

Design of a Hobby Farm Tractor for India

By

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M. Des. – Transportation Design

(2013-15)



School of Design Studies

University of Petroleum and Energy Studies

Dehradun

April 2015

Design of a Hobby Farm Tractor for India

Project submitted in partial fulfilment of the requirements

For the award of the Degree of

MASTER OF DESIGN

IN

TRANSPORTATION DESIGN

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Declaration

I hereby declare that the project work entitled "Design of a Hobby Farm Tractor for India" submitted by me in partial fulfilment of the requirements for the award of the degree of Master of Design (Transportation Design) at School of Design Studies, University of Petroleum and Energy Studies was carried out by me during 15 Jan 2015 to 20 April under the supervision of "Mr. Jagpreet Singh, Asst. Professor, SoDS UPES Dehradun".

Date: 20th April 2015

Sign:

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ACKNOWLEDGEMENT

This satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned my effort with success.

I wish to express my deep sense of gratitude to **Mr. Jagpreet Singh**, for his guidance, inspiration and encouragement throughout my project. I am grateful to **Mr. Savarkar** for rendering all sorts of facilities and sound encouragement throughout this work.

I also thank **Dr. Kamal Bansal**, Dean, COES, UPES and **Mr. Manas Mishra**, Head of Department, SoDS for all the encouragement and support for this project.

I express my sincere thanks to **Prof. Atul Kedia**, Program director, School of Design Studies, University of Petroleum and Energy Studies, Dehradun for lending me all the help, support in terms of advice and for his wholehearted encouragement throughout the project duration.

Words are not enough to express my feelings towards my parents, as they have always been the constant source of moral encouragement throughout the completion of my course. I express my heartfelt gratitude to each and every individual who was associated with my project work, including those whom I may have inadvertently failed to mention.

Abhishek Ramesh Chavan

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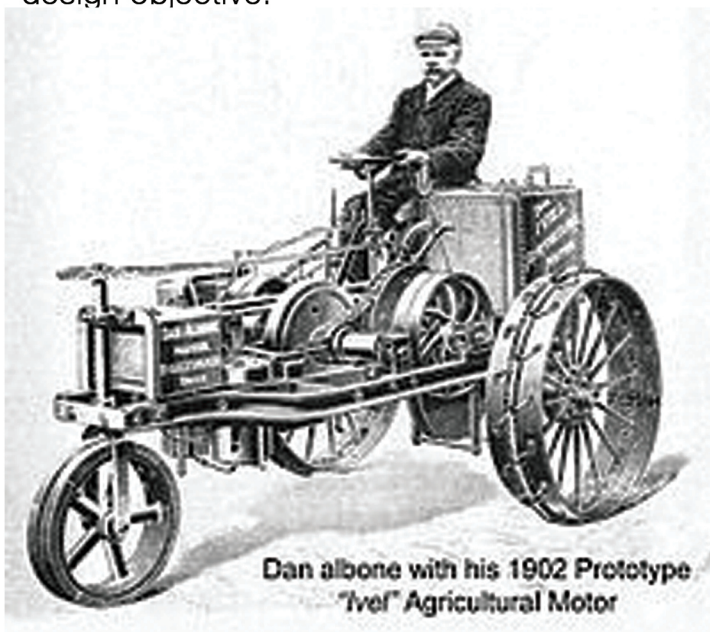
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Worldwide, Tractors are always seen as a piece of machinery that works in agricultural fields. The basic functionality of a tractor makes it obvious that styling parameters like aesthetics and design are not important. This belief has stranded the design of Tractors with a conventional looking machine. Off late, people around the globe have started to cultivate the hobby of farming in their leisure time. This evolved a need of cabin with essential technology for the user. Owning a Tractor is a matter of pride for the person who develops a farm as his/ her pas-time. It is also predicted, in upcoming years Agriculture to be a big business and talk of the town which shall drastically increase the sale of Tractors. This increased sale calls in for more sophisticated designs predominated by user demands. Thus, good styling of Tractors which gels with the owners personality is desired. The project to be carried out is an effort to conceptualize the Exterior A-class styling of a Tractor driven by parameters such as Aesthetics and Ergonomics for the year 2030. The basic functionality shall act as design constraint, the forms of Tractor as design variables and to achieve a conceptual farm Tractor for the year 2030 being design objective.



John Fowler pioneered the application of steam power to agriculture in the 1850s, and invented machines for ploughing



Dan Albone with his 1902 prototype Ivel Agricultural Motor, the first successful gasoline-powered tractor.



Image 1. Future of Indian Agriculture

About Agriculture ^[2]

Agriculture is an important part of India's economy and at present it is among the top two farm producers in the world. This sector provides approximately 52 percent of the total number of jobs available in India and contributes around 18.1 percent to the GDP. It is also proposed that agriculture is going to be a big business in upcoming years. may be ten years down the line. ^[2]

Earth's population is expected to hit 9 billion by 2050 . According to the United Nations' Food and Agriculture Organization, food production must increase by 60% to feed that growing population and, since they aren't making any more land, ninety percent of the growth in crop production is expected to come from higher yields on existing farm land. Farmers must become more efficient and increase production of crops drastically or people who own lands should start cultivating their own food. Growing population calls in for shortage of food crops produced by farmers, it might be expected to start developing hobby farms and cultivate home grown vegetables and crops. This will reduce the burden from farmers who shall get good income by growing lesser crops. ^[2]

Organic farms and hobby farming are developing worldwide and has started taking its course in India as well. This hypothesis establishes a potential for the project to design (styling) of a Tractor for Hobby Farm. ^[2]

Economics of Indian farming^[2]

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support almost 17 per cent of world population from 2.3 per cent of world geographical area and 4.2 per cent of world's water resources. The economic reforms, initiated in the country during the early 1990s, have put the economy on a higher growth trajectory. Annual growth rate in GDP has accelerated from below 6 percent during the initial years of reforms to more than 8 percent in recent years. This happened mainly due to rapid growth in non-agriculture sector. The workforce engaged in agriculture between 1980-81 and 2006-07 witnessed a very small decline; from 60.5 percent to 52 percent.^[2]

The degradation of land and surface as well as ground water resources results in fast deterioration of soil health. Losses due to biotic (insect-pests, diseases, weeds) and abiotic (drought, salinity, heat, cold, etc.) stresses account for about one-fourth of the value of agricultural produce. The storage, transportation, processing, value addition and marketing of farm produce need to be improved to enhance household food, nutrition and livelihood security. Indian agriculture is characterized by agro-ecological diversities in soil, rainfall, temperature, and cropping system. Besides favorable solar energy, the country receives about 3 trillion m³ of rainwater, 14 major, 44 medium and 55 minor rivers share about 83 per cent of the drainage basin. About 210 billion m³ water is estimated to be available as ground water. Irrigation water is becoming a scarce commodity. Thus proper harvesting and efficient utilization of water is of great importance.^[2]

Intensive cultivation as a result of introduction of high yielding varieties in the mid 1960's required higher energy inputs and better management practices. Land preparation, harvesting, threshing and irrigation are the operations, which utilize most of the energy used in agriculture. The share of animate power in agriculture decreased from 92 per cent in 1950-51 to 20 per cent in 2000-01. For desired cropping intensity with timeliness in field operations, animate energy sources alone were no longer adequate. Farmers opted for mechanical power sources to supplement animate power.^[2]

Average size of farm holdings gradually reduced from 2.58 ha to 1.57 ha. Small and marginal farmers have limited resources especially in rain-fed regions where only animate power is used resulting in low productivity. Though agricultural production is high, the per hectare productivity is much lower than world average. There is an urgent need to increase productivity.^[2]

Smaller the farm, greater is the need for marketable surplus, so that small farmers can have a reasonable income. Achieving this goal will be possible only if we develop and disseminate eco-technologies rooted in the principles of ecology, economics, gender equity and employment generation. This is the pathway to an "ever-green revolution" in agriculture. The estimated food requirement in India and total production of major crops indicate that to keep pace with the present population growth and consumption pattern, food grain requirement has been estimated to be 240 MT by 2020 and 300 MT by 2025. ^[2]



Image 2. Conventional farming practiced in India



Insights

Large population of Indian farmers still follow the conventional method of farming. Manual ploughing, sowing, watering, spraying insecticides and harvesting is carried out due to lack of funds for mechanized equipment purchase.

Agricultural demographics ^[8]

India has diversified topography, Himalayan mountain ranges extending from Jammu and Kashmir in the west to Arunachal Pradesh in the NorthEast. They have hill ranges in the form of Eastern Ghats and Western Ghats. Apart from variation in landform, the country has varieties of climatic conditions, and soil types. These physical variations along with other factors like availability of irrigation, use of machinery, modern agricultural inputs like High Yielding Varieties (HYV) of seeds, insecticides and pesticides have played their respective roles in the evolution of different farming practices in India. ^[8]

1. Subsistence and commercial farming: Majority of farmers in India practise subsistence farming - for own consumption. In other words, the entire production is largely consumed by the farmers and their family and they do not have any surplus to sell in the market. In this type of farming, landholdings are small and fragmented. Cultivation techniques are primitive and simple, total absence of modern equipments like tractors and farm inputs like chemical fertilizers, insecticides and pesticides. Farmers mostly cultivate cereals along with oil seeds, pulses, vegetables and sugarcane. ^[8]

Commercial farming is just the opposite to subsistence farming. In this case, most of the produce is sold in the market for earning money. In this system, farmers use inputs like irrigation, chemical fertilizers, insecticides, pesticides and High Yielding Varieties of seeds etc. Some of the major commercial crops grown in different parts of India are cotton, jute, sugarcane, groundnut etc. Rice farming in Harayana is mainly for commercial purpose as people of this area are predominantly wheat eaters. However in East and North-Eastern states of India, rice cultivation would be largely of subsistence type. ^[8]

2. Intensive and Extensive Farming: The basic difference between the two types of farming is the amount of production per unit of land. In comparison with temperate areas of USA, Canada, and former USSR, India does not practise extensive cultivation. When we use large patch of land for cultivation then we call it extensive farming. Here, total production may be high due to larger area but per unit are production is low. Intensive Farming records high production per unit of land. ^[8]

Best example of intensive cultivation is in Japan where availability of land for cultivation is very limited. Similar kind of situation can be observed in the state of Kerala in India. [8]

3. **Plantation Farming:** It is an estate where a single cash crop is grown for sale. This type of agriculture involves growing and processing of a single cash crop purely meant for sale. Tea, coffee, rubber, banana and spices are all examples of plantation crops. Most of these crops were introduced in India by the Britishers in the 19th Century. [8]

4. **Mixed Farming:** It is a situation in which both raising crops and rearing animals are carried on simultaneously. Here farmers engaged in mixed farming are economically better off than others. [8]

All classifications are based on nature and purpose of farming. It may overlap. For example: Banana is a plantation type of farming. It can also be classified as commercial farming.

5. **Organic farming:** Organic farming is very much native to this land. Whosoever tries to write a history of organic farming will have to refer India and China. The farmers of these two countries are farmers of 40 centuries and it is organic farming that sustained them. This concept of organic farming is based on following principles:

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.
- The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
- The soil in this system is a living entity
- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all cost.
- The total environment of the soil, from soil structure to soil cover is more important. [8]

In today's terminology it is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. [8]



Image 3. Mechanical appearance and Indian jugaad



Insights

Indian heavy equipment machinery looks like conventional machines.

Jugaad still persists and it works well.

Agricultural mechanisation ^[2]

At present in India, tractors are being used for tillage of 22.78% of total area and sowing 21.30% of total area. Although, utility of manually and bullock operated equipment has been established but the response of the farmers has been selective. ^[2]

The bullock drawn seed-cum-fertilizer drill and manual paddy transplanter have not been universally accepted in spite of financial incentive from the Government. Due to limited use in a year and economic advantage of many items, some improved implements could not replace the local alternatives. The land levelers, seed-cum-fertilizer drills have also been accepted by the farmers but on limited scale. ^[2]

Major adoption of agricultural machinery in addition to irrigation equipment and tractor, was thresher for wheat crop. Due to various applications of paddy straw, preference has been limited for paddy threshers. Self propelled / tractor operated combines, reaper harvester, potato and groundnut mechanization machinery are also commercially available and accepted by the farmers in states where tractors were introduced. Now combine harvesters are commonly used in different parts of the country, on custom hire basis, for wheat, soybean and paddy harvesting. ^[2]

The traditional animal drawn country plough has low output (30-40 h/ha). Tractor drawn MB plough, harrows, cultivators and rotavator are better machinery used by the farmers. There is need for high capacity machines for custom hire services. For precise application of seed and fertilizer, mechanically metered seed drill and seed-cum- fertilizer drill operated by animal and tractor have been developed and are being manufactured to suit specific crops and regions. Zero till drill and strip till drill have also been developed to reduce energy inputs in crop Production. ^[2]

Target customers



Image 4. Potential target customers for the sub compact tractor

Hobby farming is taking a leap in India. So, target customer is an industrialist / businessman who develops farms as his recreational activity or hobby.

