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Transforming Architectural Planning: - Exploring the Potential of Text-to-Image Models

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Peer Review Information	Abstract
<p><i>Submission: 21 Oct 2025</i></p> <p><i>Revision: 18 Nov 2025</i></p> <p><i>Acceptance: 05 Dec 2025</i></p> <p>Keywords</p> <p><i>Floor plan analysis, Image processing, Architecture, Space planning, Deep learning, 2D plans, Graph neural network (GNN), Text-to-Image Models.</i></p>	<p>Text-to-image models have the potential to transform architectural planning by making it possible to quickly and easily generate and visualize new design options, improve communication with clients and other stakeholders, and automate some of the tasks involved in architectural planning. This article describes various methods and techniques for developing text-to-image model for architectural plan. This review compares different methods and algorithms with the help of a pie chart.</p>

Introduction

Architectural floor planning is the process of arranging rooms and spaces within a building to create a functional and aesthetically pleasing design. It is a complex task that requires careful consideration of a variety of factors, such as the building's purpose, the needs of its users, and the constraints of the site.

AI-based text-to-image models can be used to assist with architectural floor planning in a number of ways. For example, these models can be used to:

- Generate visualizations of floor plans based on text descriptions. This can help architects and designers to quickly explore and iterate on different design ideas.
- Identify and correct potential problems with floor plans. For example, AI models can be used to detect and fix code violations, accessibility issues, and inefficient space utilization.

- Generate realistic renderings of floor plans. This can be useful for communicating design ideas to clients and contractors, and for creating marketing materials.
- Overall, AI-based text-to-image models have the potential to revolutionize the way that architectural floor planning is done. By making it easier to generate and visualize floor plans, and by helping to identify and correct potential problems, AI models can help architects and designers to create more efficient and user-friendly designs.

Here are some specific examples of how AI-based text-to-image models can be used in architectural floor planning:

- An architect could use an AI model to generate a variety of floor plan options for a new office building, based on a text description of the building's purpose and the needs of its users. The architect could

then select the floor plan that best meets their needs and proceed with further development.

- A designer could use an AI model to identify and correct potential problems with a floor plan for a new restaurant. For example, the model could be used to detect code violations, such as inadequate digress, or accessibility issues, such as narrow doorways.
- A real estate developer could use an AI model to generate realistic renderings of floor plans for a new condominium complex. These renderings could be used to create marketing materials and to give potential buyers a sense of what the finished product will look like.

Overall, AI-based text-to-image models are a powerful new tool that can be used to improve the architectural floor planning process in a number of ways.

Literature Survey

Authors discuss the development of automated floor plan analysis and recognition using machine learning techniques [1]. There is a drawback due to the lack of a standard notion and high variability in style and composition make it crucial to develop reliable and effective approaches to analyze and recognize objects like walls, doors, and rooms from rasterized images. They provide a critical analysis of methodologies and tools from rule-based and learning-based approaches, focusing on datasets, scopes, and algorithms to guide future developers in improving productivity and reducing costs in the construction and design industries. Major contributions are:

- Exploring and describing the available datasets used for floor plan analysis.
- The rule and learning-based methods are described that recognize and model the building objects from rasterized floor plan images.
- Presenting a choice of floor plan analysis applications within the industry.

This study presents [2] an intelligent generative structural design method for shear wall building based on "fused-text- image-to-image" generative adversarial networks (GANs). The proposed method, TxtImg2Img, is based on generative adversarial networks architecture, which encodes, extracts, and fuses texts and images, and generates new design images. An entity named, "discriminator" is developed to identify real and fake images and texts. TxtImg2Img is advantageous in extracting features from multimodal text and image data, fusing the features using the Hadamard product,

and generating designs to satisfy text- image requirements after learning from a limited number of design samples. It can generate structural design images without distortion, and the corresponding structural design meets the mechanical requirements after being trained by dozens of words and hundreds of image data. Current generative design methods can only learn from design drawings and cannot meet both code requirements and architectural image guidance.

Authors explore the use of linguistics in studying architectural texts, focusing on the interpretation and author's open thoughts [3]. It highlights the role of language in architecture and its connection to understanding it. The study suggests that incorporating linguistic data into architectural discourse can help researchers understand the relationships between texts, words, and contexts. In [4, 5] Computerized space planning involves automatically creating floor plans based on user's geometric dimensions and topological requirements. The EPSAP algorithm is used to generate alternative floor plans, assessing and ranking solutions based on thermal behavior using Energy Plus. This approach helps architects allocate rooms within a building frontier efficiently.

