# Assistive Holder for People with Disabilities
# Final Proposal Report

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# EXECUTIVE SUMMARY

This report is generally concerned with the designing of the Stick holder for the people with disabilities. It starts with the basic introduction about the Stick holder and its importance for the poor people which suffer from certain disabilities. After the introduction, the project layout is briefly described in the report. The structure, operation and performance of the original system were described under separate headings. After the proper explanation of the product to be designed, special light is showered upon the customers' needs in order to make the holder as close as to the actual requirements of its users. The customer requirements, the engineering requirements and the house of quality are elaborated in detail under this heading. Then the existing design of Stick holder was discussed. Three existing designs i.e. collapsible, handgrip and Argos design are explained along with their pictorial views for better understanding. The functional decomposition of the device is also done in this report and a black box is created for identifying certain inputs and their corresponding outputs. After these ten different considered designs are explained one by one. These designs include Clapper Holder, Paper Cups Holder, Sawed Teeth, Serrated Saw Teeth, Shutter Design, Lock Design, Adjustable, spring, Collapsible and Obontomed Design. The hand-made sketches of all these designs are also included in their respective headings. At the end of the report, the selected design is discussed in detail. The reasons of the selection of this design are thoroughly discussed under the heading of the rationale of the selected design. Also, at the end of this report, our actual design is explained. The CAD model of the Stick holder is shown at the end of the report from different isometric views for better understanding of the selected design.

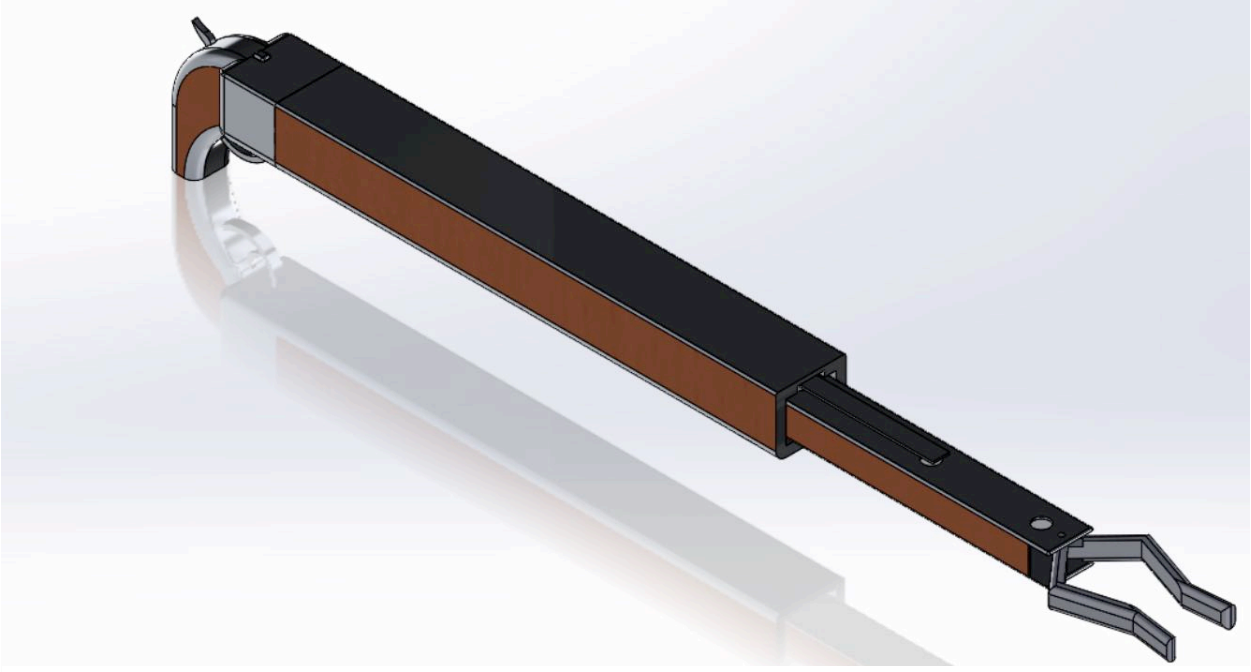

*Figure 1: Isometric View*

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# 1 BACKGROUND

## 1.1 Introduction

The aim of the project is to help people with disabilities to hold things that are beyond their reach because of their disability. People having disabilities are using different kind of assistive devices. Such devices allow people having disabilities to carry out their everyday routine tasks thereby improving their living standard. Use of assistive devices provides opportunities for people having disabilities to play a more productive role in society. This engineering project is to help such people to play their part for the uplift of society. [1] This project aims to form an innovative and adaptable device, which would be used as assistive device by individuals having disabilities. Although many such devices already exist, this project aims to make an assistive device to help people with disabilities to grasp things easily from a distance.

## 1.2 Project Description

This design is for people, which find it hard to move or face some muscle problems to hold something for long durations. This device basically consists of an extension bar with two ends. One end is held in the hand by the person having disabilities. It contains a handle at the users end for easy gripping. The other end contains a clamp to grasp objects. This device is not solely for art but it is designed by keeping in focus everyday problems faced by people with disabilities. This device assists people with disabilities and makes them independent.

## 1.3 Original System

Generally, the original system was flexible in such a way that it could be handled in different sizes Moreover; the design was lightweight and easy to use. However, it had some weakness, which elicited need for improvement. Also for the new system has the safety lock to secure the object that want to hold it by the device. Moreover, the new system has 3 different lengths that will give the users more options to use this device.

### 1.3.1 Original System Structure

This is an adjustable design so that it can be handled at various lengths. Originally, these assistive devices were built in different sizes such that each size was fixed and was only capable for performing specific tasks. The materials are selected keeping in view their availability. Metallic components are used where strength is required whereas plastics are used wherever possible to optimize weight of the final device. The adjustable length of our design makes it more comfortable and user friendly as it adapts readily according to user requirement.

### 1.3.2 Original System Operation

This device basically consists of an extension bar with two ends. One end is held in the hand by the user. It contains a handle at the users end for easy gripping. A lever actuator is provided near the grip. This actuator, when pressed with finger, closes the jaws of clamp thereby holding the object in between them. A locking lever at rear end of grip is used to keep jaws of clamp closed. Normally, if a user presses the lever to hold an object, he will have to keep the lever pressed to hold that object until he requires. This function exhausts most of the users. The locking feature is provided which allows the user to lock the jaws of clamp with any object in between them.

### 1.3.3 Original System Performance

These devices are fulfilling the basic operational requirement which is expected of them. As, these devices are designed to provide assistance to people having disabilities to enhance their mobility and range. These systems exist from a long time but innovations are always required from time to time to meet the ever-increasing needs of humans.

