CS PRO

Clothes Selector Pro (Group #5)

G Sin Beta: *Changing the future*

Pavneet Gill (gillp28)

Samandeep Singh Virdi (virdis2)

Mustapha Bello (bellom2)

Marco Wong (wongm58)

Hajanan Mohendran (mohendrh)

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1.0 Introduction

1.1 Background Information

Fiona is a client with Cerebral Palsy. This is a disorder that affects movement of muscles, body movement, muscle tone, reflex, posture and balance [1]. A subset condition to Cerebral Palsy is Spastic Quadriplegia which is the loss of use of whole body, inability to legs, arms and body (paralysis) [2]. Due to this Fiona has minimal range of motion of arms, wrists and ankles of less than 50 % and has no range of motion in legs since they are strapped to her wheelchair. Suffering from Cerebral Palsy Fiona is unable to do daily living activities that require use of hands, for example, taking clothes out of her closet. Fiona has a Personal Support Worker doing those activities for her.

1.1.1 Independence

Currently Fiona is unable to do anything by herself from taking her clothes out of a closet, eating food by herself, have a private conversation on the phone and taking out the garbage.

Removing Clothes Process

First thing the personal support worker (PSW) needs to do is ask Fiona for which clothes she wants to wear. Then, the personal support worker worker has to go into the closet and find the clothes that Fiona wants to wear. After, the personal support worker worker has found the outfit he/she has to push clothes that are near the selected outfit outward to grab it. Next, personal support worker has to pull the hanger off the pole.

Eating food and Drinking

First thing in the food process is selecting what type of food Fiona wants to eat. Than pour the food into a bowl. Use a spoon that slowly comes to mouth with the food. After, eating to drink a straw can be used by psw to help her drink or hold up the cup for Fiona to drink out of.

Using the Phone

First thing in the using the phone is answering the phone either by picking it up or by pressing the speakerphone. After picking up the phone. PSW worker has to hold it near her ear to have a private conversation or use the speaker function. At the end PSW worker has to end the call and put the phone back.

Taking out the Garbage

First thing in taking out the garbage is to grab the bag from the inside of the garbage can and tie it out. Than pull the garbage bag out and take it outside the room. Next, is to take the garbage out of the house and place inside the bin by opening the top and closing it. Than go back inside with the garbage bin and place new bags inside of it.

These were the four major problems that were focused on during the project in order for Fiona to gain her own independence. Fiona is unable to do any of these activities due to her limited range of motion due to Cerebral Palsy. The first problem is removing clothes and Fiona is unable to do everyday things as a normal person due to her disorder. Therefore, a tool is required that can assist Fiona in removing clothes from the closet. The second problem is eating food and drinking. Fiona has limited motion of arms so she unable to eat by herself. A tool designed to use her small range of motion to bring food and drinks close to her mouth in order to eat it or drink it. The third problem is using the phone due to her limited range in motion. Essentially, a tool is required that can pick up and end calls without the help of the PSW worker in order to have a private conversation. The last problem is taking out the garbage due to paralysis in lower body fieona is unable to walk and uses a wheelchair. Developing a device that allow Fiona to take out the trash without the help of her PSW worker.

1.2 Refined Problem Statement

Create a device that allows Fiona to have independence in selecting her clothes. In terms of taking clothes out of the closet. Provide a working sample of the design as proof of concept to Dr. Fleisig and for Fiona to use.

1.3 Objectives and Constraints

There are five main objectives for the project designed: durable, safety, portable, cost effective and comfortable. First,we have to make the users feel comfortable. Since Fiona uses a wheelchair to move around in her home in order to get through the door, the dimension of her wheelchair cannot change. To achieve this objective there invention should be attachable and detachable to the wheelchair. Also to make Fiona feel comfortable we needed to make something that requires few motions. Therefore, in order to make the design comfortable it need to be attachable/detachable and requires few motions of wheelchair.

Secondly, the device created needed to be durable. Fiona needs something that she can use for good amount time maybe even her entire lifetime. To achieve this objective we have to make something that is rugged and able to perform under heavy duty.

Another objective is to make the device safe. Fiona should be safe while using the device herself and the others around should be safe as well. To achieve this objective have to make an object that is stiff, stable on the wheelchair, environmentally friendly
and made of light material like thermoplastics. Also we will avoid using sharp points or objects of metal.

Next objective is to make the object cost effective. For users to afford this device, it should be relatively cheap for us and users but still use durable material. To achieve this objective we will hold the max cost of a hundred dollars and make it out of reusable materials.

Final objective is to make the device portable because if Fiona was going to move in the future it could be taken with her. To achieve this objective we will make something that is extendable and can be resized whenever required. Also lightweight for portability and thermoplastics allow us to meet this objective. These are the objectives that are be achieved when assembling our device during the design process.

1.4 Prior Art

1.4.1 Existing Commercial Products

There are plenty of commercial products on the market that are used in order to assist people who have cerebral palsy. The most common of the many commercial products available is the wheelchair. Wheelchairs are almost always used in the case of a cerebral palsy(c.p.)/spastic quadriplegic person, due to having hypertonia (muscle spasms) in all four limbs of the body. There are also many different types of wheelchairs that serve for different functions of the body that patients are either lacking or need support of, for example, a person with cerebral palsy can move certain parts of their body to move the wheelchair, depending on the severity of their symptoms. In the case of Fiona, she is able to move and control her fingers, so the way she is able to move around with a wheelchair is by using a joystick that controls the movement of the wheels. However, there are many limitations for wheelchair users, such as the inability to move at a faster pace, or limit to how high you can go without using the stairs. But going up certain stairs could be solved by creating a ramp alongside it, or using other assistive technology, such as the stairlift. The stair glide/lift, can help people who use wheelchairs often (or lack the ability to walk up or down stairs) get up to different levels in their house. Some assistive technology that's used for communication are made especially for people with c,p,, including the 'Steady Write Writing Instrument' which provides an attachable support for people with the symptom to write normally, and Augmentative Alternative Communication (AAC) devices that use augmentative aids to help people who have speech and/or writing impairment to express and communicate with other people (ie. pictures and symbol communication boards, text-to-speech converter,etc.). In Fiona's case, she doesn't have any significant problem with speech communication, so this issue doesn't apply to her.[3]