Authors [6] introduce floor plans with an L-shaped boundary, focusing on the concept of non-triviality in constructing such plans. The authors analyze the behavior of non-trivial NRFPs, particularly L-shaped ones, where the boundary is inflexible and cannot be transformed into a rectangular boundary without disturbing module adjacencies. They plan to extend their work to other NRFPs like U-shaped, T-shaped, and Z-shaped and investigate their graph-theoretic properties. The authors also propose a flipping algorithm for constructing non-trivial L-shaped planes from PTPG. The main objective of a smart city is to enhance city functions [7], provide core infrastructure and promote economic growth and also provide a decent quality of life to their citizens by using smart technologies and data analysis.

In [8] presents a hybrid approach for generating automated 2D architectural layouts using agent-based modelling and deep learning algorithms. The goal is to maintain the designer's high-level idea and control over the generated outputs, ensuring they satisfy desired topological and geometrical conditions. The hybrid approach that was put forward consists of two methods,

- Agent-based modelling – hierarchical phase where a bubble diagram is generated through stimulation to an agent that satisfies topological condition.

Rule-based algorithms converts bubble diagrams into heap maps.

- Deep learning approach pix2pix algorithm translated heat maps into an architectural spatial layout as a conditional GAN. This paper concentrates on generating automated 2D layouts conditioned to a fixed footprint, the entrance door, the windows, and the desired topological constraint.

Paper [9] presents a methodology for automatically creating a 3D model from a 2D floor plan, which is used in renovations. The process involves pre-processing and extracting image features, identifying geometrical primitives and separating texts and graphical elements. The paper also outlines two types of evaluation: pixel-level and building-level. The software is based on the Qgar project led by Loria. A house floor plan recommendation system using deep neural networks and graph similarity computation, utilizing AI technology like SimGNN to find suitable designs for architects is presented in [10].

Paper [11] discusses the use of computer vision-based construction progress monitoring (CV-CPM) in construction projects. They use the PRISMA framework to categorize various concepts, tools, technologies, and algorithms reported by these studies, resulting in an integrated process framework for CV-CPM. In conclusion, the paper highlights the importance of computer vision in construction progress monitoring and its potential to support emerging areas such as Digital Twin. The authors [12] propose a fully integrated construction planning process using a project information modeling (PIM) platform, allowing stakeholders to collaborate on design, schedule, budget, and risk information. They call for further research and industry collaboration to adopt this new approach.

[13] The human-cyber-physical system (HCPS) approach for post-digital design and construction integrates computational design, robotic fabrication, and mixed reality for a flexible, agile process. This promising approach has the potential to revolutionize building design and construction, but faces challenges before widespread adoption. The paper [14] proposes a geometric variable sequential optimization method for improving thermal performance in automatically generated floor plans, despite being computationally expensive for complex designs. The model optimizes resource scheduling and machine maintenance policies for prefabricated component production, considering stochastic processing times and uncertain machine failures [15]. Formulated as a mixed-integer nonlinear

programming problem, it minimizes project duration and costs. The online trajectory planning method effectively controls offshore boom cranes by adjusting payload swing angles and ship roll/heave motions, ensuring desired world coordinate position [16]. [17] Building information models (BIMs) can enhance building operation and maintenance by reconstructing existing buildings from 2D drawings. A proposed method consists of four phases: object detection, annotation extraction, coordinate system generation, and IFC BIM generation, offering accuracy and efficiency.

The model, which combines CPM and GA, optimizes project schedule, cost, and quality in mega construction projects [18]. It considers various variables, resulting in significant improvements in schedule, cost, and quality. [19] A universal and automatic approach to generate synthetic images of building indoor scenes with comprehensive annotations for multiple building scene understanding (BSU) tasks. The approach is based on BIM models and computer graphics. It consists of two stages: image generation and annotation. The proposed approach is still under development, but it has the potential to revolutionize the way that synthetic images are generated for BSU tasks. A framework for using convolutional neural networks (CNNs) to generate conceptual structural designs for shear wall buildings [20]. The framework consists of three main steps:

- Data preparation: A dataset of existing shear wall buildings is used to train the CNN.
- CNN training: The CNN is trained to predict the wall thickness, length, and location for a given building plan.
- Conceptual structural design: The CNN is used to generate a conceptual structural design for a new shear wall building.

