

Role of Artificial Intelligence Text-to-Image Tools in Design Education

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Abstract – *Unlike belief and knowledge, intelligence is not information: it is a process, or an innate capacity to use the information to respond to ever-changing requirements. Through assiduous practice, one can become more skilled. By diligent study and careful observation, one can become more knowledgeable. But creating machine intelligence, however, poses challenges of an altogether different order. Similarly, developing algorithms and designing a model to train the Artificial Intelligent software for generating concepts constantly requires attention to feed the software with appropriate data, although giving less assurance of predictive and accurate results. The assistance given by these tools is used by many designers across the world to explore the creativity of these software models. This paper aims to study and explore the rate of desired idea/concept generation with the help of Artificial Intelligence based computer software and understand its role in conventional design education. The study will use a relative comparison between the produced outcome and the expected ones as a parameter to investigate the efficiency of artificial intelligence-based tools. Design professionals and students that employ artificial intelligence-based software for developing concepts to speed up the concept generation process in their design process will be considered for the qualitative research stage.*

Keywords: *Artificial intelligence, creativity, designer, education, algorithm*

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I. Introduction

For many designers, exploring creativity with different mediums, particularly newer ones is an integral element of their lifestyle. The introduction of new digital tools out there has led to the accelerated development of products (both tangible and intangible) with better designs. Similarly, now Artificial Intelligence, the newest explorative medium is enabling artists to create realistic artworks and designs with AI image generation. Despite its rapid development, artificial intelligence (AI) has not been deeply applied in art teaching (Kong, F. ,2020). AI-based image creator model uses Generative Adversarial Network or Nets (GAN), invented in 2014 by Ian Goodfellow, who was a Google researcher. It uses two neural networks; one that creates an image and another one that judges, based on real-life examples of the target image, how close the image is to the real thing. After scoring the image for accuracy, it sends that info back to the original AI system. That system learns from the feedback and returns an altered image for the next round of scoring. This process continues until the scoring machine determines the AI-generated image matches the “control” image (Bernard Marr,2021). Certain programs such as DALL.E developed by OpenAI and Imagen by Google enable the artist or a non-artist person to create some beautiful artwork. The algorithm behind this program mainly works on transforming the text into a composition of images. The transformation of text to image derives a couple of iterations until the best representation is achieved.

The purpose of this study would be to understand: How does the application of Artificial Intelligence-based tools play a role in developing concepts in the design process? Explorations done in the concept/ idea phase will be used further to derive desired results. The research will also draw a scope for certain requirements needed in AI tools for the refinement of outcomes.

II. Research Problem

The Text-to-picture services are sophisticated, identifying the most important parts of a user’s prompts and then guessing the best way to illustrate those terms (Jordan Novet, 2022). For the program model to work as expected, the AI chips must be trained with some hundred million internal image-text pairs in addition to outside data.

The following study investigates –

1. What is the potential of artificial intelligence software in design education?
2. How is the AI software assisting the design students to simplify their design processes?
3. In what ways is the AI model useful for the concept generation stage in the design process?
4. What is the possibility of an AI model overriding human intervention in design?

III. Literature Review

In recent years, several researchers have investigated training multimodal AI models: systems that operate on different types of data, such as text and images. In 2021, OpenAI announced CLIP, a deep-learning model that can map text and images into the same embedding space, allowing users to tell if a textual description matches a given image. This model has proven effective at many computer-vision tasks, and OpenAI also used it to create DALL-E, a model that can generate realistic-looking images from text descriptions. CLIP and similar models were trained on a dataset of image-text pairs which are scraped from the internet, similar to the LAION-5B dataset.

While end-user applications of the generative method remain largely out of scope, they recognize that the potential downstream applications of this research are varied and may impact society in complex ways.

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Figure 1

A cute corgi lives in a house made out of sushi



Note. Image source: <https://imagen.research.google/>

On the COCO benchmark, Imagen achieved a zero-shot FID score of 7.27, outperforming DALL-E 2, the previous best-performing model. Using DrawBench, the Brain team evaluated Imagen against DALL-E 2 and three other similar models; the team found that the judges "exceedingly" preferred the images generated by Imagen over the other models.

