

## Research Article

# Design Dreamer: ControlNet Based Generative AI Application for Interior Designing

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**Abstract**— The emergence of state-of-the-art technologies, which powers the process of Generative AI, is now altering the interior design landscape. This study starts with Design Dreamer, the latest application among all, which gives users an opportunity to dream about and customize their living space in a remarkable way. Design Dreamer makes it possible to implement the most advanced systems in the ControlNet family that provide best-in-class immersive and interactive experience for the end users. Users share their room photos, give a purpose of their preferred design styles and room type then they get digital replays, which are AI-generated, and they are capable of visually reflecting what a person wants to see in their room. Our approach involves a multi-step procedure, uploading images, choosing style preferences, using the ControlNet Hough Model by calling through Replicate API, and efficiently retrieving the generated image when users pose a design. Key findings of our research demonstrate that Design Dreamer significantly enhances image quality and provides a unique output each time. The significance of this research lies in its potential to leverage Diffusion and ControlNet based models for their applications in Interior Design industry.

**Keywords**— Generative AI, Interior Design, State-of-The-Art Technology, Image-Processing, Text-to-Image Generation, Image-to-Image Generation, Image-to-Image Transformation, Stable-Diffusion, ControlNet, AI-Powered Design Tools, Diffusion Models

## 1. Introduction

Artificial Intelligence (AI) is probably the most discussed phenomenon that is rapidly revolutionizing the field of interior design which happens to be amongst the ones on the rise[1]. The research of this topic addresses the ‘deep waters’ of this transformation, especially with real examples that use the intelligent control framework ‘Design Dreamer’ to capitalize on the potential of the latest generation (AI) known as “ControlNet” [2][20]. Design Dreamer is a platform designed purposely to be user friendly and with a creative touch to allow the user to interactively co-create spaces of their dreams.

Picture yourself showing an easy to make image of your room, make a choice of some design preferences for your preferred style and the type of a room and utilizing the power of AI, let Design Dreamer do its job in front of your eyes. This exhibits a visionary guidance for the interior design, using Generative AI and going beyond its usual routine. It weaves in an era where AI and humans join forces for the sake of innovativeness [3].

In its core, Design Dreamer should be imagining of the rooms in the manner that the user uploads pictures joined with the most researched 3D models and simulations. Our approach involves the creation of Design Dreamer by incorporating utilizing technologies such as Replicate, ReactJS, NextJS, Python, & ControlNet, which is an AI assisted image generation model based on Stable Diffusion [4][5]. Design Dreamer establishes a special symbiosis of user perception and algorithms offering to their stakeholders that resonates with their imagination.

This research has a generalization of Design Dreamer over the technical advancement perspectives. We examine these effects, to reflect how creative practices of people in the design community are changed, and also, how the built environment is entirely transformed by AI design. Design Dreamer resolves this issue by combining fashion voices and room dimensions into one unified solution, thus allowing the users to conveniently explore design opportunities that will reflect their unique taste and style [6].

On the other side, by means of AI it can substantially reduce the length of the lengthy design process by producing the

multitude varieties in the same number of time than before. By a part, AI enables to everyone to have the opportunity to use a professional design system. eliminating the need to pay hefty sums and consult professionals to make personalized and eye-catching interior designs [7].

In addition to this, AI in designing has many art-associated and physical burden-reducing tasks. Here it is explored how AI creates the opportunities to maximize space usage, resources allocation and facilitates the emergence of ecologically-friendly and sustainable interior designs. As in the current time, Earth faces the environmental problems, the AI driven design would be a great tool of resource efficiency and the environmental consciousness within the buildings [8]. We discuss the inner workings of the app from the point of use of user input suggestions to how they effectively work with AI in real time to bring forth truly charming and personalized creative interior design solutions. Through careful examination of the impact and the limitations of AI in Interior Design, we seek to engage with the paradigm shift that AI is causing on creativity and personal living spaces, to ensure we shape the future of design and support creativity.

