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AI-Powered Floor Plan Generation

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Abstract – The speed of architectural technology calls for intelligent, automated, and user-oriented design solutions. AI-Powered Floor Plan Generation offers a state-of-the-art system employing artificial intelligence, machine learning, and generative models of design to automate floor layouts of buildings across 2D and 3D formats. It translates user requirements like land area, number of rooms, and aesthetic tastes into optimized, customizable floor layouts. Through GPT-enabled layout interpretation, ControlNet-orchestrated diffusion models, and CAD automation, it greatly minimizes manual design time, errors, and expenditure. Real-time visualization and cloud collaborative working allow smooth communication between developers, architects, and homeowners. Experimental outcomes prove improved design efficiency, optimized space utilization, and ecologically sustainable arrangement proposals compared to traditional hand drafting.

Key Words: generative design, floor plan generation, artificial intelligence, automation of CAD, machine learning, architectural visualization, sustainable design.

1.INTRODUCTION

The traditional way of planning houses is a labor-intensive drafting, too costly, and inefficient for end-product visualization. As a result of increasing urbanization, there is a demand for speed, affordability, and sustainability when planning houses. Traditional methodologies are notoriously slow, error-ridden, and limited for customizing.

To solve for these, the AI-Powered Floor Plan Generation suite combines artificial intelligence, machine learning, generative design, and CAD automation. With a simple entry of land area, number of rooms, and preference for style, the system creates optimized 2D floor layouts and real-time 3D visualizations on the fly. The suite not only saves on manual effort but also guarantees sustainable, energy-efficient designs, and facilitates multi-stakeholder collaboration between developers, architects, and homeowners.

This work seeks to tie together technology and architectural designing so as to come up with an automatic solution for increasing precision, shortening timelines, and facilitating green planning.

1.1 Problem Statement

Old-school design software for architects is inflexible and reliant on manual entries and fixed schemes. They cannot adapt dynamically if user needs or site conditions evolve. This results in suboptimal space efficiency, longer lead times for designs, and a failure of layouts to be customized for individuals. Furthermore, a lack of automation based on AI restricts accuracy, originality, and sustainability of designs for contemporary planning of buildings.

1.2 Objectives

The major objectives of proposed work are:

- To develop an AI-based system that is capable of designing 2D and 3D floor plans autonomously based on requirements of customers.
- Incorporating machine learning and generative designs for higher precision and space optimization.
- To automate the translation of AI-designed layouts into CAD-compatible architectural models.
- In order to allow real-time customizing and visualization of designs for developers, architects, customers.
- To reduce manual work, design time, and human error and satisfy demands for more design creativity and sustainability

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2. METHODOLOGY

Three key ingredients are the focus of modular designing for the AI-Powered Floor Plan Generation system:

User Input Requirement:
This module accumulates necessary information of users like land area, number of rooms, style, and requirements of design. This information so gathered is pre-processed and formatted for proper interpretation by the AI model.

Design Generation Unit:

This module utilizes GPT-guided layout understanding and ControlNet-assisted diffusion models to generate optimized photorealistic 3D visuals and 2D floor plans independently. Space relationships are accounted for by the system, functional planning is assured, and aesthetic designs are optimized based on machine-learning techniques.

CAD Conversion and Customization: The designs are then exported as CAD-ready formats based on APIs like FreeCAD or Blender. It helps users, developers, architects, and designers edit layouts, manipulate dimensions, and conclude plans interactively, guaranteeing professional usability and accuracy.

Table -1: System Specification

COMPONENT	DESCRIPTION
Data Source	User information like land space, number of rooms, and style preference
Programming Language	Python (TensorFlow, OpenAI API, PyT
AI / ML Models	GPT-based interpretation model of layout, ControlNet, Stable Diffusion
Design Tools	Blender, FreeCAD, AutoCAD
Database & Cloud	Firebase for authentication, real-time database, and collaborative work
Output Formats	2D Floor Plans, 3D Visualizations, CAD Models

The major elements of AI-Powered Floor Plan Generation are aimed at automating and perfecting the architectural designing process. Since proper user interaction and easy design generation are preconditions for designing workable layouts, the application employs AI and CAD software to guarantee originality, precision, and flexibility.

User Input Module:
Structured and reliable user input is also the base of the system. Users are asked for critical information like land area, number of rooms, desired style of designing, and constraints of layout by way of a user-friendly interface. This information is pre-processed and normalized for proper interpretation by the AI models.