Lifestyle board

BOARD



Image 5. Lifestyle board of a passionate hobby farmer

Hobby farming is developed by farmers who have passion for cultivating farms, a zeal to work amongst nature, a sense of togetherness with family and friends. Also, deep interest in growing food crops and fruits.

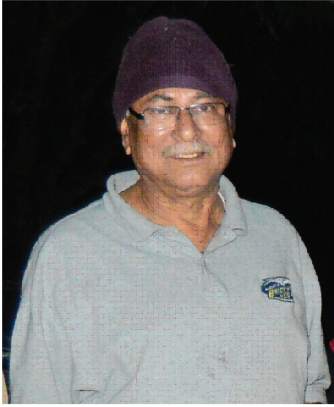


Image 6. Farmhouse in Dapoli, Maharashtra

- Name: Mr. Tambe
 Age: 68 years
 Occupation: Contractor/ Business in Real Estates
 Location: Pune.
 Vehicle: Skoda Fabia, Volkswagen Vento
 Color: Golden beige and silver
 Farms: Cashew, Mango, Rice, Organic farms spread out in an area over 50 acres in Dapoli, Maharashtra.
 Personality: A very dynamic personality with outspoken nature. Having farm spread out in large area becomes difficult to keep an eye on single handedly. Despite having 7-8 care takers, he believes to check the complete farm personally. Ready to spend, he desired to have his own farm tractor.



Mango cashew farms



Organic farms - reared with worms



Cashew farms



Beetelnut trees

Image 7. Hobby farm developed by potential customer in Dapoli, Maharashtra



Name: Balwant singh
 Age: 24 years
 Occupation: Driver
 Vehicle: FARMTRAC Tractor
 Color: Blue

Personality: He was very outspoken and provided all the required information he knew about tractors. He works as a driver since he was dropped out from school since 9th grade.

Insights

- People sitting on wheel arch face high vibrations.
- Fear of the front portion of Tractor being lifted up because of heavy weight in the rear trailer.
- No proper braking on uphill's due to absence of disc brake system.
- Post applying brakes, the rear trailer further pushes the tractor amplifying the impact leading to more distance for braking.
- Front tractor brakes and trailer brakes should be aligned so that the same amount of pressure is applied on tyre, leading the tractor and trailer to halt instantaneously.
- Fabric roof is volatile. Weather conditions like wind and rains won't provide any safety. This being a major concern.
- Absence of suspension system like shock absorbers can lead to breakage of glass if provided to the cabin.
- Utilizing Acrylic sheets for cabin construction with thickness of 2mm should work.
- Color of the tractor – 'We buy the color, what the company manufactures'
- Black color is not favorable as it is not visible at night.
- Low wheelbase tractors cannot ride up a hill.



Front 3/4th quarter of FARMTRAC Tractor



Ingress/ Egress of Tractor

Image 8. Tractor used for transporting water

Insights from user survey

- Industrialists who are developing hobby farms in India desire an unique product exclusively for hobby farmers.
- Absence of cabin makes them exposed to all sort of weather conditions such as, heat, rains and cold.
- There is a lag in the sub compact tractor segment in India.
- With design advancements in automotive industry like Trucks, Buses and Cars, the design of Tractors remains untouched with conventional appearance.

Common myths

- Tractor should not be black in color.
- Users wanted engine in the front, believing it to resemble a Buffalo/ cow.
- Users buy the Tractors available in market.

To Design a sub compact Tractor for passionate people developing Hobby Farms in India with aesthetics (Styling) being the most significant parameter. Ergonomic aspects are considered for easy Ingress/ egress along with reach of the driver for console operations within the cab and functionality of Tractor, which includes user experience (UX) design of tractor dashboard console and tracking device.

CONCEPT
SUB COMPACT TRACTOR

Form development

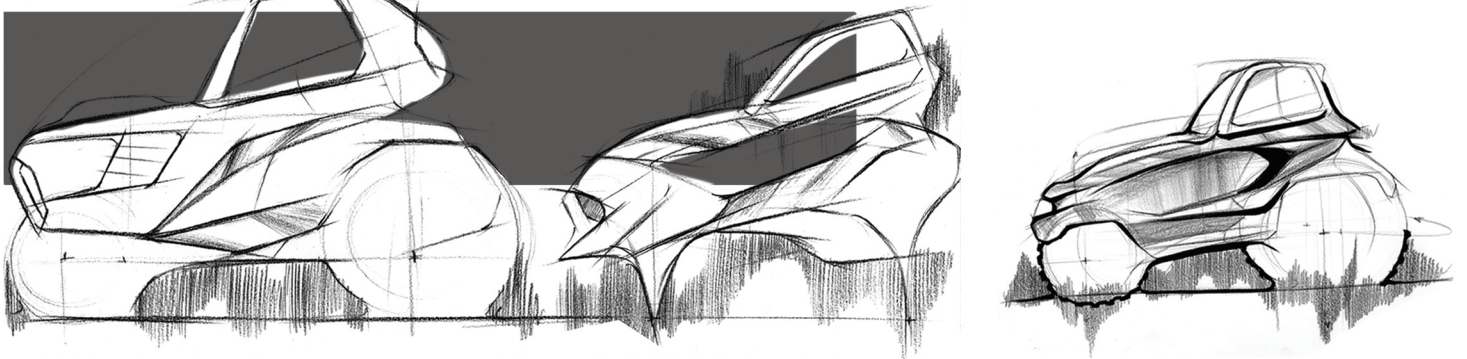


Figure 1. Initial form study

Keywords Compact, Futuristic, Elasticity

In developing the forms for a Tractor, the above keywords were taken into consideration. To develop conceptual forms it is very much essential to observe the lines, continuity and overall shape. This shall give more scope to the minute detailing of product.

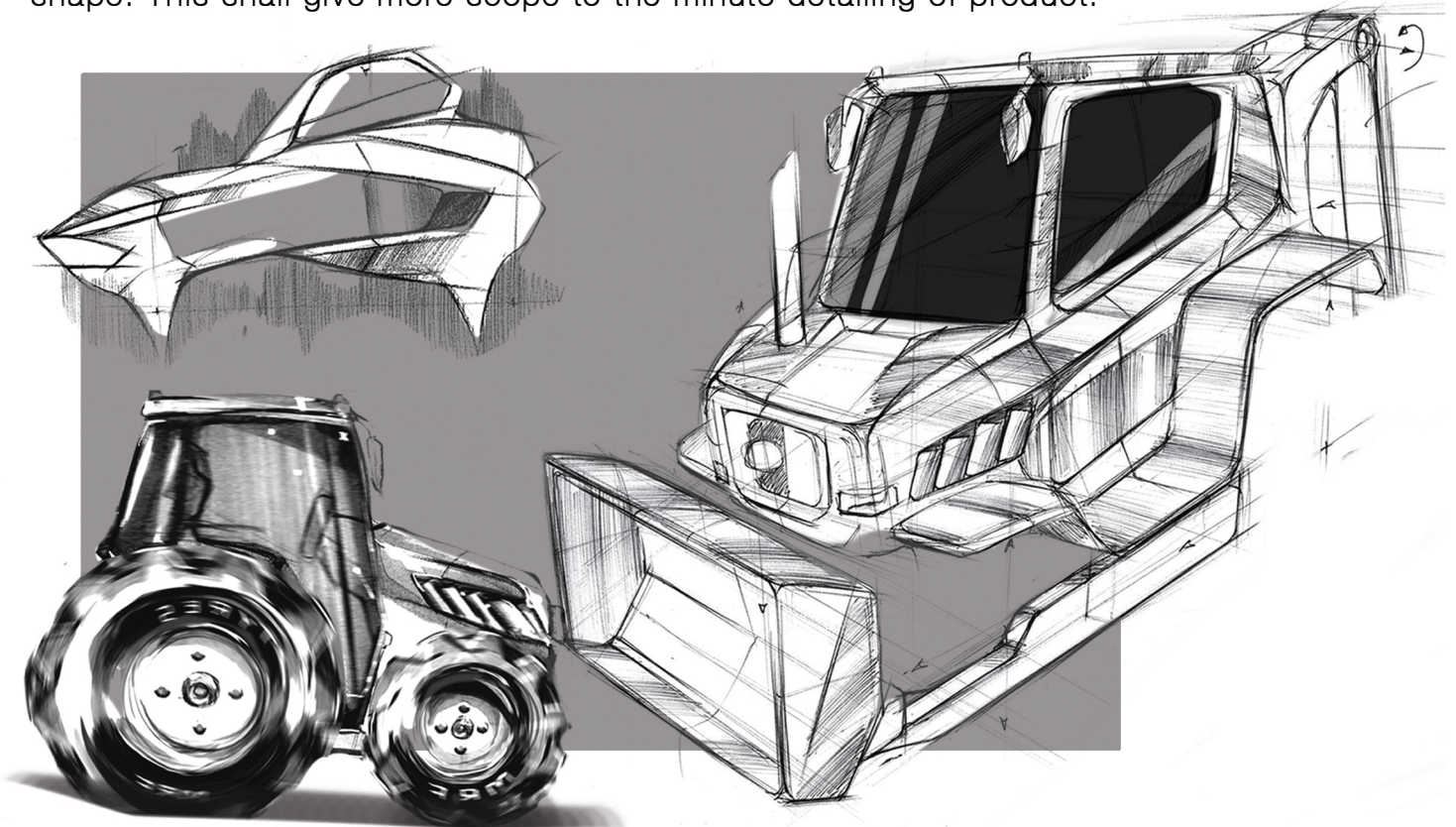


Figure 2. Concept one ideation sketches

Description

Initial ideations and sketches were pertaining to futuristic and adding of aesthetic touch to the main body, keeping wheelbase as a constraint. Inspirations were taken from the sci-fi, fantasy movie as well to further trigger my own imagination and develop forms.

In concept one, muscles were added to the body making it look sturdy and filled up. High glass panes were provided for better visibility. Attachments to plough, harvest and irrigate the fields were also considered. The wheelbase was kept considerably low to make it even more compact than the regular tractors.

Concept ONE

After ideations and sketches for the taken keywords, the image in right is final render for concept one.

A large panel of glass is placed to make it a complete transparent cabin for ease in visibility. The plough equipment is inspired by the scorpion sting form. The air vents along sides of body panel, allows easy intake of air and further better efficiency.