**Table 1.** Timeline of Progress of Generative AI over Years

Year	Progress of Generative AI
<b>1940s-1990s</b>	Early Neural Networks are developed. Potential Image-to-Image translation techniques using convolutional neural networks (CNNs) are developed.
<b>2014</b>	Generative Adversarial Networks (GANs) are introduced, significantly improving image generation quality. Text-to-image research begins. GANs become the dominant approach for image-to-image translation tasks.
<b>2016</b>	Variational Autoencoders (VAEs) are introduced. Initial text-to-image models using LSTMs and CNNs show promise. GANs continue to be refined.
<b>2020</b>	Generative models pre-trained on large datasets show significant improvements. Text-to-image models using transformers achieve impressive results. GANs with advanced architectures like StyleGAN lead to photorealistic image generation. Early explorations of diffusion models for image generation begin.
<b>2022</b>	Generative AI models like Imagen, Dall-E 2, and Stable Diffusion achieve state-of-the-art text-to-image results. Text-to-image becomes a major focus. GANs are still widely used for image-to-image translation tasks. Diffusion models gain significant traction.
<b>Present</b>	Generative AI research continues to push the boundaries. Text-to-image models are constantly evolving. Image-to-image translation with GANs remains a powerful tool. Diffusion models are a major area of research.

## 2. Literature Review

This literature analysis is on the emerging area of Generative AI in interior designing which is generally contained on ControlNet, being one of the new technologies that was developed on basis of Controllable Neural networks [2]. It

talks about the shortcomings of the traditional design concept and use the example of ControlNet to see the prominent effect it has in developing this field.

Both CAD and VR/AR, when used in traditional methods, provide helpful facilities and at the same time lack the fluid creativity and rapid iteration rate that nowadays, designers require to design them quickly yet efficiently so that design changes can easily be implemented and visualized [9]. This issue is being redefined by including the implementation of intelligent in-built Artificial Intelligence Models. The examples of case studies illustrate a prior successful implementations of AI-aided design platforms, as well as existing AI tools that allow realistic virtual simulation of interior layouts [10]. The genealogy of Generative AI literally answers the question of how so far impressive the concept of ControlNet sounds.

We go back to the 1940s with Alan Turing's Turing Test and arrive at a machine's candid expression of intelligent conduct, which permits us to evaluate its efficiency [11][12]. The next decade introduced major breakthroughs in the field of neural networks, which have been the foundation of deep learning ever since their inception. However, the critical shift from machine learning to generative adversarial networks (GANs) happened in the early 1990s. These are innovative models which are arranged in such a way that one network produces datasets and the other inspects its realism by criticizing them [13].

There is ceaseless competition between the networks to do better and better, as finally the creation of the God-like graphics and the most imaginative plot lines by the networks is the consequence. Move ahead to the late 2000s and early 2010s, and we find emergence of differentiated and thoroughly worked modelling approaches for natural language generation [14]. They developed the basis for generating AI-based personal assistants like Siri and demonstrated the practical side of building generative AI programs to everyday life by producing it. 2010s were the decade when the use of GANs deepened into its applications and reshaped the whole market of computer graphics with improving CGI (computer-generated imagery) to be more and more realistic [15]. The recent years can be characterized by a rather big creation of the sophisticated generative models, DALL-E, Midjourney, and Stable Diffusion are among those [16][17][18]. These technologies are the frontrunners of the generation of unique stories, proof positive of the versatility of AI.

Presently, with these historical issues being the backdrop, we can begin to explore the details of ControlNet and the possibilities it is having on revolutionizing the field of interior design.

## 3. Methodologies

The development of Design Dreamer, our application for interior designing is guided by a systematic approach. We utilize the combined capabilities of Replicate, ReactJS,

NextJS, Python, & ControlNet to create an integrated system [4][5][20]. The primary workflow, as demonstrated in Figure 1, involves designing and rapid prototyping of the application interface, integration of the ControlNet Hough Model by API calls. A diffusion model and a control network are the two primary parts of the ControlNet architecture [2]. A generative model that has been trained to produce images from noise is called the diffusion model [18]. A neural network called the control network processes an input image and a prompt to generate a synthetic image that complies with the input image's restrictions and corresponds to the prompt [2][19].