Figure 2

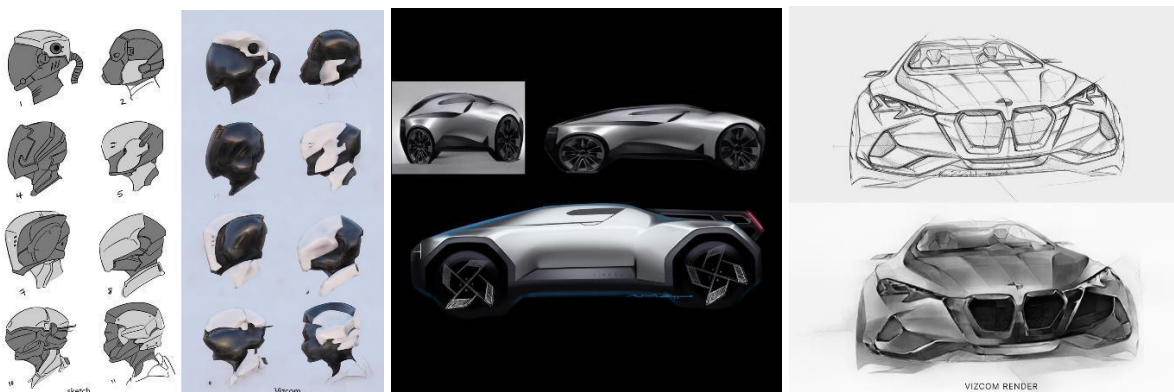
AI generated Text-to-Image from words: Future La La Land



Note. Image source: <https://creator.nightcafe.studio/>

Figure 3

Sketch to render (S2R) development using Vizcom, a web-based AI tool



Note. Image source: <https://www.vizcom.ai/>

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Many Automotive Designers are experimenting with AI software tools such as Vizcom to generate different concepts. According to them, the amount of time spent making realistic renders is less as the AI tool helps them build volumes to the product within no time, and further refinement gives a clear idea about the concept.

IV. Theoretical Framework

The Design Thinking - Key theoretical principles include the Design process; Design thinking, Word dataset; Concept development phase; concept iteration till the desired results are derived. For the research, the study of Design thinking in the learning activity is crucial for the designer to develop a mindset of thinking progressively and creatively. Interest in how designers work and think progressively has moved from the purview of designers and architects to the field of management and business administration (Elsbach & Stigliani, 2018). Both communities emphasise iterative processes, collaboration, speed of concept modelling and testing through prototyping, and interaction with users. Johansson- Sköldberg et al. (2013) describe this difference in terms of “designerly thinking” vs. design thinking:

“A simple way of discussing the discourse of design thinking is as two distinct discourses: One we call ‘designerly thinking’. This refers to the academic construction of the professional designer’s practice (practical skills and competence) and theoretical reflections on how to interpret and characterise this non-verbal competence of the designers. The other discourse is ‘design thinking’. We reserve this term for the discourse where design practice and competence are used beyond the design context (including art and architecture), for and with people without a scholarly background in design, particularly in management. ‘Design thinking’ then becomes a simplified version of ‘designerly thinking’ or a way of describing a designer’s methods that is integrated into an academic or practical management discourse.” (Johansson-Sköldberg et al., 2013, p. 123)

The Design Thinking theory would be useful in evaluating the terms onto which professional designers practise and try to connect the processes they use to obtain the outcomes with their traditional techniques. Thus, it will assist in bringing up the question of How learning from a hybrid approach in design education can become more efficient? Implementing AI-based tools in conjunction with conventional design processes can help bring out more possibilities and scope to study the extent of intervention of AI tools’ creativity in Design as a whole.

