



Product Design Project III

Power Assisted Bike for Youth

by

Abhishek Prasad

Roll No. 076138031

Guide:

Prof. R. Sandesh

INDUSTRIAL DESIGN CENTRE

INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

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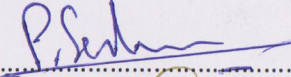
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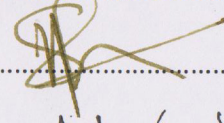
Master of Design in Industrial Design

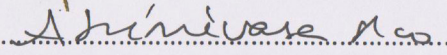
at

**Industrial Design Centre,
Indian Institute Of Technology, Bombay**

Guide.....

Chairperson.....

Internal examiner.....

External examiner.....



The Project revolves around the Future of the Bicycle in IIT. There is a vast pool of bicycle inside the Campus - Unmanaged and Untracked.. Every year thousands of new bicycles are added to this number but

what happens to the old ones?
Where they go?

The campus is full of young blood which has ambition, fire, self-Identity and vision for the new green and sustainable world. Yet these things doesn't reflect in their transport media. Some thinks its good to retain the long coming convention bicycles, while other thinks...

IIT needs an IIT Bicycle...

This project is all about...
the designing of a bicycle for the youths (male) of IIT involving exploring unique form and better use of modern day technology. Understanding the lifecycle of bicycle in IIT and User Scenario.



There are many people whose assistance helped me in this project and I would like to thank them all.

Firstly, I thank Prof. R. Sandesh, my project guide, for all his time and suggestions which helped at every stage of the project. I also thank him for his initiative in making this project happen.

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Finally, I thank my family for their support in whatever I have done till date.

Abhishek Prasad
IDC, IIT Bombay



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1.1 Bicycle - A World on Two Wheels

Bicycle is one of the most widespread forms of transportation in the world. Most of us remember our first childhood bicycle, with it came the chance to explore the unknown world with new vision and more freedom than ever before. As we grow, however, bicycling becomes more than just a childhood dream. Wind on the face and feet on the pedals, we have several good reasons to climb on and take a fascinating voyage to the edge of our imagination.

Much of the people uses bicycles as a primary form of daily transportation. Not to be constrained by simple transportation, bicycles have helped people become healthier by losing excess weight and improving cardiovascular fitness. The exercise benefits of cycling are well known.



1.1

1.2 The Project Objective



Bicycle as the form of transportation in IIT Bombay is common . But with the advance in the technology and the widespread fascination of youths towards Motorcycles, the use is declining.

Lack of maintenance facility and loss of track of bicycle in campus leads to the increase in the unused bicycles in the campus.

The project is all about the study of the scenario of Bicycle in IIT Bombay and problems associated with it. It's about exploring new forms to satisfy the emotional needs of the young generation which is free, dynamic and receptive towards the new trends.



1.3 Need of the Project

There are several reason for the need of this project –

- i) For the past several years, the evolution of bicycle we have seen. We are still in the Mountain Bike Era and New Material Era. The bicycle use has been decreasing due to the evolution of the other forms of transportation. So, bicycle needs to be revamped keeping the present user in mind in modern youth context in IIT.
- ii) Present change in the bicycle is best and easy as we are dealing with the ZAP86 Generation. Experimentation is easy as this generation for what they represent can accept any shift in the designing and form. Thinking of this generation in self Identity and the love for radical design is also the major cause.
- iii) Some of the reasons that is affecting the use present context are -
 - a) ZOOM factor - The recent ban of Motor bikes in the institute. Youth's life is fast and they want the same dynamism in their product. The love for the ZOOM factor in their transportation is one of the basic factor . Bicycle is the most viable target as per the campus rules. An average student who takes admission in IIT has a dream to buy motor bike, and most of the time they manage to get.
 - b) Starting of the efficient Tam-Tam (Bus) facility in the campus is also the major cause in the decrease in the number of the bicycle users. Time has changed and with that thinking is also changing. Whatever explanation is given regarding healthy or cheap form of transportation, it keeps less relevance in present context.

iv) There is a culture associated with the campus and the use of bicycle is one of them. For the past so many years bicycle has also become the part of youth persona inside IIT. In the past we could have easily seen two or three students on the same bicycle, now its rare.

But the present decrease in the use of bicycle inside campus found during user study is affecting this culture. To protect this its needed to know their needs on the basis of physical as well as emotional front.

v) New technologies and materials are available on the doorstep to bring a revolutionary change in the bicycle in a positive way. For so many years students have seen bicycle in the form of diamond shaped frames but the technology has evolved a lot to offer to see the form beyond the architectural play with the rods.

vi) The irregular maintenance facility inside campus is also one of the major cause in the decrease in the use of bicycle and loss of track.

vii) The introduction of the internet facility in the hostel rooms has decreased the social gathering and made the student more reserved. Bicycle is also one of the factor of social interaction. The decreasing use can make the situation even more worse.

Earlier several attempts were done (banning of internet in rooms from 4pm to 7pm) to increase the social interaction. But it failed and withdrawn.

viii) Most of the parts are needed to be focused depending upon their need and use.

ix) Sustainability – A sustainable form of transportation is always accepted inside the campus.



1.4 Project Brief



To design a **Power Assisted Bicycle**
which can be used for
Transport
as well as **Pleasure**
For **Youths** (Boys of IIT)...

Area of focus will be exploring **Unique Form**
& assisted by **Electrical Source.**

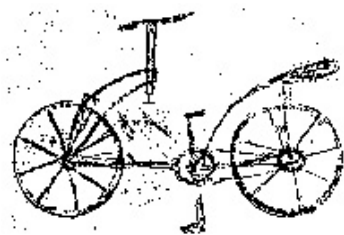
2 History of Bicycle





2.1 Timeline of Development of Bicycle

The story of Bicycle is rich with technology innovations, social and urban history, sporting history, and environmental benefits. Its a journey that has seen our development from past to the modern day technological world. Here the evolution of bicycle is shown through a timeline to simplify the understanding.



2.1

Leonardo da Vinci's sketch of Bicycle



2.2

The Earliest Bicycle - 1790

Celerifere
Comte Mede de Sivrac
France



2.3

1817 to 1860
Draisienne Era

Draisine
Karl von Drais
Germany

Named after its inventor, Karl von Drais of Germany, the draisine was one of the earliest widely used two-wheeled, self-propelled machines.



2.4

1863 to 1869
Velocipede /Boneshaker Era

Velocipede
Pierre & Ernest Michaux
France

Attachment of cranks and pedals to the front wheel. Fitted with a rudimentary brake & bell. Most were heavy, being constructed from wood and iron.

1870 to 1891 - High Wheel Era

The high-wheel bicycle evolved from the boneshakers through two principal advances: The first incorporated design improvements spawned by boneshaker racing. Cyclists knew that a larger front wheel would be faster, and they discovered through experimentation that the rear wheel could be made smaller. The second area of innovation included manufacturing improvements through mass production in factories, metallurgy improvements with lighter and stronger steel tubing, and engineering advances—most notably the mechanized production of steel ball-bearings.



2.5

Child's Currie
Tandem



2.6

Child's Highwheel
Tricycle



2.7

Child's Toy
Horse



2.8

Penny-Farthings
1880s



2.9

Coventry Rotary
Tandem



2.10

Eagle



2.11

Loop Frame
Tricycle



2.12

Star

Safety Bicycle Era

The safety problems of the high-wheel machines forced the invention of the bicycle that emerged from England in 1885 soon became known as the "safety bike." It forced the **High wheel to extinction**. Aside from small changes in materials, the safety bikes of the late 1800s are very similar to modern bikes. With **equal size wheels** and a chain drive, the new bike allowed the rider to sit **low enough to touch the ground with feet**. The new chain-operated drivetrain incorporated gears, **ending the problematic 1:1 pedalstroke to wheel circumference ratio limit**. Major innovations of the early safety bike included the chain (become cheaper to manufacture), the **pneumatic tire** (invented in 1888) and **the diamond-shaped frame**, also from 1888.



2.13

1916 Pierce Arrow
Motorized Bicycle



2.14

Cleveland Lady's Safety
Bicycle - 1893



2.15

Dursely-Pedersen



2.16

Lady's Elliott
Hickory



2.17

Old
Hickory



2.18

Reading Chainless
Spur Gear Drive



2.19

Unknown Dual Suspension
Safety Bicycle

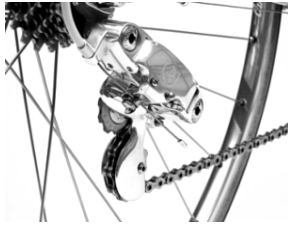


2.20

Waltham
Orient

1908 to 1988 - Derailleur Bike Era

The slow evolution of the bicycle drivetrain over a 70 to 80 year period beginning in 1908. Early development of derailleurs started with French efforts to improve on the gearing systems.



2.21

1908 to 1988
Derailleur Bike Era

1971 to 1974

Bike Boom/Baby Boom Era



2.22

1971 to 1974
Bike Boom/Baby Boom Era



1953 to Present - Mountain Biking Era

In the 1970s, the idea for mountain bikes progressed under the guidance of Gary Fisher, Joe Breeze, Tom Ritchey and other Northern California enthusiasts.



2.23

1953 to Present
Mountain Biking Era

1980 to 2000

Steel Frames & New Materials Era

The period was a turning point in the materials used in bicycle frames. During this period, lightweight steel was continually refined to be lighter and stronger, while still maintaining excellent riding characteristics and durability. New materials including aluminum, titanium and carbon fiber gained respectable acceptance among cycling consumers. During this period, manufacturing improvements in these new materials resulted in frames with consistent performance advantages,.



2.24

1980 to 2000
Steel Frames and New Materials Era

NEXT ?

2.2 History of Bicycle in a Nutshell

Innovation	Year	Country	Details
	1817	Germany	Baron Von Drais invents the "running machine" or Laufmaschine. Patented the following year. Known in various forms as : Draisine, Draisienne, Velocipede. English version was the Hobby Horse (Denis Johnson). All have two, in-line wheels and the ability to steer.
Hand Drive	1821	England	Louis Gompertz adds a hand-driven, ratchet mechanism to the front wheel of a Hobby Horse but the innovation, as with Drais' was never really followed up.
	1839-1840	Scotland	Kirkpatrick Macmillan is traditionally credited with a machine in which power was supplied to the back wheel via rods connected to treadle-type pedals. Thomas McCall marketed copies; an 1845 version is in the Dumfries Museum. It is questionable whether significant progress resulted from either.
Rear-Wheel-Drive Bicycle	1843	France	Alexandre Lefebvre is credited with a rear-drive machine; he took it to America twenty years later and it still exists in the "History San Jose" museum (the earliest extant bicycle?).
Pneumatic Tire	1845	England	R. W. Thompson invents the pneumatic tire but with no commercial follow-up.
Treadle Drive	1847	Scotland	Gavin Dalzell builds a two-wheeled hobbyhorse with a treadle-drive, possibly copied from the Macmillan design.
Crank-Driven 4-Wheeler	1851	England	Willard Sawyer exhibits his four-wheeled, crank-driven vehicle at the Great Exhibition and subsequently becomes established as a Velocipede manufacturer.
Boneshaker Bicycle	1864	France	J. Townsend Trench documents his purchase of a velocipede from the Michaux family. Possibly the first record of a "production" front wheel, pedal-driven bicycle (but note that it was not presented until 1895). This style became known as the "Boneshaker". Historians still debate the claim of Pierre Lallement that he had previously invented the first pedal-driven machine.
	1866	USA	Lallement, now in the USA, gets the backing of an investor, James Carroll, and their patent application is granted; probably the world's first public record of the pedal-powered two-wheeler.
	1870	England	James Starley products the "Ariel" High Wheeler (aka "Ordinary" or "Penny Farthing"). Later versions had front wheel sizes of upto 5 feet.

"Every time I see an adult on a bicycle, I no longer despair for the future of the human race."
~ H. G. Wells



*“Get a bicycle. You will not regret it if you live.”
~ Mark Twain
‘Taming the Bicycle’*

Innovation	Year	Country	Details
Wire-Spoked Wheel	1870	England	W. H. J. Grout patents the radially spoked, nipple adjusted bicycle wheel (unlike prior load-bearing wheels). Some credit Meyer with this design two years previously.
Ball Bearings	1872	German	Friedrich Fischer first mass-produces steel ball bearings, patented by Jules Suriray in 1869
Caliper Brake	1876	England	Browett and Harrison patent an early caliper brake.
Differential Gear	1877	England	James Starley patent a differential gear; probably the first for a bicycle but the principle was not new.
Internal Hub Gearings	1878	England	Scott and Phillott patent the first practicable epicyclic change-speed gear fitted into the hub of a front-driving bicycle.
Folding Highwheeler	1878	England	Grout patents a folding High Wheeler, the first "portable" bicycle.
	1879	England	Henry J. Lawson patents a rear wheel, chain-driven safety bicycle, the "Bicyclette" (his earlier models were lever driven)
Chain	1880	England	Thomas Humber adapts the block chain for use with his range of bicycles.
Safety Bicycle	1885	England	John Kemp Starley (James Starley's nephew) markets the revolutionary Safety Bicycle (the "Rover") with a chain/rear-sprocket drive and tangentially-spoked, similar sized wheels. Includes many of the major features of modern bicycles.
Seamless Tubing	1886	Germany	The Mannesman brothers are credited with the invention of the process to manufacture seamless steel tubing.
	1888	Scotland	Commercial development of the pneumatic bicycle tire by Dr. John Boyd Dunlop.
	1890s	France	Cycles Aluminium becomes one of the earliest manufacturers of an aluminium bicycle.
Derailleur	1896	England	E. H. Hodgkinson patents a 3-speed Gradient gear, a pre-cursor of the modern derailleur.
Internal Hub Gearing	1896	England	William Reilly patents a two-speed hub gear. His later 3-speed version was put into production by Sturmey Archer in 1902.

"It is by riding a bicycle that you learn the contours of a country best, since you have to sweat up the hills and coast down them. Thus you remember them as they actually are, while in a motor car only a high hill impresses you, and you have no such accurate remembrance of country you have driven through as you gain by riding a bicycle."
~ Ernest Hemingway

Innovation	Year	Country	Details
Butted Frame Tubes	1897	England	Alfred M. Reynolds takes out a patent on "butted" steel bicycle tubes.
Freewheel	1898	Germany	First major commercialization of the freewheel by Ernst Sachs. William Van Anden had obtained the first freewheel patent in 1869.
	1910	France	The first, easy-to-use derailleur is invented by Paul de Vivie (Velocio) that shifted among four gears at the pedals.
Recumbent	1914	France	Peugeot markets their production recumbent bicycle. Charles Challand had exhibited his "Horizontal Bicyclette Noemale" in Geneva in 1895.
Dual-Suspension Mountain Bike	1915	Italy	Bianchi produced a folding bicycle for the Italian Army with telescoping seatstays, a leaf spring at the bottom bracket, a spring fork and large profile pneumatic tires. Bianchi now calls it the first dual suspension mountain bike! There are earlier versions of military folding bicycles.
	1930	Italy	Tullio Campagnolo introduces the bicycles hub quick-release.
Recumbent	1932	France	Charles Mochet designs the Velocar, a recumbent bicycle on which Francois Faure breaks both the mile and kilometer records.
	1933-1934	USA	Introduction by Schwinn of the balloon tire and "streamlined" bikes which leads to rugged bikes that can take the abuse of teenage boys and which set a forty-year trend.
Mountain Bike	1938	USA	Schwinn markets the "Fore-wheel" brake, "Cantilever Frame" and the "Spring Fork". Resulted in what was to be the Grandfather of today's mountain bikes.
Folding Bicycle	1939	France	A. J. Marcelin patents "Le Petit Bi", a 16-inch wheeled folding bicycle, remarkably similar to the Moulton and Bickerton of later years.
Shifter	1946	Italy	Campagnolo markets the dual-rod "Cambio Corsa" gear shifter (over ten years after the prototype) widely used for at least a decade.
Index Shifting	1949	England	The Hercules Herailleur is launched; a rear derailleur with indexed shift levers. Marketed for five years.



*“Life is like riding a bicycle - in order to keep your balance, you must keep moving.”
~ Albert Einstein*

Innovation	Year	Country	Details
Derailleur	1951	Italy	Introduction of Campagnolo's modern Gran Sport derailleur.
	1962	England	Launch of the Moulton small-wheeled bicycle with separately sprung suspension and custom tires. Competed successfully in time trials and track pursuit events.
String-Ray	1963	USA	Schwinn introduces the Sting-Ray that subsequently helped launch the BMX craze.
Rear Derailleur	1964	Japan	The Sun Tour Grand Prix is marketed as the first slant parallelogram derailleur, a design that has held up till the present day.
Index Shifting	1969	Japan	Sun Tour launch their indexed shift lever, the Five-Speed Click, and a combined freewheel-plus-rear hub, the Unit Hub. Neither of them found a market, and were abandoned. Bayliss Wiley in England has also experimented with unit hubs as far back as 1938.
	1970	England	The aluminium Bickerton portable small-wheeler is developed. Followed by the successful Brompton in 1976 and Dahon in 1980.
Bmx (Bicycle Motocross)	1970	USA	The movie On Any Sunday by Bruce Brown debuts. Although it is a motorcycle documentary, a brief scene during the beginning of the movie shows kids on Sting-Ray bikes emulating motocross. This small spark eventually evolves into full-fledged, organized BMX racing by 1974.
Mass-Produced Titanium Frame/Fork	1974	USA	Teledyne markets the first titanium bike that was produced in any quantity (Speedwell of England had some Ti production frames as far back as the 1960s, welded by Lamborghini!) Litespeed brought titanium frames to a broader market in the 1980s.
	1975	USA	The first carbon-tubed, metal lugged frame appears: the Exxon Graftek. Suffered from frequent frame failure. The technology was later perfected by Look, Trek and others.
Aluminium Frames/Bikes	1975	USA	Gary Klein displays his welded and heat-treated aluminium frames at the International Bike show. Alan (Italy) and Vitus (France) were producing their lugged aluminium frames around the same time. Cannondale launch their "Aluminium for the Masses" in 1983.

“After your first day of cycling, one dream is inevitable. A memory of motion lingers in the muscles of your legs, and round and round they seem to go. You ride through Dreamland on wonderful dream bicycles that change and grow.”
~H.G. Wells,
The Wheels of Chance

Innovation	Year	Country	Details
	1978	USA	Fomac Corporation designs the Avatar recumbent. It is one of the many styles that constituted the 1980s renaissance of recumbents which included Lightning Cycle winning the HPV-RAAM relay and Easy Racers breaking the 65 mph barrier.
High-Quality Folding Clincher Tire	1978	USA	Specialized introduce the first high-quality foldable clincher tire (the Turbo) which launches the demise of the tubular.
Aerodynamic Road/Track Bicycles	1980	East Germany	Introduction of aerodynamic bicycles with a stable construction. Culminated in the American "Super Bike" at the 1984 Los Angeles Olympics.
Mass-Produced Mountain Bike	1981	USA	The specialized Stumpjumper mountain bike is launched nationwide, capitalizing on the Marin Country vogue inspired by Californian icons, Gary Fisher, Joe Breeze, Tom Richey et al. (all of whom also produced earlier mountain bikes).
Electronic Cycle Computer	1983	USA	Avocet launch the first electronic cyclometer (bike computer).
Moulton	1983	England	Moulton launches his second generation of "space-frame" small-wheeled bicycles.
Clipless Pedals	1984	France	LOOK markets their clipless pedal (following on an earlier track model launched by Cinelli in 1970; the "Death Cleats", no automatic release).
Index Shifting	1985	Japan	Shimano introduces SIS indexed shifting (learning from their inferior product, the Positron, from 1977).
	1986	USA	Kestrel introduces their production non-lugged, carbon fiber frame and Trek market their first lugged carbon frame.
Suspended Mountain Bike	1987	USA	Paul Turner demonstrates a full suspension bicycle with front and rear shocks. Eventually becomes a partner in Rock Shox. Diversified the sport of off-road biking.
Aero Handlebars	1987	USA	Scott USA manufactures the first modern aerobars, originally the brainchild of Boone Lennon. Pete Pensyres had earlier used his own clip-on style bars in setting his RAAM record.



"The bicycle is a curious vehicle. Its passenger is its engine."
~John Howard

Innovation	Year	Country	Details
High-Performance Folding Bike	1989	USA	Hanz Scholz designs the Bike Friday "World Tourist". A reasonably compact folding bicycle that matches the performance of conventional touring machines.
Integrated Brake/Shift Levers	1990	Japan	Shimano introduces integrated brake/gear levers.
Electric Derailleurs	1993	France	Mavic markets their ZAP electronic shifting. Ceases production in 2001. Possible future follow-up by Campagnolo. Browning Research had invented a prototype electronic system in 1974.
Hydraulic Disc Brake	1994	USA	Sachs (SRAM) introduces Power Disc, the first mass-produced hydraulic disc brake system.
	1998	Germany	Rohloff develops the Speedhub, 14 equally-spaced hub gears which are operated by a twist-grip with no overlapping ratios and a gear range as wide as a 27-speed derailleur system.
30-Speed Derailleur Drivetrain	2002	Italy	Campagnolo offers a 30-speed derailleur drivetrain with the Record 3-x-10a drivetrain.

3 Types of Bicycles





Bicycle (Categories)

- a) Road Bike
- b) Mountain Bike
- c) Hybrid Bike

Road Bike :

- Light & Stiff Frame
- Narrow Wheel Rims & Tires
- Dropped Handlebars
- Uncompromising riding position
(Bars lower than saddle)
- Very responsive
- Twitchy feel to ride



3.1

- Riding takes a little getting used to
- Design translates effort into speed effectively

-Mountain Bike :

- May have suspension
- Sturdy Frame
- Flat Tires



3.2

Three Types -

- i) Rigid
 - It applies equally to all Road Bikes as well as Hybrid Bikes
 - No suspension
- ii) Hardtail
 - Only Front Wheel Suspension
- iii) Full Suspension
 - Suspension on both wheels

Hybrid Bike :

- Includes -
- City Bike
 - Street Bike
 - Urban Bike
 - Utility Bike
- Flat Bar
 - Upright Riding Position
 - Lighter in Frame, Wheel & Tyres than MTBs



3.3

Some features of other two Bikes are introduced to satisfy the emotional needs of the user.

