Personal Mobility Solution for future

Product Design Project III

Submitted by:
Prajwal Janardhana Ullal
07613804

Guide:
Prof. V. P. Bapat

Submitted in partial fulfilment of the requirements of the degree of
Master of Design in Industrial Design

Industrial Design Centre
Indian Institute of Technology, Bombay.

Approval Sheet

Industrial Design Project III titled

Personal Mobility Solution for future

By
Prajwal Janardhana Ullal
07613804

is approved for the partial fulfilment of the requirements for the post graduate degree of Master of Design in Industrial Design

Project Guide:

Chairperson:

Internal Examiner:

External Examiner:

Acknowledgement

I am very grateful to my project guide Professor V.P. Bapat for providing his guidance throughout the project period and also for helping me out at various stages of the project process. I am also very greatful to him for sharing all his knowledge and also the great books from his huge collection which helped me a lot to getting into the mindset of future.

I am thankful to all other faculty members for their invaluable inputs in the form of suggestions which were poured in during different stage presentations which helped me make the product even better.

I am also thankful to all my batchmates, my parents and relatives and all my friends who helped me out at various phases of the project and also for their invaluable suggestions which led to a few improvements in the design. Also I am very thankful to our Librarians and workshop staffs for their unconditional service any time during the premises.

Index

Abstract

The project is based on providing an innovative mobility solution for the future. The project work deals with understanding and predicting upon the future scenario based on the current world trends and thus coming up with an innovative mobility solution suiting the future generation requirements.

An innovative approach was followed to handle the project which included understanding and analyzing several science fictional books, movies and also works by concept artists like Syd Mead, Scott Robertson, Simon Daniel, etc.

The process also included ideating various possibilities of a compact vehicle in form of sketches and these were further refined by making 1:5 scaled mock-up models to get the proportions right and also for better understanding of surfaces

The final concept is an innovative form of a compact bike named ‘Synxos’ (Sync-cross) which is capable of transforming itself based on the requirements.

Project Aim:

Designing a personal mobility vehicle for the youth of 2K generation

Scope of the project:

The project basically deals with providing innovative mobility solution and also a major emphasis on innovative and futuristic form

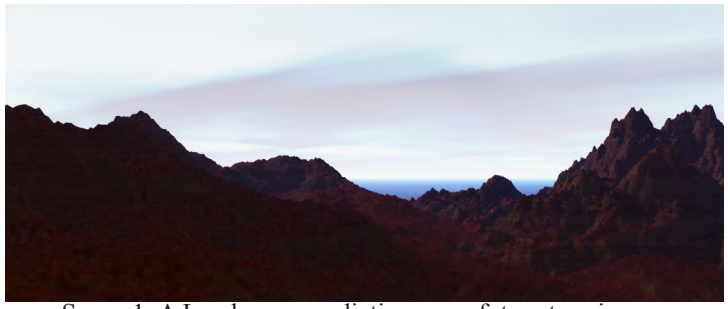
Scenario

Taking into account the current global scenario, the future could be very unpredictable. In the current world, a general trend being seen is the shifting of the population towards the city due to better economic and infrastructural conditions of the cities.

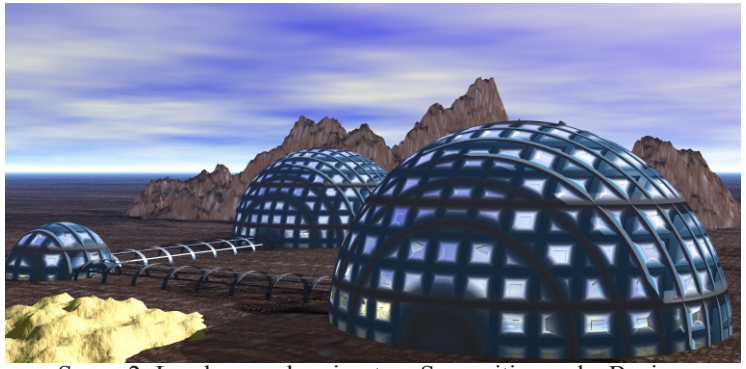
As more people shift towards the city, the population concentration increases in the city leading higher stress situation on the infrastructure thus leading to improper handling and in turn congestions . The traffic congestion is one of the major issues in cities due to improper utilization of the vehicles to fullest capacity. In the matter of fact, the average occupancy ratio globally is 1.6 leading to unnecessary wastage of ground space, energy and thus leading to all sorts of pollution.

To get rid of this congestion and also due to the reducing size of the family or rather individual life approach people are slowly moving towards compact vehicles which are a form of personal mobility vehicles(PMV). Due to smaller size and hence mass, it requires less power and hence smaller engines to run. This in turn also increases the efficiency and resulting in better manoeuvrability due to reduced size.

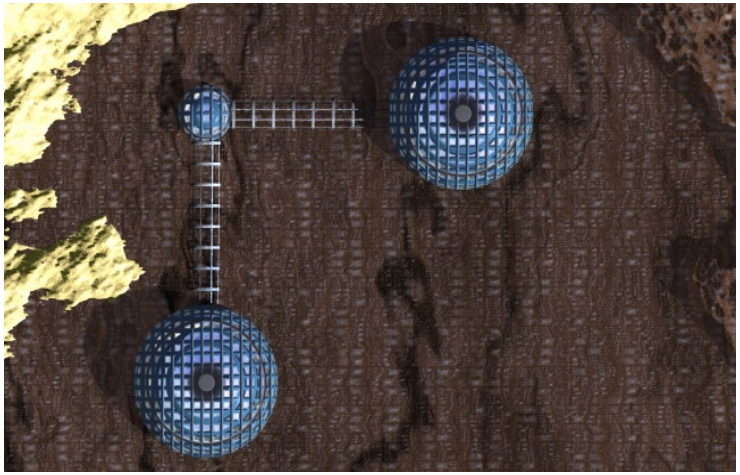
Yet the current PMVs are not very highly efficient due to the higher factor of safety consideration for preventing or reducing damage during collision resulting in increased overall weight and hence the efficiency of the vehicle. But with the extension of the current technology there can be a possibility where the vehicle is completely protected by a system of electronic systems preventing any possibility of a crash.



Scene 1: A Landscape predicting upon future terrain



Scene 2: Landscape showing two Supercities and a Business hub(Smaller dome) conneteced through spaceways



Scene3: Top Overview of the Supercities (All three Scenes rendered in Bryce and are rough predictions)

The future world, in some years' time, would not be sustainable for human life if the current trend and quantity of pollution and other factors like nuclear testing and blasts keep on continuing. These may finally lead into heating up of the earth's atmosphere above sustainable temperatures and leading to evaporation of major amount of surface water.

This may lead into barren land on major portion of earth's surface. To survive in such arid conditions, humans may have to come up with superstructures capable of consuming a whole city called 'Supercity'

These supercities basically will be huge township with all sorts of amenities like gardens, Supermalls, Hotels, amusement parks, etc. Such type of supercities consists of high amount of population residing and living in a very confined space leading to crunch of space. With better infrastructure major travelling will be done through synchronised and systemized mass transportation vehicles. There will also be other forms of transportation like compact vehicles carrying around single or two people and having minimal possible size.

Several such supercities remotely located could be connected through 'Spaceways'. There are also business hubs which are basically mass trading and business hubs for a series of supercities. These business hubs are also connected to supercities via spaceways. These space ways are freeways and do not carry any speed restrictions leading to usage of high speed super efficient vehicles in form of personal as well as mass transportation vehicles.

The major issue with the vehicles is to be able to transform between compact and highly manoeuvrable vehicles to high speed sleek supervehicles while on superways. The youth of the 20XX generation prefer to have a vehicle capable of satisfying both such conditions.

Introduction

Personal mobility vehicles (PMV), currently being used or available, are very compact vehicles and generally are the cheaper form of mobility. These vehicles consume lower ground space or footprint as compared to other vehicles. These vehicles have greater manoeuvrability due to which such vehicles are preferred in cities where traffic congestion is a common problem. Due to their comparatively compact size they are comparatively more efficient than normal petrol or diesel powered vehicles.

Scooters and bikes are the most commonly known form of PMVs, but compact vehicles like the Smart ForTwo are also a form of currntly available PMVs. The bicycle is the most efficient form of PMV but requires person's effort to move around leading to limited speed and distance of travel.

Fig 1:A Scooter- Honda Eterno
www.flickr.com

Fig 2.: A Car -Smart ForTwo
www.netcarshow.com

Fig 3.: A Bike -Yamaha FZ 16
www.yamaha-motor-india.com

Fig 4.: Bicycle
www.flickr.com

Types of PMVs:

As mentioned earlier, vehicles like small cars, Scooters, bikes, mopeds, bi-cycles, etc. are the current form of personal mobility vehicles. The modern PMVs include the Segway(Fig 7), the easy glider(fig 5), etc. Also there are various new types of PMVs coming up like the Toyota I-real(fig 10), Toyota Winglet(fig 9), Suzuki Pixy(fig 8), etc.

Fig 5: Uno Motorcycle
www.technobob.com

Fig 6: Easy Glider www.easy-glider.com

Fig 7: Segway www.co2calculator.wordpress.com

Fig 8: Suzuki Pixxy www.netcarshow.com

Fig.9: Toyota Winglet www.tuvie.com

Fig 10: Toyota I-real www.netcarshow.com

Fig 11: Easy glider and Segway

The current generation modern PMVs, like the Segway and the easy glider,are open type vehicles and are basically minimal form of designs. They donot provide any seating and hence can be used comfortably for short amount of time.

Fig 12: Suzuki Pixxy

The PMVs of the future, however, are designed with comfort and safety as a major focus and these vehicles are so advanced that the vehicles, by themselves, can interact with each other making them not just a vehicle but also a communication device.

Fig 13: Traffic Congestion at a highway
www.news.blogspot.com

Current Scenrio:

The compact cars do have the capacity to house four people but these are not fully utilized. In the matter of fact, the average occupancy rate of vehicles is 1.6 which leads to very low efficiency as it has no flexibility according to usage leading to greater footprint covered for carrying less people. Also the vehicles are loaded with series of technology and other stuffs which lead to increase in dead weight of the vehicles other than the weight added in the form of rigidity for safety during crash. These also being large in size also lead to lower manoeuvrability lead to traffic congestion and leading to several problems like pollution, noise, etc.

The other form of vehicles, like scooters, bikes, etc., have lower width but has more length and hence covers more area as compared to the footprint of a person. The best form of personal mobility is a bicycle, but the major issue being it requires human effort to give motion and hence generally leads to limited range and limited speed.

The next generation PMVs like the Segway, the easy-gliders are the best form of low footprint vehicles but are constraint to limited range and speed due to the current technology and the type of design. Also these vehicles do not provide the comfort of seating while travelling around.

Types of current developments:

Fig 14: Parajet Buggy
www.collapsemag.com

Fig 15: Terrafugia Transition
www.gadgetreview.com

Fig 16: Moller skycar 400
www.weirdomatic.com

Vehicles generally used for travelling, especially personal vehicle, are majorly or almost all of them are terrestrial vehicles. These vehicles generally use any form of ground surface as a medium to transfer force and hence leading to motion. Though there are several forms of development taking place in ways to traverse on the ground surface, there is also few experimental work of exploring other forms of travelling in personal mobility context. These are as mentioned below:

Aerial: Due to Though a compact vehicle capable of vertical takeoff and landing is still practically a difficult task and above it making it easily feasible for everyday travelling is still a distant task but vehicle taking off from a highway or elevated areas are being tried out.

Fig 14 shows an experimental vehicle by parajet. It basically is a buggy with a rotor on its back which helps it move around using a parajet parachute.

Fig 15 shows the concept model of Terrafugia Tansition which is a transforming car, where the vehicle takes few minutes to transfer from car to small plane is also attempted and also successfully tested.

Fig 16 shows Moller's Skycar 400 which is almost ready prototype of a personal vertical take off car.

Fig 17: Innerspace Dolphin Boat
www.innerspace.com

Water surface: The other mode of travel could be water as major part of the earth's surface is covered by it. Compact vehicles completely dedicated to travel over water or amphibious vehicles are tried and tested and further are being developed for better, practical usage and efficiency. Fig 17 shows Innerspace's Dolphin boat which travels over the water surafca and is available in the market.

Fig 18: Rinspeed sQuba
www.netcarshow.com

Water, Submersible: New vehicles capable of submersed travelling are also coming up and hence opening up a new form of mobility frontier. These can lead to a new form of habitat inside the water surface. Fig 18 shows Rinspeed's sQuba which is a submersible amphibian vehicle and can work great both on land or inside water.

Technology Advancements

Fig 19: Segway
www.co2calcuator.wordpress.com

Fig 20: Uno Motorcycle
www.technobob.com

Self balancing two wheeler:

Most of the modern PMVs, having two side by side wheels, work on a basic feature of Self balancing technology. This self balancing technology basically consists of a series of sensors and controller systems making the vehicle work as a human body. These systems basically consist of gyroscopes and tilt sensors.

The gyroscope is used as a base for retrieving the angular tilt of the vehicle and this is recorded or analysed by the tilt sensor to inform the motor to react accordingly to regain balance. This is similar to what human body does while losing balance, only in this case instead of brain, reflexes and muscular system its a sensor, controller and motor system.

In case of a Segway(fig 19), there are three active gyroscopes to detect the angular motion, though these gyroscopes actually are solid state angular rate sensors using silicon for better maintenance and reliability. (Source www.howstuffworks.com)

The Uno motorcycle(Fig 20) also works on the similar lines of the Segway but providing aggressive seating posture making it a unique design.

