Design of Handle Bar for Tricycle

Design Project I
MVD I- 26

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BOMBAY 2016

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APPROVAL SHEET

This Mobility and Vehicle Design project report entitled "Design of Handle Bar for Tricycle", by Shreyas Ganesh Barve is approved in partial fulfilment of the requirements for Master of Design degree in Mobility and Vehicle Design.

Project Guide:-

Date:-

Place:-

ACKNOWLEDGEMENT

I would firstly like to thank my guide, Prof. Nishant Sharma for the support and valuable inputs that he has provided during the course of project.

Last but not the least, I would like to thank my family and all my dear friends at IDC and from other places for being a constant source of support and inspiration throughout the project.

Shreyas Ganesh Barve
Date:-

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Background Study

With the use of three wheels balancing is not required but on the other hand three wheels create more frictional force that user has to overcome.

Due to increased friction, effort required to move the vehicle from speed of zero is difficult, with existing cycling system. In existing cycling motion user apply pull force with one hand and push with the other. Same system in tricycle can create some problems which can be associated with handling the vehicle as same hands used for handling are supposed to apply forces in opposite directions.

As the vehicle is designed for paraplegics, safety is given the maximum importance. To make vehicle safer it is very important to have good grip at all wheels at any point of time. Due to the position of handle it is not possible to power the rear wheels. Drive is connected to the front wheel to simplify the construction. As shown in the above diagram front wheel gets enough grip because it is connected to the drive and at rear users body weight is enough to provide enough traction at rear wheels. This also helps is uniform weight distribution.

Background Study

Tricycle is the ideal and most frugal mobility solution for paraplegics in our country. It is provided with all controls easily accessible to paraplegic users.

Users use their hands to power the vehicle, maneuver the vehicle and to control other accessories like gears, brakes. With the use of three wheels balancing is not required but on the other hand three wheels create more frictional force that user has to overcome. Due to increased friction, effort required to move the vehicle from speed of zero is difficult, with existing cycling system. In existing cycling motion user apply pull force with one hand and push with the other. Same system in tricycle can create some problems which can be associated with handling the vehicle as same hands used for handling are supposed to apply forces in opposite directions.

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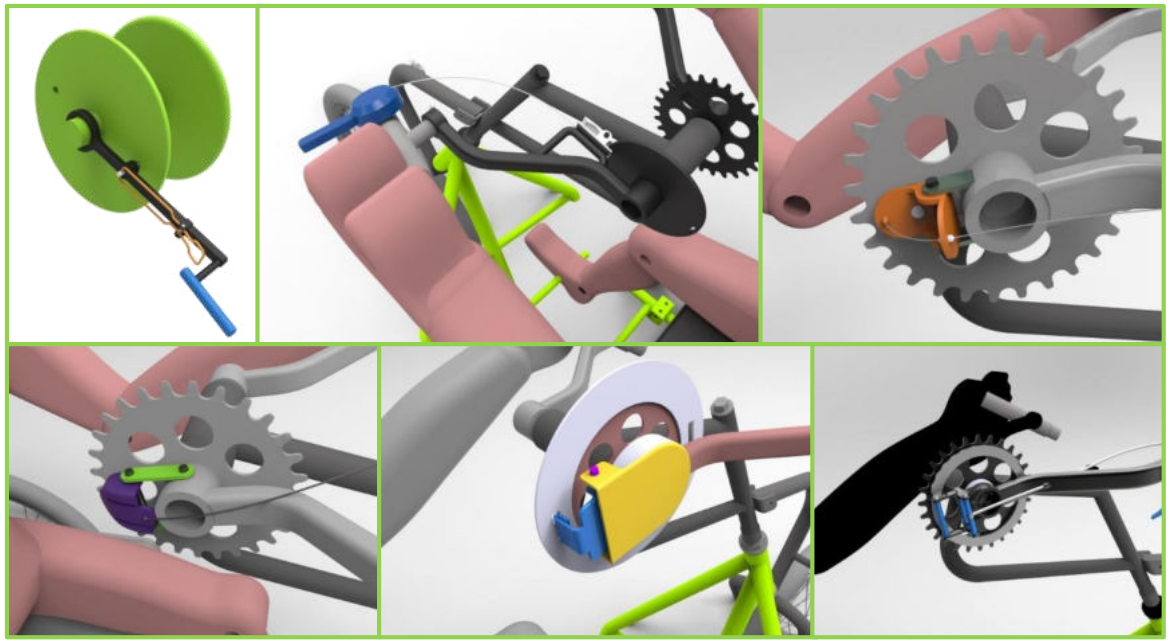
Objectives