V. Previous studies

The first interaction of photographs and words, and sentences by employing Artificial Intelligence was achieved by Andrej Karpathy- A computer Scientist in 2015, It was an Automated Image Captioning model. After that many architectures were developed to generate images from words. The technique behind this model was based on letting the model learn on its own. To start with, these models were trained with millions of images over the internet as primary data. Leon A. Gatys et al. work on the artificial system based on a Deep Neural Network that creates artistic images of high perceptual quality is an algorithmic understanding of how humans create and perceive artistic imagery. Huiyu Huo and Feng Wang’s study on AI-based poster layout design in visual communication by working through the LeNet architecture using the golden ratio and trilateration parameters to produce multiple optimised templates for making good visual design layouts in graphic design leads us to understand the systematic approach for desirable outputs.

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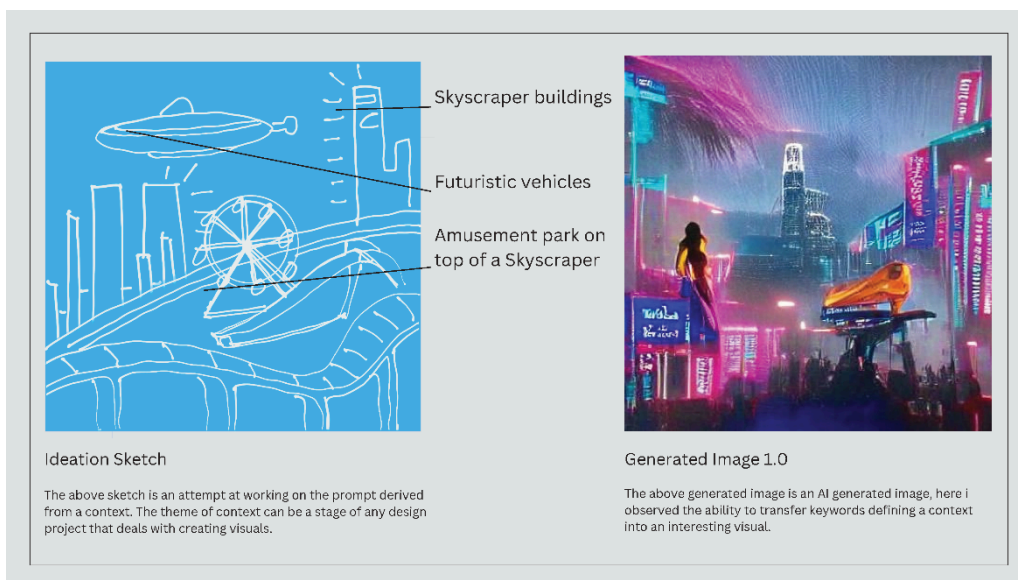
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VI. Design of Experiment

To understand the method of combining AI image-generating tools with the Design process, a series of techniques were practised. The challenge was to design an activity which is easy for the design students to understand and also work out efficiently. So, to get a hold of it, a simple method was developed first-hand. A stage of the design process was stimulated to develop a concretized theme. After establishing the context, specific keywords were jotted down in the ideation stage. These keywords were further translated into low-fidelity sketches in conjunction with forming short sentences which described the idea and the intent to a far more extent. The entities in the sketches were then labelled for better understanding and relative comparison. Upon completion of this stage, the same text prompt was used to feed to the AI model. For the experiment Night-Cafe, an AI Image generator was used. Slight modifications were made in the text prompt to generate more iterations. After generating a set of images, the criteria for selecting the images were none other than choosing the one that represents the intent closely, critical assessment of images led to narrowing down the selection. The AI model allowed using several visual styles, although the intent was not to create different visual styles. Certain visual styles were shortlisted only based on pragmatic thinking.

