Impact of AI –Artificial Intelligence Enabled Tools on Interior and Exterior Architectural Designs

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Abstract

The advent of Computer Aided Design CAD tools around mid-1960 was evolutionary in nature. CAD software features evolved slowly and they emerged as enabling and productivity tools. CAD tools did not eliminate jobs but enriched the productivity and output of draftsmen, designers, and engineers. It facilitated the merger of roles of draftsmen, designers, and engineers by enhancing and complementing their competencies. Artificial Intelligence (AI) deals with intelligence demonstrated by computers and it is as old as CAD tools. AI as a discipline over the years had many fits and starts based on the commercial successes of products and solutions. AI experienced a severe lack of funding for many years. However, in the last two decades, AI research has been based on highly mathematical and statistical machine learning. This approach has proved highly successful and created many sophisticated solutions to solve the problems of the industry. AI is emerging as a disruptive technology that can alter the way we do things and the way business is conducted. It encompasses all intellectual tasks. AI techniques are pervasive and CAD tools are no exception. Slowly AI tools and techniques are getting integrated into CAD tools. Generative Design, Design Assistants are AI-based tools that are incorporated into CAD tools. AI tools are fast making inroads into visual arts and it will have an impact on future designs. AI tools use a data-driven approach and give design recommendations to designers based on extensive information on design trends, user preferences, and space configurations. Large Language Model- Generative pre-trained Transformer tool (ChatGPT) has the ability to produce human-like text and has the potential use for architects to communicate and collaborate with all stakeholders to produce their designs Today AI tools are available for creating floor plans, home styles, and décor. Creating visual narration for clients using Virtual reality and augmented reality. This paper attempts to study and document the key features of AI-based design tools and present samples of work done on these tools. The scope of work is not exhaustive. Work is focused on popular and readily available tools.

Keywords: AI, AI design tools, AI art, ChatGPT, Design assistants, Generative pre-trained transformer, Virtual reality.

1.0 INTRODUCTION

Since 1960, CAD tools have played a significant role in the design industry. CAD tools have become the backbone of design competency. CAD is an enabling technology that increases the productivity and quality of draftsmen, designers, and engineers across the globe. Features of CAD tools evolved slowly and organically blended with the overall skill repository of designers.

Over the last two decades, AI research has focused on mathematical statistical machine-learning approaches. This approach is very successful in developing solutions to complex industry and business-related problems. Traditional banking, Enterprise Resource Planning (ERP) applications are being AI-enabled.

Interactive chatbots, intelligent process automation, AI-enabled financial planning,

intelligent process automation, AI-infused financial planning, cyber security, fraud detection, data analysis, predictive analysis, and expert systems are a few examples of AI-enabled features in traditional software applications.

The technology industry heavily invests in AI, generative design, natural language processing, machine learning, and simulation. Millions of inventions have been patented in the last three years. These technologies promise the industry to transform routine tasks to achieve higher productivity and quality digitally.