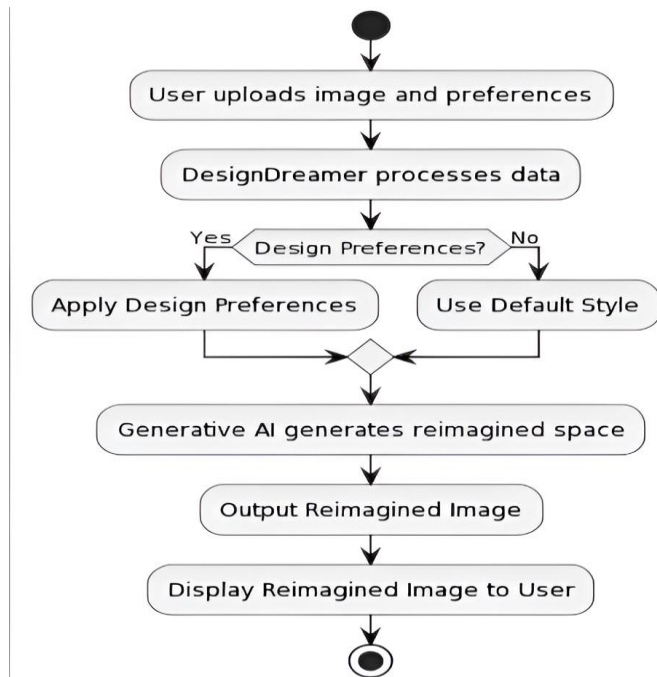


Figure 1. The Working of Design Dreamer

A Generative AI-based application for Interior Designing is more complex as they have continuous learning capability, each time the model is working to generate the output, it has to be unique every time, it also knows how to store previous output logs, and along with this based on the previous history how to generate an output in a more proactive way to the user [19].

The process is completed with the output generated by the ControlNet Model through the API call resulting in the display of the generated output. Figure 1 explains the working of the Design Dreamer and complexities on both generative and retrieval-based communication (conversation and response) via the API calls.

Further breakdown of each step followed by its sub-stages are explained in the upcoming sections.

## 4. Data Collection and Preprocessing

Achieving the data collection and preprocessing of the design details necessary for the ControlNet-based Generative AI interior design prototyping is a key aspect of our research procedure. The wide and complex reality of interior design

presents an intricate web of learning materials, but understanding and summarizing all this information is a necessity for the artificial intelligence model we are working on [19][20].

### 4.1 Data Collection

The process of our data collecting has the nature of the systematic and detailed collection of a comprehensive selection of interior design images from many diverse and reputable sources. Therefore, the variance, which is formed as a result of such diversity is very important for the creation of the robust and agnostic model of the AI that can provide creative and user-focused designs, which will appeal to most human senses. To define our profile, we build our following by posting pictures which symbolize different styles that are popular, such as professional, contemporary, minimalistic, maximalist, or modern. In addition, we plan to characterize rooms that have varied characteristics, such as bedroom, living room, and dining areas. On the other hand, we also catch photos that suggest various color combinations and models of furniture arrangements, which mirror different design decisions our clients might consider for their homes. Data collection should be followed with a strong quality control measure. It also ensures that only exceptionally sensed information out of all the training data is learned, and then used to create really well-designed outputs.

### 4.2 Data Preprocessing

However, we have a diversity of designs from which to draw inspiration, they, prior to smoothly integrating into the ControlNet architecture, need to be preprocessed. Along with data preprocessing, the model is able to acquire those essential design rules and connections in the dataset through a correct approach and efficiently learn the characteristics of the design. Here, we outline the key steps involved in our data preprocessing workflow:

#### 4.2.1 Resampling and Standardization

The resolution falls under the category of image parameters; in most instances pictures are available for download at different resolutions. For the image resolution to be uniform and faster convergence of training process, the resampling of images is done into a predetermined resolution, and thus they are all held on an equal footing in terms of quality.

#### 4.2.2 Data Augmentation

In order to further diversify the training samples and widen the range of generalization that the model could display, we apply data augmentation methods. The collection approach involves generating new variations by the process of repetition without the necessity of acquiring new data.

#### 4.2.3 Normalization

In a similar way to sampling remediation, image normalization is used to assure consistency inside the dataset. While here, we scale the pixel values of each image to a common range (for example maximum pixel value is 0 or pixel value is 1). This prevents the model from unfavorably responding to numerical instability, which may affect the model's training outcome.