The CNN framework, evaluated on 100 shear wall buildings, generates structural designs similar to existing ones in terms of wall thickness, length, and location, potentially enhancing structural engineering. A digital twin is a dynamic model of a physical object or system, continuously updated with data [21]. It can monitor performance, predict future behaviour, and optimize operations. This technology can revolutionize infrastructure management by providing real-time insights, improving safety, reliability, and efficiency. This comprehensive overview is a valuable resource. The research [22] proposes a graph constrained conditional Generative Adversarial Network (GAN) for architectural layout generation. The GAN generates a vector representation of the layout, decoded into a raster image, and trained

adversarial. The model can produce aesthetically pleasing layouts, allowing users to control the generated space layouts. Paper [23] investigates the relationship between cognitive style and information load on dashboards for construction tasks. It hypothesizes an inverted U-shaped curve, with field dependent users having a larger cognitive burden. Authors [24] introduces a new method for creating aesthetically pleasing building layouts. It uses a deep learning model to generate a vector representation of the layout, which is then decoded into a raster image using a graph algorithm. This approach has the potential to revolutionize building construction. In the paper authors [25] discuss a variety of AI techniques that can be used for this purpose, including rule-based systems, heuristic search algorithms, and machine learning algorithms. They also discuss the challenges and opportunities of using AI for architectural spatial layout planning. AI algorithms can also be used to generate spatial layouts that are more efficient and sustainable than those that can be designed by humans alone. The paper [26] introduces a deep learning-based method for understanding floor plans in rural residential buildings. It uses raster images and outputs a semantic representation of the layout, including wall, door, window, and room locations. The method is trained on a dataset of manually annotated floor plans and achieves high accuracy in semantic segmentation and object detection. [27] AI can be applied to building designs to maximize indoor environmental quality, waste management, materials selection, energy efficiency, and conservation of water. This can lead to significant reductions in environmental impact and operating costs for buildings. The document "Artificial intelligence in green building" discusses the use of AI for a variety of green building applications, including. The paper [28] proposes a Generative Adversarial Network (GAN) for generating vector representations of residential floor plans. The layout of doors and windows, the sizes and forms of the rooms, the connections between them, and other aspects in the floor plans may all be learned by the generator network. Realistic and imaginative floor layouts may be produced by the suggested GAN. Two convolutional neural networks (CNNs) make up the Floor plan GAN: a discriminator CNN and a generator CNN. A topological graph of spaces and their adjacencies, as well as the position of the building's entrance and boundary, are inputs to the CNN generator. After that, it produces a vectored space arrangement that complies with geometric and topological requirements. The paper presents [29] a unique approach to automated structural design of shear wall

structures using modified evolutionary algorithms and previous knowledge. The methodology uses an adjusted genetic algorithm to iteratively select and generate fittest designs. The difficulties of automatically creating 3D building models from pre-existing 2D drawings and photos are covered in this study, along with the recent developments in machine learning that have made it feasible [30]. After reviewing publications on the subject, the writers suggest a number of interesting lines of inquiry. Authors [31] presents the method for automating the creation of theme architectural layouts based on image processing. The method creates an architectural arrangement that corresponds to a theme pattern by using a picture of the pattern as input. The approach works by first segmenting the image into regions that correspond to the different elements of the pattern. The segmented regions are then used to generate a graph representation of the layout. The paper [32] studies the behavior of Generative Adversarial Networks (GANs) trained on artificially constructed datasets. In order to identify the relationships between the performance of GANs and network width/depth, mixing of networks, and training set size, the author runs controlled experiments and suggests a set of measures for assessing GANs trained on synthetic datasets. Generative models are challenging to evaluate and compare. Inception Score (IS) and Fréchet Inception Distance (FID) measure sample quality, but can be fooled [33]. A neural network trained to discriminate between samples detects over fitting but is time-consuming and may favor adversarial models. The study [34] presents a Generative Adversarial Network (GAN) to accurately extract buildings from high-resolution remotely sensed imagery, addressing obstacles like cars, vegetation, and tree shadows. The GAN uses a SegNet model with Bi-directional Convolutional LSTM (BConvLSTM) to create segmentation maps. The method outperforms other techniques with an average F1-score of 96.81%, highlighting the importance of precise feature extraction for urban planning and geospatial analysis.