Ex-

- i) Swapping the handlebars for a pair of drops to pass as a Road Bike.
- ii) Bigger Knobblier pair of tyres to cop with moderately serious Mountain Biking.
- iii) Some are called Hybrid because they have front suspension which does soak up the bumps on rough city streets and bike tracks.





4.1 Major Bicycle Manufacturers in India

With an annual turnover of more than 12 million bicycles, the bicycle industry is one of the most established industries in India. It has raised the country's position to that of the second largest bicycle manufacturer in the world, next only to China. India has seen a tremendous increase in the number of bicycle manufacturers and bicycle exporters in the recent past. Today, the Indian bicycle manufacturing and bicycle spares industry is well accepted and is also widely recognized for its quality standards in international markets.

Most bicycle components, spares and bicycle accessories in India, except for free wheels and single piece bicycle hubs, are manufactured by the Small Scale Sector (SSIs), while the large scale units are permitted to manufacture bicycle frames, chains and rims for captive consumption. Manufacture and export of complete bicycles falls within the purview of the Organized Sector. The Indian bicycle industry is currently in the midst of making endeavors for enhanced and increased bicycle exports since the scope for export of Indian manufactured bicycles in the international market is significant. As per public reports the present level of exports falls within the range of Rs. 150 crores. This includes Bicycles, bicycle spare parts and bicycle accessories.

The main manufacturers of bicycle in India are HERO Cycles, BSA HERCULES Cycles, ATLAS Cycles and AVON Cycles. The current and popular bicycles of these companies are shown on the coming pages.



4.1.1 HERO Cycles



4.1 HERO Octane 26T



4.2 HERO Nitrogen



4.3 HERO Nitro Integra



4.4 HERO Hawk



4.5 HERO Buzz Nu-Age



4.6 HERO Razorback NE



4.1.1.1 Other Bicycles of Hero Cycle which are not very common



4.7 Escape



4.8 Vengeance 26T



4.9 Thunder Racer



4.10



4.11



4.12

4.1.2 BSA & HERCULES Cycles



4.13 BSA Wow 21 speed



4.14 BSA Ryders ACT 105



4.15 BSA Ryders ACT 106



4.16 BSA Ryders ACT 108



4.17 Hercules Flash



4.18 Hercules Blazer IC 24"



4.1.3 ATLAS Cycles

ATLAS



4.19 STEALTH SERIES 100



4.20 MOON RAKER



4.21 T-20



4.22 FRENZY 26



4.23 SHARP SHOOTER SR



4.24 DOMINATOR 18 SPEED



4.25 DUROSHOX



4.26 COLUMBUS SR



4.27 SCUD SHOX



4.28 NUCLEUS XT



4.29 PRO-VX



4.2 Bicycles in International Market



4.30 Micargi 18 Speed Mountain Bike



4.31 Avenue bicycles



4.32 Cannondale Prophet 400 Bicycles



4.33 Cannondale 2007 Six13 Team 1 Bicycle



4.34 Norco Bicycle



4.35 HUMMER Tactical Mountain Bike



4.36 Cannondale Raven 3000



4.37 Trek Bicycle



4.38 Trek 2009 Madone



4.3 Electric Bicycles in International Market



4.39 Panasonic Electric Bike



4.40 Electric Bike



4.41 Ohm Electric Bike



4.42 The Eight Speed Transmission Electric Bicycle



4.43 Rietti GTX Electric Bike



4.44 Optibike 800Li



4.45 A2B Electric Bike



4.46 Yamaha Divide (concept)



4.47 Yamaha Deinonychus (concept)





5.1 Defining the User - Youths of IIT Bombay (Persona)

Youth is that section of the society who are the future. They have fire and ambition to do anything. They are very adaptive to the new technological and modern products and their products reflect the youth dynamism. Some of the general mentality associated with them are written here.



5.1

- Age group 17-27
- Party Goers
- Receptive to the New Trend
- Rebellions in Nature
- Status Symbol
- Student
- Gadget Freak
- Bike & Car Lovers
- Generally have Girlfriend
- Believe in their own Identity
- Believe in breaking the rules
- Dream to win the whole world
- Zap 86 Mentality
- Updated with latest Technology
- Used to have Cell phone & MP3 Players
- Experimental in Nature
- Love western as well as Indian Lifestyle
- Life is fast and their product should reflect the same.

Living Style

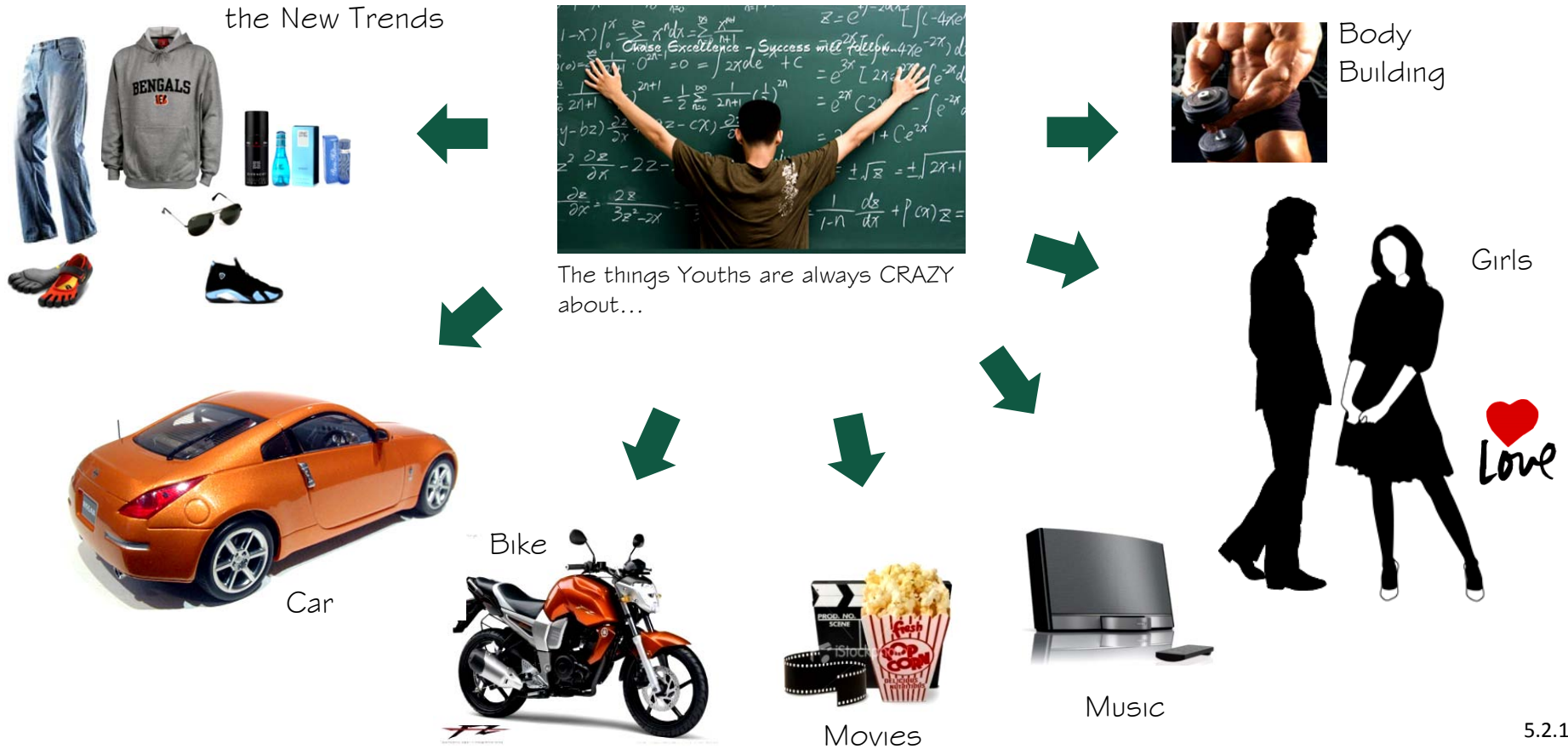
- Alone
- With Roommates
- With Friends
- With Family

5.2 Mind Map

A proper research was done to define the persona of the youth.
Involving their like and dislikes and various other factor that can affect
the design to better serve their emotional as well as basic need.

Receptive towards

the New Trends



5.2.1



Student



Party Goers



The one who is born after 1986 belongs to of ZAP 86 mentality, are rebellion & non-compromising generation.



Status Symbol



Fast-Food Lovers



Gadget Freak

These people are very flexible and very receptive towards new trends and technology.



Identity



This generation believes in Self Identity.

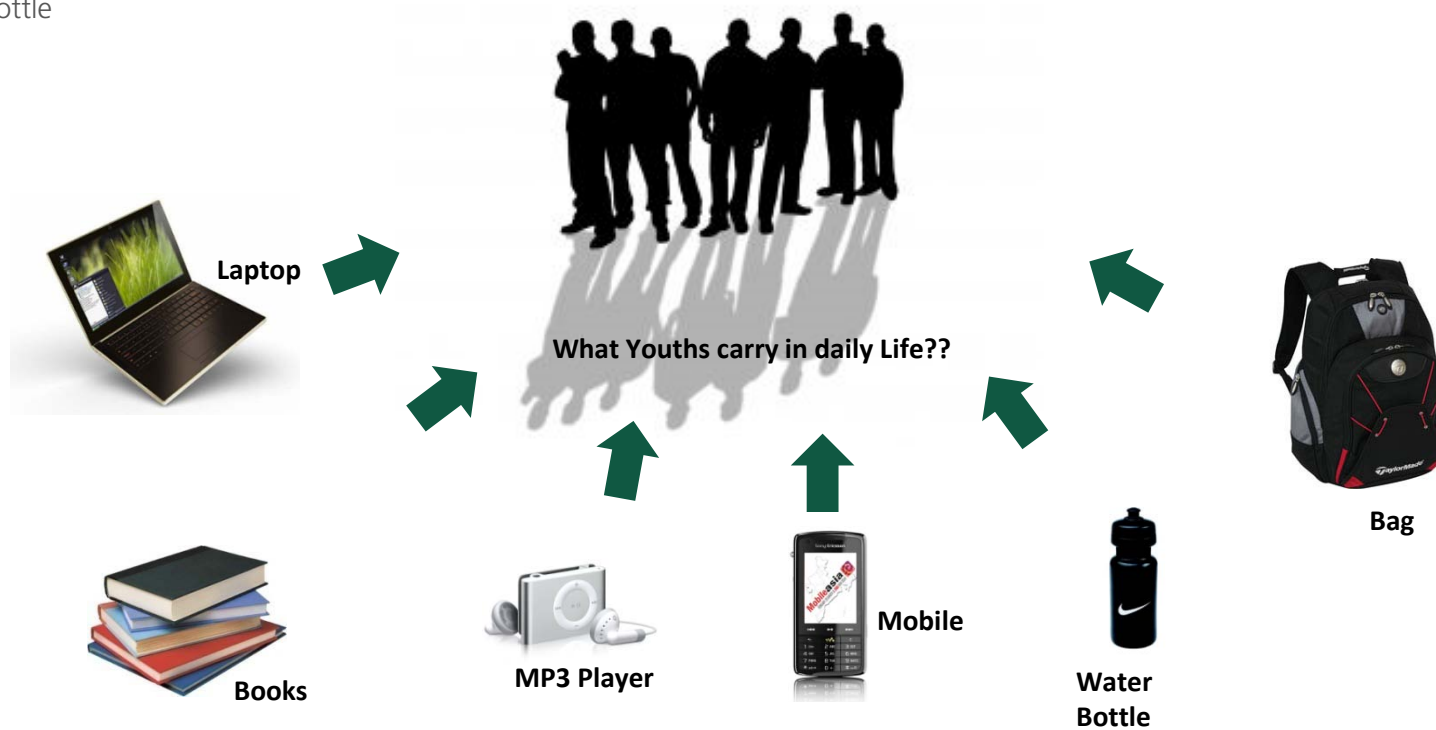


5.2.2

5.3 User Requirements

This section of society has unlimited requirement just like their nature. Yet there are some specific requirements of a college going youth. They generally use to carry few of the things daily which comprises of –

- Laptop
- Books
- Mobile Phones
- Mp3 Players
- Water Bottle
- Bag



5.3



5.4 Bicycle Users in IIT Bombay

The main user study started with the user survey of numerous students across the various streams of IIT, Bombay to include variation. Different students were with different opinion gave their views towards their dream bicycle.

Table 5.1 shows the percentage of students having Bicycle. Approx 66.7% of students are having bicycle while 33.3% are not. Yet most of the student use bicycle, either their own or others.

Bus facility inside IIT Campus has accounted for the decrease in the use of Bicycle. But facility is still not a 24*7 service. The recent ban of use of motorized vehicle inside campus is slowly encouraging the use of bicycle. Bus facility is not available at night, so bicycle becomes the major source of transportation during late hours of night.

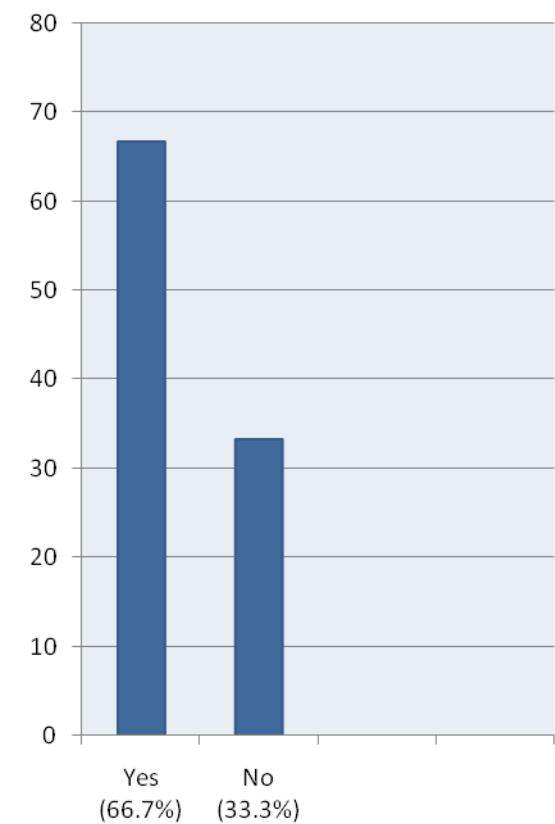


Table 5.1

5.5 Using Frequency & General Problems associated with Bicycles

User frequency of the bicycle is still diverse. There are several causes of it but the major and the most common are listed below. Many problems account for the decrease in the use of the bicycle but the most common are written in bold.

Table 5.2 shows the user frequency of the bicycle inside campus by several students. There are several students who use bicycle everyday while there are others whose using scenario is unpredictable. All the data regarding this thing has been tabulated in table 5.2.

- Up-Hill Slope of IIT Bombay
- Sweating on Destination
- Better Affordability
- Maintenance Problem
- Inconvenient to Carry too Many stuffs
- Rainy Season
- Availability of Tum-Tum
- It's better to walk
- Tum-Tum and Autos are far more efficient
- IIT is too small
- Loss of Track

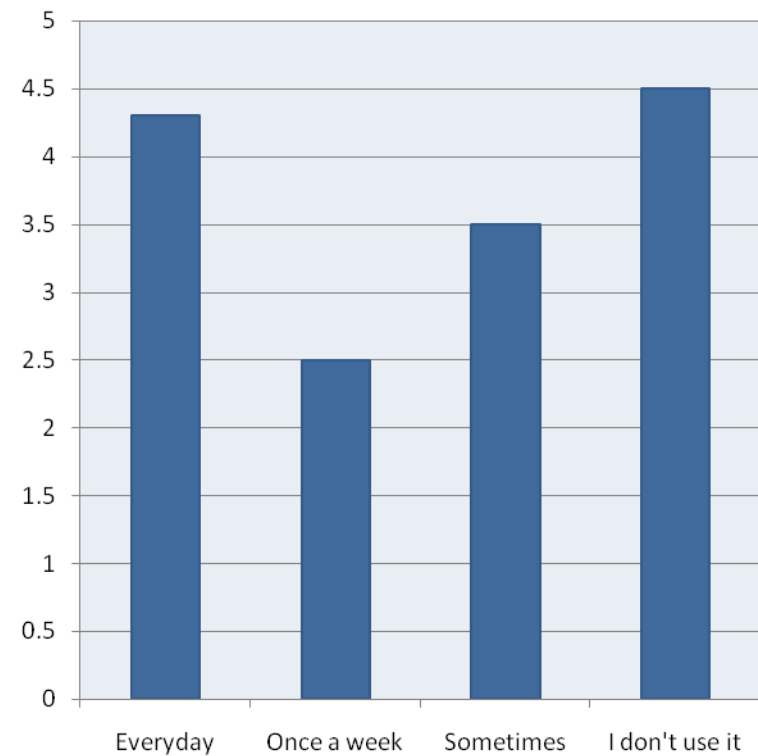


Table 5.2



5.6 Perception of Bicycle in IIT Bombay

Different users have different perception of bicycle inside the campus. Some consider it as the mode of commutation while some do perceive it as a mode pleasure too. A few students do consider bicycle as problem as the maintenance scenario of bicycle inside campus is pathetic. This user use bicycle as the last resort when no other facility is available. Mostly this need rises in night when bus facility is not available and auto-rikshas are scarce.

For many still bicycle is the cheaper alternative of transportation and these are generally regular users. The survey was done on 35 students across various streams of IIT Bombay (table 5.3).

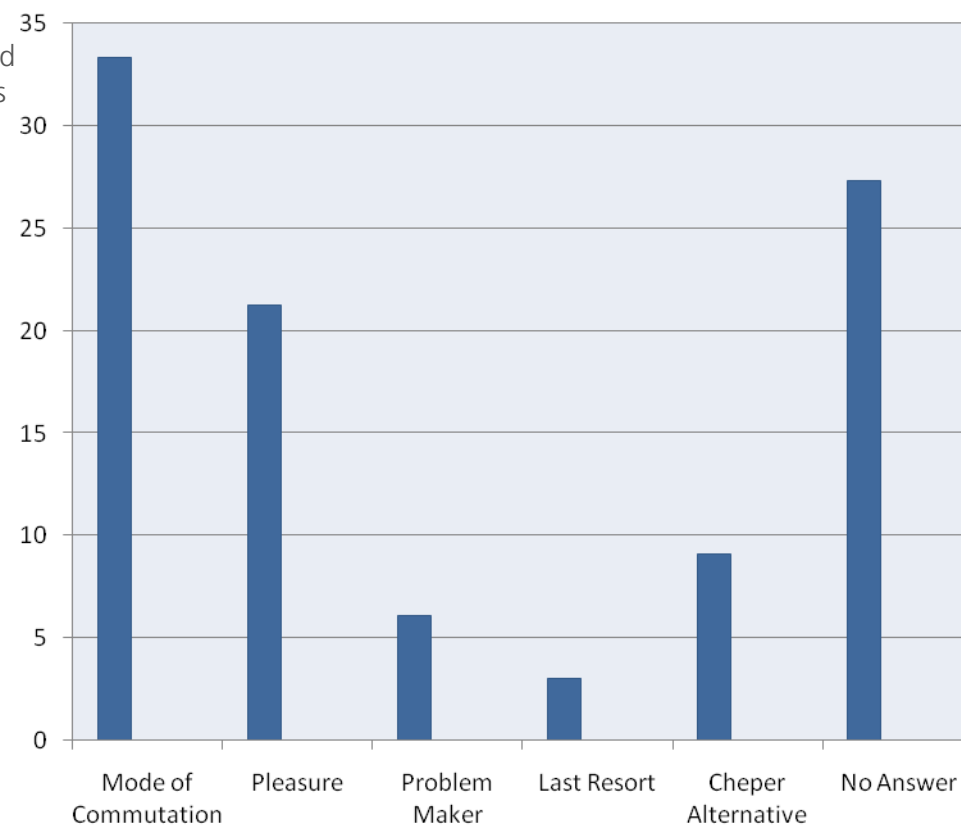


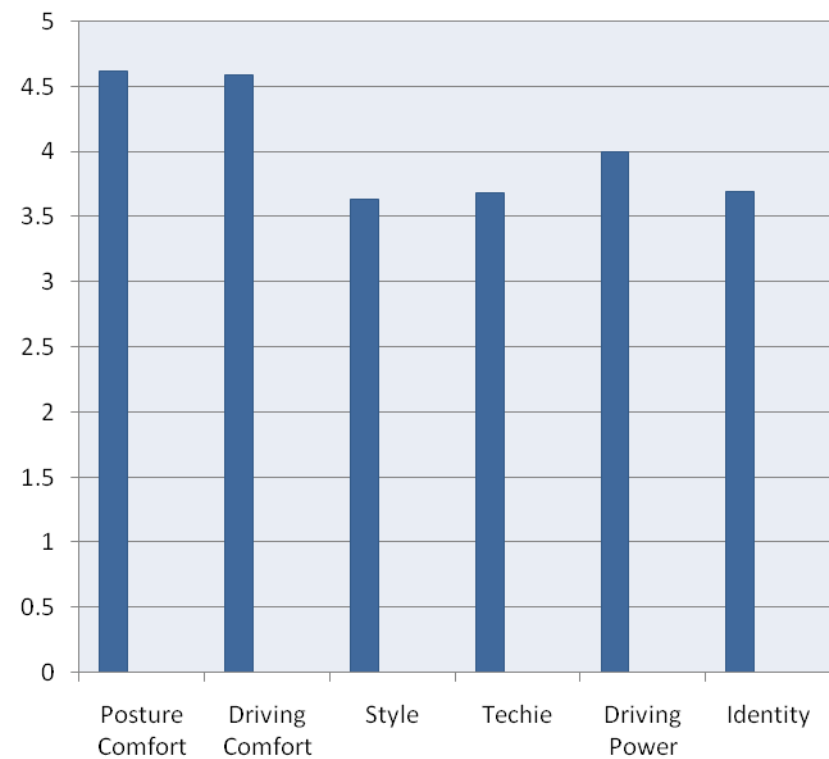
Table 5.3

5.7 User Preference For Desired Bicycle

Students do give preference to various features of bicycle. Here during user survey, five of the major points were taken into account. Students voted the feature on the scale of five. The tabulated data is shown in the form of table 5.4.

