this report as part of a university course requirement. While considerable effort has been put into the project, it is not the work of licensed engineers and has not undergone the extensive verification that is common in the profession. The information, data, conclusions, and content of this report should not be relied on or utilized without thorough, independent testing and verification. University faculty members may have been associated with this project as advisors, sponsors, or course instructors, but as such they are not responsible for the accuracy of results or conclusions.

EXECUTIVE SUMMARY

The fundamental purpose of this design is to promote mobility, inclusion and enhanced quality of life of the user who are unable to move. With the help of this design they can do their artwork or anything like sketching without any need to move. Effective Mobility is the most important need of all people specially .We have proposed some in-home gravity balancing harness system that people with movement disabilities can build with limited resources. There are many people with weak muscles and other issues, which make it hard for them to stand and do their work. We have tried our best to make it as simple and easy as possible. It is most important issue and should be given importance especially in this era in which technology has evolved to a great extent. The devices until now are really old design devices. Our goal is to make an advanced device with more functioning capabilities.

This is a senior level engineering project. The goal of this project is to design a device that helps the disable people. This device will be suitable for both people with moving disabilities and people having weak muscles which make them unable to move their hands etc. Our main focus was to make the device safe to avoid any Misuse of equipment that can lead to serious injury. It helps approachability of the art to the disable people in an easier way. The shape of the device makes it more stable and leaves fewer chances for any mishap. We have tried our best to make it as comfortable and feasible as possible.

ACKNOWLEDGEMENTS

We would like to express our deepest appreciation to all those who provided us the possibility to complete this report. A special gratitude we give to our project sponsor, Ms. Terri Engel, whose contribution in stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report. Furthermore we would also like to acknowledge with much appreciation the crucial role of the staff of mechanical engineering who gave the permission to use all required equipment and the necessary materials to complete the task “Assistive device for the art studio”. Last but not least, many thanks go to the head of the project, Professor David Trevas who have invested his full effort in guiding the team in achieving the goal. We have to appreciate the guidance given by other sponsor as well as the panels especially in our project presentation that has improved our presentation skills thanks to their comment and advices.

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DISCLAIMER

EXECUTIVE SUMMARY

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1 BACKGROUND

1.1 Introduction

There are many examples of assistive devices for people with manipulative disabilities. These devices enable disabled people to perform many activities of daily living thus improving their quality of life. Disabled people are increasingly able to lead an independent life and play a more productive role in society. In the case of disabled Adults, such assistive devices have been shown to be critical to their cognitive, physical and social development

This is a high level engineering project. Our goal is to design a device which can assist the disabled people. The objective of this project is to survey the cutting edge in the innovation for assistive gadgets for individuals with handicaps. Many assistive devices for manipulation and locomotion have been made. We have focus on making an assistive device which can help the disable people to perform their tasks easily.

1.2 Project Description

We are making a device which can help disable to perform any task life drawing, sketching etc. as the easel is capable of holding the paper. This device or will be able to assist disable to get their work done. For this we have brainstormed many ideas and designs. These device will help those disabled people to enjoy or get entertained without any motion and pain.

We have utilized the concept of rotational system too in our machine to make it more efficient. Despite rapid scientific and technological progress in allied disciplines, there has been very little innovation in wheelchair design. We will focus on this aspect as well. Hence the following report will describe all the designs and their comparative analysis.

1.3 Original System

This project involved the design of a completely new rotational system based device. There was no original system when this project began. Our design is to make an easel for disable people who have body issues in their hands and legs. We are trying to make a design to help them draw easily and make them comfortable and we found 20 designs to make and every one chooses a design to talk about in an assignment. We chose the design of easel with rotational machine that can help the disable people work on drawing by just pushing the leg button and the machine will move the easel up and down to make the person who have an issue to reach all the points of the easel and draw on it.

2 REQUIREMENTS

As the device is to be used by disabled people so the main requirement is that it must be safe to use so that they can handle it with safety. Moreover the settling time of the device must be as small as possible so that the disable people can set it at minimum time required. It must be flexible and should not be dangerous at any cost. Moreover another requirements Is the cost effectiveness. A complete analysis of requirements was done to meet the most important of them .For that we set priority list for these requirements and worked on it to achieve the goals.

Moreover we also interviewed the customers and the clients who are the real stakeholders in this case. We listen down their requirements and decided on the basis of that.

2.1 Customer Requirements (CRs)

To find out what requirements are necessary and important for the customers we did a complete analysis and research on this process. We interviewed few disabled people who were interested in this project. We asked them what their most important requirements or needs are. Following table describes the compact interview we took from 3 of our customers.

Customer 3	Customer 2	Customer 1	Customers
Easy to handle	Flexible	Movable	priority Requirement 1
Low cost	Low cost	Light	priority Requirement 2
safety	Light weighted	Low cost	priority Requirement 3
Flexible and moveable	Easy to setup	Safe to use	priority Requirement 4

Appendix A- Customers requirements

In this part of our project we integrated customers' requirements in our projects. Our objective is to make it according to the needs of the customers. While interviewing the customer everything became clear to us that the designing process must focus on the

needs of the customers. If we design it according to the needs of the customers, it will give them a lot of opportunities to explore their life and show their hidden skills and make themselves feel better than laying idol.

