# Design of Bike for Youth

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**Guide: Prof. R.Sandesh** 

# **Design of Bike for Youth**

Industrial design project II

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Guide: Prof. R.Sandesh

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

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degree of Master of Design in Industrial Design.

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Chairperson

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Two wheelers are the most widely used means of transportation in India. But for many riders they are lot more than just a vehicle. It's a product which they use to reflect their identity as a part of them. The Bike is targeted towards Indian youth in the age group of 20-30. The project also deals with understanding this particular user group to know about their lifestyle, likes & dislikes.

Initially data was collected to understand the history of two wheelers in Indian and current market status. Different segments and sub segments were studied in for their distinguishing character and design values. A vehicle base was formed. With user study and bench marking. Various aspects of styling, performance and usability were compared. A design brief was developed after analyzing the data. For concept generation my user group was analyzed and certain keywords and themes were listed. Creative modes of explorations like metaphors based styling was done. Ideation was done to generate concepts, 2 concepts were generated initially and based upon requirements and user feedback one was chosen and was developed further.

India is one of the largest two wheeler market in the world. Two wheelers are most popular cheap mode of transport in India, because of reasons like overcrowded public transport, traffic congestions rising fuel prices two wheeler segment dominates the automobile market by huge margins.

India has the second largest population and one of the fastest growing economy. India is one of the Upcoming potential market for personal mobility solutions. Many international automobile manufacturers are entering India to take a share of this potential market.

India's major share of population belongs to the age group 20 and 30. Rise in IT Companies and other Industrial firms has led to Youth moving up in the salary bracket having created a segment of buyers who are the major potential buyers of the Bikes. Companies believe that these potential buyers have a power to influence others towards a particular product.

Motorcycle companies are always trying to impress youngsters by launching performance bikes which are moving up in the power band with improved styling features in accordance with international styling trends.

Aim of this project is to study Indian youth to understanding their aspirations and lifestyle. Analyze Indian bike segments and target one particular segment within it which is best suited to my user group.

Observe various styling trends followed in bike design in India and in International market. Analyzing the user group and bike market to come up with themes and styling options which would attract my target user and finally to develop a bike concept which best reflects the today's Indian youth.



Wheels are considered as the greatest invention of a human being. Wheels offered a continuous uniform motion and two wheels in line gave directional control so was a bicycle developed.



Speed and control has fascinated human beings since their origin. History of motorcycles starts with invention of wheel and bicycles. Bicycles evolved further to add more sophisticated mechanisms like chain drives for transmission and brakes.

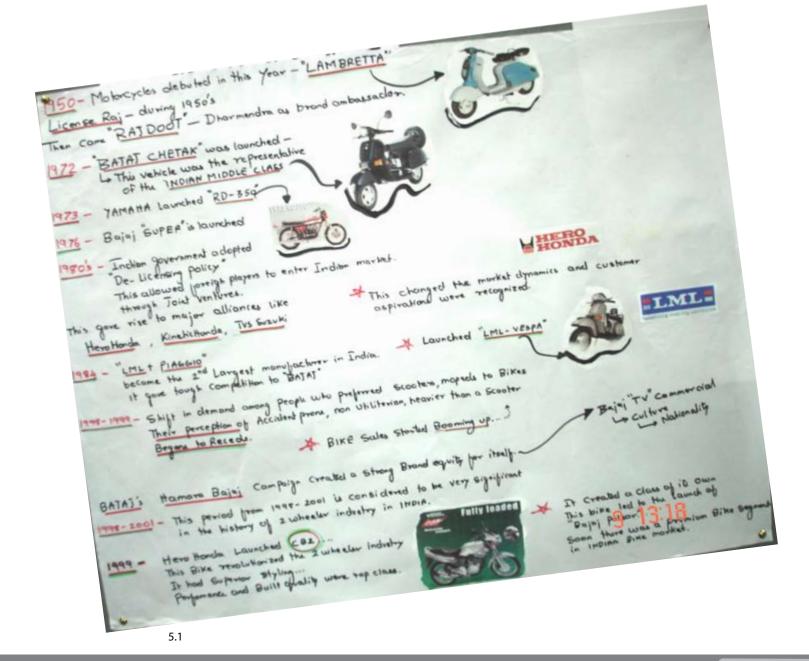


Soon man found the speeds very manageable and started looking for more. A bicycle was coupled with various engines for better speed. Different engines like steam engine, electric motor, internal combustion engine were tried.

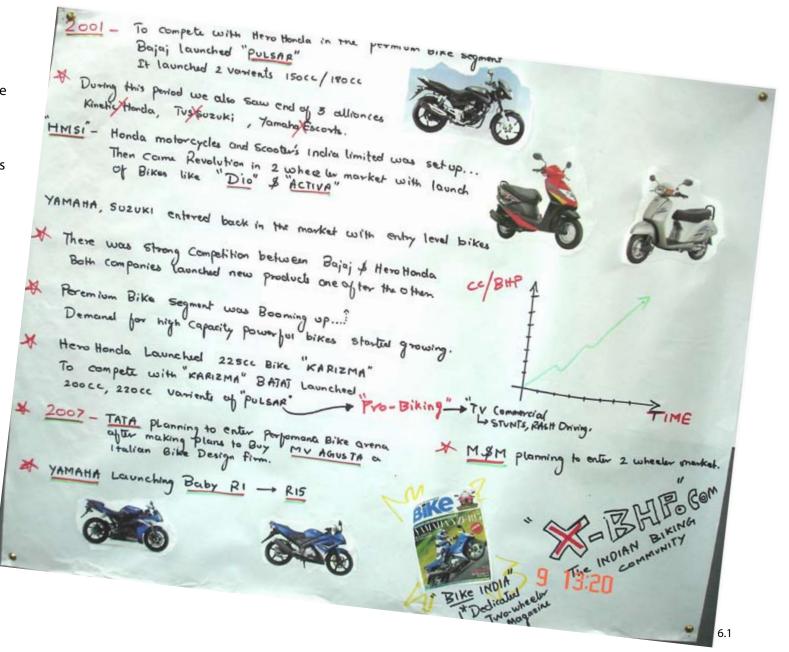


But only gasoline powered internal combustion engine proved most suitable because of better power, low weight, high speeds, ease of use and compact size. This led to the development of bikes.

Posters explaining the development of indian 2 wheeler industry.



This exercise helped me to study the history of 2 wheeler industry how it evolved what were the turning points which brought drastic market changes.





History of Indian two wheelers dates back to 1955 when Royal Enfield started their manufacturing unit at Chennai India. Indian army was the only buyer at the time but soon found few more enthusiasts on roads.

Rajdoot 7.2



They were soon followed by Rajdoot. With the kind of specifications and price tags motorcycles or in fact automobiles were products for rich and enthusiasts.

Lambretta



In 1950 Lambretta was launched it was a Scooters powered with mid-size engine.

Bajaj Chetak 7.4



Soon Bajaj launched Chetak. It was a breakthrough in Indian 2 wheeler market. It did not fail to impress youngsters. Market was shared by motorcycles and scooters in major share where mopeds started losing likes of users.



Scooter market took a boom when kinetic introduced its new sleek design. They introduced all new looks to a scooter and brought back customer attention. It had eye catching style and great usability limits.

Hero Honda Splendor



Motorcycle market soon had a major contender Hero Honda who introduced a four stroke mid-size engine motorcycles like "CD Dawn", "Splendor" for better fuel economy and smoother ride. "Splendor" gave the company huge sales and became the worlds largest selling motorcycle.



Hero Honda CT 100

In the current scenario Indian two wheeler market can be classified into three main segments.

## Three main segments are:





8.2-a, b, c Scooters/ Scooterettes/ Motorscooters



Light weight, highly fuel efficient, easy to ride and handle in urban conditions.

The tank is mounted in the front in vertically inclined position

With engine below tank and petrol tank below seat on medium size wheels mopeds look neat and compact.



Features like step through riding position, low saddle height, low speeds and light weight made this segment favorite for young female riders.

Mopeds started as a small size motorcycles and developed themselves for female riders. Nothing much has changed since its birth. Typical high raised handle, rectangular tube like petrol tank and rectangular body still characterize a moped. Though different colors and were tried in the past mopeds have lost most of its market in recent times due to better performances and looks offered by other segments.

Urban personal transport vehicle carry less than 50 cc engine and have without gear option.

9.1

When motorcycles were considered symbol of bold strong male scooters emerged as stylish alternatives. Scooters were not about raw power and bully attitude but were safe and stylish.

Provision of extra wheel at the rear end was very useful in case of emergency.

Large bulging surfaces are the prominent features. The Engine is mounted on right side of the vehicle.