Figure A

Design of research: Trial and error method activity sheet 1.0



VII. Activity with Design Students

At the time of this research, the participants were familiar with only a few online AI image-generating models, so there was no obligation of using a particular online AI image-generator. The software used for the activity were: Mid-Journey, Dall-E, NightCafe, VIZCOM. During the exercise, an environment of the design process was simulated, and the participants were asked to follow their usual practice while working on the project. A set of keywords was provided to the participants for reference purposes. The keywords were selected by a thorough analysis of the trending words in the Discord servers of AI image-generators. Art movements that happened in the 20th century were taken into consideration for making keywords. The words from film and art genres were added to the list as well. The purpose behind using the keywords was to provide cues to accelerate the concept generation stage only after the design premise was set up. Participants were asked to sketch their ideas and paste them on the left-hand side of the activity sheet followed by pasting the three generated images that are close to the design intent, followed by selecting 1 from 3 images and describing it thoroughly.

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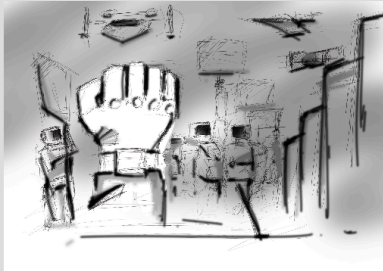
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Figure B

A Vintage-style painting of people in a riot wearing exoskeleton suits, and the atmosphere air is unbreathable and the jets are hovering in the air.

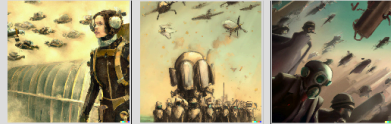
Name : **Mayank verma**
Discipline : Transportation and automobile design

Ideation Sketch:

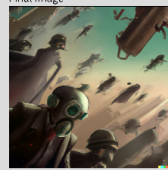


Description of the sketch:
Prompt - A vintage-style painting of people in a riot wearing exoskeleton suits and the atmosphere air is unbreathable and jets are hovering in the air.

AI images: (3 best images)



Final image



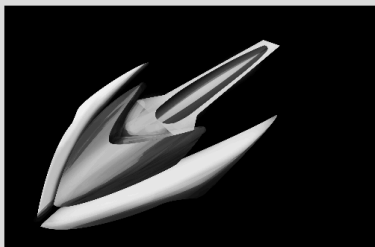
Give reason for selecting this image
The image resembles more to the original idea of mine which take my imagination to good render and in realizing the visuals of the scenario and the possibilities.

Figure C

A Sci-Fi spaceship design for the year 2700, producing surrealist, hyper-realistic renders.


Name : **Amit Ranjan**
Discipline : TAD

Ideation Sketch:

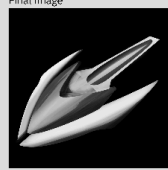


Description of the sketch:
Prompt - sci-fi spaceship design for year 2700, Surrealism hyper realistic renders

AI images: (3 best images)



Final image




Give reason for selecting this image
AI didn't generate the image of the spaceship I had in my mind. Symmetrical fins and more of an alienist type of ship which gives a feeling of not belonging to earth.

Figure D

Tornado Vehicle

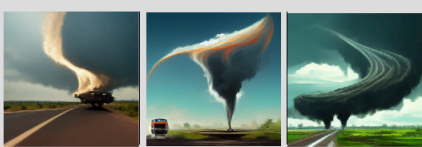
Name : **SASIDHARAN R**
Discipline : TRANSPORTATION AND AUTOMOBILE DESIGN

Ideation Sketch:

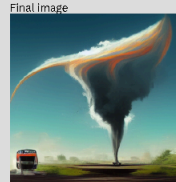


Description of the sketch: Tornado vehicle
Prompt - Concept: design a vehicle that can travel in tornado. Vehicle form should look like a form that should flexible to travel in the tornado.

AI images: (3 best images)



Final image

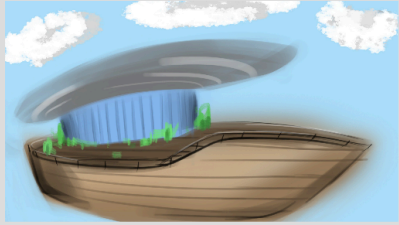


Give reason for selecting this image
This as the same as the tornado and it follows the tornado path to travel. The vehicle form are similar to the spiral of the tornado and this as been used for smooth transition to travel. This look like a spiral cone slide down in cloths which travel smoothly from top to bottom.