2.2 Engineering Requirements (ERs)

Our main focus was to make the device safe to avoid any Misuse of equipment that can lead to serious injury. It helps approachability of the art to the disable people in an easier way. The shape of the easel makes it more stable and leaves fewer chances for any mishap. We have tried our best to make it as comfortable and feasible as possible.

Here is the list of requirements we will be keeping in mind while selecting our design. sharp parts, movable, light material, flexible, simple design, force, cleanable, easy to handle, efficient, and low cost.

- 1) No sharp parts
- 2) Moveable
- 3) Light materials <(20lb)
- 4) Flexible
- 5) Simple design
- 6) Muscle less = 5lb
- 7) Cleanable
- 8) Easy to handle
- 9) Time = 2hr
- 10) Low cost <500\$





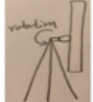

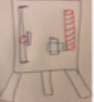
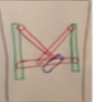
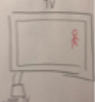

2.3 Testing Procedures (TPs)

For testing we did many procedures which can be listed below:

- 1) Decision Matrix.
- 2) House of quality matrix..
- 3) Customers analysis.

DECISION MATRIX:

After analyzing all the designs we worked on choosing one of the designs. Here is the list of designs we did decision matrix for:

Concept										
Criteria	1	2	3	4	5	6	7	8	9	10
Design Name	Rotation Easel	Hydraulic	Adjustable Easel	Wall Stand	180 Stand	Wheelchair Stand	Easel Gear	Regulator	iPod	Chair Stand
No sharp parts	D	+	+	+	+	+	-	+	+	+
Movable		+	-	-	S	-	+	+	-	-
Light Material		-	+	-	S	+	-	-	-	+
Flexible	A	-	-	-	+	-	S	+	-	-
Simple Design		+	+	-	+	+	-	-	+	+
Muscle less		+	-	+	-	+	+	+	+	+
Cleanable	T	-	+	-	+	+	-	-	+	+
Easy to handle		S	-	+	-	+	S	+	+	+
Time		-	-	+	-	+	-	+	+	+
Low cost	U	-	+	-	S	+	-	-	-	+
$\sum -$		5	5	6	3	2	7	4	4	2
$\sum +$		4	5	4	4	8	1	6	6	8
$\sum S$	M	1	-	-	3	-	2	-	-	-

Appendix B- Decision matrix

After complete analysis we came of the result that rotation easel is the design we will continue working with.

2.4 Design Links (DLs)

Engineering Requirement
No sharp parts*
Movable*
Light material < (20lb)
Flexible*
simple desing *
muscle less = 5 lb
Cleanable*
Easy to handle *
time = 2 Hr
Low cost < 500 \$
[add or remove ER columns, as necessary]

The design which we have chose is rotational easel .It is first of all safe in use. It has no much expense in designing that will be plus point for disabled people, plus it is adjustable as the person can move the canvas or the mount as per the requirements. It is not costly, it is feasible in use. Hence this design is meeting all the requirements, which have been mentioned in ER.

2.5 House of Quality (HoQ)

We have a objective to make it cheap to satisfy customer needs. This will be difficult but still we will modify our design to meet the requirement. Our aim is to focus on what we are designing and to implement the ideas of the better design to our original design to make the best product possible. Through this step the team realized that the factors like power, life span, cost, weight, usability, all-weather preparedness, short setup time, non dangerous, standard components used and Level of creativity are most important to be given first importance while designing the device. HOQ helps us compare devices based on different parameters. It helps to analyze the design to be selected. This assists us in making the decision of selecting the design. Keeping in mind all the requirements, which we have analyzed above, does this. The requirements list enclose that the design must be moveable, light in weight, flexible, easy to handle, low cost, less settling time, safe, ease of assembling etc. This list helped us a lot while designing the device. This process helped us in making functional improvements.

Customer Requirement	Weight	Engineering Requirement	No sharp parts*	Movable*	Light material < (20lb)	Flexible*	simple desing *	muscle less = 5 lb	Cleanable*	Easy to handle *	time = 2 Hr	Low cost < 500 \$	[add or remove ER columns, as necessary]
1. Safety	5		9	6			6			6			
2. Easy to store	5		9	1	6	6				6	3		
3. Light weight	4		3	9		6		6		6		6	
4. Adjustable	4		6	3	9	3					1		
5. Easy to use	4		6	6	3	9	3			6	6	1	
6. Comfortable	4		6	6	3	6	6	6	9			3	
7. Easy to clean	4		1			6	3		9	3	6		
8. size	3			3			6			6		9	
9. saving time	3			3		3	6		6		9		
10. Low cost	2			3	6		9					9	
11. Shape	5			6		3			1	9		1	
12. Mobility	4	9		9			6					6	
Absolute Technical Importance (ATI)			74	185	77	121	222	60	90	123	94	89	
Relative Technical Importance (RTI)			9	2	8	4	1	10	6	3	5	7	
Target(s), with Tolerance(s)											<2 hr	<\$600	
[add or remove T/T rows, as necessary]													
Testing Procedure (TP#)													
Design Link (DL#)													
Approval (print name, sign, and date):													
Team member 1: Jarrah Albathali													
Team member 2: Abdulrahman Almarri													
Team member 3: Aly Alharbi													
Team member 4: Rakan Alhajraf													
Team member 5: Yongzhen Li													

Appendix C- House of Quality

3 EXISTING DESIGNS

There are many devices in the industry and market which are designed for disable people. These devices either help them move from one place to another or they help them to pick things by moving. We have researched many devices on interest especially which have been designed for disable people. These all devices were really inspiring and creative but we were focused on naming a device, which can help the disable people to do their art without any difficulty. People with limited mobility are often unable to socialize; leading to developmental challenges later in life.