Mainly most of the users were in favor of good posture comfort as well as good driving comfort. Other options were also of equal importance according to survey. Many wanted their bicycle to be Stylish and as they are in technical institution , it should look Techie.

Some want the bicycle should reflect their self identity. Many of them who are familiar with the uneven terrain of IIT Bombay thinks that something is required to be done on the driving power of bicycle. Off course gears are their to cop with this thing, still its maintenance is frequent and expensive. Yet gears do not give the sense of speed and power.



Rating of the user on scale of 5 (5-Highest & 1-Lowest)

Table 5.4



5.8 Problems associated with Bicycle Carrier

Bicycle Carrier was always a point of controversy during User survey. To retain it in the new bicycle is completely a bit difficult. So, a complete dedicated survey was done on the bicycle carrier.

On contrary to the other places where carriers are used to carry loads as well as person, IIT Bombay uneven terrain does not allows this. It's really difficult to carry someone up-hill ride. So, this point is sorted out.

Other point remains whether it is used to carry bags and loads or not? Several students were interviewed regarding this and the outcome is written below.

Most of the users complained that its always dirty and difficult to clean. They seldom use bicycle carrier for carrying their bags because of the fear of getting the bag straps in the bicycle tire. They can't keep their Laptop bag on the carrier due to safety purpose. Some think as the distance to be travelled is small, so its always easy to carry bag on your back.

"Its always easy to carry bag on your back"

"Sometimes I need carrier"

"Ya, its always difficult to clean"



5.4

"Its always easy to carry bag on your back"

"Carrying bag on back gives the sense of balance"

"Carrier is most of the time dirty and its always difficult to clean"

"I don't have time otherwise I would have removed it"



5.5



5.6

Almost most of the bags were considered for the user survey purpose and user across various streams were considered to understand their actual needs.



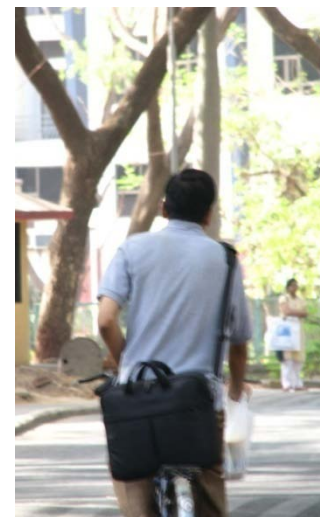
5.7



5.8



5.9



5.10



5.9 Bicycles which are common in IIT



5.11

HERO Razorback NE

Razorback NE	
FRAME	Ergonomically designed based on D-technology frame & unmatched strength built-in design. Unique design mountain bike frame with integral carrier.
FORK	Uni-crown MIG welded fork. Extra rigidity provided in design. Eye catching pair of Crown caps.
HANDLE	MTB style double curved handle with extended stem. Synthetic resin grips for better riding comforts. Attractive bar ends with comfortable sleeve.
BRAKES	High strength steel reinforced, Three finger design levers for an effective caliper brake system.
MUDGUARDS	Steel U-shaped wider section.
HUBS	Thick barrel, steel Nickel Chrome plated.
CHAINWHEEL & CRANK	44 Teeth x 165mm Crank with attractive plastic molded rotating disc.
CHAIN COVER	Elegantly styled Steel half Chaincover with combination of rotating plastic chain disc.
SADDLE	Moulded PU foam comfortable.
PEDALS	Synthetic fiber molded wider body single piece reflectorized body.
STAND	Steel Black Powder Coated side stand. Sturdiness built into the design.
COLORS	Model available in attractive thermosetting acrylic/metallic laser tinted/flourescent special synthetic paints.
GRAPHICS	Attractive graphics styled to match the taste of today's youth.
SIZES	Models available in 26T & 24T wheel size.



HERO Nitrogen

5.12

Nitrogen	
FRAME	Ergonomically Designed oversized MIG Welded ATB frame.
FORK	Uni-crown MIG welded fork. Extra rigidity provided in design.
HANDLE	ATB style handle with extended stem. Matching colored Synthetic resin grips for better riding comforts. Stylishly curved bar ends.
BRAKES	Side pull caliper, Steel Black Powder Coated. Friction-free casing for braking with ease.
MUDGUARDS	Steel U-shaped wider section with Nickel Chrome plated stays.
TYRE	26 x 1.75 with Red / Blue side wall matching with frame color.
CHAINWHEEL & CRANK	44Tx 165MM crank, Black.
SADDLE	Comfortable PU Foam padded, Rexine top saddle.
PEDALS	Reflectorised wider body resin molded MTB pedal.
CARRIER	Attractive sturdy carrier, Steel Black.
STAND	Steel Black Powder Coated side stand. Sturdiness built into the design.
COLORS	Model available in attractive twin - shade special synthetic paints.
GRAPHICS	Attractive graphics styled to match the taste of today's youth.



5.13

HERO Buzz Nu-Age

Buzz Nu-Age	
FRAME	New Contemporary, Ergonomically Designed MIG Welded Y-Style Frame. Oversized Hi-Tensile Tubing for extra strength.
FORK	Moto-Cross Bike type, oversized MIG welded fork with stylish double crown design.
HANDLE	ATB style Handle Bar with Extended Stem. New Design Long Rubberised Handle Bar Grips for improved gripping. Attractive Painted Handle Bar Ends.
BRAKES	V-Cantilever brakes (F & R) for effective Braking. Steel reinforced Plastic coated Brake levers. Friction-free casing for braking with ease.
MUDGUARDS	Steel U-Shaped Wider section Mudguards with Chrome Plated Stays.
CHAINWHEEL & CRANK	36T x 100mm Crank, Black Powder Coated for model in 20 wheel size. 44 T x 165mm Crank Black Powder Coated for model in 24 & 26 wheel size.
CHAIN COVER	New Curved Pistol Shaped Plastic Chain Cover in 20 wheel size. New Curved Pistol Shaped steel Black Chain Cover in 24 & 26 wheel size.
SADDLE	Comfortable PU moulded saddle manufactured as per vacuum-based technology.
PEDALS	Wider body Resin Moulded Black pedals with Amber coloured reflectors.
CARRIER	New design Sturdy Carrier, Steel Black, with rectangular reflector.
COLORS	Model available in attractive Red & Blue Colour combinations.
GRAPHICS	Attractive graphics styled to match the taste of today's youth.
SIZES	Models available in 20, 24 & 26 wheel size.



HERO Nitro Integra

5.14

Nitro Integra 26T / 24T	
FRAME	Ergonomically Designed oversized MIG Welded ATB frame. Integral Carrier an added attraction.
FORK	Double bridged -crown MIG welded fork Extra rigidity provided in design
HANDLE	MTB style Handle Bar with Extended Stem. Stylishly curved bar ends.
BRAKES	Side pull caliper, Steel Black Powder Coated. Friction-free casing for braking with ease.
MUDGUARDS	Steel U-shaped wider section.
CHAINWHEEL & CRANK	44T Chain wheel
CHAIN COVER	Quarter chain cover made from special engineering plastic. Trouser guard on chain wheel an added protection to the rider.
SADDLE	Comfortable Rexine Top, PU Foam padded.
PEDALS	Reflectorised wider body resin molded pedal.
STAND	Steel Black Powder Coated auto locking side stand. Sturdiness built into the design.
COLORS	Model available in attractive shades.
GRAPHICS	Attractive graphics styled to match the taste of today's youth.



HERO Hawk

5.15

Hawk Nu-Age	
FRAME	Brazed lugged track racer frame
FORK	Swaged / Brazed crown type rugged fork with sleek Appearance & Sturdiness inherent in Design.
HANDLE	Ergonomically designed drop-down racing style handlebar. Foam type Soft Synthetic Resin Grips.
BRAKES	Cable operated Caliper type brakes. Friction-free cable casings for effective braking. Steel sheet formed brake levers for effective braking.
MUDGUARDS	Sleek Mudguards with longer length
HUBS	Steel CP, Thin Barrel Hubs.
PEDALS	Reflectorised molded-rubber type pedals with steel side plates.
SADDLE	Ergonomically engineered extra cushy, Integral PU foam Molded
STAND	Pistol type extra origid with Black powder coating finish.
CHAINWHEEL & CRANK	44 Teeth x 165mm Crank, Black.
CHAIN COVER	Elegantly styled Steel half Chaincover with combination of rotating plastic chain disc.
WHEEL SIZE	27 * 1-1/4.
RIM	Endric, Steel CP.
CARRIER	Specially designed, stylishly engineered wire type carrier with Black powder coated finish.
OPTIONAL ACCESORIES	Specially designed arm-rests for leisure riding. Arm-rests adjustable to many positions suitable to the rider. Water bottle. Hand operated pump.
COLORS & GRAPHICS	Available in attractive Graphics & Colors.



5.16 **HERCULES** Flash

Features

Lower step-thru stylish frame
Strong Integrated Carrier
Comfortable Saddle with spring
Wheel & Pedal Reflectors

Benefits

Easy mount & dismount
Higher Strength
For a Comfortable Ride
For Safety during Night Riding



5.17 **BSA** Wow 21 speed

Features

Low step thru Stylish Frame
21 Spd COMPLETE Shimano
gears
Front & Rear Shox
Dual Disc Brakes
Aero Profile Alloy rims

Benefits

Easy mount & dismount
Low Gears For uphill & High
Gears For speed
For a Comfortable Ride
Immediate & Effective Breaking
Rust Free



5.18 **ATLAS** DUROSHOX
ATBs/MTBs

Features

Frame Size: 19
Wheel Size: 26"x1.75"
Colours: Victor Blue/Coke Red,
G.M Grey/Black
Age Group: 14 & above
Packing: SKD Single Cycle Packing

Benefits

Frame with Razor Back Carrier and
Centre Shox, Fork with Suspension



5.10 How your Desired Bicycle should be....?

In the last section of the user study, students were asked how their dream bicycle should look like or what special feature they want to be in it. Several were weird and out of the world while some were practical. Some of them which were common are listed below and will serve as key point for the designing of the new bicycle.

Unique	Light Weight	Youthful	Foldable	Stylish	Features
Minimalistic	Attractive	Sleek	Funky Color	Aggressive	Radical
Comfortable	Functional	One Piece	Strong	Speed	Non-Tech
Non-Glamour	Awesome	Trendy	Sporty	Techie	Bike
Stable					
Sizable	Small	Feminine	Cute	Elegant	Simplistic
					No Spokes



5.11 Key Findings

- 1) With the declining use of bicycle due to availability of Auto-Riksha & Bus facility, its necessary to protect the old culture of the campus i.e. use of bicycle.
- 2) Time is changing and so the thinking. Students want something new out of bicycle to use. Bicycle needs to be revamped according to the physical as well as emotional need of the target user.
- 3) User wants a new identity of the bicycle which could reflect modernness and technology. The age old identity of the bicycle as a diamond frame shape needs to be broken.
- 4) A proper channeling and auction is needed inside the campus, so that bicycle don't end up in scrap. A new system needs to be introduced so that bicycle which are not found due to loss of track, can be tracked.
- 5) Students are willing to pay anything that can be a wise alternative to Motorbike. In the case of post-gaduates, it's basically due to increase in the TA (Teaching Assistant) money.







6.1 Lifecycle of Bicycle in IIT Bombay

The life cycle of bicycle in IIT Bombay is pretty complex. To understand this a chart of the lifecycle has been prepared on the next page depending upon the survey.

If we consider from the initial phase of admission, almost 70% of the students buy bicycle, may be new or second hand from the maintenance shops within the campus while others use alternative transportation services or cover the journey on foot.

There are three types of transportation services are available in IIT Bombay, Bicycle, Auto-Riksha and Bus service.

There are two bicycle maintenance shops in IIT campus, one is near campus playground and other is at market gate, with a bit irregular timing or odd hours of opening.

Whenever there is a maintenance problem, students approach these shops. If the problem is solved easily then there is no problem with the use of bicycle. Otherwise due to hectic schedule of the students in the campus, maintenance scenario seems insufficient. These students try to further get their bicycle repaired otherwise start to use alternate transportation services.

With time some of the students who don't get time to get their bicycle repaired, lose the track of the bicycle.

Finally these unmaintained, lost and the bicycle left out by the passing out seniors add up to the number of unused bicycles in the campus. The absence of any method to identify these bicycles further increases the problem.

At the end of the semester Hostel Secy and Hall Manager arrange for the auction of the abandoned bicycles. But by the time these bicycles are chosen for auction, approx 95% are rusted and end up in scrap.

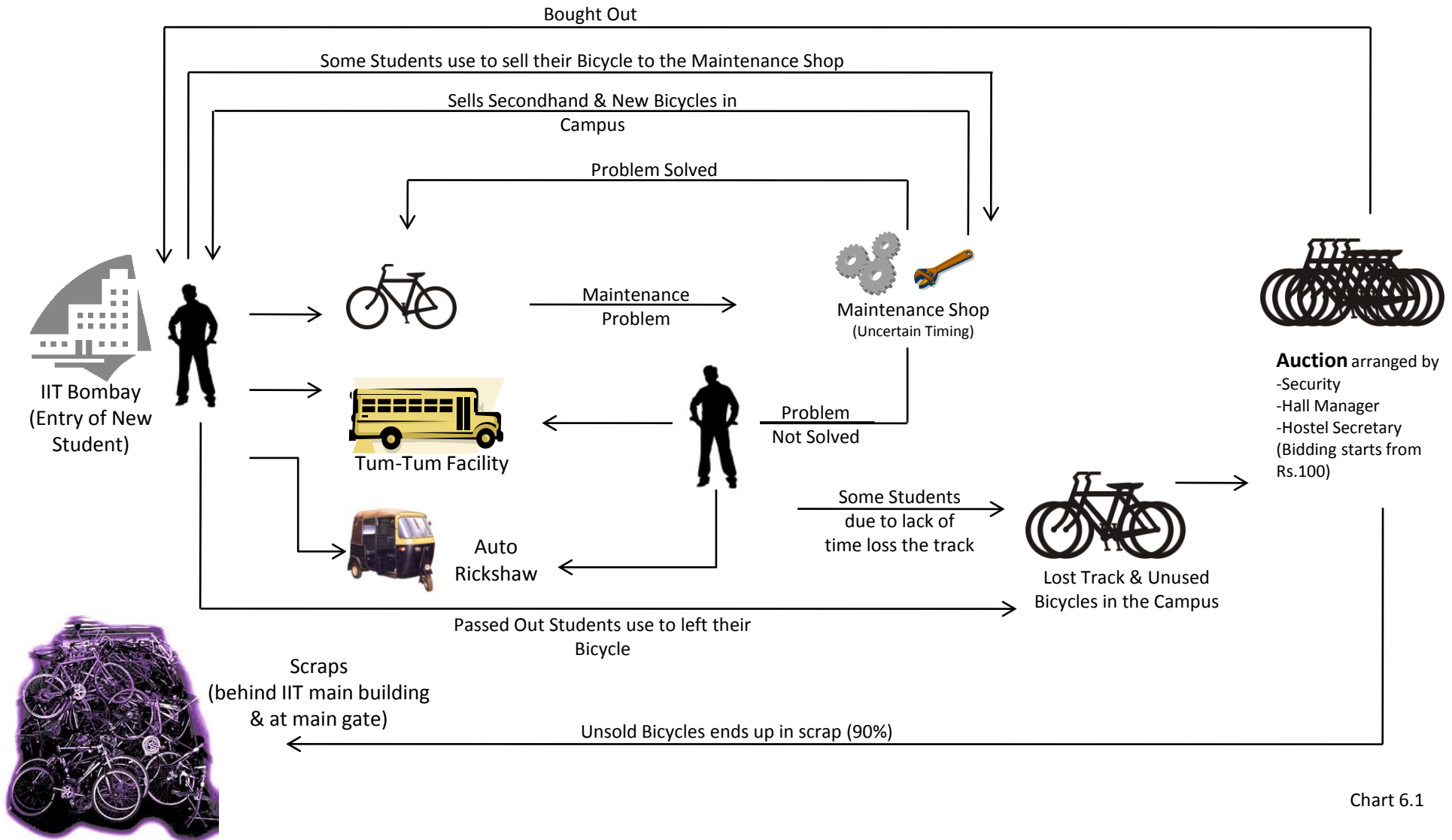


Chart 6.1



These auctions are only for students and the staff of the IIT campus. Further during auction, due to lack of the potential buyers, only few bicycles are sold. Auction starts from Rs.100 onwards. Due to rusting and lack of maintenance, only few bicycles are bought by the students .

Later the unsold bicycle are sent for scrap. We can easily see a huge pile of bicycle scrap behind the IIT main building and at the main gate.

From the given flowchart we can easily see the lifecycle of the bicycle in the campus. There are several problems, but few can be solved easily like loss of track, identity and proper channelization in the auction of bicycle to involve as many people as possible.





Designing of a **Power Assisted** &
Maintenance Free bicycle for the **Youths of the IIT**
in present scenario . Its about reviving the lost enigma of bicycle in the potential user serving
their physical as well as emotional needs. Area of focus will be **Exploring**
Technology and **New Form.**





8.1 Approach to the Unique form

Form can be explored in several ways but I have taken two criteria –
Structural Exploration
Volume based exploration

But simply going for the exploration will become a styling project. So, a semantic graph is plotted to see where the bicycle is heading and this can be of great help in the interest of the user.

Semantic Shift in the form of bicycle

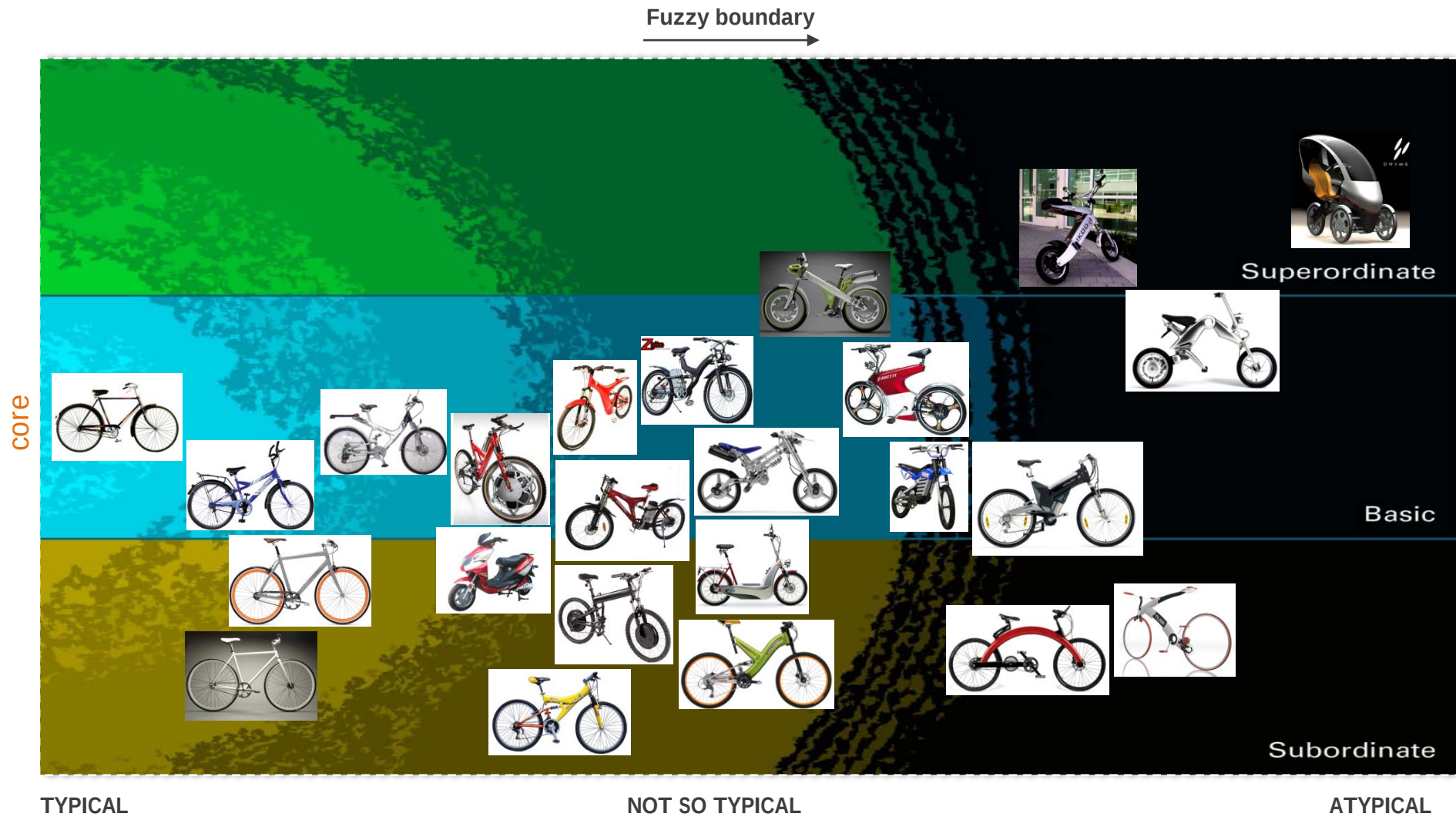


Chart 8.1



8.2 Semantic Shift in the form of bicycle

This graph on the left hand side has been plotted keeping throughout development of the bicycle over many era in the history of bicycle, starting from Safety bicycle era in the left hand side and present scenario in the right hand side, in mind.