According to industry reports, AI-assisted CAD technology is placed under the 'Accelerating' category. Technologies that are in the initial phase of development are classified as 'Emerging' and technologies that have made substantial progress are classified as 'Maturing' as classified in a 'S' curve model of Global Data Patent analytics (*Innovation in Artificial Intelligence: AI-Assisted CAD*, 2022). Related to the domain of design, 'Smart Lighting' is classified as a mature technology, and 'Finite Element Simulation' is classified as an emerging technology. This paper reports the technologies that are currently relevant to design in the form of a S-curve model.
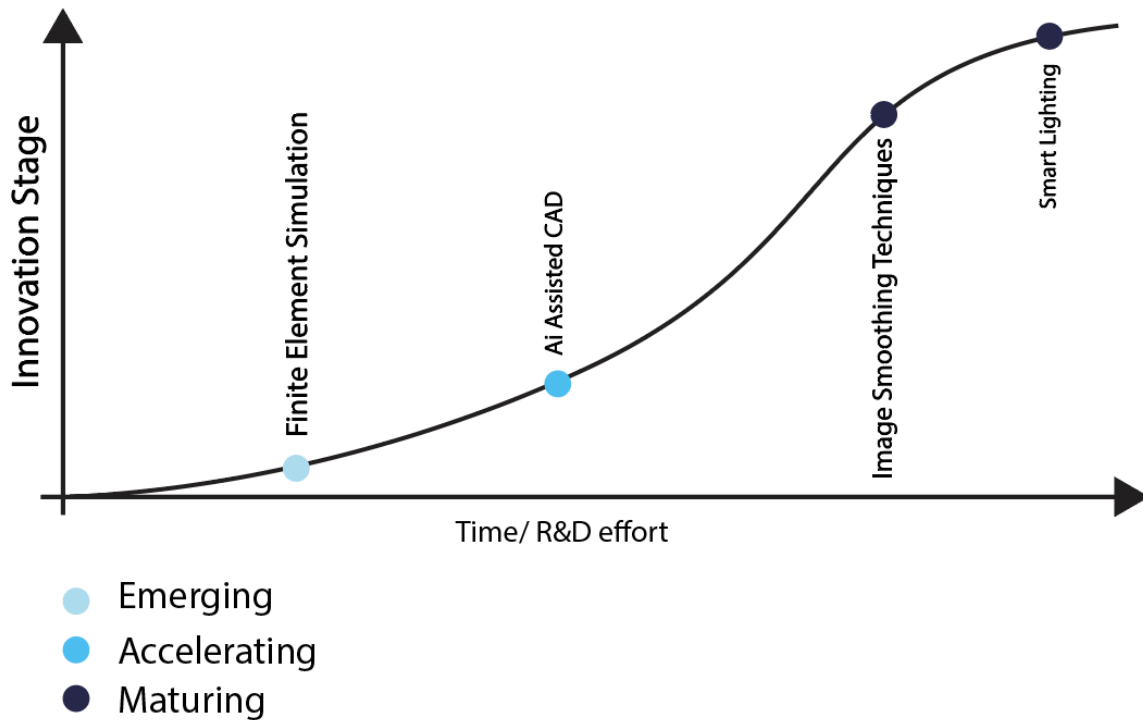

Figure 1: An S-curve graph showing the use of AI Innovation in the technology industry (Innovation in Artificial Intelligence: AI-Assisted CAD, 2022) (Kanchana M, 2023)

This paper attempts to study and report features of various AI-enabled tools that are commercially available to designers.

2.0 Design Phases

According to the American Institute of Architects, the 5 phases of a design project are Schematic Design, Design Development, Construction Documents, Bidding, and Construction Administration (Valdes, 2023).

For the purpose of the study of AI tools, this paper proposes a simple three-phase classification.

1. Pre-Design Phase
2. Design Phase
3. Post-design Phase.

Figure 2: Phases of design stage (Kanchana M, 2023)

Each phase of design requires certain features to facilitate the process. All AI tools evolve to a stage where an end-to-end solution for all design phases is provided. However, few tools excel in one or two phases. The following table documents the features needed in each phase of design

PRE-DESIGN FEATURES	DESIGN FEATURES	POST DESIGN FEATURES
Conceptualisation	CAD drawings	Project Monitoring
Sketch to concept	2D /3D Models	Cost Monitoring
Design styles as option	Rendering	Documentation
Bill of material and costing	Project Plan	Showcasing the project
Client presentation	Design defect identification	Client presentations
Client feedback capture	Autosuggestion and prompts	Design reuse/archival
Briefing to designers	Design recommendation	Virtual reality and remote demonstrations
Realistic images/staging	Standards and safety parameters	Feedback and continuous improvement

Table 1: Features that are needed in different design stages.

Design tasks can be easily mapped into these three phases. Each of the commercially available tools can be bucketed into these design phases.

3.0 AI CAD tools for Pre-Design Phase

Designedbyai.io is an AI-powered platform. Designers can convert their interior/exterior design ideas into realistic images to showcase to clients (*Designedbyai*, 2023).