Guarded leg space in front and assured safety made it a popular family vehicle.

A step through climbing and storage made it a typical family vehicle.

Scooter had a basic sheet metal structure to hold and cover the engine components on small wheels.

It has a circular head lamp with handle bar integrated with it.

When Bajaj introduced Chetak it became a popular family vehicle. Bajaj's campaign 'Hamara Bajaj' worked great for the product and the company.

Scooterettes were first introduced to compete with mopeds and low profile scooter requirements.

With a small size engine and scooter like styling are most prominent characters of this segment.

They have a single long seat as compared to scooters which have a split seat for rider and pillion.

It has a step through climbing with foot rest acts as a storage space. The foot rest is at a lower level as compared to the mopeds.



They are available without manual gear shifting options.

A front fairing to guard legs, small wheels, trendy colorful body panels are most prominent features of this class.

Small proportions, trendy cute looks, attract most of young female riders. Products in this range are Bajaj Sunny and spirit, Hero winner, Kinetic zing.

A scaled down version of scooters can best describe this segment. It combines advantages of scooter, and mopeds in best ways. They are light weight, easy to ride and handle, they look safe and trendy, they carry limited storage space and are high fuel efficient.

The character of a motoscooter suites a young dynamic character and hence is popular in the same.

Bold graphics and aggressive styling, step through riding are most essential features of a motoscooter.



These are great combination of style and power. It combines attitude and expression of a motorcycle and safe stylish looks and convenience of scooters.

Concealed lighting clusters and indicators, a wind shield are used to generate a singular form. Polymer body all around allows use of many colors and shapes.

Honda Dio is first motoscooter in India.

Motorcycles have come all the way from era of Indian to Honda's. From simple engine on two wheels to one of the most sophisticated technologies and complex mechanisms like green technologies of fuel cells.

Though not very environment friendly gasoline powered internal combustion engines are most popular because of ease of use, response levels, compactness, power developed, and infrastructures available.

Royal Enfield was the first one to manufacture motorcycles in India followed by Rajdoot. Earlier companies were following global trends and manufacturing high power motorcycles. Soon the trend was changed with Japanese two wheeler revolution. Indian market was full of two stroke and four stroke mid size motorcycles. Motorcycles became popular as a personal transport only when hero Honda introduced four stroke mid size motorcycle into Indian market. And now motorcycles hold largest share in Indian two wheeler market. These motorcycles were fast enough, light weight and affordable.

In Indian 2 wheeler market motorcycles are divided into 3 major segments they are as follows.



Economy
Hero Honda CD Dawn
13 1



**Executive**Bajaj Discover
13.2



Premium
Hero Honda Hunk
13 3

As name suggest they are designed for low profile users. These are machines to function than to perform or look good.

These motorcycles were introduced to compete with scooter market with cheap pricing and good fuel economy.

Extensive use of graphics to improve aesthetics is found pronounced in this segment.

They cheapest in the motorcycle segment and carry only essential elements.



Hero Honda CD Dawn

These motorcycles are functional and durable. They are just cheap and functional commuters than motorcycles with character.

Round head lamps, projecting instrument panels and side indicators, Square shaped flat tank are some of the common features of these motorcycles.

Up to 100cc High mileage/low power 90kmpl / 7bhp

They are made strong and durable to appeal customer. They are fuel efficient and cheap and require very less maintenance. Fuel economy, low cost, durability and low maintenance are the most important factors at the time of design than performance and looks. These are popular in lower middle class and rural areas. This segment has products like Hero Honda CD dawn, Bajaj CT 100.

This is the most popular and so is most populated segment in Indian motorcycle market.

Considering an executive at their professional places and personal life the motorcycle is designed to carry sober, understated still smart attitude.

Also limited graphics are used to make a statement.

Though these motorcycles carry essential elements they are treated for better aesthetics.



Bajaj XCD 125 sprint 15.1

Good fuel economy, smooth flowing curves and surfaces, small fairing to cover headlight and instrument cluster, are some of the essential features of styling in this segment.

These motorcycles offer a balanced combination of good aesthetics, performance, fuel economy and durability. And hence they appeal the most to Indian consumer.

100-125cc Decent mileage / power 70kmpl / 10bhp

Products in this category are TVS Victor, Hero Honda Passion and Splendor, Bajaj Caliber Discover, LML Freedom.

These are closest brothers of motorcycles in global market in terms of Styling and performance. These are motorcycles with lot of attitude and statement of their own. They are highly detailed and expensive performers.

Performance and styling are the most important factors in design of these vehicles.

They are highly detailed at each component level to make overall bold statement.

Power speed and attitude of these motorcycles make them most popular in young generation and biking enthusiasts as both carry same attitude in their life.



Priced comparatively higher these motorcycles make a loud statement with varied proportions of different elements.

They are the latest ones to appear in market and are popular in young users and Enthusiasts.

Yamaha FZ 16 16.1 150-250cc High power/low mileage 18bhp / 30kmpl

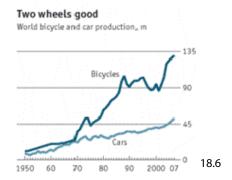


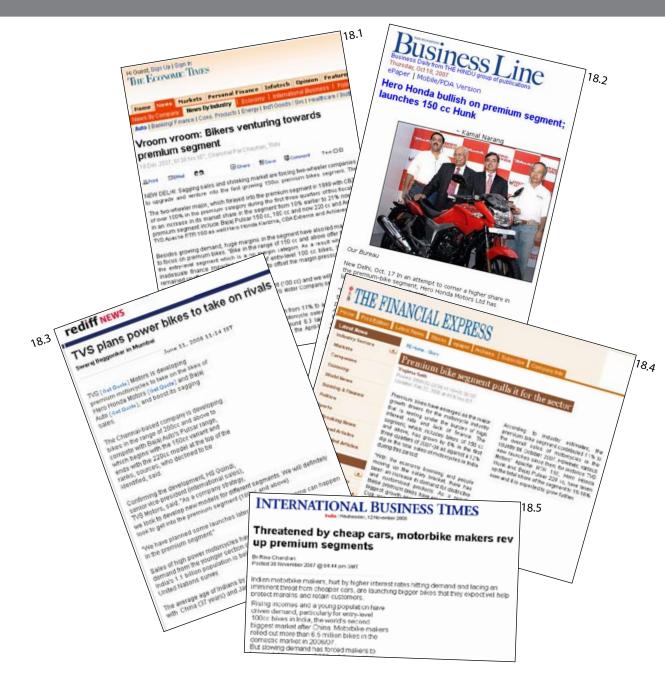
## **Economy segment**



According to industry estimates, the premium bike segment contributed 11% to the overall sales of motorcycles in the country till October 2007. However, various new launches since then, for instance TVS Motors' Apache RTR 160, Hero Honda Hunk and Bajaj Pulsar 220 cc, have taken up the total share of the segment to 15-16% now and it is expected to grow further.

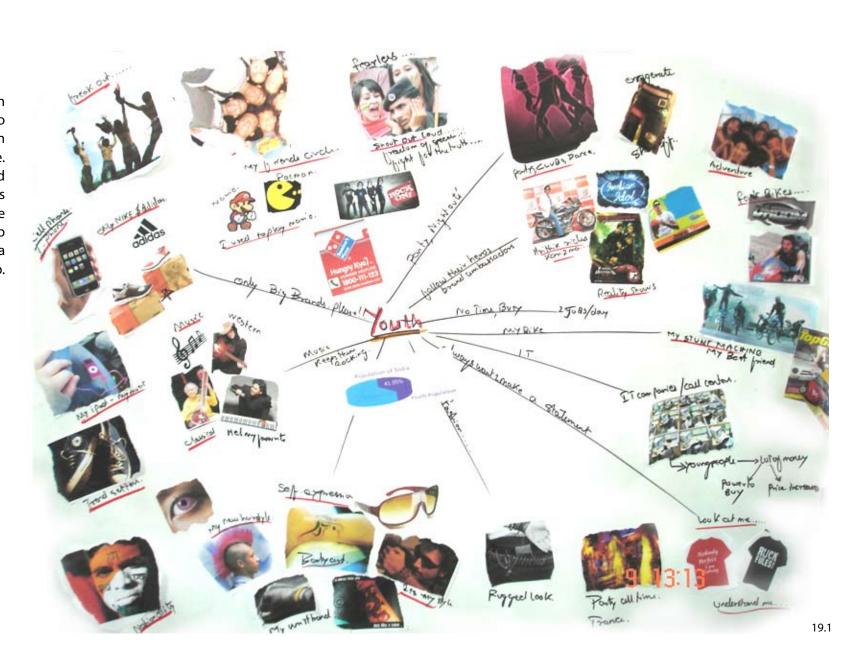
With the economy booming and people moving up the salary bracket, there has been an increase in demand for distinctive and customized products. Bike in the range of 150 cc and above offer huge profit margins unlike the entry-level segment which is a no margin category.