### 1.3.4 Original System Deficiencies

Although the original system performs the intended function but a deep review of original design shows a lot of deficiencies which need to be addressed. One such deficiency is the limited and fixed length of the extension bar. The design weight needs to be optimized in order to minimally exhaust the users. The gripping and grip locking mechanisms also need special attention to make them function properly and effectively.

# 2 REQUIREMENTS

The basic requirements for any device come from its users. As this assistive device will be used by people with disabilities, it must be easy and safe to use. It should also provide its users with adjustments according to their needs and requirements. It should not pose any threat to its users in any worst condition. A complete requirement analysis was performed to identify and accommodate the important requirements in the final design. Customers were interviewed about their needs and requirements to prioritize their requirements in the form of a list as given below.

## *2.1 Customer Requirements (CRs)*

A complete analysis on this process was done by us to examine the necessary requirements of the customers. The stick holder must be light weight and should not be more than 1kg weight. It must have adjustable length for easier accessibility of the object at different times. The adjustable length will be useful to the user to access the objects positioned at different distances. The operations associated with the stick holder must be minimal and the user must be capable of using it with minimum discomfort. The stick holder must have sufficient strength and the user must be able to pick considerable large objects. The holding capability of the stick holder must have a larger range. It must be able to hold a small object as well as a large object with minimal operations. The safety associated with the stick holder must be large and it should not hurt the user ever in case of incorrect operation. Options for changing the length must be present. The user must be able to adjust the length as and when required. The stick holder must be able to pick the object positioned at different angles. Table 1 gives the details on the customer requirements.

Table 1 Customer Requirements and Weights Scale

| Number | Customer Requirements | Weights (0-5) |
|---|---|---|
| 1. | Light weight | 5 |
| 2. | Length change | 4 |
| 3. | Easy to set up | 3 |
| 4. | Easy to use | 3 |
| 5. | Safety | 4 |
| 6. | Angle change | 2 |
| 7. | Size change | 4 |

An interview was conducted in this research process. The same question was asked with all the clients about the most vital thing that they are looking for in this design. The given table 2 describes the interviews of three of our customers.

Table 2: Interview Customers

| Customers | Customer 1 | Customer 2 | Customer 3 |
|---|---|---|---|
| 1 | Light weight | Easy to set up | Length change |
| 2 | Angle change | Easy to use | Light weight |
| 3 | Length change | Light weight | Safety |
| 4 | Easy to set up | Safety | Angle change |

We work on this design based on our client and customer requirement. The main aim was to design it in accordance with the customers' needs. The interviews with the customers paved way to clearly understand about their needs and design our product accordingly.

## 2.2 Engineering Requirements (ERs)

The main focus of this project was to create a stick holder in accordance with the basic customers' needs and safe to handle. The comfort and aesthetics of the stick were also given prime importance while it's designing. The basic requirements of the customers were listed below and a special effort was made to ensure the achievability of these needs. Based on the customer requirements we have created the engineering requirements as the following:

The engineering design requirements were generated after thoroughly analyzing the customer requirements. Focus was given mainly in three areas namely the weight, strength and the adjustability. The weight has to be limited to lesser than 1kg. Using materials such as aluminum or plastic can reduce the weight. The stick holder must have sufficient strength to withstand considerable loads. The length of the stick holder must be limited to lesser than 80cm and the estimated cost must be lesser. Table 3.

Table 3. Engineering Requirements

| **Customer Requirements** | **Corresponding Engineering Requirements** | **Tolerences** |
|---|---|---|
| Edges round | up to 3mm | $\pm\ 0.5mm$ |
| Weight | < 1kg | $\pm\ 100gram$ |
| Max applied pressure | 5kpa | $\pm\ 0.1kpa$ |
| The opening angle | Near to 180 degrees | $-\ 10\ degrees$ |
| length | 80cm | $\pm\ 10mm$ |
| Estimated cost | $250 | $\pm$ $20 |

## 2.3 Testing Procedures (TPs)

It is required to ensure that generated engineering requirements meet the design criteria. The mechanical characteristics of the design has to be evaluated and the properties mainly modulus of elasticity (E), load carrying capacity (axial and lateral), opening angle measurement and ultimate load carrying capacity. Experimental testing will be performed to estimate each of the properties. In some cases, mechanical analysis software can be used for finding the mechanical properties.

The modulus of elasticity (E) of final designed stick holder has to be carried out by loading it with different masses and estimating the deflection with respect to a reference position. The applied load and the surface area will be used to estimate the stress and the deflection will be used to estimate the strain. Modulus of elasticity (E) = Stress/Strain. The load has to be applied until the stick holder enters the plasticity region before ultimately failing. By estimating the plasticity region, we can find out the maximum load that the stick holder can handle.

The load carrying capacity can be estimated by lifting loads of different weight and holding it for a specific time. The deflection happened in the stick holder has to be measured for every load. It has to be found out whether the load being lifted causes any permanent deflection to the stick holder. This experiment has to be carried out in both the axial and the lateral directions of the stick holder. While testing in axial direction, the stick holder will directly lift the object whereas in lateral direction the test weight will be suspended to the stick holder through a string.

The opening angle of the stick holder has to be evaluated through protractor or any other angle measuring instrument. It has to measure the angle of the stick holder jaw at fully opened and fully closed conditions. The angle has to be nearly equal to 180 degrees under fully open condition and close to 5 degrees.

The weight of the stick holder has to be kept lesser than 1kg and weighing scale can be used to measure the weight. Certain materials such as aluminum and plastic can be used to find out the weight of the system.

The minimum length of the stick holder has to be kept nearly equal to 80cm. The length of the pick holder can be measured using ruler.

For the testing, we did some testing to set up our device and try to apply the engineering requirement. Some testing:

1- Safety; we have applied to our design the lock button to lock the device while using it, also made the edges not sharp in order not harm the users by making the edges 3mm.

2- Length change; we applied to our design to shafts (inner shaft, and outer shaft), so we have drilled three holes in the inner shaft and attach a flat bar with a small pin in the end of it on the outer shat in order to let the users to change the length by using the extender button.

3- Light Wight; some of the team members have visited some stores to look at the light weighted material. So, the found out that the Plastic, and Aluminum are the best two materials that will meet with our customer requirement.

4- Angel change; we have cut the end both sides of the inter shaft that the grabber teeth attached to it in order to let the grabber teeth's degree 180. So, with this angle the device can hold large objects and small as well.

## 2.4 House of Quality (HOQ)

The customer and engineering requirements as described above should be met in the final design in order to fulfill the purpose of this device. Although accommodating all the requirements in our design is difficult job but all possible efforts are made to incorporate as much requirements in the final design as possible. House of Quality (HOQ) analysis makes it easy to identify the incorporation of customer and engineering requirements in final design using a grading system. The requirement list as discussed above must be kept in mind while designing. The relative importance of requirements and their mutual correlation helps us to make design improvements without compromising any requirements.