AI Room Planner is an AI-powered tool for producing interior design concepts (AiRoomPlanner, 2023). Users can upload photos of a space and the tool produces rendered images of the space in different styles. Designers can use this in their discussions with clients before embarking on detailed design. The images below show how the Ai Room planner has taken an existing space and based on a few prompts it has produced different concepts. The prompts that were given for the first image Fig 3 (a), were a Living room interior design with a Biophilic theme. From what we can see, the interface has changed the nature of the space including the existing furniture, and has given a concept design to fit the theme.
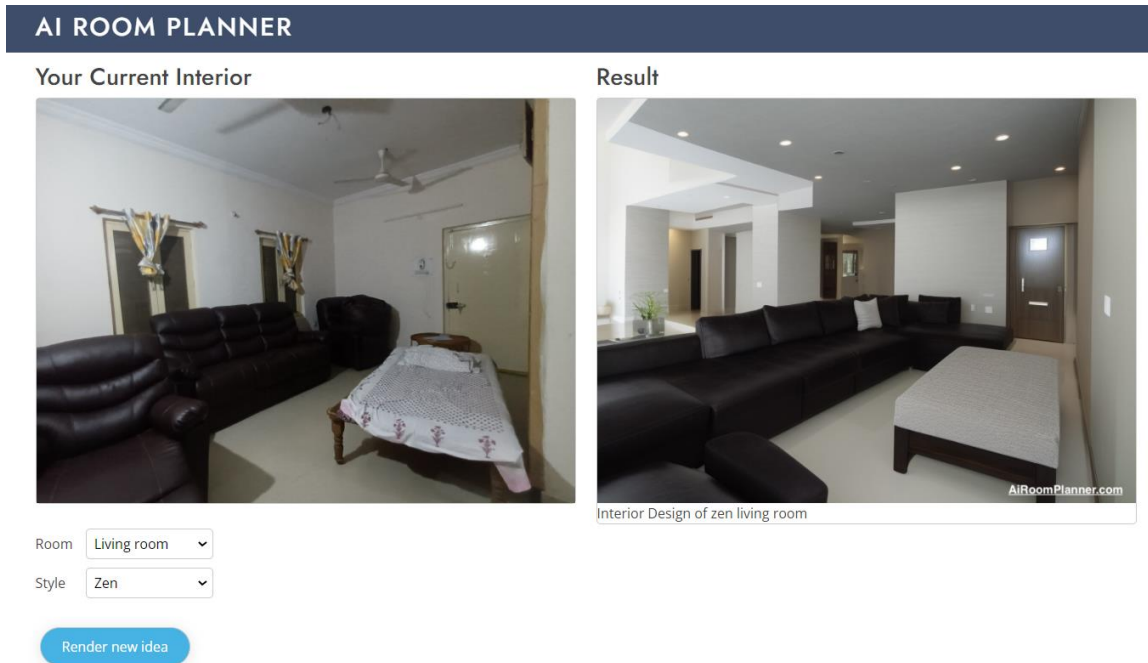

Interior Design of biophilic living room

Figure 3: (a) Living room interior design with a Biophilic theme, (b) Living room interior design with Zen theme (AiRoomPlanner, 2023)

In the next image Fig 3 (b), we can see more changes in the concept and it shows a design based on the Zen concept. The Ai has suggested changes in the structural aspect of the space in order to fit the theme. Based on these concepts, an architect or designer can make the decision on how to proceed further and add their own changes to the same concept before presenting it to a client.

3.1 AI CAD tools for Design Phase with Sample Designs

Architechtures is a generative AI-powered building design platform to help design optimal residential developments in minutes, rather than months (SmartScapes Studio, 2023).

Interior AI With this tool photos of your own interior can be used. Interior AI to transform it into a new style and get design recommendations (InteriorAi, 2023.).

ArchitectGPT is an AI-powered design tool that transforms homes and buildings into breahtaking spaces using AI (ArchitectGPT, 2023). It has many features to virtually stage your design and create images of the design.