A small research was done to understand youth and their lifestyle. This involved observing various kinds of people in this age group and making a mind map.

# Mind map



My target user age group is 18-30 consisting of male riders.

In this particular user group the user enters a new world and enjoys all his freedom and self decision power. The user group may involve students and young executives. Student though do not have buying capacity studies show that they influence buying decisions and so can Be considered as potential users.

Inferences which I could derive out of this user study are as follows:

Experimental nature

Normal is boring

Zest for speed

Tend to be guiltless consumers



20.1

Want to Stay ahead of everybody

Awareness of latest styling trends

Products they use reflect their identity

Like customizable products



We all use many products everyday. All of these products have some function. But apart from its intended function these products are also used to make a style statement.

Use of accessories like sun glasses, shoes, gadgets like cell phones mp3 players etc. For some these products bear more of style statement than their designed use.

Young buyers believe in branded products whether it is a cloth or gadget or any accessory.



Self expression:
Some of them do body art like Tattoos.
Wear wrist bands with slogans and
messages or color their hair in bright
colors.





Shoes also play important role in establishing user character. Sports shoes and floaters give sporty and strong looks where as rough leather shoes are used for rugged aggressive looks.

Clothing projects the character of person wearing it or the way he wants to present himself. A variety of clothes are available right from traditional kurtas to trendy new short sleeve T-shirts.

T-shirts with bold graphics and faded looking jeans and jackets with pronounced stitches are popular for rugged looks.



To start with the design process and concept generation there was a need to study the segment of bikes which attracts most to my target user.

With market study and user interaction it was clear that most of the youth preferred premium segment bikes apart from performance and speed these bikes offered they were attracted towards them because these bikes had a lot more of character in them and owning them was like making a statement.



Most of the users would like to buy a bike from the premium segment and some important reasons given were:

- 1. They look better then rest of the bikes in other segments.
- 2. They are more powerful and fast.
- 3. They have more features which are close to characteristics of foreign bikes.

The styling trend being followed in the premium segment is moving towards naked bike designs. This can be inferred from the recent launches of bikes like Pulsar 220, Yamaha Fz16.

The naked bike concept is not popular in Indian Bike market but in global bike market these bikes are very popular.

## Naked bikes:

Naked bike refers to a class of road motorcycles without fairings. Also known as a "standard" or "street bike," this is the basic form of the motorcycle stripped down to its fundamental body parts. The emphasis is on functionality and ergonomics rather than aerodynamic body panels and exaggerated riding positions that are most common on sport bikes.

### Characteristics:

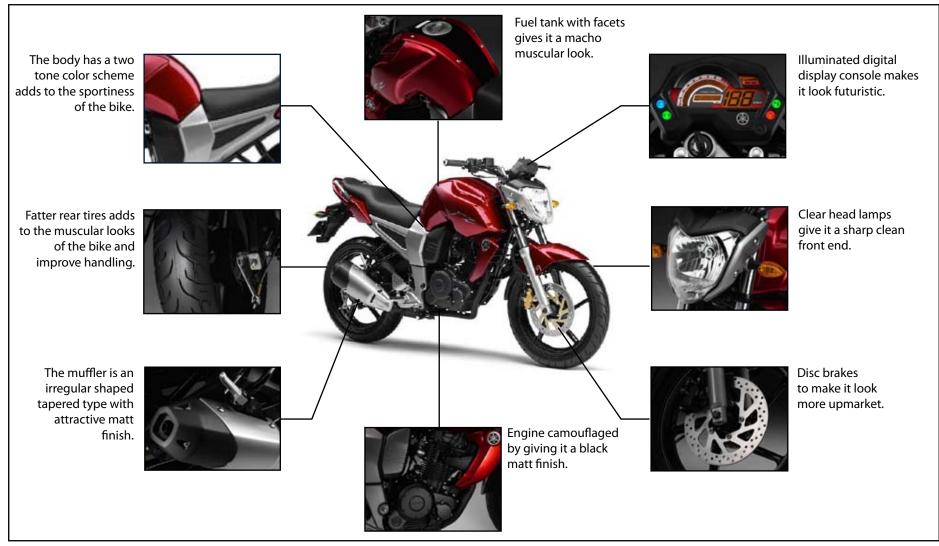
As their name implies, all naked bikes lack fairings (e.g. Triumph's Speed Triple) or have small, half-fairings (e.g. Ducati's Monster S4R).





These bikes are loved for their tough, bare-bones styling and the subsequent attitude they seem to exude. The structural members like the chassis, engine are exposed to give it a very macho muscular look.

For benchmarking the latest Yamaha Fz16 was chosen as it was based on naked styling. Its various features were studied so that a base is formed for the concept development.



There is a need for an engine with better performance than the existing ones. The best in the premium class offers 225 cc 16 bhp engine. So a 250cc power plant with output of about 18bhp would be sufficient.

Disc brakes and alloy wheels shall be standard equipment on the motorcycle. A digital instrument panel shall be used as special feature. New monoshock suspension shall be used to give more sporty and dynamic stance.

Considering time constrain and factors affecting buying decision styling was given foremost importance. Motorcycle is an optimization of ergonomics and dynamics. To avoid technical complexities dimensions of existing Indian motorcycle were referred for design.

## **Technical Specifications:**

Engine : 250cc single cylinder four stroke air cooled

Power : 15-18 bhp.

Gearbox : 5 speed manual

Suspensions :

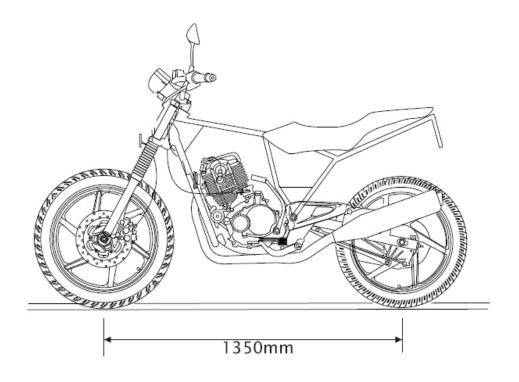
Front - Telescopic fork

Rear - Monoshock with swing arm

Wheelbase : 1350 mm

Tire size

(Front/rear) - 100/80-17 / 140/60-R17



Bikes are not only vehicles for moving from point A to point B, but products that express the owners lifestyle and personality.

Premium segment buyers are looking for more power and better performance than the existing motorcycles.

New technologies are emerging, and new forms of crossover vehicle designs are emerging to meet the requirements of the future.

By extracting Styling elements and features from International bike segment and using them to create a crossover design, to cater to the user who always dreams to have a foreign bike.

Through shapes create feeling of exclusivity

Through styling create a differentiating factor

"



The styling trend in the premium Bike segment is moving towards naked bikes designs

Some examples of naked design are:



The approach to the design process done from two sides. It was decided that two concepts will be made one concept focused on making a compact bike- a single seater and the second concept was based on a particular theme.

Then a concept would be chosen based upon requirements and feedback from users.

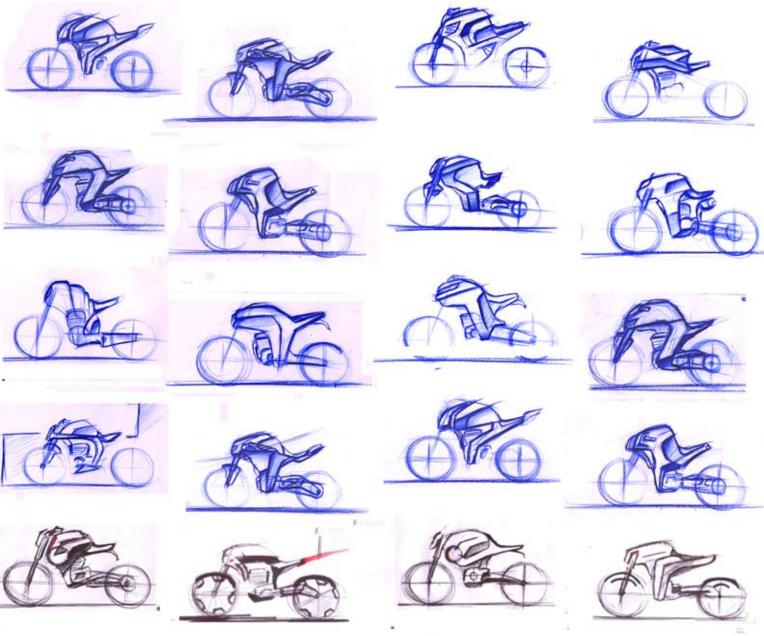
Then the final process would be to detail out this concept.

