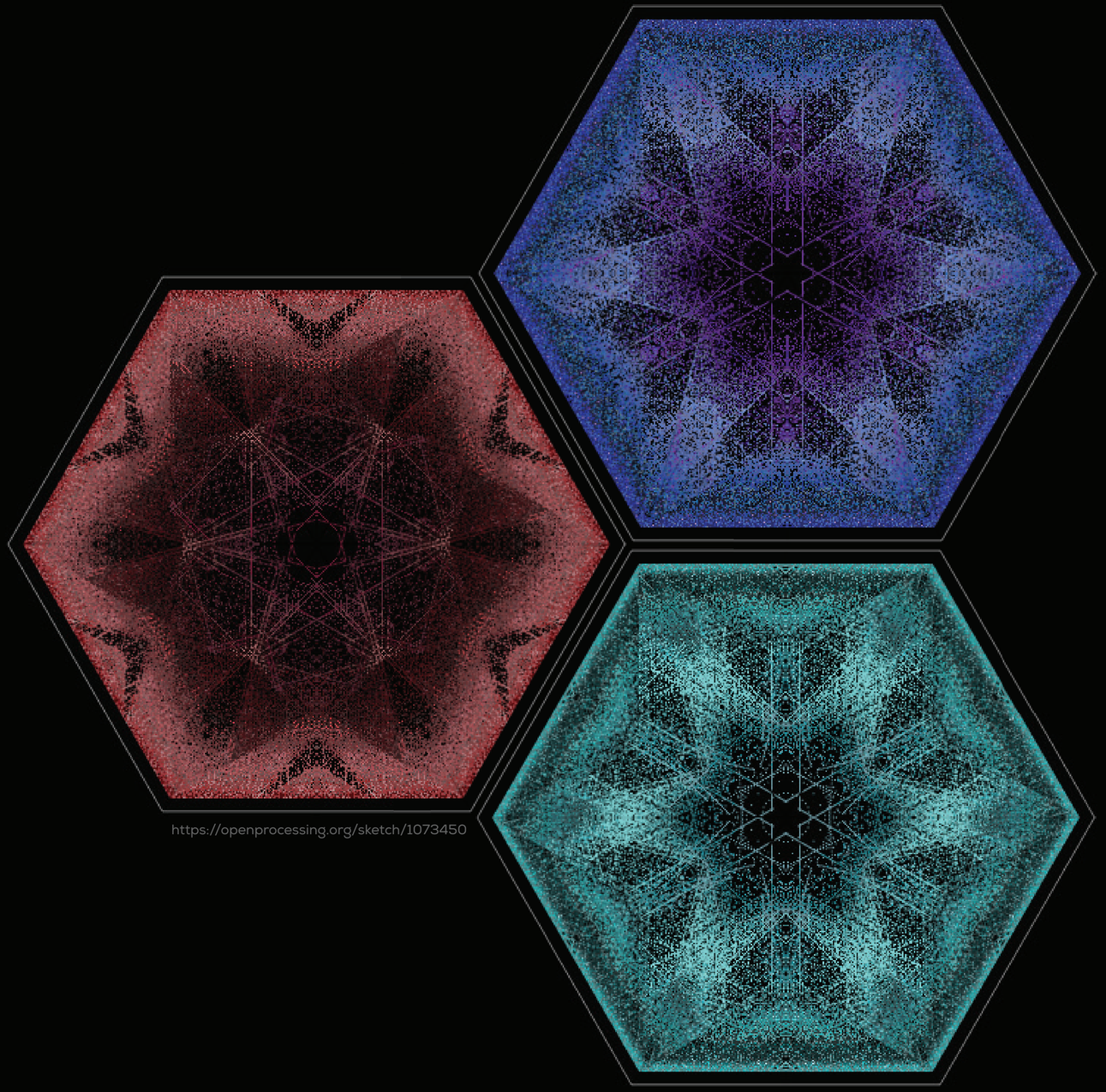
Technological Factors Evolving the role of Transport Designers



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TANAY NANDANWAR
FINAL MAJOR PROJECT

Masters Thesis Project

Module Title
7031AAD - Automotive and Transport Design Specialist Investigation - 2122MAYSEP