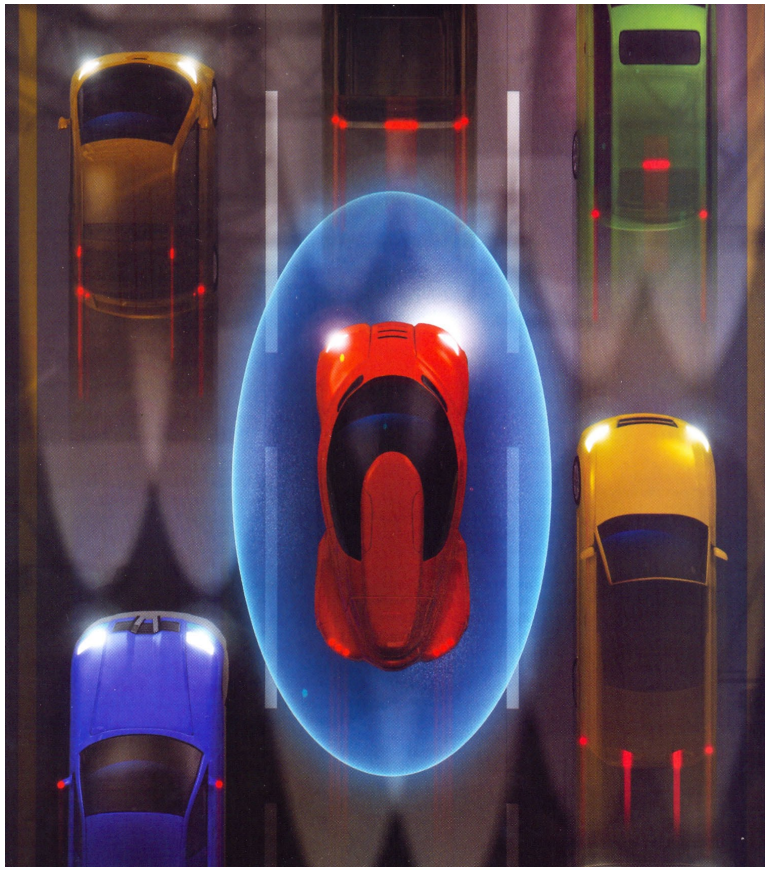


Fig 21: A graphic depicting the 'Virtual Safety Bubble
Scientific American Dec2008

Virtual Safety Bubble:

The Virtual Safety Bubble (VSB) is very interesting concept cum proposal. This is a type of system which basically creates an imaginary shell created around the vehicle using the ultra modern electronic technology thus preventing any collision between vehicles. It consists of a vehicle fully loaded with different individual electronic controllers to create a system to monitor and maintain a minimal space between vehicles and also preventing collision by networked controlling system. The current concept proposes a system of the following electronic systems:

Anti lock Braking System: The ABS basically prevents the wheel from locking when brakes are applied. So eventually it helps up in improving steerability, since the wheels do not slip due to locking of wheels and also increases the deceleration under hard braking

Auto Braking: Automatic braking is one of the experimental level technologies where the vehicle decides by itself if to apply brakes in case of preventing a collision. In the current world this is applied into few vehicles for low speed applications but this further can be developed and enhanced for high speed applications too.

Automatic Pedestrian Recognition: APD is one of the majorly required systems in the modern day world due to the high chances of lower visibilities in cities due to high amount of suspended matter present in the air. This system basically detects and informs the driver about any pedestrian or animal on the road

Back over detector: This system basically helps the driver in detecting any obstacle or pedestrian while reversing the vehicle and in the presence of one puts over the brakes.

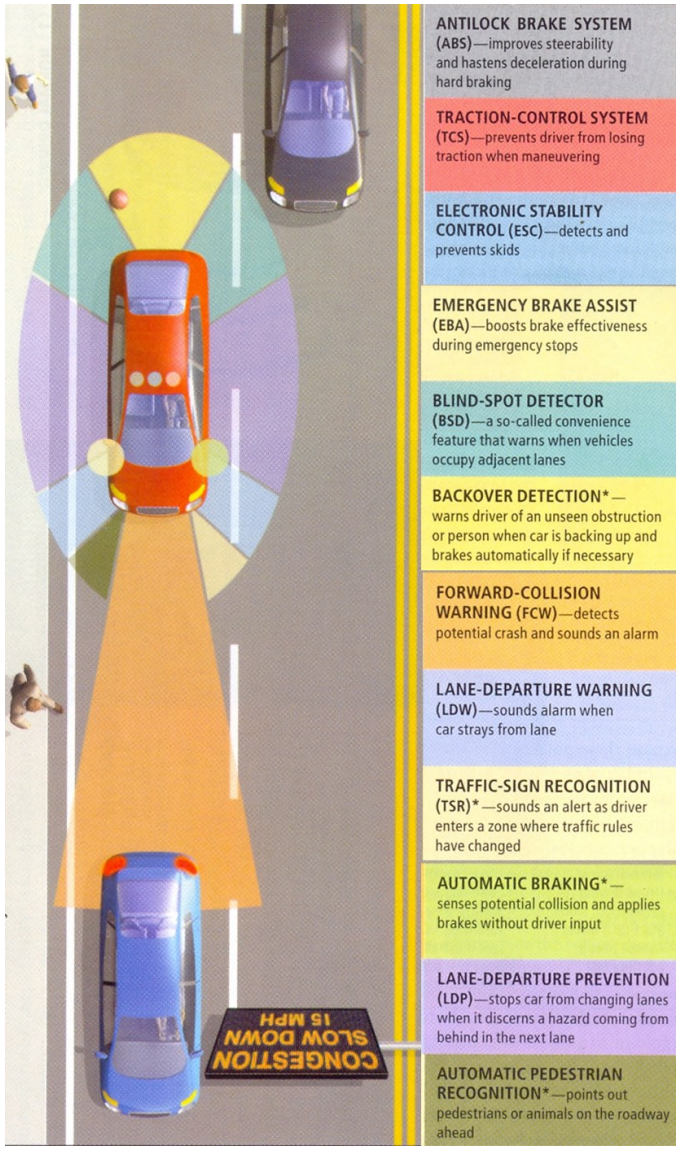


Fig 22: All the elements for the Virtual bubble
Scientific American Dec 2008

Blind spot detector: The blind spot detector can play a major role in vehicles especially with thicker A, B or C-pillars by alarming the driver about any incoming obstacle hidden out behind the blind spot

Emergency Brake Assist: This system helps in enhancing the braking ability of the vehicle under emergency situations and hence reducing the effective time for complete stop and also the distance.

Traction Control System: The TCS helps in maintaining traction in all the wheels while manoeuvring and prevents rolling over of the wheels or skidding of the wheels.

Electronic Stability Control: The ESC system detects any hint of slip at any end of the vehicle and controls and aligns a vehicle onto a straight or desired direction of motion

Forward Collision Warning: This system comes into act if it identifies any case of upcoming collision and alerts the driver by blowing off the alarm

Lane Departure Warning: The Lane departure warning system alarms the driver as the car tends to change the lane.

Lane Departure Prevention: The advanced form of LDW, prevents the vehicle from changing the lane if it identifies any incoming vehicle from behind the vehicle and also alarms the driver about it

Traffic Sign Recognition: This advanced system alarms the driver in case the vehicle moves into an area or grid or enters a new region of any changed traffic rules.

All these elements sum up to form a form of a bubble around the vehicle and basically reduces or eliminates the chance of any collision and thus leading to redundancy of the excess heavy mass added for the sack of safety during crash. This in turn leads to a better, light weight vehicles running on smaller engines leading to higher efficiencies.

Power trains of future

Internal combustion engines (I.C.Engine) have been the power source for almost all types of mobility solution for almost a century. In this century long journey, lots of evolutionary works and modifications have gone through on I. C. Engines making them more efficient, reliable and as eco friendly as possible. But with the depleting fuel reserves and increasing concern over global warming an efficient and sustainable power source is required for fulfilling all sorts of power requirements including the mobility.

Lots of alternative technologies are coming up day to day, some evolutionary while some groundbreaking. In the current world, Battery Electric vehicles, Hybrid Electric vehicles and Hydrogen Fuel cell are the potential alternatives for I.C.engines.

But in case of Battery Electric vehicles, energy storage has been a major problem as the high potential, high capacity energy reservoir is still not easily available and also the problem of recharging within a limited amount of time as in case of I.C.Engines, fuel can be filled up within minutes time. While Hybrid electric vehicles are just an extension of I.C.Enigne where the engine is coupled to a electric motor powered via a battery. Since the capacity of battery is a problem and so is the limited fuel reserve hence this solution can only be good up to a limited period of time.

The other option, Hydrogen Fuel cell vehicles, seems to be a promising option for the future as it basically requires hydrogen, which is abundantly available in the atmosphere, and the by-product being heat and water thus preventing any form of hazardous pollution.

As hydrogen fuel cell technology is too new, as compared to I.C.Engines, there are several issues like manufacturing the proton electrolyte membrane or the basic membrane responsible for the generation of electricity is very costly in the current scenario, the volume required to store hydrogen is too high, also the generation of hydrogen is very complex process and the simpler methods are not efficient enough to help in reducing the global warming or release of hazardous waste in atmosphere, etc. But these are in the current world scenario. But with further research and developments there can be a possibility of a better, compact and highly efficient power train evolved out of the current generation Hydrogen Fuel Cells.

There is currently a research going on Regenerative Hydrogen Fuel Cells, where the fuel cell itself tries to regenerate hydrogen from the water left out as a by-product. The regenerative process can be initiated by using external power source like solar energy or wind energy which activates the electrolysis process, a general way of separating hydrogen and oxygen from water.

Future Analysis:

The basic motto of the project was to predict the future and propose/ predict upon a vehicle suiting the scenario. This required understanding the trends or basically the way to express things as futuristic, to understand the visual grammar defining the future or futuristic products.

As we do say, the roots to the future basically lies in the presenthence in order to understand and perceive futuristic things an innovative way of analysis was followed. The process included watching science fictional, sci-fi, movies, reading sci-fi books, concept artists' works and analysing and understanding them and in the end coming up with the elements or visual grammar of it.

This process also included analysing the products like vehicles, gadgets etc used in the movie or the works of concept artists and come up with few elements actually defining or making a product being classified as a futuristic product. It basically was a way to catch the essence of the term 'Futuristic'.

The moajor works done by concept artists like Syd Mead, Scott Robertson, Simon Daniel and Harald Belker were also refered to understand the basic elements making a product futuristic.

Movies

Fig 23: The Galaxy of Star Wars
www.zdnetasia.com

Fig 24: A spaceship leaving into the space from a main ship - Image from the Movie

Case Study 1: Star Wars

Release Year: 1980's

Director: George Lucas

The starwars series is a benchmark generally considered for sci-fi movies as these are based onto a completely new timeline. The story is based on some galactic time in the galaxy where planets and human beings have evolved to a completely new form. A human being has grown strong enough to have an army of androids and can travel through space easily with huge spaceships and also capable of making artificial planets.

The basic visual language is very bright inside planets with two or more moons and suns. Space represented with a basic tint of blue but usually very dark.

Vehicle are categorized clearly in the form of good character's and bad character's. Normal vehicles are shown in a very crude manner with shabby details and show or reveal patches of metals riveted together while evil characters' vehicle are generally very advanced and shown in shades of black.

Fig 25: Land Speeded
www.krunker.com

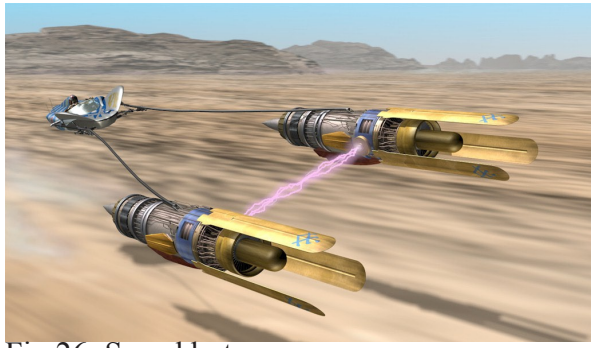


Fig 26: Speed bot

There is high usage of bright fluorescent colours very persistently at places. There are instances where there has been usage of showcasing a technology always dreamt of but not properly detailed out or known exactly how it works.For e.g. the anti gravity system or gravitational repulsion system used in the 'Land Speeder'(Fig 25) and other vehicles, though the exact working or mechanism were not known yet it was showcases and as an idea was appreciated majorly due to the way of presenting them, using trick photography and digital media, and hence making them easily percievable.

Few episodes also had showcased the usage of completely customed vehicles used for racing which was similar to the 'Hot-rod era; in US. Also is seen in the movie that very complicated technology was being used for day to day activities in form of 'droids' showing how technology was simply taking for granted.

Fig 27: A scene from the movie showcasing flouroscent colour www.allyoulike.com

Fig 28: Another scene from the same movie,usage of bright or dull colours

Case Study 2: I, Robot

Release: 2004
Director: Alex Proyas

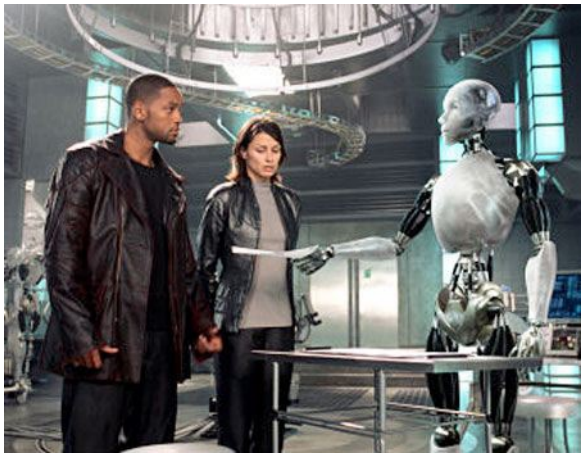


Fig 29: A scene showcasing overall furnishing in metal
www.images.businessweek.com

Fig 30: A scene showing glossy white/ Grey colour for body www.blogs.freshminds.co.uk

The story is based on the world situation in 2035. It talks about life with robots, where robotic technology has evolved several folds leading to people opting for robots as maids or companion. It majorly talks about the possibility of robots gaining control over humans and how robots do have the capacity of understanding feelings. There is also an interesting concept of human body transplanting with robotic system where a human hand was replaced with a robotic arm due to incurable damage taking place to the human hand

Transportation systems majorly are mono rail trains for mass transportation, while mammoth sized trucks used for transferring cargo and towing robots hanging on supports. There are also well developed highways capable of high speed travelling and also high speed semi automatic cars. These vehicles can also be driven in manual mode as normal day cars and specially had spherical wheels capable of rotating in omni-directions. Personal vehicles are generally showcased having very shiny surfaces, high quality fit and finish.