#### 4.2.4 Metadata Annotation

To de-power automatically learning tasks and provide for the generation of individualized design tips, we incorporate the information metadata within the pictures. This image may hoses situated, tags with made to describe the specific design features in the image, type of room, or furniture if it is categorized as a sofa, table, bed or other.

#### 4.2.5 Dataset Splitting

We set the data we have preprocessed into three different categories, which are training, validation, and testing. So, it is through this three-way channels of information, the training of the model will be robust and the performance of the model will be truly evaluated.

Implemented by taking into account, data sets that feed into this system, we are able to gather and process massive collection of images which are converted into a structured knowledge database. The aforementioned meticulous data set powers Design Dreamer created with the help of ControlNet, which is tuned to learn the most intricate relationships between design components and user preferences thus translating them into creative and tailored to person's design solutions.

## 5. Development

The creation of Design Dreamer, our ControlNet-based Generative AI tool for interior decorating, could be viewed as a collaboration of the latest technologies that have been applied to put the user-centrism as paramount [4][5]. Lets take a look at the pivotal aspects which interactively result into an impeccable and insightful design and will benefit the end user.

Figure 2 navigates through the flow of data and the systematic working of Design Dreamer as it creates visually stunning designs for your dream spaces.

#### 5.1 User Interface and Experience (UI/UX) Design

The interface of Design Dreamer is made to be interactive and accessible, as it is one of the main components of our solution. By deploying ReactJS or NextJS framework for a reactive interactive user interface which encourages exploration and creativity. Tailwind CSS can provide a maximum visual appeal through the utility approach, which means the styling would easy to manage and delivered a consistent UI. The UI caters to the beyond the objective looks, but also the functionality aspects, through publishing of reference images and giving design recommendations; all in the aim to make the users the master of their creation and simplify the creative process.

#### 5.2 Backend Development

We build up the full potential of NodeJS and ExpressJS to have a server designed with robustness and capable of handling the request and responses, especially with the API [4]. This is the key enabling intermediary that promotes the communication with Replicate's Jagilley Control-Net Hough model, the basis of the applications' design output generation [21].

#### 5.3 Data Handling and Security

Data integrity impact and security are the foremost considerations. We use TypeScript on all parts of the application. Not only does it improve safety controls but it also keeps the code secure. This method protects from user's mistakes and also ensure the program operates well in the end.

#### 5.4 Integration and Testing

The smooth interaction and harmony between the front-end and back-end, matter the most to deliver an enjoyable user experience, which is made possible by carefully combining the software layer that establishes a smooth communication channel for operations ensuring impeccable operations. With the help of strict testing methodologies, having both unit testing and integration testing, the working of each component is confirmed, along with the entire system operating as a synergy. Utilizing this multi-faceting system guarantees robustness and user-friendliness in the application software [20].

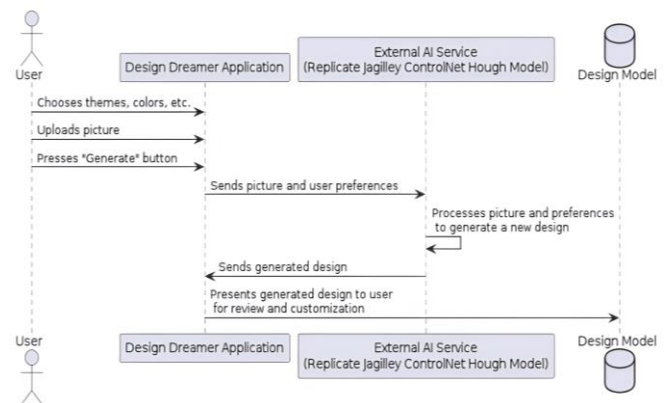


Figure 2. The Flow of Data in Working of Design Dreamer

However, while the mentioned technologies mentioned are quite robust, it shall also be noted that alternatively Python can be very effective for backend development and the Streamlit library can be utilized to make the front-end process clean and simple.

The foregoing careful arrangement of these different trivial things will become one that can produce a useful software application which helps users to materialize their design ideas. The control algorithm of ControlNet is the crucial capability situated in the heart of the system, plus the ease of use for a common use, jointly offer a new way of designing interiors.