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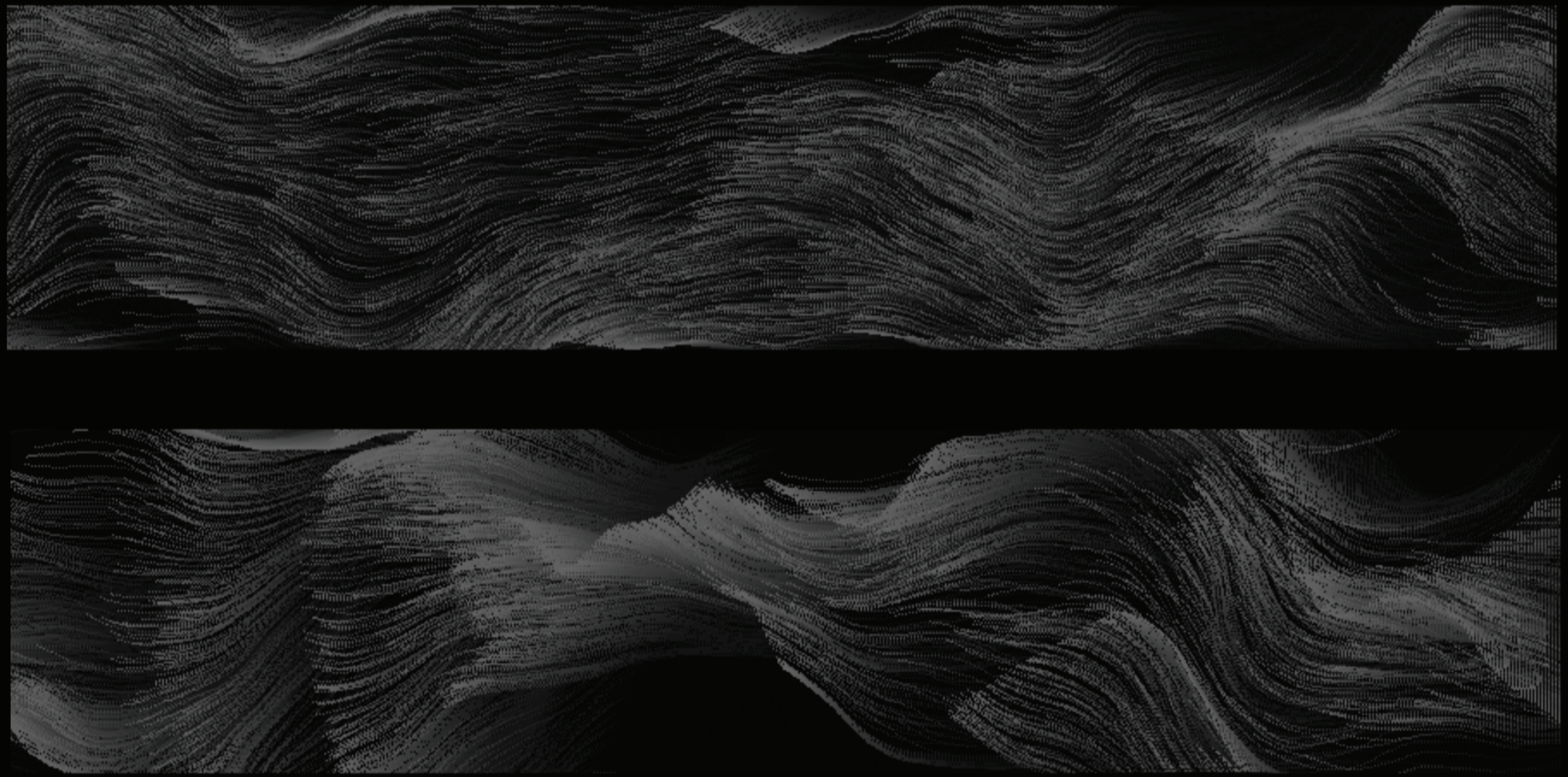
Abstract

The following report underlines my research for my Final Major Project (FMP) at Coventry University. The report focusses on the technological factors which affect the role of Transport designers in the future. The major emphasis is on the new age design tools and technologies being or could be employed in the industry in future.

The Research methodology was majorly Secondary Data but also contains some primary data sources via informal conversations with industry experts. The author also got a chance to use and integrate some of these design tools in his FMP to better understand their effects on the creative design process.

Artificial Intelligence, Virtual Reality, Generative design, Evolution of design tools, Algorithmic Design



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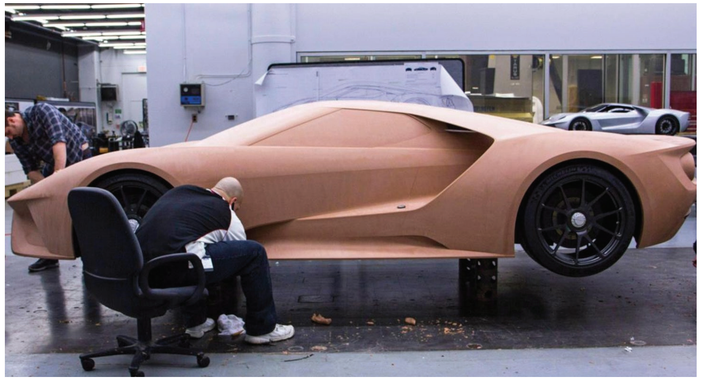
Introduction

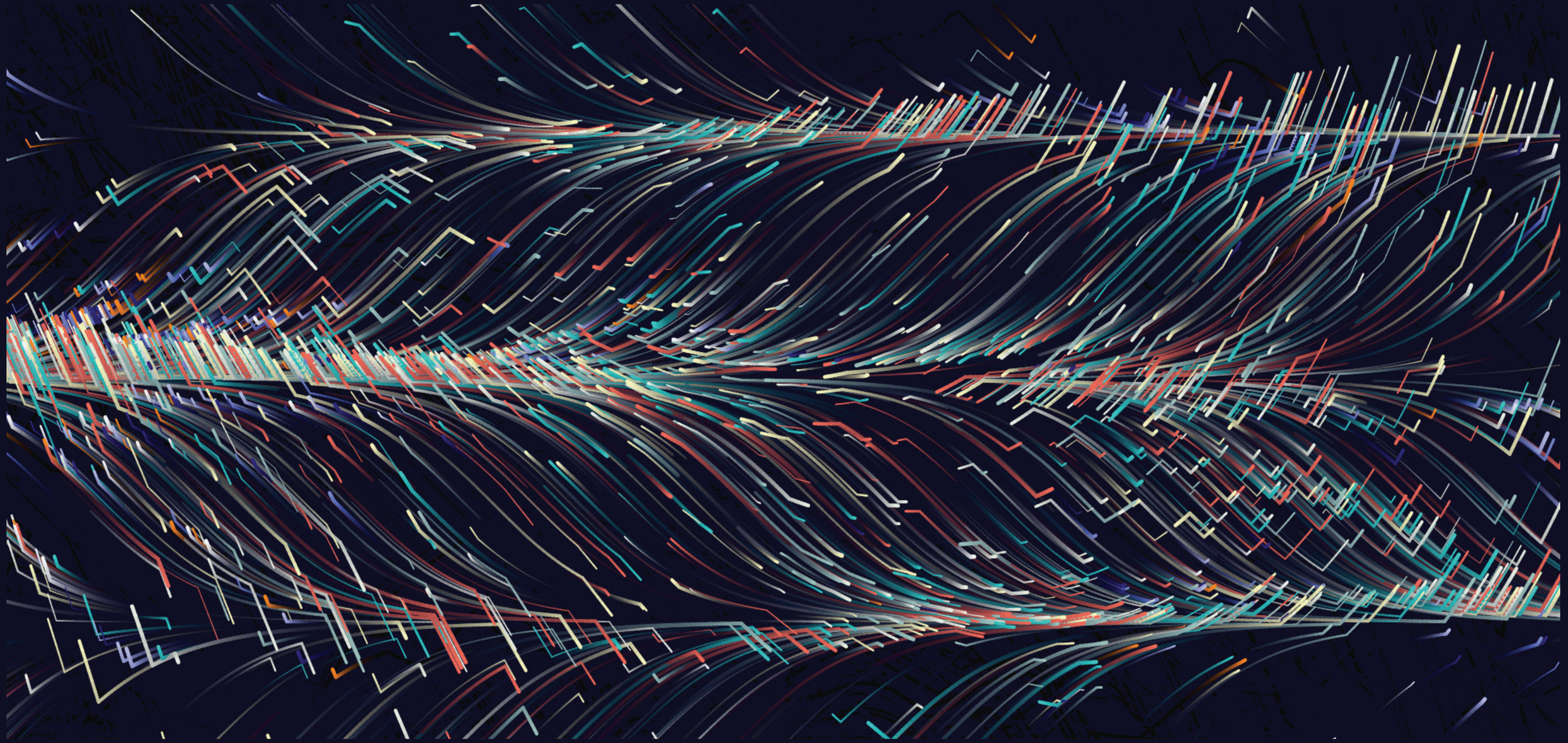
Automotive and Transportation design is a fairly young industry. And in layman's terms, it is associated with the appearance of any vehicle. But if we dive deeper into the topic, the role of a Transportation designer has been constantly evolving under different circumstances over the years. And is at a point of a major overhaul due to industry shift into electrification, moving towards autonomous technologies etc.

