

Tricycle for Paraplegic

Special project

Guided by Prof. Nishant Sharma

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Declaration

I declare that this written submission represents my ideas in my own words, and where other's ideas or words have been included, I have adequately cited and referenced the original source. I also declare that I have adhered to all principles of academic honesty and integrity and have not falsified, misinterpreted or fabricated any idea/data/facts/sources in my submission. I have understand that any violation of the above will be cause for disciplinary action by the institute and can invoke penal action from the sources from which proper permission has not been taken, or improperly cited.

Signature:



Name:

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126390006

Date:

7-7-2014

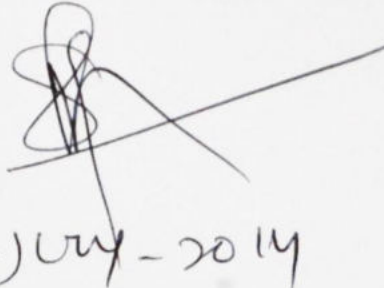
Place:

Mumbai

Approval sheet

This Special project report entitled Tricycle for Paraplegic, by Unni Mohan M is approved in partial fulfillment of the requirements for Master of Design degree in Mobility and vehicle design.

Project Guide:

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke extending to the right.

Date: 07-July-2014

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 this project.

I would like to thank my family and all my friends at IDC and from other places, for being a constant source of support and inspiration throughout the project.

Unni Mohan M

Date

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Introduction

The project idea was suggested by Prof Nishant Sharma. Professor had previously used a standard tricycle. This experience of using trike, had encouraged him to come up with a design project for providing a better designed product for paraplegic. Quick research through the market revealed that model which are available have similar layout and found to be less involving to use. The project started with studying examples from India. After preliminary research, for user study paraplegic foundation in Sion and fellowship of physically handicapped in Mahalaxmi

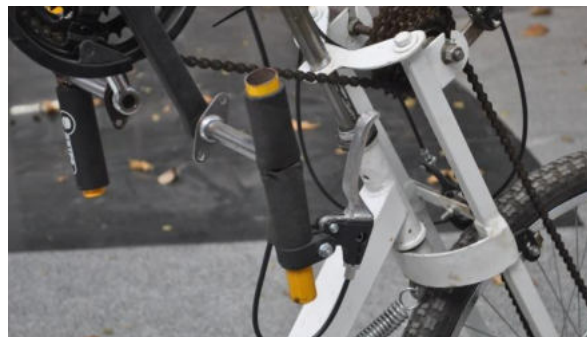
was visited. Detailed study of videos from user study enriched the team with valuable insights. This was followed by a brainstorming session to generate and group keywords. Design directions were compiled after brainstorming. These design directions were constantly referred for concept development. Initial stages of concept development was done with the help of wireframe models and CAD. Selected concept was taken up for prototype development. After two iterations a promising prototype was developed.



Prototype 2 was developed with the help of Kiran Gangadharan, who joined the project. Having good experience in fabrication, Kiran developed a civilian version of the first lab prototype.

Features-

1. Vertical handle bars with brake and gear integrated
2. Multiple mount point for seat
3. Self centering fork with spring.



Special project

Prototype-3

Design considerations

1. Drive
2. Ingress and Egress
3. Braking and protection
4. Suspension

Special project starts with discussions for the development of third prototype which can be distributed for user testing.

1. Drive

Front wheel drive and steer is used for proto1 and 2. Two sets of chains are used. Derailleur can be used for top chain or bottom chain. A combination of two derailleur can also be provided . Benefit of using derailleur in top chain is that, the chain can be accessed easily from seat in the unlikely event of chain coming out. Visually this arrangement looks heavy.

When derailleur is used for bottom chain more gears are possible because of larger chain length. The assembly looks lighter. Access of chain is not possible from seat.

Derailleur when used for both top and bottom chains, no of gears gets multiplied. This can be an option for a sportier version- built for speed and performance.



Upper section

Lower section

2. Ingress and Egress

The proto three has to offer easy ingress and egress to user depending on crutches, wheelchair and other low height mobility devices.

Other desirable characters-

- Protection for cloth
- No sharp edges
- Frame members adding up as support members for ingress and egress
- Storage of crutches, low height mobility devices
- Floor board wide enough to allow the user to sit while moving to ground



IR-1



IR-2



IR-3



IR-4

3. Braking and protection

Type of brake used in conventional bicycles.

Type-1



Most common and cheapest version of bicycle brake. Braking force requirement is higher for this type of brakes. Single mount point make the assemble loose and requires regular maintenance.