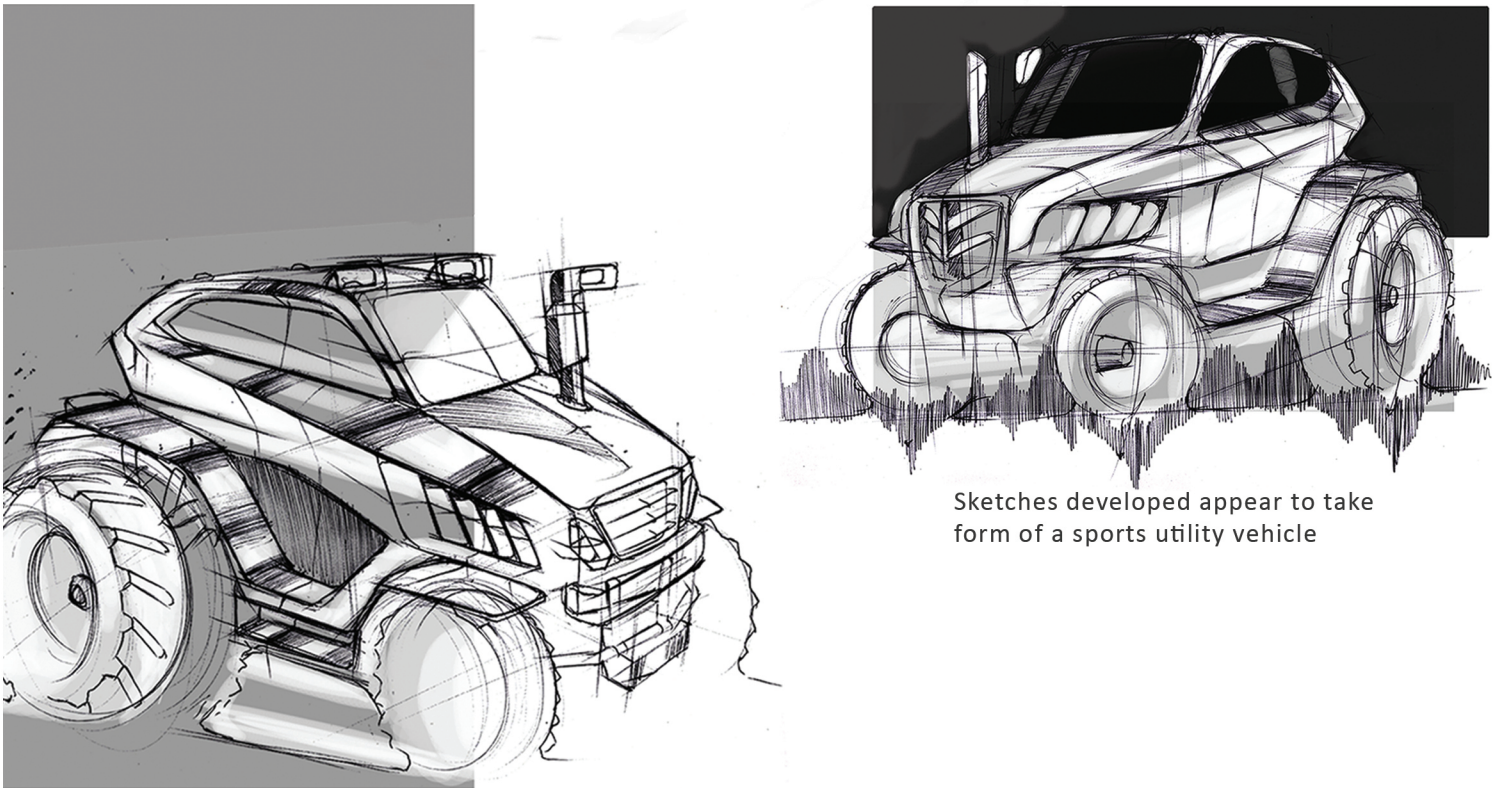


Final render

Figure 3. Concept one final marker render

Concept TWO

Keywords Compact, Transformers - Hollywood inspired, Aerodynamics

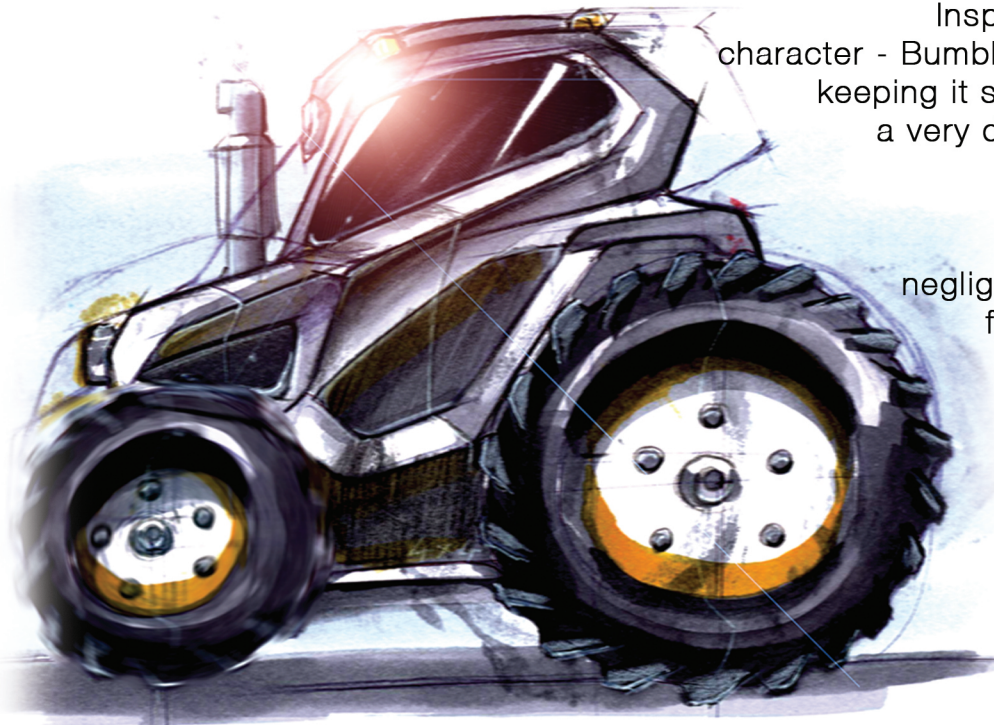


Sketches developed appear to take form of a sports utility vehicle

Figure 4. Ideation sketches for concept two

Highly inspired by the hollywood movie theatricals, my imagination started to think beyond the conventional appearance of Tractor. Why a Tractor should look like a Tractor ? Design of farm Tractor has remained the same since decades. My effort is to enhance aesthetic appeal for its customers - Hobby Farmers.

Marker render



Inspired by the Transformers movie character - Bumblebee. The form was developed keeping it subtle, tall height. Cabin is given a very dramatic shape, which goes well with the overall form.

The overhang of the vehicle is negligible, which will be replaced with front loader hook and a front bar for crash impact safety. The front hood line meets the shoulder line, making it look crisp and compete with existing car design language.

Figure 5. Concept two final marker render

Description

In concept two, attention is given to the cabin (body) again. More aesthetics comes into play. This establishes a potential for a tractor to not have conventional appearance.

Inspirations were derived from the tractors manufactured in European market. The wheelbase is less for the overall dimensions to shrink and give much dynamic appeal to the tractor.

Final digital render
Sketchbook pro

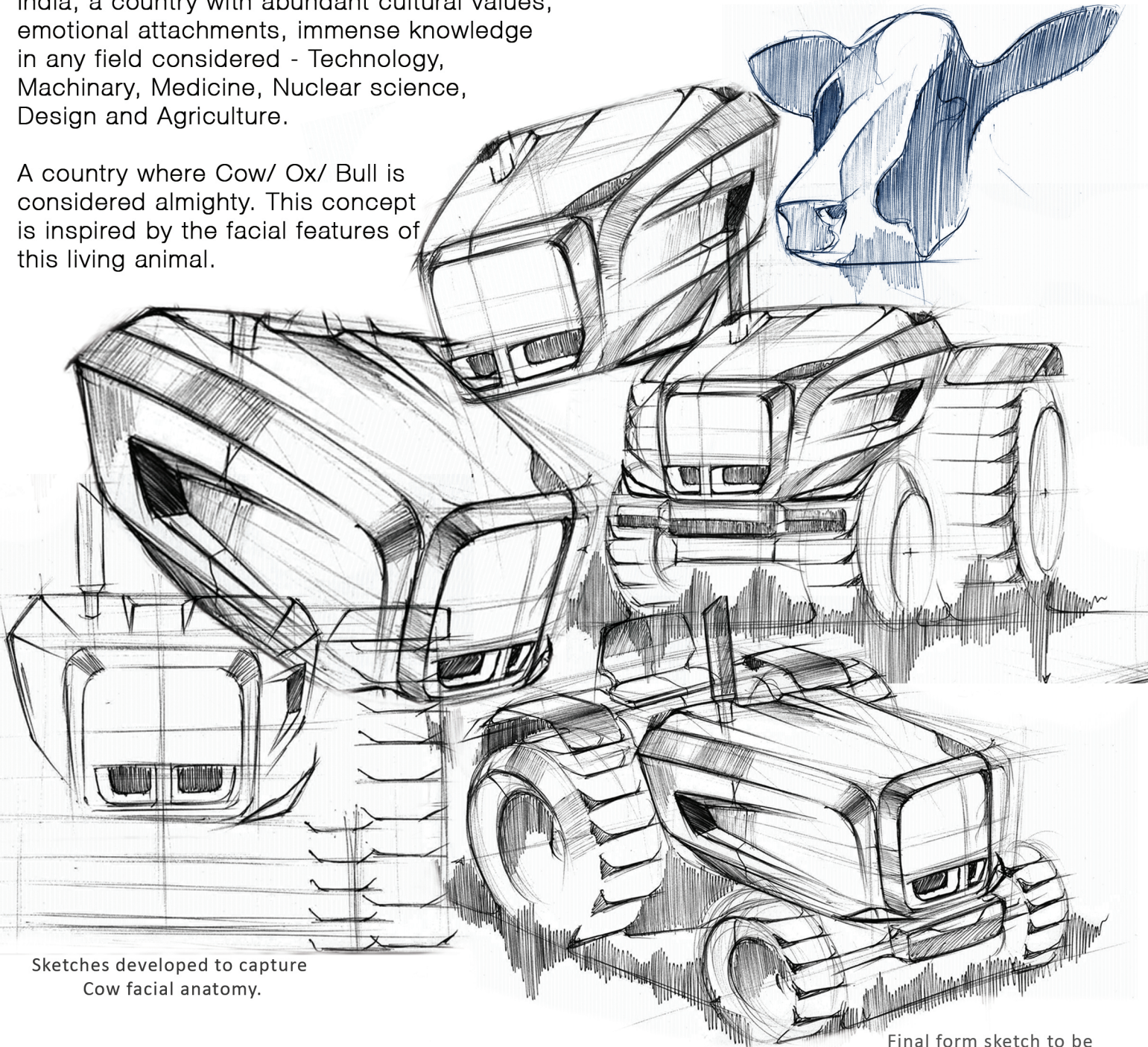


Figure 6. Concept two final digital render

Inspiration

India, a country with abundant cultural values, emotional attachments, immense knowledge in any field considered - Technology, Machinery, Medicine, Nuclear science, Design and Agriculture.

A country where Cow/ Ox/ Bull is considered almighty. This concept is inspired by the facial features of this living animal.



Sketches developed to capture Cow facial anatomy.

Final form sketch to be conceptualized further

Figure 7. Ideation sketches for concept three

Description

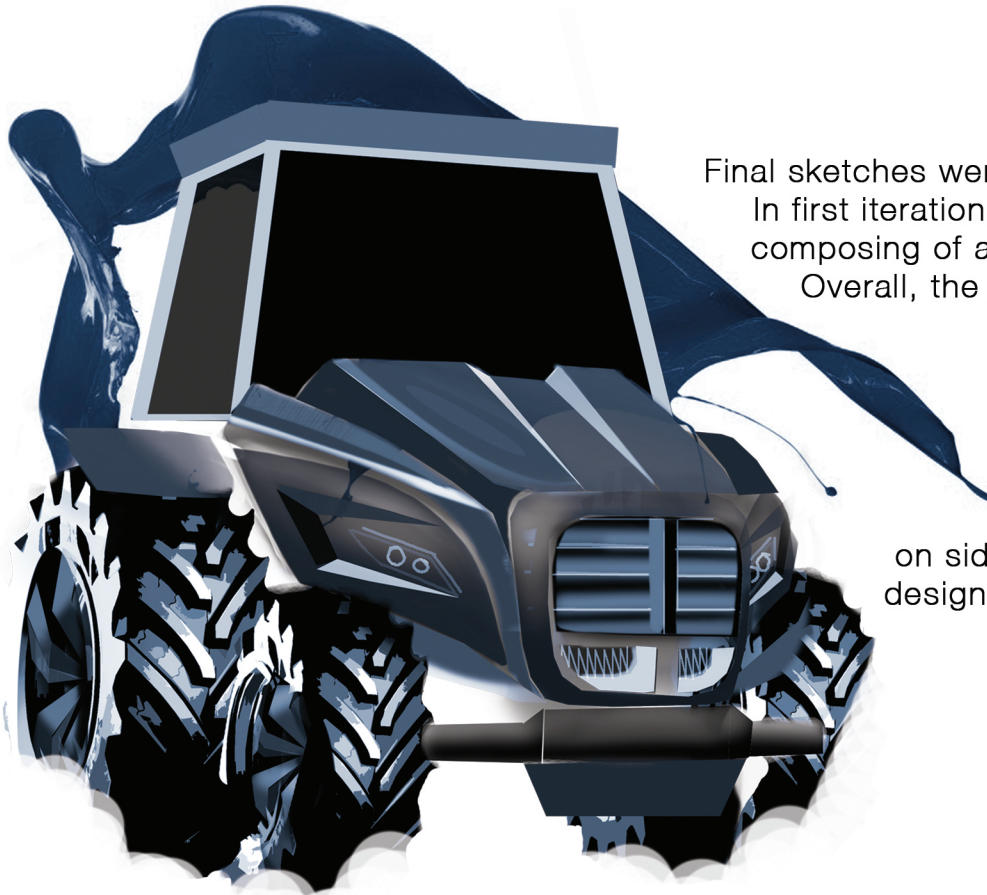
The front facia of a Cow is very dramatic and masks a character in itself. The eyes look calm and steady could be used as headlamps. The overall stance of the head inclined at certain degrees showcased aerodynamics, aggressiveness and ready to roll attitude. The two air vents in front of radiator grill depicted the holes and septum of nose.

The form when seen as a complete product, an essence of Cow/ Bull face can be picturised. This concept has weightage over the other two as, there is an Indian sense to the design.