Figure E
Skyscrapers on a moving ship in the sky


Name: **Priyang Priyadarshi**
 Discipline: TAD

Ideation Sketch:



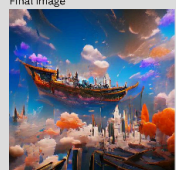
Description of the sketch:
 Prompt - "Skyscraper on a moving ship in the sky"
 Skyscrapers in the sky ship sailing through the winds. Moving continent. Moving State.

AI Images: (3 best images)
NightCafe AI (Login Necessary)



Coherent Stable Artistic

Final image



The objects are visually merging well with the surrounding objects. good differentiation between sky and land and a ship in the sky particularly.

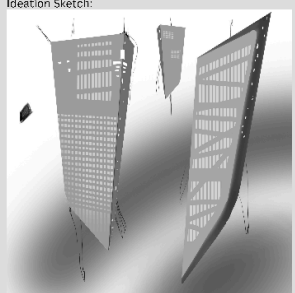
The skyscraper city, that is modern and cyber-punk theme is glowing inside the shop.

The city below is also influenced by the post apocalyptic scenario of the new world.

Figure F
A vertical levitating infrastructure which can travel in air as well.


Name: **Bhushan Naik**
 Discipline: TAD

Ideation Sketch:




Description of the sketch:
 Prompt - Vertical levitating infrastructure which can travel as well
 While making this illustration I thought of modular infrastructure and transportation together. so I made combination of both infra and transport through this illustration. In this, builds can levitate and travel as well. To gave depth of build I have added some square patches which looks like windows and to show some electric connection to overall concept there are strands looks like wires

AI Images: (3 best images)



Final image

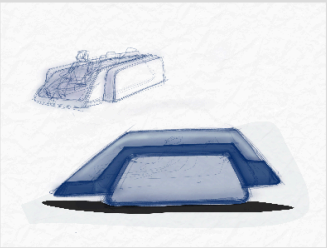


Give reason for selecting this image
 As per illustration we can see I wanted to show vertical infra , and levitating as well. with some kind of electric connect to it , there I have added travel word to it so in final image I can connect these all thigs

Figure G
Autonomous Futuristic hovering electric vehicle inspired by cubism movement.

Name: **Mukul Lingwal**
 Discipline: TAD


Ideation Sketch:




Description of the sketch: geometric shapes.

Prompt - **Autonomous futuristic hovering electric vehicle inspired by cubism movement**, no wheels, photo realism, octane render. sci-fi, exo-planetary

AI Images: (3 best images)