1.4.2 Patents

There are many things that are being built around the world whether it be the improvement upon a product or a completely new invention. There are several patents that can help assist the resident with her difficulty, one being a writing Instrument. This patent is a writing device that can be used by a handicapped person. This patent is very valuable for this project as the client has a difficulty choosing a lot of things alone. By using this patent, the client is able to have independence in choosing clothes. This independence comes as the client can

indicate the picking of clothes through from of the written symbols or line or even words. This will allow F.M to gain independence as she will be able to have already selected what to wear before the personal support worker arrives make the process of selecting fast and efficient. This idea works like a mouse as pressure is applied to the top the object it begins to cause the scribing instrument to contact the surface of the paper to be written upon, and the scribing instrument is taken off the surface when the pressure is taken away. Only the middle portion comes down as is applied so the scribing instrument does not touch the paper while adjusting. The scribing instrument can be adjusted into pen, pencil, paintbrush or stylus by taking out the middle portion of the mouse. Also, the location of the instrument can be adjusted by moving the device by sliding it across the surface like a mouse. [4]. Another patent that exists is a visual tracker. It uses a video camera pointed at the individual and captures their image. By the use of the camera it can get a view of where the eye of the user is pointed. By doing so the user can control the location of the mouse on a visual computer screen. This patent adds a lot of value to the project because it gives us different ideas to approach the problem. [5]

2.0 Conceptual Design

2.1 Brainstorming

Through a collective agreement, our group started brainstorming ideas using the gallery method to visualize design concepts to help Fiona retrieve clothes from her closet. We started the process by individually developing our own ideas to resolve the problem. Then we gathered all the ideas together and posted it on a whiteboard to space out the different concepts. This allowed our team members to reflect on the others design thoughts and share their own opinion. Using the gallery method to brainstorm concept, it prompted our group members to ask questions, give feedback and alternative solutions to each of our concepts. After gathering each group members opinions, we modified our initial sketches to produce a second generation idea.

While brainstorming ideas to solve the user's concern, we came up with a couple of efficient designs. An idea incorporated a pulley system, a metal hook and an electronic crank can perform a function which grabs the user's clothes. A hook attached to a thin metal string which is then tied up to a crank.The device would allow the user to to grab the hanger of the pole and pull it back to the wheelchair. The user can use her wheelchair to help guide the hook towards her desired clothing.

Another idea that was presented was for the disposing garbage problem used a trolley with highly magnetic magnets attached to the front of the users wheelchair and the trolley. This device would help allow Fiona to collect her garbage bin without any physical movement or help from her assistant. The user would simply control her wheelchair and guide it toward the trolley containing the garbage.

The group also had an idea to help resolve Fiona's ability to use her personal phone. An idea which uses an adjustable coiled wire, a phone stand, and a C clamp can be put together to form a phone rest. This device would allow the user to use the phone without requiring the assistant to hold the phone for her. The phone would rest on the stand and the user will have privacy while using the phone.

Another concept to grab clothing out of the closet was using an extension. This extension can be made with a lightweight rod, a hook and a C clamp. The function of this design is to grasp onto the desired hanger by simply moving the wheelchair towards the clothing. It can be attached and detached to the user's wheelchair which makes the device more accessible and efficient to use.

We also had a team member come up with an idea that uses an electronic claw to help Fiona grab her phone from her table and use it independently. The claw can be activated by pressing a button attached to her wheelchair and the device itself is connected to the wheelchair with a clamp.

2.2 Design Alternatives

2.2.1 Preliminary Alternatives

Tutorial 8 gave our group an opportunity to come up with a few solutions for two of Fiona's problems with the garbage disposal and the problem retrieving her clothes. Our first initial idea that our group came up with to help our client with her garbage bin was a wooden trolley which carries the bin from place to place. The user's wheelchair and the trolley is connected using magnets which will attract each other using a really strong magnetic field. Magnets would be more easier to help attach the wheelchair and trolley together.

We also had a design for the clothes retrieval. The concept was a plastic extension to the user's wheelchair which can be used as a hook to grab the hanger. The plastic pole is attached to a metal hook and a C clamp used to attach the device to the hand rest. As the user uses the joystick to move in the direction of the desired clothing the extension will then hook onto the hanger and pull the clothing out the closet. This device does not require the user to use any physical effort in grabbing the clothes.

2.2.2 Secondary Alternatives

Taken all the factors into consideration, we chose to focus our project on Fiona's problem with her clothes. We made this task as our main focus because this problem gives the user more independence than the other challenges she faces. Firstly, the problem can be resolved using a mechanism which is easy for the client to use. Another reason why we decided to focus on the

cloth removal was the fact that it seemed to be efficient. The device would be designed in a way that would make the user's ability to grab clothes easier and accessible. Trying to figure of how to make the process of retrieving her clothes easier, we figured that extending her ability to grab her clothes would be sufficient. By providing an extension to her range of motion, this reduces Fiona's the work done by her.

From the sample designs we have previously illustrated, our group had 2 design alternatives that solved the problem of the clothing. The first design used a PVC tube pole, a stainless steel hook and a plastic C clamp. This device was designed to hook onto the desired cloth hanger and pull it back to the user's bed. The user's wheelchair would simply act as the motion which allows the device to go in the direction the user wants. The wheelchair's ability to shift in an angle also helps the device accurately latch onto the hanger and pull it out. To make the device more efficient, we have redesigned the hangers in the user's closet by removing the tips off. To each hanger we have added spacers to prevent the device from grabbing more than one clothing at a time.

Our second design had a new concept which used dollies and long poles that carried individual clothing. For this design alternative we have included the extension from the first design alternative to help retrieve the dolly from the closet. The design was set up so that the user could move the extension forward using the wheelchair and hook onto the pole carrying her clothes. In this design alternative we have positioned the extension to be perpendicular to the user so that the user will have a clear view at the target.