Concept THREE

DESIGN OF A HOBBY FARM TRACTOR FOR INDIA

Iteration one



Digital renders Sketchbook pro

Final sketches were rendered in sketchbook pro. In first iteration, a cabin with four glass panes composing of a closed envelope is proposed. Overall, the tractor seems very composed.

Scoops provided on side panels gives an edge to the design. Iterations were carried out in front grills, headlamps.

Iteration two

Description

Iteration two has a unconventional cabin with again, changes in the front grills.



Figure 8. Digital render of concept three

TRACTOR

HOBBY FARM

BEST IN CLASS SEGMENT
Sub-Compact



Figure 9. Digital render of concept three iterations

Description

In concept three, iterations were carried out considering the headlamp position, shape and size, variations in the front radiator grills which was a prime factor in designing of any vehicle. As the front facia gives the first impression of the vehicle stance and design language such as - calm, subtle, aggressive, edgy, fluidic and so on.

As we are aware, design and iterations are never ending process. In the same manner, there were a few flaws in the above designs which were refined to get a better design. The cabin appeared to be very sharp and did not go well with the front portion so designed with bull as inspiration. Ergonomics play an important role in design. But, for forms and concepts to come up with a free mind it is essential not to consider them at initial stages. Once, the design form is finalized, ergonomics shall be taken into effect. In the above image, the models are displayed as showroom tractors with variants in their power and displacement.

Color of Tractor in India, plays a major role. It is believed that, colors like black should not be used in the fields as it is considered to be superstitiously bad luck causing low yield of crops and thus affect fertility of the land. Instead, Tractors in Red, Green or Blue increases the yield of crops, improves land fertility and thus bring positive change. Thus, considering sentiments of indian human potential customers matter a lot while choosing a color for Tractor.

Iteration - Final front body



Figure 10. Digital render of concept three iterations

Design History

India, a country with cultural attachments and emotions where Agriculture being the most primal occupation. Ox is used to plough and harvest the land, extensively used even in today's agricultural fields. Tractors used by farmers are very conventional in design. Also, there are ATV's and regular length tractors available but sub-compact tractors or Hobby Farm Tractors are yet to find a place in India's Agricultural domain.

This concept designed caters to the Businessmen or Industrialists who develop farms in their past time as a Hobby. Aesthetics and comfort being the most considered parameter for the project. Ergonomics and Functionality being secondary features.

Iteration - Boxy cabin



Figure 11. Digital render of concept three iterations

Description

The proposed iteration is in white color. Considering Indian influence on white being the color of honesty and purity, also the color symbolizes holy cow, potential customers shall find it being adaptable. Now, where there is good, there has to be something bad or where there is a rose, there is a thorn. As, Tractors are meant to be used in farming with lot of dust and dirt, white color can be a negative option for the buyer as there is high requirement of cleaning it often. But, in a positive sense, white is the color for royalty and pride.

The cabin is an environment where, the owner will be spending most of his time while farming. It becomes quite essential to provide him with comfort and safety. Easy ingress/ egress being the prime factor along with the reach to dashboard console controls and cabin height with adjustable seating systems. To accommodate comforting environment, a cubicle/ boxy cabin was proposed as an iteration as seen in the above image. The ground clearance is kept considerably high to avoid breakdown due to impacts from ground on the underbody of Tractor. There will however be an additional step or foot-rest provided for easy solution.

The tyres will be large in the rear and small in front. This will facilitate for easy wheel movement during turning as well as provide lighter steering to the driver. The Tractor will be Front engine with rear wheel drive. One axle each in the front and rear wheels will be governed.

ALIAS model

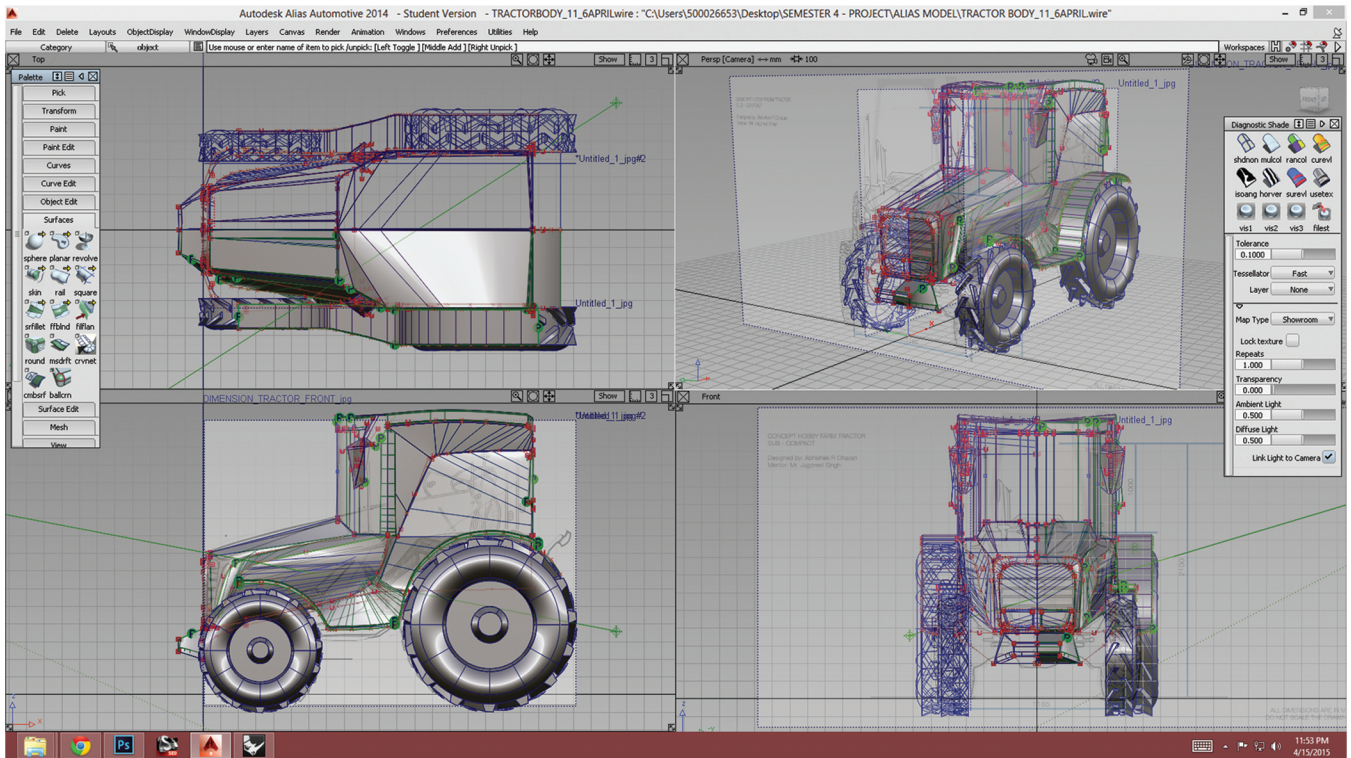


Image 9. ALIAS model of tractor in different view layouts

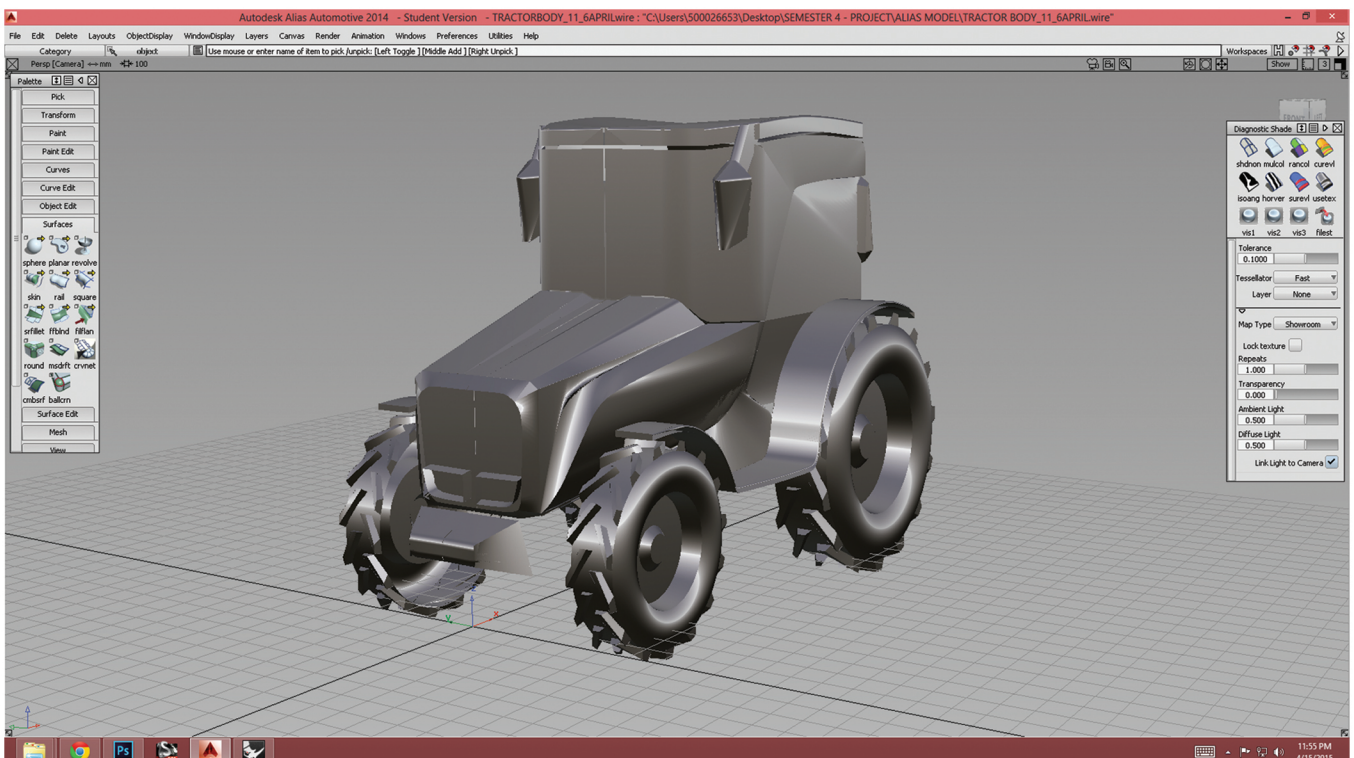


Image 10. ALIAS model of tractor in perspective

Iteration - Cabin & scoop

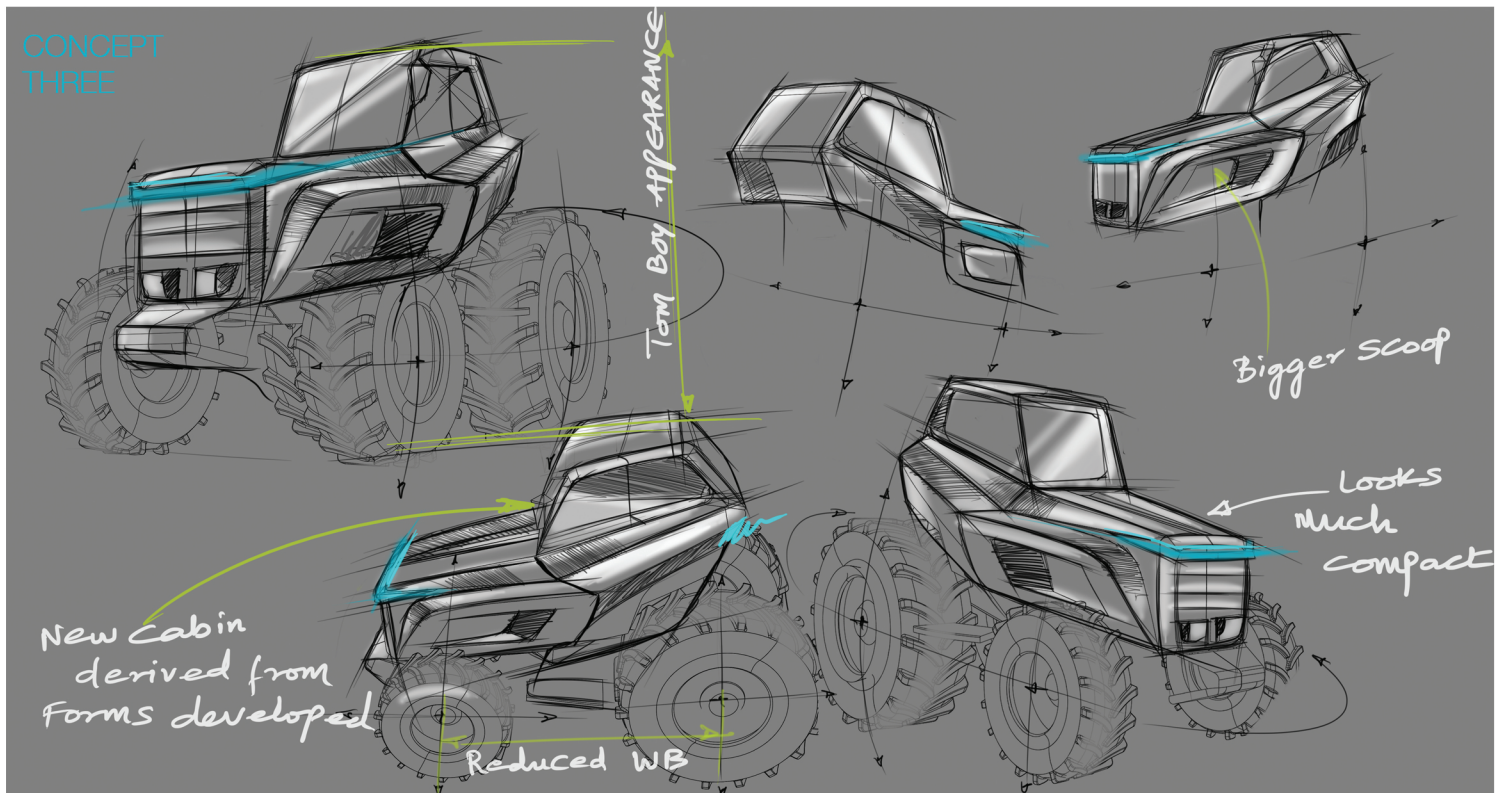


Figure 12. Iterations for cabin of tractor

Description

The cabin shape - boxy, which was considered in the iteration appeared bulky, rigid and huge. The design language of tractor was not followed and this is the reason for it to be discarded.