Getfloorplan is an AI-powered online portal. Users can create detailed 2D and 3D floor plans, as well as 360° virtual tours (GetFloorPlan, 2020). Users can upload a floor plan or sketch to Getfloorplan to get 2D/3D floor plans

Dreamhouse AI is an interior design and virtual staging tool that employs AI to assist users in redesigning their homes. Users can explore design options, and personalize their spaces with extra capabilities (*Dreamhouse Ai*, 2023). Dreamhouse uses prompt commands to generate concept designs for Interior or architectural spaces.
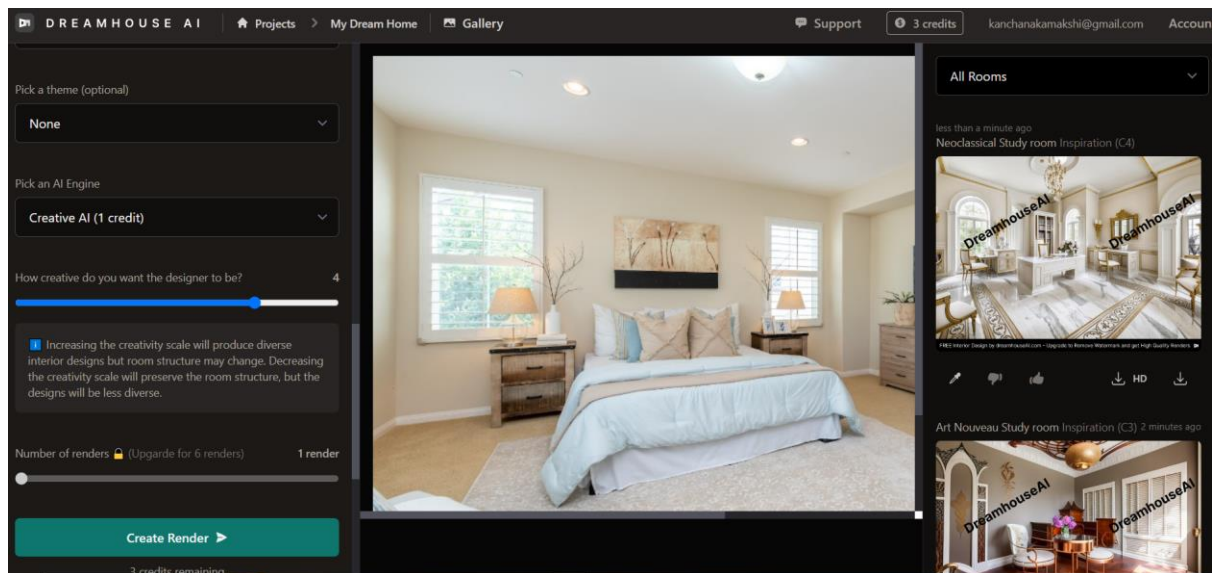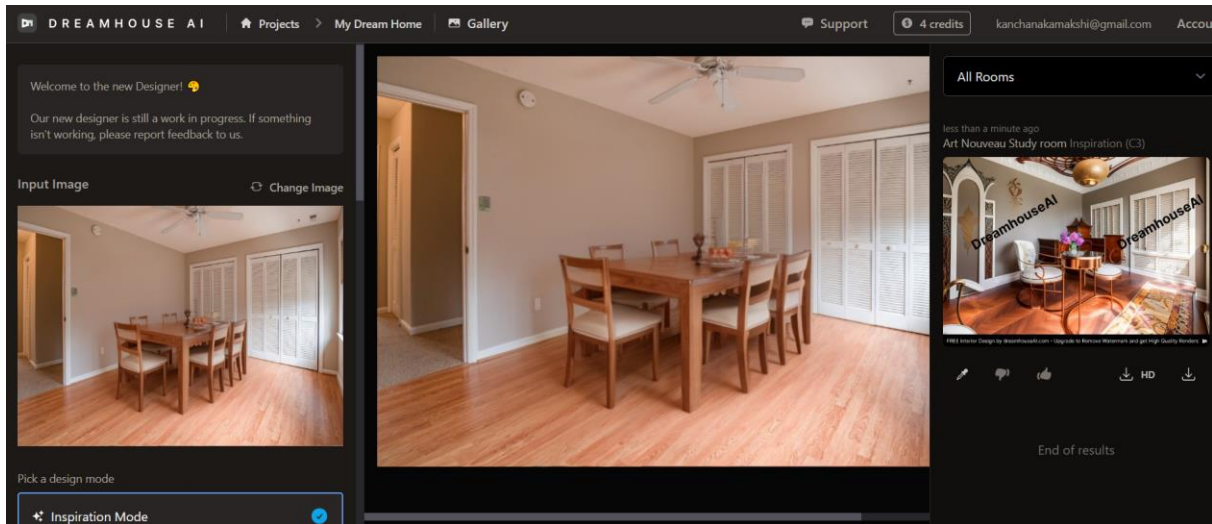
Figure 4: (a) A Demo Living room image is converted into an Art Nouveau-styled Study Room. (b) A Demo Bedroom Image is converted into a Neo-Classical style Study room, again as per prompts that were given in the interface (Dreamhouse Ai, 2023).