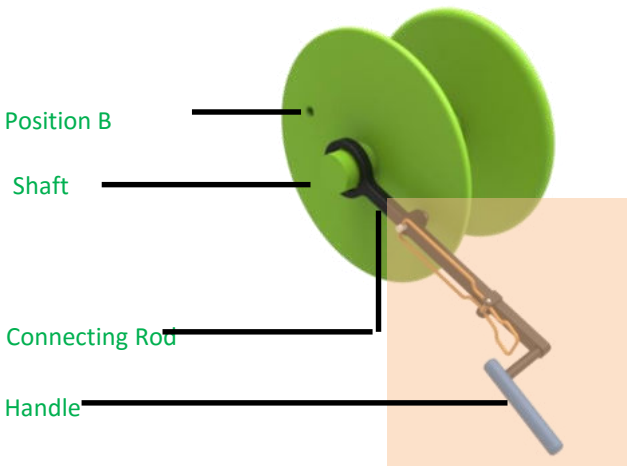
- The objective of this project is to improve the overall user experience of the existing Tricycle for Paraplegics.
- After study of the existing vehicle I found out few areas where I can work and improve the quality of user experience.
- Improving quality of user experience includes reducing the effort required for using the product, providing more flexibility to the users, give physical comfort to the user and also to enhance its aesthetic value.
- Keeping in mind above objectives I worked in following areas.
- Design of Clutch Mechanism
- Design of Handle Grip.

Design of Clutch Mechanism



In the existing Tricycle user is provided with only one action that is rowing as shown in the diagram. This arrangement allows user to apply more torque at the start. As vehicle is Tricycle more effort is required to move vehicle at the start. Rowing action allows user to start moving the vehicle but rowing for longer duration user will experience more fatigue. A simple clutch mechanism will allow user to shift from rowing to simple cycling action.

Concept A



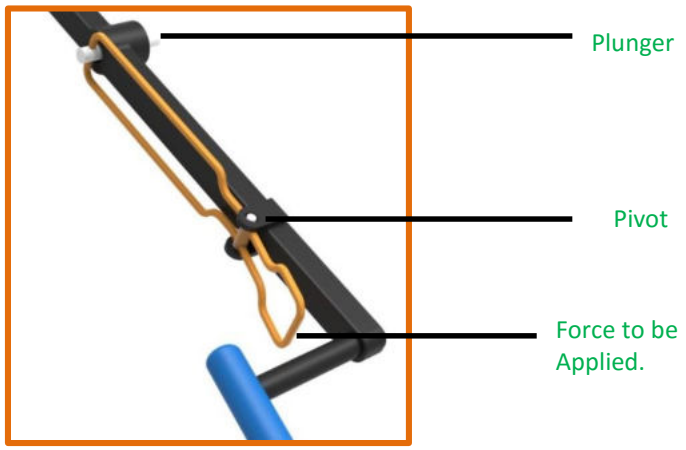
Construction

The system consist indexing wheel attached rigidly to the main shaft. Wheel is provided with 2 holes positioned at an angle of 180 deg to each. Connecting rod is mounted on shaft such a way that it is only allowed to rotate along the axis of shaft. Lever mechanism consists of plunger at one end , pivot in the middle and trigger at the other end.

Working

When user wants to shift from rowing to cycling or cycling to rowing he/she will press the trigger laterally. Lateral movement at trigger end will lift the plunger out of position A hole. Now connecting rod is free to rotate in clockwise or anticlockwise direction. User will leave the trigger as soon as the plunger is disengaged. Now as user rotates the handle, plunger will slide against the disc. As plunger reaches the Position B , plunger will enter in to the hole at position B because pivot is provided with torsion spring.

Concept A



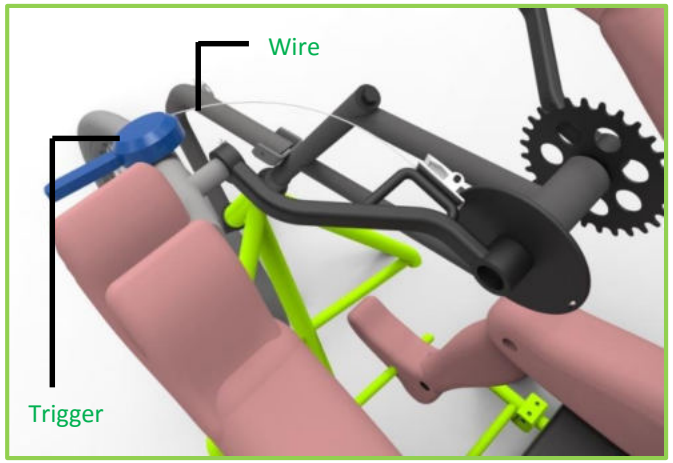
Advantages

- Rigid link between trigger and plunger provides reliability to the mechanism.
- By manipulating the length of lever and position of pivot force to be applied by user can be adjusted.
- Construction is very simple and reliable.
- Minor modifications are required in the existing system reducing the cost.