Type-2



Type two is getting more popular nowadays because of performance and reliability. Braking performance is far superior to type-1

Type-3



Disc brakes are very effective in providing good braking force. Disc brake assembly is costly and requires regular maintenance.

If brake are provided only in front wheels.

- Type 1,2 and three are possible

For brake in all three wheels

Front-

Three types of above mentioned brakes are possible

Rear-

Disc brakes can be mounted on swing arm. Type 1 and 2 requires mount points near the rim which make brake assemble complex with rear suspension.

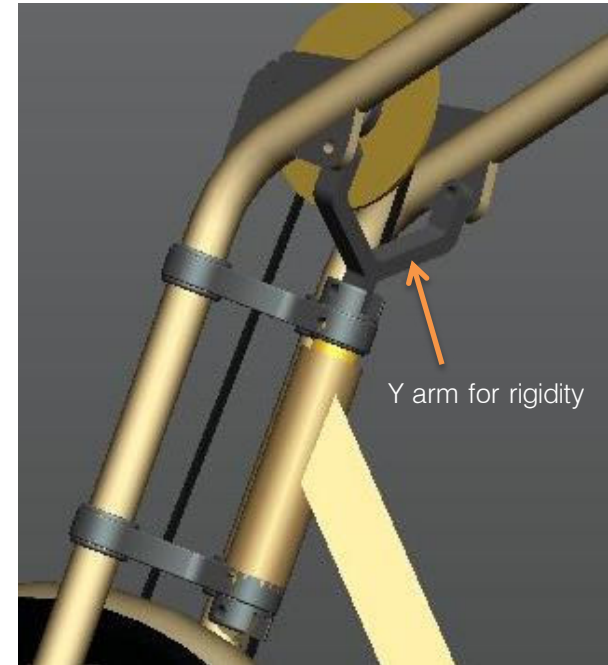
4.Suspension

Front-

For front suspension fixed forks are chosen, since front wheel are driven by chains. Following front fork assemblies are studied to generated CAD model for a new front fork which continues to pedals.



Front fork-CAD model



IR-9

4.Suspension

Options for rear suspension-

- Rigid arms
- Independent suspension

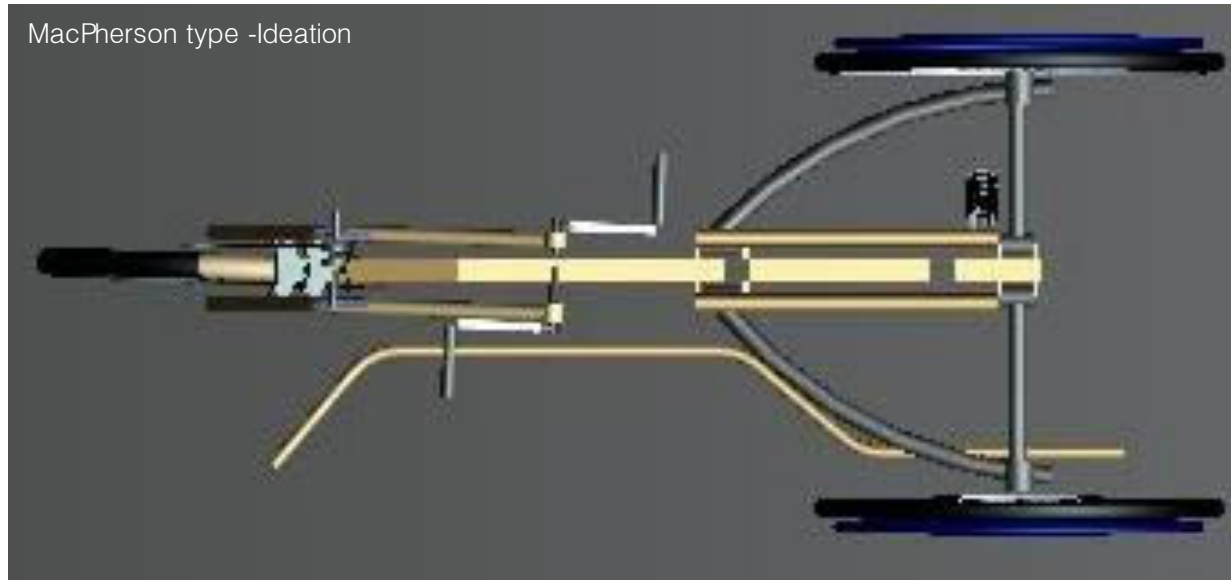
From user study and experience of pedaling prototypes suspension at rear was inevitable.