Left side of the graph deals with the typical form of the bicycle which belongs to the Safety Era Bicycles. This has been taken as the core as today's conventional bicycles belong to this family.

Further as we move towards the right, we deal with the atypicalness in the form. The form starts to change, some due to change in the trend and some change due to change in the need of the end user. The atypical nature increases as we further go in the right side.

Further as we go from top to bottom, while chart has been divided into three parts Sub-Ordinate, Basic and Super-Ordinate namely.

Sub-Ordinate -

These are those bicycles which have been targeted for certain need, use or section of society and can easily be identified by just going through the form. Most of the bicycles which have specific need or target user belong to this category.

Basic -

These are the category of the bicycle which are in between Sub-Ordinate and Basic. These bicycles do have their own specific need and functionality but they also focus on maintaining their unique identity.

Super-Ordinate -

The bicycles which are completely radical in shape and functionality belong to this class. Sometimes it really becomes difficult to identify them as bicycles. They have completely unique shape and carry their own identity. Their basic need or the target user, it's really difficult to guess.

Target Segment of the proposed Bicycle

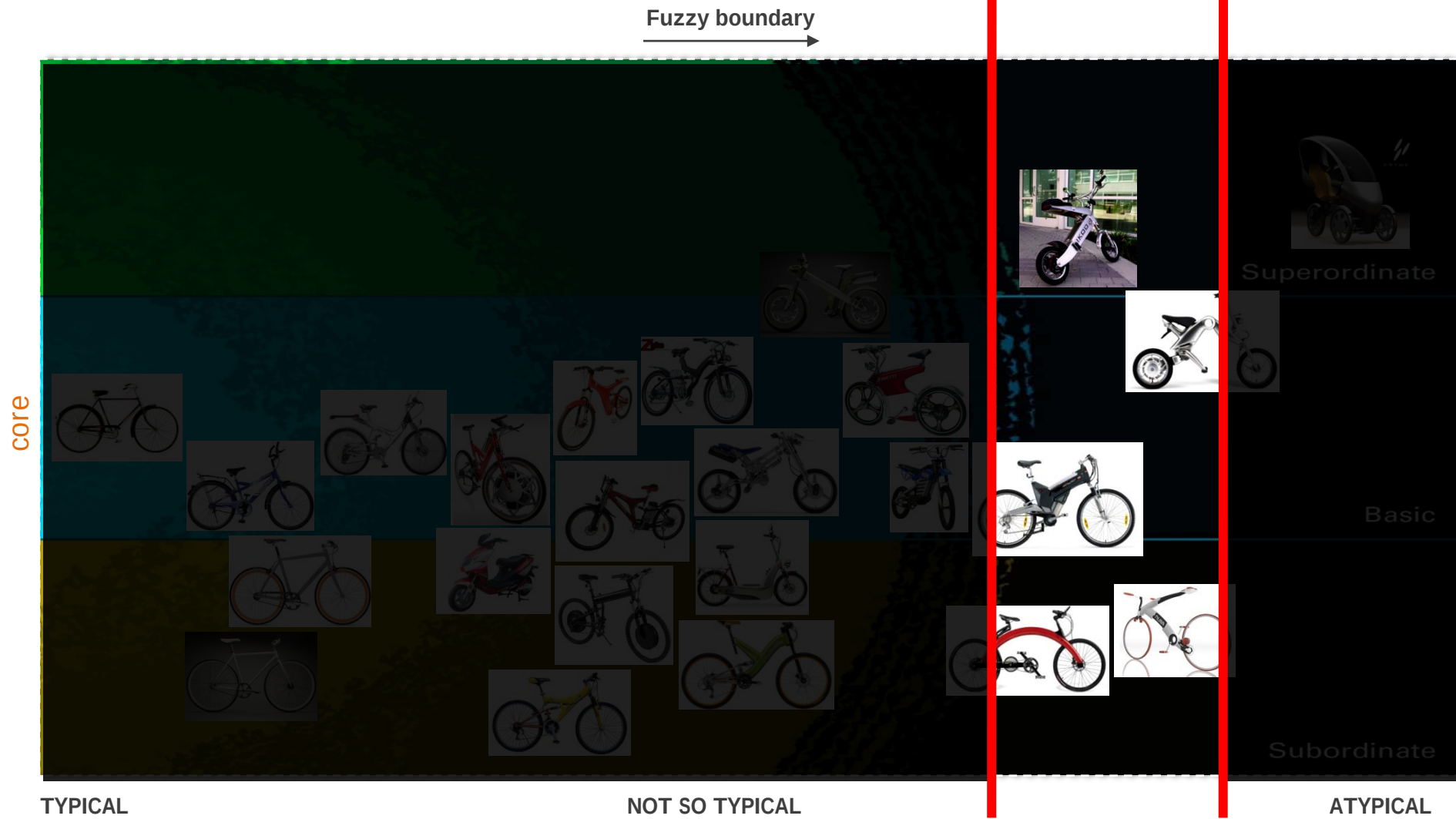


Chart 8.2



On the graph I have drawn two red bars to select my target. My target will be in between not so typical and atypical. On top tio bottom, my design will lie in between super-ordinate and basic.

Based upon the semantic study of the evolution of bicycle over the era, I am going with the volumetric exploration of the form. But yes structure can be part of it. To break the monotony of the age old identity of bicycle in the rods, a new approach is needed which can have a equilibrium of form and functionality. To incorporate the technologies to see the proposed bicycle to look as an same rather than separate attachment, volume needs to be explored.

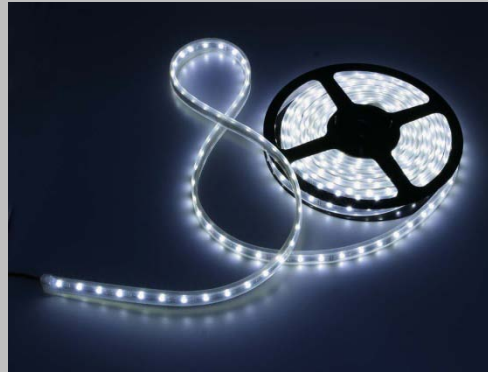
8.3 Image Board & Design Elements



8.1 Apple iPhone

TECHIE
Advancement

Wise



8.2 LED Lighting

Modern
TECHIE



8.3 iPod

Simplicity

Elegance

The products shown here are techie by function as well as form. There are various elements associated with the product that makes the product look like what it is. These elements can wisely be used in other products to provide the same feel.

Several elements have been tabulated here keeping the featured products in context. Various keywords that are associated with the products are written with the photos.

Techie

- Translucent Colour & Translucent Parts gives it a Techie looks
- Wise combination of Shining and Matt surface gives it a Techie look
- Use of LEDs and Chronographs adds to the Techie Quality
- Geometrical shapes provides an object a techie look

Elegance

- Small number of lines and surfaces impart a design a simple and elegance character.



8.3 Image Board



8.4 Yamaha FZ 16

Youthful
Force
Dynamic

Muscular
POWER

Youthfulness

Curve with Variable radius gives Muscular look. Lines at an angle to the horizontal gives Dynamic looks. Shiny surface gives it a fresh look.

Rugged

Radii manipulation at the edges and the corner gives a product a Rugged look. Even Choice of colour plays a great part.

Speed

Several parallel lines gives the feature of speed, but a wise decision should be taken while designing because it may can make the element look static

Techie

Translucent Colour and Wise combination of Shining and Matt surface gives a product, a modern look. Geometrical shapes provides an object a techie look.



8.5 Sea Waves

Youthful
Energy **POWER**



8.6 Nokia 7500 Prism

Modern
TECHIE



8.7 Harley Davidson

Muscular **Big**
Enormous *Elegance*

The curves used in the Harley Davidson can directly give feminine quality to a product but still it looks men product and elegant.

The bike looks muscular and elegant due to use of big curves with minimum cross section to avoid the visual clutter arising out of it.



8.8 Space Shuttle



8.9 Fighter Planes



8.10 Concorde



The flares of the rocket exhaust adds dramatic feel of power to the observer. Further in image 8.9 the playful nature of the aircraft can be seen. The aerodynamic function and the form plays a major role in the looks. These aerodynamic feature the experience of youthfulness to the spectator.

These flares and aerodynamic shape are the elements of these products those impart the feel of speed and youthfulness of the product.

These can be used in the youth product to impart the youth dynamism. The various keywords associated with the form are written on the right hand side.

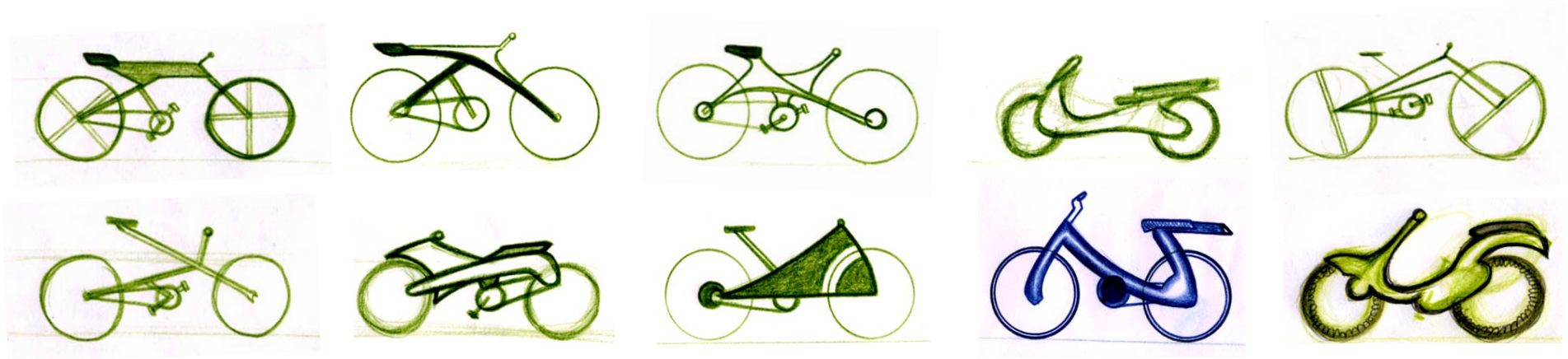
Speed Freedom
Phenomenal
Energy **Big**
Enormous **POWER**

8.4 Ideation

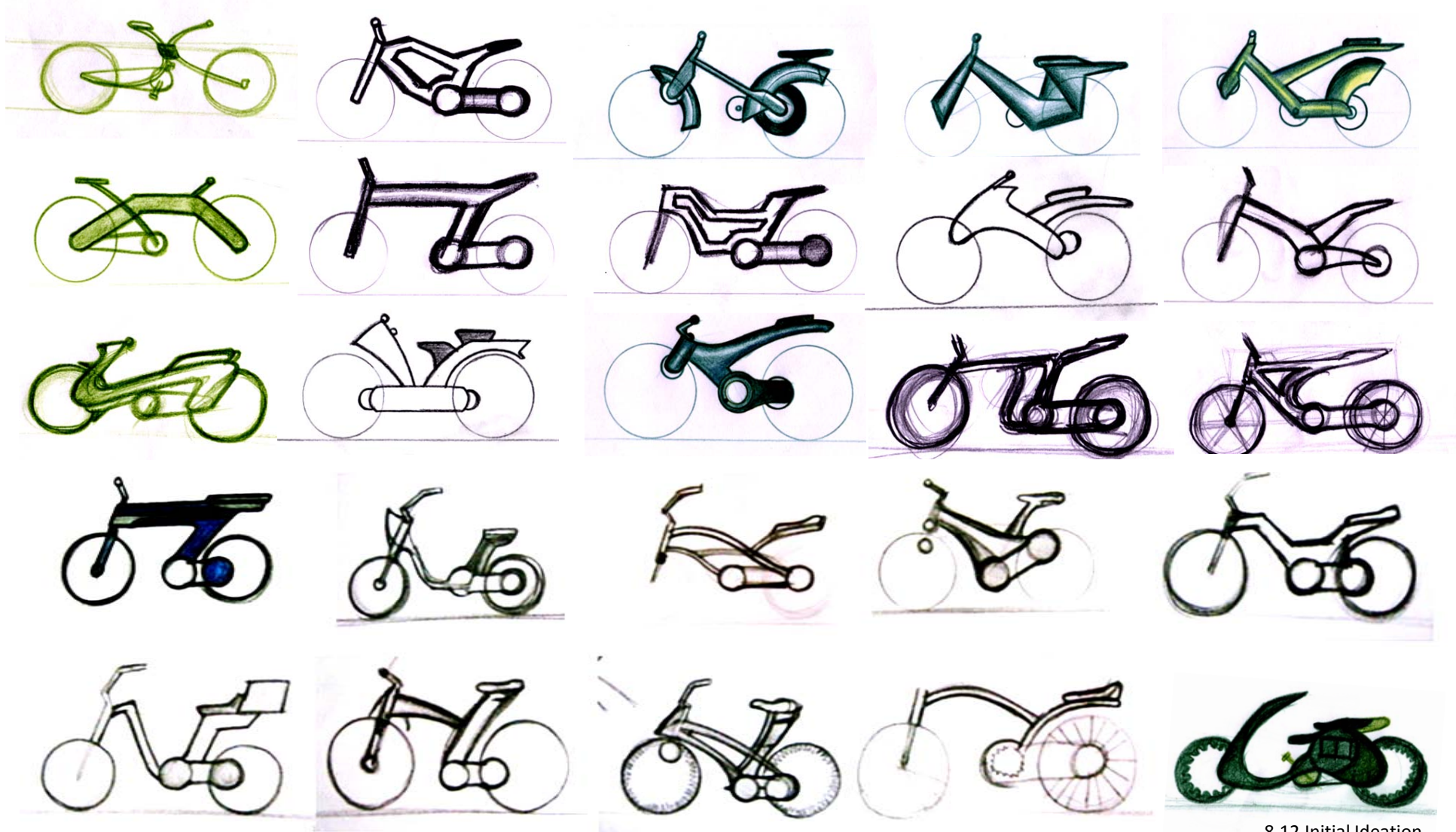


8.4.1 Initial Ideation (Stage - 1)

Initial exploration started by taking the insight from the current available bicycle as well as the concept bicycle. Theme behind this was to get into the form exploration. Some bicycle were really unique in form and feature. Simplicity was the main motto behind it.



8.11 Initial Ideation



8.12 Initial Ideation

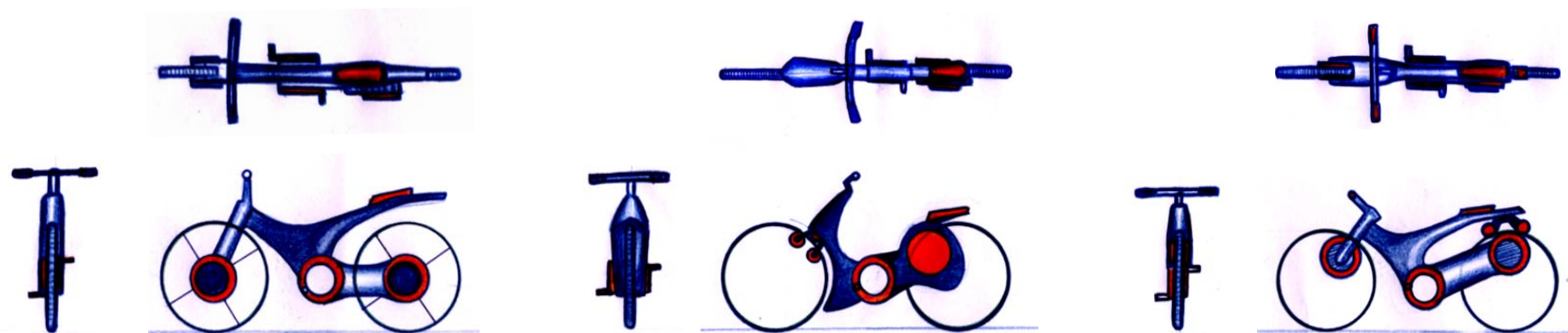


8.4.2 Metaphor Based Ideation (Stage - 2)

Second stage started with taking inspiration from motorbikes. Most of the youth of this generation are fascinated by motorbikes. This can be taken as the design element to satisfy their emotional needs.

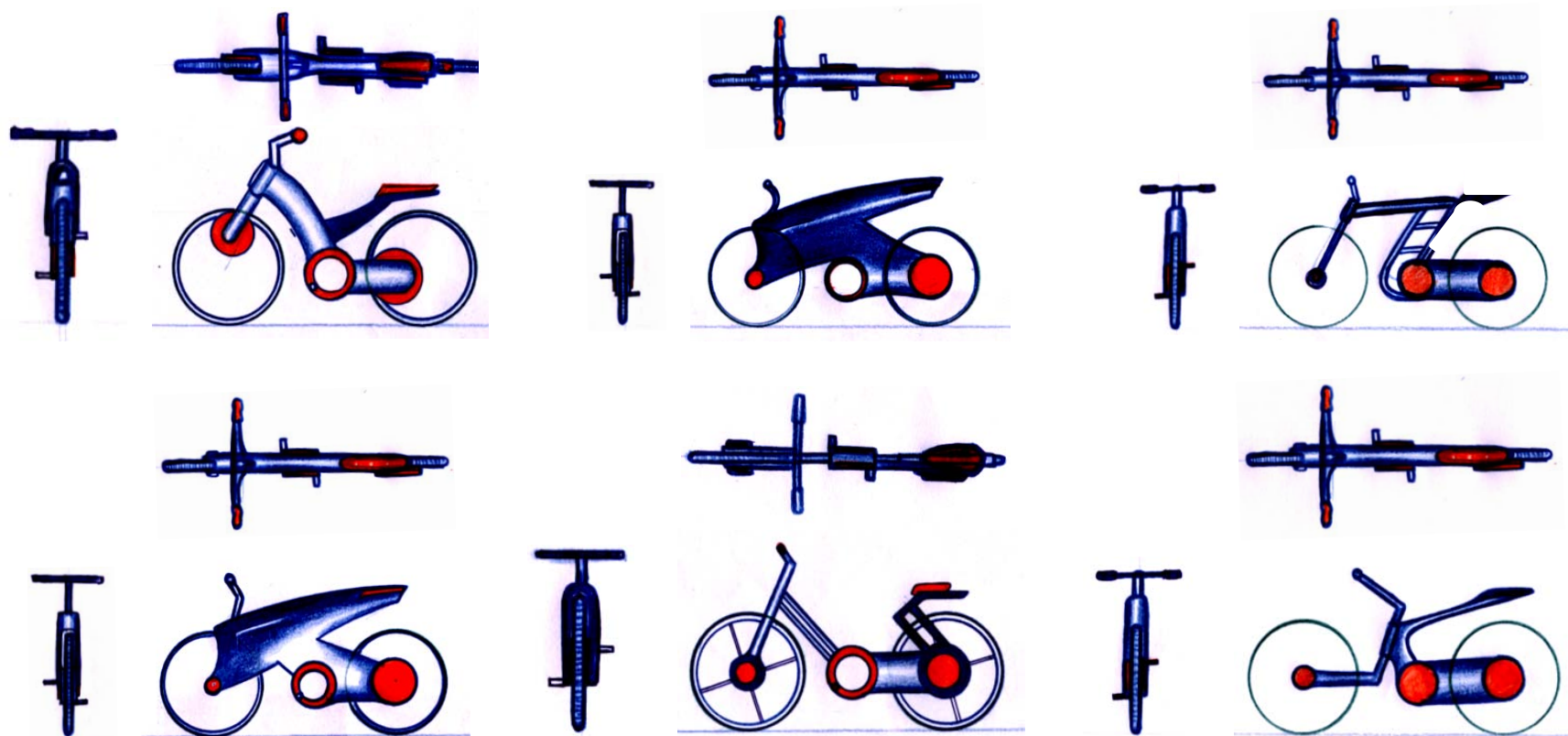
Several new possibility were explored. Newer technology which are around the corner and about to come into the scene were explored. One of the most sought feature is hubless wheel. This gives new definition to the bicycle and one can perceive it differently.

Most of the works were done to provide surface to the bicycle to the bicycle to break the century old rod made identity of bicycle. Exploration and invention in the field of materials have given us wonderful materials to make it possible. It can look like motorbike but as light a the conventional bicycles.



8.13 Metaphor Based Ideation

Most of the work was done on the placement of the various parts to maintain the youth dynamism.



8.14 Metaphor Based Ideation



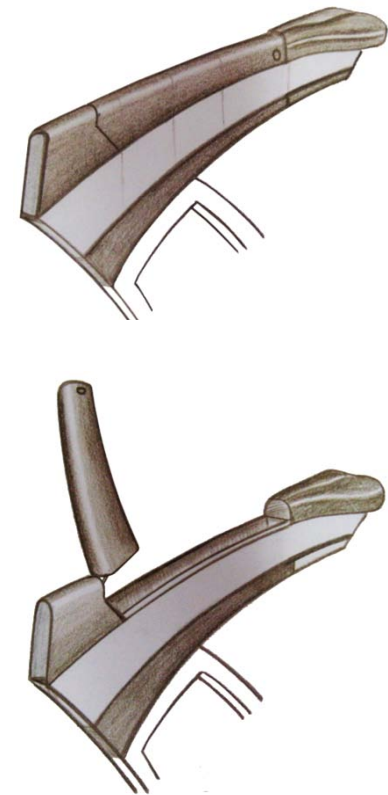
Refinements in Stage - 2

This idea is completely unique in its radical structure. Inspired from the Ocean's waves, we can easily see the flows of the waves in the design.

Photo in the right hand side show a compartment to keep tools and umbrella. It's typical in campus to carry umbrella during rainy season.