Disadvantages

- User need to change the position of hand to operate the trigger.
- Trigger adds to the existing controls provided on handle making it more complex.
- There is a possibility that cables connecting different controls can trap in the current mechanism. This effect reduces the reliability of the system.

Concept B



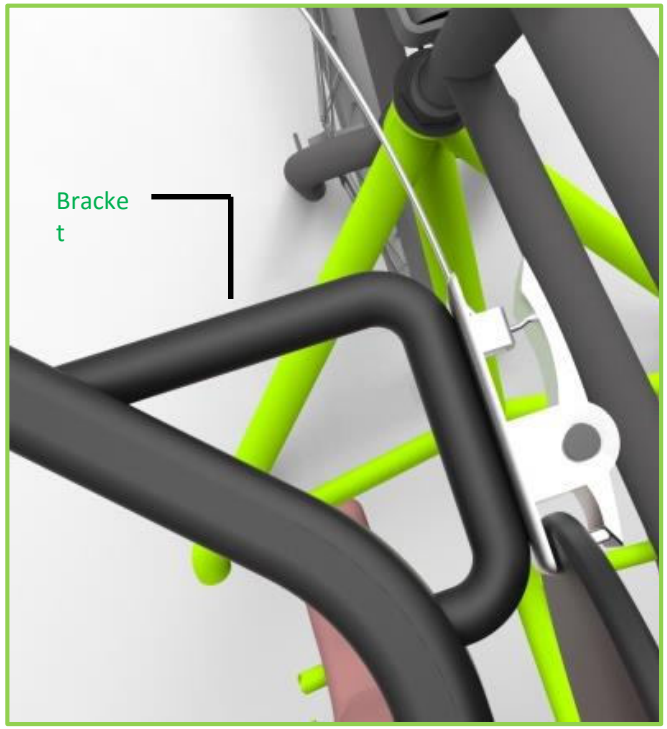
Construction

Elements of this system are almost similar to break system used in current ordinary cycles. Main shaft is provided with positioning plate. Plate consists of 2 holes representing 2 possible positions of handle. System contains clamp positioned close to the positioning wheel and trigger is positioned on the handle. Both elements are connected to each with the help of a cable.

Working

In normal condition the clamp will firmly hold the plate at any of 2 positions. When user wants to switch from cycling to rowing or rowing to cycling he/ she will pull the trigger, movement will be transferred to the clamp through wire. Movement of cable will unclamp the clamp. Now handle is free to rotate in any direction. Now user will move handle to the alternative position, clamp jaws will simply slide across the positioning plate and enter in to the hole at other position.

Concept B



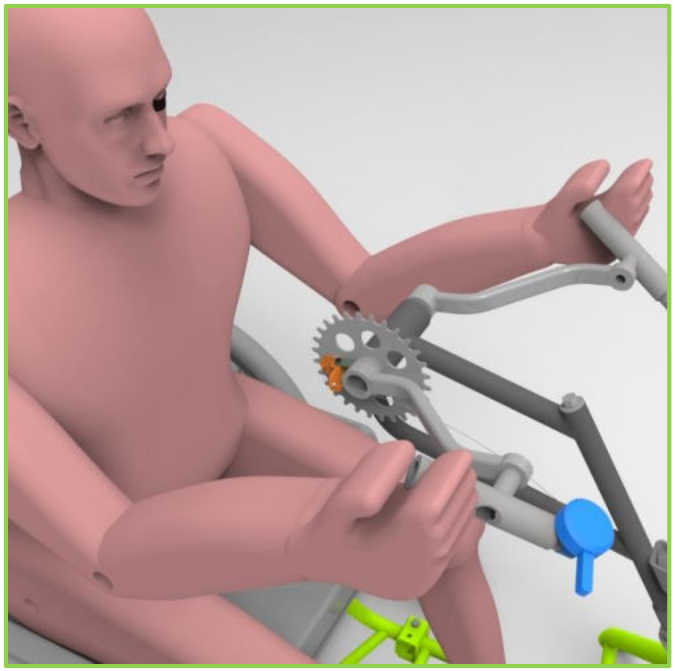
Advantages

- The construction is very simple.
- Many components can be borrowed from current bicycle brakes and gear systems.