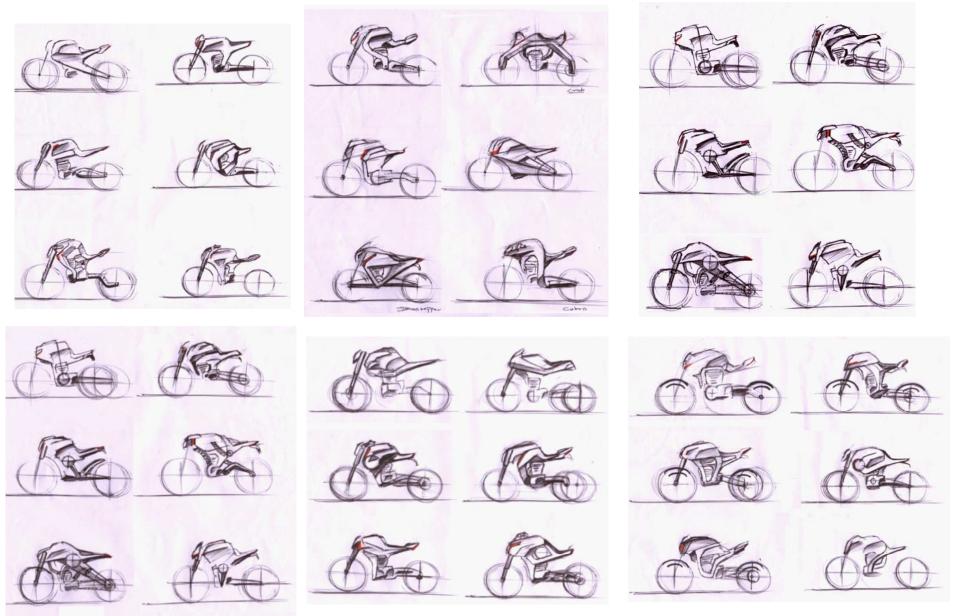
## Concept 1:

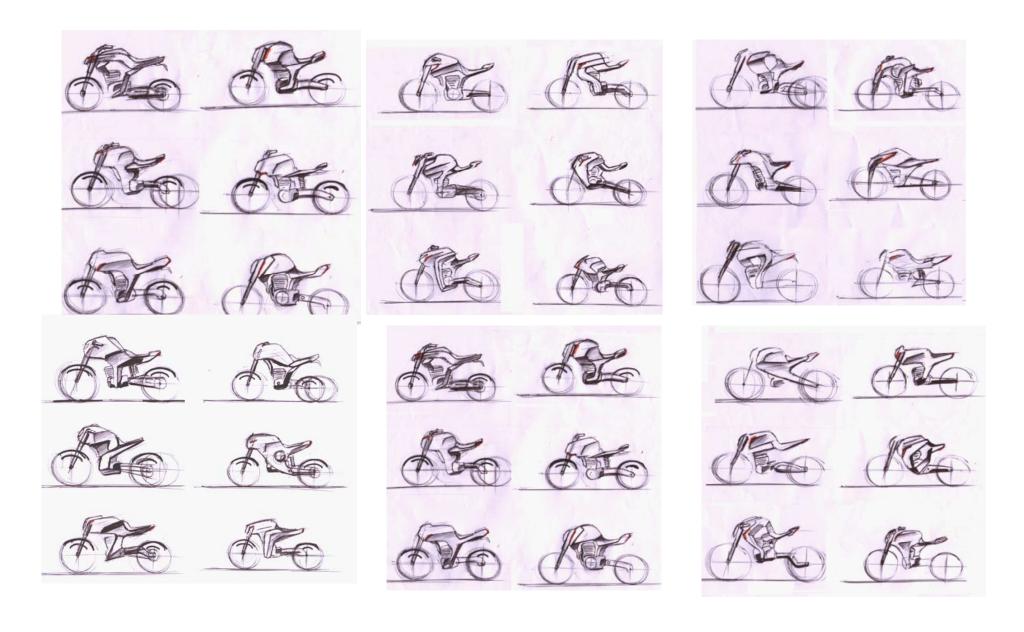
Exploring naked Styling -Take it on a higher level to achieve a single seater compact bike.

Keywords: compact, Radical, Integration.

Integrate body elements with structure to form a compact single unit form.





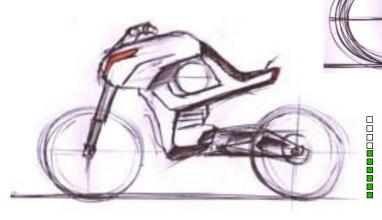


Grading: 10 point scale Concept 1:

Out of the ideation concepts some of them were chosen which went along the required keywords.

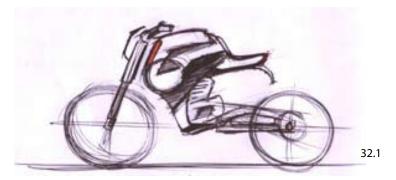
Decisions were based on visual appearance and user feedback. These concepts were then self rated on a 10 point scale.





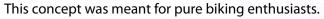


Concept 1:
Out of the chosen concepts one was finally selected by grading.



The chosen concept was having a compact form the tank and the lower body panels merged to forma single unit. It went well with the keywords compact, Radicle single seater.

Also a single seat was provided which added to the compact looks.





32.2

## Metaphor based styling:

It is a creative way of coming up with design concepts. This process involves taking analogies from a certain metaphor. The analogies can be based upon form, function or logic. Based on the design brief a Image board is made which consists of several inspiring images and from these inspiring images styling options are made. The process involves carefully studying the images extracting the emotions, lines and surfaces which define the image and use them to generate concepts. Some examples are given below.



In this concept the designer is inspired from the form and aggression of the shark. The sharp lines of the fins are converted into te sharp facets on the car. The face of the shark gives the car a pointed hood.



33.1 Lamborgini Reventon Inspired from Tiger shark

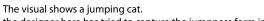


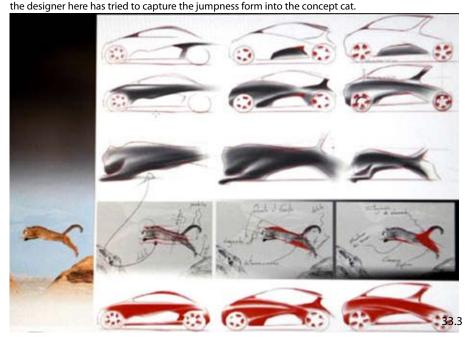


This is a large cargo plane designed by Airbus its named the "Airbus Beluga". Beluga is a huge whale having a hump on its head. The hump on the head was projected upon the aircraft to get a large storage compartment.



33.2 Beluga Airbus Inspired from Beluga whale



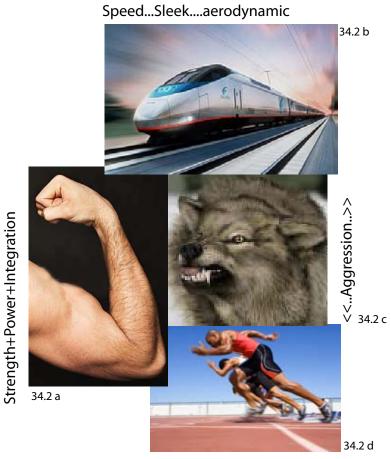


The styling trend in the premium Bike segment is moving towards Naked bikes designs. Exploring naked Styling-Take it on a higher level was direction for concept 2.

Studying behaviors and lifestyle of my target user certain inferences were made and these were then analyzed to get a theme for the bike styling process.



Out of the inferences made from target user research four were selected as themes To be worked upon for concept development.



Stay ahead of everybody...>>

Out of the 4 themes

Stay ahead of everybody..>>

was chosen as the final theme to be worked upon for the concept development.

Based on user research the nature of today's youth is that they always want to be ahead, aim high, tackle competitors, they are sporty and are ready to accept challenges which come up in their life easily.

The final chosen theme also had the essence of other themes like strength, speed, Power and aggression within it.

Thus it was decided to make a concept based on this image showing a athlete on a run.

A form having elements depicting muscles.



A closed wrist formed by integration of 5 elements. depicts strength, unity, about to punch.