Design of swing arms for rear suspension can either be an extension of the existing designs used in regular bicycles or MacPherson strut types used in automobiles.



Bicycle swing arm.

MacPherson type -Ideation



Concept development.

Following keywords were set for frame design

LAY FLAT

Cost effective

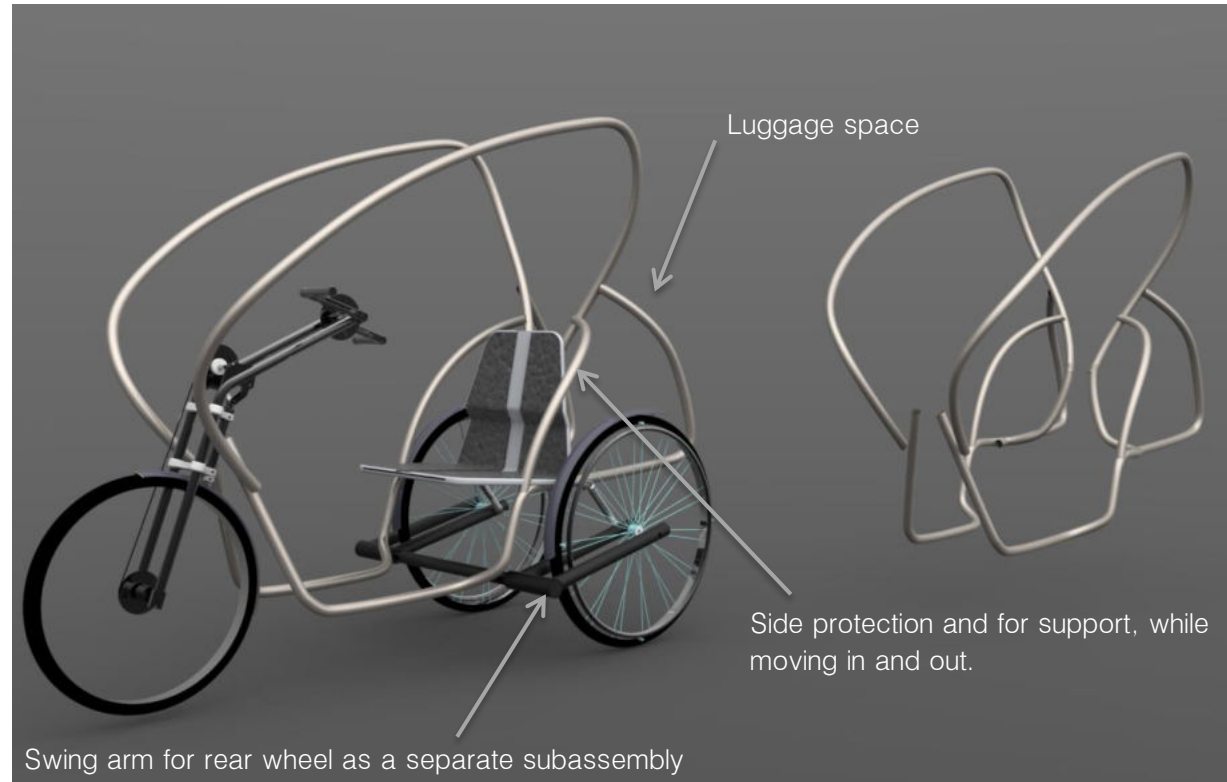
Lightweight

Ideations

Idea-1

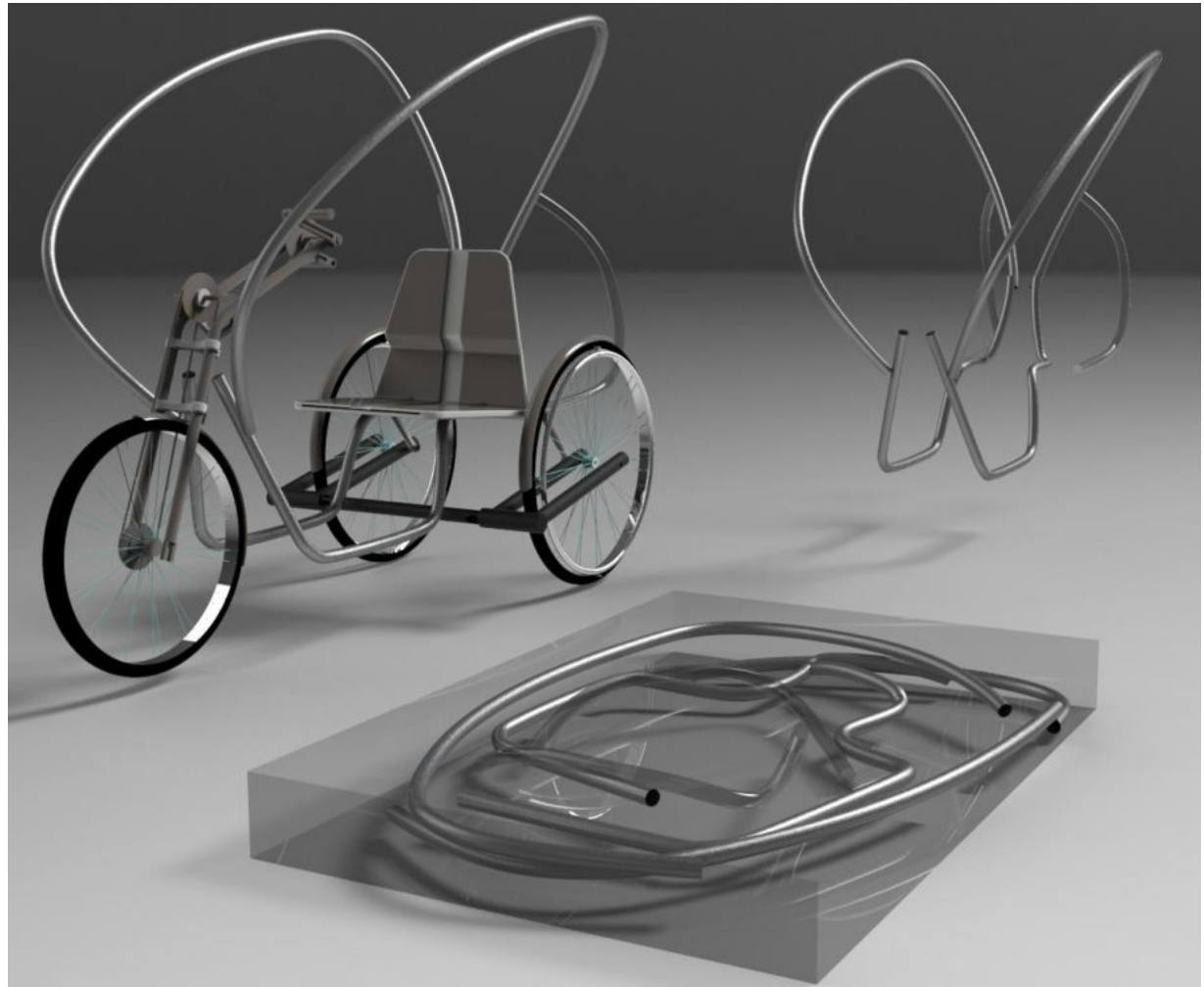
Tubular frame

- *Tubular frame joined together to give a monocoque body architecture*



Tubular frame

- *Butterfly inspired frame layout .Frame components laid flat -1m*.8m*30cm*



Idea-1.1

Tubular frame

- *Frame extended to form carrier*
- *Roof frame starts from a lower point near floor board and widens as it moves up.*
- *Idea 1 is modified to give a mature feel to design.*



Idea-1.1

Tubular frame

Front view



Rear view



- *Seat can slide to vary the reach to handle.*
- *Water proof fabric used to connect the roof frame*

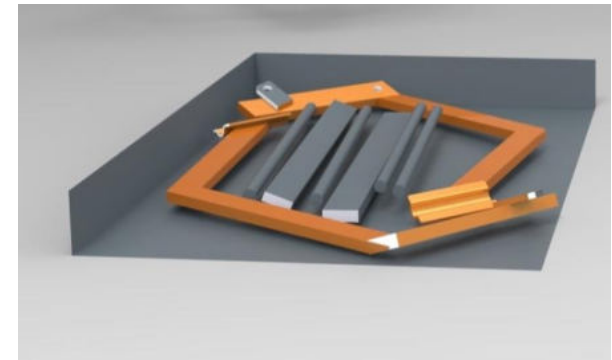
Idea-2

Rectangle frame

- *Double spine made from rectangular section is joined near the fork.*
- *Rear sub assembly joins the double spine below the seat.*