To find out the needs of these types of designs we researched many articles and visited websites. The website disabled world also gave a complete overview on how the designs must be made to feel the disable more comfortable. Furthermore the website was also a good source which helped us a lot to understand the requirements.

1) Rotation Easel

The other design is rotational easel.. It has wheels, which can even be locked if the person is not moving. It's feasible and adjustable. Good thing about this is that it can reach different angels.

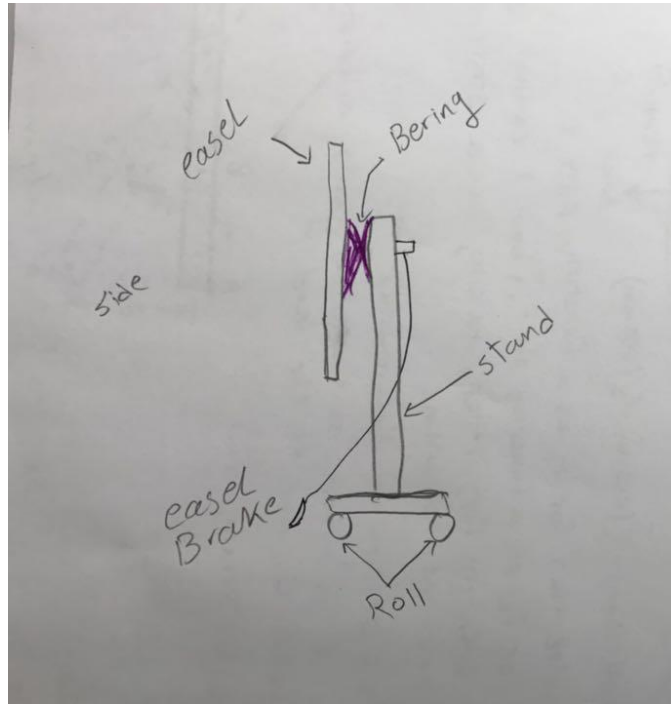


Fig 1: Design

2) Hydraulic

This hydraulic design system incorporates a hydraulic power unit, advanced circuitry and pressure transducers which will evaluate and react to the pressures on and movements of the vehicle during access. This system is effective and, above all, safe to use.

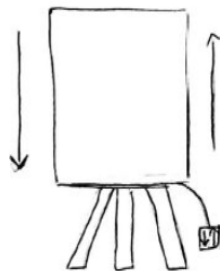


Fig 2: Design

3) Adjustable Easel:

This easel design is adjustable and moveable. It's easy to use, transportable, easy to

store and allows the person to get close to the work when working on the paper or artwork.

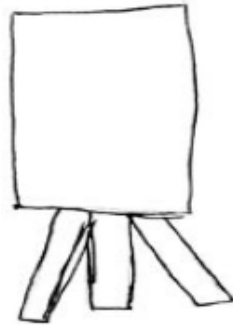


Fig 3: Design

4) Wall Stand

It's wonderful for those with disabilities and limited mobility. This is comfortable for them to use.

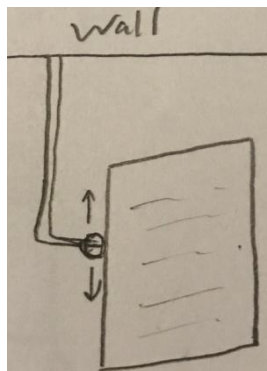


Fig 4: Design

5) 180 Stand:

This design is feasible to use and is movable. This helps the person to move the paper or rotate it as required.

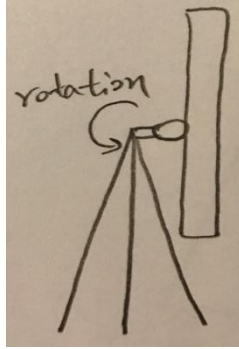


Fig 5: Design

6) Wheelchair Stand:

This stand is also a comfortable and easy to use design. It helps them do their work in complete ease.



Fig 6: Design

7) Easel Gear:

This design is adjustable and can be handled up to different levels. It is stoppable and has a gear too. It's moveable and depends on the activity the person is performing.

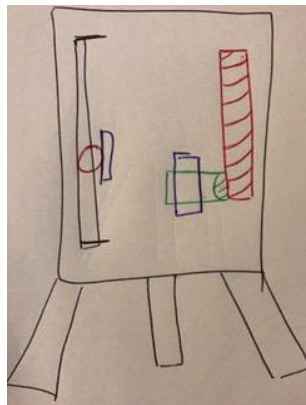


Fig 7: Design

8) Regulator easel:

it is an easel that works with regulator machine like the one in the car. This design will work on a machine that have the power of electricity to make it go up and down.