The general colour scheme overall used, majorly for vehicles and new technology are white while most of the objects, especially things like furniture and life space shows usage of metals at high amount.

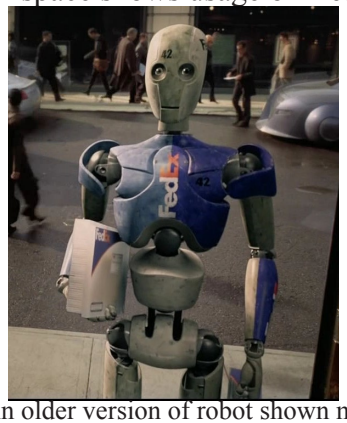


Fig 31: An older version of robot shown more matt finished and a bit rugged
www.movielab.tv

Fig 32: The vehicle speeding on the advanced Highway
www.imcdb.org

Case Study 3: Minority Report

Release Year: 2002
Director: Stephen Spielberg

The story is based on the world situation in 2054. The technology advancements has been too high leading to development of sixth sense based computing system where hand gestures are used for interacting with computer actively, transparent clear crystals are used as data drives.

The infrastructure has been very well developed and laid onto leading to homes directly connected to highways which are system controlled and managed and aso the building have infinite vertical reach.

Transportation solutions are also high tech with cars featuring Higher Day light opening(DLO) with self controlling system making travelling an easy task. Personal transportation include backpack based jet propelled equipment making short distance aerial flying easy.

There is also a giant hovership mimicking natural form capable of vertical take off, though the propulsion system is unknown. The hovership feature rugged construction with matt type surface finish making it visually strong and few detailing making it feel rugged. The vehicles showcased have great surface finish and showcase high quality fit and finish

Fig 33: A sixth sense technology based computer system.
www.codinghorror.com

Fig 34: The Backpack powered Propulsion system
www.imdb.com

Fig 35: A Lexus Monorail concept
www.joshdavid.com

Fig 36:
The hovership

www.zetamirror.com

Fig 37: ARCEE in both forms
www.transformers2007.nl

Fig 38: Optimus Prime, An Autobot
www.transformers2007.nl

Fig 39: Jazz in both forms
www.wallpaperz.net

Case Study 3: Transformers

Release Year: 2007

Director: Michael Bay

Story based on current time but the major showcase being extraterrestrial technology driven robots. These robots have the ability of transform from an undefined form to normal day vehicles. These robots are categorized into two groups i.e. Autobots and Decepticons.

The Autobots have the capability of hiding in form of normal cars and transforming back into exoskeletal robots when required. The Autobots are showcased to be from the good side and are represented with refined and well defined shapes, bright and generally primary colours.

The Decepticons being from evil side are showcased with rough, rugged form and massive size with high amount if sharp and crude elements and mostly are dark or dusky in colour. Radical forms generated. The power sources of the bots are not well defined and rather are behind what is known as the power of eternity 'A cube'.

Fig 40: Brawl in both forms
www.transformers-toy.blogspot.com

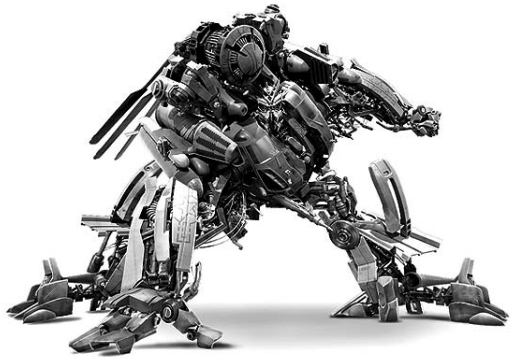


Fig 41: Blackout in action, A Decepticon
www.transformers2007.nl

Iron Man

Case Study 5: Iron Man

Release Year: 2008

Director: Jon Favreau

The Story is based on near future. In this time period all the advanced technology is easy available and under the control of a hard core brain it showcases how all basic limitations can be easily broken to develop a ground breaking exoskeletal shell as a weapon.

Good character is showcased with elegant compact design and the body presented in bright contrasting colours. Bright colours are used for representing unknown technology. The body is featured with lots of elements ranging from slotted pattern to faceted surfaces at several places. Bad character represented in rugged, massive structure and with rough and incomplete form.

The transformational phase of wearing the exoskeleton and assembling and motion of each and every component makes the whole character look more complex and attracts attention.

Fig 42: Concept form of IronMan
www.coceptart.org

Fig 43 and 44 The crude form of initial IronMan (V1.0)and kind of detailing in the final Ironman (V 2.0)
www.streetbillionaire.com

Fig 45: The intermediate Ironman, shown in partial finished form www.allmoviewalls.com

Product Brief

- Designing a compact personal mobility vehicle for the youth of the 2K generation
- The design has to suite the nature of the youth of 2K generation
- It should have minimal footprint and high manoeuvrability while inside the supercity while should also be capable of being more stable and high speed capabilities while on the spaceways.
- The vehicle should be highly efficient and should have minimal footprint as well as overall dimensions
- The vehicle should be innovative in form of driving

The Youth

The youth of the 2K generation are a lot more different from the youth of the current generation. Though the youth are radical, powerful, fun loving and trendy but due to the suffering and agony went through during the calamities and the war they are more responsible towards the society and much more passionaite towards their work and welfare of the society.

There is no gender bias as both sexes have equal status and respect all over. They are more involved personally with their vehicles and like to persionalize them according to their personality. As this generation is submerged in all sorts of technology, in general technology is taken for granted and they expect their vehicles to do any sort of things possibly dreamt of.

Attributes defining the youth

- Muscular
- Powerful
- Ageless
- Passion
- Radical
- Trendy
- Free
- Reliable
- Responsible
- Agile
- Technovanza
- Ambitious
- Dominant

Attributes defining the design

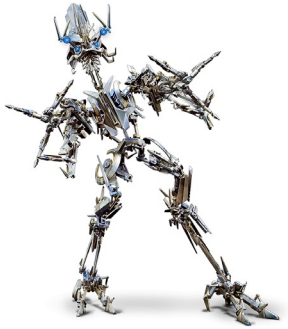
- Muscular
- Radical
- Trendy
- Agile
- Powerful
- Dominant
- Transform
- Sporty
- Minimal footprint

Mood Board

Trendy

Transform

Agressive



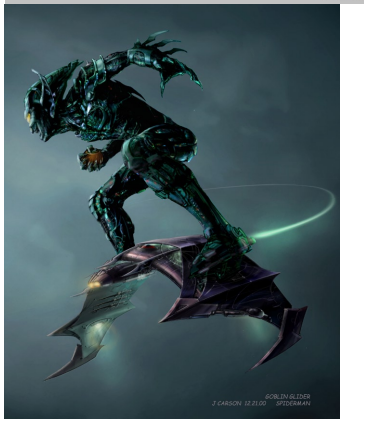
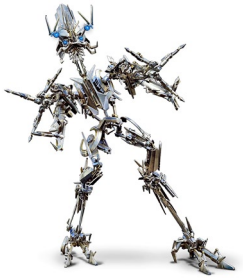


Image Group1:



The Image Group 1 showcases radical ideas. These have completely unique approach for a problem eg. BMW GINA, where innovative flexible material used for surface.

Radical concepts carry features like sharp and edgy form

Image Group 2:

Transform

Image Group 2 showcases transform-ability. These ideas are unique and provide unique ways of morphing under different circumstances.

Designs feature faceted form making it look unique

Image Group 3:

Trendy

Image group 3 showcases trendy products. These products use bright and contrasting colours. Trendiness is basically an added value to any product

Ideation

The initial phase of ideation was basically done with just a single restriction of minimal footprint. This stage was undergone to get as many ideas as possible and prevent any mental blockage due to predefined series of restrictions or attributes. The basic way used for ideation was generating 2D sketches of ideas and these are as shown below:

Though no restrictions were put in, still a mental blockage was encountered basically leading to similar ideas, with more vertically aligned designs, being put up with small variation in form. To eliminate the mental block, postural analysis was undertaken

Posture analysis

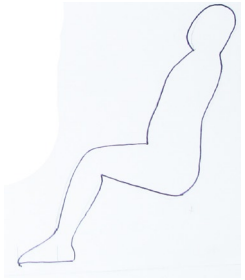
The posture analysis was basically done to explore new and more postures in order to get more ideas and hence to break the mental block which was faced at the initial phase of ideation. The process basically consisted of playing around with the manikin and thus coming up with all possible, or as much as possible, and also analysing them asper the better options suiting particular conditions

Due to this analysis several new options were explored and these were further used for ideation process leading to several new ideas. The postures and the data related to them are as below:

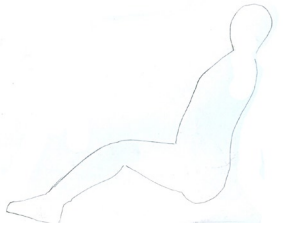
The posture provides minimal possible footprint but also occupies highest vertical space. Thus the comfort level is minimal and not suitable for long distance travelling.

The posture provides higher horizontal footprint but consumes lesser vertical space. The posture provides some amount of comfort but is suitable of short distance travelling.

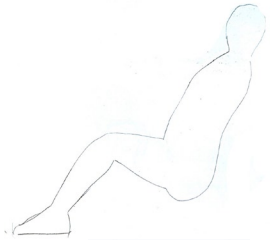
The posture is basically upright seating posture. The vertical space required is lesser but horizontal footprint is higher thus compromising on the space requirement. The comfort level is higher as the person is properly seated.



The posutre occupies higher footprint but lower vertical space making it more stable at high speeds and hence is preferred for high speed travelling



The posture is completely reclined seating position and hence occupies the highest footprint but also requires lowest vertical space making it best suiting for high speed applications.



The posutre occupies higher footprint but lower vertical space making it more stable at high speeds and hence is preferred for high speed travelling. Also the seating position provides best comfort.

The posture occupies minimal footprint and also lower vertical space. The stability at high speeds is not great but suits very well for city travelling

The posture occupies lower footprint and also lower vertical space leading it to be well suited for city travelling and less prefferable for high speed travelling

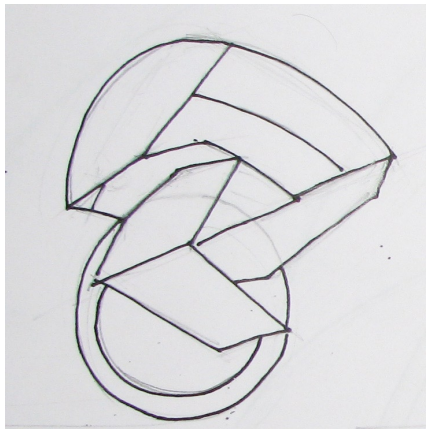
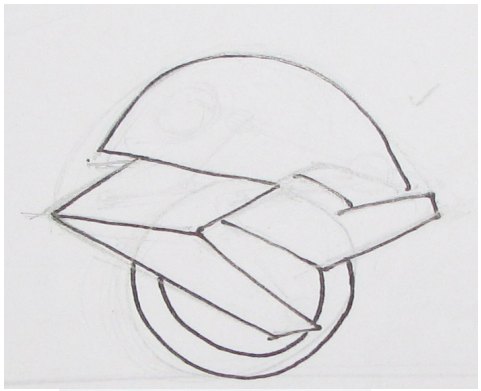
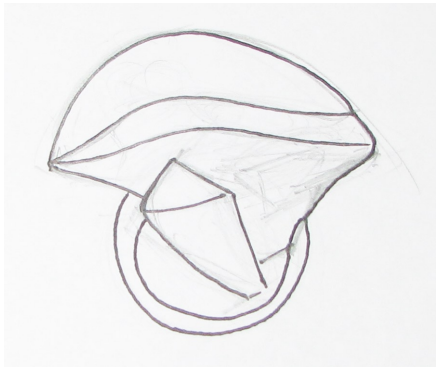
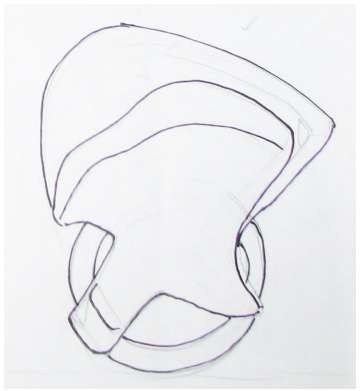
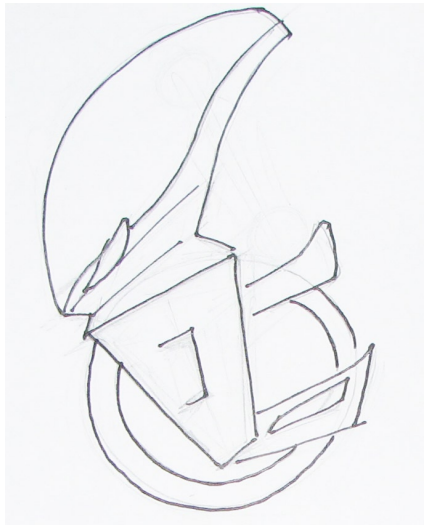
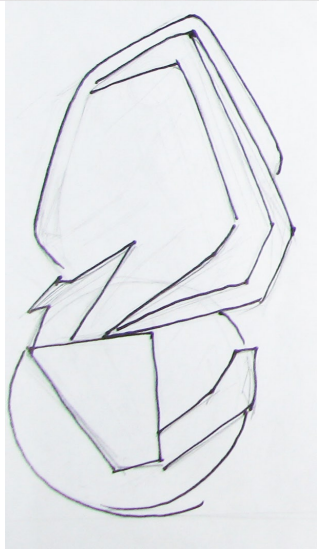
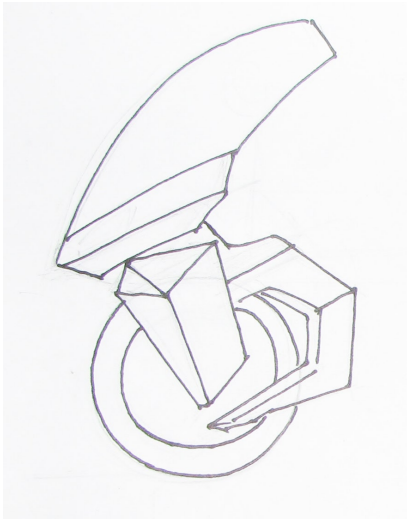
The posture is also similar to the earlier posture but is more oriented towards the front making it more agressive seating than the earlier one.