Disadvantages

- Current vehicle already consists many other controls mounted on handle connected with cables, 1 more cable in the system will make operation more complex.

Concept C



Construction

System consist one L shaped bracket mounted on existing handle bar assembly. Bracket is mounted such a way that it can rotate at its linkage with existing handle. L shaped bracket is connected to the trigger with the help of cable. Bracket is also provided with plunger.

Working

When user wants to switch the position he/she will pull the trigger lifting the bracket. This will disengage the handle with the main shaft. Now user can rotate the handle to the other position to engage with the other position. Plunger is rigidly mounted on the bracket itself.

Concept C

Advantages

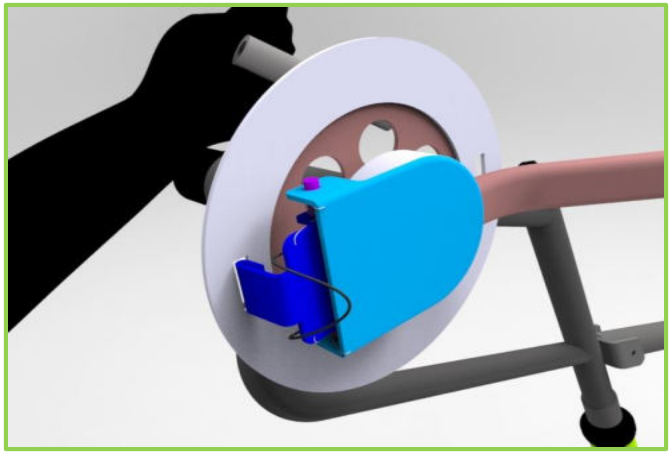
- NO need of extra positioning plate. Sprocket wheel itself can be used as positioning plate.

- The construction is very simple.

Disadvantages

- Current vehicle already consists many other controls mounted on handle connected with cables, 1 more cable in the system will make operation more complex.

Concept D



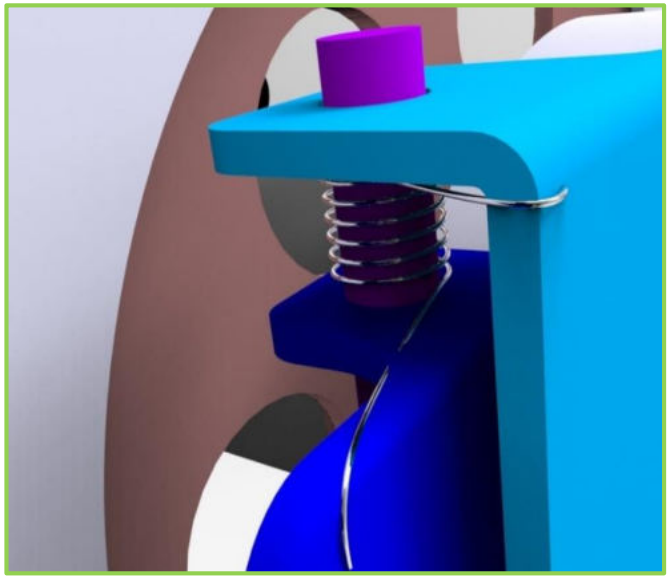
Construction

The system consist basically 2 metal brackets. Common pin passes through both plates. Pin forms a rotary joint between two plates. Rotary joint is provided on both sides of moving plates. Moving plate is also provided with bent wire wrapped around to form a handle.

Working

Unlike previous mechanism the trigger is provided at the axis of rotation itself. In running condition the torsion springs placed at two ends of pin will keep the moving plate engaged with the indexing plate, not allowing any relative motion between the moving plate and indexing plate. When user want to change the style of powering the vehicle, he/she will pull the handle out .Handle will lift the moving plate, disengaging the moving plate with the positioning plate. Now the handle is free to rotate around the axis of main shaft. During the shift the moving plate will slide against the positioning plate. At other position moving plate will engage with the positioning plate due to torsion springs provided at the shaft.

Concept D



Advantages

Position of trigger for shifting the position of handle is different. It is not provided near other controls. This will reduce the chances of user getting confused with controls.

Aesthetically mechanism looks compact and strong.