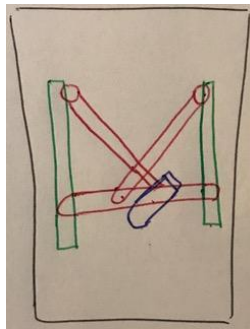


Fig 8: Design

9) IPod:

IPod is an easy to use way for the disabled people to do their artwork. This can help them do their work in a comfortable way. They can just connect to an apple TV and do their own work and then print it with special printers that should be offered to them from their sponsor.

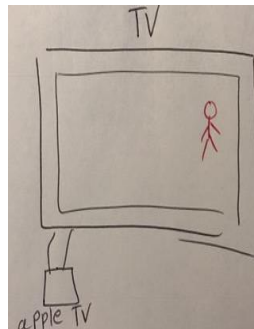


Fig 9: Design

10) Chair Stand:

This design is basically a chair with a stand of wood placed in front of it. This stand is basically attached with the chair. It is not too easy to move though.

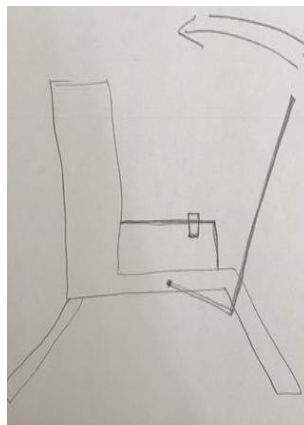


Fig 10: Design

3.1 Design Research

A lot of work has been done in previous years to make the disable people less dependent on others. We have researched many articles and did a lot of reading to find out how much industry has developed to achieve this goal. There are many devices in the industry and market, which are designed for disable people.

These devices either help them move from one place to another or they help them to pick things by moving. We have researched many devices on interest especially which have been designed for disable people. These all devices were really inspiring and creative but we were focused on naming a device which can help the disable people to do their art without any difficulty. People with limited mobility are often unable to socialize; leading to developmental challenges later in life.

To find out the needs of these types of designs we researched many articles and visited websites.

3.2 System Level

There are several designs, which fulfill the needs and requirements of our projects. These designs have been mentioned below too. There are three system levels in this device. Following are the designs that we have analyzed in system level:

- 1) Chair stand
- 2) Easel gear
- 3) Rotation Easel

In these designs we have first of all analyzed the levels to which the device can move and its accessibility. The hydraulic design is complex design. 180 design is easy to use but it can just move to a certain angle. Rotation easel is most suitable for this design.

3.2.1 Existing Design #1: Chair Stand:

This design is basically a chair with a stand of wood placed in front of it. This stand is basically attached with the chair. It is not too easy to move though.

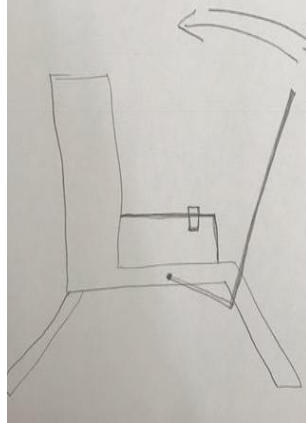


Fig 11: Design

3.2.2 Existing Design #2:Easel Gear:

This design is also meeting our requirements. This design is adjustable and can be handled up to different levels. It is stoppable and has a gear too. It's moveable and depends on the activity the person is performing.

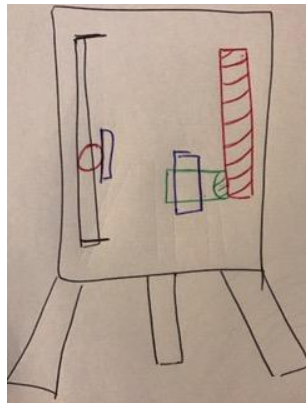


Fig 12: Design

3.2.3 Existing Design #3: Rotation Easel

This design of rotational easel, which already exists, has some limitations and is not too much comfortable. It has yet to be modified to make it meet the needs of the customers.

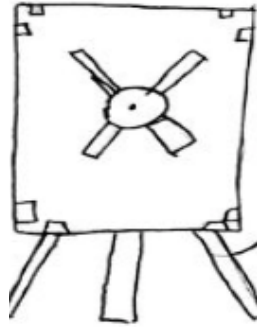
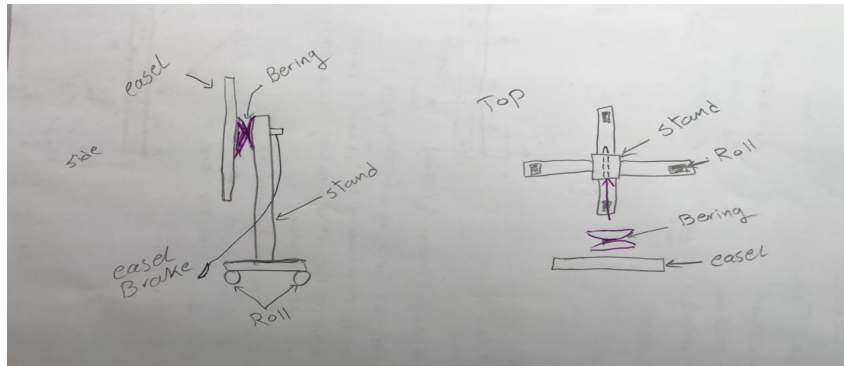


Fig 13: Design

3.3 Subsystem Level

1) Functional decomposition:

The design problem for this project was a device enabling people with very limited skills to create art. This problem resulted from discussions with people with different disabilities. The customer needs include: easy to operate, easy to cleanup, and easy to create art with limited skills. Participants in the experimental “functions” group were given the basic functions of: the device must contain, position, and dispense an art medium along with holding a paper in place.