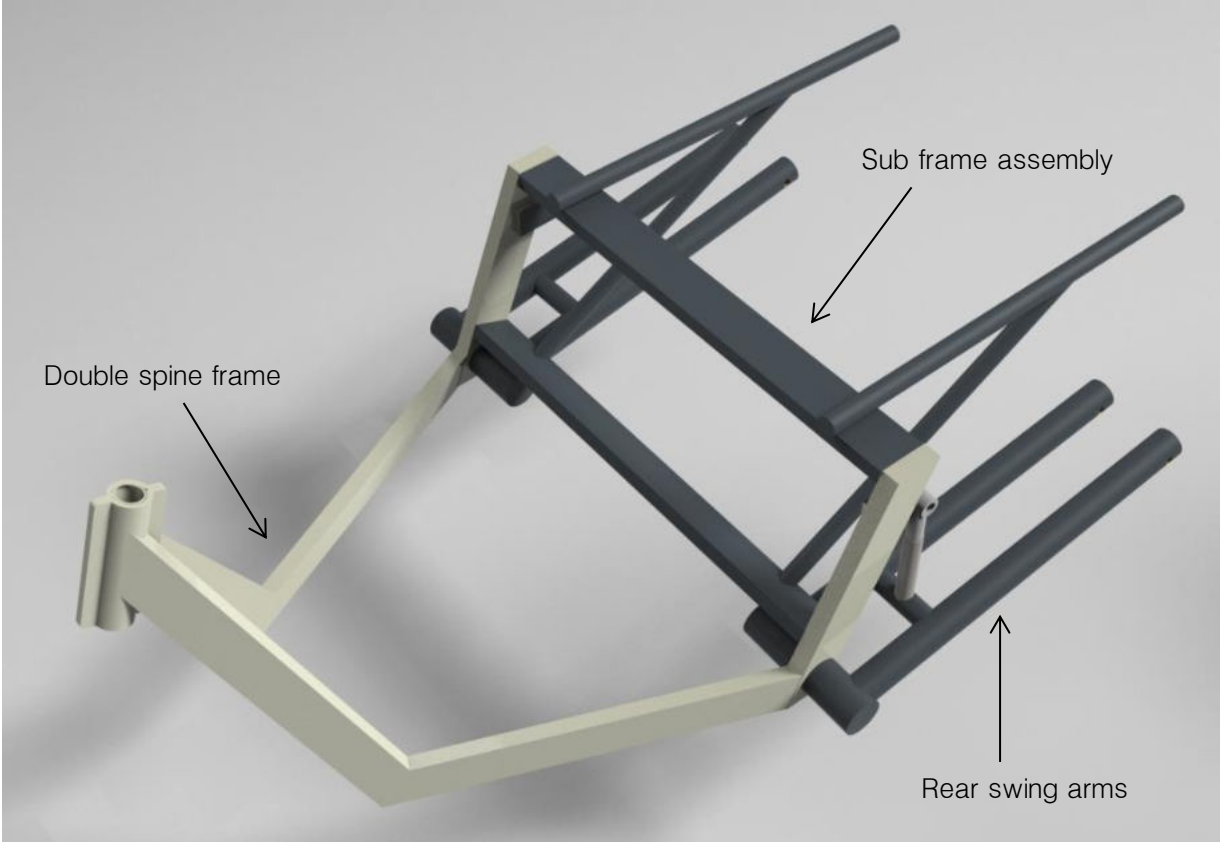


- *Images showing the chassis collapsed and laid flat .*



Rectangle frame - Details

- *Frame in detail*
- *Rear suspension is independent swing arms, hinged to spine frames*