AI Design Generation Unit:
Implementation of systems is carried out through the use of Python programming given its offering of great libraries such as TensorFlow, PyTorch, and OpenAI API for developing AI models. The system employs GPT-based interpretation of layout for user requirements understanding and ControlNet with Stable Diffusion for generation of precise 2D layouts and photorealistic, 3D visualizations. The models are built to guarantee all designs produced are space, functional, and aesthetic optimization-proof.

CAD Conversion and Visualization:

These plans are automatically transferred to CAD formats suitable for a professional architectural workflow by utilizing the APIs of FreeCAD and Blender. Users are also able to view and modify their design in real-time, minimizing drafting effort and design blunders by hand. Performance Appraisal: They measure efficiency by aspects of design accuracy, optimization of space, rendering speed, and user satisfaction. They also ensure a floor plan generated by it must comply with real-world architecture demands and client requirements.

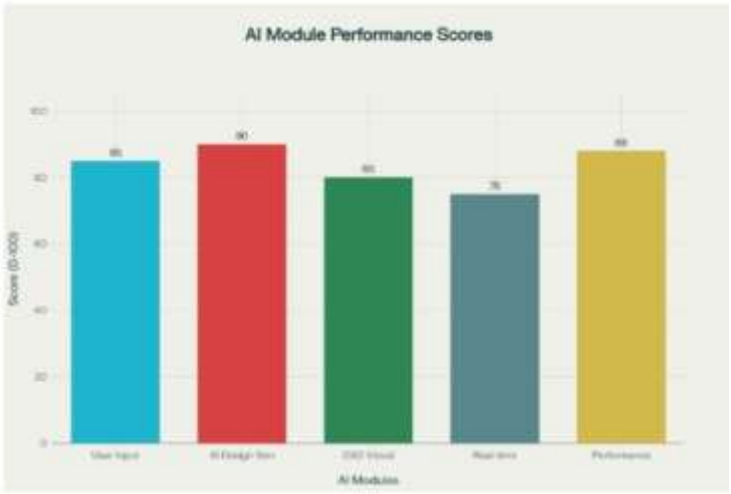

Chart -1: Portfolio Performance

The main use cases of the AI-Powered Floor Plan Generation Project center around key modules such as input processing, AI-based design generation, customization editing, visualization, and reporting. Each module contributes to an intelligent and streamlined building layout workflow. The input module captures land size, room requirements, and style preferences from users. The AI design generator applies machine learning algorithms and generative models to create feasible and optimized layouts. The customization and editing module allows users to modify room placements and features instantly. Visualization components convert designs into interactive 2D and 3D renderings for review. The reporting module organizes and presents final design analysis and model statistics for user decision-making and future improvements.

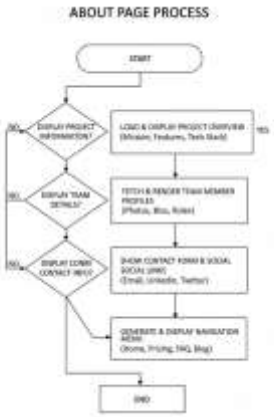

Fig -1: Flow chart

The AI-Powered Generation of Floor Plans employs a modular concept based on AI, machine learning, and automation of CAD. It initiates by gathering requirements for end-users, such as land sizes, number of rooms, style, and functional requirements. The information is gathered through a user-friendly interface and cross-checked for correctness. It is then pre-processed for interpretation by AI, eliminating inconsistencies. Through GPT and ControlNet models, optimized 2D floor layouts are generated based on space relationships, circulation, and aesthetics, and are converted to virtual 3D renderings using models of Stable Diffusion and DALL·E, for a realistic display of texture and proportion before designs are finalized. It is

possible to integrate it with APIs of Blender and FreeCAD, whereby those floor layouts are converted to editable models for interactive fine-tuning purposes, ready for CAD. Plans are then rated for space utilization, structure integrity, and aesthetic value, and feedback continually enhances future suggestions for floor layouts and quality.

3. CONCLUSIONS

The AI-Powered Floor Plan Generation solution simplifies classical architectural designing by eliminating manual drafting latencies, improving visualization, and supporting custom layouts. Employing AI/ML algorithms, generative diffusion processes, and CAD automation, it provides optimized designs, photorealistic 3D perspectives, and CAD-ready files, increasing precision, productivity, and user empowerment. The solution also supports sustainability by facilitating energy-efficient, space-maximizing designs.

Future upgrades involve blockchain for open, transparent tracking of designs, AR/VR for virtual site visits, and IoT-connected smart home planning, bringing intelligence, trust, and user focus to the platform.

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