Final image

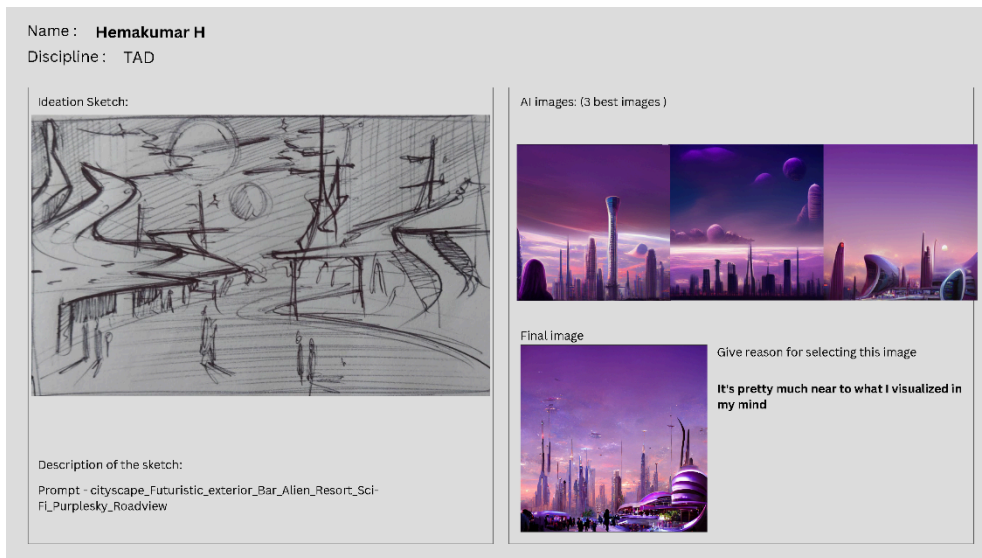


Give reason for selecting this image
 This image is really off from my initial idea but it has covered the essence of cubism, architecture and future of autonomous vehicles very well.

I wanted to capture the cubism art style and how it can be included in vehicles at the same time wanted to carrying the architectural essence.

Figure H

A Cityscape_futuristic_exterior_bar_alien_resort_sci-fi_purplesky_roadview.



Vizcom Software Activity: The intention behind this activity lies in the definition of the software itself. Design fields such as Industrial design, Automotive design, Toy and Game design, Product design, and Animation and Film making demand sketching of products, complex surfaces and characters respectively. For them sketching is the prime-most tool to express ideas in less time, so doodling is the most common exercise for making thumbnail sketches. The Vizcom software allows you to visualise your simple line drawings into a rendering.

In this activity, three students from Transportation and Automobile Design discipline and two from Product Design participated voluntarily. This exercise involved working on a concept from 1. To sketch from imagination, 2. Use of a premade sketch.

Participants were requested to do both and describe the methodology of their work.

A. Exercise No. 1.

In the first exercise, one of the participants attempted to sketch the rear $\frac{3}{4}$ angle of a cross-segment vehicle. The intention behind this low-fidelity sketch was to make a doodle of a car by blocking colours and some character lines (Character lines are the features of styling representing the brand's identity via exterior design). Certain features were sketched in a minimalistic form and let the software guess to complete it. The software was successful in building the volumes and surfaces of the vehicle. The generator settings were on a lower scale. Certain parts of the car were ambiguous to understand as they did not come out very well. Also, in the below example, the prompt sketch had no logo on it but the generated sketch had a not-so-clearer representation of the logo on the rear boot lid. It is proof that the software keeps on learning and tries to fill in the gaps in the design. This example also highlights the areas where it does not make sense, so the designer should remember that the software should understand the sketch used as a prompt. Therefore, the low-fidelity sketch should have some clarity. The software alone should not do the task of guessing and producing the results as it may lead to incomplete renders.

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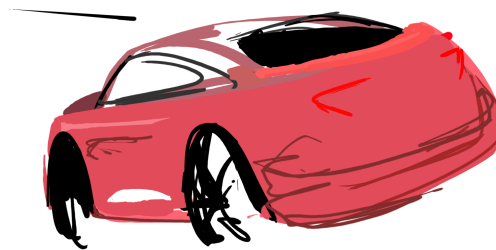
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Figure 5
Vizcom Render



Figure 6
Prompt sketch



Description:

The resulting image looks like a merger of a Mahindra EV400, a BMW Coupe greenhouse, some Hyundai Verna influence and an SUV Side body. Overall, it can be a new SUV Sedan compact concept. I was trying to make the sketch complicated enough to understand the surface, but it ended up simple in that case.

B. Exercise 2

In the second exercise, one of the participants attempted to add a sketch of a futuristic machine/ vehicle that was sketched already. The technique employed here is simple, Sketching the perspective lines, building volumes and adding some visual effects and glowing lights to the sketch. Here the intention was to obtain a convincing result. It was a trial-and-error attempt to understand how the software produces images based on a rough sketch. The generator settings were on a lower scale. All the details were enhanced and uniform with the overall geometry of the vehicle. It can recognize the illuminated entities present in the prompt sketch. Fig. 8 shows some kind of light fixed on the machine's body, but here the software has put up the same light with much more accuracy in terms of visual effect, colour and aesthetics. Roughly sketched doodles were sufficient enough for the designer to create different ideations.