Strength+Power+Integration

Speed...Sleek....aerodynamic

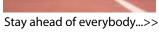


Sharp edges Fear elements-(teeth) Focused

Image of speed

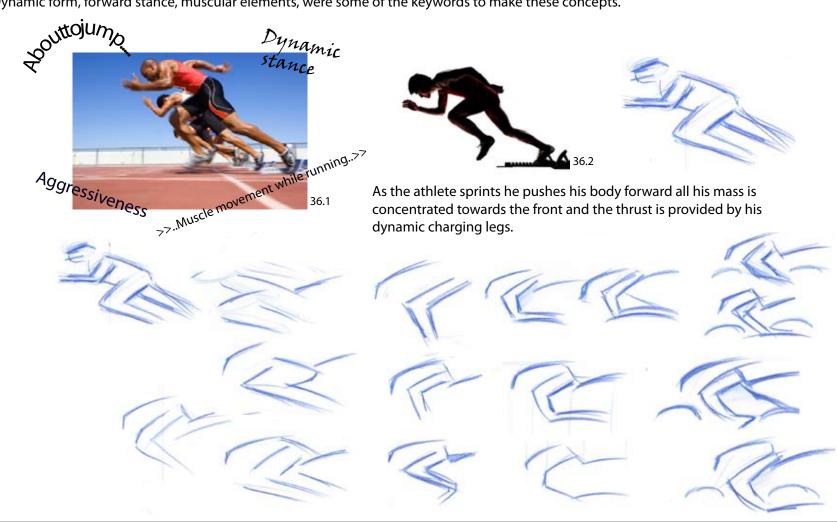
**Charging ahead** 

Sleek



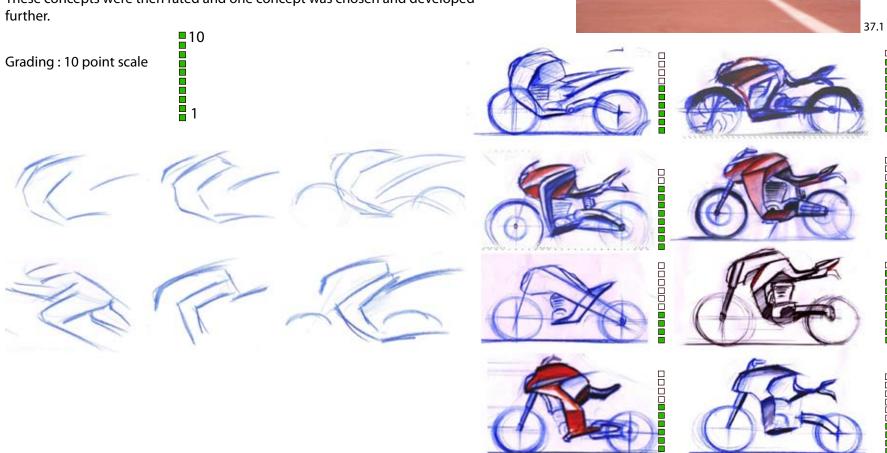
Moving forward with "Thrust"
Dynamic stance
Aggression
– Muscle movement while running
About to jump
Directional
Focus

Some ideation was made to capture the stance of the runner into the bike, 2d side view sketches were made. Dynamic form, forward stance, muscular elements, were some of the keywords to make these concepts.



ideation was done to capture the lines of the running athlete into the bike some concepts are shown below.

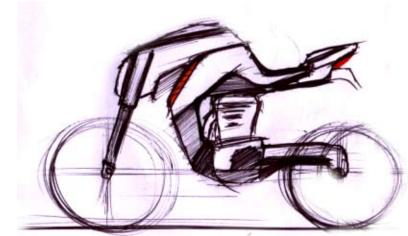
These concepts were then rated and one concept was chosen and developed further.



37.2

The concept with the highest points was chosen. The grading was done on visual appeal of the bike form and how well it represented the theme.

The concept sketch was quickly rendered in Alias sketch book.





38.1

Concept development: Selecting one of the two concepts.

Concept 1

Large tank shaped in a way as to form the main integral part of bike.



It has a short tail end enhancing the compactness.

Compact classic single seater
Large curved surfaces give it a classic retro look.

Concept 2

Sharp edges, forward stance, lowered front.



Dynamic sporty two seater

Raised thin rear end gives it a very sporty look.

## **Decision:**

25 users were asked to vote for one out of the 2 concepts and user feedback was taken for making the final decision.

Concept 1 was not accepted by the users because my user group always wanted to hang around with their friends and as the bike was a single seater it would not attract them.

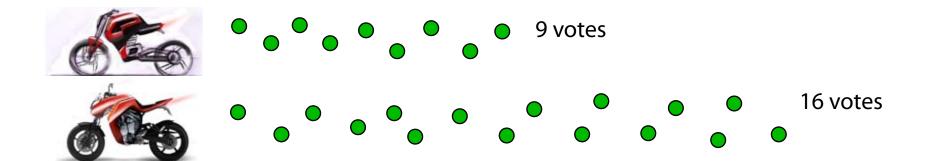
According to them it looked underpowered and it did not have the looks of the racing bikes they always dream of. Such single seater bikes have a lot of demand in the international market but in India they have not yet become popular.

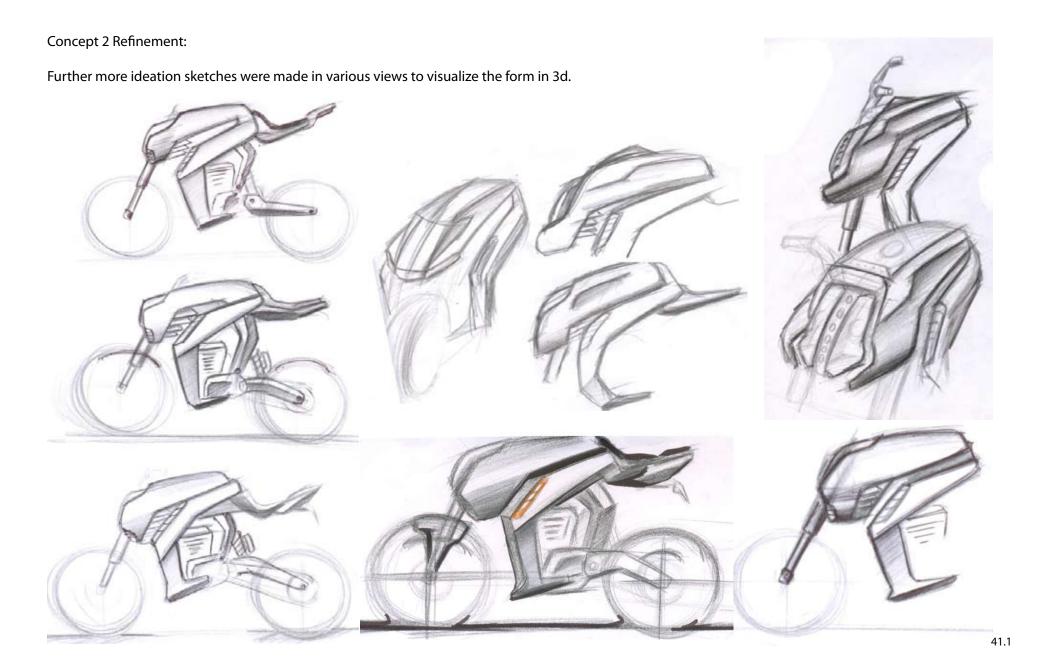
Concept 2 got most of the votes it was liked by all the users they said it looked a lot aggressive and It had a strong character in it as compared to concept 1.

Out of the two bikes concept 2 was chosen as the final concept to be worked upon.