The first cars were designed and built almost exclusively by skilled craftsmen who had learned their trade over many years of training, but by the 1980s it was virtually impossible to find any car made entirely by hand. The advances in technology allowed for more automation and less dependence on skilled labor.

Today, there are many different types of work within the automotive design field from 3D CAD designers, vehicle architects, visualization experts. The future looks promising as we continue our path towards autonomous vehicles. But as technologies advance further, Will these roles be still relevant or will they evolve into something else? The automotive industry is just one of the many industries that will be changed by Artificial Intelligence. AI systems will be able to understand human needs. I believe this will bring automation in the design process similar to the automation in vehicle manufacturing via assembly lines back in 1913, Revotionising the automotive industry.

The focus of this research report is to understand how various newer tools and technologies is going to affect and evolve the transportation design process. And what are the other situational factors which affect it? Following that the author tries to use these newer tools to create a concept vehicle.





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Definitions

by Merriam Webster

Artificial Intelligence (A.I)

: The capacity of computers or other machines to exhibit or simulate intelligent behaviour; the field of study concerned with this. Abbreviated AI.

Virtual reality (VR)

: an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment
also : the technology used to create or access a virtual reality

Generative

: having the power or function of generating, originating, producing, or reproducing

Additive Manufacturing

Instead of the old approach of carving a usable part out of a large block of material, additive manufacturing builds an object up layer by layer.

Literature Review

What were the role of automotive designers in different automotive eras ?

Invention Era (1885-1895)

The Designer of the first automobile (Karl Benz) was considered as an inventor

The aim was to create a vehicle that ran on its own power.

Majorly focussed on proof of concept of an Automobile

Innovation Era (1900 - 1910)

The concept of Automobiles became much popular but was still considered as a novelty item than a useful object

Designers had to differentiate the body styles from horse-drawn carriages as vehicles of the different segments.

Manufacturing era (1910-1915)

Ford motor company started to mass manufacture the automobiles on an assembly line

Automobiles were heavily inspired by ornate Edwardian-style Architecture.

Designers had to keep mass manufacturing constraints in mind

Capsule era (1920-1930)

An era where Cars bodies were starting to be closed like a capsule

The interior space division altered the emotional expression of the space

Classic era (1930-1940)

In this era car bodies started to become sleeker and curvacious to create a feeling of luxury and aerodynamics

Most of the cars were inspired by the forms of Aircraft and trains of the time as they symbolised speed and power.

Integration era (1950-1970)

This era focussed on the unibody style of cars with the integration of different body structures into one single unit.

This era also focussed on the integration of safety factors into the Automobiles

Modern Era (1970-2010)

Not just functionality but consumer's emotional reaction became a very significant part of any design

Introductions of newer body styles to suit the demands for different types of customer lifestyle

Expansion of regional brands into newer international markets.

Transitional Era (2010-present)

Biggest change into the automotive industry with the transition of the Oil-based powertrain to electric architecture

Major shift into the vehicle architecture opening newer possibilities and freedom for Automotive designers

Traditional automakers revamp their design language to suit the electric era

Many new companies get a chance to enter the market.

Different Factors affecting Automotive Design in any era

Technology

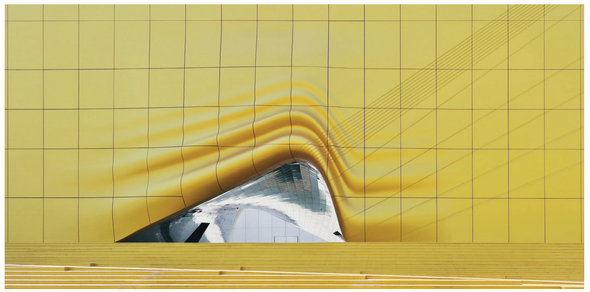
Technology in any era is very influential to automotive design. Newer technologies bring newer possibilities to designers to create vehicles. A major technological shift can influence everything from the manufacturing techniques of the vehicles to the user lifestyles. Affecting the design of the vehicle. Designers need to be at the forefront of technological advancements to implement and integrate them into vehicles. For eg. we are moving towards autonomous vehicles, although it is still in a distant reality automotive designers have started working on how would it affect the experience in the car and designing experiences for potential users in the future.