2.3 Design Evaluation

There were multiple factors that were considered to evaluate the design. The metrics used to evaluate how effective the design is shown in the metrics table in Appendix E Figure 1. All the metrics had a scale out of 10, with 10 being the most efficient, and 1 being the least efficient. The device starts off with 10 and set amount is subtracted if the device breaches a penalty. One of the most important factors that had a big role in the design was safety. F.M.'s safety was top priority and, therefore most of the attention was spent in that category trying to perfect the design. Another important metric was that the device should be comfortable for F.M. to use because there is no benefit of making a device that works but is very uncomfortable to use. The next factor that was looked at was whether or not the device is durable enough for the clothes hangers (e.g. if it's sturdy and doesn't lose its form while in use). Another important metric that came from a constraint was that the device has to be easily attachable and detachable because her wheelchair dimension's match exactly with her doors so therefore the device has to have an easy attach and detach mechanism. Finally, the cost of the device was the last metric that was deemed important. The decided maximum cost was deemed to be $100 which was to be followed strictly. After considering these metrics, the most efficient design alternative that was selected from tutorial 10 was Appendix B Figure 1. This design alternative was the best fit for all of the metrics

that were stated above. This design was the safest, most comfortable, durable, had a simple attach and detach mechanism, and costed less than $100.00.

3.0 Final Design

3.1 Description

The clothes selector is a hanger grabber for our client, Fiona. The device essentially converts the motion of the wheelchair onto to a device to control the movement. The device is basically a pole with one end attached to the user's wheelchair while the other end contains a hook the performs the grabbing action. To make the grabbing or collecting of the hangers from the hanger rack easier, the closet and the hangers used to hold the clothes were redesigned. The tip of the arc of the hanger that keeps it held on the hanger rack was cut to reduce it. The hanger rack was then modified to have 0.5-inch spaces between each hanger to prevent accidental collisions that might cause an unintended cloth to fall.

3.2 User

To use the device, the user will depend solely on the wheelchair and less on her own physical ability. The device is to be attached to the right side of the wheelchair using a very strong clamp. The wheelchair does most of the functioning and F.M. will only need to control the movements of the wheelchair to get her clothes. While one end is attached to the wheelchair, the other end has a hook which grabs the redesigned hangers in the closet.

It is also easier for F.M. to remove the hangers for the closet because the hangers are redesigned in a manner that it would be easily be removed when she is trying to retrieve it. We cut out part of the tip of the arc of the hangers that keeps them on the hanger rack and then added 0.5 inch spacers between each hangers.

3.3 Construction

The prototype of our design was constructed using a mix of cardboard and heavy-duty duct tape. The main rods were made of rolled cardboard, and the hook was made from wrapped duct tape rolled into a hook like shape. The 'suction cup' was made using a 'bridge' made from tape and was attached onto a small square piece of cardboard acting as the suction cup itself.

After many revisions and variations of prototypes, we settled with our current design: two PVC pipes (the smaller with a 2" radius and the larger 3"), connected by a screw and butterfly nut. The purpose of this connection is to allow ease tightening and loosening of the two rods. The metal hook, which has a vinyl coating on top of the metal (for extra smoothness to prevent accidental injuries from contact with the hook), is connected to a small wood piece, shaped to fit the inner radius of the smaller PVC pipe, which is then screwed along the interior radius of the

PVC pipe. The pole is then attached to the wheelchair by attaching a clamp to the side of the armrest and and squeeze the PVC pole in between the clamp and the arm rest. The clamp itself is a fairly large and heavy duty, to make sure the device doesn't break apart from the wheelchair. However, the strength of the clamp cannot be too tight, because it may cause the device itself to crack under the pressure of the clamp.

The construction of the device required minimal manipulation of material, as it would keep the costs to a minimum. Some drilling was required to make the hole in the PVC pipes to hold the screw and butterfly nut, and the screw connecting the wooden piece (with the hook) and the top of the pipe. Other than that most of the materials we used stayed in their original form, for the most part. The total cost of the device came to $54.88. Refer to Appendix A, Table 1 for more info about the individual costs of the parts.

3.4 Safety

We made sure the safety of F.M. was first priority when it came to the design of our device. There are many safety risks to consider when designing a product for a person with a physical disability. One is the safety of the materials. Is it flammable? Does it require manipulation with sharp objects? Does it defer the original physical capability of the user? In the case of our clothes selector, we have considered all of these possibilities and risks that F.M. may have during the use of the device, and have taken the corresponding measures to minimize the hazards that could possibly appear when operating the device. There is a vinyl layer in top of the metal hook, to prevent the hook from being too sharp and causing tear and damage to other household items in her bedroom. The PVC plastic pipes are made to be lightweight, so that the weight of the entire device does not impede their (already) limited movement. The device is adjustable in size, so that it won't obstruct her freedom of movement when the device is not in use. Also, since the device is held by a clamp, it is easy to remove (with help from personal assistant) and convenient to store somewhere else after it has retracted to a smaller size.

3.5 Description of Prototype

To get to this final stage design, there were numerous challenges faced and these challenges led to the numerous changes made to our prototypes. During the prototyping stage of the design, we tried to make the entire design as practical as possible. The first and second prototypes of the design are shown in the appendix. In our first prototype, one end of the device was to have a suction cup to attach it to the wheelchair. The other end was to have a hook which would act as the grabber to remove the hangers from the hanger rack. The main or middle part of the device was to be made of wood and have a pull and lock mechanism to allow extension to various lengths which would promote the versatility of the device. The closet was also redesigned so that instead of the closet to have just one pole hung parallel to the user as it originally is, the closet had a flat board with poles sticking out perpendicularly to the user. There

were numerous poles facing the user and this made it easier for the user to view the clothes she wanted to select and it also made it easier for the device we had made to work since it wouldn't need to bother about accidental collisions, which would cause unwanted falling of clothes, since there would be enough space between the poles. Each pole was also to have multiple segment for better arrangement and to make it easier for the user when selecting clothes.