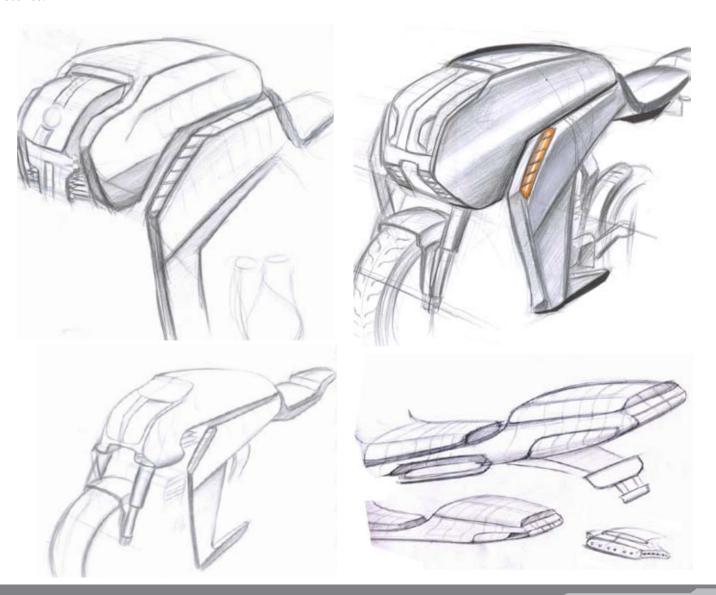




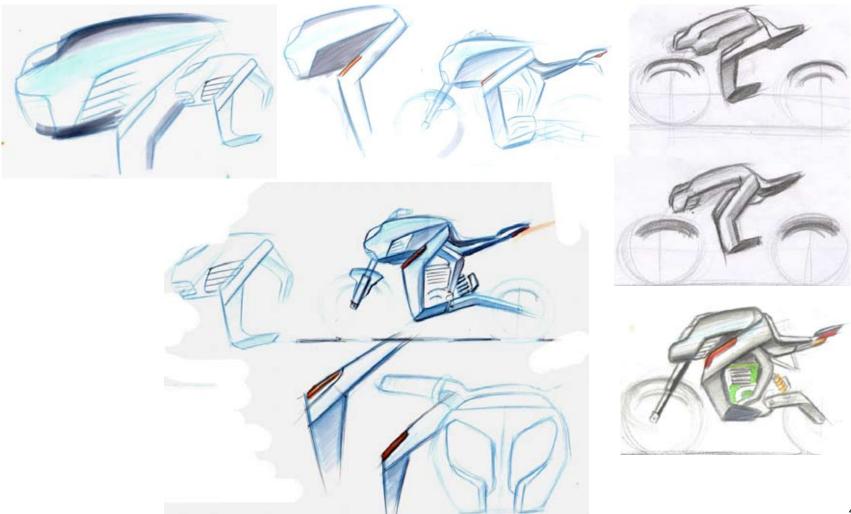


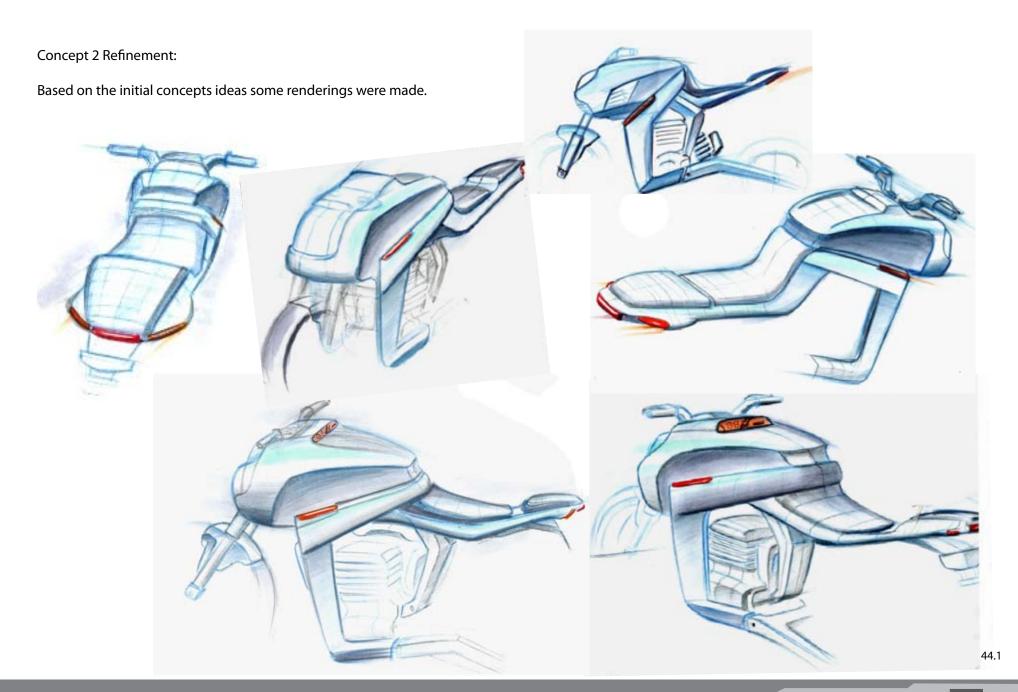


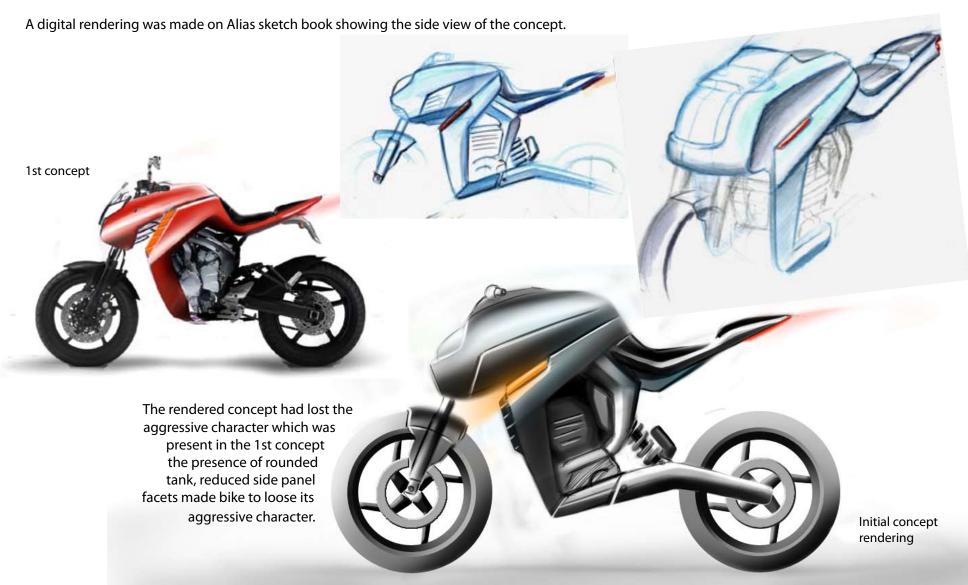
Front and rear end ideation sketches.



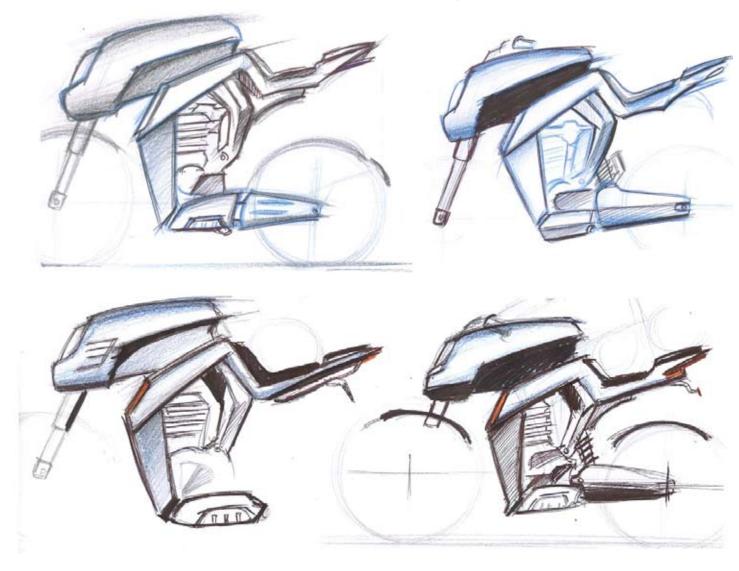
Ideation sketches were made for trying out new stance options.



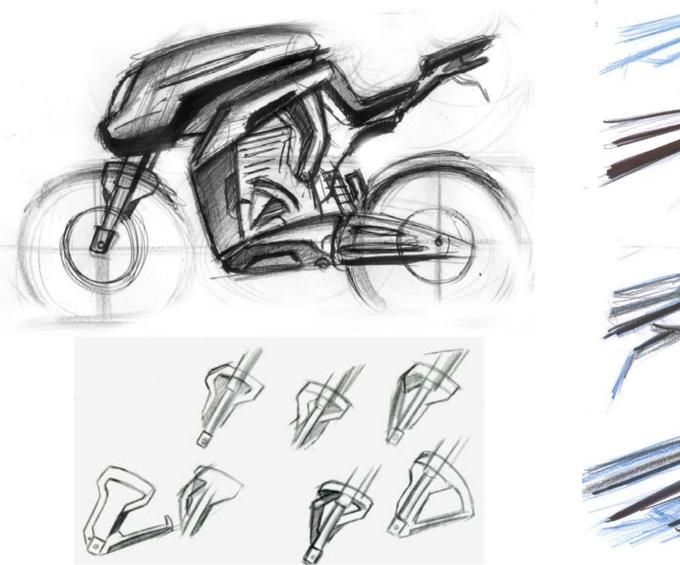


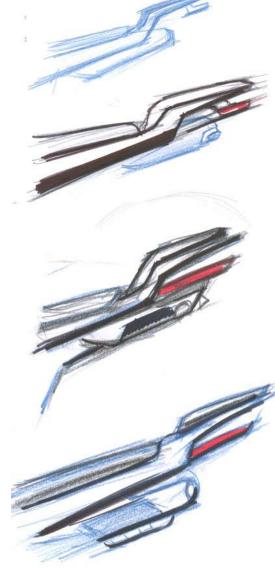


Some more side view sketches were made to improve the stance and make the bike look more dynamic and aggressive.