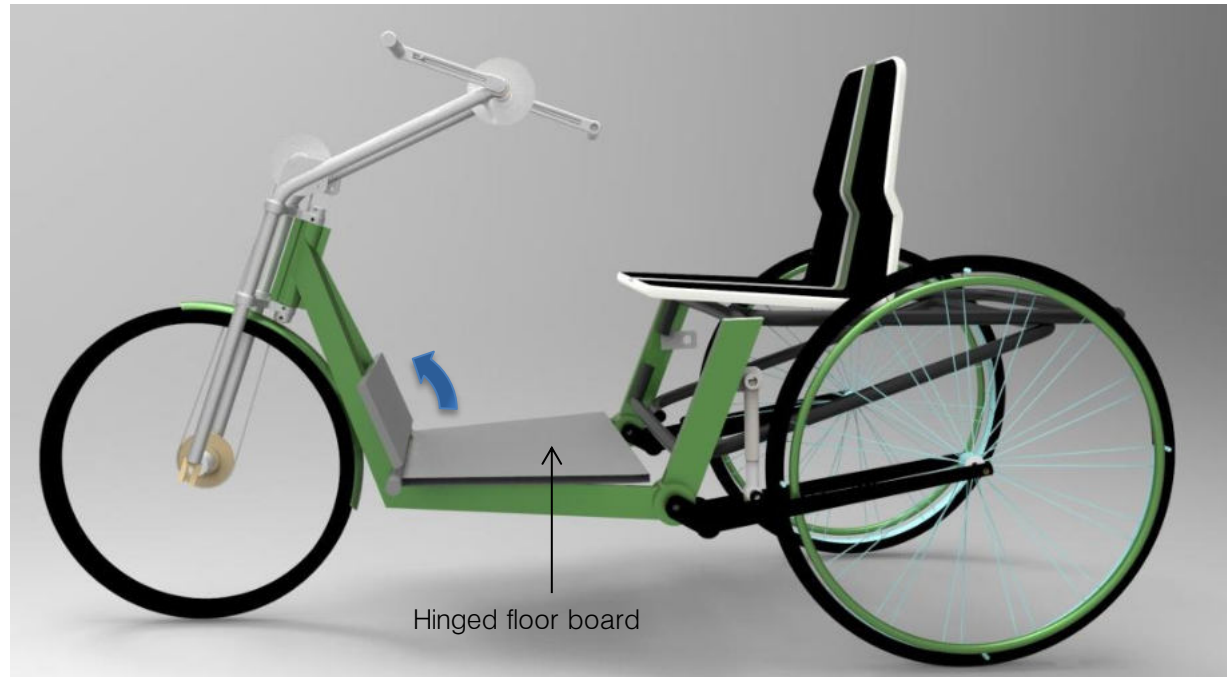
- *Rear sub frame assembly flow*



Idea-2.1

Rectangle frame

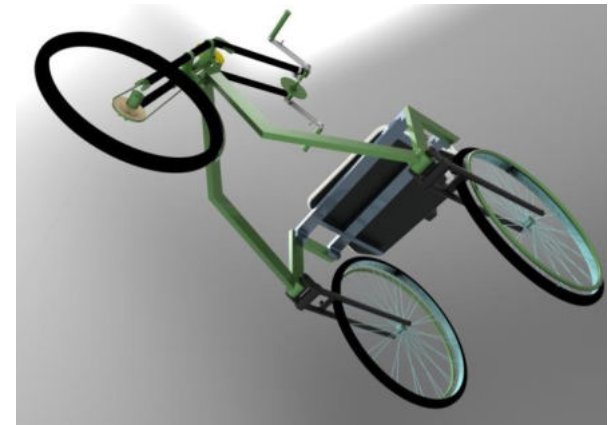
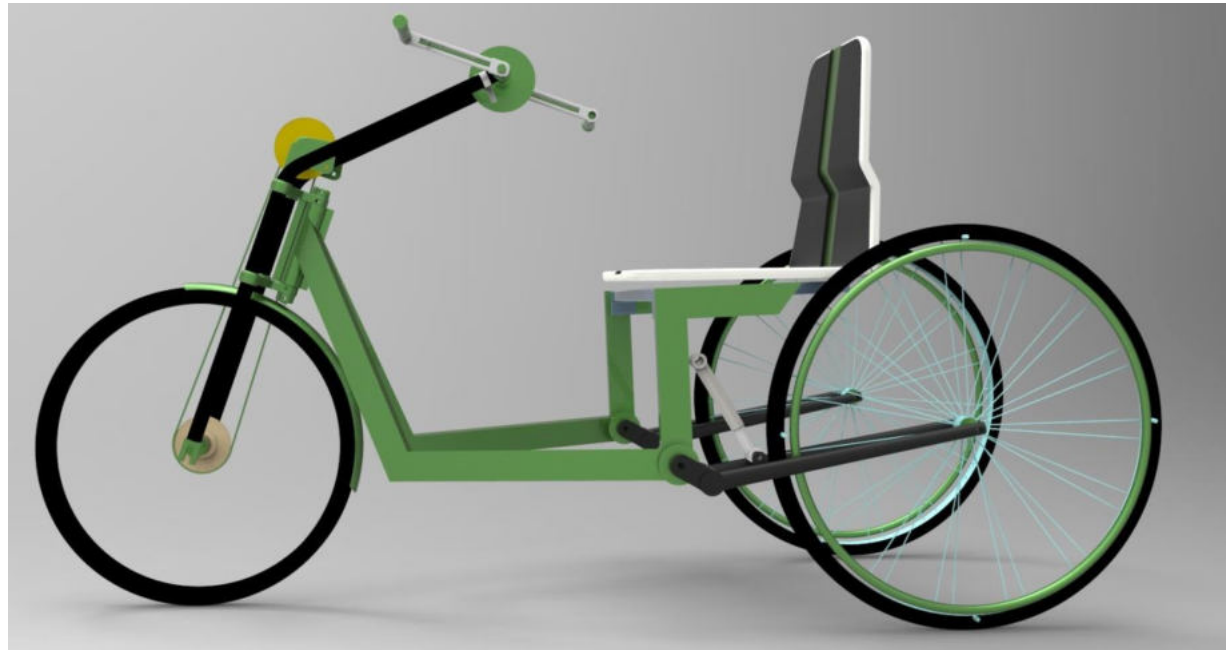
- *Rectangular frame with tilt able floor board.*
- *Once the passenger is seated the lower limbs can be secured with the tilted floor board*