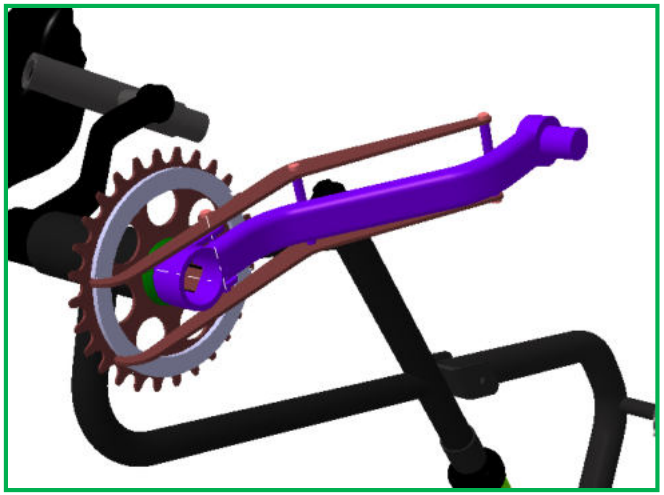
It also gives confidence to the user as he/she is directly controlling the deviation of moving plate.

Disadvantages

Every time when user want to change the style of powering the cycle he/she need to remove the hand from the grip and pull the trigger.

Lever mechanism is not implemented , so the effort applied by the user is unnecessarily high.

Concept E



Working

In this system there is no intermediate link connecting trigger and plunger. One end of lever mechanism forms a trigger and other forms a plunger. Pins are provided perpendicular to the metal brackets to provide strength to the assembly. Pin on the extreme outer end forms a trigger. When user want to change the position of

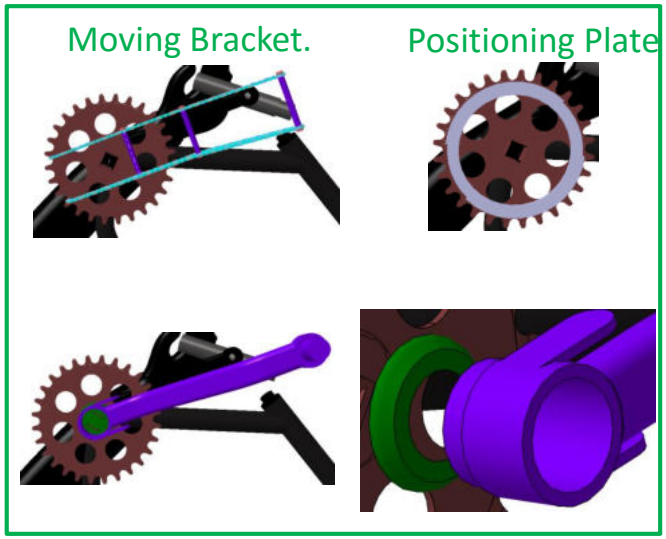
Construction

The system consist basically three subcomponents. They are as follows.

- Lever mechanism
- Rotary join
- Positioning plate

Lever mechanism contains basically two metal brackets, linked with pins and hinged to the main handle. Handle bar at the axis end is provided with metal cap threaded on the main handle body. Gap between main handle bar and metal cap is filled with ball bearings. Ball bearings stay at their position because on the free side sprocket wheel is positioned.

Concept E



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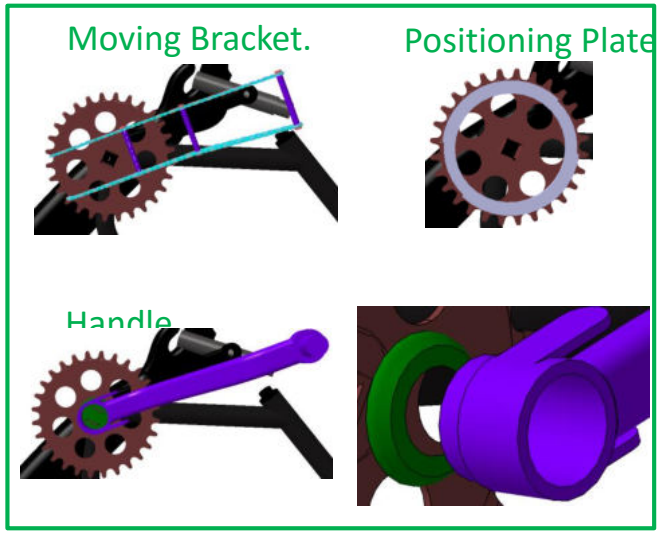


Working

In this system there is no intermediate link connecting trigger and plunger. One end of lever mechanism forms a trigger and other forms a plunger. Pins are provided perpendicular to the metal brackets to provide strength to the assembly. Pin on the extreme outer end forms a trigger.