Finch is an AI tool that can optimize building designs. It provides feedback on building performance, helps in the detection of errors, and offers optimal solutions early in the design process (Finch3d, 2022).

DecorAI is an AI-powered interior design tool that helps users come up with new decorating ideas. Users can take a photo of their room and get up to five free design ideas (DecorAI, 2023).

ArchitectAI transforms photos and sketches of buildings, interiors, and landscapes into a new style of design (ArchitectAI, 2023). Designers can generate concepts and visualize their ideas by selecting from over 400 design styles.
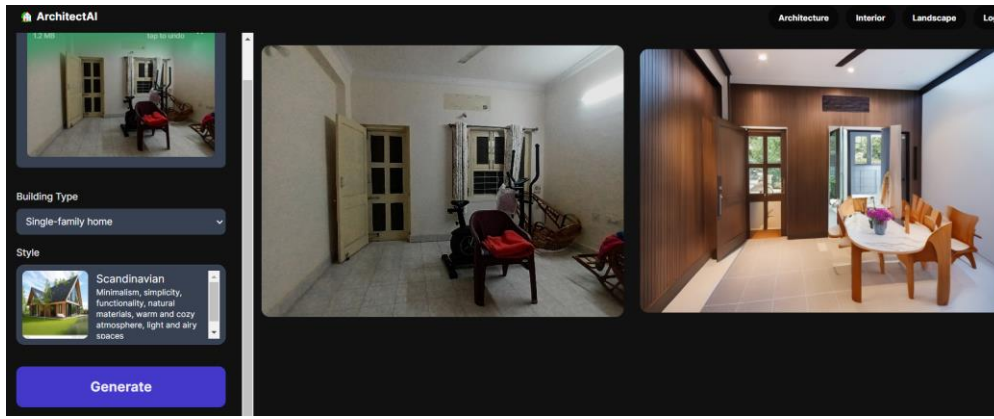
Figure 5: ArchitectAi creating a design concept for an existing bedroom space based on Scandinavian design prompts applied to the image (ArchitectAI, 2023)