Considering the design language to be followed for the cabin as well, forms were developed and final outcome was as seen in the above image. The shoulder line had a continuity in design that connected side panels in front hood. It started giving tractor a character in itself. The stance is leaning forward to give an impression of ready-to-roll attitude. The minimal scoops were replaced by huge ones to make it look very dramatic. Tyre size was marginally increased to make it stable and avoid the risk of toppling. The tall stance makes it appear like a tom boy vehicle, though the overall height is just 2270 mm it gives a sense of commanding position.

The wheelbase is further reduced to 1807 mm to make it even more compact. As per regulations for commercial vehicles in India, the only rule for tractor is the height of head lamps to be placed at 1200 mm. This concept follows the regulations and front headlamps are placed at approximately 1200 mm.

Final model in ALIAS software

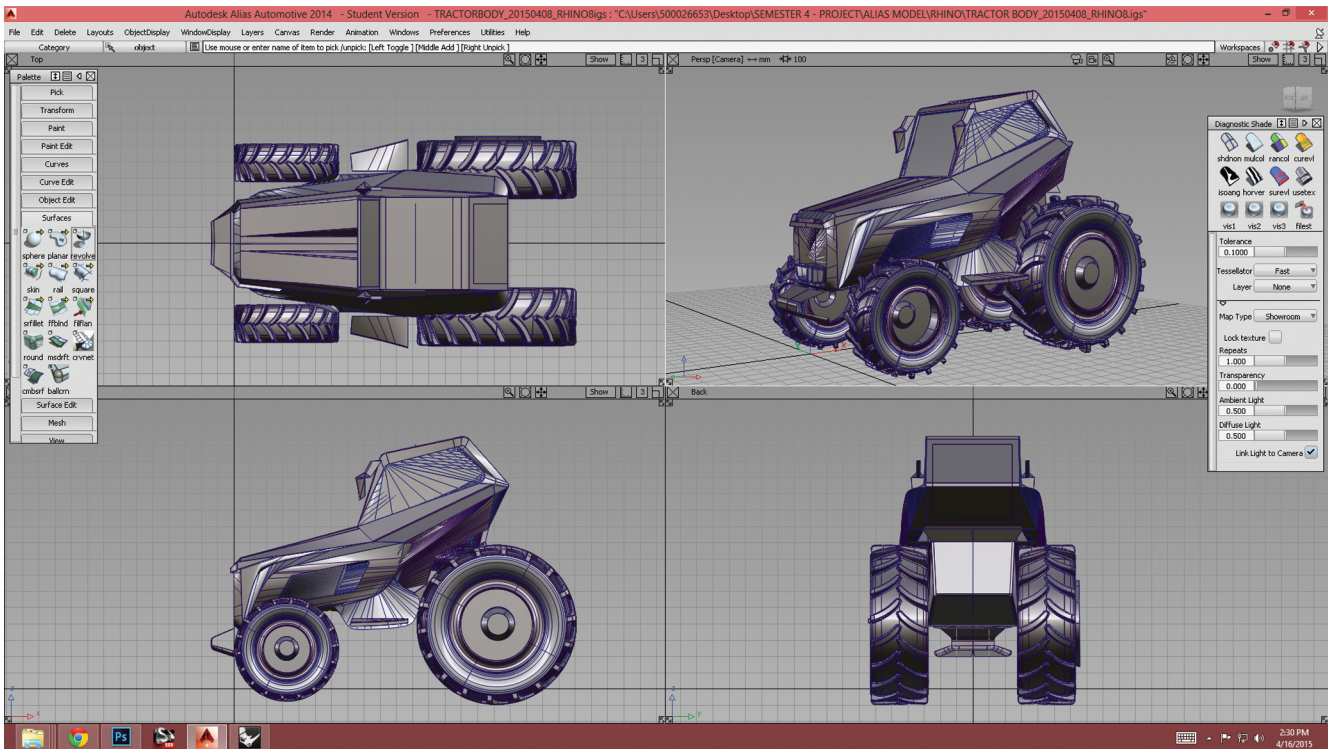


Image 11. ALIAS model of tractor in different view layouts

The concept design was finalized and modeled in ALIAS software considering the dimension details and ergonomics. The above image shows layouts of different views - top view, side view, front view and perspective.