When user want to change the position of the handle the trigger needs to be moved in Y direction. This movement will move the other end of lever mechanism out of the positioning plate. Now user can change the position of the wheel and change style of riding the vehicle.

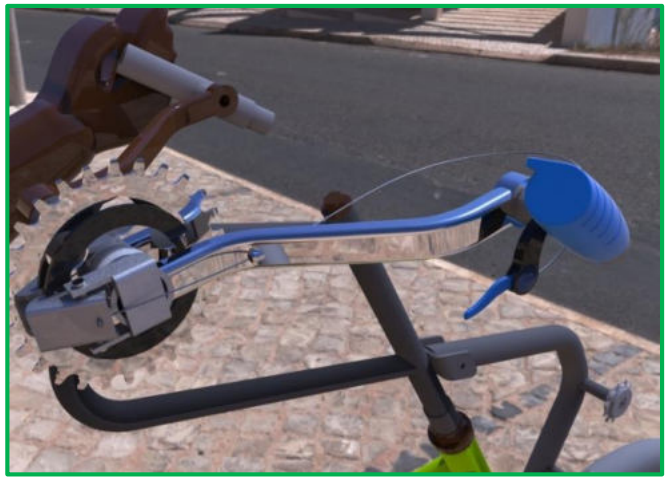
Advantages

- There is no cable involved improving the reliability of the system
- Aesthetically mechanism looks slick and light.
- As trigger and plunger are in direct link user gets direct and true response from the system.

Disadvantages

- Length of metal brackets is more, increasing the chances of deviation due to bending stresses.
- Due to size of metal links there is possibility that it might entangle with cables connecting other controls.

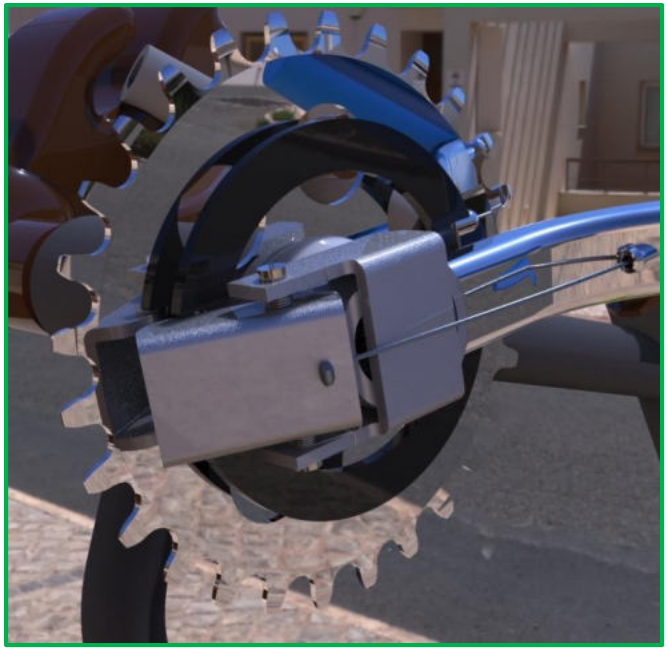
Concept F



Construction

The mechanism contains two metal plates bent to form a C section. Both plates are attached to each other by pin forming a rotary joint. Rotary joint is provided with two torsion springs. Sprocket wheel is provided with positioning plate. Rotating plate is linked to trigger. Main connecting rod is provided with threads at shaft end. Metal cap is fixed on connecting rod at threaded end. Ball bearings are placed in the space form by connecting rod , metal cap and sprocket wheel. Moving plate is connected to the trigger with the help of cable.

Concept F



Working

When user want to shift from rowing to cycling or cycling to rowing , he/she will pull the trigger. As trigger is linked to moving plate with the help of cable moving plate will rotate. Axis of rotation will be the axis of Pin. After disengaging with positioning plate, connecting rod assembly is free to rotate around the axis of sprocket wheel. As user rotates the handle and reach the opposite position torsion springs will make sure that moving plate enters the slot provided and engages with the sprocket wheel.