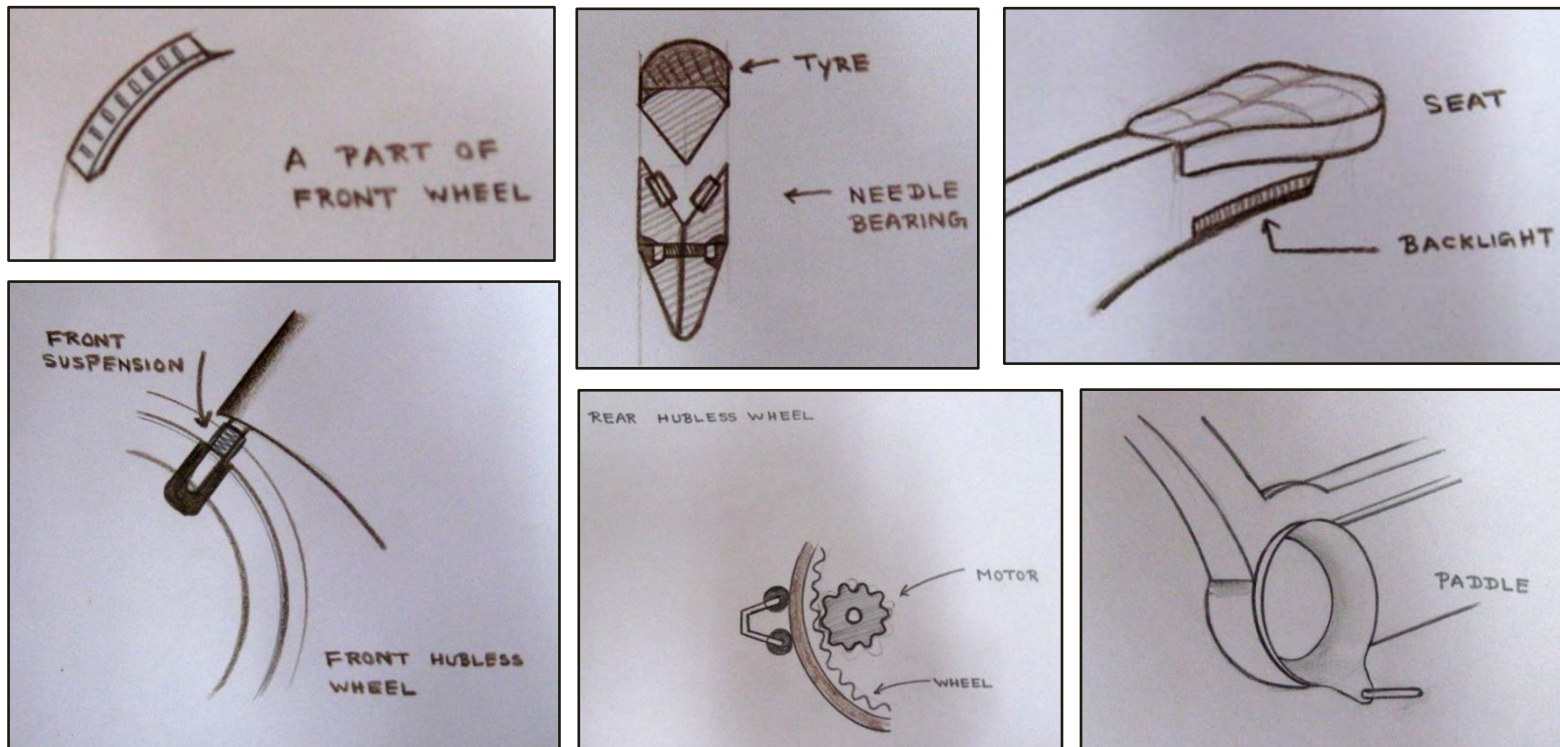


8.15 Concept 01



8.16 Compartment for tools & Umbrella

Further, this concept is backed by various new modern advancement and technology. There is a use of hubless wheel in rear wheel driven by a electric motor. Needle bearing has been used to work for the front wheel. Paddle has been designed radically.



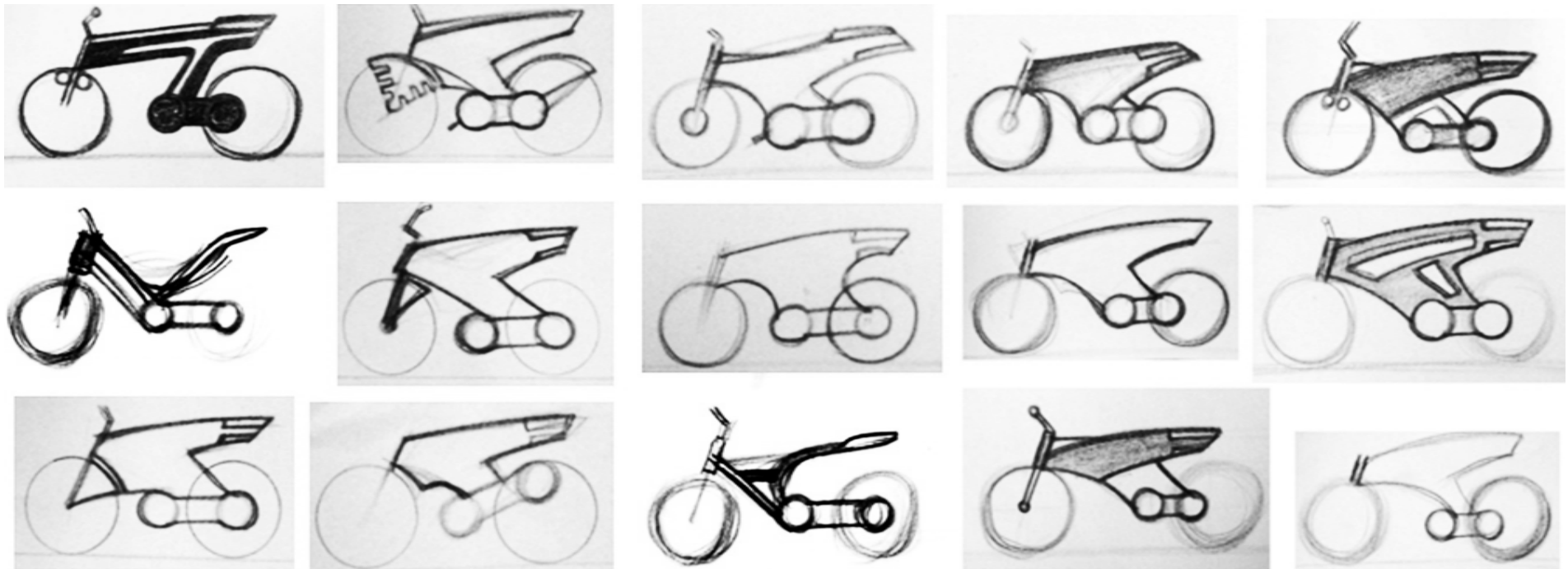
8.17 Some Detailing



8.4.3 Metaphor Based Ideation (Stage - 3)

Source for the second metaphor related was sea waves which can perfectly depict the youth dynamics. Sea waves represent speed, power, energy and the youthfulness of the mother nature. These keywords acts as the design elements for the bicycle.

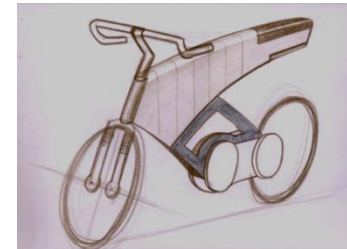
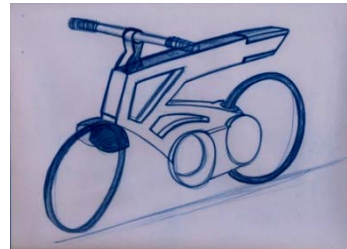
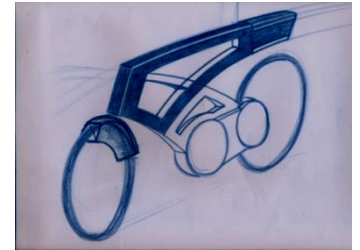
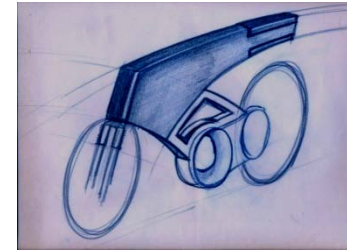
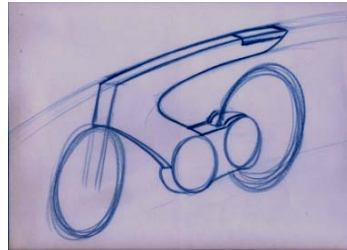
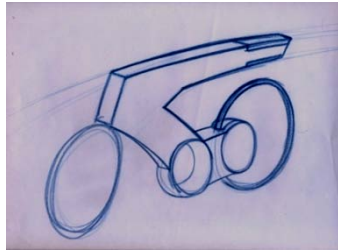
Youthful
Energy **POWER**



8.18 Metaphor Based Ideation



8.19 Metaphor Based Ideation



8.20 Metaphor Based Ideation

8.4.4 Metaphor Based Ideation (Stage - 4)

The flares of jets coming out of the rocket engine can be inspirational approach towards innovative design. The youthfulness & speed of the fighter planes also similar kind of design element.

The sharpness and aerodynamics of the U2 blackbird and Concorde gives a wise touch to the design along with other conventional design elements.



8.21 U2 Blackbird



8.22 Space Shuttle

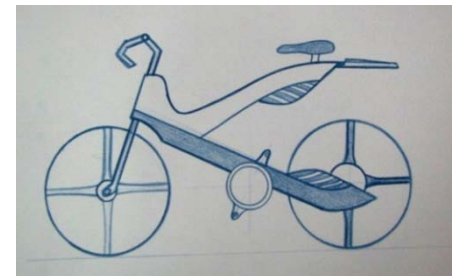
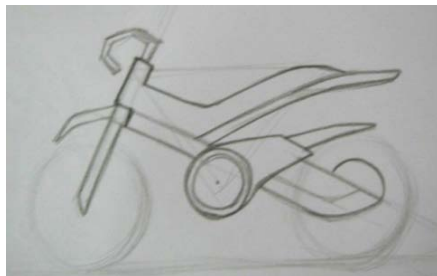
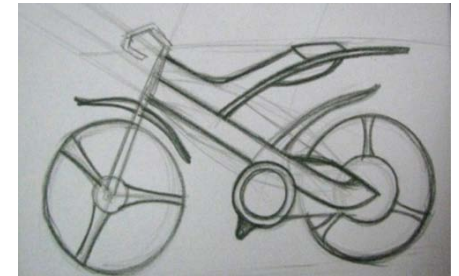
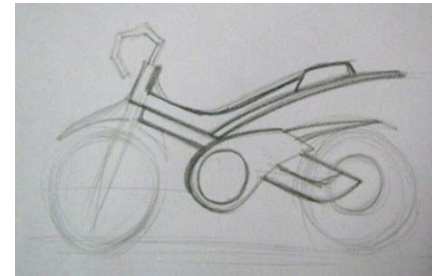
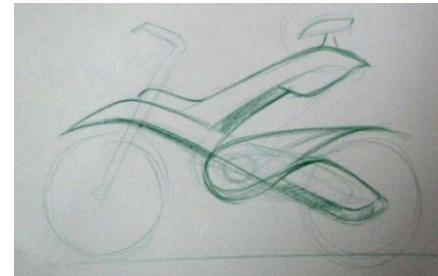
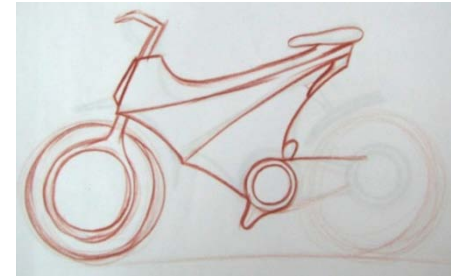
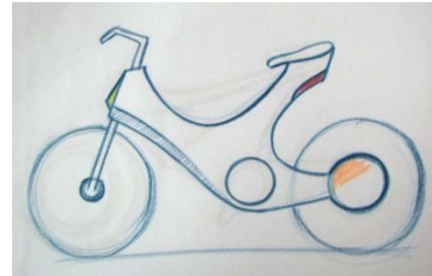
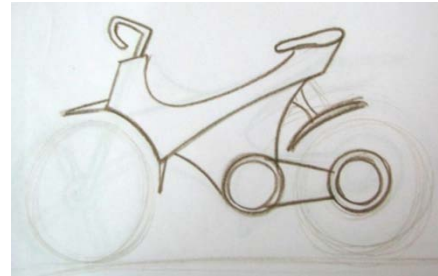
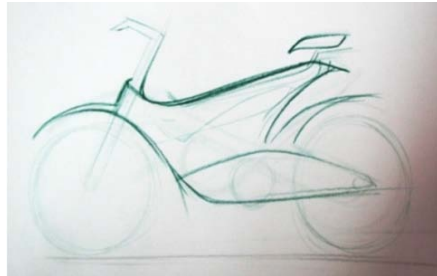


8.23 Fighter Planes



8.24 Concorde

Speed Freedom
Phenomenal
Energy **TECHIE**
Big
POWER



8.25 Metaphor Based Ideation

8.5 Concepts



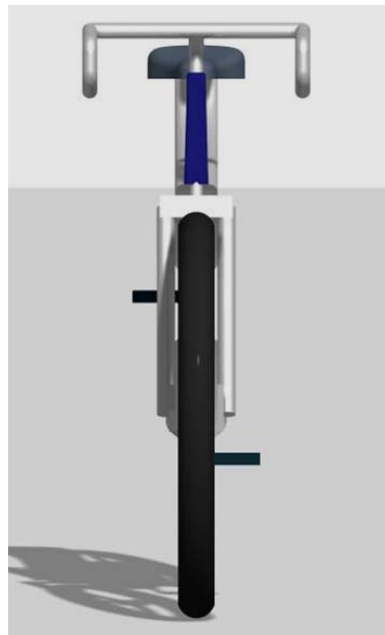
8.5.1 Concept 01

This designed has its own identity. It is based on stage 4 ideation. This is inspired from the rocket jet engine. If we consider the paddle are as the jet engine of a plane, chain cover shows the flares of those engine.

Sturdy look is one of the main feature of this concept, which goes along with the identity of the students inside the campus.



8.26 Concept 01

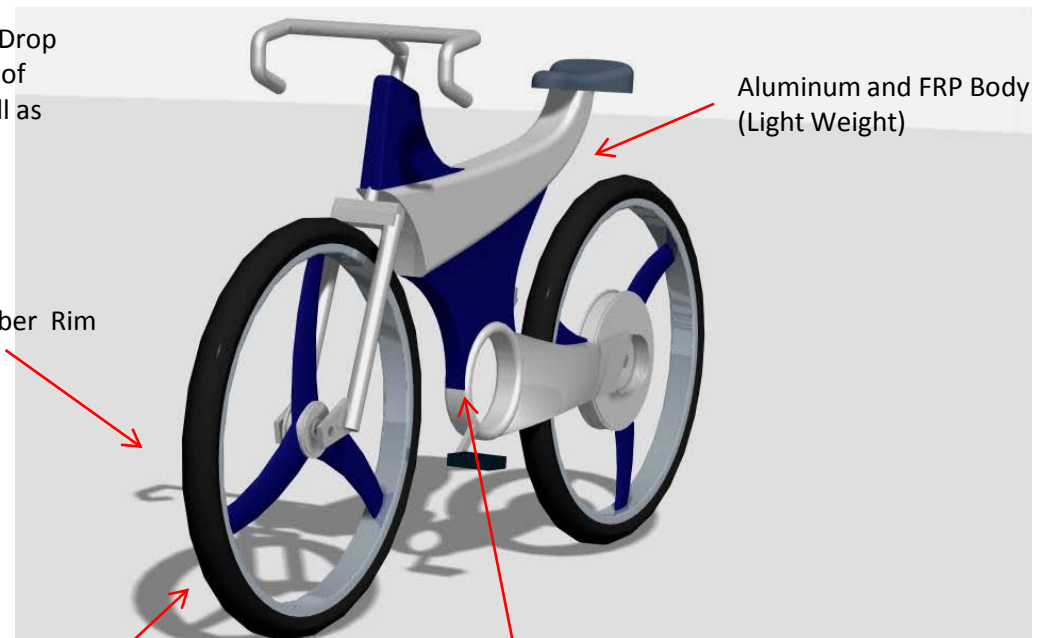


8.27 Front View

Straight Handle with Drop bars to give pleasure of Mountain Bike as well as Road Bike

Carbon Fiber Rim

Tubeless Tires



Aluminum and FRP Body (Light Weight)

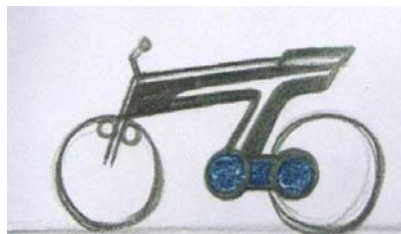
Covered Wheel Chains for protection of cloths

8.28 Concept 02

8.5.2 Concept 02

This concept is also unique in its design as it is radical in shape. Form Inspiration has been taken from stage 1 ideation. A little inspired from motorbikes, this is a true mixture of youth dynamism and modern design shift.

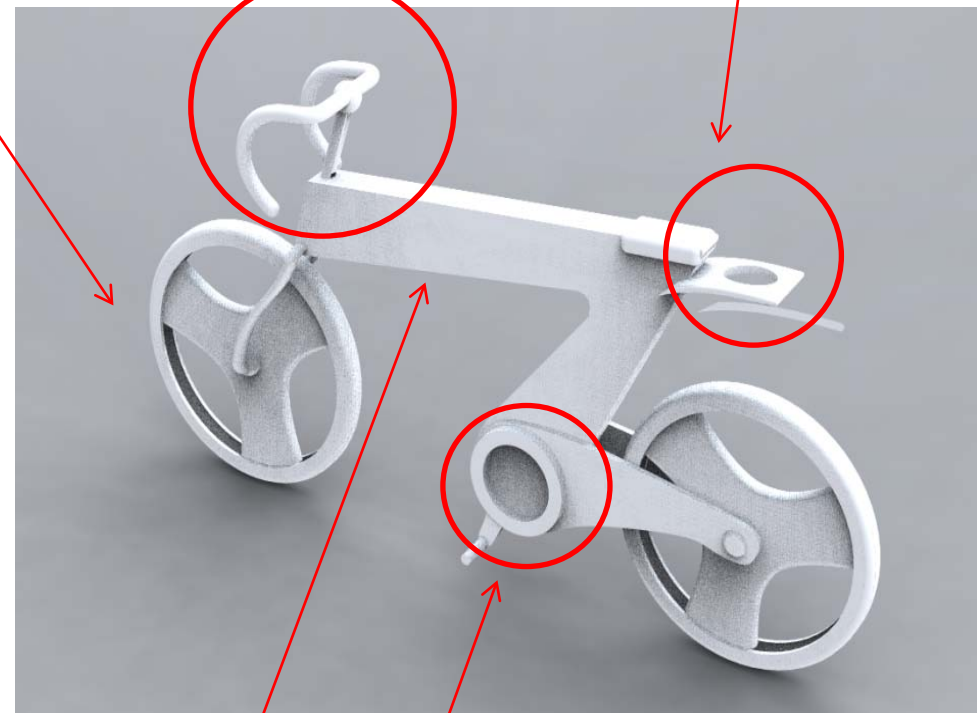
Further the dropbars serve the need of the rode bike lovers.



Straight Handle with Drop bars to give pleasure of Mountain Bike as well as Road Bike

Flat surface Carrier – Easy to clean, One Piece

Carbon Fiber Wheels and Tubeless Tires



Aluminum and FRP Body (Light Weight)

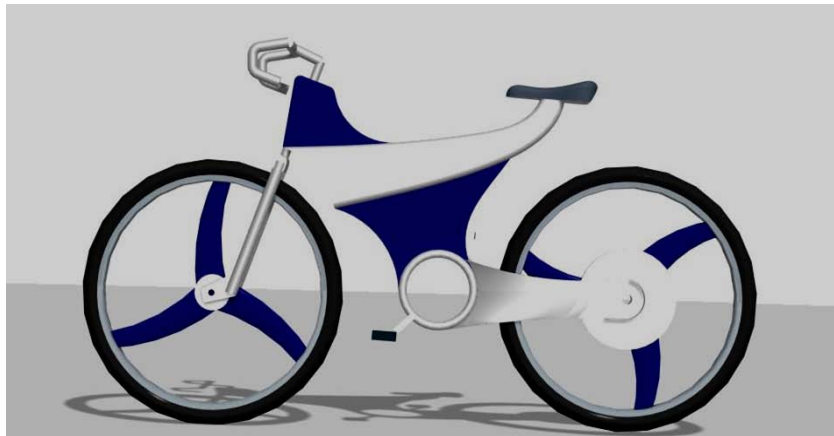
Covered Wheel Chains for protection of cloths

8.29 Concept 02



8.6 Concept Evaluation & Selection

After the two concepts, evaluation was done to choose the best out of them and also if possible, to find the good features of the other concepts.



8.30 Concept 01



8.31 Concept 02

20 user across the various streams of IIT Bombay were take into consideration for evaluation of the two concepts.

Concept : 1 - This was rejected by the users because –

- a) This was looking Bulky
- b) Was looking Feminine due to use of excess of curves

Good Feature : Looks stable

Concept: 2 – Got most of the votes because

- a) Radical looks
- b) Looks more Youthful,
- c) Minimal and Simplistic.