Lifestyle

The user lifestyle, psychological factors and sociological factors played a very important role in the vehicle design of that era. For eg. when the world wars broke out there was a higher push towards the development of military vehicles and many vehicles of the era were designed to satisfy those needs. It is also a very region-specific thing as each region and markets have their own demands and preferences. which greatly affects the design of the vehicle in the region. This has given birth to very interesting design attributes associated with the different regions of the world.

Arts and Culture

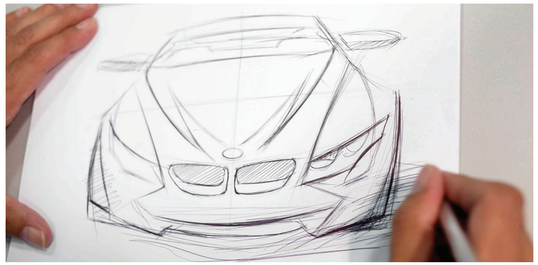
The arts and culture of an era affect greatly the automotive design of that era. This may include architectural styles of the era, pop culture, social revolutions etc. Vehicles have been very influential to societal needs and practices and the same is true vice-versa. The definition of what a car means has regularly changed in different eras. Automotive designers are vastly inspired by these cultural changes and art moments of the society and reflect it back into the vehicles.
Nowadays it's such an important factor for the automotive industry that there are specialist trend forecasters for this in a company.



How are our tools Creative design tools evolving?

The design tools used in designing any vehicle has a major significance in the overall outcome of the Final design of the vehicle. As these tools evolve they bring a newness to the creative process and are generally observed to also make the design process much more time-efficient. Here are some classifications of what our current design tools are and how are they evolving

Passive Design Tools



A Passive design tool generally refers to any tool where extensive human intervention is required to create anything. These tools perform at their maximum potential when paired with a human with high level skills and experience related to the tool. One of the most basic examples of this is simple Pen and Paper, It is arguably the most extensively used design tool in automotive design. And Automotive design students have to practice and train extensively to develop their sketching skills to reach a certain minimum required level. Other tools also include clay modelling, wood working, Digital Modelling etc. Most of the tools used in automotive design till now are Passive Design tools.

Generative Design tools

These are the next generation of design tools being adopted by the automotive industry at a very rapid pace! These tools were extensively being used in engineering departments but now it's also making its way into the design industry! The generative design tools primarily use machine learning and algorithms to generate or synthesize geometry all by themselves. Although the human intervention is lesser compared to the Passive design tools, these still require a certain level of human guidance to define goals, set constraints and to make decisions. The generative design tools can generate multiple design solutions simultaneously which reduces the exploratory time required in any design project and can also create highly efficient designs which are. There are a few generative design tools that the author could try out like Autodesk Fusion 360, and Vizcom Sketch2Render. These two tools perform very different tasks but the core working of both are very similar.

Intuitive Design tools

These will be the future of our design tools which are being extensively developed as there are more advancements in Artificial Intelligence and Emotions being developed. This is when the design tools develop their own intuitions and reasoning to solve a design challenge on its own. These tools will be capable to create multiple design solutions with minimal or no human interventions. Since these tools will have their own intuitions and reasonings they might also be able to analyze, rectify and correct any human mistakes in their designs. It's for tools like these the question arises that how will the role of an automotive and transport designer will evolve in the future than as what it's perceived today.

Objectives of the Study

Research aim

Automotive and transportation designers have always been in forefront of implementing technology and innovation into usable forms of vehicles. Over the different eras, the designing tools have evolved affecting the creative workflows of designers. The aim of this research is to investigate what are the latest tools used in Automotive and transport design such as the use of A. I and Virtual reality and how are they affecting the design process. What are their advantages and disadvantages? How will it affect the way we design vehicles in the future and studying how will it ultimately evolve the role of transportation designer.

Research Objectives

- Automotive design is a fairly young industry but the role of the automotive designer has been evolving constantly over the years. So studying the major factors that affected automotive design in different eras.
- Studying what impact will newer designing technologies like Artificial Intelligence, Virtual reality bring to automotive design and how they will alter a designers creative workflow.'
- Will, there be automation in the design process, and how will it alter the role of an automotive designer than what it is perceived today.
- Sociological implications on automotive design when it becomes much more accessible to the general public with help of these technologies.
- To interact with few experts in the fields of new tool design, academicians, Automotive designers and understand their expert views on the subject.
- Finally, To design a vehicle for the future based on the above interaction feedback and using some of the new AI tools.

On the basis of the above literature study and objective following research questions were hypothesised

- The role of automotive design has undergone big change/ evolution over the years
- More and more intelligent design tools are being developed and being implemented in the industry
- The role of the Transportation designer will change just from what it is perceived today and will evolve more into 360-degree social researcher/reformer and curator
- The use of new-age tools will assist the designer to perform better in a practical situation

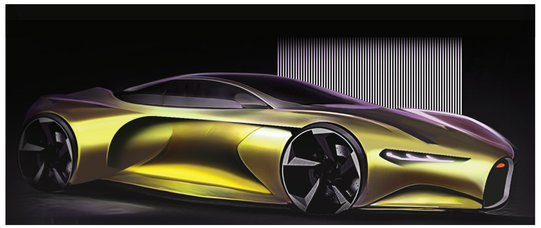
Research Methodology

For the purpose of this study various magazines, books, periodicals, research papers were referred to understand secondary data on past studies and future evolution of the transportation industry Primary data was collected by interactions with fellow postgraduate researchers, experts from new tool developers, academicians, designers in the field.