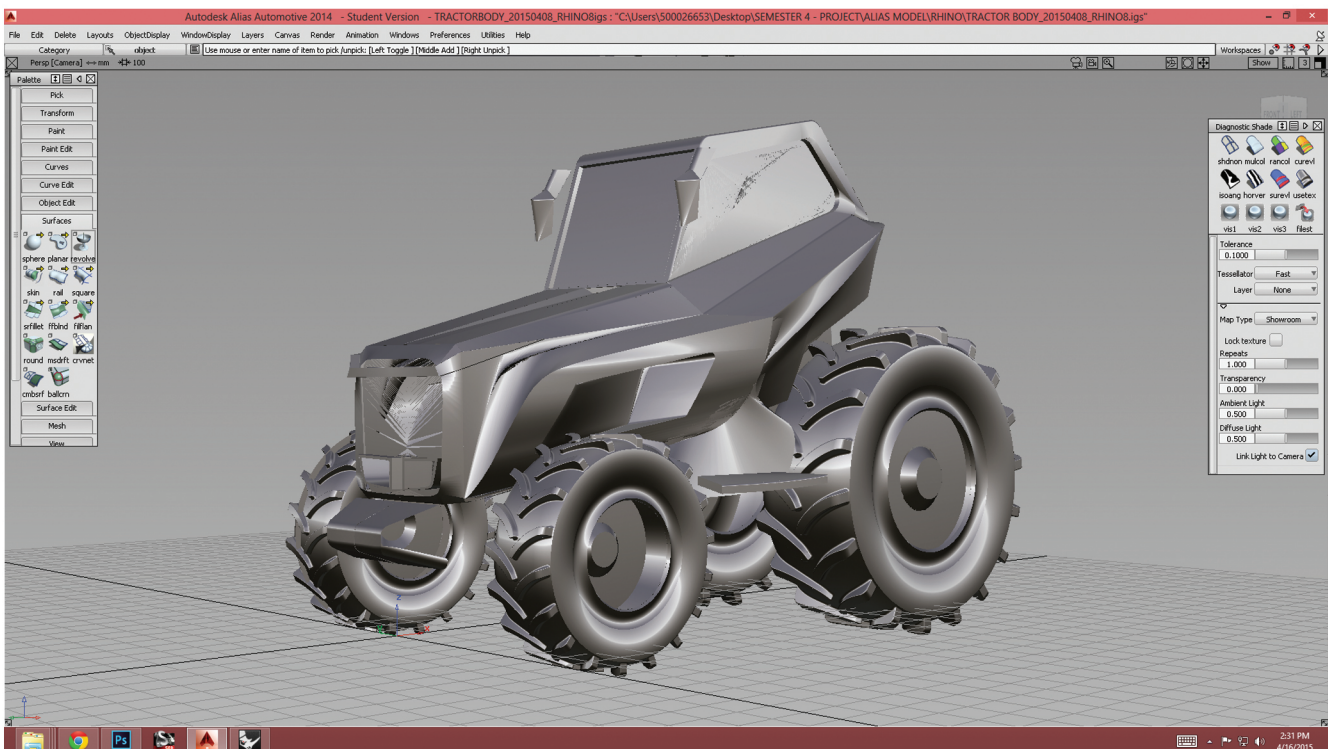


Image 12. ALIAS model of tractor in perspective

ALIAS Model

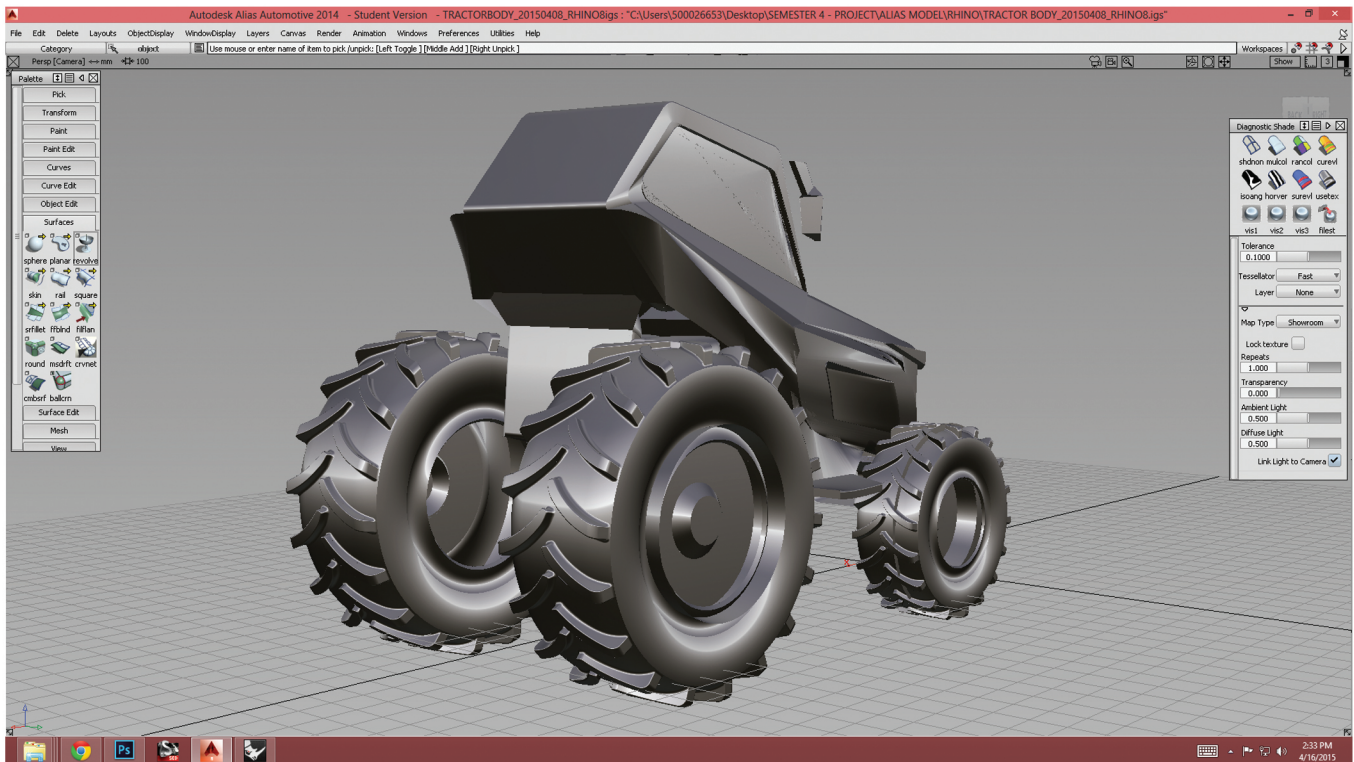


Image 13. ALIAS model of tractor in rear view layout

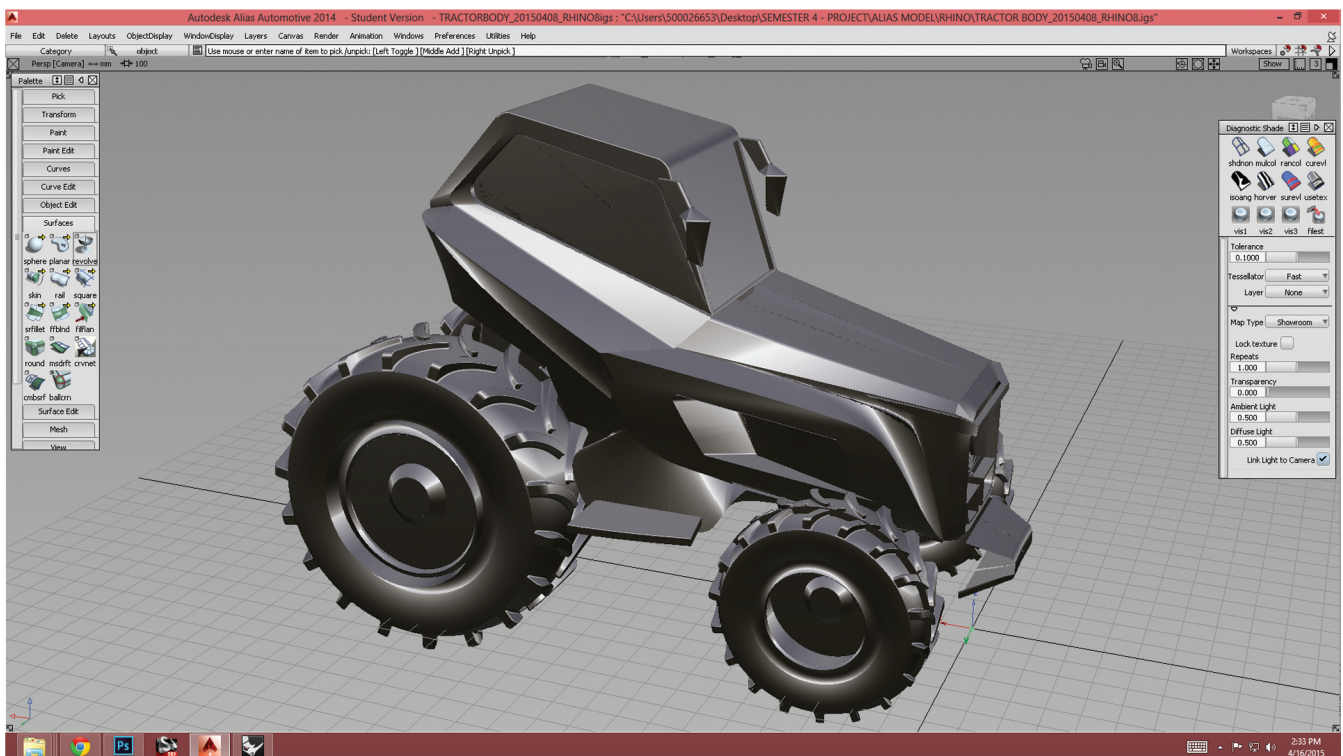


Image 14. ALIAS model of tractor in side top view layout

Digital render

3/4th quarter view of the final model
Figure 13. Digital render of final concept of tractor

Why Orange?

Final model of the tractor is colored in Reddish-orange. Orange combines the energy of red and the happiness of yellow. It is associated with joy, sunshine, and the tropics. Orange represents enthusiasm, fascination, happiness, creativity, determination, attraction, success, encouragement, and stimulation.

**Orange has very high visibility,
so you can use it to catch
attention and highlight the most
important elements of your design.**



Figure 14. Digital render of final concept in side view



Figure 15. Digital render of final concept of tractor in rear view

Description

Inspired by organic shapes, the final form of tractor was generated. Inspirations from architecture, furnitures and naturally found products were the main source of ideation of cabin. The rear windshield is very unconventional with V-shaped glass separated by certain degrees of angle. The cab design is kept very comfortable for driver to enjoy his ride. As, the potential customer is an industrialist or a businessman, lot of gadgets and equipments will be provided in house to not let his hobby bore him.

Organic farming is developed worldwide but India. In India ofcourse, this hobby farming is being cultivated in very few locations and it can only increase by proper media support. There are farmers who take up this job of cultivating and developing organic farms globally. Such international farmers have a tendency to use tractors with proper mechanisation and cabin is certainly preferred for their comfort and safety. In this case, this project Tractor shall find its usability and its potential owner.

Vehicle packaging

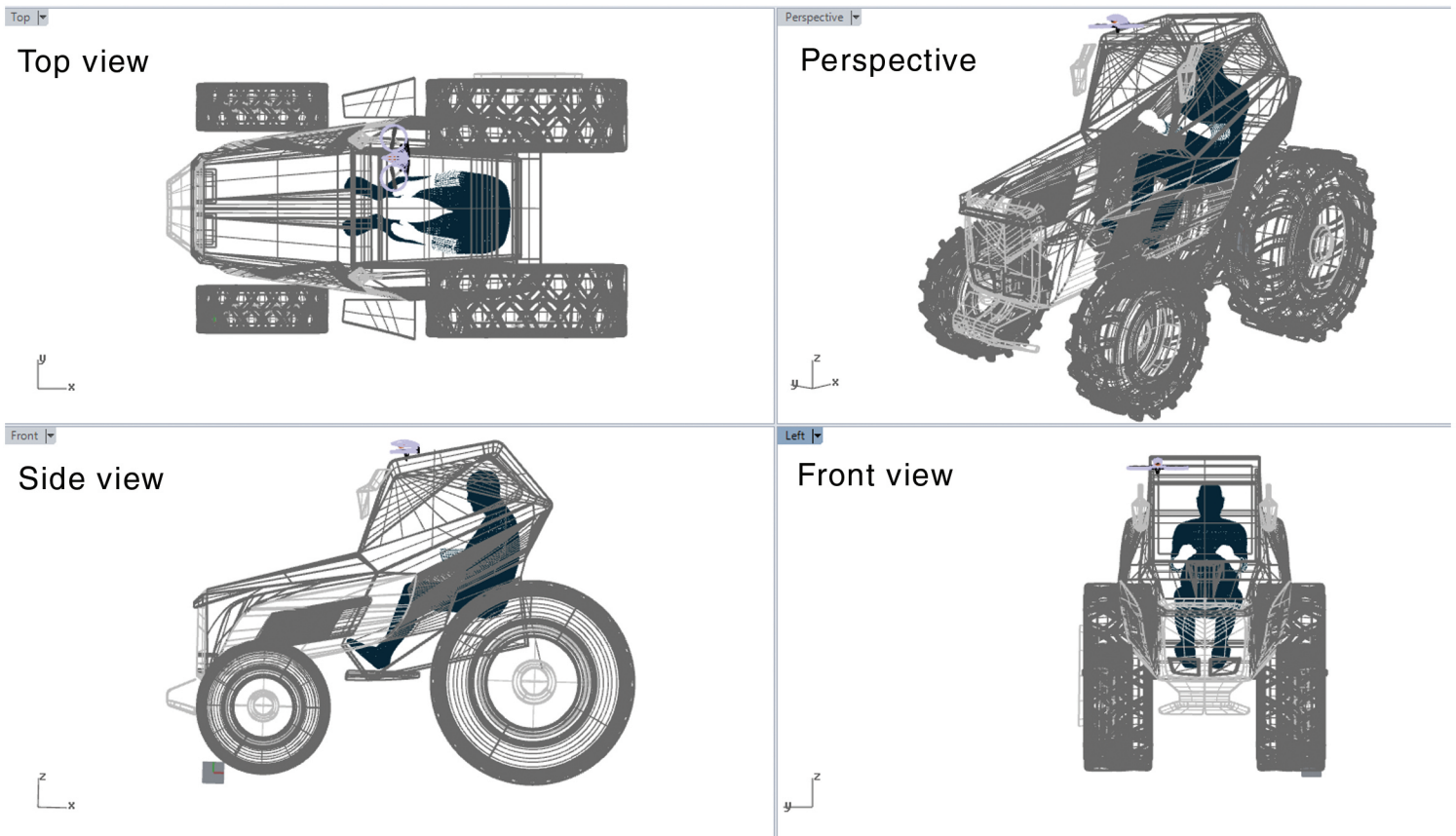


Figure 16. Package layouts of hobby farm tractor

The above image shows packaging of the Tractor. The total length from the front loader hook till the rear tyre end is 3130 mm. This length is required to keep the chances of the tractor toppling to a minimum. As, we are aware and seen that, tractor front wheels are raised in the air when load in trailer is on the higher side. To avoid this problem, the length of tractor is designed at optimum measurement and the rear tow hook to fix up the trailer is kept at 925 mm.

The design is a tall boy design with overall height of 2273 mm. This height is appropriate for human population of 5th percentile and 95th percentile male. Height of average male population in India is 5'5" (1520 mm) and 6' (1840 mm) globally, which makes this design acceptable worldwide. The ground clearance is 425 mm for easy ride. Also, ingres and egress is appropriate as suggested by the potential customers surveyed.

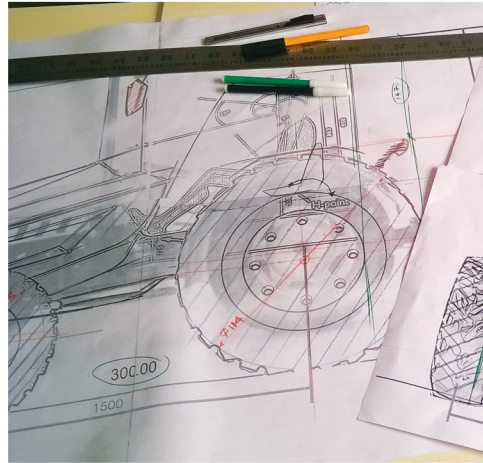
There was a question which triggered everytime as to, why can't front tyres be replaced with the same dimensions as that of rear ones. But, since the tractor is an electric version, and torque requirement is also high, front large diameter tyres can cause lot of friction and lead to low torque, high battery consumption and low efficiency ultimately. Thus, front tyre diameter is maintained at 890 mm and rear diameter at 1365 mm respectively.