When the design was attempted, various changes had to be made. Wood was too heavy and was not durable. Also working with wood tended to be difficult. Therefore, it the material was easily replaced with a more durable, flexible and cheaper product, PVC plastic. Suction cups that was intended to be used was also replaced with strong clamps. This was because there was no available suction cup that was small and strong enough to fit the space provided on the right arm of the wheelchair. Finally, the redesign of the closet was changed. The spaced created to avoid accidental collisions was too much and as a result, only have of the user's hangers could fit into the closet. The closet was then redesigned again. The original appearance of the closet was used however, 0.5-inch spacers were used to create spaces between the hangers and the the hangers were also redesigned. The tip of the arc of the hangers we cut to make it easier for the user to pull out the hanger from the closet.

3.6 Discussion of Feedback from Design Reviews

In the first design review, our first prototype was presented to health students for evaluation. The prototype that was presented is shown in Figure 1 Appendix B. After learning about the device and its functions, the health students had a few things to say to make the device better and more functional. The health students were impressed about the redesigned view of the closet because the user would be able to see more clothes since the clothes were facing her. However, they had a few suggestions to make. They were not convinced about how the hook of the device would be able to effectively collect the hangers from the closet. The health students also advised that the poles sticking out of the redesigned closet should be a bit angular pointing downwards to enable the user to see more of the clothes behind and it would also make it easier for the hook to get the clothes. Feedback was also collected from the classroom. Most of the classroom evaluators were very impressed especially with the closet redesign. However, just like the health students, some of them proposed that we replace the hook with a straight rod to take the hangers off the closet. Also, some of them were bothered about how the user would be able to drop the clothes once selected or return the clothes in the case that the wrong clothe was selected.

When creating the next prototype, all the things the health students and the classroom evaluators talked about were taken into great consideration. However, on finding out that the initial redesigned closet was not functional because it could only allow space for less than half of the user's hangers, the prototype had to be remade. The new redesign of the closet was simpler and allowed space for more hangers. It was simply the appearance of the original closet with

0.5-inch spacers between each hangers. The hangers were also redesigned to make it easier for the user to pull them out from the closet.

In the next design review, the prototype that was presented is shown in Figure 2 Appendix B. The device was evaluated by the health students and they had some things to say. The health students were bothered if the length of the device would cause an obstruction. That problem was easily answered when the prototype showed that it was able to extend and reduce. Also, the device is detachable so it would only need to be attached for the purpose of being used in the user's room to prevent obstructions. The health students also proposed that we provide some safety mechanism to keep the user safe in the case that the clothes fall off the hook and onto the user. They felt that the only possible problem would be attaching the clamp to the wheelchair and advised that our device should be more practical than theoretical.

4.0 Conclusion

Overall the design is well thought out to help Fiona independently choose her clothes without the help of her personal support worker, other than clamping the mechanism to the wheelchair. Considering the limitations that Fiona has due to cerebral palsy, it was successfully applied to the design, which avoids fionna using her hands as her motion is very limited. Also the object retains good accuracy with movement along wheelchair. After composing many different designs, highest level of output was considered for objectives, maintaining the constraints and complete the product in a way that would benefit the client in the most predominant way.

In order to evaluate the different prototypes and the final prototype in the most quantitative way we established several metrics for the objectives at the final problem definition step. A scale was produced to represent how the design meets the given objectives. One (1) meaning not meeting objective and ten (10) meaning highly meeting the objective.

The first objective is comfort. For our client who has cerebral palsy, doing the most simplistic of tasks is not achievable as it requires high accuracy and full use of body. We made a product that only requires three motions of the wheelchair when it connects. It connects to the right side of wheelchair as the door opens towards the left. To decrease the amount of accuracy required to grab the hangers spacers were put in between the hangers so there was more than enough space for the hook to go between the two hangers. By doing so we gave Fiona a device which does not require motion of body nor does it require too much accuracy. According to the setting, 8 score for the least amount of accuracy required, thus greater the accuracy required lower the score. The expected size of spacers was 0.4 inches since it has increased to 0.5 inches it required less accuracy resulting in a score of 9 which was highest possible. As we increase size of space the amount of clothes that the client can hang decrease.

Next objective was cost effectiveness. For our clients and us it should be something that is easy to make and is affordable for both. To compete against other groups and existing products so we needed to make the price as low as possible. The metric was based on price. The lowest

cost has a metric of 10 which was close to $15 and highest cost has a metric of 1 which was near 100 dollars. Our final price was near $55, which is somewhat affordable giving it the final score of 5.

The next metric was portable. The device should not take too much space when transferring from different locations and it should fit within a closet, so it can be stored away. We set a 10 score for size equal to 4 ft length and 10 cm in width and 1 for 6ft in length and 40 cm in width. The final prototype was 5ft 5 inches and 10 cm in width. Therefore, the score of this device would be 7 in this case. The ability to change the size of the CS pro, made the device really portable and the ability to attach/detach.

Another important objective was lightweight 7 lb being the lightest and 15 lb being the heaviest. In order to make our device lightweight we decided to use PVC pipes as their light in weight and can support weight of the clothes. The weight of the CS pro turned out to be around 9 lb in weight. Therefore, the score of this device would 8 in this case.

As proven above through our metrics/objectives, our device achieves good standards to prove that the CS pro is an optimal device for fiona to use while removing clothes from her closet.

Several constraints were set at the beginning of the design process for the device, which are never ignored. If these constraints were not implied, our device would be impractical for fiona to use and we would have not helped fiona in any way. For the CS pro to meet the constraints it should be under 15 lb, attachable/detachable and costs less than $100.

Having a maximum weight is a constraint because a device that is too heavy cannot be used as it causes safety concerns and thus cannot be used, making the object created useless. We made sure to make the CS pro as small in length as possible but also making it lightweight at the same time. In the given time we were able to create a device that was 9lb. Keeping this in mind we provided fiona with a device that is easily operable with the wheelchair.

Another constraint that was set during the initial design process was the device need to be attachable/detachable. This was necessary since fiona lives in an apartment and uses the wheelchair to travel everywhere so the dimensions of her wheelchair cannot change. If we were to change the dimensions of the wheelchair than she would not be able to go through the door in her room. Keeping this in mind we provided fiona with a device that can be attached and detached with a clamp whenever required.