A 360-degree rotating easel with a bearing on device comprising: bearings, stand, easel, brake, rollers, etc.

The rotational Easel for Disabled Artist is a custom made it operated by easel designed to provide complete adjustability for individuals with a physical disability. The design allows the easel to be used from a wheelchair, or by artists who use their feet. Each unit is tailored to the individual needs of the user and can be manually controlled. Because most individuals with a physical disability have a limited reach, this rotational easel is ideal in that it moves left and right, providing a much larger workspace for the artist.

People can control rotation, lateral position on the board and 360-degree rotation. There

are wheels or balls at one end that permit easy movement, but when in use the base rests directly on the floor.

Initially our design was not movable as it was flat from the base. We modified it by adding different components. Now the bearings at the back of the mount are responsible for rotating the mount to different angles. It adjusts the device as per the requirements of the customers.

3.3.1 Subsystem #1: Hydraulic

Hydraulics based devices have already been used for disabled persons. These devices help them to move from one place to another.

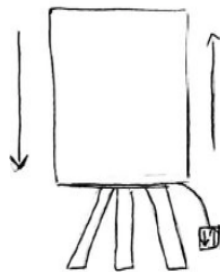


Fig 14: Design

3.3.1.1 Existing Design #1: Wall Stand

It's wonderful for those with disabilities and limited mobility. This is comfortable for them to use. It uses hydraulic system to move the stand. It also helps the disabled persons to

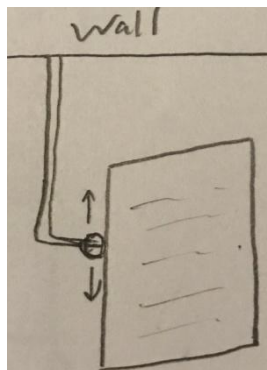


Fig 15: Design

3.3.1.2 Existing Design #2: Hydraulic

These hydraulic design systems incorporate a hydraulic power unit, advanced circuitry and pressure transducers, which will evaluate and react to the pressures on and movements of the vehicle during access. This system is effective and, above all, safe to use. This design also incorporates the hydraulic system.

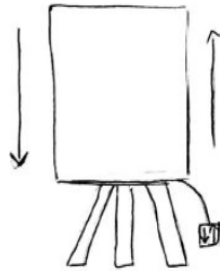


Fig 16: Design

3.3.2 Subsystem #2: Easel

It is a normal design of the art easel that you can find in all the places of the art for the artist who use it to draw their own drawings.

3.3.2.1 Existing Design #1:) Easel Gear

This design is adjustable and can be handled up to different levels. It is stoppable and has a gear too. It's moveable and depends on the activity the person is performing.

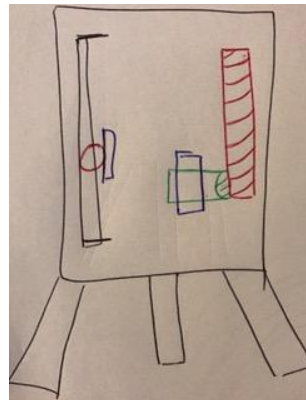


Fig 17: Design

3.3.2.2 Existing Design #2: Rotation Easel

This is the design of rotational easel and is very much comfortable and easy to use. It has the bearings and the mount, which can move to 360 degrees making it easier for the patients.