Authors [35] introduces latent diffusion models (LDMs) to enhance the training and sampling efficiency of DE noising diffusion models (DMs) for picture synthesis. LDMs, using cross-attention layers, offer flexible generators for various inputs, including text and bounding boxes, and achieve state-of-the-art outcomes while using less computing power than pixel-based DMs. The study [36] tackles the challenge of interpreting neural networks' complex hidden representations by proposing a objective

translation method using an invertible interpretation network on existing neural network typologies. This method disentangles hidden representations into semantically meaningful concepts, using only two pictures and an unsupervised approach, making it more adaptable to various network typologies. Authors [37] provides an introduction to graph neural networks (GNNs) in machine learning and data mining, dividing them into four groups: spatial- temporal, graph auto encoders, convolutional, and recurrent GNNs. It discusses their classification, applications, challenges, and future research avenues in the rapidly expanding field. [38] A thorough analysis of Generative Adversarial Networks (GANs), a hot area in study lately, is presented in this paper. The review discusses the theory, applications, and techniques related to GANs. The goals, mathematical representations, and structural elements of many GAN algorithms are introduced at the outset of the work, along with their similarities and differences. The generator and discriminator models, which are usually implemented using neural networks, are the two models that make up the GANs. While the discriminator acts as a binary classifier to separate created instances from actual ones, the generator seeks to capture the distribution of genuine examples and produce new data. The research introduces [39] the Dual-Discriminator Conditional Generative Adversarial Network (DDcGAN), a deep learning model for integrating visible and infrared pictures of different resolutions. The model uses two discriminators and a generator to preserve texture features and heat radiation. The DDcGAN offers significant advances in generator architecture, discriminator input space expansion, trainable DE convolution layer introduction, and medical image fusion application. The study [40] provides a comprehensive overview of deep learning-based Image Super-Resolution (SR) methods, a crucial aspect of computer vision. It categorizes these methods into supervised SR, unsupervised SR, and domain-specific SR. The survey offers insights into these methods, their advantages and limitations, and suggests future research directions in this rapidly developing field. Reviews of deep learning techniques for graph data analysis, addressing challenges like large-scale graphs, heterogeneity, irregular architectures, and multidisciplinary knowledge integration are mentioned in [41]. It categorizes techniques into five, highlighting their development history, differences, and compositions. The work [42] addresses the challenge of visually explaining generative models, particularly variation auto encoders

(VAEs). The authors achieve state-of-the-art results on the MVTEC-AD dataset, a dataset for anomaly identification, demonstrating how visual attention maps may assist in localizing abnormalities in pictures. In summary, this research contributes to explaining generative models by developing gradient-based network attention techniques for VAEs, facilitating anomaly localization and improved latent space disentanglement, thus extending the applicability of VAEs in various domains.

Review [43] of DE noising diffusion models, which is a quickly developing area in computer vision, particularly in the context of generative modeling. Diffusion models are composed of two stages: a forward stage where input data is gradually perturbed by adding Gaussian noise, and a reverse stage where a generative model gradually reverses the diffusion process in an attempt to recover the original data. Diffusion models have acquired respect for producing high-quality and variety produced samples, despite their computational constraints. The survey begins by identifying and presenting three key diffusion modeling frameworks: stochastic differential equations (SDEs), noise conditioned score networks (NCSNs), and DE noising diffusion probabilistic models (DDPMs). The authors explore the connection between diffusion models and other deep generative models, providing insights into their integration into generative modeling. The survey aims to analyze DE noising diffusion models in computer vision, highlighting future research prospects and application areas.

The research [44] introduces "Enlighten GAN," an unsupervised generative adversarial network for improving low-light pictures. It introduces unpaired training, a global- local discriminator structure, self-regularized perceptual loss fusion, and a global- local discriminator structure. Enlighten GAN is the first technique to use unpaired training, allowing larger training datasets. It also relies on self-regularization, surpassing state-of-the-art techniques in visual quality and picture quality evaluation. It is flexible and can be tailored to improve real-world low-light photographs. Paper