## 6. Results

The output of our UI inspection of Design Dreamer, an advanced Generative AI application using a cutting-edge ControlNet technology, provided some really amazing and versatile discoveries that helped in demonstration of the adequacy of this tool in defining the next generation of interior design. Here we go over main functionalities evaluated that include user feedbacks and all-round performance measure.

### 6.1 Enhanced Design Exploration

Design Dreamer hands customers' hands to work with their designs, allowing them to explore the world deeply. The system-users experiments showed the number of design concepts generated increased significantly with much variety compared to tradition approaches. With the new openness that comes with this way of thinking, a more holistic process of design possibilities occur where each interaction opens a door to discovery, which inevitably leads to innovation and originality [7].

### 6.2 Fidelity and Realism

The main element that makes Design Dreamer unique is creating highly detailed 3D models and photo-realistic images[21]. Users' feedback was always helped by the software in rendering full-fledged photo-realistic renditions, allowing professional designers to look at their concepts in a fully interactive manner. This immaculate adhesion between our thoughts and practice among designers not just helps in the quick idea representation but also builds a trustworthy base [18].

### 6.3 User Centric Control

Design Dreamers is one of the many strength, wherein the character controlling mechanisms are gameplay-driven and user-centric. Thanks to the ControlNet functionality, customers trusted the iterative approach and described their experience of modifying the design concepts as successful, with most of them expressing a high degree of satisfaction. The designer thus is given the power of control in a granular level to produce the preferred design look, while still keeping the ownership of the creative process [3].

### 6.4 Style and Consistency

Designer Dreams master creativity that results in designs that are developed accordingly with specific styles and building design consistency throughout a project. When user testing was done, it turned out the application could vibe with user-preferred styles like mid-century modern or minimalism and combine all these into the harmonious and stylish interiors.

### 6.5 Integration and Workflow Efficiency

One of the crucial issues to note when building the development process is seamless integration with existing design workflows. Feedback from users illustrated a conclusive improvement in workflow productivity among members from the usage of the Design Dreamer tool. The app has a best of the breed UI that complements the designers' software environment and allows to use its functionalities as an integral part of their business processes without major obstacles.

### 6.6 Challenges and User Insights

While users gave majority of mixed reviews but in fact these reviews actually undermined a lot of the good which Design Dreamer seemed to do, some challenges were recognized. This main concern was about the lack of noticeable details, especially in complex materials. Those findings that came from the more tests of this type really informed how the next phase of our development efforts were planned in order to

allow many more materials to be flawlessly rendered by the software.

In conclusion, Design Dreamer's evaluation lead to the idea that this application can prove to be a revolutionary concept in the interior design realm. Through cultivating the exploration in depth, delivering emotionally engaging visualizations and supplying the user control over the design options at hand, Design Dreamer can turn into an important instrument for the professional designers and amateurs alike. The feedback from its users not only showed its strong points but also the emerged for future consideration during the development of the app, with additional functionalities in the late versions. As Design Dreamer gets more advanced by somehow capturing the user feedback and merging it into the system, it explains a future where AI serves as a competent associate that boosts creativity and productivity level of an interior designer.

## 7. Discussions

Our artificially intelligent software product, Design Dreamer, a ControlNet-based generative AI application that lets users define their interior designs, successfully portrayed its working under various conditions, as per the user-preferences, and different input image samples provided. It is demonstrated as one of the simplest ways to create a product that will help users to not only make interior design process easy and time-reducing, but also create unlimited creative options which puts the power of choice and customization in the hands of individuals to imagine, enhance, and effectively visualize their dream spaces come to existence[21].

### 7.1 Accessibility and Ease of Use

Through Design Dreamer, the audience will appreciate design that has no barriers! Those new and quality conscious designers have the power to play with many of them including various styles, layouts, and furniture combinations. This democratization challenges the traditional design approach and ensures that all stakeholders' voices are heard during the procedure [1][20].

### 7.2 Enhanced Creativity

The improvement of the imaging quality in the interior of the illimitations, conducted by the given prompts, drives even more creative ideas. People can try out what they thought of as ideas that already exist, and through visualization they can gain the confidence to come up with innovative design solutions.

### 7.3 Rapid Prototyping and Iteration

Having a design mindset, the tiring iterations are not needed. Rapidly test the suitability of the offered options immediately gains positive visual feedback. As a result of which, design decisions are manifested faster and more effectively.