7 Votes



13 Votes

8.32 User Voting



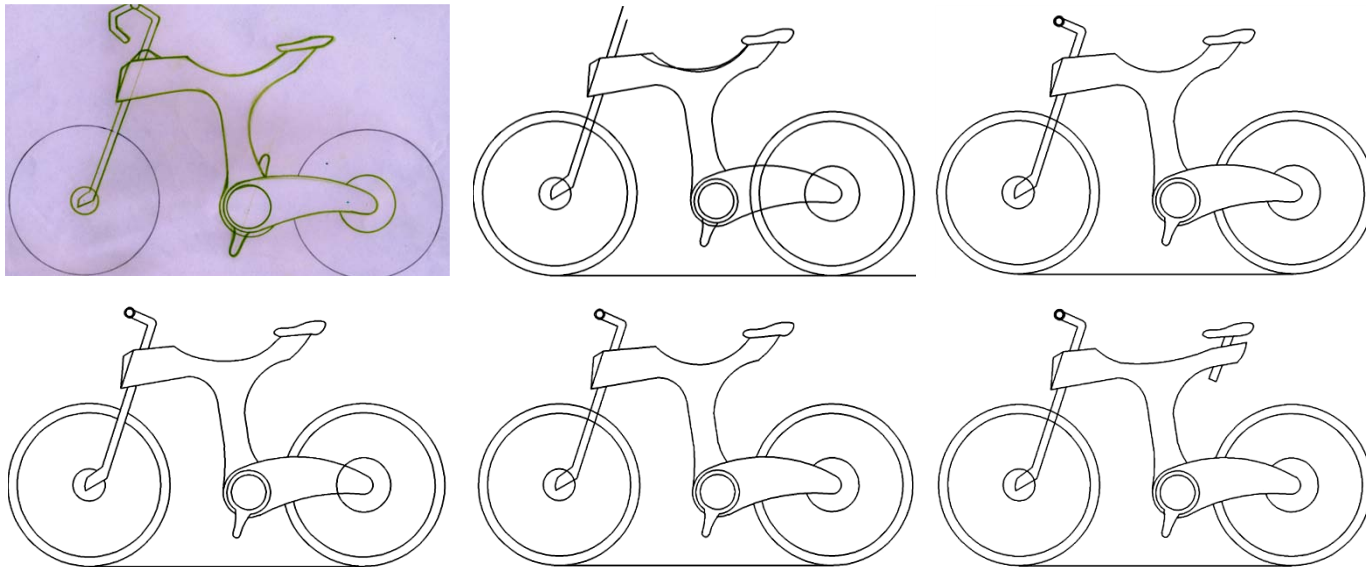
8.7 Concept Refinement

Now with the chosen concept-2 out of the three, we make 10 variations to get some uniqueness. In the shown sketches, there is a minor variation in saddle and middle rod. All the 10 variations are shown in image 8.33.



8.33 Variation in Chosen Concept

Few of the variations are explored further to find out the uniqueness.
Out of the choosen variations, one of the variation is explored for some new changes.

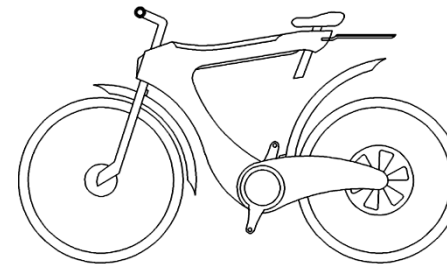
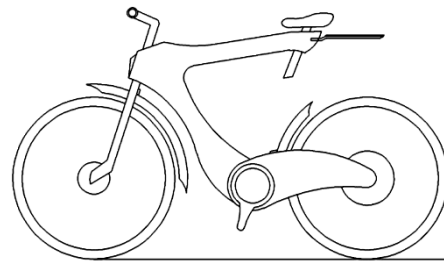
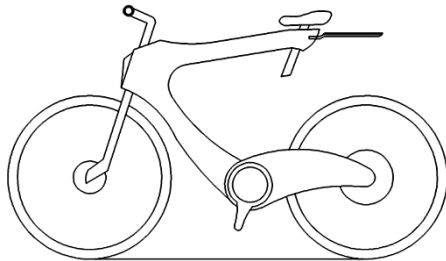
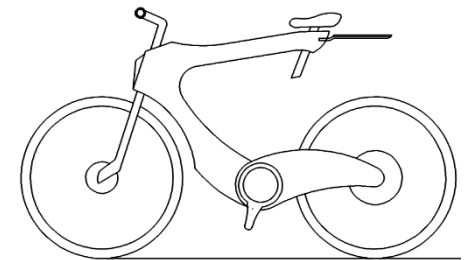
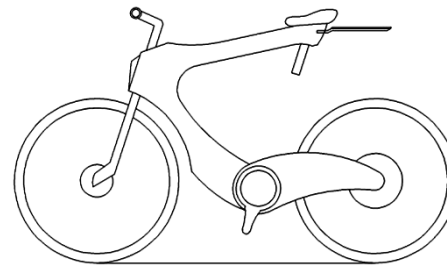
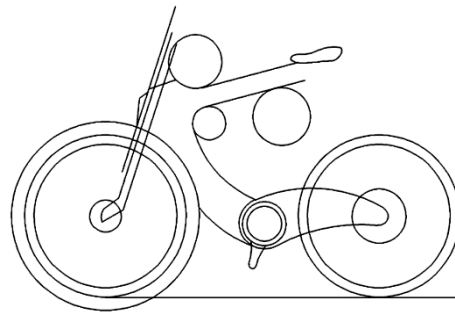
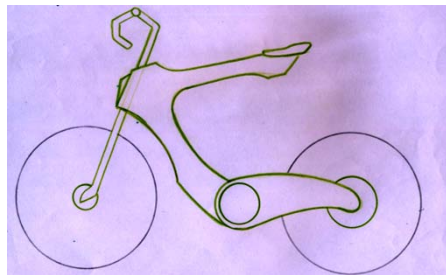


8.34 Some explorations



One of the other variation was taken for the exploration. This Variation was one of the most radical among the all.

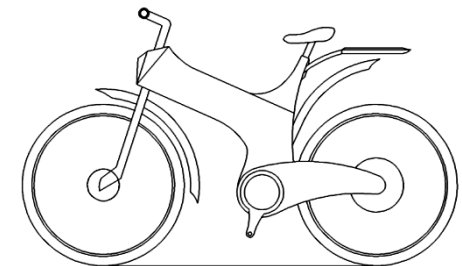
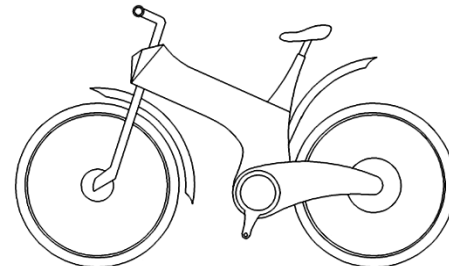
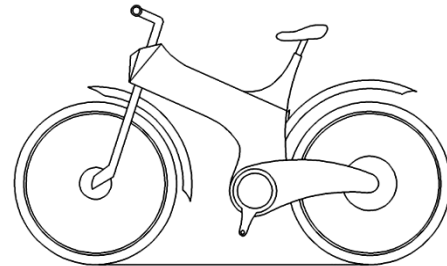
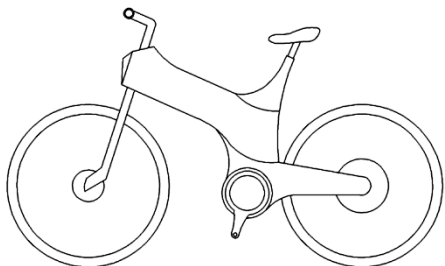
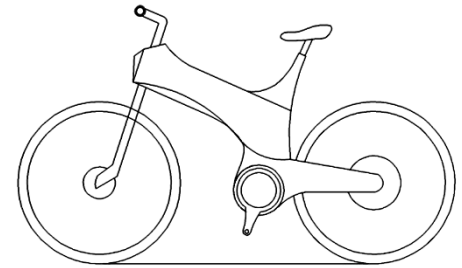
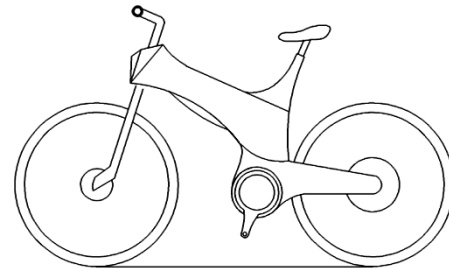
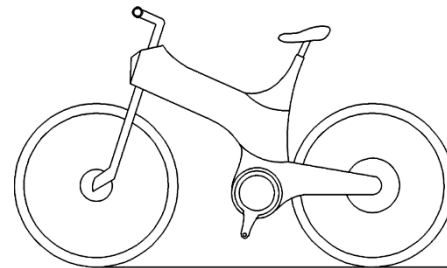
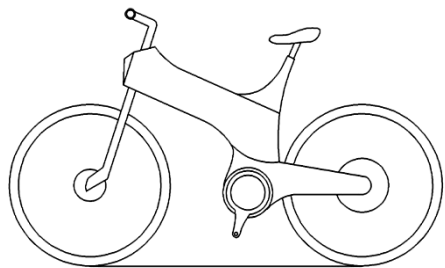
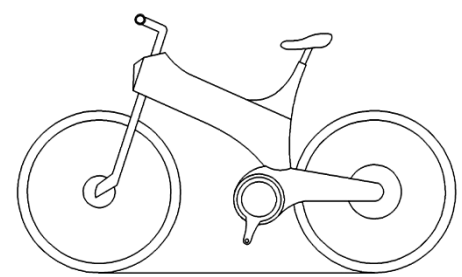
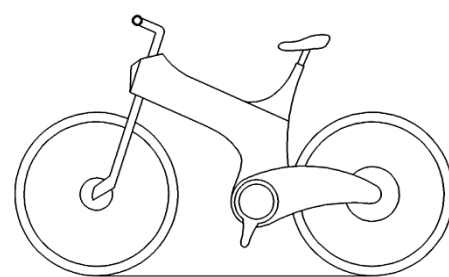
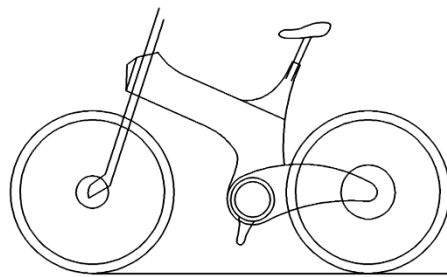
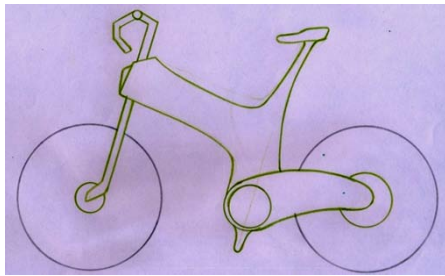
Later during mock-up stage, some parts of this design looked weak visually. That's why this design was abandoned.



8.35 Some Explorations

8.7.1 Final Concept Refinement

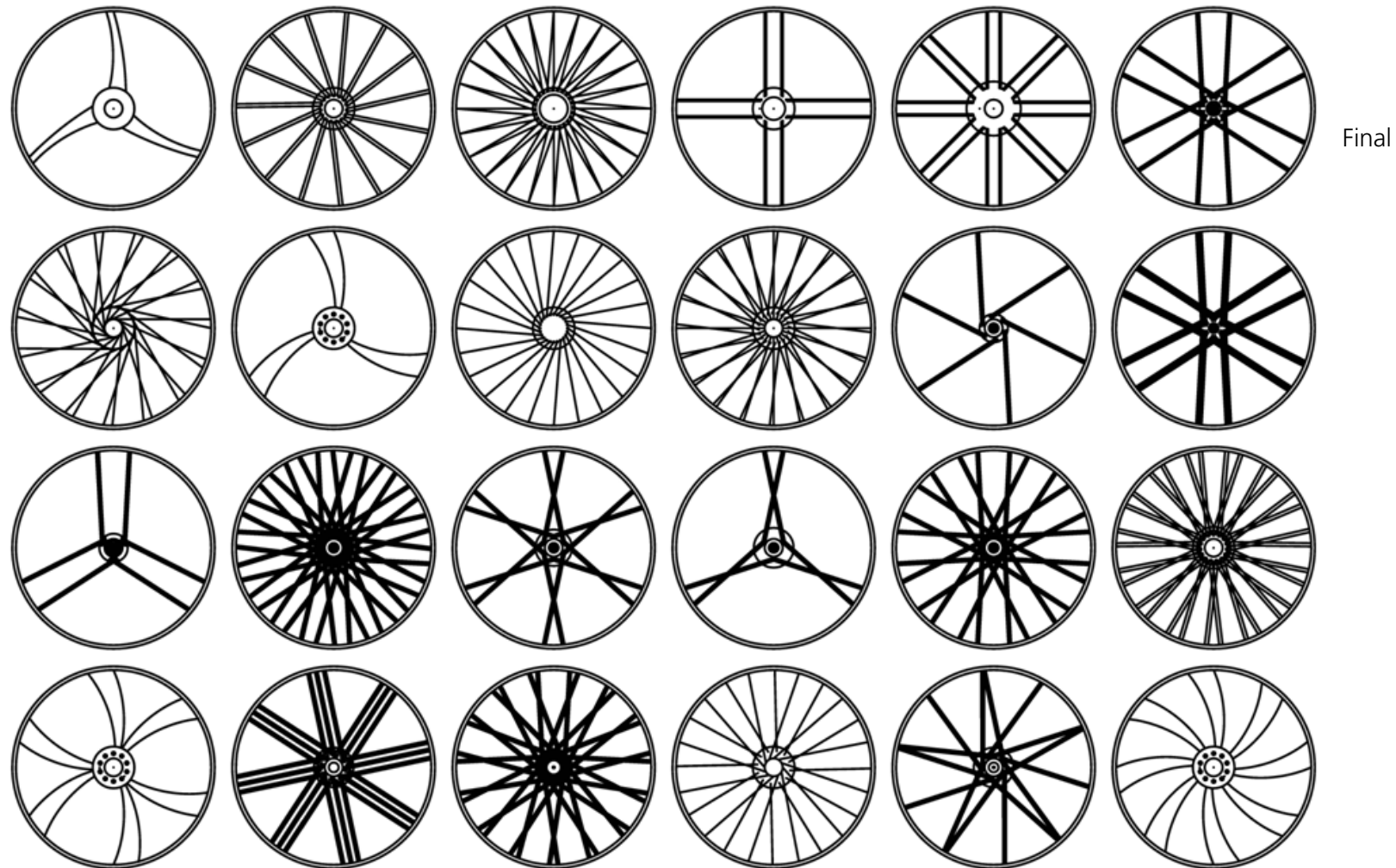
Further the concept is further refined keeping the integrity of the form intact. Main body & chain covers are constantly explored to get new look, because these two keep the most importance in the present design.



8.36 Final Concept Refinement



8.7.2 Bicycle Rim Design



8.37 Bicycle Rim Designs

8.7.3 Final Concept



8.38 Final Concept





9.1 Motor & Battery

Motor Type - Direct Drive, Gearless and Brushless Hub Motor
350 watts (Weight-8.8 lbs)

Battery - Lithium-Ion - 36V 9.6A (Weight-6.8 lbs)

Motor Capacity –

P_{max} = Maximum Power

P_r = Road Resist Power

P_s = Climb Resist Power

M = Total Mass = $M_{frame} + M_{FRP} + M_{motor} + M_{battery} + M_{extra} + M_{rider}$
 $= 10 + 3.99 + 3.09 + 3 + 100$

$M = 117.08 \text{ kg}$

g = Gravitational Constant = 9.8

V_{max} = Maximum Velocity = 20 km/hr

V_{avg} = Average Velocity = 10 km/hr

θ = Angle of Climb = 20°

V_b = Battery Voltage = 36 volt

$P_r = 0.036 M g V_{max} = 231.313$

$P_s = 0.05 M g \sin \theta V_{avg} = 54.94$

$P_{max} = P_r + P_s = 286.253$

Ampere Rating = $P_{max} / V_b = 286.253/36$
 $= 7.95 \text{ amp}$

350W Motor

- Power: 350 W nominal and 700 W peak.

- Nominal torque: 10 N.m

- Maximum torque: 32 N.m

- 4 power-assist levels: The strain gauge allows the BionX motor to measure the rider's effort and boost the thrusting power by 35%, 75%, 150% or 300%, according to the selected assist level.

- Weight: 4 kg/8,8 lb



9.1 Hub Motor for Bicycle

Battery

The battery is an important element for the autonomy and the weight of the bicycle. It is for this reason that NiMH (Nickel Metal Hydride) and Li-Mn (Lithium- Manganese) batteries, each offering their own strengths and advantages. The battery makes it possible to have an excellent autonomy without adding too much weight to the bicycle.

Ni-Mh Advantages:

- Good energetic density (60-80 Wh/kg)
- strong
- safe
- flexible

Li-Mn Advantages:

- Very high energetic density (100-200 Wh/kg)
- Much lighter than the Ni-Mh

Bicycle will be –

Hardtail (Front Suspension)

Power assisted

Motor - Direct Drive, Gearless and Brushless Hub
350 watts (Weight-8.8 lbs)

Battery - Lithium-Ion - 36V 9.6A (Weight-6.8 lbs) (30cm*8cm*10cm)

Programmable Anti-Theft Alarm and a Thumb Throttle for Instant Acceleration

Light Frame - Aluminium Frame and FRP (8kg)

RFID Tagging for keeping the track on Bike

Carbon Fibre Wheels & Tubeless Tyre

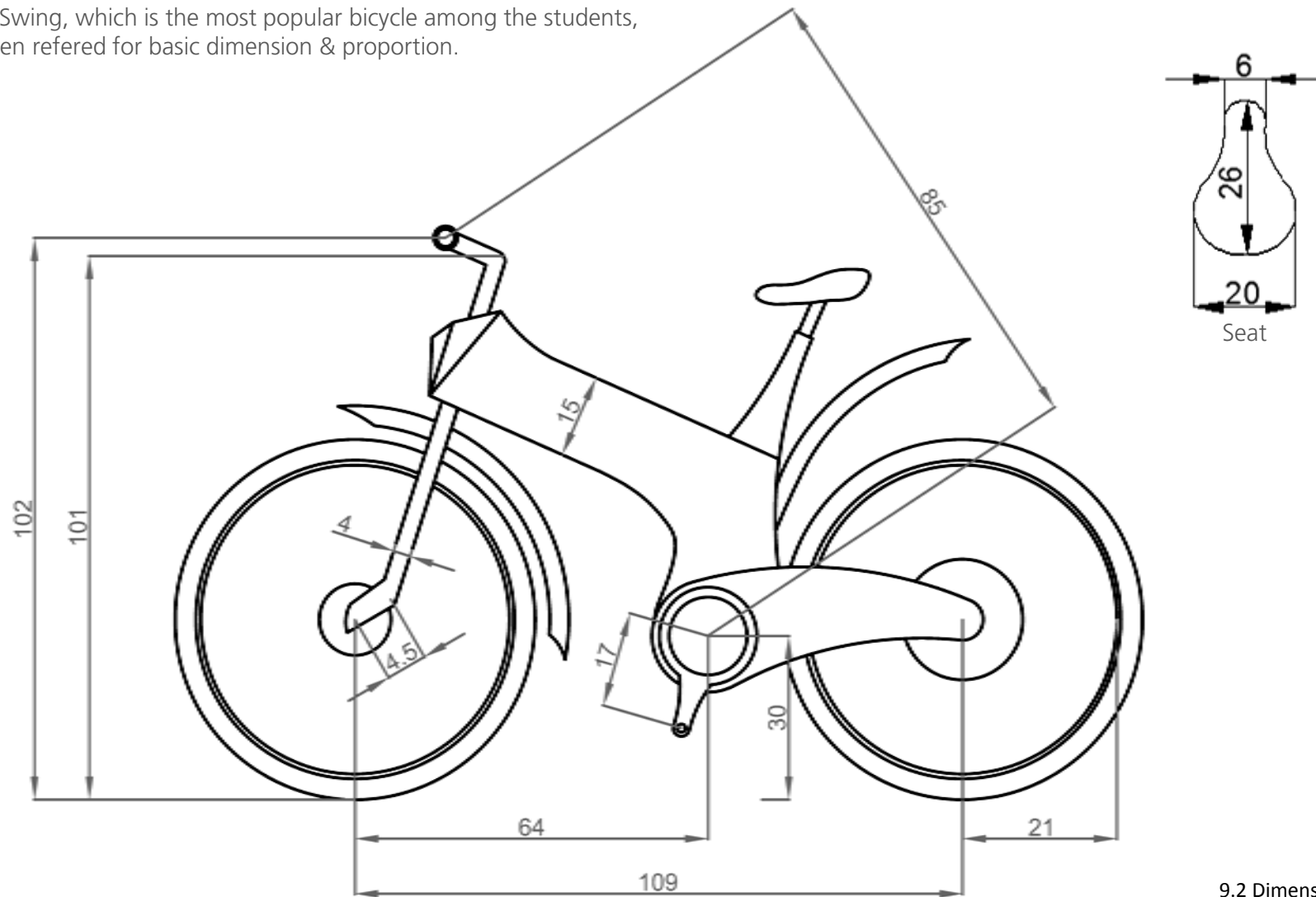
Regenerative Braking Charging

Bicycle Specification	
FRAME	Ergonomically designed, Unique design mountain bike frame with integral carrier.
HANDLE	MTB style double curved handle with extended stem. Synthetic resin grips for better riding comforts. Attractive bar ends with comfortable sleeve.
BRAKES	Disc Brakes will be used.
MUDGUARDS	Plastic U-shaped wider section.
CHAINWHEEL & CRANK	44 Teeth x 165mm Crank with attractive plastic molded rotating disc.
CHAIN COVER	Elegantly styled Plastic cover, chains are covered to protect it from water and dust.
SADDLE	Moulded PU foam comfortable.
PEDALS	Synthetic fiber molded wider body single piece reflectorized body.
STAND	Steel Powder Coated side stand.
SIZES	Modewill be available in 24T wheel size.



9.2 Overall Dimension

HERO Swing, which is the most popular bicycle among the students, has been referred for basic dimension & proportion.



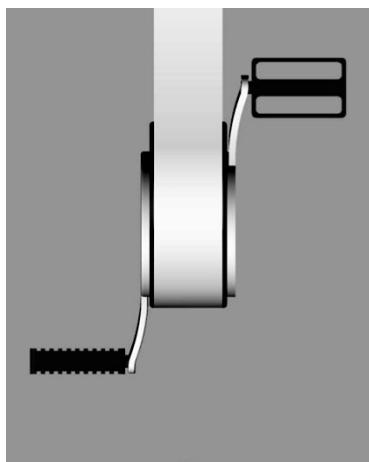
9.2 Dimension of Bicycle

All the dimensions are in cm.