Foyr Neo is an advanced AI tool for home design that combines the power of artificial intelligence, virtual reality, and augmented reality (Foyr Neo, 2023). It offers a comprehensive set of design tools for space planning, furniture selection, material customization, and lighting simulation. The advantage of using this interface is that it can instantly render the layout that was designed, and it allows the user to explore the various typology of textures, furniture blocks, and styles to create an immediate presentable render. The interface is a combination of the traditional CAD software with SketchUp included.
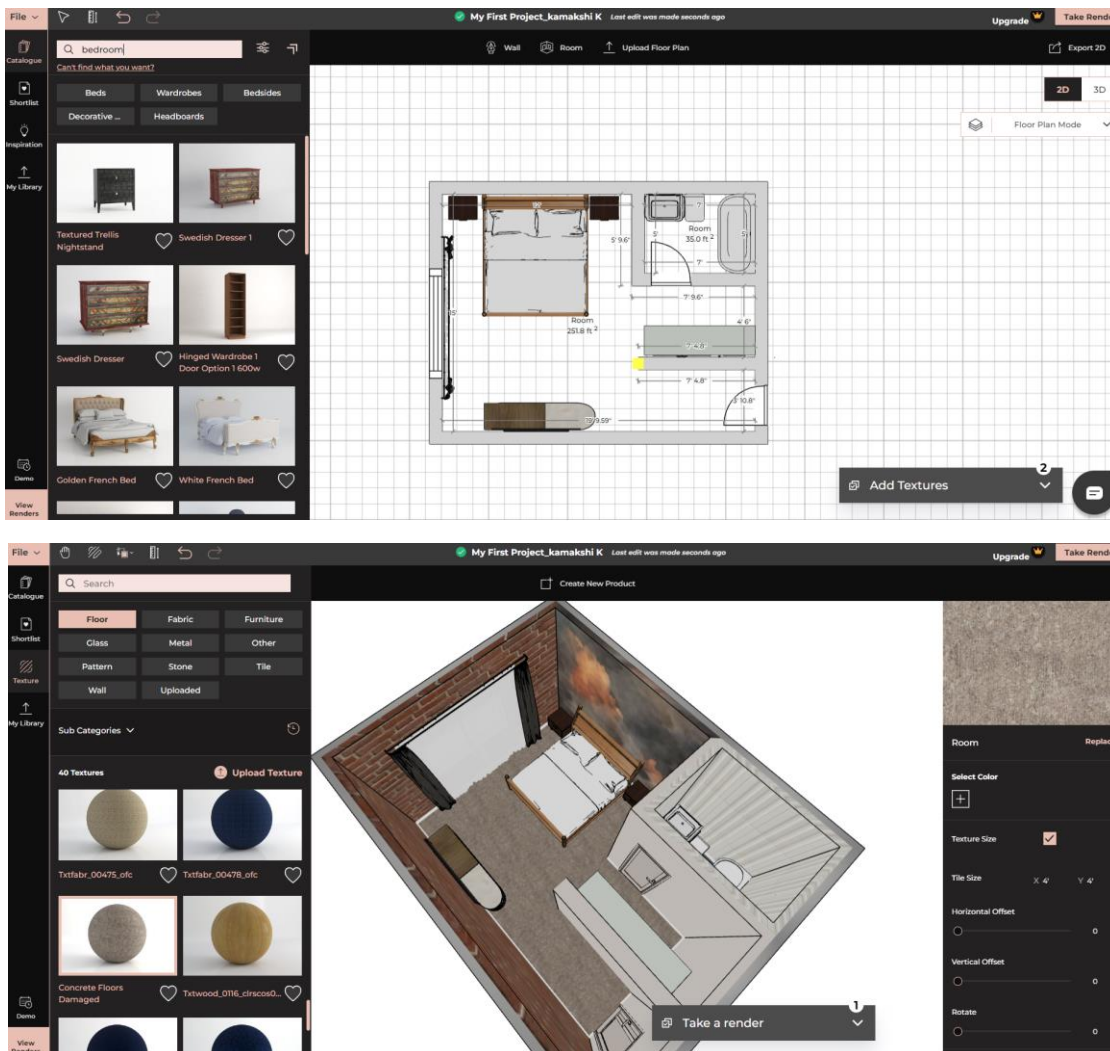

Figure 6: Room Layout designed in Foyr Neo (Foyr Neo, 2023)