The posture is more oriented towards the front and is similar to the posture of riding a bike. The vertical and horizontal space consumed is average and the posture is suitable for both low speed as well as high speed travelling

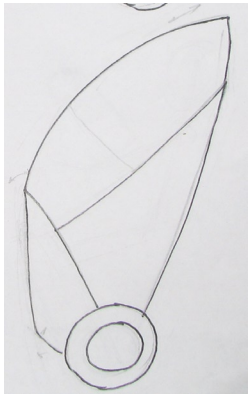
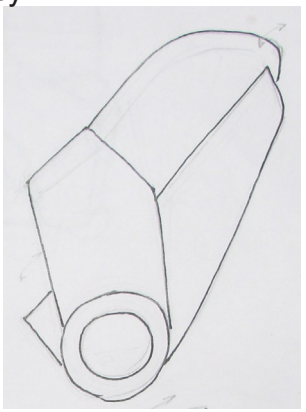
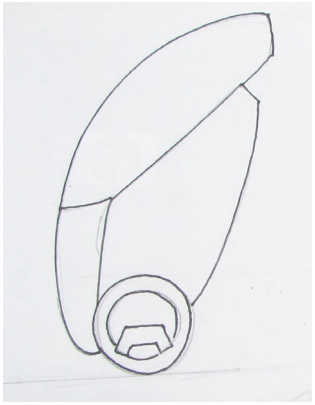
The posture is the most agressive of all and also the best combination of least vertical space and lower footprint. The posture is better suitable for high speed travelling.

Due to the new and innovative postures, ideation process was reinitiated leading to several ideas again worked out in 2D and a few selected were transformed into 3D renderings.

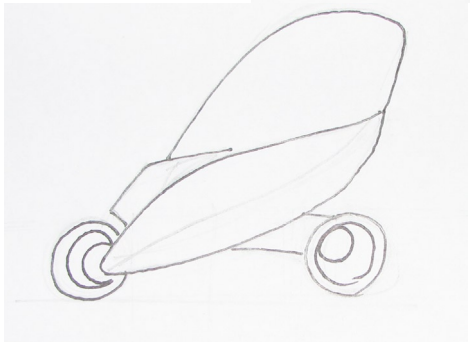
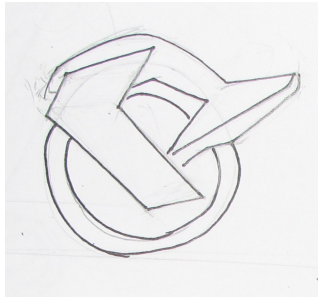
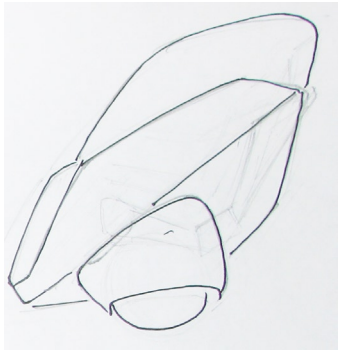
After the postural analysis, the ideas being generated, were of mixed type with few of them having horizontal alignment while few having vertical alignment

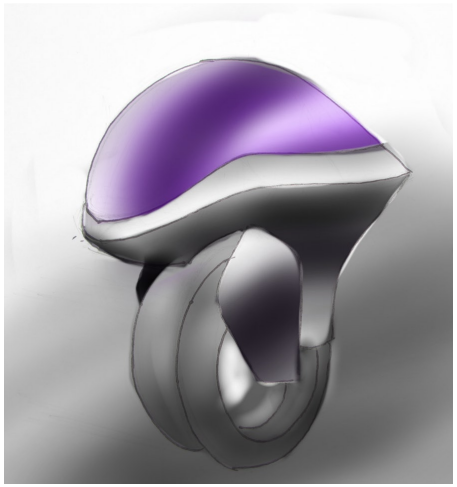

The Posture analysis helped out in getting the overall proportion of vehicle right as compared to the proportions of human being. This made comparing different ideas from each other easy.

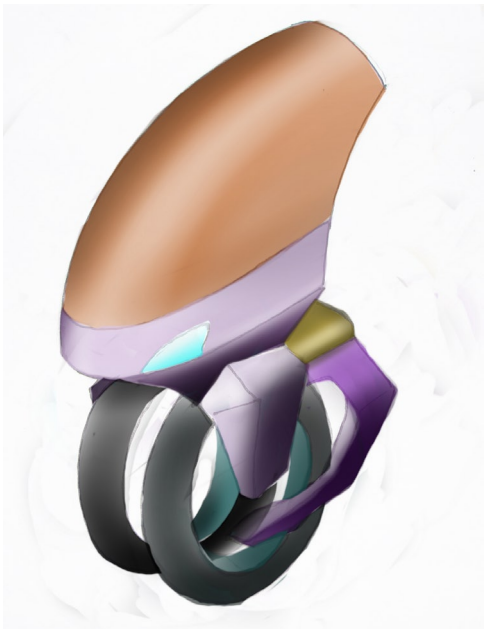







The following are the 3D renderings of the ideas





Idea 1 (Fig 46)

The vehicle is a two wheeler basically working on the self balancing system. The radical concept provides a closed enclosure and also showcases minimal height.

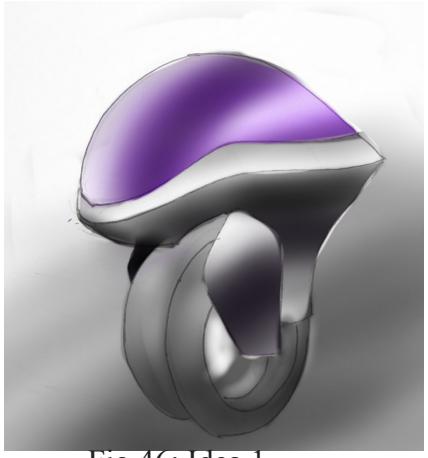


Fig 46: Idea 1

Fig 47: Idea 2

Idea 2(Fig 47)

The vehicle is a three wheeler with a rather low height. The rear two wheels are hinged to the main body providing ample inclination adjustability and easy manoeuvrability. The body has a transparent cover over the top provided spacious feel as well as 360° clear view.

Idea 3 (Fig 48)

The third idea is a 4 wheeler concept showcasing vertical stance. The main design element being its frame structure onto which the body or capsule is suspended providing complete freedom in motion and inclination.

Fig 48: Idea 3

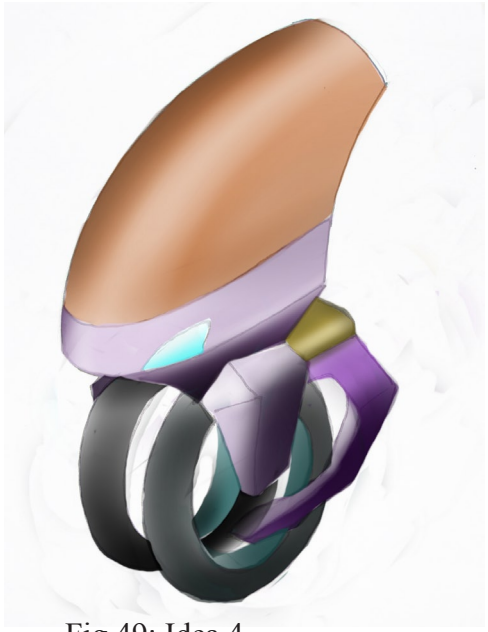


Fig 49: Idea 4

Idea 4 (Fig 49)

The vehicle is a two wheeler with wheels arranged side by side and working on self balancing system. The vehicle is a form of extension of a bike but providing upright seating.

Idea 5 (Fig 50)

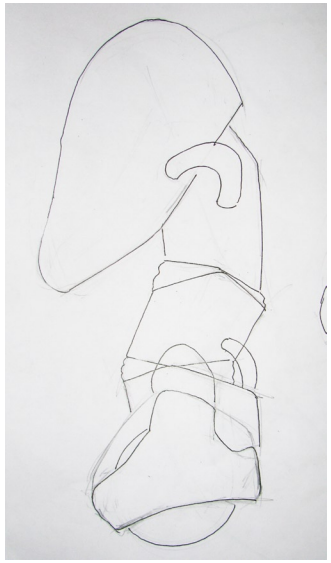
The vehicle is a two wheeler with adjustable wheels allowing flexibility in height and also angle for suiting the condition of travel and speed. The seating posture being semi seating, this idea provides minimal horizontal footprint.

Fig 50: Idea5

Fig 51: Idea6

Idea 6 (Fig 51)

The vehicle is a four wheeler with the rear wheels being a single unit connect to the main body about a hinge providing flexible motion about vertical as well as angular motion. The vehicle showcases semi seating posture and at higher speed inclines backwards making the design more dynamic and easy for high speed travelling.



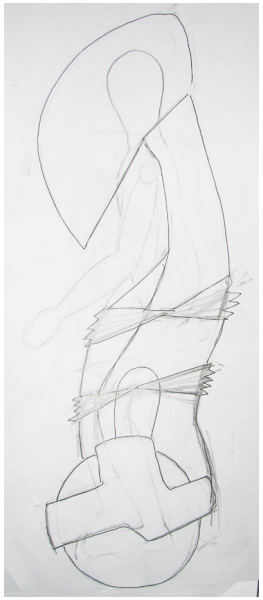


Fig 52: Idea 2

In this phase the basic essence of the earlier ideas were taken into consideration and new ideas suiting the defined attributes and scenario were tried out. The major context at this point was the vehicle had to have minimal footprint within the city limitattions compromising upon the speed, while once on to spaceway it had to transform into a high speed vehicle with better stabiltiy and agression.

The major focus in this stage was to provide an innovative solution, suiting the context, as far as mobility is considered and the design had to have some basic features making it futuristic including the ability to transform.

Several ideas were put up and were tried out in 3D but for clear understanding of surfaces and the play of it 3D exploratory models were tried out at 1:5 scale.