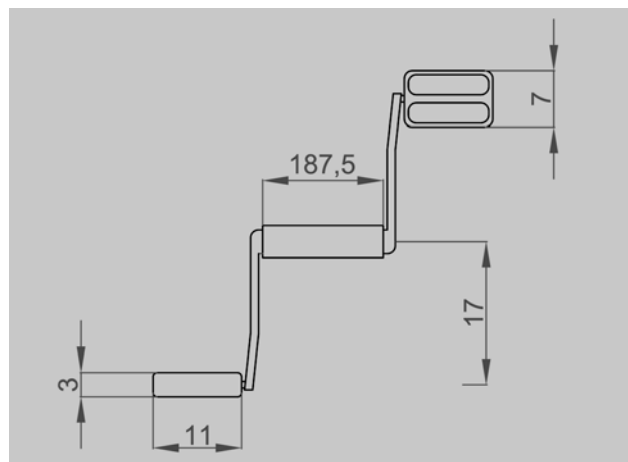
9.3 Paddle, Hub & Chain Cover

All the details are shown in the image.

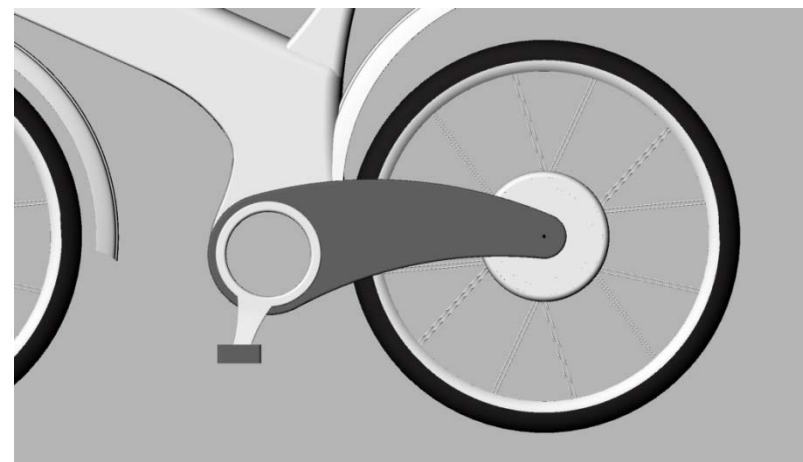
Paddle - Length - 11cm
Bredth - 7cm
Height - 3cm



9.3 Paddle



9.4 Paddle Dimension



9.5 Chain Hub

All the dimensions are in cm.

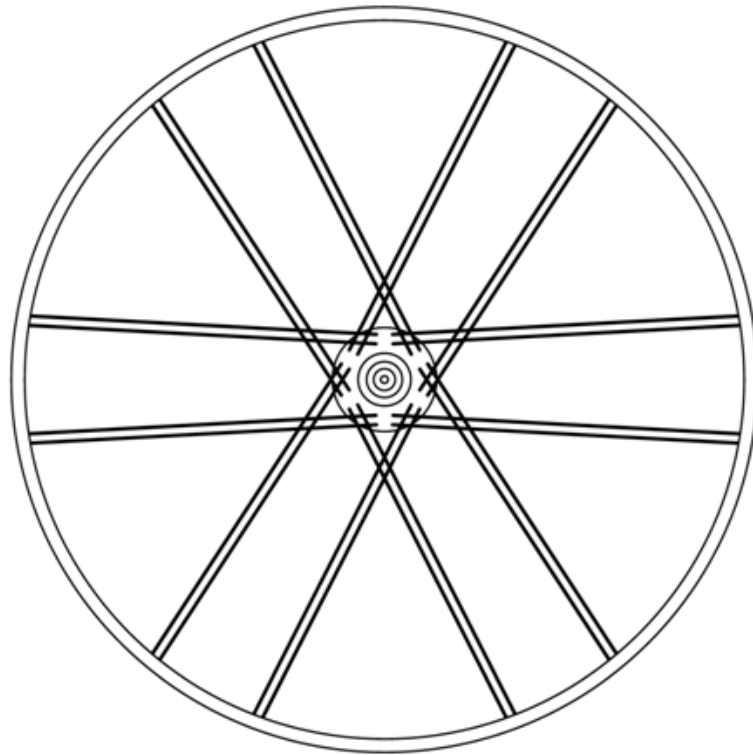


9.4 Rim & Tyre

As per the design in the Aesthetic & Styling section, bicycle rim is designed. Most of the surfaces have been kept plain so that it can be cleaned easily.

Rim Width – 5cm

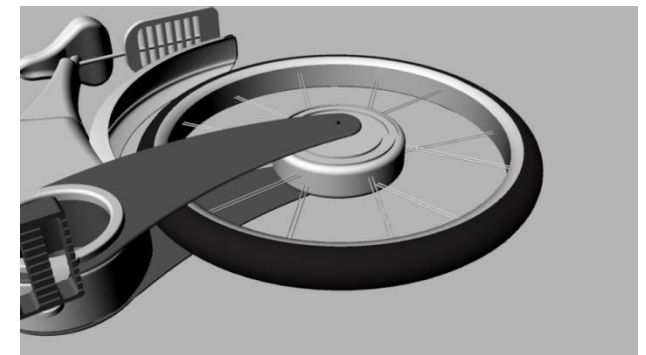
Tyre Width – 6cm



9.7 Bicycle Rim & Spokes alignment



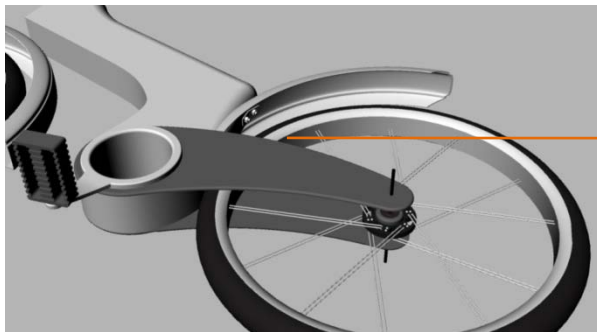
9.6 Front Wheel



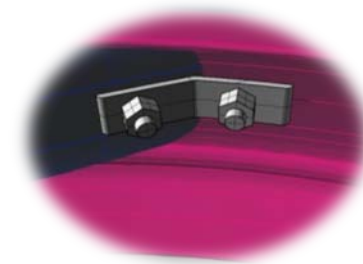
9.8 Rear Wheel

9.5 Mudgard

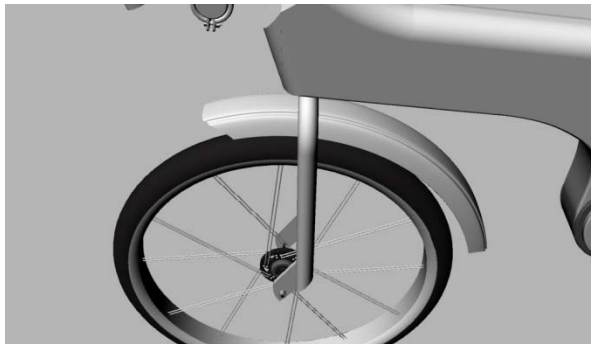
Mudgard have been designed with less complexities to make it easy to clean. Joining and the fixtures have been shown through several pictures below.



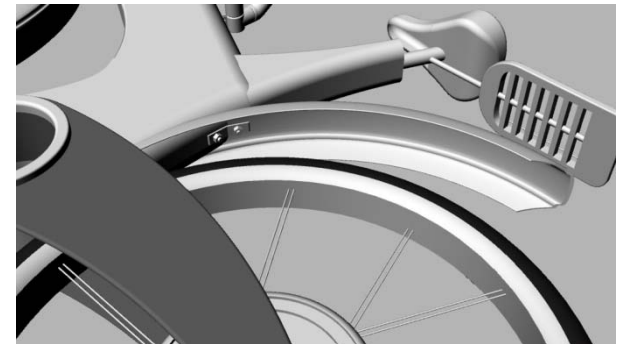
9.9 Mudgard & Fixtures



9.10 Front & Rear Mudgard (side view)



9.11 Front Mudgard



9.12 Rear Mudgard



9.6 Bicycle Carriage

As found in the User Study, most of the students don't like bicycle carriage. Most of the times they don't need this and it's always difficult to clean.

The new carriage will not be a part of the bicycle. Carriage will be provided as an accessories, those who need can buy. The new carriage has clean clean surfaces which does not add visual noise to the form of the bicycle. Further as it has less complex structure, it's easy to clean.

As the IITB terrain are not suitable for triple seating and user study results were also against it, so use of bicycle carriage as a seat has been avoided. It has been designed to carry small stuffs. This will be provided as an attachment to the seat. IITB bus service is sufficient to serve the other occasional need of students.



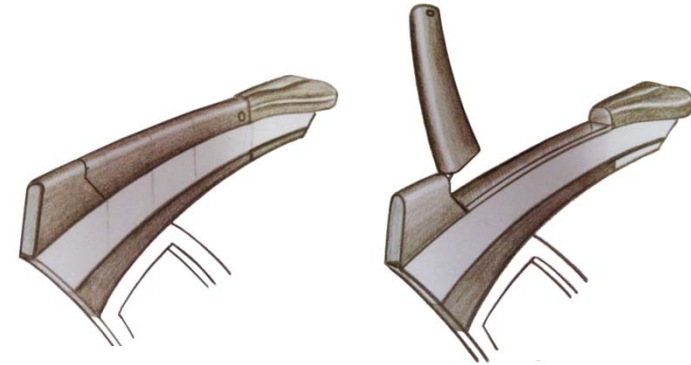
9.13 Bicycle Carriage

9.7 Bicycle Saddle & Tool Compartment

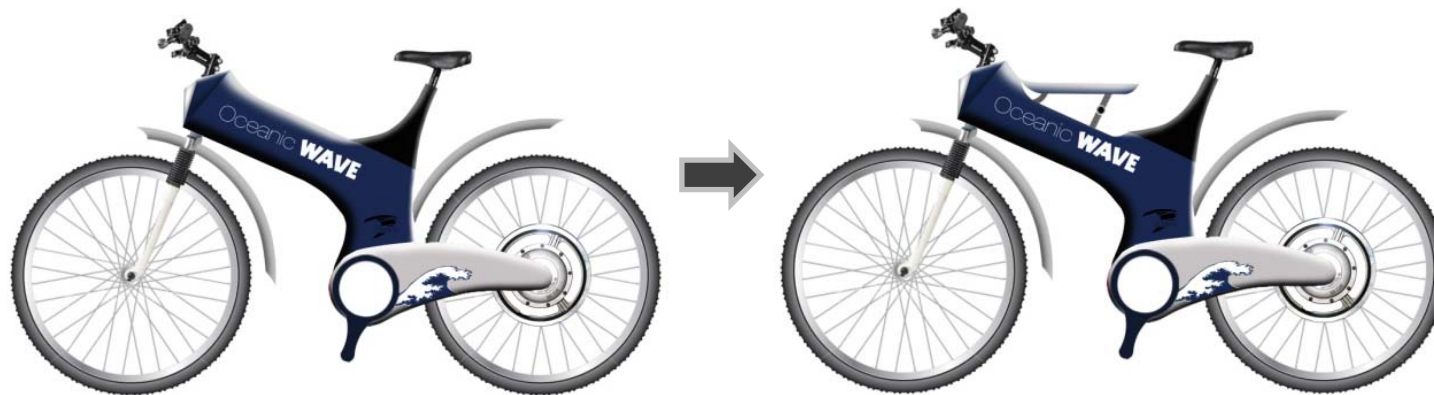
Inspired from the first concept, the bicycle saddle is hollow which will be used to keep tools and umbrella.

Further students like single seated bicycle, but sometimes need of two seats arises. In the current design, saddle can be opened to work as seat, shown in the image. When not in use, it can be closed to give bicycle a compact look.

Further, as the saddle is lower in height, it can equally be used by girls. This is one of the USP of the bicycle.



9.17 Sketch of Tools Compartment from Concept 1



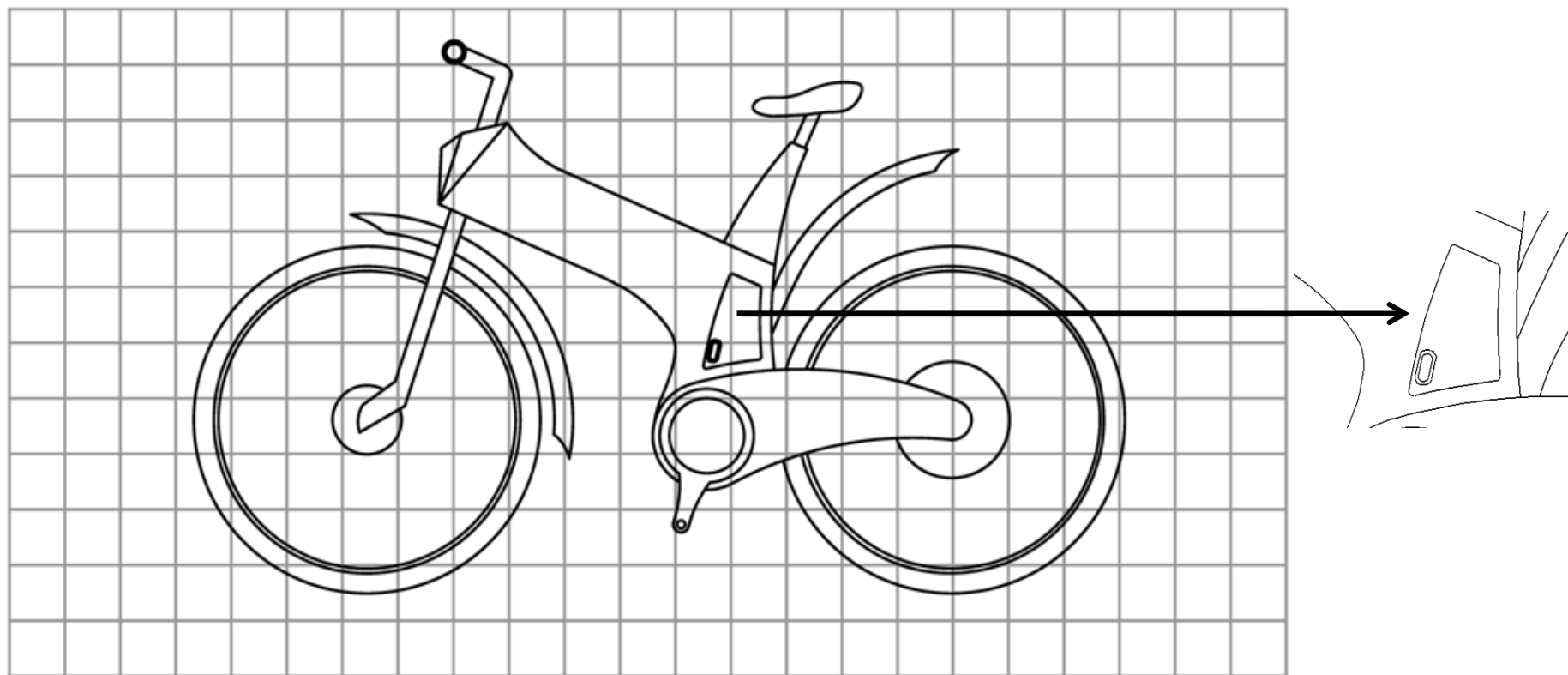
9.18 Conversion of saddle into front seat of bicycle & Opening of Tool Compartment



9.8 Battery Compartment

As the batteries today are custom made, so there is no problem the shape. The battery compartment has been shown in the image. All the dimensions are in cms and each grid is 10cmx10cm.

Battery adds up one of the major weight to the bicycle. So, the placement of battery has been given in the lower part of the bicycle to keep the center of mass lower for the balance of the vehicle while riding.



9.19 Battery Compartment

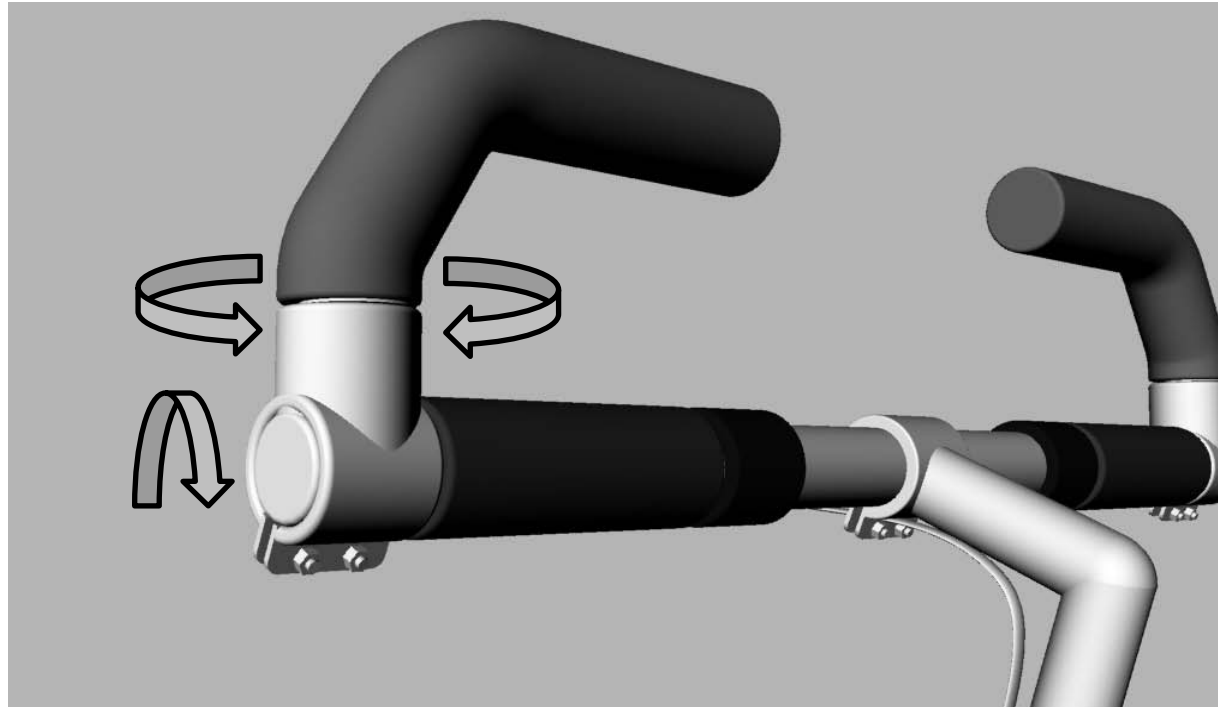
All the dimensions are in cm. Each grid is of 10cmx10cm

9.9 Handle

The universal nature of the handle to change in several shapes gives the bicycle an upper hand.

The movement of the handle is shown in the image. Several combination to these handle parts gives exciting look to the bicycle.

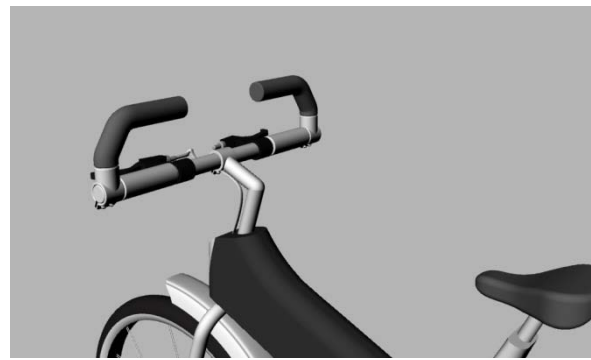
The configuration given in the image 9.22 and 9.23 is of Mountain Bike.



9.21 The axis of movement of the parts of handle



9.20 Various placements of the movable part



9.22 Mountain Bike Configuration



9.23 Mountain Bike Configuration



A hybrid configuration which has essence of both Road bike as well as Mountain Bike.

Similarly several other configurations are shown in the following images.

9.24 Hybrid Mountain Bike Configuration



9.25 Hybrid Mountain Bike Configuration



9.26 Road Bike Configuration



9.27 Road Bike Configuration



9.28 City Bike Configuration



9.29 City Bike Configuration



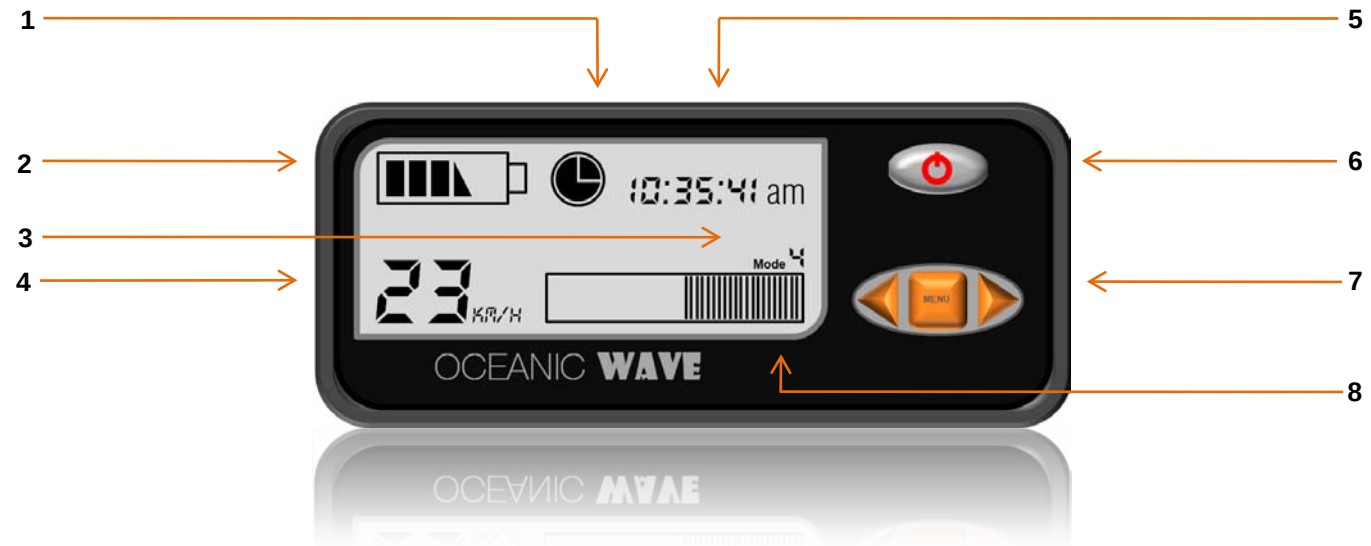
9.10 Control Panel & Display

Display Unit & Control Panel of the bicycle has been designed keeping the User interaction and convenience in the mind.