Idea-2.2

Rectangle frame

- *A different version of rectangular frame without rear sub frame.*
- *The entire area behind the seat have space for customization*



Idea-2.3

Rectangle frame

- *Rectangular frame with alternate arrangement for rear suspension mount*



Idea-2.4

Rectangle frame

- *This version has a welded frame assembly with the main frame having two sections joined near the floor board.*



Idea-2.5

Square frame

- *The frame is made from square section of 40mm .The assembly is similar to idea 2.3 except square section.*



Idea-2.5

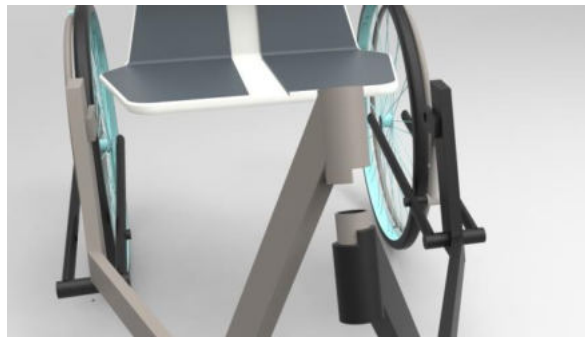
Square frame – With roof



Idea-3

Asymmetric spine design

- *An attempt on building a self locking frame with asymmetric spine frame members. The hardware to hold the fork will keep the interlocked frame in place.*



Idea-3

Asymmetric spine design – with roof



Idea-4

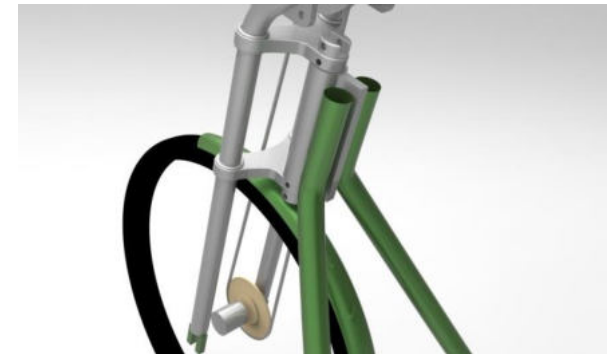
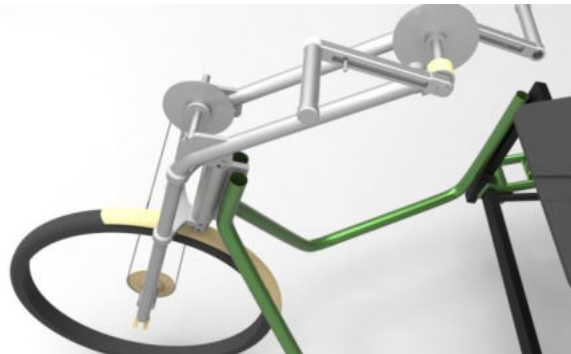
Weld free frame

- *The central twin spine elements are bolted to fork and rear sub frame*
- *Rear frame is a completely welded unit. This can also act as cage for packaging*



Idea-4

Weld free frame - details



Idea-4.1

Weld free frame - details

- *Tubular elements are bend to allow weld free joining.*
- *Joining by hardware's through holes drilled through bend frame members.*
- *Ideation has been done to bring this benefit in all joints.*