The final constraint that was set during the design process was a maximum cost. Our group decided that it necessary to have a cost efficient device. This was necessary as the government and the client are already paying huge sums of money for care. By not allowing our cost of our product exceed $100, we made the device a good investment for the user to gain independence in removing clothes from the closet. The CSPro only required $54.88 in materials, which is within the cost constraint.

Aspects of design for the CS Pro could not be compromised. By staying within the constraints, the CS Pro shows that it is a device capable of use by patients of cerebral palsy such as Fiona.

For building the prototype there many things taken into consideration such as what is the best possible solution that can be created by putting these materials together.

The first thing we did was take light piece of wood and put it inside the pvc pipe so the hook could be stable while taking out the clothes.

Considering the size and depth of the closet we made cuts into the pvc pipe so it can be extended whenever required to a certain length with ease using a bolt. Through this process we also learned that the use of the suction cup in our original design was not possible as there was no flat spot on the chair.

One of the most important things was the safety that's why instead of wood we used pvc as it weighs less. Also the hook was a dangerous part of the design too so we bought a hook that was coated with plastic for safety. Also when we cut the hook a bit we made sure to smoothen it out so it was not sharp and we made the pvc smooth at the ends.

In addition, the overall design's technical aspect could have been improved. The redesigned hangers can be modified in terms of being able to hook onto the pole. Replacing the tips of the hanger with a flexible foam can improve the stability of the hangers inside the closet. The main purpose of this project was to provide F.M. with a safe, reliable device that can give her the independence that she needs. With our clothes selector, she is able to choose her own clothes, and get them off the rack, all without the help of a nurse. It is important to give every human the freedom of choice and independence, and while F.M. may have difficulty achieving this with her disability, she deserves no less.

5.0 References

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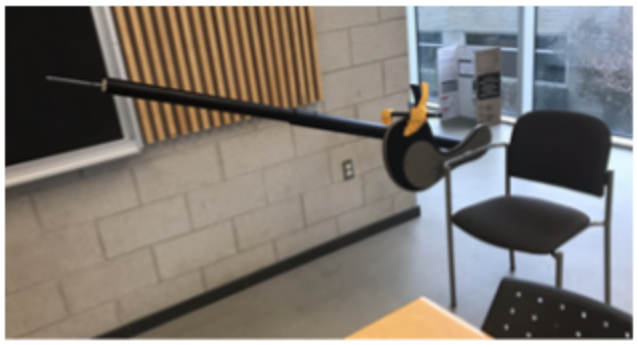
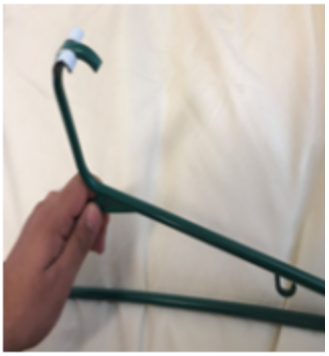
Appendix A

Steps for Using Hanger Grabber and Material Required

Figure 1:





Clamp attaches to end of device to connect to wheelchair

Table 1:

Product	Store	Price
Vinyl UTL Hook	Home Depot	$2.98
Clamp	Home Depot	$28.98
ABS 2'' x3' PVC PIPE	Home Depot	$7.78
ABS PVC PIPE	Home Depot	$11.48
3390 Forged Steel Bolt	Home Depot	$0.63
2650 Screw	Home Depot	$0.21
2x2x8 SPR Wood Piece	Home Depot	$2.82
	Total:	$54.88

Appendix B

Final Design Alternatives and Prototypes

Figure 1: Final Design Alternative 2

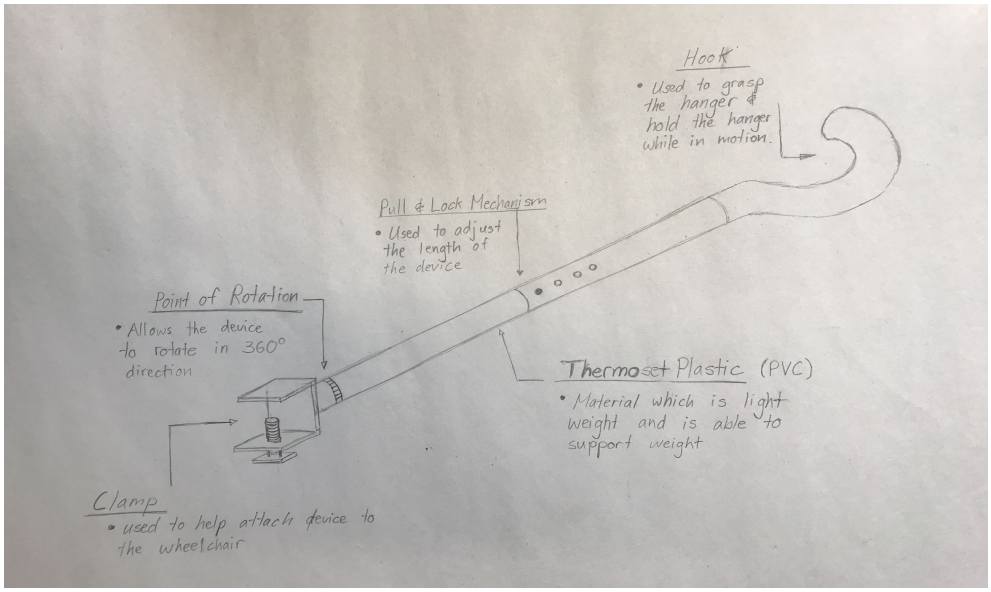
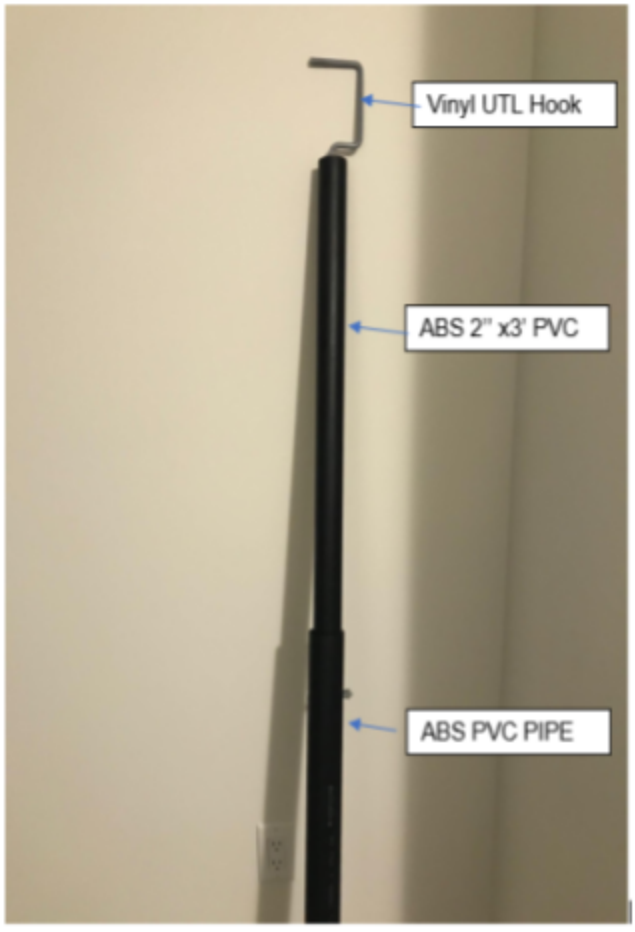
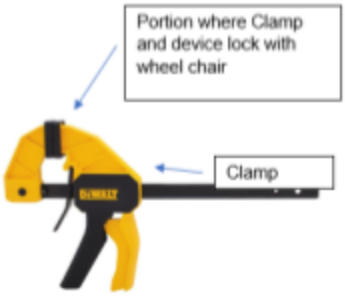