New firsthand experience of created by studying new age designing tools and employing them in designing a process based on the interaction with an expert in the fields to create a new futuristic design. This was also an exploratory and evolutionary process wherein the new AI design tools were searched, learned and used in the design process in a live ongoing process.

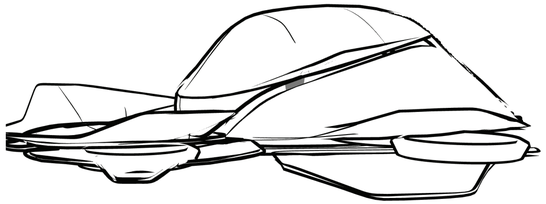
What are the different Artificial Design tools there currently?

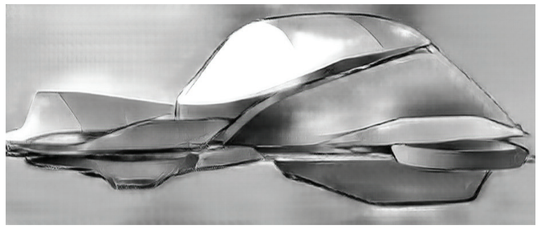
Vizcom.io https://www.vizcom.co



Vizcom.io is one of the very few A. I design programs that are purposely built for the Automotive design industry. It uses machine learning with thousands of render samples to create or generate a vehicular looking image. At the moment it is useful in the initial ideation process, where it can generate a lot of images in a small amount of time to aid automotive designers

Sketch2Render Beta Testing Participant





From the same developer of Vizcom.io, Sketch2render is another A. I powered the design tool which creates 2d sketch renders from uploaded sketches. This program can be also considered as a much more advanced version of the Vizcom as it studies the uploaded sketch, understands it and applies a greyscale value render to the sketch. It is very interesting to see how an A. I interpret the surfaces on a sketch done by humans.

- Note from the developer

I was fortunate enough to have an informal discussion with Mr Jordan Taylor the developer of these tools. And wanted to know his views and opinions on the research topic. He believes that it is very difficult for A. I to replace humans in designing vehicles yet as it doesn't have any emotional perceptions like humans which is a very important factor especially in the automotive design industry, which is heavily emphasizing on emotional design. But he also mentioned that the Automotive design process right now has a lot of repetitiveness to it for eg. Rendering side view variations for a car, which can be easily done by an A. I Program much more efficiently and in a shorter span of time.

Rather than a replacement to humans, he sees the A.I technologies more as another tool in a designers toolkit which will make his/her design process faster and help them create much more interesting results.

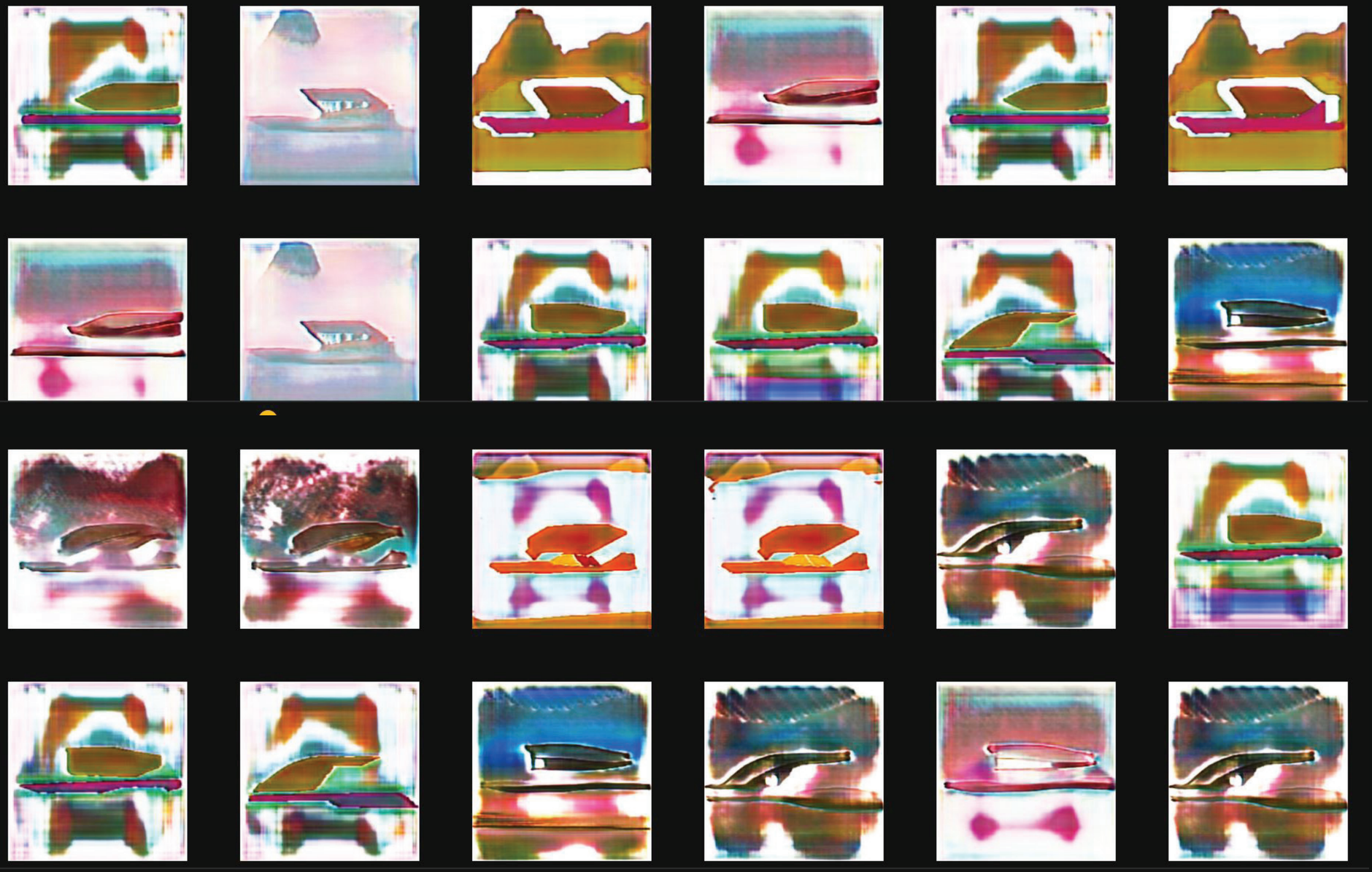
What are the different Artificial Design tools there currently?