Homestyler is a product from Autodesk. The platform offers a vast library of 3D models, furniture, and decor items (Autodesk et al., 2009-2023). Designers can create and customize virtual spaces. Homestyler's AI algorithms recommend design elements, colors, and styles based on user input and preferences. Additionally, Homestyler provides augmented reality features. The interface is user-friendly, similar to Foyr Neo. The users can easily navigate from 2D frame to 3D, and can easily use the tools provided by the interface. There is an option to upload existing files, which allows the user/designer to make use of their original work and make quick 3D models and renders in a short time span. Furthermore, the interface provides templates, blocks that are editable, and a whole range of customizable options that give freedom to the designer allowing them to work on personal projects efficiently.
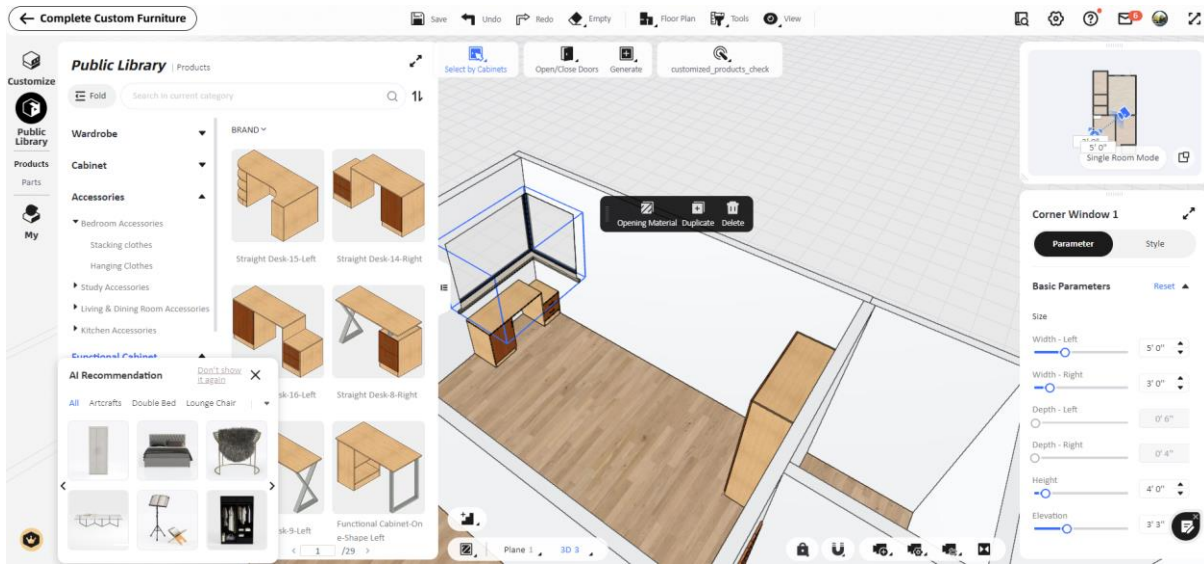