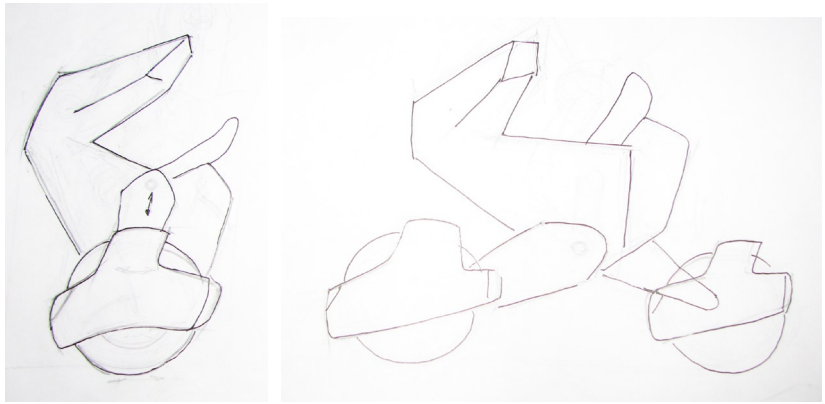


Fig 53: Idea 1

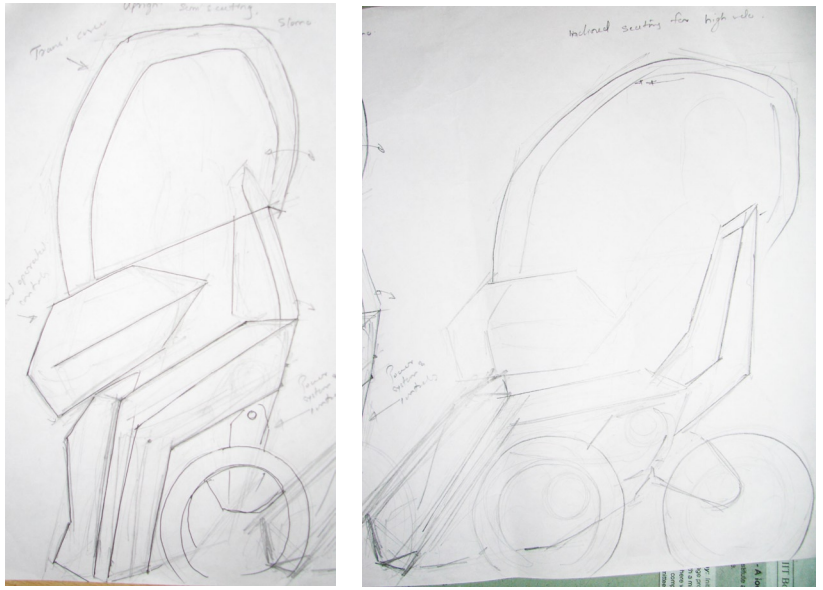


Fig 54: Idea 3

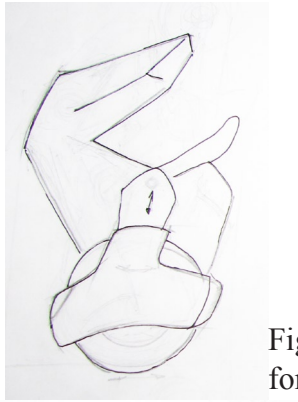


Fig 55: Idea 1 in closed form

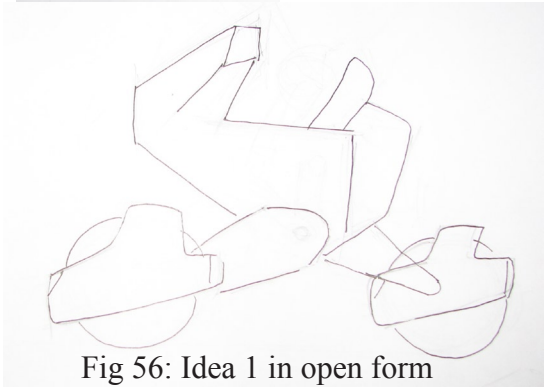


Fig 56: Idea 1 in open form

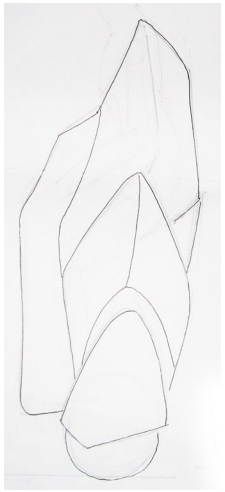


Fig 57: Idea 2 in compact form

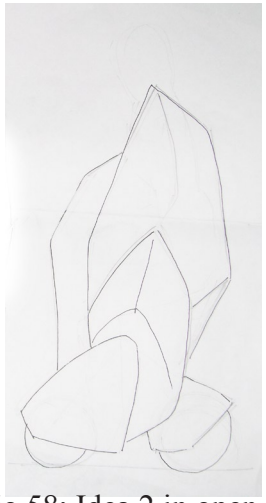


Fig 58; Idea 2 in open form

Idea 1:

The vehicle is a two wheeled and the basic design is on the lines of a bike except for the feature that the wheels are arranged side by side. This design feature leads to minimal footprint and easy manoeuvrability. When it needs to move at higher speed the wheels move away leaving the side by side alignment and also reclines towards front making the vehicle more dynamic and more stable for high speed travelling. The design has no enclosure leading to usage of a protective gear for travelling in space ways.

Idea 2:

The idea is a wearable form of vehicle with partial rigid components hinged about each other making it flexible to adjust itself. The vehicle basically has vertical stance with the person seated at semi seating position for urban mobility but it adjusts itself as per the user's desire to form a lower and much more stable design for high speed travelling

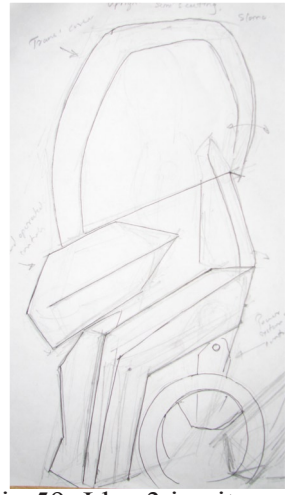


Fig 59: Idea 3 in city mode

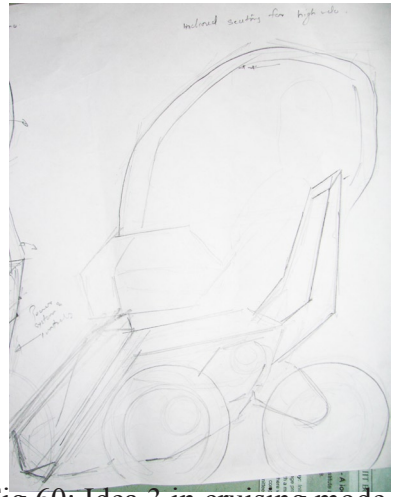


Fig 60: Idea 3 in cruising mode

Idea 3:

The vehicle is a two wheeled wheel chair with a protective enclosure from top. The cover is to be lifted up to get into the vehicle and the hand controls are basically positioned in the cover.

The vehicle is more vertically oriented leading to low footprint for city travelling while the vehicle reclines towards the back and thus reducing the height of the vehicle making it more comfortable for moving at higher speeds.

3D Explorations

Fig 61: Idea 1 Exploration

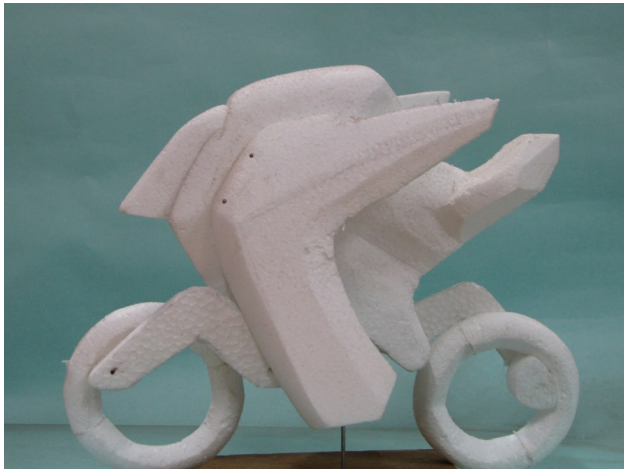


Fig 62: Idea 1 Exploration in Open mode

The concept is more refined version of the earlier idea. The design was more oriented towards youth due to the similarity with a bike and aggressive design elements and aggressive seating. The feature of transforming provides the essence of futuristic.

The design is much more compact than the current motorcycle. The vehicle works on dynamic balancing when within the city limits leading to minimal footprint and better manoeuvrability(Refer fig 61). At high speed, the vehicle transforms into a normal bike where the arms handling the wheels move ahead/ back thus repositioning the wheels to make it perform as a bike(Refer fig 62.

The vehicle uses off-set hub system for power transfer with hubless wheels and hub centred steering. The vehicle has one issue; the seat height of the vehicle is too high for getting on and out of it easily.

Fig 63: Idea 2 in normal mode

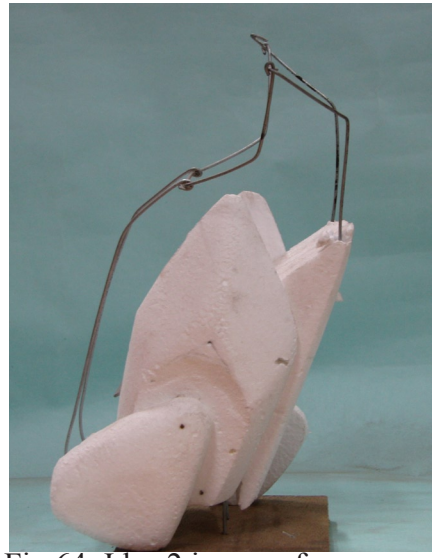


Fig 64: Idea 2 in open form

The second concept consists of a rigid base which houses most of the equipments while the remaining body is made of a very flexible material put over a flexible frame structure. The concept is similar to the BMW's 'GINA' concept.

The vehicle initially has much vertical stance(Refer fig 63) and the person actually seats in semi seating condition but as the vehicle transforms for high speed travelling the seat moves down and so does the flexible frame structure making the vehicle lower in height and providing better stability(Refer fig 64).

Though the high speed transformed position is not too low leading to a possibility the vehicle could be not very stable at high speeds.

Fig 65: Idea 3 in city mode

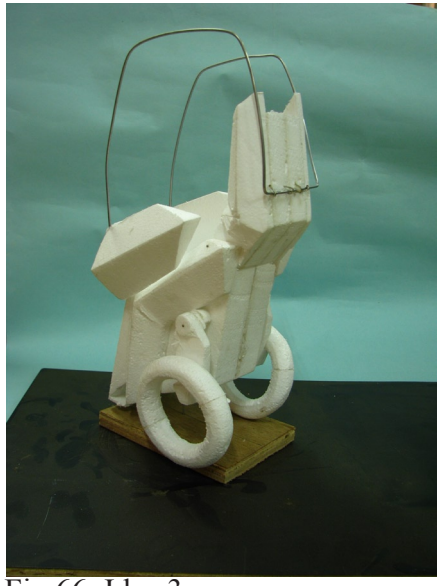


Fig 66: Idea 3

TheThird concept is more conservative as compared to the earlier concept but more comfortable than the earlier one. The vehicle features semi seating posture while moving within the city thus resulting in lower footprint(Refer fig 65).

The enclosure provides cover while moving around and leading to better aerodynamics. While moving at higher speeds the wheels move away from the aligned position thus reducing the height of the vehicle and also the vehicle reclines back making the vehicle more stable and more dynamic(Refer fig 66).

The design elements, though, make the vehicle look more static due to the parallel nature of the lines moving along the side panels. The vehicle looks visually very heavy due to high amount of flat surfaces on the front panels and the handle area (hand protectors) look too big as compared to the other elements.

Refinements

Concept1

Fig 67: Refined Idea 1

Fig 68: Refined Idea 1 Open form

The earlier concept was refined by reducing the seat height for comfortable seating and easy in and out off the seat. The new design had simpler surfaces and few hints of facets making it look sleek(Refer fig 67).

The linking arms of the wheels had been given higher visual emphasis by including a strong base link on which the linkages were connected to the bike.

Few problems were brought into account during the stage presentation; one of them being the offset seat positioning which naturally would lead to mass imbalance in the vehicle and also could lead into a possibility of failing of a system or making it more complicated.

The other issue being reliable working of offset wheel configuration which took place when the vehicle is in bike mode. The result of such system couldnot be easily answered or resolved hence an alternative had to be worked out.

Concept 2

Fig 69: Concept 2 in closed form

Fig 70; Concept2 in open form

The refined models had more dynamic lines all along including the side panels, the front surface and the rear panels(Refer fig 69).

The inclusion of dynamic lines was brought in by including lines at an angle. This also made the vehicle look sleeker.

To reduce the visual mass of the front panel few sharp and discrete elements were introduced. But the inclusion of this element led the design to feel clumsier.

Idea finalization:

The first concept seemed to have more potential as a concept suiting the youth as well as the scenario. The concept is basically more aggressive visually as well as the basic stance. The seating of the vehicle after transformation makes it feel more dominant and very aggressive and fast.

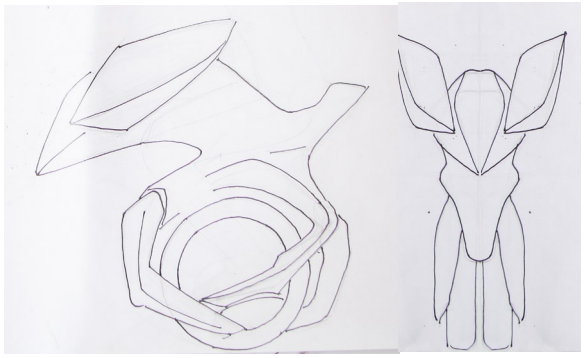
The type of transformation taking place and almost a complete conversion from one form to other makes it technologically futuristic and also makes the concept look radically different at both the instances. Also the overall design is sleeker and lighter as compared to the earlier concept.

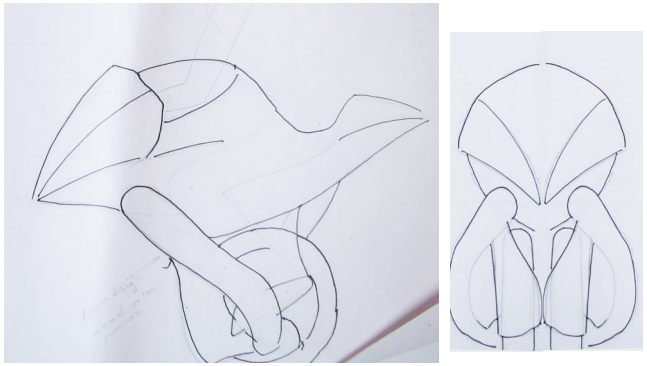
Few issues that had to be taken into account were the seat position with respect to the C.G. of the vehicle, the offset configuration of wheels while in the bike mode also had to be resolved.

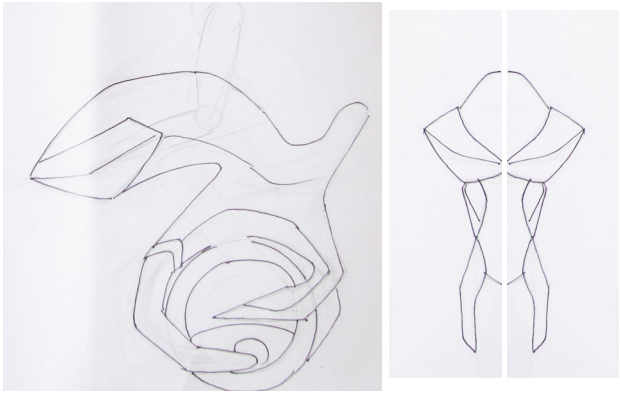
The design had to be made more futuristic visually and also the linking element had to be explored for getting better design.