Platform.io

https://www.playform.io/

Platform.io is a website that advertises itself as a tool that empowers designers, artists and creators to train their own A.I program to create interesting art pieces.

Harnessing the power of Machine learning in A.I it creates different results using the images curated by the creator. The best part about this tool is that it doesn't require the user to have a piece of prior knowledge of coding.

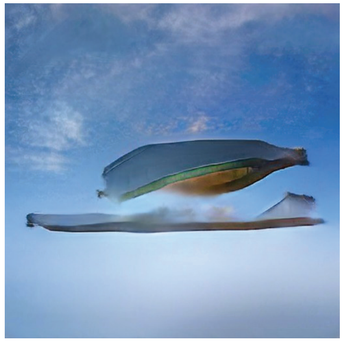


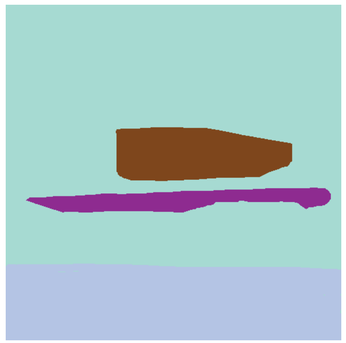
What are the different Artificial Design tools there currently?

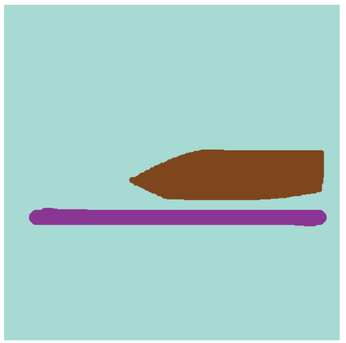
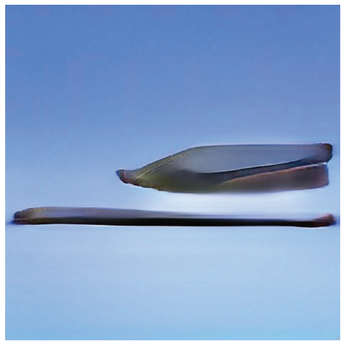
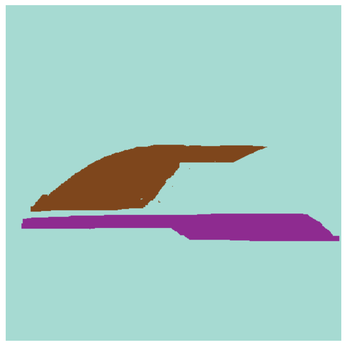
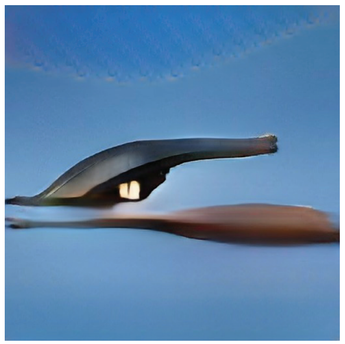
Nvidia GauGAN

http://nvidia-research-mingyuliu.com/gaugan

Nvidia GauGAN is probably one of my favourite A. I tool in the bunch. It is an experimental tool designed by Nvidia, A graphic card manufacturing company.
In this tool, the creator simply has to create a doodle of a landscape using different colours representing different materials, And the A. I turns it into a very realistic looking picture using millions of samples on the internet. Although, It cannot be directly applied in the context of automotive design this tool has immense potential to be very useful in the future if modified for the automotive context.

Use of Virtual Reality into Designing the concept vehicle

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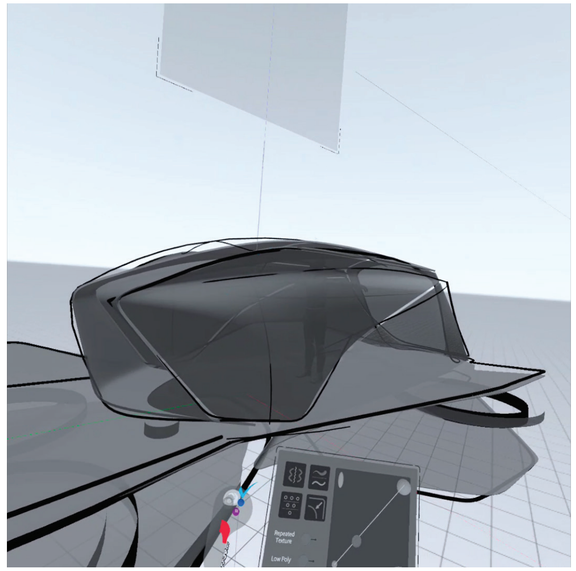
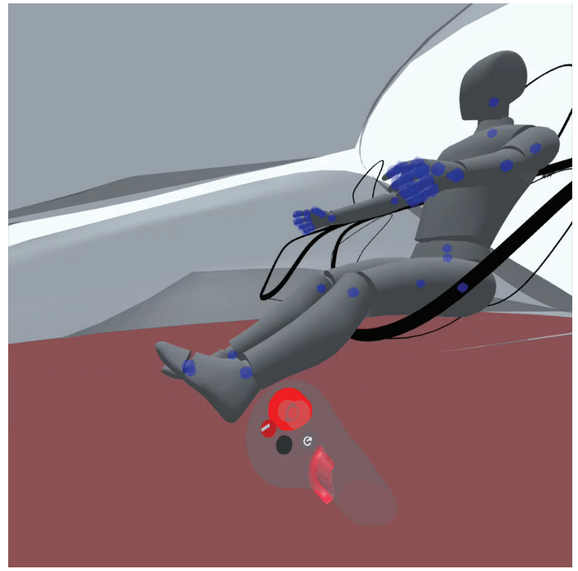
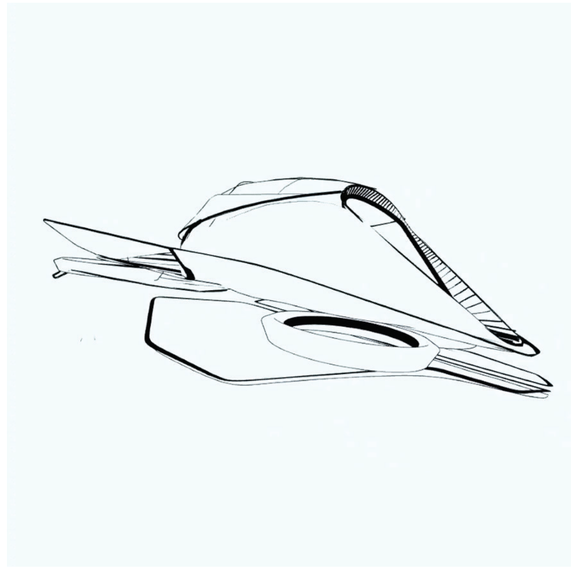
Gravity Sketch