Table 4: House of Quality

| Customer Requirement | Customer Weight | Applied pressure 5kpa | The estimate cost between $100 to $200 | The weight less than 1 Kg. | The length is about 80cm | The opening angle is 180 degrees. | Edges round to 3mm |
|---|---|---|---|---|---|---|---|
| 1. Safety | 5 | 9 | | 9 | | 9 | 9 |
| 2. Size Change | 4 | | | 3 | 3 | 9 | |
| 3. Light Wieght | 4 | 3 | 9 | 9 | 3 | 3 | 3 |
| 4. Length Change | 3 | 3 | 9 | 3 | 9 | | |
| 5. Angle Change | 4 | | 3 | | 3 | 9 | 9 |
| 6. Easy to Set up | 5 | | | 3 | | | 3 |
| 7. Easy to Use | 5 | 9 | 9 | | 9 | 9 | 3 |
| **Absolute Technical Importance (ATI)** | | 111 | 120 | 117 | 108 | 174 | 123 |
| **Relative Technical Importance (RTI)** | | 5 | 3 | 4 | 6 | 1 | 2 |
| **Testing Procedure (TP#)** | | | | | | | |

# 3 EXISTING DESIGNS

## *3.1 Design Research*

Prime motive of many researches, in the past years, has been to somehow allow people with disabilities to carry out their everyday task independently. There is vast literature containing theories, working and development of many assistive devices. These devices are intended to either help the user to move or to help them pick up things with minor or no movements of lower limb. The main objective of our project is to make an assistive device to help people with disabilities to do their art work and other normal works with ease. It has been observed that people with limited usually refrain to socialize with other people thereby suppressing their mental and creative development.

A thorough research with a focus to study existing assistive devices for people with disabilities is already available, advantages and design gaps of these devices along with the expectations of the users from these devices. All this useful information is then implemented to bridge the gap between user requirements and existing designs by introducing a modified design of a holder stick.

## *3.2 System Level*

There are a lot of existing designs for assistive devices similar to holder stick which fulfills the basic requirement of holding objects. These devices are characterized depending upon their degree of motion and the extent of accessibility they provide to their users.

### 3.2.1 Existing Design #1: Collapsible Design

The figure 2 given below shows a collapsible type design of holder stick. The clamp jaws are such designed so as to make this device easy to grab objects from a reasonable distance [3].

Figure 2: Collapsible Design [3]

### 3.2.2 Existing Design #2: Handgrip Design

The figure 3 indicates a Handgrip design [2]. This design is used to help people with mobility problem on and off the latrine or all through a shower, giving soundness and support in the shower or helping with activating here and there a solitary advance.


Figure 3: Handgrip Design [2]

### 3.2.3 Existing Design #3: Argos Grabbing

The figure 4 indicates an Argos grabbing stick. Argos grabbing stick has got rails which are utilized to help with adjust and bolster, as a guide to help with movement or in regions where a slip or fall is viewed as a high hazard [5].

Figure 4: Argos Design [5]

## 3.3 Functional Decomposition

The functional decomposition process was utilized for breaking down of the device into smaller components to make the selection of our design easier. The material needed in the device is also explained in this chart. The main components of the device are also shown in the given chart. As you see in the figure 5 that the device with the parts.

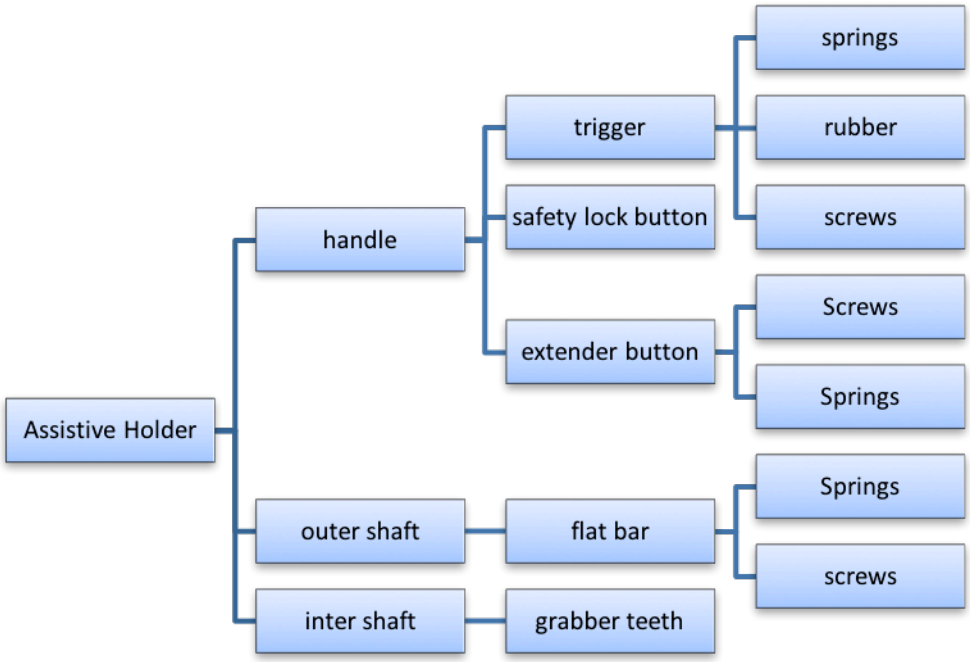


Figure 5: Functional Decomposition

### 3.3.1 Black Box Model

The black box model is explained what the maid target of the device. So, its explain what can the device do and how. Also, it explains the material, signal and energy for the device. What kind of energy needs to work and from any materiel the device should be made.


Figure 5: Black Box Model

## *3.4 Subsystem Level*

### 3.4.1 Subsystem #1: Jaw Design

The jaw design will be an important part for the stick holder. The jaw portion has to hold the object and it is expected to have sufficient strength and at the same time should not damage the object through excessive force. Some option can be provided to the user to exert smaller and larger force on the object that is being handled.

#### *3.4.1.1 Existing Design #1: 1 X GardenersDream*

This design has a rubber coating along the inner metallic structure [2]. The rubber coating will provide a small load on the object. These teeth will have more grips and will hold the part in an easier manner. However the sawed teeth can also damage soft and weak objects.

#### *3.4.1.2 Existing Design #2: Homecraft AA8058W Handi-Reacher*

The stick holder will have nearly 180 degrees jaw angle to lift bigger sized object [1]. The wider angle will ensure picking of the large sized object.

#### *3.4.1.3 Existing Design #3: Litter Picker*

The jaw can have a rubber clamp to prevent slipping of the object under hold. During the lifting operation, the rubber clamp will first hold the object and increase the grip [7]. The user will then operate the lever mechanism to further hold the object in a tight manner.