Clay Modeling

DESIGN OF A HOBBY FARM TRACTOR FOR INDIA

Scale 1:5

Clay Modeling Process



Dimension drawings to scale 1:5



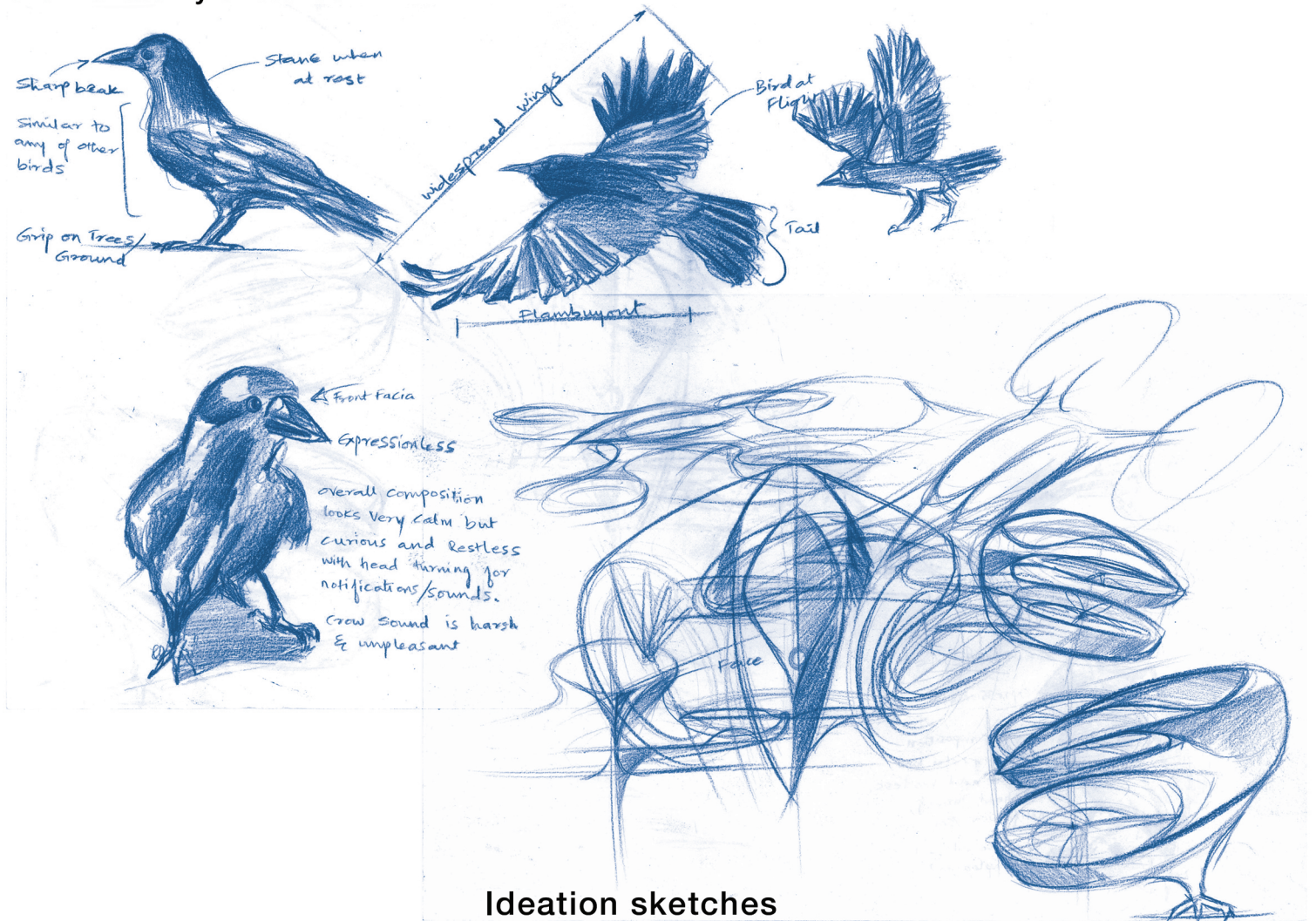
Display Model



Display model of tractor in clay to scale 1:5

CONCEPT - DRONE

Crow anatomy sketches



Ideation sketches

Figure 17. Inspiration and concept ideation sketches

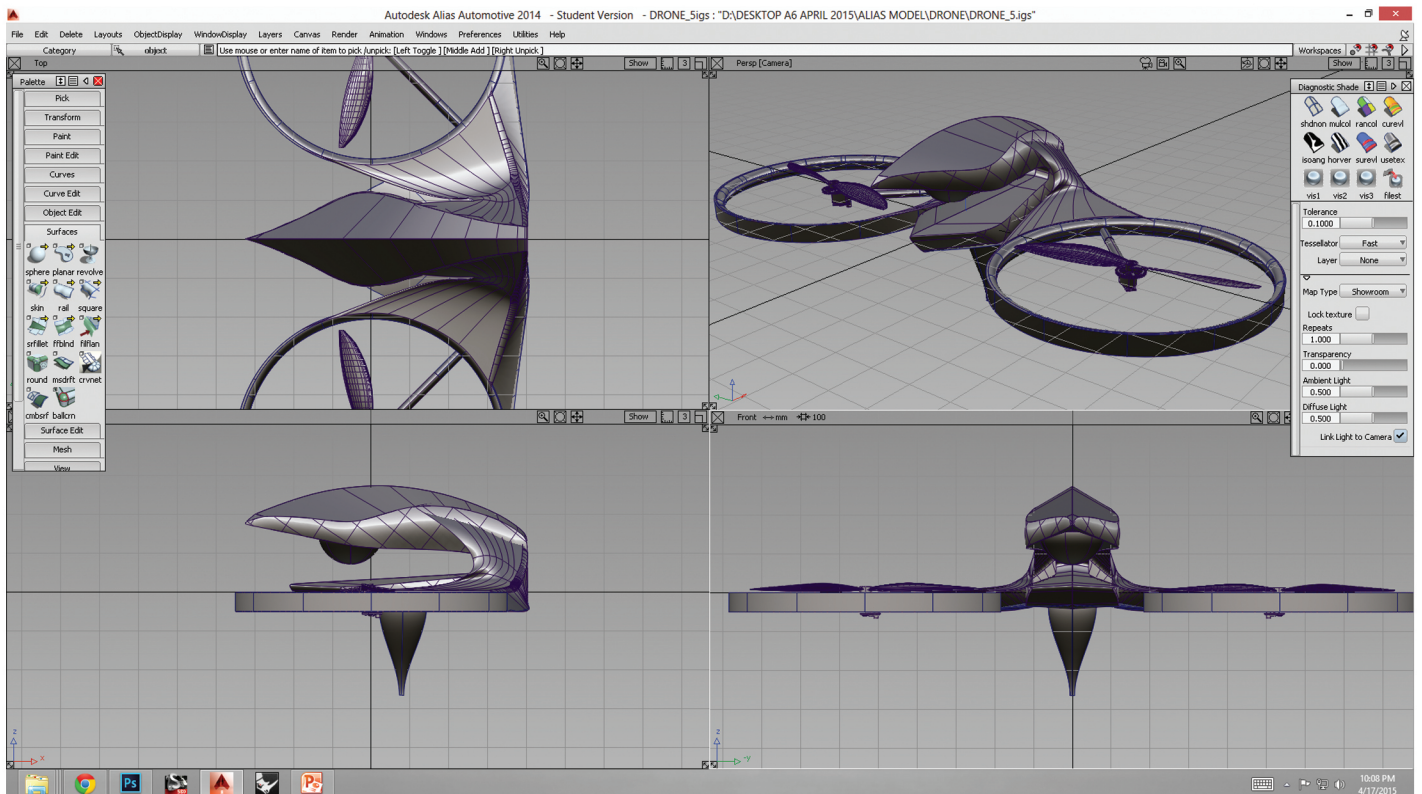
Inspiration



Image 15. Cow and crow inspiration

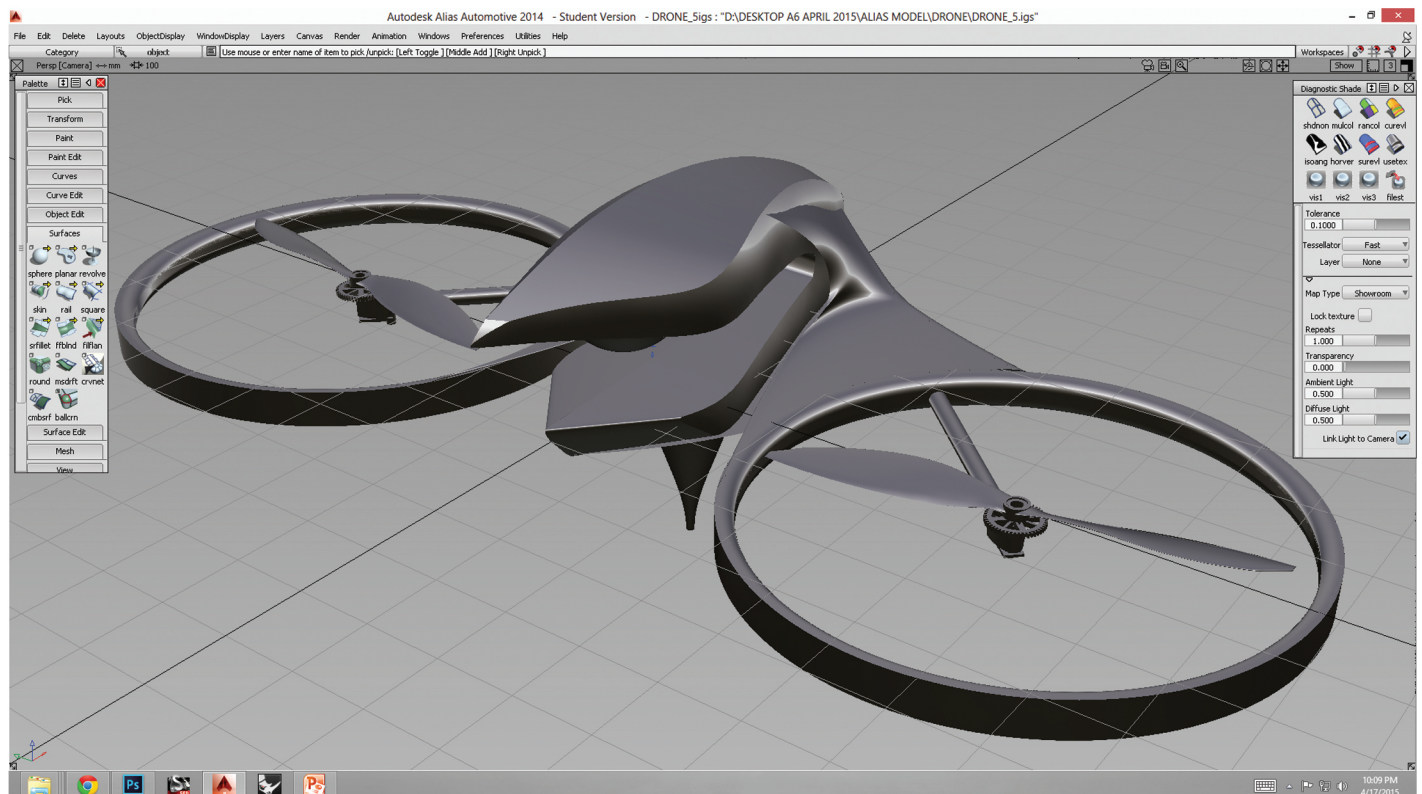
In India, we always find a crow sitting on the horns of a Cow/ Bull or an Ox. As, the tractor form is inspired by bull facia, the crow is taken as an inspiration to develop the drone final form as a product which shall find its usability in tracking the ahead obstacles.

ALIAS Model



Different views of the Drone model

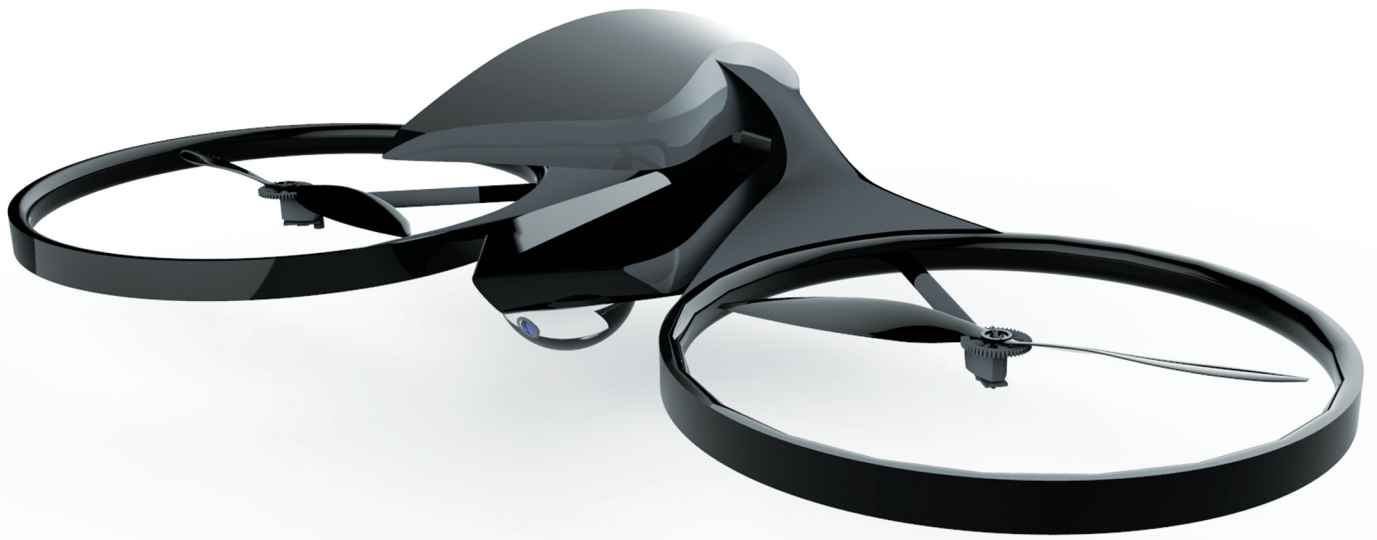
Image 16. ALIAS model of Drone concept in different view layouts



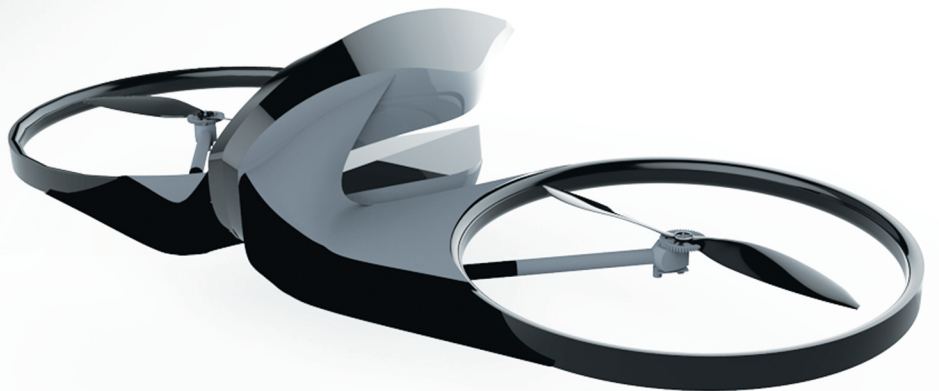
Final model in perspective

Image 17. ALIAS model of Drone concept in perspective view

Final model in perspective



3/4th front quarter view



Rear view



Different views of the Drone model

Figure 18 Digital render of Drone concept in different view layouts

USER EXPERIENCE
TRACTOR CABIN

Fuel indicator

Problem: There is no proper indication regarding the amount of fuel remaining and what will be the distance that can be covered with the remaining fuel in the system. Spotting nearby petrol pumps with proper navigation.