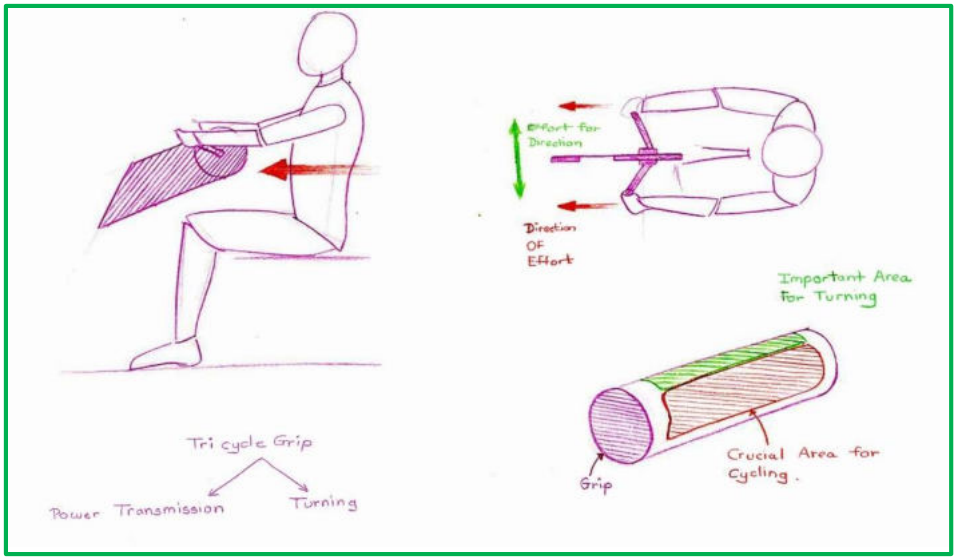
Advantages

- Mechanism is aesthetically sound.
- Effort required to operate the mechanism is lesser.

Disadvantages

- Use of cable increases the complexity of controls provided on the handle.
- There is no rigid linkage between the trigger and moving plate.

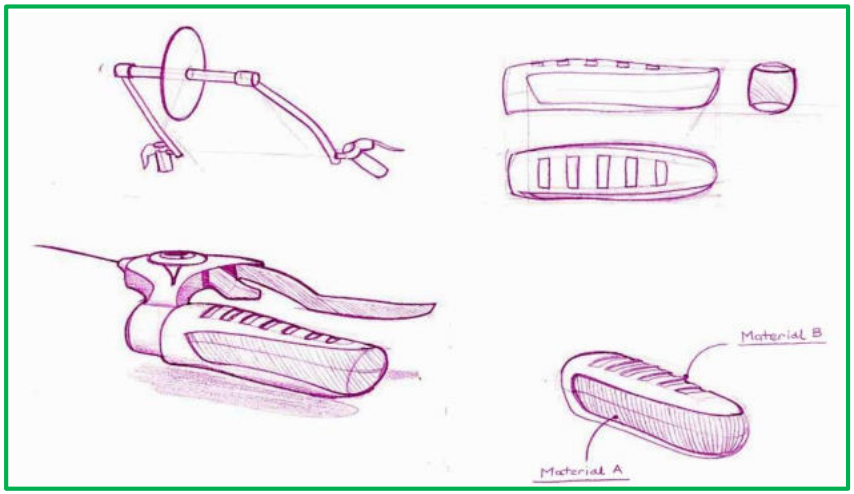
Design of Grip



The second objective of my project was to provide different alternatives for grip. I considered following points for designing the grip.

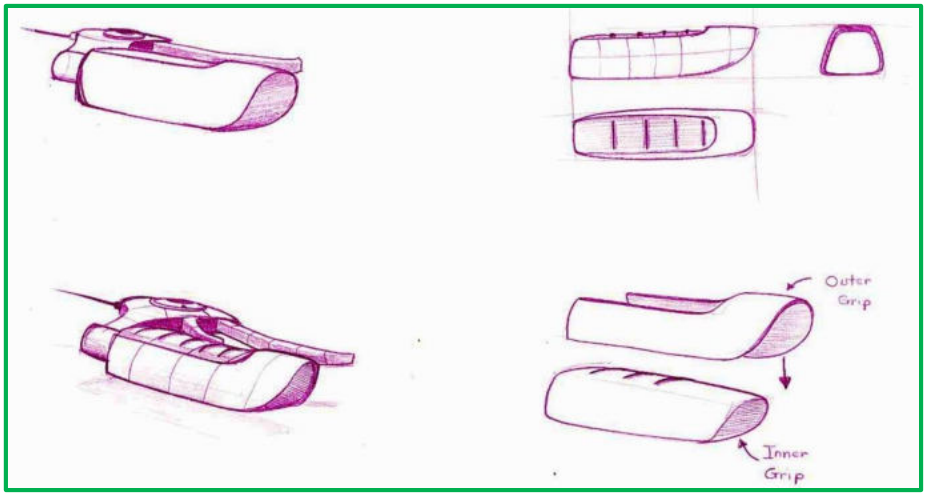
- Grip position and orientation relative to the user
- Psychology of paraplegics
- User expectations
- Surrounding conditions
- Forces applied