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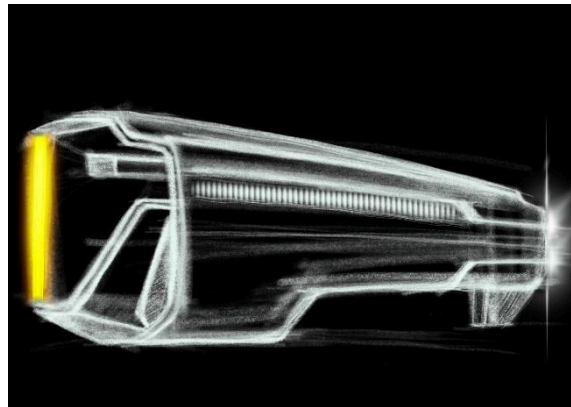
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Figure 7
Vizcom Render



Figure 8
Prompt sketch



Description:

The surfaces came out to be good, although certain features were superficial in appearance in the sketch that I could not imagine. The result goes well with the rest of the concept and enhances the rugged character of the vehicle in the side view. The possibility of generating more ideas seemed more inclusive and exciting.

VIII. Scope

The popularity of AI image generators is growing exponentially. The online content creator community has been phenomenal in accelerating creativity. Artists that work in Digital and Analogue mediums, Illustrators, and Designers whether be it Fashion designers, Graphic designers, Automotive designers, and Concept Architects have been unleashing the potential of AI tools in art and design. Experts in the field of computer science, art, design, architecture, fashion, and legislation are commenting on the speculative future that AI holds. Although this trend has ignited a series of hot debates which are based on the ethics of copyrights owning to the production of art and designs. As explained in the introduction section of this paper, these AI models are trained on a large data set of images, captions and relative textual matter, this paper does not look into the matter of copyright, plagiarism and ownership of the artwork generated from these AI models. With its growing usage and becoming known to more and more people, this technology is constantly questioned because of the data that it uses to learn and generate images. As the data set comprises millions of images, therefore the artworks of many

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famous artists and painters, as well as the painters' unique styles are also taken into training along with generic images that are on the internet. According to Computer scientists who have been working on developing AI models- there is no control mechanism to keep a check on verified data. Many corporations that are leading in this AI domain have been issuing a statement of intolerance towards unique artwork and its visual styles, therefore as a means of preventative measures, certain keywords are banned for generating artwork ultimately safeguarding authenticity.

This research study helped in gathering insights from different perspectives. To start with, the artist and designers would have to come up with a collection of better keywords, correct sentences and sometimes add words that enhance the quality of images. For every individual out there, the English vocabulary differs and might not align with the concept intent. So, there is a requirement to have a proper understanding of the keywords, and grammatical correctness. The possibility of building AI models to suit the requirements of specific domains is very dense. The year 2022 has witnessed the wave of making videos using AI, A large population of smartphones users relying on high-resolution cameras to click selfies are also using an application known as LensaAI to create beautiful self-portraits which would rather take hours on photoshop, Machine learning has enabled them to develop AI essay write-ups by using GPT (Generative Pre-Trained Transformer). Doing research and building narratives have now become a matter of seconds. Also, there is fear of loss of jobs and the replacement of professional designers, artists and writers, but many experts and trend analysts predict that new jobs will be created in place of mediocre and redundant jobs.

Conclusion

This paper was compiled based on a research study of 6 months. Although for a short duration, more research needs to be done in understanding the implementation of AI tools in the design process. The research adequately satisfied the following hypothesis - If AI text-to-image tools are employed, the Idea generation stage in the design process will be more fast-paced and flexible. Artists and designers are more likely to use AI tools and devices in their practice in the coming years. At the time of writing this research paper, Concept artists and designers were the ones to set a benchmark for the rest of the community.

Contribution

The Contribution of this research to the IDR publication's aim and scope is significant because it will potentially help in encouraging the study of Design education and the latest Artificial Intelligence tools. For the IDR publication, this paper can be a newer addition to the theme focused on Design Education and Thinking.

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