### 7.4 Advanced AI for Personalized Design

We foresee the AI model development to be further enhanced and get the requests of guests personalized in their design recommendations. Based upon the focus on the preferences,



lifestyle and spaces that are needed, Design Dreamer can provide unique and pragmatic design ideas that are truly relevant. Moreover, a component of natural language processing (NLP) can be added to the user interface whereby users can provide their description of an ideal landscape in natural language which will save much time and effort on every aspect of the design process.

### 7.5 Collaborative Design Workflows

The future of suitable Design Trend is cooperation and collaboration. Collaboration will involve notes jotting, idea exchange in real time, and getting helpful prompts from other users or designers via the interface.

### 7.6 Seamless Integration

Extending Design Dreamer towards mobile channels (iOS and Android apps) will serve multi-channel design needs. Besides that, collaborations with e-commerce web sites will be able to enable users to purchase furniture and décor items directly within the app and hence make this transition seamless from the initial stages, right from vision to the completion.

### 7.7 Hyper Personalization

By integrating personalization on advanced level, users will be able to set their design template considering their style of living and receive recommendations that will match their preferences. Say that Imagine Design Dreamer served as your personal design advisor, that they can provide highly specialized guidance to suit your specific taste.

Design Dreamer is not just an interior designing platform, it rises as a robust tool, in the interior designing domain that helps people to realize and visualize their vision of spaces and open a door of their fantasy and imagination. Through creating a multi-dimensional experience that fully exploits the usage of the latest technologies, Design Dreamer should be the chosen platform for whoever dreams of the upcoming design transformation.

## 8. Conclusion and Future Scope

Altogether, Design Dreamer based on ControlNet comes as an industry-changer with Design Dreamer as its application that is capable of taking designing to a whole new level. Meticulously, we've gone through the whole process of requirement collecting, design, development and testing and we've created a well-tailored user-friendly online space where everyone can easily visualize the transformation of their ideal space.

By introducing the state-of-the-art model, the Jagilley ControlNet Hough model, enables the creation of a new, synthesized design functionality. This kind of synergy enables people to develop individualized, just-fitting products, resulting in the production of product that give consumer satisfaction and ultimately enjoyment.

Our agility and chance to survive in the face of technological problems, resources constraints, and also scope adjustments were important elements in overcoming technical obstacles. And making timely delivery of a good quality product is

formulated. From an always-developing basis, the steady exchange of user feedback, and the continual tuning, Design Dreamer has grown into a multi-faceted and proficient tool, it is capable to adapting to the different & various needs of the users.

Forward to future, Design Dreamer becomes the expedition of the innovation way and expansion. The modified release shall make it a more enjoyable and enthralling experience to the users, which will also attract them to a larger extent. Through Design Dreamer, this process is also possible where the items displayed will illustrate how to apply these principles in one's design journey, which is in the beginning, will influence the way how one should approach the process towards it. This extraordinary system can look to be a life-changing experience for the people by offering interior design like never before, regressive and refreshing. artificially intelligent software, Design Dreamer, a ControlNet-based generative AI application that lets users define their interior designs, now lets you define the new wave of design by yourself. The simplest way to create a product that will help users is creating a software that will not only make design easy but also create unlimited creative options which puts the power in the hands of the individuals to imagine and see their dream spaces come to existence.

### Data Availability

There is no data available for this research.

### Conflict of Interest

All the Authors declare that they do not have any conflict of interest.

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### Authors' Contributions

All Authors contribute equally to the development and presentation of this manuscript.

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**Vinamra Khandelwal** is a dedicated student currently pursuing a Bachelor of Technology degree in Artificial Intelligence & Data Science at Prestige Institute of Engineering Management and Research. With a profound interest in cutting-edge technologies, Vinamra specializes in Machine Learning, Artificial Intelligence, Deep Learning, and Web Development. Driven by a passion for leveraging technology to solve real-world challenges, Vinamra's academic journey has been marked by a relentless pursuit of knowledge and innovation. Through rigorous coursework and hands-on projects, Vinamra has honed a comprehensive skill set, equipped with the latest tools and techniques in the field of AI and Web Development.



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