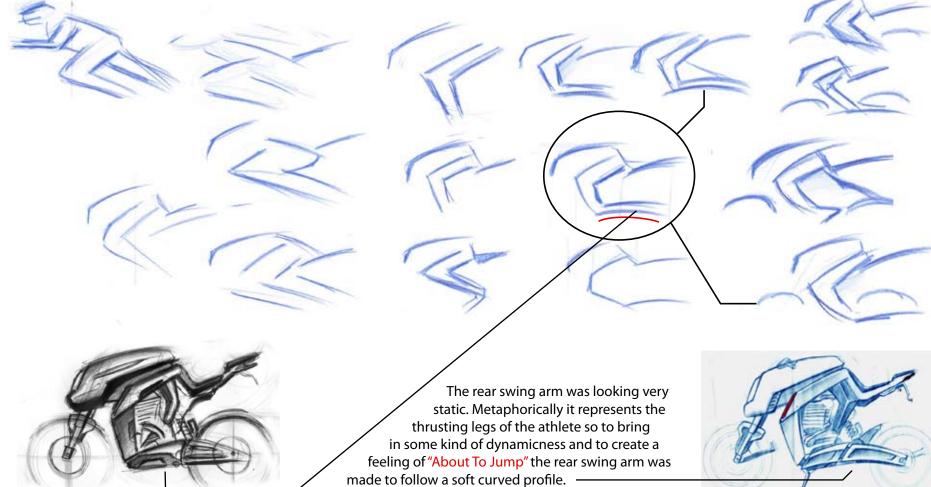
Ideation was done for the front mudguard and the rear tail end.  $\label{eq:continuous}$ 





Work needed to be done on some elements of the bike which were looking very static. So comparing the final concept sketches with initial form lines. Further more sketches were made for improving the concept.

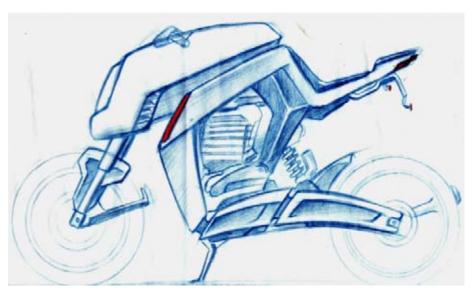












Some sketches were made to visualize the top view as to how the elements would look when viewed from the top.



Final concept sketches.

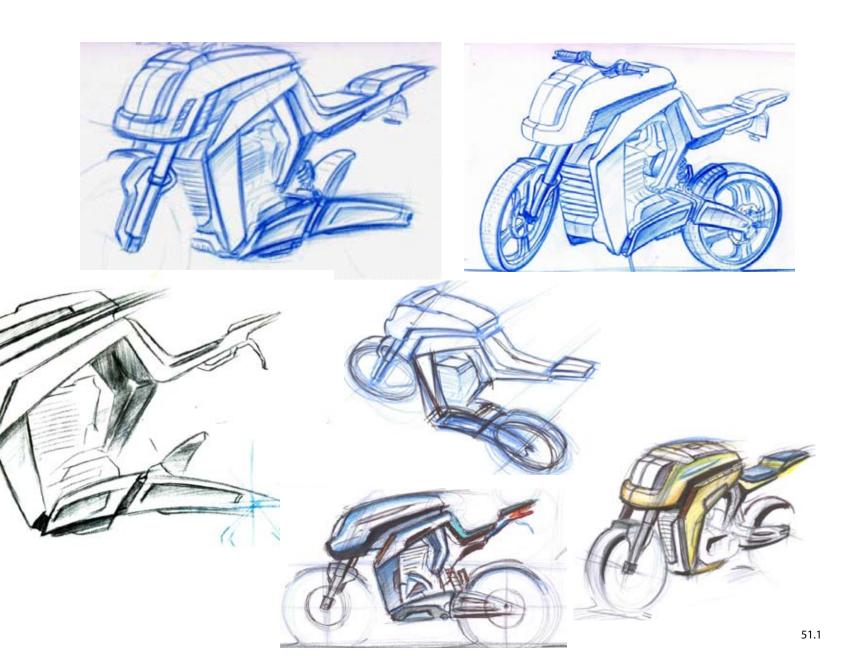
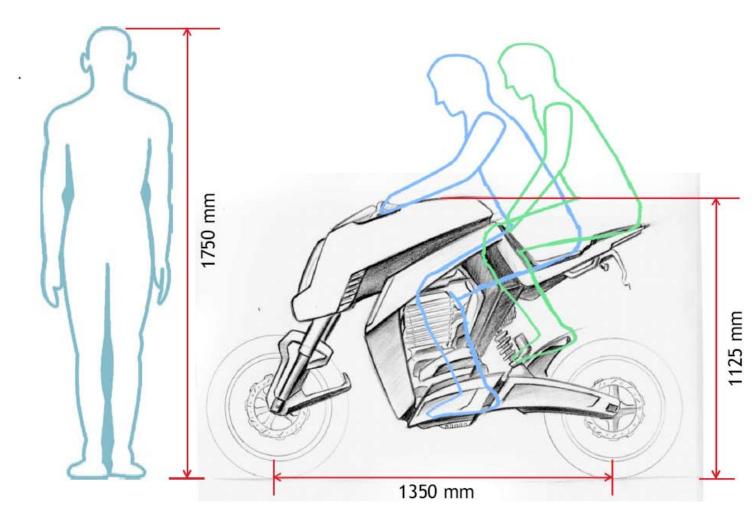


Illustration shows the 2 main dimensions of the bike the wheel base and overall bike height. The manikin used is a 95<sup>th</sup> percentile Indian male in normal standing position and having of height 1750mm.



## Ergonomic data reference:

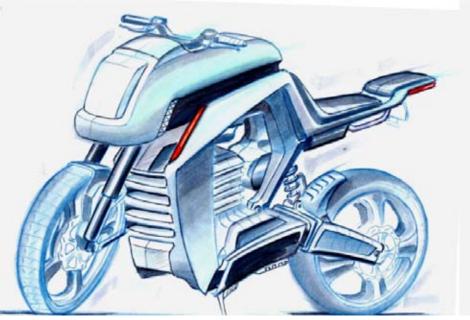
"Indian Anthropometric Dimensions" for Ergonomic Design Practise.

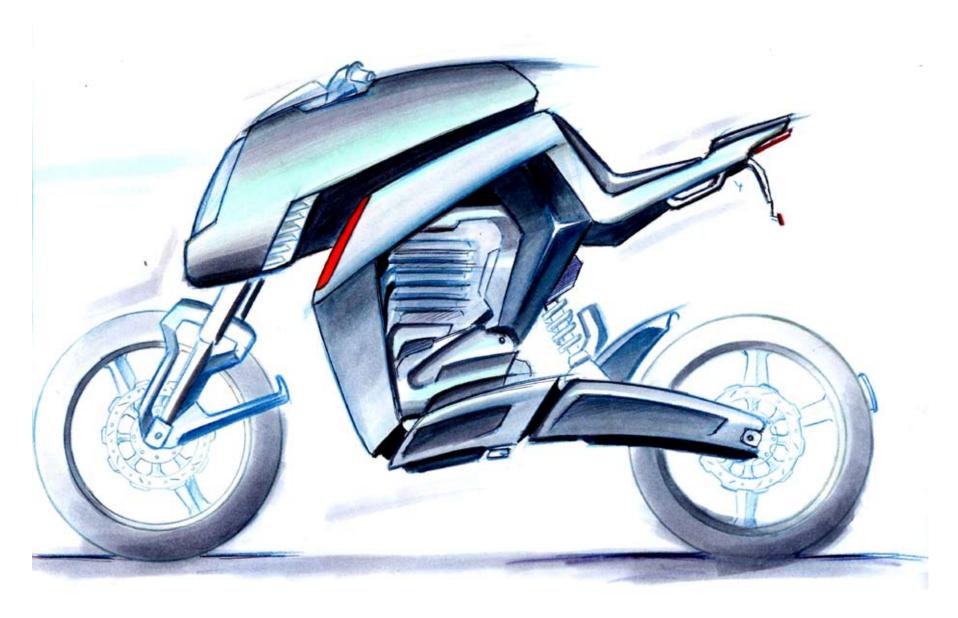
By **Debkumar Chakrabarti** published in 1997