### 3.4.2 Subsystem #1: Light Weight

The light weight construction of the stick holder will give more comfort to the user. This is one of the main design criteria and is associated with almost all the stick holders.

#### *3.4.2.1 Existing Design #1: 1X GardenersDream*

The arm of this stick holder is tubular and thereby reduces the weight to a large extent. Other materials such as rubber and toughened plastic materials are used for the accessories to further reduce the weight [4]. This stick holder uses high quality aluminum as the base material to reduce weight.

#### *3.4.2.2 Existing Design #2: KEPLIN STRONG ALUMINIUM PICK UP*

This stick holder uses aluminum for weight reduction. The arm resting portion and the object holding portions are made of high quality light weight plastic materials [8]. The weight is kept as lower as possible and at the same time the strength is maintained at the required value.

#### *3.4.2.3 Existing Design #3: Reacher Grabber by BeGrit Healthcare*

The frame contributes for the maximum weight and this stick holder has a lightweight frame. It is made of aluminum alloy and the design is such a way to minimize the weight and maximize the strength [5].

### 3.4.3 Subsystem #1: Extendibility

The stick holder has to be extendable to larger distances so as to allow the user to pick objects that are placed at nearby locations.

#### *3.4.3.1 Existing Design #1: Reacher Grabber by BeGrit Healthcare*

This design will allow 32 inches adjustability. The user can elongate the stick holder up to 32 inches to pick and hold objects that are at nearby locations [4]. However, the increase in length will cause a reduction in the weight lifting capability.

#### *3.4.3.2 Existing Design #2: KEPLIN STRONG ALUMINIUM PICK UP*

This stick holder has a grip lock trigger that will lock the jaw before lifting the object. This will ensure safety to the user as well as the object that is being lifted [3]. It has hole-lock mechanism to lock the holder at different lengths so that they can be comfortably used by different users.

#### *3.4.3.3 Existing Design #3: Reacher Grabber by BeGrit Healthcare*

This stick holder has an extender that works on two concentric tubes [5]. The outer tube gives strength to the stick holder and the inner tube extends as per the users' requirement. The jaw is present in the inner tube and it operates to hold the object [5]. The user must have sufficient strength to hold the device.

# 4 DESIGNS CONSIDERED

Designs described below are considered to form an effective design solution for the specified user and engineering requirements.

## *4.1 Design #1: Clapper Holder Design*

The first design that was considered is called clapper holder. This design can be lightweight, which is one of our CRs and it's important for disabilities. Also this design can come with all ERs we want to apply it to our Project. This design has some advantages like Lightweight and can anyone use it by one hand. On the other hand, disadvantages for this design it might be broken with some parts. Because it made from light materiel so it cannot hold heavy parts.

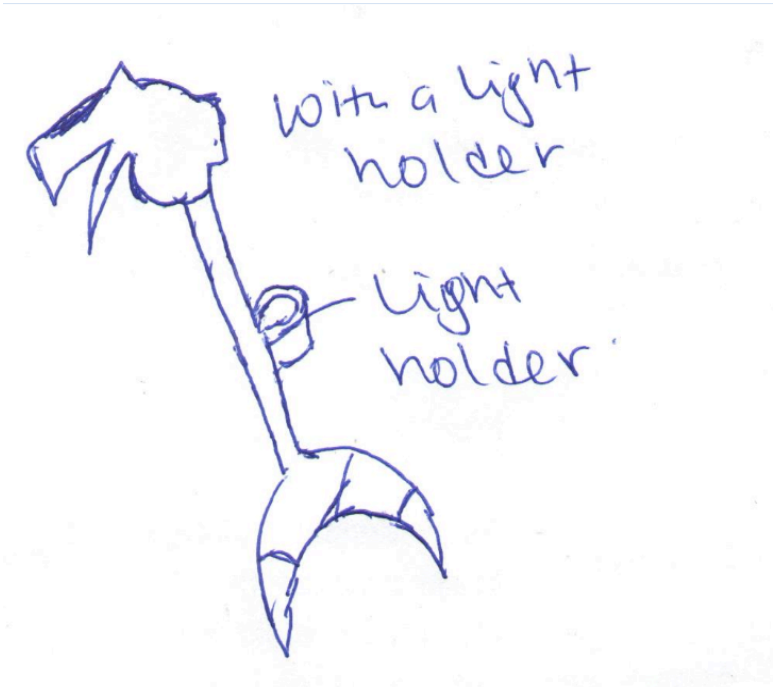


Figure 6: Clapper Holder Design

## *4.2 Design #2: Paper Cups Holder Design*

The second design that was considered is called paper cups holder. With this design can a person use it from high place to pick up any parts form low level. This design will be very good to use it in one place. Any person stays in one place and droop something with this design can bring it

back. This design can follow what the customer needs for the easy to use. Because we can make it what simple part. So there will be no more than 3 or 4 parts in this design. This design can be useful to pick up cups and other small parts. But it might be problem if a person wants to pick something not in the ground.

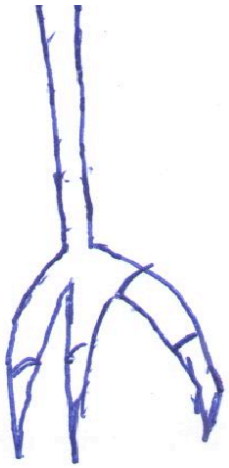

Figure 7: Paper Cup Design

## *4.3 Design #3: Sawed Teeth*

The third design that was considered is called sawed teeth .is adjustable and moveable. Allows the person to get different part. Because it has sawed teeth so it can hold any solid part. With this device person can use it many ways. For example, turn light on and off and it can be useful to turn water from sink on and close it. Some of the disadvantages for this design the teeth might damage the part that wants to hold or pick it.

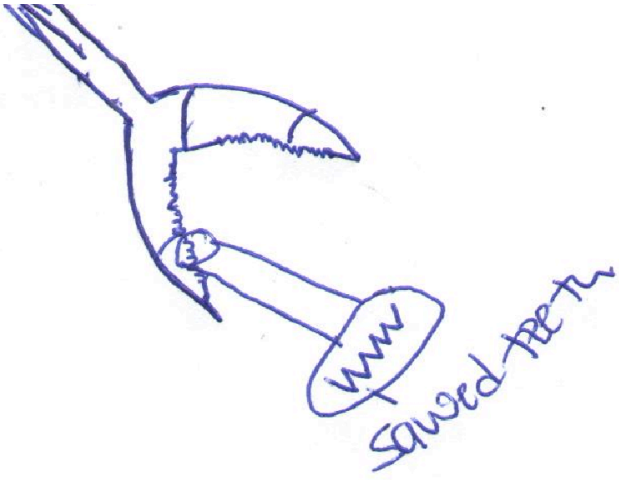


Figure 8: Sawed teeth Design

## 4.4 Design #4: Serrated Wide Saw

The fourth design that was considered is called serrated wide saw. This design is following the CRs. Because it angle can be open to 180 degree. So the people with disabilities can change the size for the angle while they are using it. Moreover, there is an extra spring will be to support the device in case the person drop it by mistake this spring will close and hole the part automatically. This is one of the big advantages for this device; it will be more safety with glass and dishes. But the device cannot work very well if the extra spring broke. Because it might drop the parts anytime.