[45] introduces fully convolutional networks (FCNs), models designed for pixel-wise tasks, particularly semantic segmentation. FCNs produce outputs the same size as input, making them suitable for spatially dense prediction tasks. They simplify learning and inference, incorporating different layer representations for better accuracy. FCNs also offer transfer learning, end-to-end learning, and are open source. The study highlights FCNs' adaptability and efficiency in semantic segmentation and image-

to-image applications. The paper [46] presents a novel approach to single image de-raining, focusing on removing rain streaks from images captured under adverse weather conditions. It uses conditional generative adversarial networks (CGANs) to produce indistinguishable drained images, reducing artifacts and distinguishing between real and fraudulent images. The paper also presents a revised loss function and creative architectures for distinguishing between real and fraudulent images. It also highlights the potential for object detection with Faster R-CNN. The study [47] provides a comprehensive analysis of recent research on picture segmentation, focusing on deep learning methods. It covers the history of image segmentation algorithms, their evolution, survey structure, and benchmarks. The research also discusses the use of 2D and 2.5D datasets and their application in various fields, including robotic perception, medical image analysis, and video surveillance. The study [48] presents a novel adversarial regularized framework for graph embedding, transforming graphs into continuous vectors for various applications like link prediction and graph clustering. The authors highlight the limitations of regularized methods and propose the Adversarial Regularization Framework, which uses a graph convolutional network as an encoder and an adversarial training module to regularize latent codes. The proposed techniques outperform other methods in unsupervised tasks, highlighting the importance of graph embedding in various fields. The study [48, 49] presents PiiGAN, a novel deep generative model for image inpainting, which uses a style extractor and repeated training to generate multiple plausible results. This model, which is applicable in facial micro-reshaping, real-time inpainting of missing pictures, and art restoration, offers diverse and realistic results, demonstrating its efficacy using multiple datasets.

We find that a diverse set of architectures and processes have been applied to tackle the challenge of generative modelling, image analysis and image synthesis. It is therefore apparent that to build a model for architectural plan generation, a hybrid architecture is necessary to address each aspect of the model. Following is an overview of the approaches used: On the basis of the literature survey we found that the widely used algorithm is GAN (generative adversarial network) which is about 33.3%, next one is CNN (Convolutional Neural Network) with 9.5% and so on.

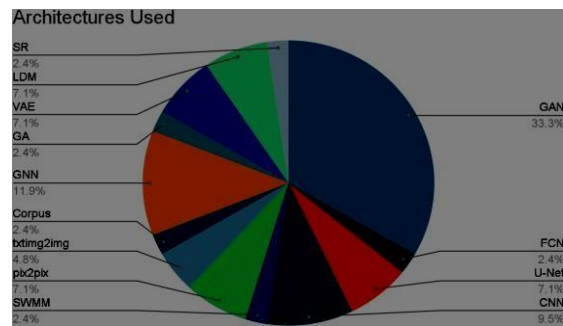


Figure 1. Analysis of algorithms and techniques used

Applications

- **Architectural Design and Visualization:** Quickly generate visual representations of floor plans from textual descriptions, aiding in the early design stages and client presentations.
- **Real Estate:** Enhance property listings with visually engaging content and provide potential buyers with a more immersive experience by visualizing floor plans based on textual descriptions.
- **Interior Design:** Facilitate space planning and customization by generating images of room configurations and layouts that match clients' textual descriptions.
- **Construction and Project Management:** Create visual representations of floor plans for better understanding of project requirements, pre-construction visualization, and progress tracking.
- **Urban Planning:** Visualize large-scale projects and proposed developments based on textual descriptions, aiding in public consultations and community meeting.
- **Educational Tools:** Provide interactive learning experiences for architecture and design students by generating visual feedback from textual descriptions of floor plans.
- **Accessibility and Inclusive:** Assist individuals with visual impairments by converting floor plans into tactile or auditory descriptions, and support inclusive design by visualizing accessibility features.
- **Renovation and Remodeling:** Visualize remodeling projects and estimate costs by generating images based on textual descriptions of desired changes.

Conclusion

Architectural floor plan text-to-image models represent a significant advancement in the fields of architecture, design, and real estate. By transforming textual descriptions into detailed

visual representations, these models enhance communication, streamline design processes, and improve client engagement. They offer practical applications in design visualization, real estate marketing, space planning, and project management. Additionally, these models support educational tools, promote accessibility, and facilitate renovation planning. Overall, architectural floor plan text-to-image models are a powerful tool that bridges the gap between conceptual descriptions and tangible visualizations, driving efficiency and innovation in the built environment.

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