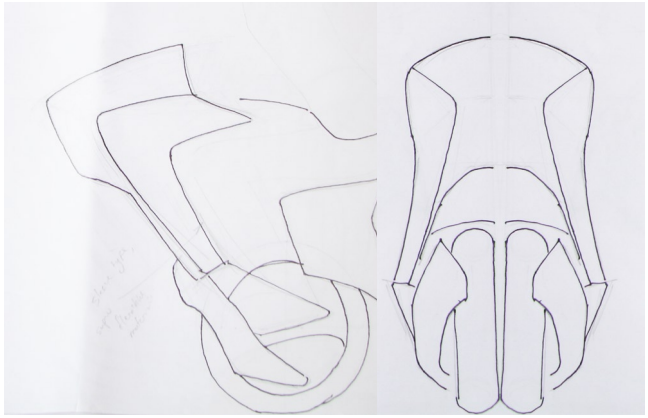
Concept Explorations

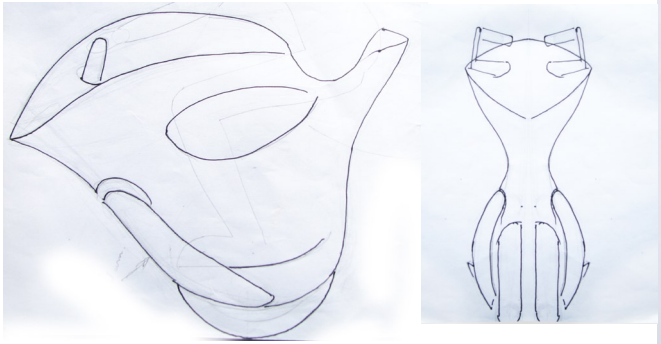
The selected concept had to be modified according to the issues identified earlier and also few forms were explored for futuristic design including exploration of the elements like the linkage and other elements.

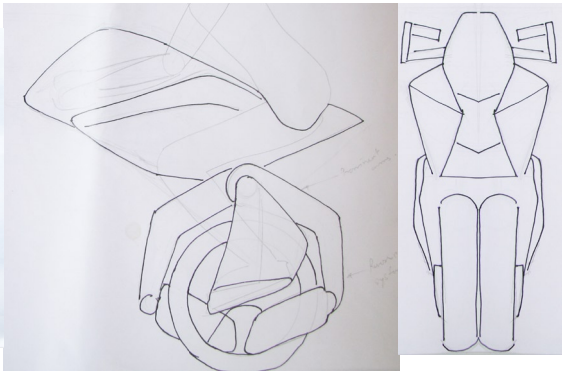












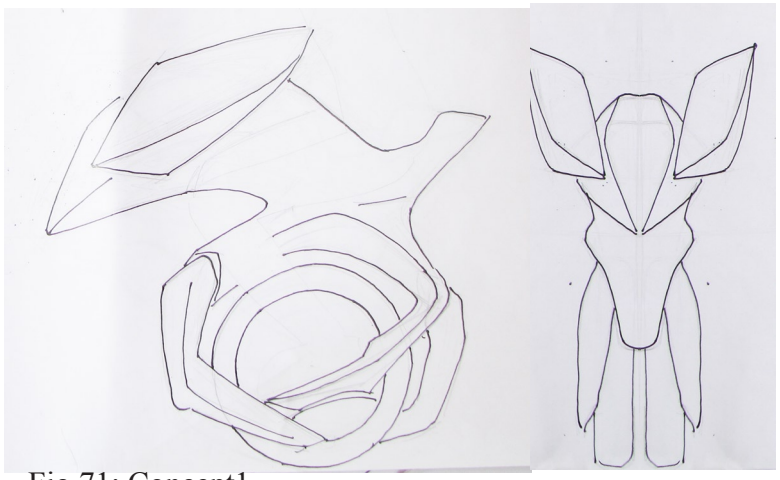


Fig 71: Concept1

Concept 1:

Fig 71 shows the first concept. The concept has very light form with sharp elements. The design includes an arm cover which guards the arm while at high speeds and acting as deflector.

The linkage also follows the similar design language with sharp elements. The linkage arm plays a prominent pert in the whole form

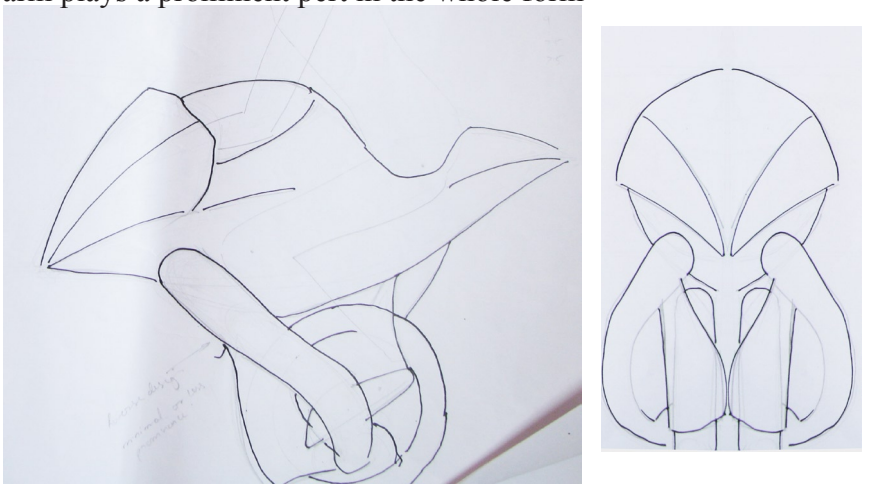


Fig 72: Concept2

Concept 2:

Fig 72 shows the second concept. The overall form is very bulky and also very wide. The linkage arms form a very prominent element of the design and also has a bulky nature.

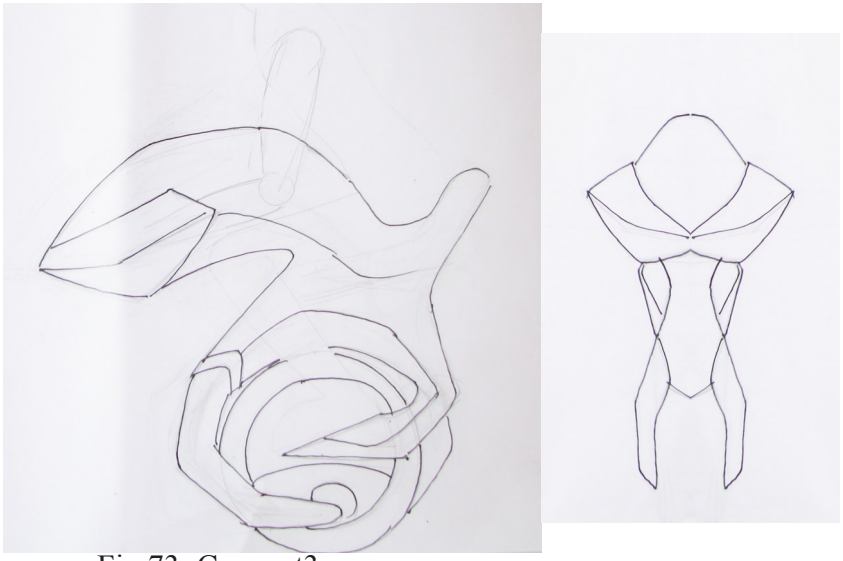


Fig 73: Concept3

Concept 3:

Fig 73 shows the third concept. The overall form is rather sleek and more dynamic. The design showcases enclosed portion for the handle to make the design more sleeker and aerodynamic at higher speeds and also making the design more sophisticated.Sharper design elements used all over.

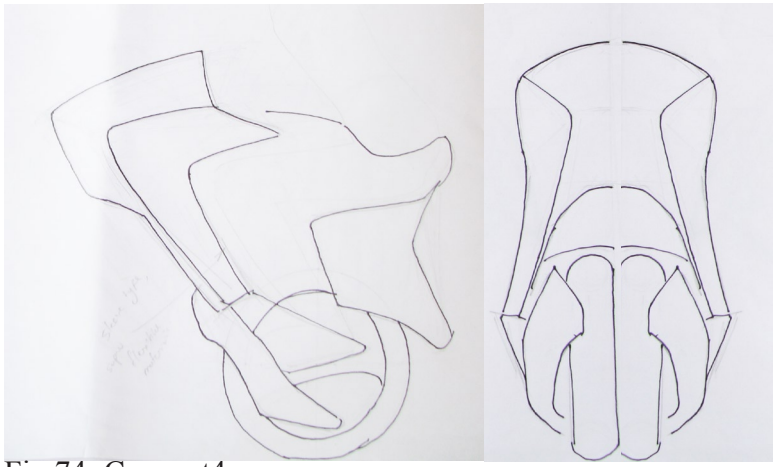


Fig 74: Concept4

Concept 4:

Fig 74 shows the fourth concept where the overall design is much more subtle and minimal. The overall form has smooth flowing lines and surfaces. The concept is a bit bulky and wider.

Concept 5:

Fig 75 shows the fifth concept. The basic form is evelved from a fish. The overall form makes the concept sleek and an element of interest of the negative space in the centre makes it more interesting concept.

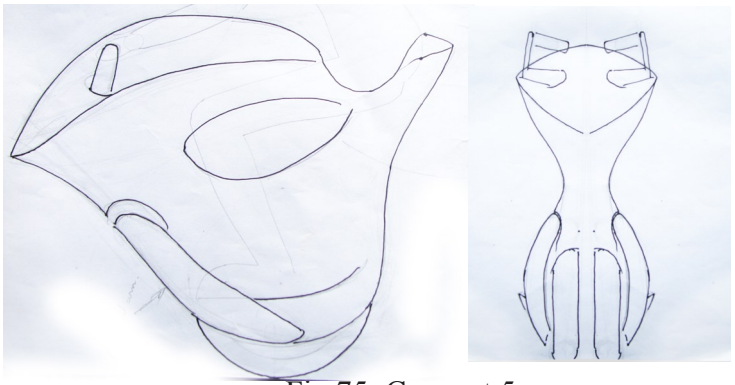


Fig 75: Concept 5

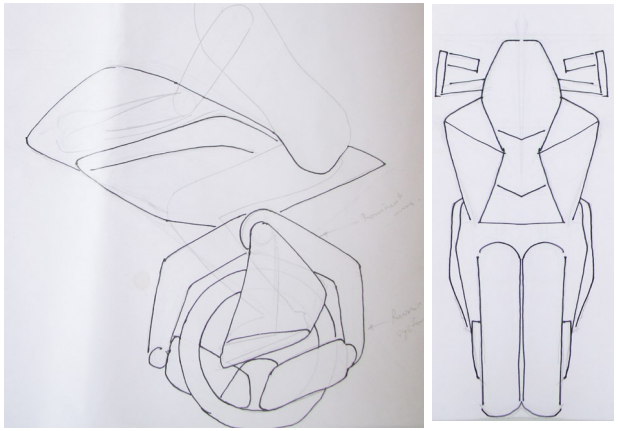


Fig 76: Concept 6

Concept 6:

The concept 6(fig 76) has a unique approach where wheels are pushed, rather than being pulled by the linkage arms, leading to reduced width at the base thus wider tyres can be used easily.

The linkages have a very prominent characteristics in the whole design.

Form Explorations:

From the earlier several concepts two most interesting concepts were selected and worked in 3D to understand the concept in a better manner

Fig 77: The concept in closed form

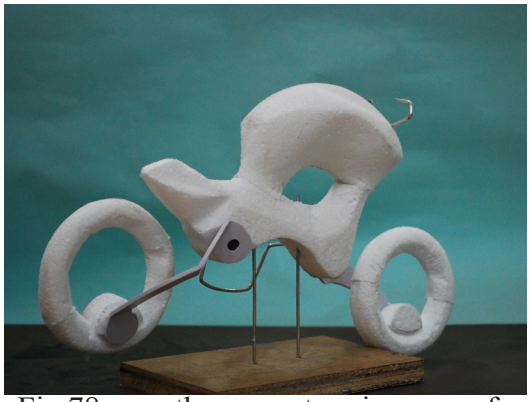
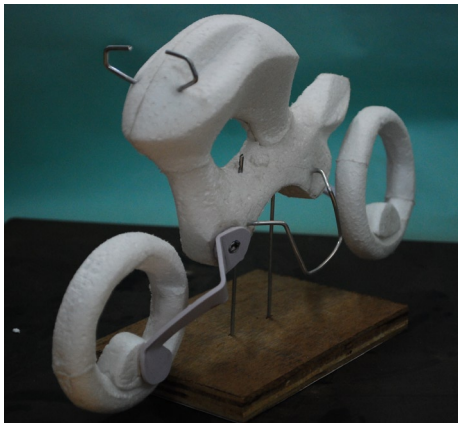


Fig 78: rear three quarter view open form



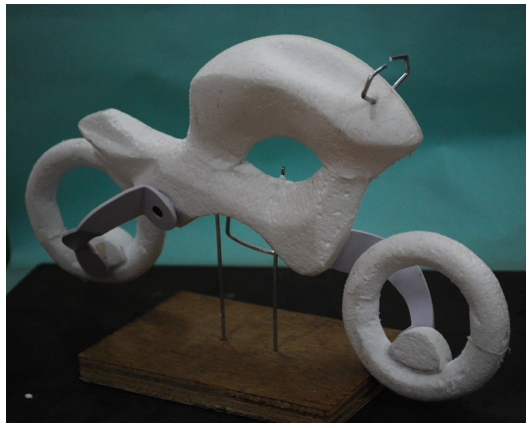


Fig 79 and 80: Front three quarter of concept

The first concept has smoother, flowing lines making it more organic type of design. The basic styling is monocoque type with a single unit fuel tank and front portion.

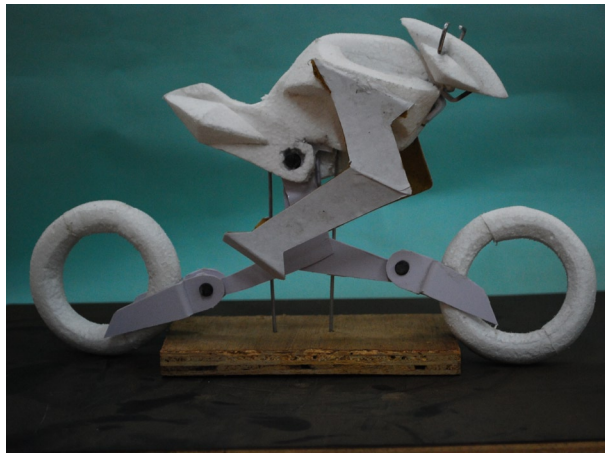
The presence of a negative space below the fuel tank reduces the mass of the vehicle and also makes the design more interesting. The linkage arms are given lower visual weightage making it gel well with the overall design.