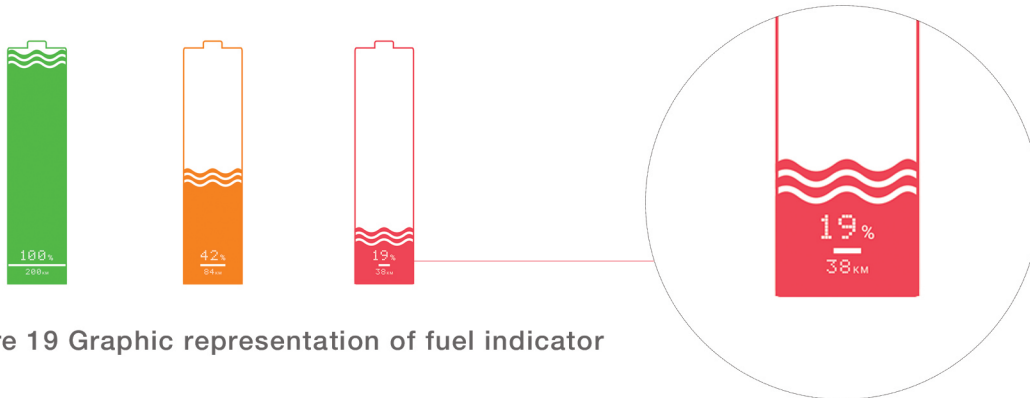


Figure 19 Graphic representation of fuel indicator

Solution: 2d representation of the fuel indicator that will indicate the percentage of the remaining fuel along with indicating the approximate distance that can be travelled (along with approximate running time). Running low on fuel, it will communicate via audio-visual alert, automatically locate the nearest gas station and will give a choice for the navigation with map towards the petrol pump.

The fuel bar will change the color according to the remaining fuel in tank.

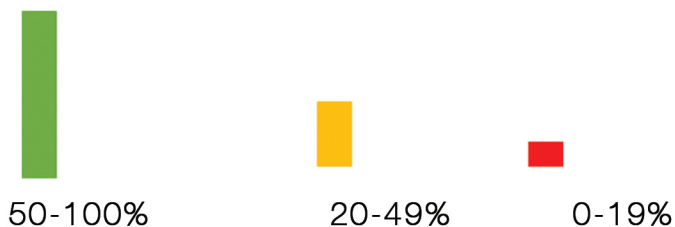


Figure 20. Graphic representation of fuel remaining in the tank

Inside the bar, it will display the approx. distance that can be travelled (only after reaching it to the stage of below 30%, 30% and below shall indicate the quantity of petrol remaining to reach the destination)

E-Key solution (Using IoT)

Problem: As the vehicle is for hobby farms in India, the trend being, an expert in organic farming belonging to some part of the globe takes up the contract to cultivate and develop the area of land designated for farming. It is usually practiced, the tractor will be used by the farm developer using tractor provided by owner of the land. But, not all the owners like anybody else using their vehicle 24x7. Therefore, sharing the key of the tractor with them sometime becomes very difficult and risky as well. In this situation, the owner expects some control over his vehicle.

Scenario

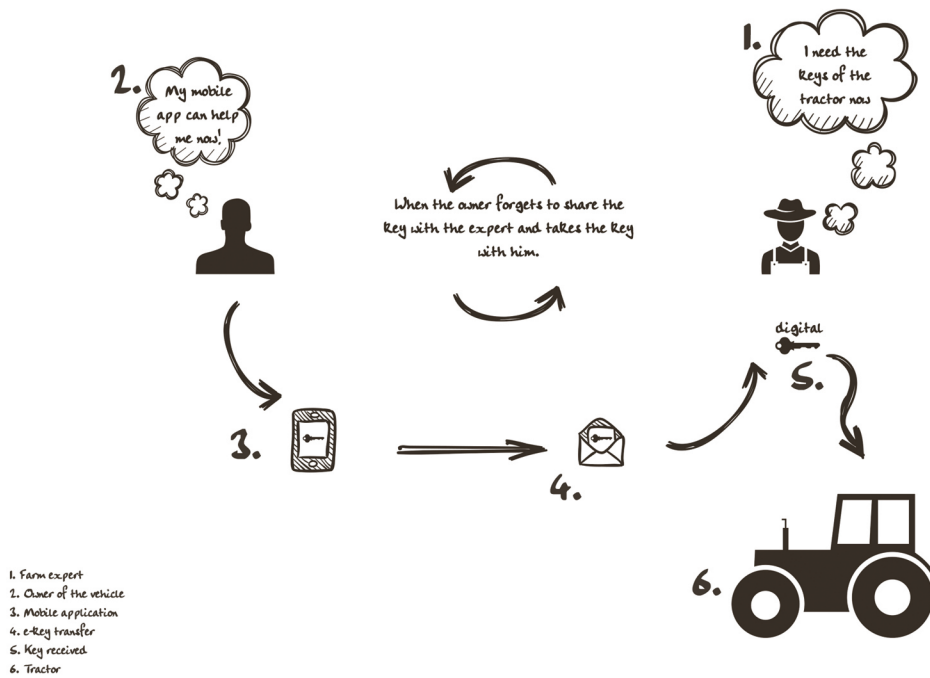


Figure 21 Graphic representation of E-key scenario

Solution: Using the scenario of Internet of Things (IoT) we can create a system, where the tractor owner can send a key digitally using his smartphone application. The farm expert (who will be using the tractor for a short duration of time) can operate the tractor for allotted time duration that is being permitted by the tractor owner while sharing the key. Once the time duration is lapsed, the key shall be locked and mobile application key will not find its usage.

Dashboard screen:

Problem: Due to many new features present in the newly designed vehicle and space limitation, it is very difficult to allocate all the information in the screen.



Figure 22. Graphic representation of display screen

Speedometer comprises of unconventional display, colors are used to alert the driver with information system such as green for optimum speed, orange for vigilance and red for danger.



Solution: After several iterations and deciding the information architecture of dashboard, the solution of floating screens was bumped. In this concept, screens of each category will be stacked as floating cards and as per the situation considering priority, the integrated system will automatically popup the concerned screen for the user. By default the generic level one information will be there on the top (speed-o-meter, torque meter, fuel/charge indicator etc.), but whenever any particular situation occurs, it will swap the screen with prioritized one. It will be a touch screen display, because of the digital display of analogue meters, system will avoid parallax errors still it continues the conventional feel of different emotions attached with a traditional tractor.

If in some screen there is a minor issue, then it will just highlight it's outer boundary and if the user wants to check that issue, he can tap anywhere on the screen and the particular window will be highlighted.

N.B: For instance there is a situation where two screens are in the top priority and both have some concern from the users point of view, then the system automatically adjust both the systems in a single screen for that particular time period.

Drone controller

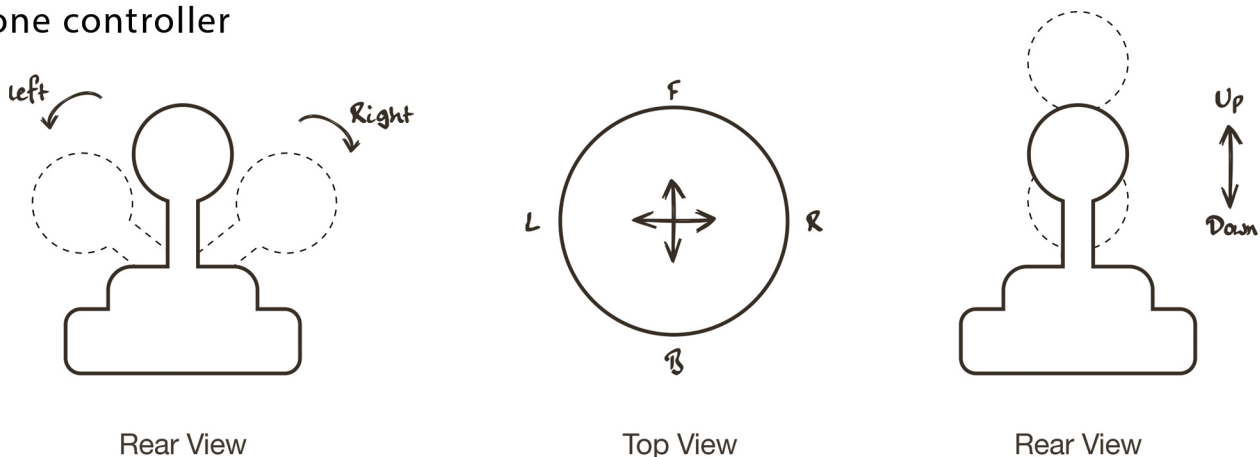
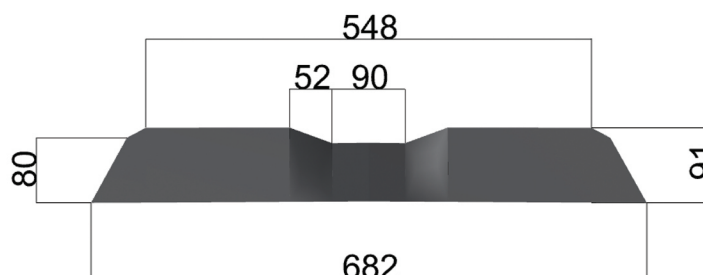


Figure 23. Schematic diagram of Drone controller - Joystick

Drone operations are kept very simple, can be compared to game joystick with control directions elaborated in above sketches. There is a button provided in the joystick which when pressed, the drone shall return back to its original position on roof top of tractor.

Dashboard dimensions



All dimensions are in mm

Final Dashboard controls

Features

With this contrasting color scheme, for better visibility.

Drone tracking panel with a visual indication (with infographics) of the height and distance of the drone from tractor.

Pictorial information for maximum



Gamification of drone controller to make the process of drone controlling easier and efficient.

Futuristic approach to organize the dashboard information, stack of swappable screens.

Description

Dashboard is so designed, considering comforts of the driver in cabin. The joystick is placed at right bottom corner of dashboard for easy movement with a radar screen for drone location co-ordinates. The display screen at centre of dashboard displays various information systems such as fuel indications, weather conditions, speedometer. There are various hard buttons placed on right side of the dashboard such as left/right indicators, start/stop press button, wiper control, headlamp switch with low/high beam adjustment controls.



Image 18. Graphic representation of Driver cabin

The Sub compact tractor designed in this project caters to most of the problems identified during survey. There was a lack in segment of tractors for passionate people who are sparing time to develop farming in their past time as a hobby. This tractor design, fits in the sub compact tractor category considering its dimensional details. India being a nationality with emotional attachments and cultural influences, this design is highly influenced by an animal which symbolizes power, aggression, energetic and ready to attack attitude.

The overall stance of tractor is kept tall, making it appear like a tom boy. Color options could have been conventional Red, Blue or Green but Orange was chosen as it is the color of youth, vibrance, color of joy and happiness, high visibility and also highlights most important elements in the design. Ground clearance is optimum at 325mm and headlamp positioned at height of 1200mm, a regulation as per Indian Commercial Vehicle rules.

Taking a leap in the project, a drone was conceptualized finding its usability in taking video captures around the field in a specified range and serve as a device to spray seeds or insecticides/ pesticides over the field. Also, working on the user experience of the tractor cabin for driver induced many opportunities to make the dashboard controls much simpler yet innovatively futuristic, provide E-key mobile application solutions, display screens, fuel indication display and parking mode for the tractor.

The tractor is designed, improving exterior aesthetics along with driver cabin design and scenario for parking. To cut a long story short, complete transportation system is designed for the sub compact tractor involving a potential customer.

- [1] SAE , "Terminology for Agricultural Equipment J1150",2003
- [2] MM Pandey Director Central Institute of Agricultural Engineering Bhopal, India, 'INDIAN AGRICULTURE – AN INTRODUCTION', Submitted to Fourth Session of the Technical Committee of APCAEM 10-12 February 2009, Chiang Rai, Thailand
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- [5] The Central Motor Vehicles Rules Act, 1999
- [6] www.lamborghini-tractors.com
- [7] Gurusamy, S. and Devaradjane, G., "Innovative Design of Tractor for Small and Marginal Farms Mechanisation," SAE Int. J. Commer. Veh. 8(1):2015
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