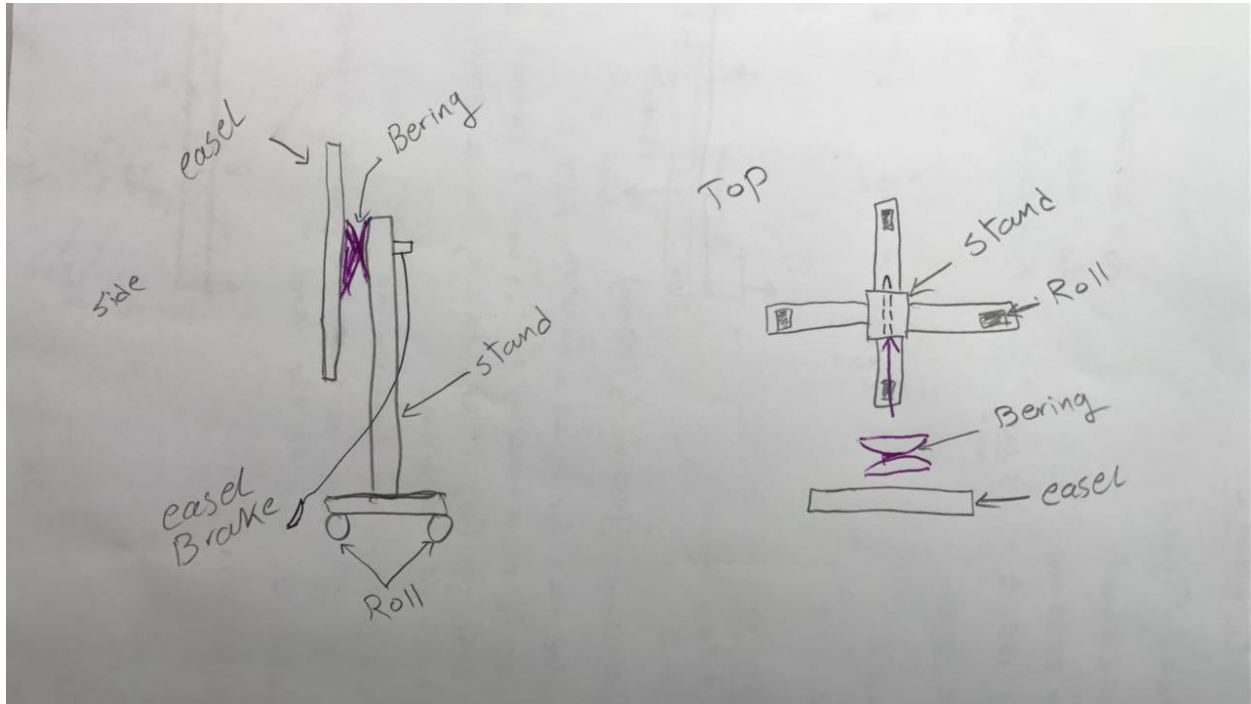


Fig 18: Design

3.3.2.3 Existing Design #3: Adjustable Easel

This easel design is adjustable and moveable. It's easy to use, transportable, easy to store and allows the person to get close to the work when working on the paper or artwork.

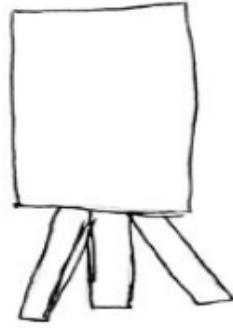


Fig 19: Design

3.3.3 Subsystem #3: Wheelchair

Wheelchairs designs are already so common and exist.

3.3.3.1 Existing Design #1: Wheelchair Stand

This stand is also a comfortable and easy to use design. It helps them do their work in complete in easy way.



Fig 20: Design

3.3.3.2 Existing Design #2: 180 Stand

This design is feasible to use and is movable. This helps the person to move the paper or rotate it as required.

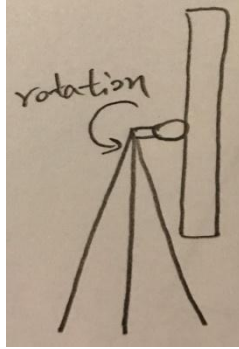


Fig 21: Design

3.3.3.3 Existing Design #3: chair stand

This design is basically a chair with a stand of wood placed in front of it. This stand is basically attached with the chair. It is not too easy to move though.

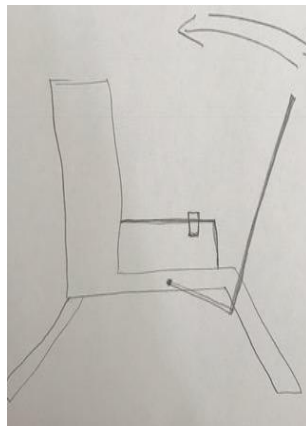


Fig 22: Design

4 DESIGNS CONSIDERED

We have considered 10 designs for short listing and converging towards one efficient design:

The list of designs is as follow:

- 1) Rotation Easel
- 2) Hydraulic
- 3) Adjustable Easel
- 4) Wall Stand
- 5) 180 Stand
- 6) Wheelchair Stand
- 7) Easel Gear
- 8) Regulator
- 9) IPod
- 10) Chair Stand

4.1 Design #1: Descriptive Title

Hydraulic

This hydraulic design system incorporates a hydraulic power unit, advanced circuitry and pressure transducers, which will evaluate and react to the pressures on and movements of the vehicle during access. This system is effective and, above all, safe to use.

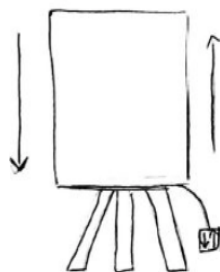


Fig 23: Design

4.2 Design #2: Descriptive Title

180 Stand:

This design is feasible to use and is movable. This helps the person to move the paper or rotate it as required.

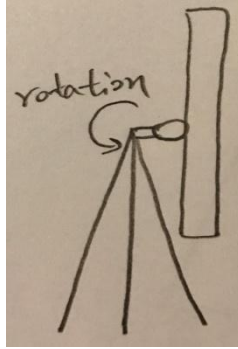


Fig 24: Design

4.3 Design #3: Descriptive Title

The design problem for this project was a device enabling people with very limited motor skills to create art . This problem resulted from discussions with people with different disabilities.. The customer needs include: easy to operate, easy to cleanup, and easy to create art with limited motor skills. Participants in the experimental “functions” group were given the basic functions of: the device must contain, position, and dispense an art medium along with holding a paper in place.

A 360-degree rotating easel with a bearing on device comprising: bearings, stand, easel break, rollers, etc. People can control height, tilt, lateral position on the board and 360-degree rotation. There are wheels or balls at one end that permit easy movement, but when in use the base rests directly on the floor.