Some of the earlier versions -



9.30 Initial Explorations in Control Panel & Display



Final Display Unit

- 1 - Chronograph
- 2 - Battery Status
- 3 - Modes of Operation
- 4 - Speed (in kilometer/hour)
- 5 - Local Time & Alarm
- 6 - Power Button
- 7 - Navigation Buttons
- 8 - Acceleration

9.31 Control Panel & User Interaction



1) Chronograph -

A chronograph facility has been provided for the time calculation or recording purpose.

2) Battery Status -

The control console includes a battery charge indicator that helps you manage the battery charge in order to prevent running out of energy on the return trip.

3) Modes of Operation -

These are the modes in which the bicycle will work. Explanation for each is given below –

i) - Power Assistance Off

In this mode, motor will be off permanently. Bicycle will work on man power.

ii) - Power Assistance On

In this motor system will be active with a accelerometer working. Whenever there will be up-hill ride, motor will automatically start and assisr the rider in paddling.

iii)- Power Drive Mode I

In this mode, bicycle will completely work on the electric motor. The control will be in the hand of the rider, who can accelerate the bicycle using the throttle control on the handle.

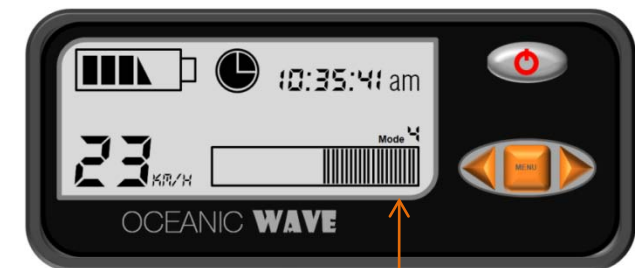
iv)- Power Drive Mode II

This is just like Mode 3 , just differ in the level of power available.



Chronograph Mode

Current Running Chronograph → **00:00:00:00**
Last Saved Timing → **00:05:24:35**

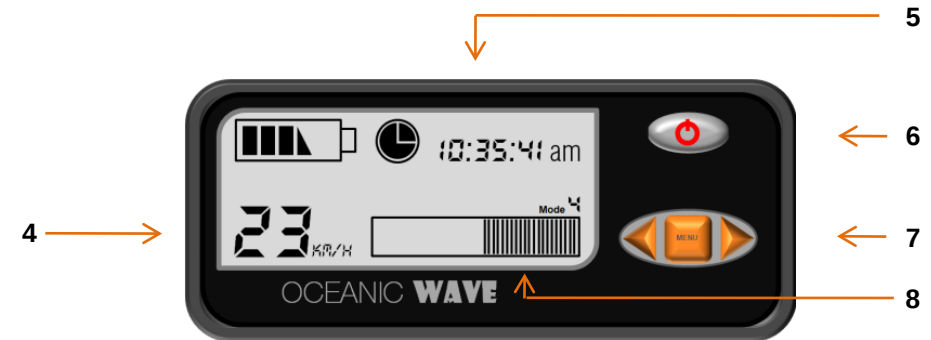


Modes of Operation

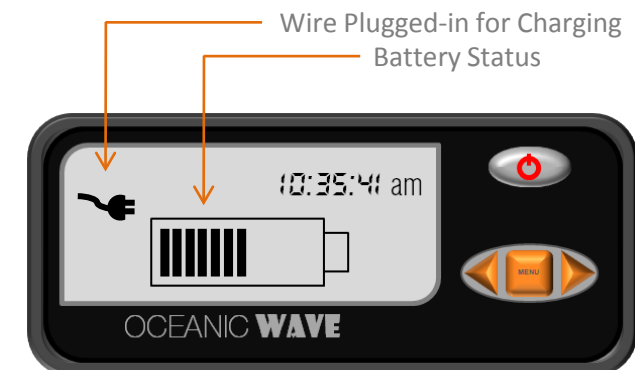


9.32 Various Functions of the Control Panel

- 4) Average Speed -
This icon gives the constant average speed of the bicycle throughout the journey.
- 5) Local Time & Alarm -
This gives the local time of the town. It's setting depends upon the need and time zone of the user. This can be adjusted manually.
- 6) Power Button –
This button is just to switch on the electrical system.
- 7) Navigation Button -
These set of buttons are there to navigate through the sets of options, features and functions of the system. This has been optimized to better suit the target users.
- 8) Acceleration -
This feature is there on the display unit to show the acceleration of the vehicle. There is a throttle control on the thumb of the rider which helps in accelerating the bicycle.
- 9) Plugged-in Symbol-
This is the symbol which appears when the bicycle is on charging. There is a symbol whether the bicycle is plugged in or not. Other symbol shows the status of the battery throughout the charging.



9.33 Display Discription



9.34 Plugged in - Charging Display

10 Evaluation of the Proposed Bicycle





10.1 How the proposed design meets the Project Brief and need of the Project??

- 1) The proposed bicycle is power assisted to help user during up-hill ride. The thumb throttle control adds experience, the zoom factor, to the ride, what an end user wants.



10.1 Hub Motor



10.2 Control Panel

- 1) Most parts which are sensitive to rusting are covered, so they are less likely to need frequent maintenance in the humid and rainy region of IIT Bombay



10.3 Front Part



10.4 Rear Wheel

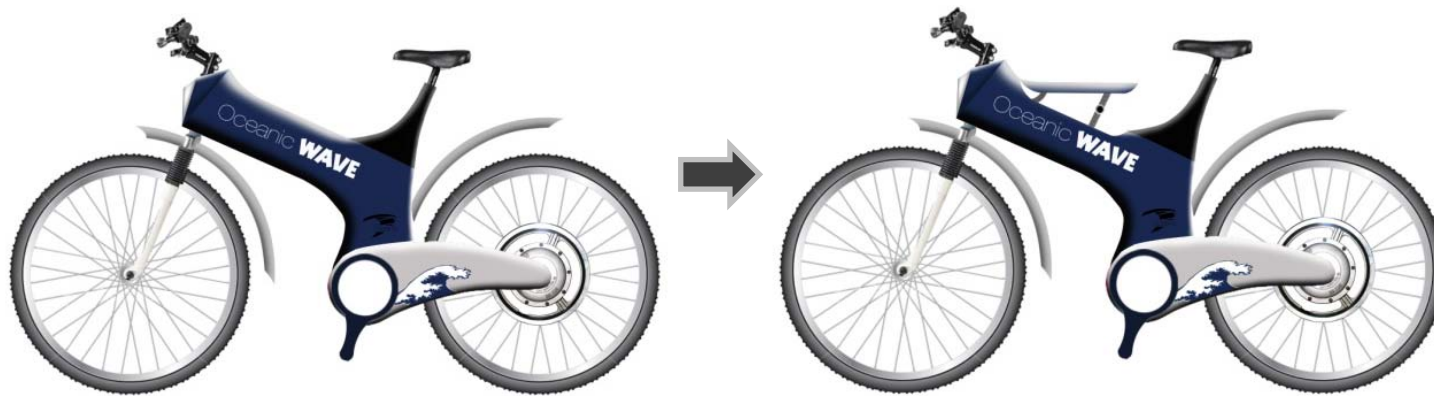


10.5 Paddle Hub & Chain Cover



10.6 Saddle & Seat Cover

- 3) As we can see in the bicycle in the first image , the bicycle looks clean and attractive and is ideal for the single user. But when needed the saddle can be uplifted to accommodate the other person

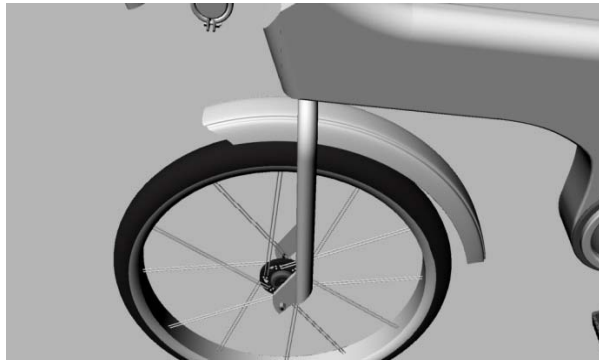


10.7 Conversion of Saddle into Front Seat

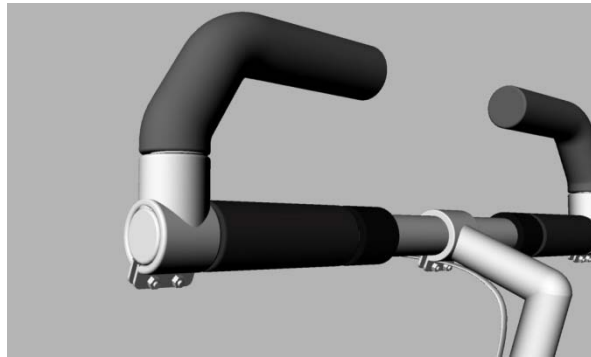
Thus the age old culture of riding the bicycle by two user is also there. This helps in the social interaction and shows the life of IIT. One of the most important need and part of the project brief is done.



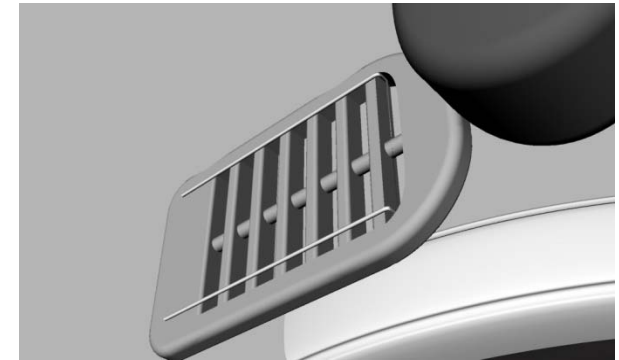
- 4) Many of the parts which are used as per the user needs will be provided as accessories. Ex- Bicycle carrier, mudguards, Chain covers, Handle fittings etc.



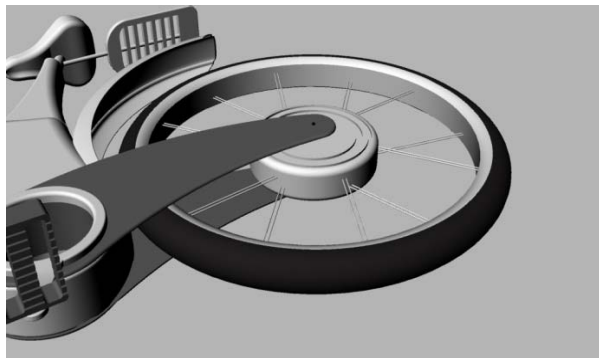
10.8 Mudguards



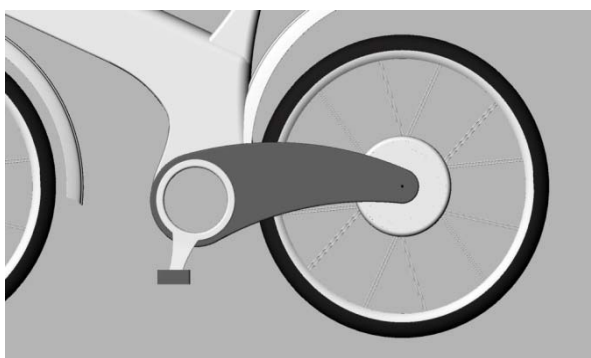
10.9 Handle



10.10 Bicycle Carriage



10.11 Chain Covers



10.12 Rim & Tyres



10.13 Handle Configuration

- 5) Based upon the semantic study, new form is explored keeping a proper balance between Form and functionality.

Fuzzy boundary

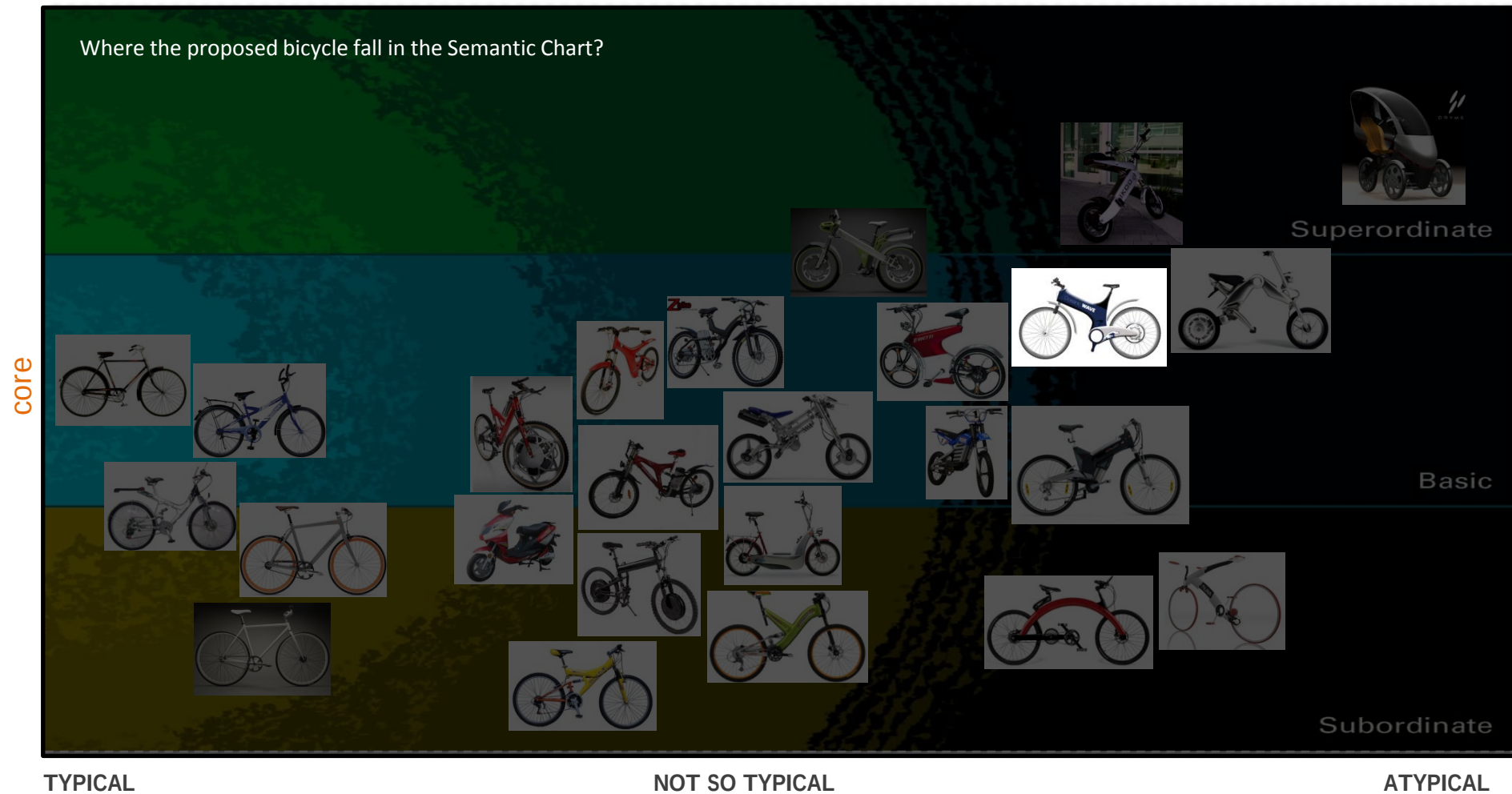


Chart 10.1



- 6) To serve the emotional needs of the various users of the bicycle in campus some changes are done –
- Straight handle with drop bars (Mountain Bike lovers)
 - Front suspension can be jammed (Road Bike lovers)
 - Look & Power assistance (Bike lovers)
 - Introduction of Chronograph and other minor health monitoring gadgets (Tech lovers)

10.14 Hybrid Mountain Bike Configuration



10.15 Road Bike Configuration



10.16 Mountain Bike Configuration



10.17 City Bike Configuration



10.2 Features of the proposed bicycle

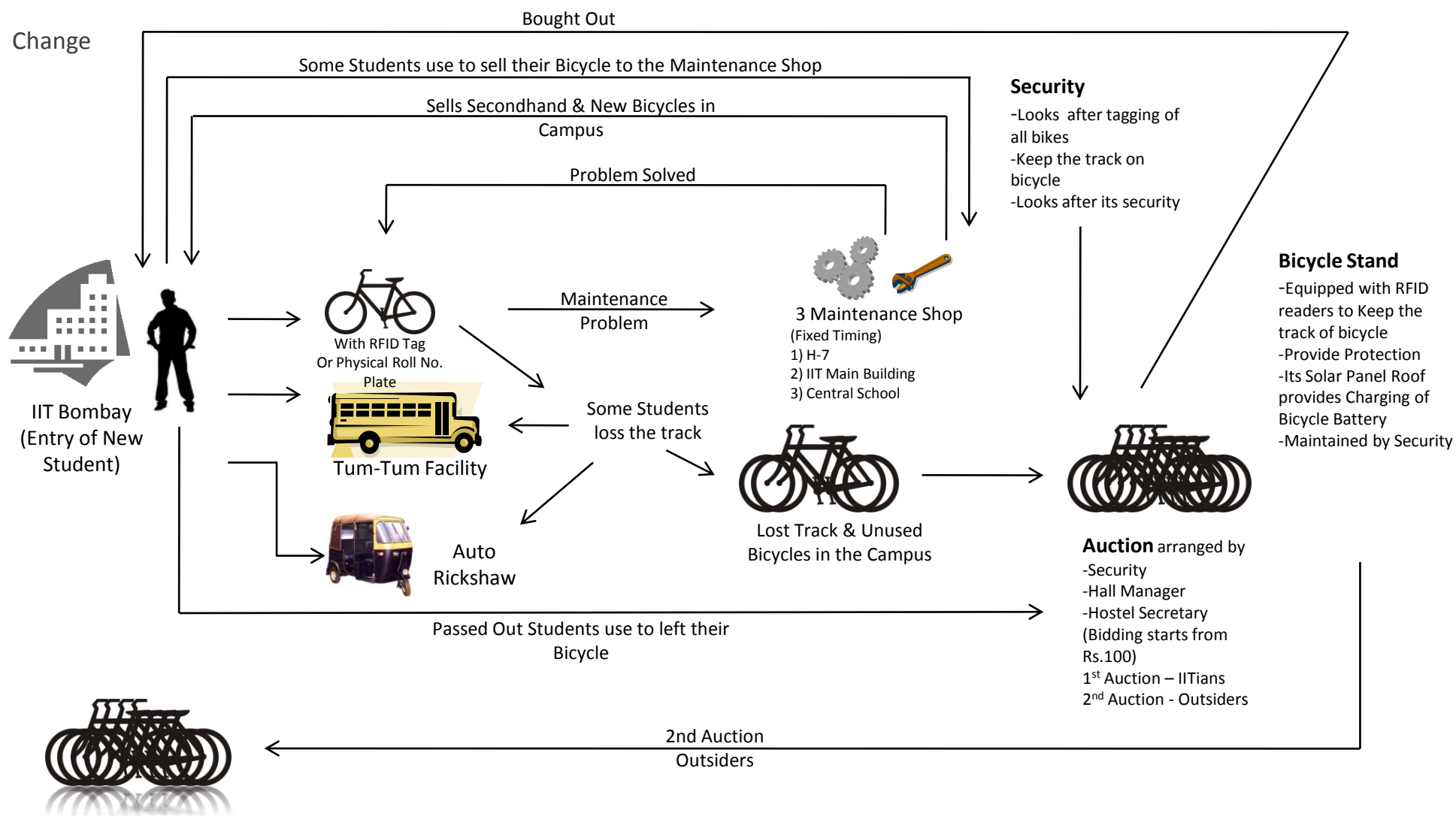
- 1) Unique form inspired from the youthful oceanic wave and U2 Blackbird to depict the youth dynamism.
- 2) Freedom to customize – Parts like Bicycle carrier, mudguards etc can attached depending upon the need.
- 3) Power assistance with 350Watt motor and 36Volt:9.9Amp Battery with thumb throttle control to give instant acceleration.
- 4) Tracking of the bicycle, it can be used at a large scale to implement in a city (Preventing loss of track and theft)
- 5) Maintenance Free feature – Most of the parts prone to rust are covered.
- 6) Two in One Bike - Mountain Bike (with straight handle and konobbler tyre) as well as Road Bike (handle with drop bars and front suspension can be jammed when needed to work as road bike)in one.
- 7) Convertible seat in the front which can be deployed in case of need, reviving the age old enigma of social interaction in IIT.
- 8) Compartment to keep Umbrella and small tools in the saddle.



10.3 USP of the proposed bicycle

- 1) Unique form
- 2) Freedom to customize
- 3) Being a low saddle bicycle it can also be target on the girls too.
Even in some areas girls like to ride boys bicycle
- 4) Power Assistance for instant acceleration.
- 5) Tracking of the bicycle, it can be used at a large scale to implement in a city
- 6) Maintenance Free feature







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- 5.2.1 : Self made collage
- 5.2.2 : Self made collage
- 5.3 : Self made collage
- 5.4 - 5.10 : Self clicked
- 5.11 - 5.15 : <http://www.herocycles.com/>
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