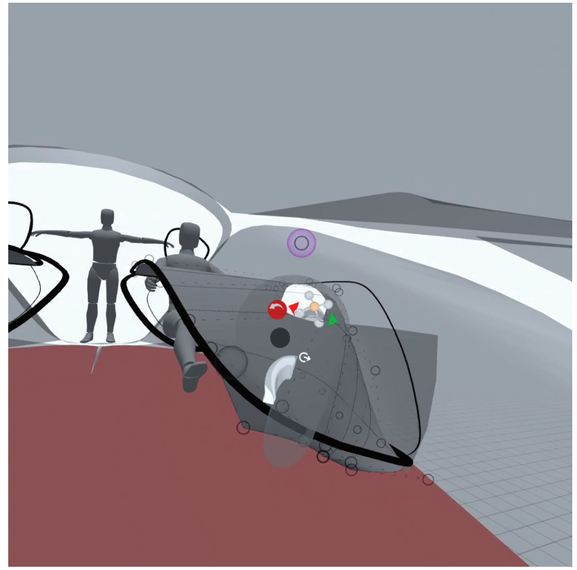
I was fortunate enough to employ the process of ideating in Virtual reality using Gravity sketch and it was a very new and different experience for me and have listed down some of the personal observations and critiques after using it.

- One of the initial thoughts using gravity sketch was that sketching in 3 dimensions made my brain think in a different way. Since I was not sketching in 2D and then translating the sketch into a 3D surface, I felt that the original essence of the sketch was not lost and its stylistic sense was preserved
- Using Gravity sketch in VR, I was able to scale the sketch into different sizes instantly. Not only this helped me to understand the scale of my vehicle and view it in 1:1 Scale, but also with the scaling aspect I could detail different parts of the vehicle very easily which created really interesting results.
- During the modelling process of the vehicle reviewing it in virtual reality was really helpful to rectify mistakes and make changes at every stage making it a very efficient tool in the design process
- The tool was most helpful to me while designing the interiors of the vehicle as I could literally be inside the vehicle and design things around me. This made my interior design process very fast and efficient and I could find the right balance between overall size and maximising the interior space.









Using Generative Design

Autodesk Fusion 360

To try out generative design, I used Autodesk Fusion 360 to experience this relatively new design method. There was a bit of a learning curve to it. some of the observations are listed below

- One of the most striking features of generative design software is the sheer number of iterations it can generate in a given timeframe with different permutations and combinations of properties and features.
- Generative designs are also "practically creative" as all the manufacturing constraints are factored in by the software which makes it a very efficient way of designing
- Its very time efficient which shortens the design process duration and helps the designers to focus on other important design factors such as human or practical engagements of designs
- One of the major challenges I faced using generative design was a very extended learning curve which was not very ideal process to complete my FMP in the given time
- Also since it heavily focussed on optimizing geometry, aesthetically designers have very little to no control over the forms generated which might not be ideal in every situation

Structural Study 1 - Outcome 2
83 %

Properties	
Status	**Converged**
Material	**Aluminum AlSi10Mg**
Orientation	-
Manufacturing method	**Unrestricted**
Visual similarity	**Ungrouped**
Production volume (pcs.)	-
Piece part cost	
Range (USD)	-
Median (USD)	-
Fully burdened cost	
Range (USD)	-
Median (USD)	-
Volume (mm^3)	**73,385.77**
Mass (kg)	**0.196**
Max von Mises stress (MPa)	**0.1**
Factor of safety limit	**2**
Min factor of safety	**2,119.48**
Max displacement global (mm)	**2.851e-4**

Structural Study 1 - Outcome 3
61 %

Properties	
Status	**Converged**
Material	**Aluminum AlSi10Mg**
Orientation	**Z+**
Manufacturing method	**Additive**
Visual similarity	**Ungrouped**
Production volume (pcs.)	-
Piece part cost	
Range (USD)	-
Median (USD)	-
Fully burdened cost	
Range (USD)	-
Median (USD)	-
Volume (mm^3)	**76,405.5**
Mass (kg)	**0.204**
Max von Mises stress (MPa)	**0.1**
Factor of safety limit	**2**
Min factor of safety	**2,079.51**
Max displacement global (mm)	**3.065e-4**