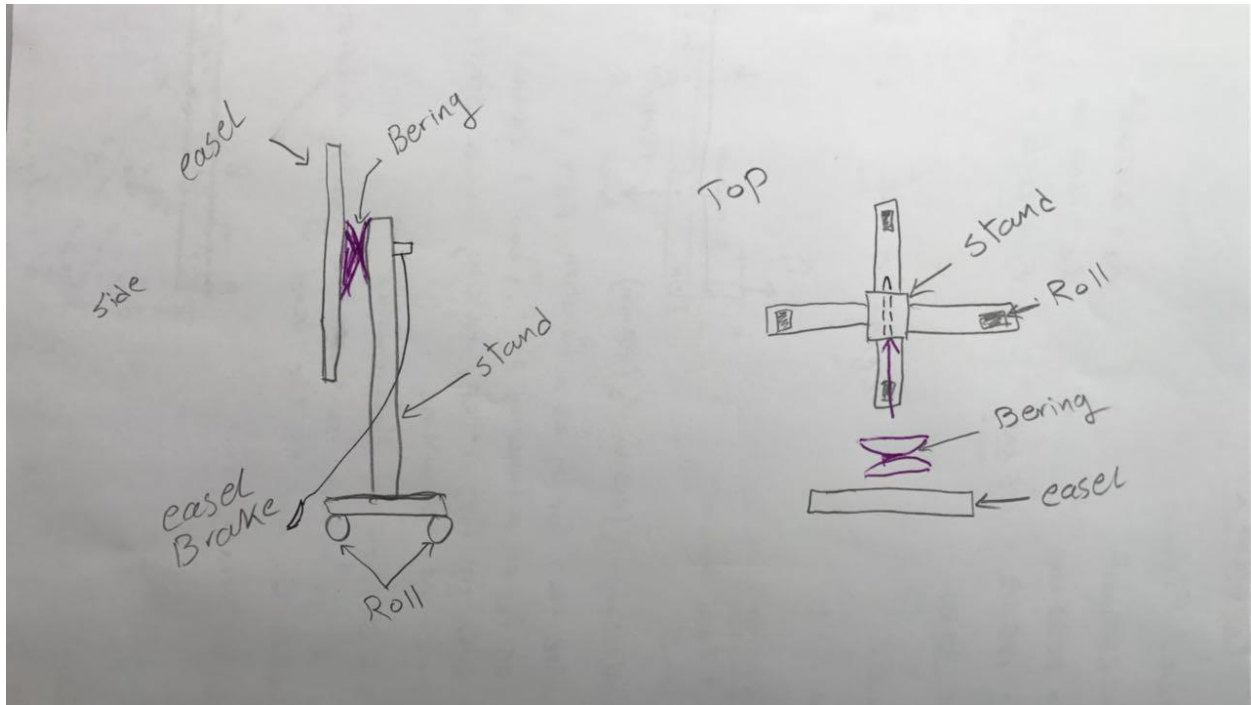


Fig 25: Design

5 Design Selection

After doing complete research and analysis, we have selected Rotation Easel as our selected design.

5.1 Rationale for Design Selection

The reason why we selected this design is that

- it is lightweight
- It has a built-in carry handle that makes it easy to take to anywhere.
- It rotates your work 360° so it turns the piece because it's top rotates on ball bearings.
- This saves the time from having to constantly pick up the piece to turn it to the area the person wants to work on.
- Easy to operate and maneuver.
- It adjustable and enables to elevate the artwork work to 3 different heights.
- it can move the piece in a complete circle for the person
- it's wonderful for those that have disabilities and limited mobility. The different elevation brings the work closer to the person, instead of having him to lean forward. Plus, it can help the person's hand, wrist, and neck and back avoid

stress and strain.

5.2 Design Description

The design problem for this project was a device enabling people with very limited motor skills to create art. This problem resulted from discussions with people with different disabilities. The customer needs include: easy to operate, easy to cleanup, and easy to create art with limited motor skills. Participants in the experimental “functions” group were given the basic functions of: the device must contain, position, and dispense an art medium along with holding a paper in place.

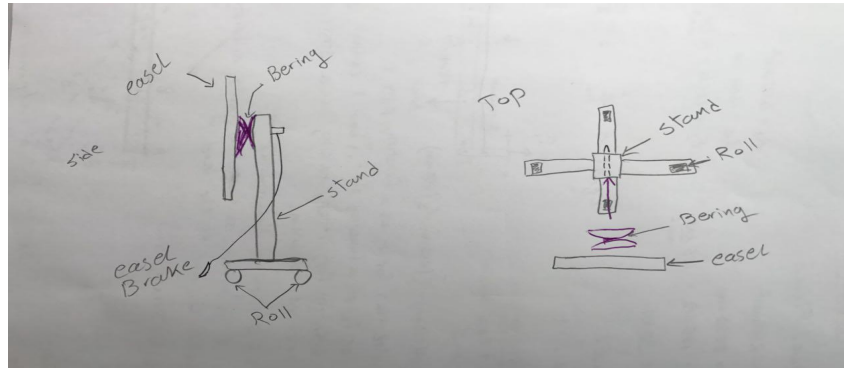


Fig 26: Design

A 360-degree rotating easel with a bearing on device comprising: bearings, stand, easel, break, rollers, etc. The rotational Easel for Disabled Artist is a custom made it operated by easel designed to provide complete adjustability for individuals with a physical disability. The design allows the easel to be used from a wheelchair or from a bed, or by artists who use their feet. Each unit is tailored to the individual needs of the user and can be manually controlled. Because most individuals with a physical disability have a limited reach, this rotational easel is ideal in that it electrically moves left and right, as well as up and down, providing a much larger work space for the artist.