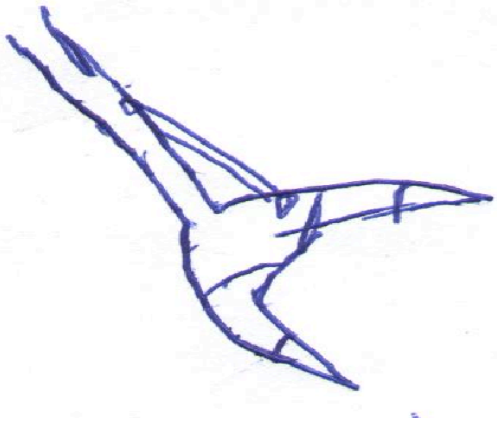

Figure 9: Serrated wide saw Design

## 4.5 Design #5: Shutter Design

The fifth design that was considered is called shutter design. In the market, there are currently different models of canes, each of which presents a different type of grip. Their design is one or the other depending on the service they are intended to provide, depending on the degree of disability of the user. Also can use it with hold and pick up some cups that have holder. This design is very easy to use which one of the customer needs in the device. But it might be not work for some person because the parts this design can hold it is limited.

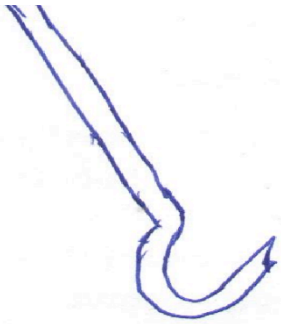

Figure 10: Shutter Design

## 4.6 Design #6: Lock Design

The sixth design that was considered is called lock design. This tactile tool, made with synthetic fibers. The people with disabilities can use this device without any problem, when they touch the subject that they want to reach it lock immediately on the solid material .So advantage of this design is making the people with disabilities feel easy to use, but the disadvantage is that this design might damage some parts such as glasses or cans.

Figure 11: Lock Design

## 4.7 Design #7: Adjustable

The seventh design that was considered is called adjustable. As you can adjust the height and length is appropriate for different sizes of hammock type vestibules. This design applied to the people with disabilities as in the CNs (length change). The advantage of this project that the users could change the length to reach the high solid material, the disadvantage is that when the users make the device taller the device will be weak with holding the solid material.


Figure 12: Adjustable Design

## 4.8 Design #8: Spring Design

The eighth design that was considered is called spring design. The spring would be a supporter for the opening. When people with disabilities use this design, the spring would be helpful for holding the solid material by not to put high pressure on the glasses or paper, the disadvantage is that , with time the spring might break down and cannot be used until the spring replaced.

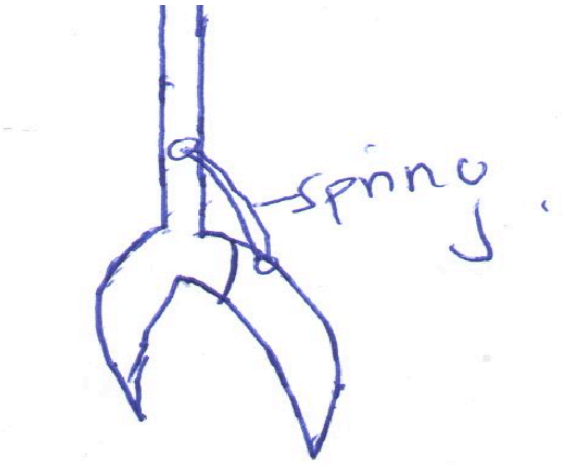


Figure 13: Spring Design

## 4.9 Design #9: Collapsible

Design number nine that was considered design that was considered is called Collapsible design. This three-point shelf holder is powder-coated steel with a flexible fit. This design is what the people with disabilities are looking for because it can help them to hold anything that is on the ground by pointing on it and pull the trigger to grab it so they can hang it and change its place. But the solid material that hanged by collapsible might full down, which will cause damages.

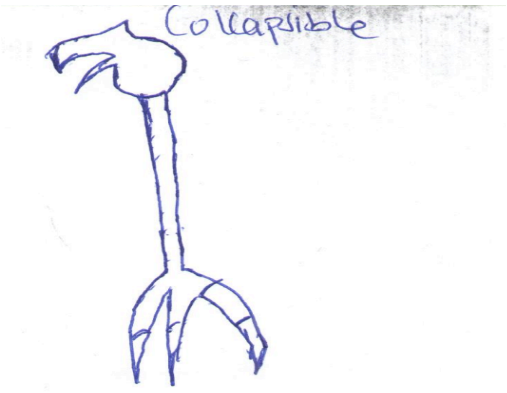


Figure 14: Collapsible design

## *4.10 Design #10: Odontomed*

Finally design number ten that was considered design was Odontomed design. It is a design that the people with disabilities could use it to pull the solid material up from the ground. It can pull up everything from the ground, but it depends how the user strong is, but it is not easy to use for the disability

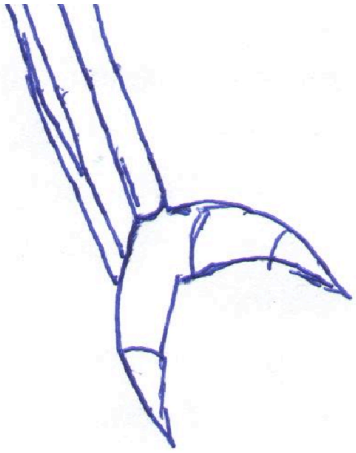

Figure 15: Odontomed design

# 5 DESIGN SELECTED

All the 10 considered design were studied. Each of the designs was analyzed with respect to the customer requirements as well as the engineering requirements. This design should be follow what the customer needs and applied our engineering requirements. As we did in design considered for the 10 designs. Each one has different idea and different way to use. So we need to figure out which one is better and can follow our customer needs. The best design we might to follow from design considered is design 1, design 3 and design 4. Because this is the best designs and we want to work with it. We chose these three designs because when we looked at the customer requirement, we figure out the three designs are meeting the CRs. Such as the safety, length change, angel change…etc.

## *5.1 Rationale for Design Selection*

The table 5 below provides a detailed Pugh chart that will compare each of the proposed designs with respect to the customer requirements and will help in selecting the best three designs.