Figure 2: First Prototype

Second Prototype

Labeled Final Prototype





Appendix C

Tutorial 9 Design Review Feedback

Reviewers: Health Students

- The hook should be more angular to prevent falling.
- It is really advantageous that she can see more of the clothes facing her. The problem is, getting the clothes might be difficult because of the movement of the wheelchair.
- Try putting a pivot on the hook so that it can turn.
- Angle the outward sticking poles downwards to enable easier reach and for F.M. to see more clothes.

Reviewers: Group 2 Tutorial 9

- Provide a way to drop the hangers when selected.
- Replace the hook with a straight rod.

Tutorial 11 Design Review Feedback

Reviewers: Health Students

- Would the length of the device obstruct her movement?
- Provide a safety mechanism to prevent clothes from falling down and hitting the user.
- Provide a way of returning clothes in the case of wrong selection.
- Change the hook to be a smaller one because it would be hard to select a single hanger when they’re many.
- The only possible problem would be the attachment of the device to the wheelchair.

Appendix D

Figure 1

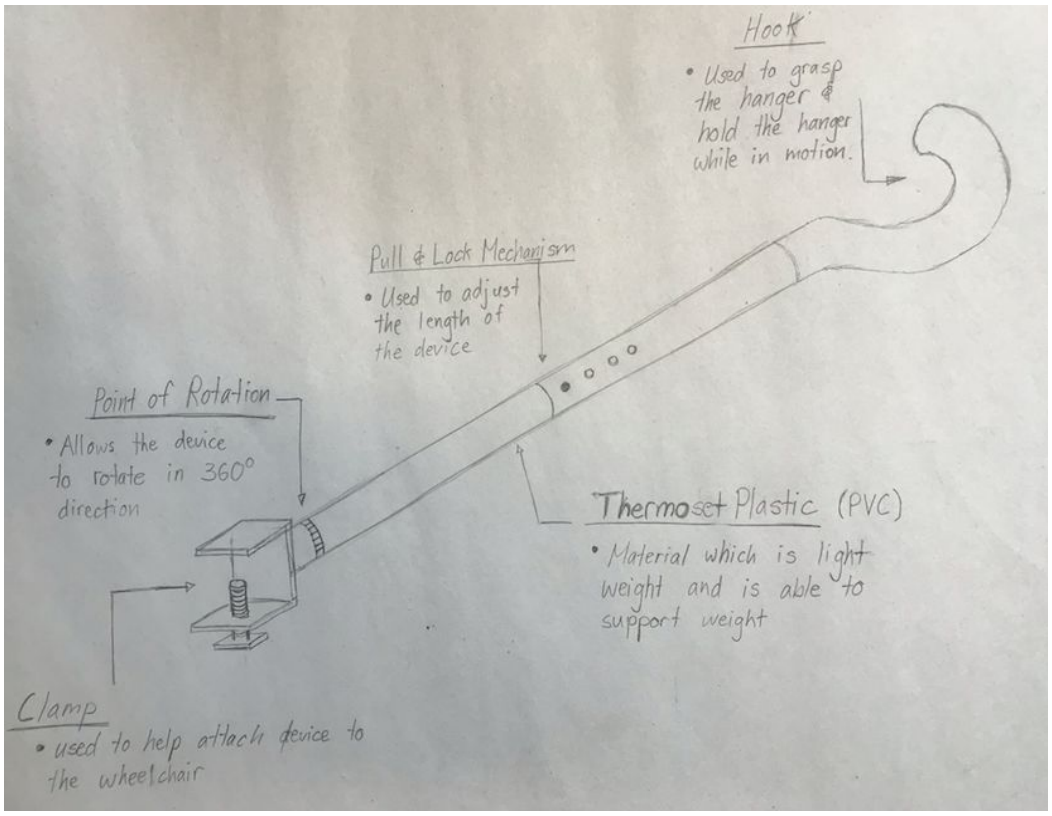


Figure 2

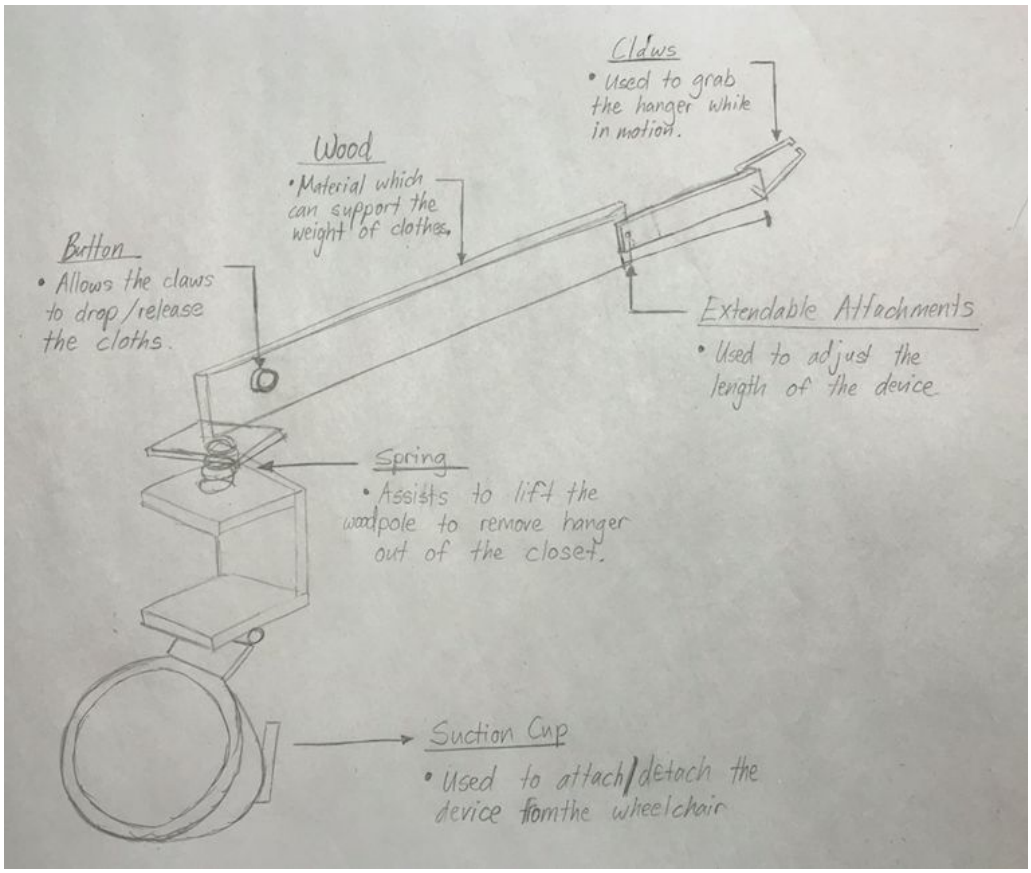
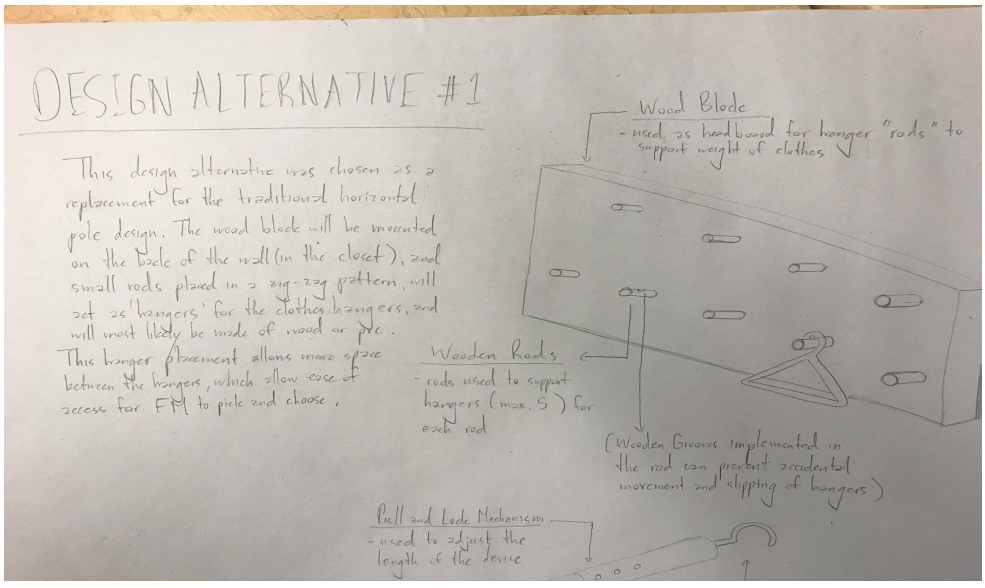