The basic issues of the offset seat is resolved by positioning the seat exactly over the wheels and pushing the frontal elements a bit further making it more dynamic and sleek and an inclined hinge resolved the problem of offset wheels while on the bike mode.

The basic problem being inclusion of a simple arm for the wheels leading it to look not too futuristic and also it led to a problem of rising up and going down while the conversion process takes place.

Fig 81: Second concept in compact mode

Fig 82: Second concept in open mode



The second concept is more dynamic with angular theme carried all around. The basic stance of vehicle is dynamic and aggressive and becomes more dynamic while in the bike mode due to the forward bent stance and also due to the sliding down of the headlamp and handle component.

The design has a bit complicated yet reliable linkage system with minimal width along the wheel area thus preventing any possibility of accidental contact.

Higher amount of transforming ability makes the design more interesting and more futuristic.

A few issues though being the heavy tank portion and a bit unbalanced seat area. Overall proportions while in the bike mode is also an issue.

The second concept is selected as the final concept but has to be refined further to increase its appeal as a futuristic vehicle and complementing the scenario.

Fig 83: The final concept in compact mode

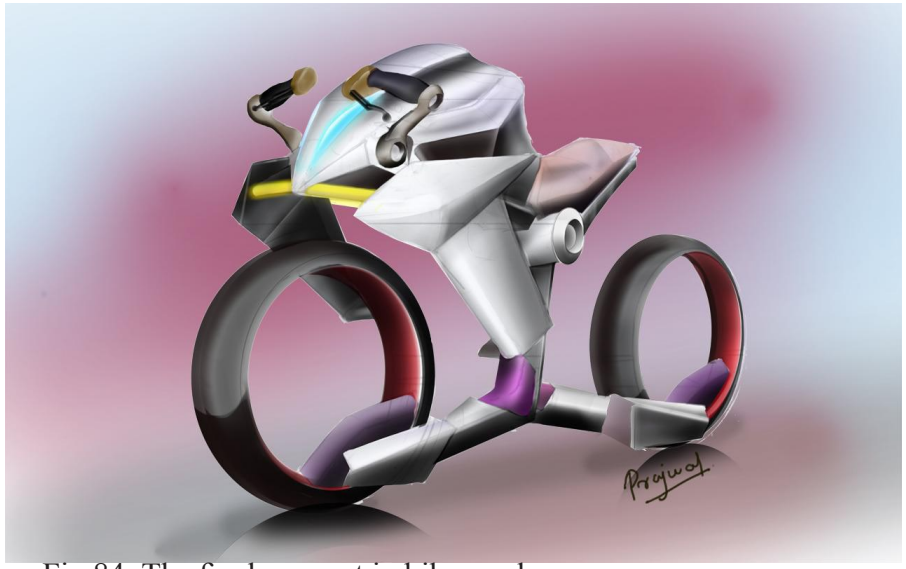


Fig 84: The final concept in bike mode

The final concept is based on the earlier slected concept but has been modified a bit to make the form more innovative and futuristic also suiting the earlier mentioned attributes.

The vehcile is powered by hydrogen fuel cells which has a regenrator technology where the by product of power generation, in the form of water, is recycled into a secondary cycle where water is processed utilizing a small reserve energy to generate more hydrogen reused for running the vehicle.

The motors are hub offset mounted on the wheels making the wheels a discrete character due to the absense of hub. The steering system used is offset steering where the whole steering is controlled through electronics via high responsive fibres providing crisp and assured steerability.

The Final Concept

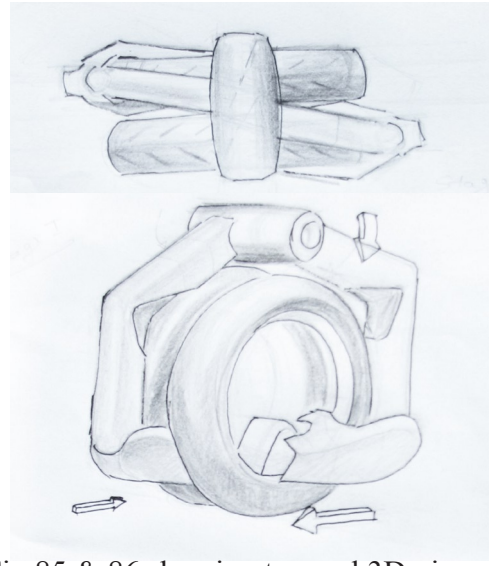


Fig 85 & 86 showing top and 3D view of the wheel arrangement in compact mode

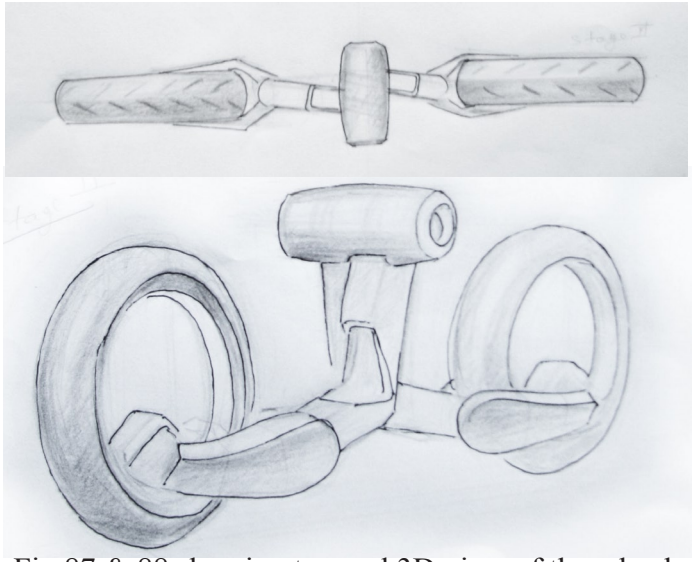


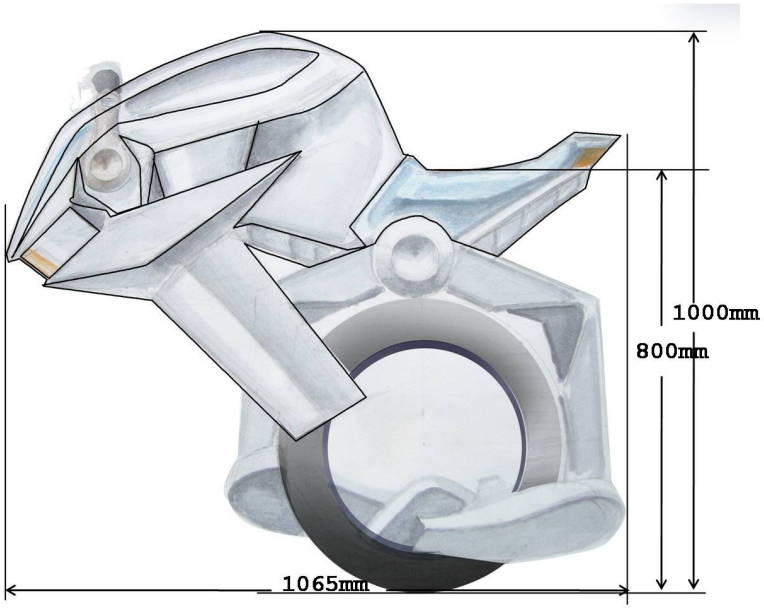
Fig 87 & 88 showing top and 3D view of the wheel arrangement in bike mode

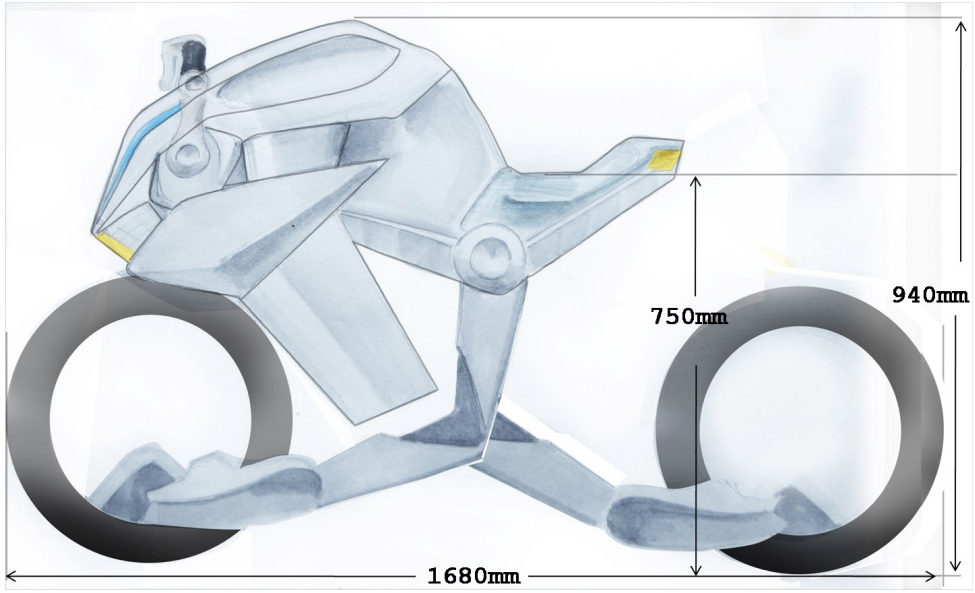
The vehicle is controlled by a system of advanced electronics, making it crashless and hence making the vehicle light weight due to non requirement of higher factor of safety to sustain crash.

The electronic system is controlled by a large remote navigation system which controls the speed of vehicles within the Supercity hence preventing it form going above a particular spees limit. But as the vehicle is out of this remote system grid and on the gesture of the driver it transforms into a bike making it capable of maving at higher speeds.

The transformation process from normal compact mode to a bike mode, as mentioned earlier, is controlled by the electronic system and also by the rider. When the transformation is to be done the rider can push a button situated at the handle, only when the system controller doesnt identify any grid restrictions, it activates the rotary motors at the central hinge (refer figs 85, 86, 87, 88) and pushes the arms(links connecting the wheels) to opposite directions and due to angle hinging the vehicle converts in a low slung agressive bike. At this moment the self balancing system turns off thus allowing full power supply to the wheels for travelling at high speeds.

Dimensional Details:





Major Dimension sheet:

Length (Compact)	: 1065mm
Length (Max)	: 1680mm
Width (Max)	: 400mm
Height(Max)	: 1000mm
Height(Min)	: 940mm
Wheelbase	: 1250mm
Wheel diameter	: 15”
Tyre size	: 120/55 15”

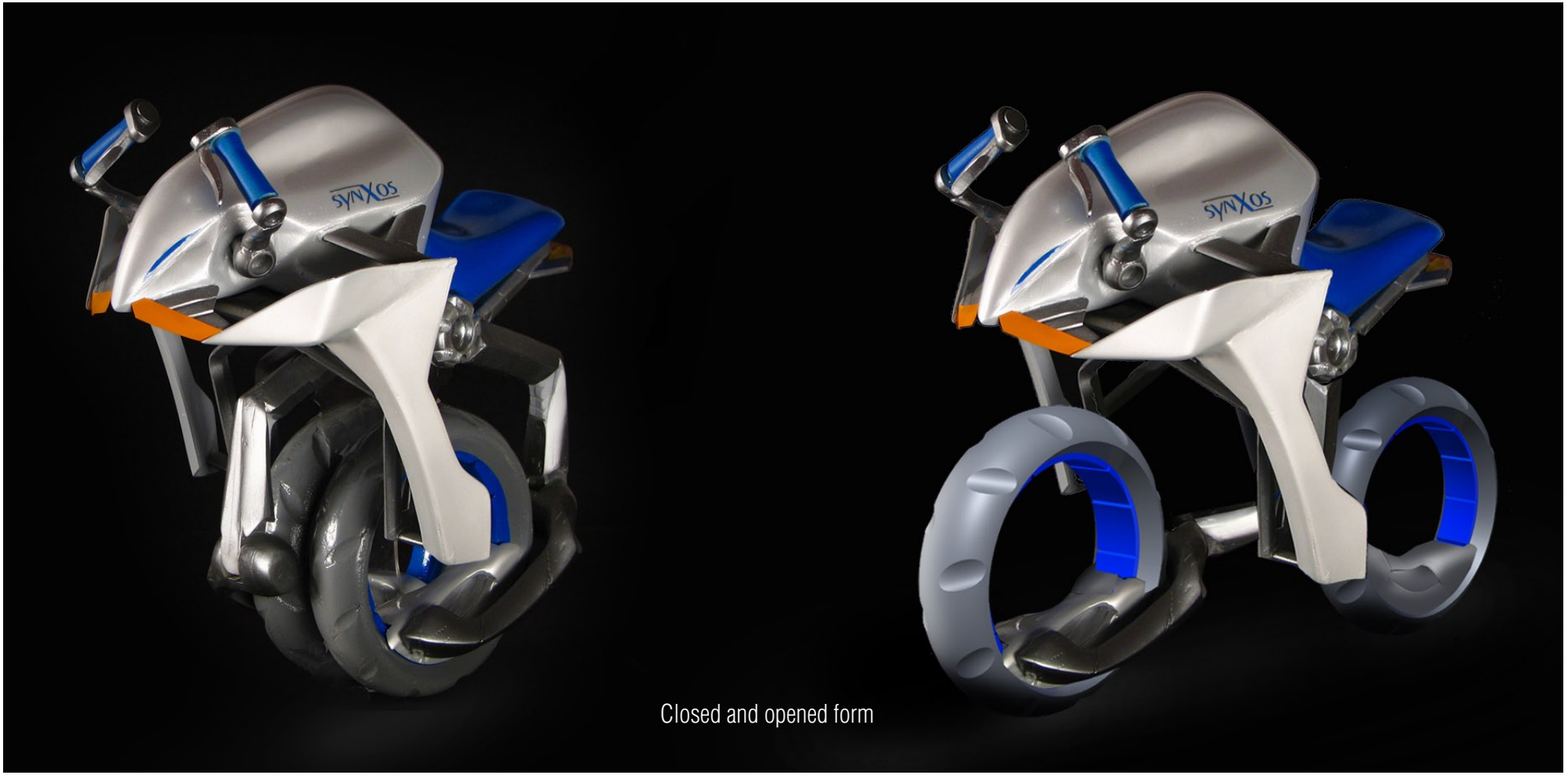
Final Concept images:

The final form of the concept is developed in order to make the vehicle look futuristic. The vehicle has a free flowing form, making it look more organic. The overall form is basically a fusion between soft, organic form and sharp edges.