Table 5: Pugh Chart for Selecting of the best designs

| **Criteria / Design #** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Light weight** | + | + | + | + | + | + | - | - | - | - |
| **Length change** | - | - | + | + | - | + | + | - | - | + |
| **Easy to set up** | + | - | - | + | - | + | - | - | - | - |
| **Easy to use** | + | + | + | + | - | - | + | + | + | + |
| **Safety** | - | - | + | - | + | - | + | - | - | + |
| **Angle change** | + | + | + | + | + | - | - | - | + | - |
| **Size change** | + | + | + | + | - | - | + | + | - | + |
| ∑ + | **5** | **4** | **6** | **6** | **3** | **3** | **4** | **2** | **2** | **4** |
| ∑ - | **2** | **3** | **1** | **1** | **4** | **4** | **3** | **5** | **5** | **3** |

The Pugh chart shows that the design #1, #3 and #4 are more suitable for the existing project and it fits well with the customer and the engineering requirements. Design #3 and #4 are most suitable for the required design. The selected designs were further confirmed through the decision matrix as shown in table 5.

The selected design is light weight making it easier to handle and use and exerting less effect on the user's hand. Also, a handle built in the design makes it easier and comfortable to use. The flexibility to vary length of the arm brings the objects closer to person so getting the work done with minimum possible movement of the person having disabilities.

Table 6: Decision Matrix

| Number | Customer Requirements | Weightings (%) | Design #1 | Design #3 | Design #4 |
|---|---|---|---|---|---|
| 1. | Light weight | 15 | 4 | 5 | 5 |
| 2. | Length change | 20 | 3 | 7 | 5 |
| 3. | Easy to set up | 10 | 3 | 6 | 5 |
| 4. | Easy to use | 15 | 6 | 6 | 4 |
| 5. | Safety | 10 | 4 | 2 | 4 |
| 6. | Angle change | 15 | 2 | 4 | 8 |
| 7. | Size change | 15 | 4 | 4 | 6 |
| **Total** | | **100** | **26** | **34** | **37** |

The decision matrix shows a good comparison of the individual selected design against the customer requirements. A weight was given to each of the customer requirements and was compared against the design capability of the selected design. The comparison was carried out in a strict manner and minimum possible weights were given for each comparison. The result shows that design #4 fits the requirements better than the other proposed methods.

## *5.2 Design Description*

People having disability have special needs to do their daily chores. Such chores which are very simple and easy for a normal person sometimes become very difficult even impossible to perform for the person with certain disabilities. The disability of lower limb makes the motion of upper body very difficult. If a person with such disability has to grab something from the floor he needs special equipment like Stick Holder to pick it up. Such people usually are on wheel chairs and it even becomes more cumbersome to pick something while sitting on the wheel chair.

As shown on the CAD (Figure 19 & figure 20) our design aims to help people with disability. So, our design comprises of four important parts namely, handle, Trigger, Lock button, outer shaft and Extender button. These three components are essential for the stick holder design. The strength of these individual components will be confirmed through analysis software as well as through experimental tests.

### 5.2.1 Handle

The handle of the stick holder is the important part and is the portion that is dealt by the user. The handle is supposed to be soft and must not harm the user. It should be sufficiently rough so that it does not slip from the user hand. A high-quality plastic with rubber lining is a preferred choice. The plastic handle can be glued together to a rubber sheet to improve the handling.

### 5.2.2 Trigger Lock

The trigger lock is the portion of the handle as operated by the user to lock the stick holder for avoiding the slippage of the object that is holding. Once the object is held in between the stick holder jaw, the user will have to operate the lock. The trigger lock can be made through a sliding mechanism. It can be a simple sliding latch like arrangement.

### 5.2.3 Outer Shaft

The shaft of the stick holder has to be a Flat bar with sufficient strength. Aluminum or its alloy can be used for the fabrication of the outer shaft. Components such as inter shaft and grabber teeth has to be appropriately adjusted to get the required strength.

### 5.2.4 Extender Button

It is essential to have an arrangement so as to extend the stick holder. A telescopic arrangement with lock provisions can be made to design the extender in the stick holder. Two concentric tubes can be made to lay one inside another. The inner tube will project out as set by the user and provisions for locking the inner tube at certain predefined intervals can be set.

The design is about 80 cm length and the size is divided in two parts:

1- From the handle to the end of the outer shaft 50 cm.

2- From the begging of the inter shaft to the end of grabber teeth 30 cm.

These parts are connected to each other when the user pull the trigger, the grabber teeth would grip the object, after that the user could click the lock button to make the grabber teeth still holding the object. Also, the users could change the length because in inner shaft are three holes that for the length changes. The users could push the extender button that on the handle the flat bar that on the outer shat goes up, so that makes the inner shaft release and slid down or up. When the users choose which size they want they remove their fingers from the extender button.