Figure 3



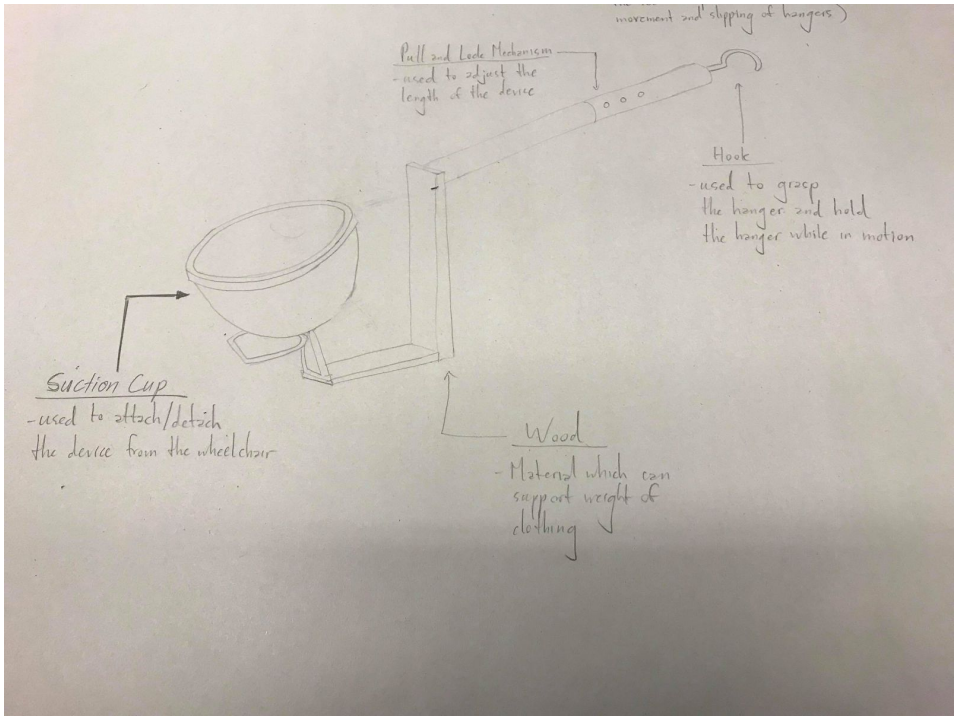
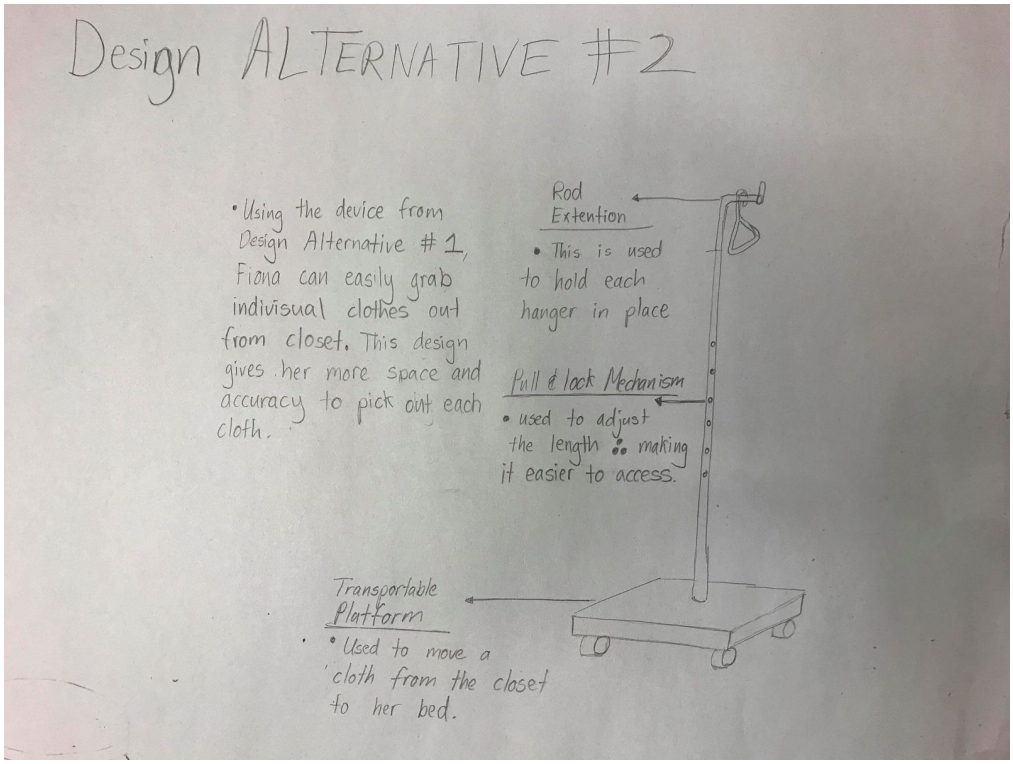

movement and slipping of hangers)
Pull and Lock Mechanism
- used to adjust the length of the device
Hook
- used to grasp the hanger and hold the hanger while in motion
Suction Cup
- used to attach/detach the device from the wheelchair
Wood
- Material which can support weight of clothing

Figure 4


Design ALTERNATIVE #2
• Using the device from Design Alternative # 1, Fiona can easily grab indivisual clothes out from closet. This design gives her more space and accuracy to pick out each cloth.
Rod Extention
• This is used to hold each hanger in place
Pull & lock Mechanism
• used to adjust the length ∴ making it easier to access.
Transportable Platform
• Used to move a cloth from the closet to her bed.

Appendix E

Figure 1

Metrics

Objective:	Should be safe for F.M. to use
Metric:	Measured by the number of ways in which the device can cause bodily harm Scale: Total Points out of 10 - Number of ways to cause harm

Objective:	To Minimize Cost of making device
Metric:	Determined by the cost of making the device. Scale: Total Points out of 10 - (Cost/ $100)

Objective:	Should be comfortable for F.M. to use
Metric:	Measured by the perceived comfort of device Scale: Total Points out of 10 - # sources of discomfort

Objective:	To be durable
Metric:	Measured by flimsiness (if it's so flimsy it's unusable), if the attach and detach mechanism breaks, and if the device breaks while F.M. is trying to pick out the clothes from the closet. Also if the device is dropped and breaks. Scale: Total Points out of 10 - # of points of failure.

Objective:	Device should be easy to attach and detach
Metric:	Measured by the number of minutes taken to attach/detach the product Scale: Total Points out of 10 - 1.5(minutes taken)

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Engineering 1P03 - 2017

Team Name: G sin Beta
Group Number: 5

As a future member of the engineering profession, I, Marco Wong, am responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University and the Code of Conduct of the Professional Engineers of Ontario.

Name (Print)	Mac ID
Marco Wong	wongm58

Signature:

Date: 2017-12-05

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Team Name: G sin Beta
Group Number: 5

As a future member of the engineering profession, I, Pavneet Gill, am responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University and the Code of Conduct of the Professional Engineers of Ontario.

Name (Print)	Mac ID
Pavneet Gill	gillp28

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Group Number: 5

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Name (Print)	Mac ID
Samandeep Singh Virdi	virdis2

Signature:

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Name (Print)	Mac ID
Mustapha Bello	bellom2

Signature:

Date: 2017-12-05

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Name (Print)	Mac ID
Hajanan Mohendran	mohendrh

Signature:

Date: 2017-12-05