Concept 1



The grip in the tricycle is subjected to 2 kinds of function, they are as follows.
Force applied to power the tricycle
Force applied to maneuver the tricycle
Area represented by Material A is subjected to force applied to powering the tricycle. As shown in the following fig maximum contact area between the users palm and grip will reduce the stress developed in the user's hand. So while designing the above concept I made sure that area in contact with the palm is flat and reduces the stress in the hand.
Top face of the grip is in action when user is maneuvering the vehicle. To have better grip, face is provided with the groves. This area will make sure that hand stays in a position while turning the vehicle.

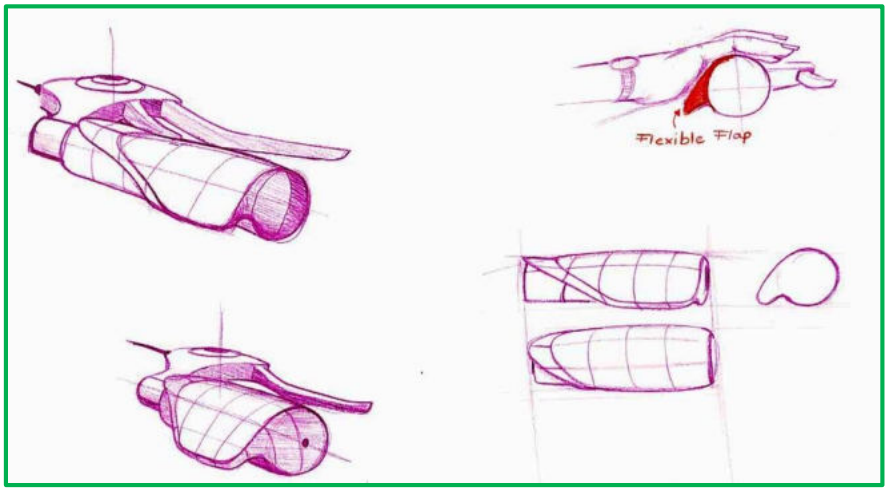
Concept 2



As mentioned in the explanation for previous concept, flat surfaces offer more area to users to apply the force while cycling the tricycle. For this concept I propose 2 different materials fulfilling two different functions. Outer grip provides the flat face for user to exert maximum force. The inner grip is exposed at the top as shown in the figure. Exposed area of inner grip is provided with grooves to allow user to hold the grip properly. It is also necessary to provide appropriate fillet at the edges. Sharp edges will be uncomfortable for user to use for longer durations and during high load.

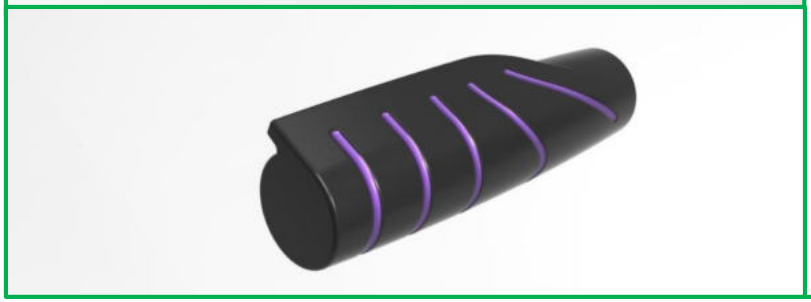
The manufacturing of such grips is slightly expensive as we are manufacturing 2 different components made up of two different material. In tricycle position of hand relative to users seating position changes every time ,so it is possible that at some positions this grip might not be comfortable for users to use.

Concept 3



This concept is based on adaptive forms. The position of handle always changes so it is important for grip to change its form slightly to provide comfort to the user. In this concept flap provided is a projection which works as a cantilever beam. This flap is flexible, so as user exerts more force on it , it will deform in a specific way so that new form comforts the user.

Final Concept



Learnings

- I was able understand all the phases associated with the project, taking it from concept to working prototype.
- Knowing different manufacturing process and their limitations is very important in design of function based products as it can avoid problems in future.
- Understanding the root cause of problem before starting the problem solving process is important.
- Priority of different functions for same product changes from user to user, as every ones point of view towards the product can change.