The sharp, strong shoulder line generates tension, while the depression along the fuel tank and the seat portion creates an interesting negative space and also bringing up a better highlight.

The lower body consists of elements with more geometric shapes giving the vehicle a more techie feel while also carrying continuity in overall form. The visible joinery and prominent mechanical components makes the design look sturdier and the minute details make the design more futuristic.

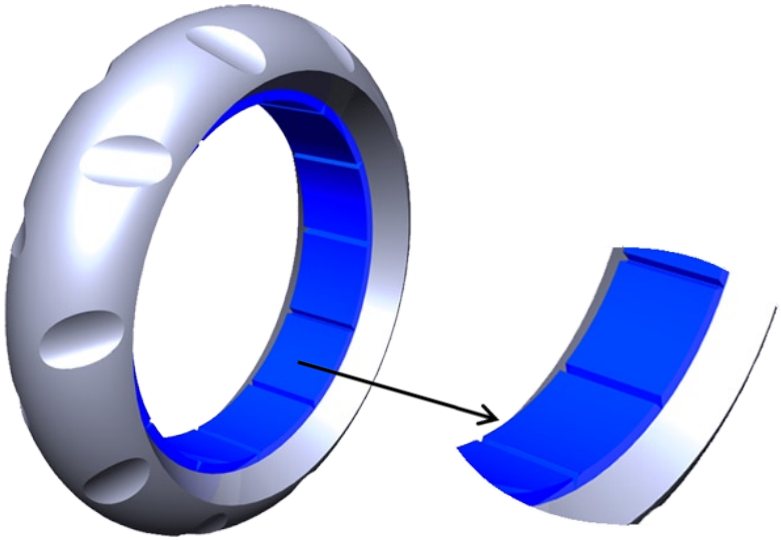
Final form



Closed and opened form

Wheel and Motor details:

Mag-Lev Offset Motor

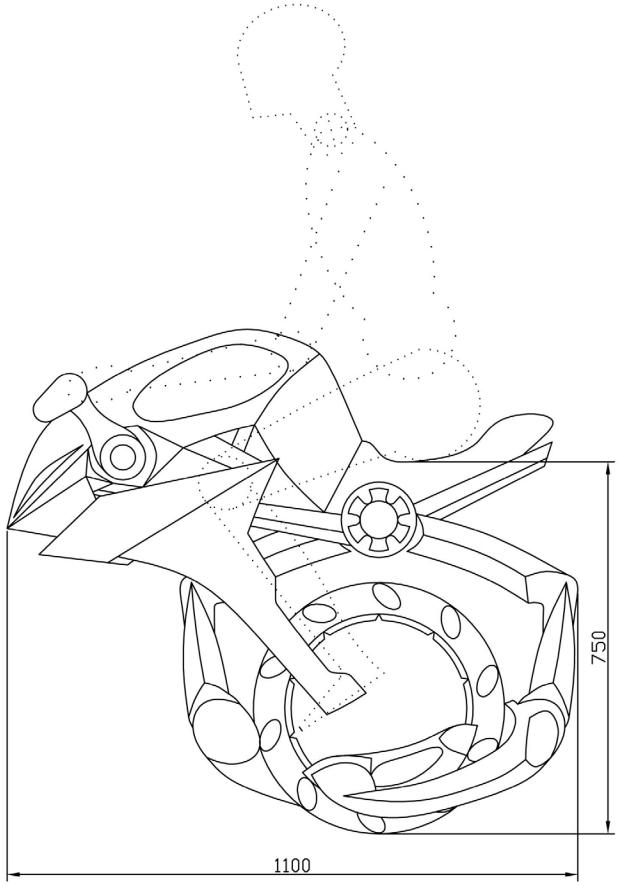


Segmented magnetic element on the inner side of rim

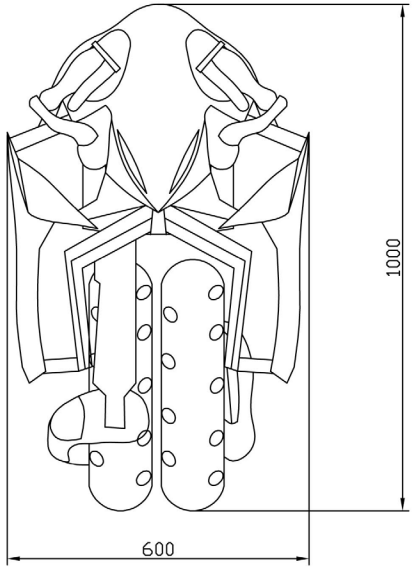
The vehicle is powered by individual hubless off-set motors, each positioned at the bottom of each wheel. These motors are highly efficient, super-compact Mag-Lev motors consisting of two sets of magnetic elements for providing power as well as the braking.

The wheel rim is a complicated unit consisting of segmented magnetic elements, running in series, positioned at the inner surface of the rim. Each segmented element is powered up to generate a magnetic field at a time, in series, leading to the stationary motor to push the wheel about the central axis.

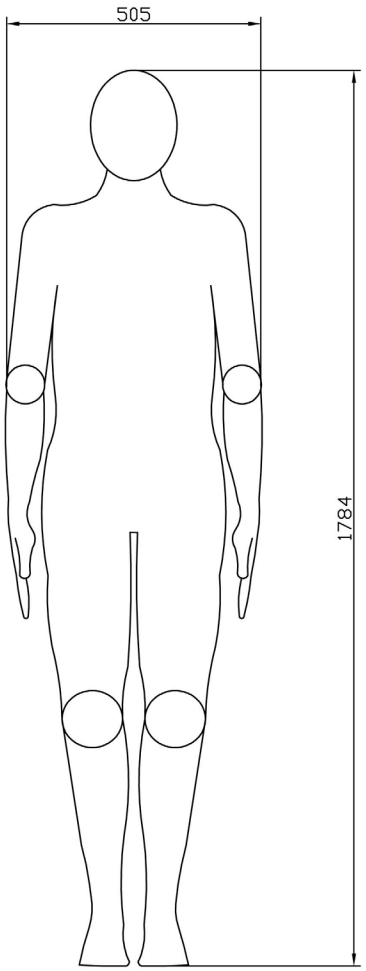
The whole system maintains a friction-less system leading to higher efficiency and reliable system for continous usage.



Side view

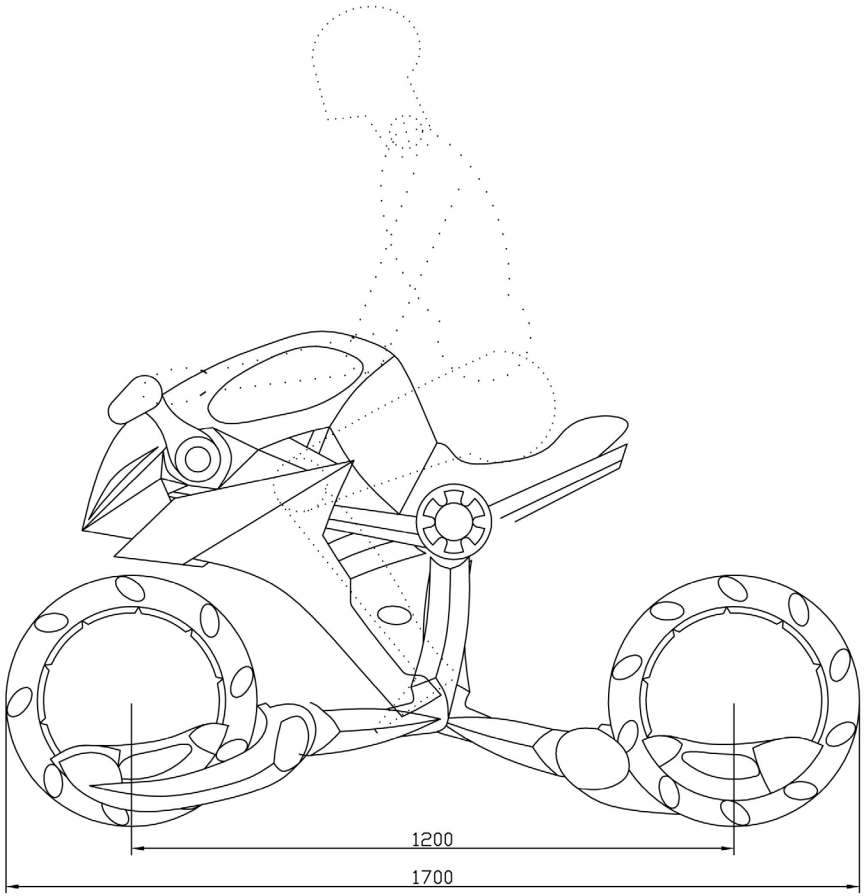


Front view

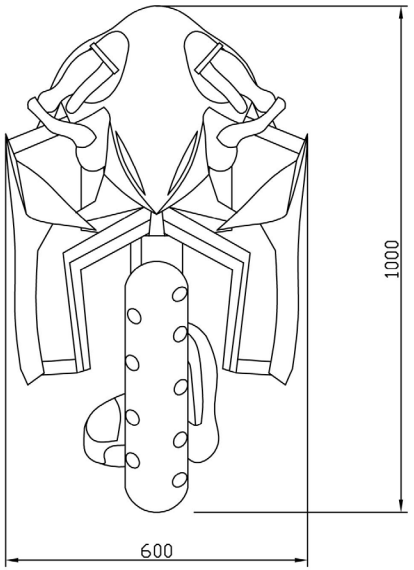


Personal mobility solution for future

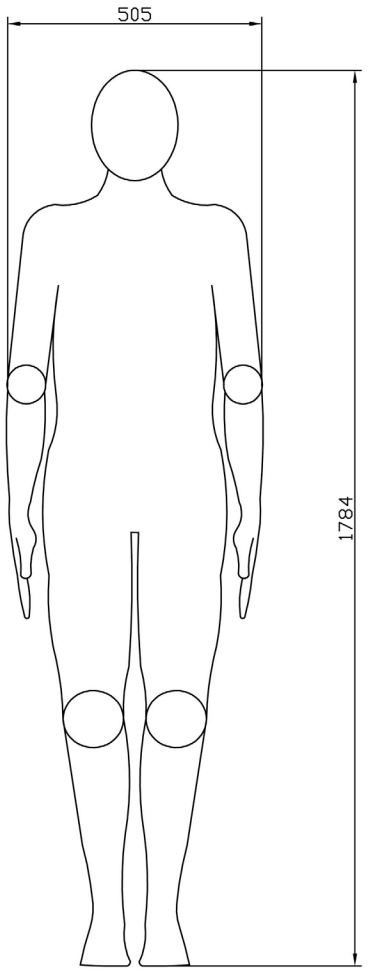
Final concept layout and dimension
All dimensions in mm Scale 1:10
Compact mode
L*B*H 1100*600*1000
Wheelbase 0 Tyre Size 120/55 15"



Side view



Front view



Personal mobility solution for future

Final concept layout and dimension
All dimensions in mm Scale 1:10
Bike mode
L*B*H 1700*600*1000
Wheelbase 1200 **Tyre Size 120/55 15"**

References

Books:

Boston Museum of science, Star Wars: Where science meets imagination, National Geographic, 2006
Stableford Brain, Futureman, London, Granda, 1984
Isaac Asimov: Isaac Asimov's science fiction treasury, Grameray, Bonanza 1980
Syd Mead, Oblagon: COncepts of Syd Mead, Japan, Kondansha Press, 1985
Daneil Simon, Cosmic Motors: Ships, cars and Pilots of another galaxy, Design studio Press, 2008

Magazines:

IVT	September 2008
Scientific American	December 2008
Autocar India Article 'A Future With Cars' Richard Parry-Jones	January 2009, Februaury 2009, March 2009, April 2009

Websites:

www.skycarexpedition.com	retrieved on January, 14th 2009
www.nextbigfuture.com	retrieved on January, 14th 2009
www.parajet.com	retrieved on January, 14th 2009
www.netcarshow.com	retrieved from December 2008 - April 2009
www.bikewalls.com	retrieved from December 2008 - April 2009
www.carwalls.com	retrieved from December 2008 - April 2009
www.imdb.com	retrieved on Decenber, 16th 2008
www.mumbaimirror.com	retrieved on January, 14th 2009
www.easy-glider.com	retrieved on January, 28th 2009
www.segway.com	retrieved on December, 25th 2009
www.youtube.com	retrieved from December 2008 - April 2009
www.cgnetwork.com	retrieved on January, 26th 2009
www.fuelcellworks.com	retrieved on March, 15th 2009
www.moller.com	retrieved on March, 15th 2009
www.wikipedia.org	retrieved from December 2008 - March 2009
www.transformers2007.nl	retieved on January, 26th 2009
www.nickbostrom.com	retrieved on January, 24th 2009
www.yamaha-motor.co.jp	retrieved on March, 13th 2009