Structural Study 1 - Outcome 4
43 %

Properties	
Status	**Converged**
Mat...	**HP 3D HR CB PA 12 (with HP Jet Fu...**
Orientation	-
Manufacturing method	**Unrestricted**
Visual similarity	**Ungrouped**
Production volume (pcs.)	-
Piece part cost	
Range (USD)	-
Median (USD)	-
Fully burdened cost	
Range (USD)	-
Median (USD)	-
Volume (mm^3)	**73,351.13**
Mass (kg)	**0.073**
Max von Mises stress (MPa)	**0.1**
Factor of safety limit	**2**
Min factor of safety	**237.39**
Max displacement global (mm)	**0.02**

Structural Study 1 - Outcome 5
23 %

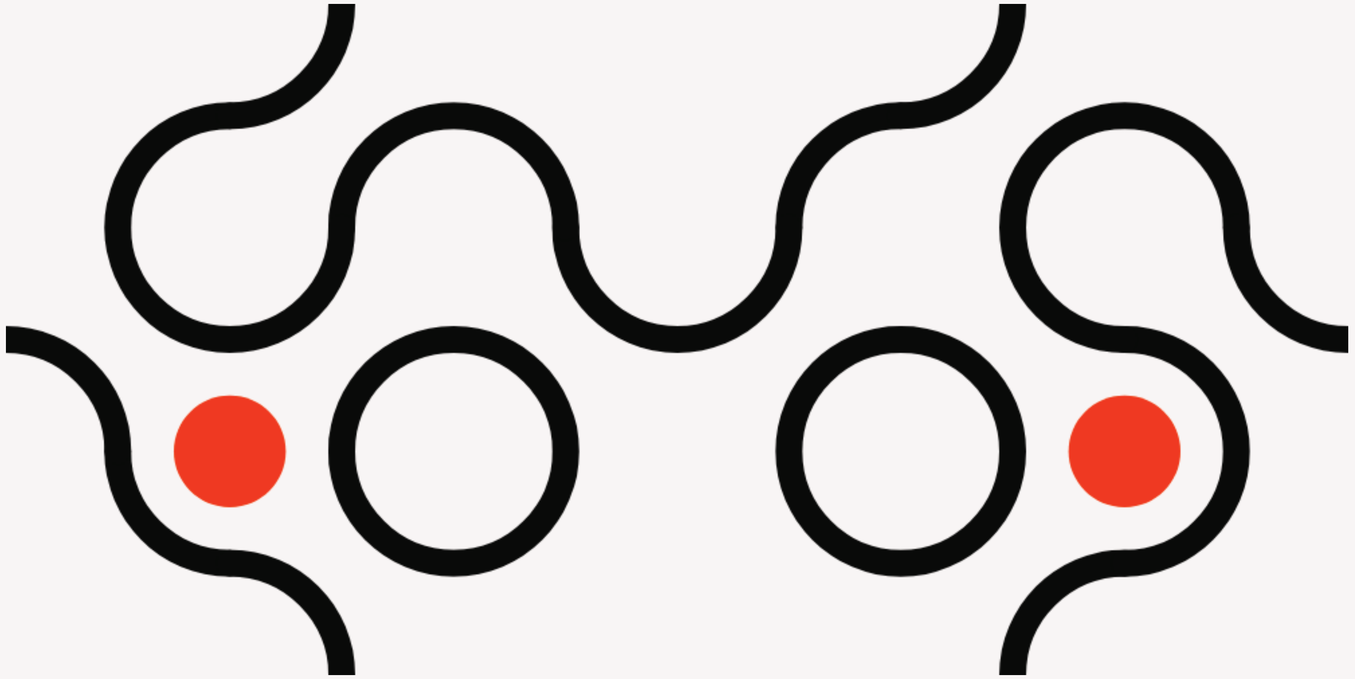
Properties	
Status	**Converged**
Mat...	**HP 3D HR CB PA 12 (with HP Jet Fu...**
Orientation	**Z+**
Manufacturing method	**Additive**
Visual similarity	**Ungrouped**
Production volume (pcs.)	-
Piece part cost	
Range (USD)	-
Median (USD)	-
Fully burdened cost	
Range (USD)	-
Median (USD)	-
Volume (mm^3)	**76,233.65**
Mass (kg)	**0.076**
Max von Mises stress (MPa)	**0.1**
Factor of safety limit	**2**
Min factor of safety	**236.77**
Max displacement global (mm)	**0.02**

Exploring Generative Arts

OpenProcessing

https://openprocessing.org/

- Openprocessing is an online platform and a creation tool to create generative art
- It requires the user to have the ability to code the algorithm which then generates artworks following those codes
- unfortunately due to time contraints i coudn't learn to code to generate desired art pieces but this platform also provides a lot of opensources codes which could be used to generate art
- This tool was pretty usefull indirectly to generate graphics for my final presentations and also for this report



https://openprocessing.org/sketch/1189013

Conclutions

Overall Conclutions

- On the study of secondary data pieces of literature available in the library, books and periodicals it was very clear that the Role of automotive design has undergone big change/ evolution over years. In the interaction with the field experts, every person has agreed to this statement. Not only our powertrains are changing but these new-age tools create a lot of new possibilities of exciting new design in the future
- On a personal level using these tools and approaching this project in a very experimental manner was a very unique experience. a lot of these tools saved me a lot of time but again that time was spent learning to use these tools and finding ways to integrate them into the design project
- According to me A.I It is still in its infancy but the tool has great potential to revolutionize the way we design vehicles and could make the overall process very time efficient.
- There is no denying that we are moving towards the age of algorithmic design and most of these design tools helps the designer to open up beyond his/her mental capacity to generate and inspire new and bold designs way faster

Limitations of study

- Following free trial packages were used for various AI / design tools
- New world order and uncertain unsafe environment posed limitations
- Time, scope and responses from experts
- My current abilities

Further scope of research

- Machine learning is learning from humans so will we be stuck in a creative loop
- How will automotive design will be shaped in the future if it gets easy enough for common public
- How will automation in design affect future vehicle segments

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