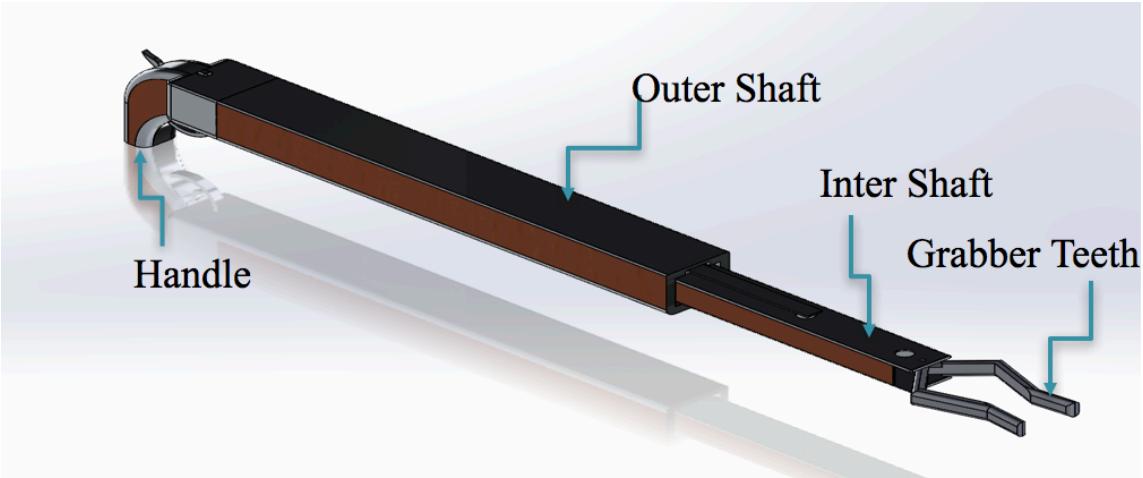


Figure17: Model Isometric View

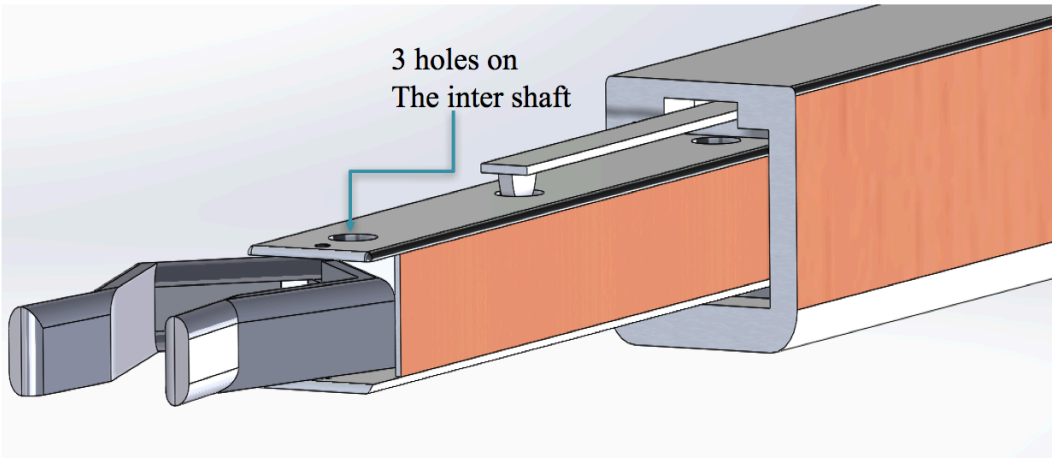


Figure18: Close up View of Clamp Jaws

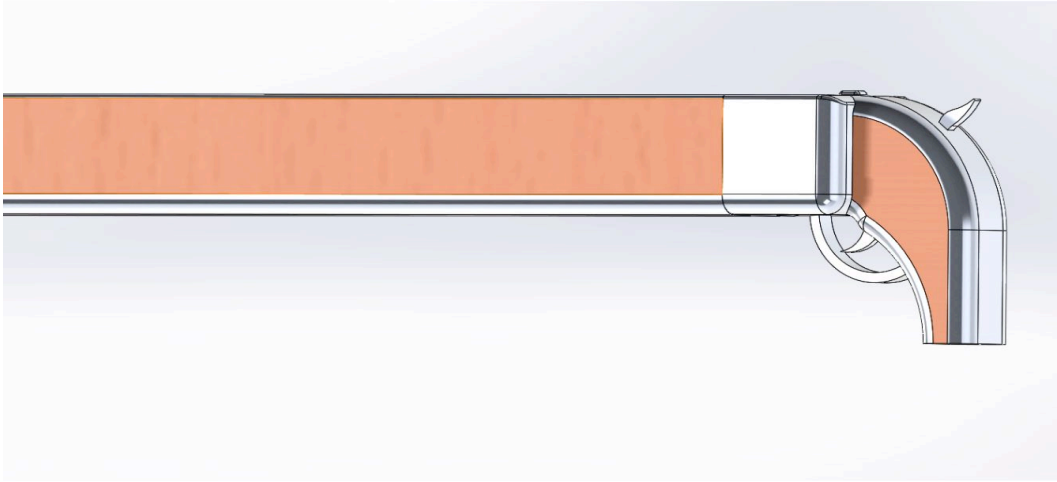

Figure19: Close up View of Handle and Actuating and locking lever

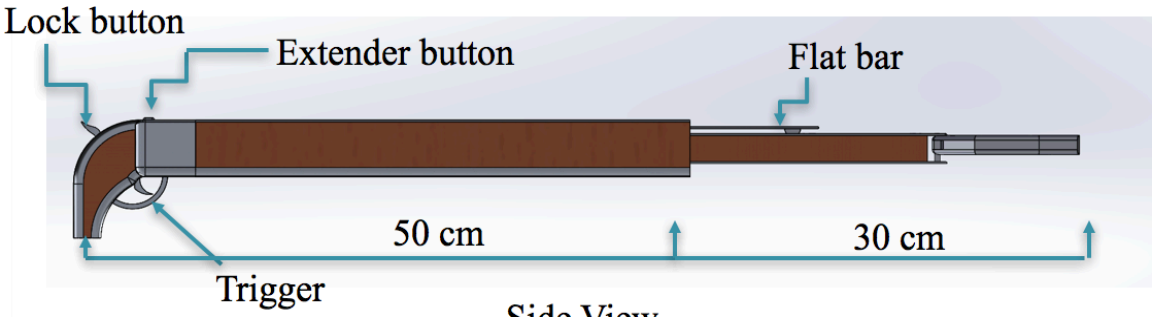


Figure20: Model Front View

# 6 Proposed Design

## 6.1 Intended Design Construction

As a team, first we have to do a prototype for our design which would look like our final design. Our prototype would be made of cardboard because it is easy to make and curve. When we finished the prototype, we looked at the mistakes that the design had. After that, we fixed it. Then we have done our CAD by following the correct dimensions, next we have to print our CAD on 3D printer so that we can go to show our client how the final design would look like.

The CAD can show all dimensions and size for each part for the device which will help us when we do the final product. We need to make another prototype using different part from some stores like HOME DEPOT and some online sources like AMAZON. So, we can made our final design by using simple materiel for example plastic pipes and extended rubber. That will help us to know how this product will work and we can explain for our Client and customer how the device will be.

Most of the design construction will be internal fabrication and we will be using certain tools to do them. The tools used will be mainly cutters, pliers, wrenches, riveters and spanners. These tools will be used to fabricate the handle and the trigger lock portion.

## 6.2 Materials

The selection materials for construction of different stick holder parts are the important consideration for the design. The material must be lightweight with sufficient required strength.
The stick holder has three main parts the frame, the holder and the handle. Aluminum and plastic will be good choose for make the device light weight.

### 6.2.1 Frame-Aluminum

The frame has to be light weight and aluminum is the best of the available options. This metal has low density and sufficient strength. The weight is lesser and has excellent corrosion resistance. The properties of this metal makes is suitable for its use in stick holder.

### 6.2.2 Metallic Holder with rubber bush

The holder of the stick holder will be made of specialized rubber that is hardened to have sufficient strength. It must hold the object without slipping. Silicon based rubbers can be the excellent choice for fabrication of the holder. The saw tooth arrangement will be provided to hold the material of larger weights.

### 6.2.3 PVC based handle

The function of the handle in stick holder is to hold to the user and also to provide functions so as to hold the object. High quality plastic has to be used for the PVC handle and the strength has to be sufficiently large. The PVC is the best choice as it can give maximum comfort to the user. The PVC part can be made rough to improve the friction and the grip.