Idea-5

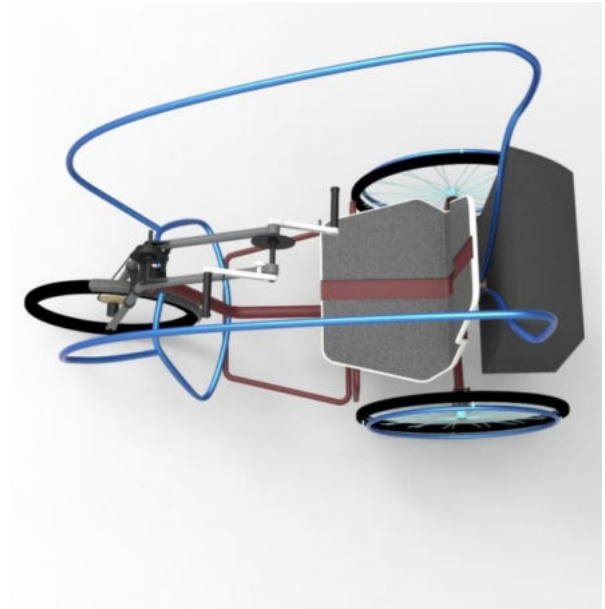
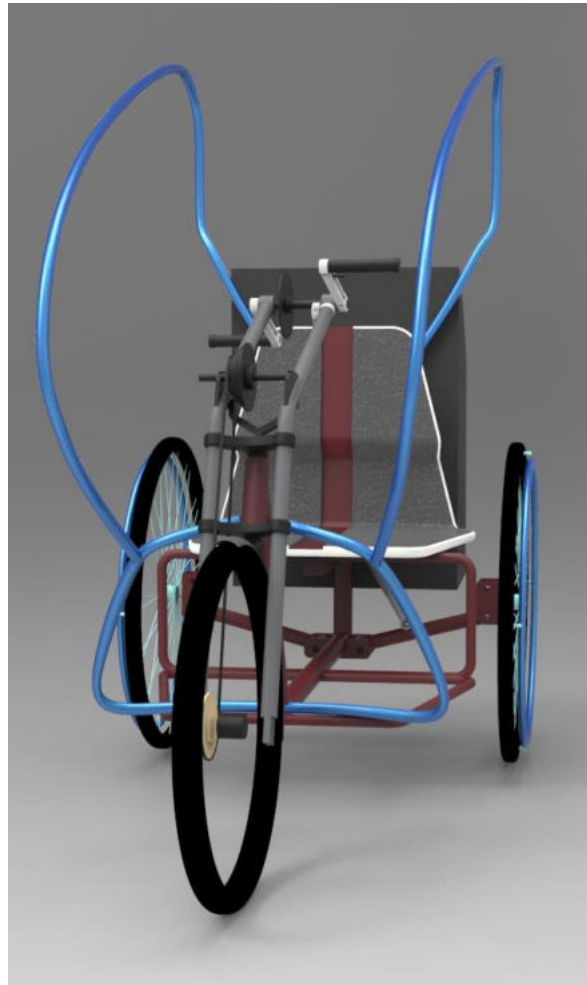
Single central spine

- *Single central spine is used. Rectangular and trapezoid sections are bolted with center spine to form a strong reinforced assembly. These members provides support for seat and also for floor board.*
- *The trapezoid frame at front helps in providing protection for legs and also helps to support roof frames.*
- *Roof members converges behind the seat and gets joined to center spine member near the seat base.*



Idea-5

Single central spine - Details



Reference

- IR-1 <http://motorised-wheelchair.com/wp-content/uploads/2011/12/commode-range-102.jpg>
- IR-2 <http://www.dinf.ne.jp/doc/english/intl/z15/z15002p2/z15002g/z1500203g18.jpg>
- IR-3 <http://www.innovativejunkies.com/images/projects/varadaan/image029.jpg>
- IR-4 <http://www.dinf.ne.jp/doc/english/global/david/dwe001/dwe001g/dwe00147g03.jpg>
- IR-5 <http://www.bicyclebrakesindia.com/images/caliperbrakes1.gif>
- IR-6 http://img.weiku.com/waterpicture/2011/11/4/13/V_brake_shoes_for_bicycle_63457_2.jpg
- IR-7 <http://upload.wikimedia.org/wikipedia/commons/2/21/BrakeDiskVR.JPG>
- IR-8 <http://images.singletracks.com/blog/wp-content/uploads/2009/06/picture-44.jpg>
- IR-9 http://i01.i.aliimg.com/photo/v0/308741889/FASTACE_front_fork_Dirt_Bike_Parts.jpg