Figure 7: Uploading an existing plan layout into Homestyler and using the interface to further customize the layout using the blocks and materials textures in the app (Autodesk et al., 2009-2023)

DecorMatters offers designers a detailed catalog of furniture and decor items (DecoMatters, 2023). DecorMatters' AI capabilities assist users in selecting cohesive color schemes along with pieces. It has a social media interface so that users can interact with any community and arrive at a final design choice.

Planner 5D This is one of the most popular AI-powered home designing tools to create floor plans and interior designs (Planner 5D, 2019). It is capable of converting 2D blueprints to 3D drawings. Similar to the above-mentioned sites, Planner 5D is another user-friendly interface that allows designers to make quick designs or layouts in 2D and 3D.

Figure 8: Similar to Foyr Neo and Homestyler, layouts can be designed in Planner 5D, and existing blocks and textures are further used to render the layout (Planner 5D, 2019)

RoomsGPT Users can take a photo of their room and get a new version created based on the themes they select (RoomsGPT, 2023). All this can be done for various rooms of the house within seconds using the tool. This site allows designers to upload pictures of existing space, and prompts are added to create a design concept for the space based on one's preference. When compared to Architectai and Dreamhouse Ai, The results of the concept images are clean and of better quality.
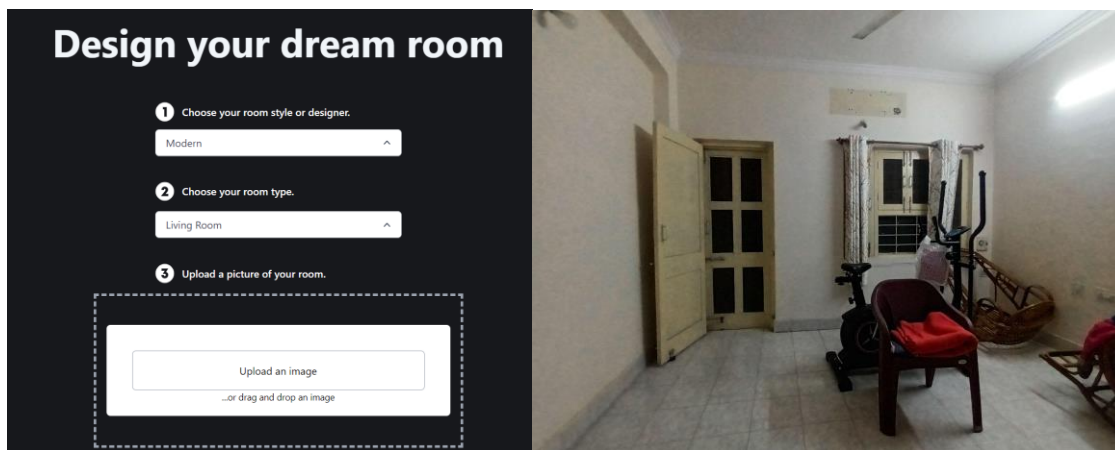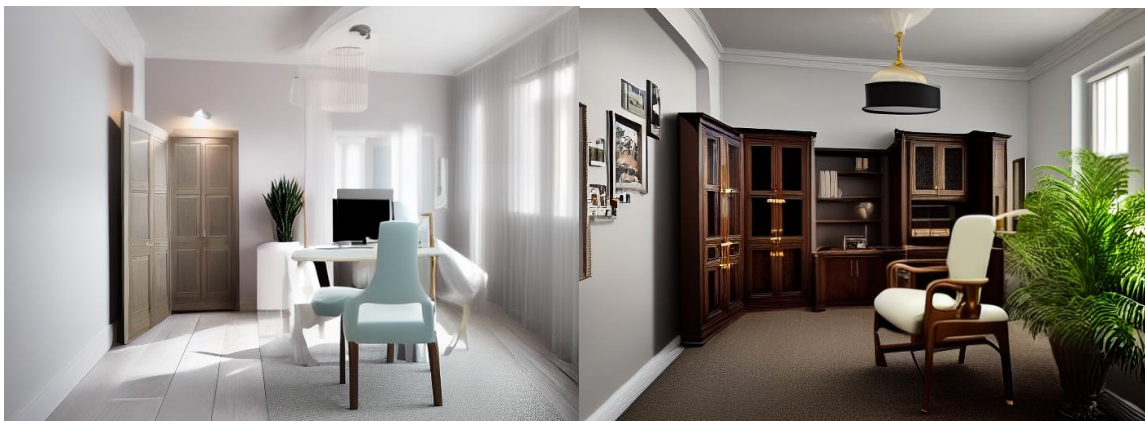

Figure 9: RoomGPT interface lets the designer upload an image of an existing space (RoomsGPT, 2023)
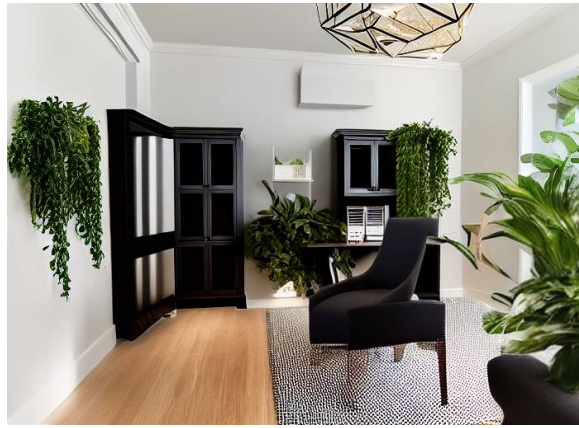
Figure 10: Design concepts generated by RoomGPT based on prompts (RoomsGPT, 2023)

Leaperr

Leaperr is an Artificial Intelligence (AI) system, which employs deep-learning, image-processing, and advanced algorithms to produce interior designs. Users can take a picture of their room, and select designs according to their choice to generate tailor-made photos for the space.

Many commercial organizations in the field of furniture and decor offer AI tools based on their catalog of products to encourage users to opt for a specific design and style.

4.0 Conclusion

AI technology has a lot to offer to designers. Tools that are trained with large repositories of designs can quickly suggest design recommendations to speed up the process of client acceptance to proceed to the detailed design phase. During the design phase, AI tools can drastically increase productivity and throughput. Repetitive tasks can be easily handled by AI tools. Checking for design errors and optimizing the design will help to reduce execution costs. In this paper, an attempt is made to test and report the features of AI tools currently available in the market. Results produced by AI tools are interesting and encouraging. Based on current data sets on which the AI tools are trained, few design options are given. However, as tools mature, it is reasonable to expect more design options and scenarios that can be presented to clients. Whether AI tools will completely make designers redundant is a philosophical question and only time will be in a position to answer the question. Based on the current state of the art, it is reasonable to conclude that AI tools are very promising and are great enabling tools to support designers to increase productivity and reduce the time to complete design projects.

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