### 6.2.4 Bill of Materials

We need to collect some of materials that we need for our project. Our budget for this project is $2000. We can buy some part and test it to see if this part works very well before we use it in the final product. That will help us in the second semester when we start build the final device. We will collect this part from some different sources to start build the new prototype and test it. We need to buy some springs, aluminum shaft, trigger, flat bar and rubber. Also, there are some part that we need to manufacture. For the handle, we did not find in any source. So, we need to make our handle with our dimensions. Maybe we need access to machine shop (98C). we will try to make some parts during the holiday. First, we will start build the shafts, the inner and outer shaft. Because these parts is the most important part for the device. The other parts for the device will be build based on this two shaft. Because all parts connecting to these parts. We need some tools to build our device such as drive screes, bolt cutter and meter ruler to measure our device's length. For building our device we will need both power and hand tools. We need power tools to cut and manufacture some small parts. And for the hand tools we can set up our project and assemble all the part together. We will start build the handle because it's need sometimes. Making the handle need between 2 and 3 weeks in the machine shop. When we have all parts ready, we can make it ready in one week. Our team will start collecting parts and manufacture part we need. In the begging of the second semester most of parts that we will make it will be ready, so we can buy to rest and start building. The device will be ready in the mid of the second semester.

Here is our bill of materials:

Table 7: Bill of materials

| Part | Source | Quantity | Cost | Tax | Total |
|---|---|---|---|---|---|
| 1- handle with trigger | Bed Bath and Beyond | 1 | $19.99 | 5.6% | $ 21.11 |
| 2-Flat bar | Home Depot | 2 | $4.28 | 5.6% | $ 9.04 |
| 3- Aluminum square tube | Home Depot | 1 | $19.54 | 5.6% | $ 20.63 |
| 4- Aluminum square tube | Home Depot | 1 | $15.31 | 5.6% | $ 16.17 |
| 5-Screws | Home Depot | 10 | $3.54 | 5.6% | $ 37.38 |
| 6-Springs | Home Depot | 2 | $3.98 | 5.6% | $ 8.41 |
| 7- Rubber | Home Depot | 2 | $1.95 | 5.6% | $ 4.12 |
| 8-Safety lock | Home Depot | 1 | $2.29 | 5.6% | $ 2.42 |
| 9- Rubber thread | Amazon | 1 | $10.99 | 5.6% | $ 11.61 |
| 10- Shipments | | 1 | $150 | 5.6% | $ 158.40 |
| | | | | | Total: $ 289.29 |

So, our budget that we have is $2000 total, so we have estimate the cost for all the parts that we need for now and it is $289.29 including Tax. Also, the remaining Budget is $1710.71. All of this are just estimation because we still have to do the prototype, Print the design on 3D printer, and we might need some other parts that support the design.

## 6.3 Cost and Budget

The budget allocated for this work is around $2000. This cost includes the design and fabrication of the proto model as well as the final design. The cost required for the proto model is as presented in table 8

Table 8: Cost Breakup for Stick Holder prototype

| **Material** | **Cost ($)** |
|---|---|
| Materials | 289.29 |
| Manufacturing | 200 |
| Assembly | 100 |
| **Total** | **589.29** |

## 6.4 Schedule

We have created our Next semester schedule. So, we will focus on the Hardware review which is finishing 50% of our actual design, so we will work on it from Jan/15/2018 to the due date. and we need to meet our client to discuss about our project if there is any change should be in the project. After the meeting with our client and likes the project we will complete the rest of the project. So, we would like to finish our project by the beginning of March. The next semester schedule shown below:

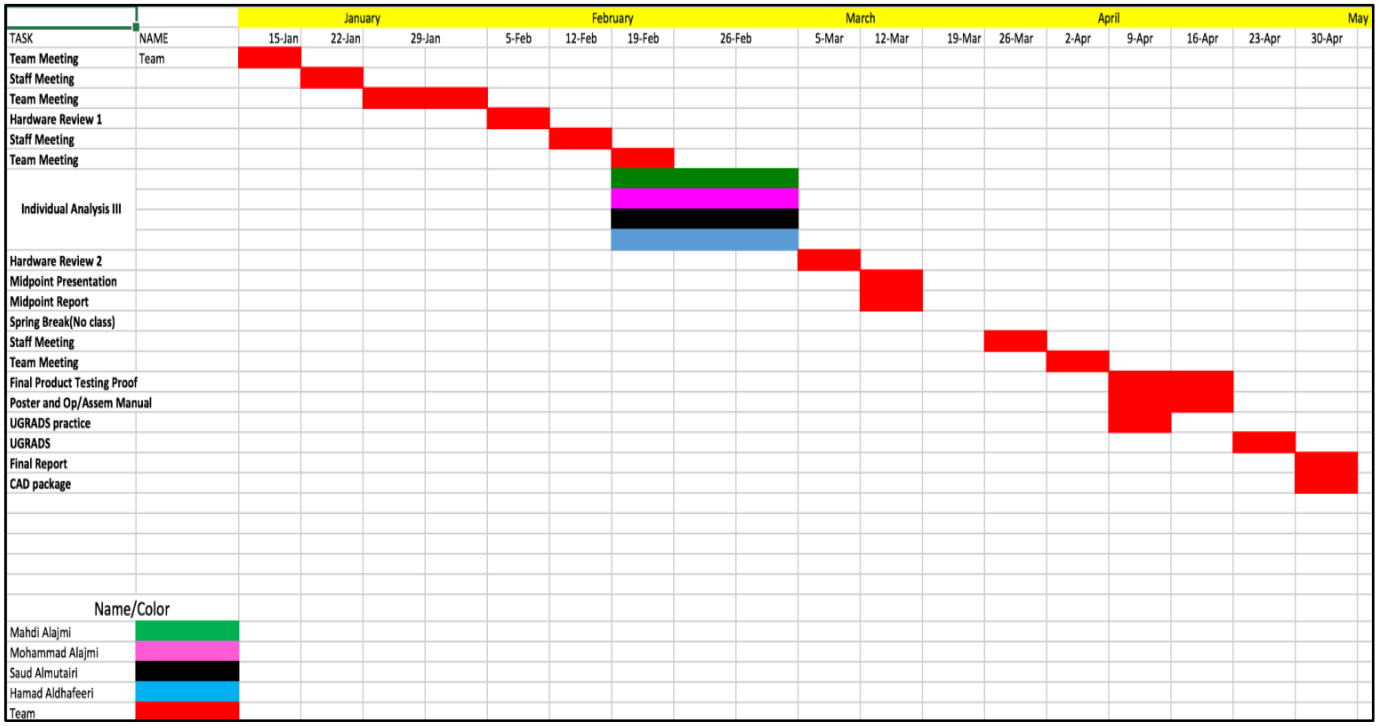


*Figure21: Gantt Chart for Schedule*

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