People can control height, tilt, lateral position on the board and 360-degree rotation. There are wheels or balls at one end that permit easy movement, but when in use the base rests directly on the floor.

6 PROPOSED DESIGN

From all above designs the design, which we proposed after research and benchmarking, is rotating easel. This is a chair having bearings in the bottom so that it can move easily. Once a canvas is loaded onto the device, the rigid frame holds the system in place as the entire device is raised to the appropriate level by the Reliant lift. There is a power source too. It is necessary to design the power supply side efficiently.

The system has rotating easel, which is movable to 360 degrees. This easel is connected to the base of this system, which can help the person to rotate. With the help of this people can make paintings of any size because it allows access to areas of a canvas that a disabled would not otherwise be able to reach unaided.

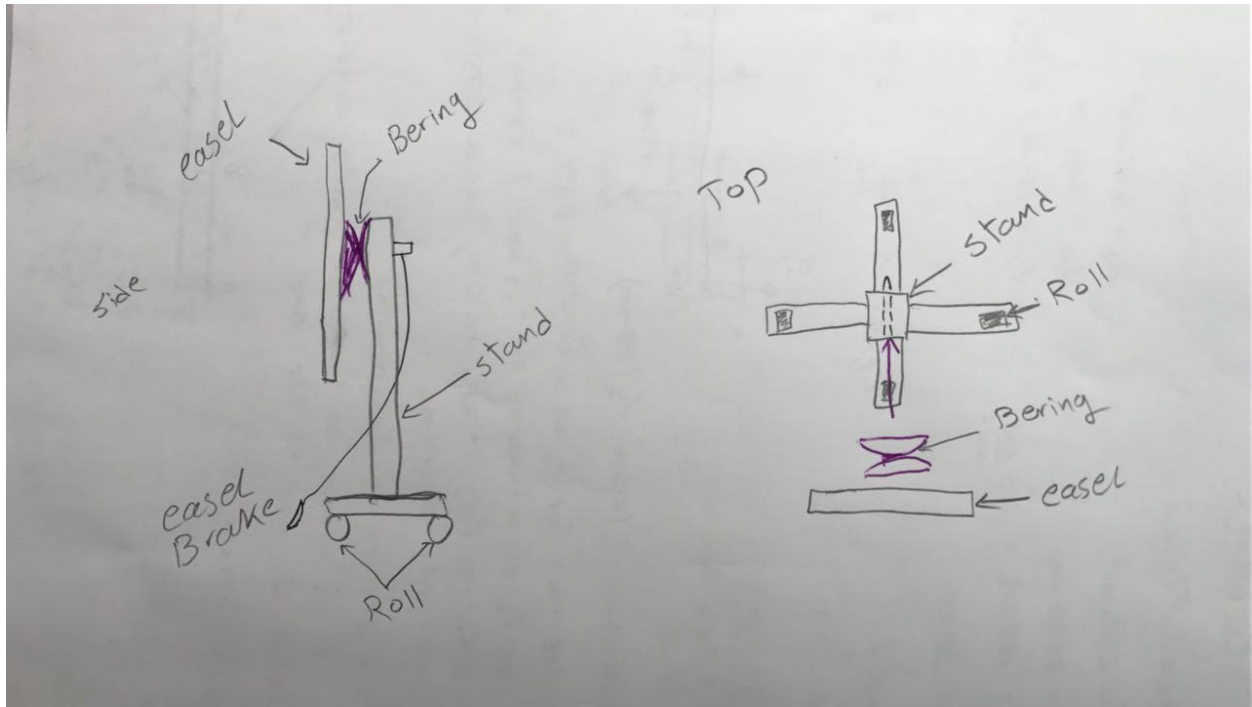


Fig 27: Design

9 CONCLUSIONS

Our design is simple yet efficient. Since assistive device often are a frame in the rehabilitation process, the need for a better understanding in the prescribing process, use and utility of assistive devices is of utmost interest to the profession. There are a lot of unanswered questions in the field and one should benefit from more studies dealing with both user experiences and underlying factors making a difference in outcome.

9.1 Contributors to Project Success

All of group members were supportive and hardworking. Everyone's contribution is highly appreciable. For the project to reach a successful conclusion we need to be working well together for a common purpose. Leading a team successfully involves learning about each individual's skills and personality in order to get the best as a whole. Our team is having a complete package of an organizer, communicator, leader and a creative thinker and I think we can well maintain project composure.

9.2 Opportunities/areas for improvement

The design is perfect until now but it can be further improved later on integrating more ease and designing. The more it is comfortable the more perfect it becomes. Areas of improvement includes that the device can be modified in a way where the person can draw even by laying on his bed. This will be more feasible for the disabled people. This will help those ones too who are unable to sit due to some spinal cord or backbone injury.

10 REFERENCES

REFERENCES:

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[3]Samuelsson, Kersti, and Ewa Wressle. "User satisfaction with mobility assistive devices: An important element in the rehabilitation process." *Disability and rehabilitation* 30.7 (2008): 551-558.

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APPENDICES

Appendix A- Customer requirements

Appendix B- Decision matrix

Appendix C- House of Quality