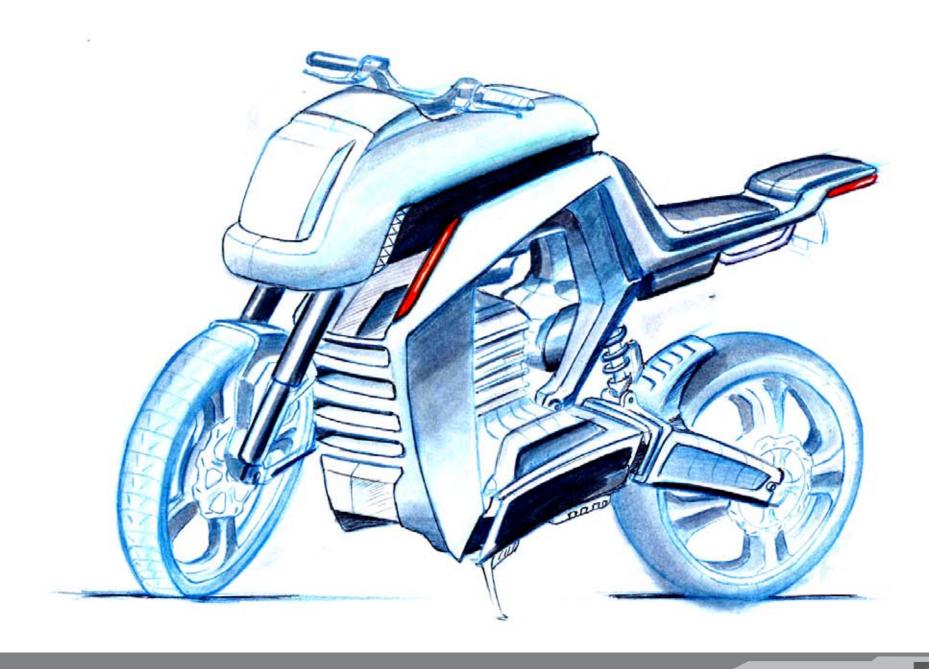
ISBN No: 81-86199-15-0











Logos of bikes present in indian market:



















CD-DAWN







For the bike name and the logo design the image board was re looked upon. From the list of keywords which were listed down.

The styling of the bike has evolved from the image of a athlete running. The bike has crisp sharp lines which bring in the required focus. The lowered front and the raised rear give the bike a dynamic stance. all this combined with the aggression and the muscularity of the bike makes it look as if a image of velocity is projected on to the bike. The bike appears to be gushing ahead even when the sketch is stationary. It feels as if the bike wants to just break free and leap forward. All these essences represent a sprinting character which very well goes with way of living of today's youth, thus the name "SPRINT".



Image of speed
— Sleek
Charging ahead

Focused

Sprint Sprint
Sprint
Sprint
Sprint

These are some of the options made for the logo.

A form having elements depicting muscles.



A closed wrist formed by integration of 5 elements. depicts strength, unity, about to punch.

Sharp edges

Fear elements-(teeth)

Speed...Sleek....aerodynamic

Stav ahead of everybody...>>

Dynamic stance
Aggression
Moving forward with "Thrust"
– Muscle movement while running
About to jump
Directional
Focus

## Note:

The final work will be presented as a 1:2.5 scaled model. It will be based on the final concept renderings and according to its overall dimensions.

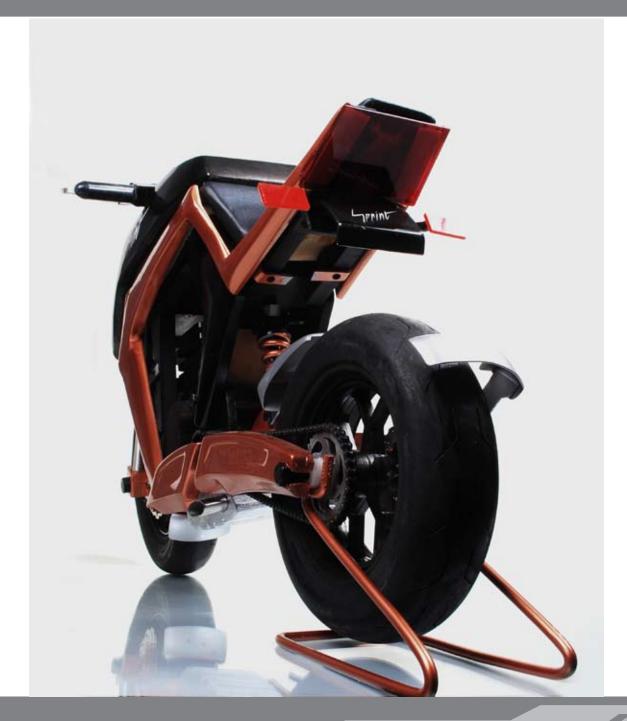














- 4.1-http://www1.istockphoto.com/file\_thumbview\_approve/5649704/2/istockphoto\_5649704-stone-wheel.jpg
- 4.2-http://img.alibaba.com/photo/51470038/OLD\_STYLE\_BIKE.jpg
- 4.3-http://autotimemachine.blogsome.com/images/motorcycle.jpg
- 4.4-http://lh3.qqpht.com/ 4CrdePjb-PQ/R42MMQHqD7I/AAAAAAAACrk/z3cpXbFLuks/IMG 2088.JPG
- 5.1-Self made posters explaining the Development of Indian two wheeler industry.
- 6.1-Self made posters explaining the Development of Indian two wheeler industry.
- 7.1-http://katalog-motocyklu.cz/clanky/royal-enfield-bullet-electra.jpg
- 7.2-http://auto.indiamart.com/motorcycles/rajdoot-excel-t/gifs/rajdoot-excel.gif
- 7.3-http://www.freewebs.com/aalborglambrettaclub/Lambretta150LD.jpg
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- 7.5-http://www.motosindia.com/gifs/kinetic-scooter.jpg
- 7.6-http://www.max-motors.com/images/Splendor+.jpg
- 8.1-http://vne-resource.iol.co.za/30/picdb/article0/7/3/45864
- 8.2 a -http://www.comparemoped.com/images/Bajaj%20Chetak.jpg
- 8.2 b -http://www.afroasiaticonline.com/images/
- 8.2 c -http://www.honda2wheelersindia.com/images/dio\_images/color/red\_large.jpg
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- 9.1-http://www.heromajestic.com/Hero%20Panther%204S%20DLX-s.JPG
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- 13.1-http://thekneeslider.com/images/cddawn.jpg
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- 13.3-http://www.amitbhawani.com/Images/H/Hero-Honda-Hunk-Blue.ipg
- 14.1-http://www.motosindia.com/gifs/dawn.jpg
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- 19.1-Self made collage

- 20.1-Self clicked image, Students IIT Bombay.
- 22.1-http://www.2wheelsindia.com/
- 23.1-http://www.wylieandhollandrat.co.uk/speedtriple\_matt\_blk\_studio\_534x242.jpg
- 23.2-http://www.idcow.net/idcow/products/nr2016m12.jpg
- 24.1-http://www.yamaha-motor-india.com/product/fz16/feature.html
- 27.1-http://www.motorcycledesign.com/site/content/blogsection/7/39
- $3.1-http://images.google.com/images?\&um=1\&hl=en\&rls=com.microsoft: \\*:lE-SearchBox\&q=Beluga+whale+airbus\&\&sa=N\&start=0\&ndsp=21\\*:les-New (a. 1.5) \\*:les-New (a. 1.5$

#### **28.1 to 32.2**-Hand sketching & Rendering.

- 33.1-http://images.google.com/images?um=1&hl=en&rls=com.microsoft: \*:IE-SearchBox&q=Reventon+shark&&sa=N&start=21&ndsp=21.
- 33.2-http://animals.national geographic.com/static files/NGS/Shared/Static Files/animals/images/1024/beluga-whale.jpg
- 34.1-Self clicked image, Students IIT Bombay.
- 34.2 a-http://www.masterfile.com/search/enlarged.html?img=821-02149540&offset=34&redirect=search&guery=muscular+&licType=ALL
- 34.2 b-http://www.rampantscotland.com/graphics/bullet\_train1a.jpg
- 34.2 c-http://www.blackfive.net/main/images/2007/09/28/angry\_wolf.jpg
- $34.2\ d-http://www.masterfile.com/search/enlarged.html?img=619-00763532\& of fset=23\& redirect=search\& query=sprinting+\& licType=ALL$

#### **37.2 to 57.1**-Hand sketching and Rendering.

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#### **Books referred:**

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By Gyorgy kepes Article- "Youths and motorcycles", Henry S. Stone, jr pg no - 172 to 185 published by Studio Vista, London-1996

