AI Interior Design

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The Future of Interior Design: Personalized & Instant

Interior design is often a complex and time-consuming process, involving costly manual designers, endless inspiration apps, and limited AR tools. Our GenAI system aims to revolutionize this by offering rapid visualization, personalized design, and significant cost savings.

Why It's Challenging

- Multimodal understanding: Combining image and text input.
- Object removal & placement: Seamlessly integrating new elements.
- Realistic rendering: Maintaining consistent lighting and geometry.

Current Approaches

- Manual designers: Expensive and time-consuming.
- Inspiration apps: Lack customization and immediate visualization.
- Limited AR tools: Often lack realism and editing capabilities.

Redefining Room Transformations

Given an input image of a room (I) and a text-based request (T) describing desired furniture, style, or mood and the system generates a redesigned room image (I') that aligns with T. Optionally, 3D models (M) of new furniture pieces are provided upon approval.

Intelligent Furniture Handling

Users can choose to preserve specific existing furniture while removing or replacing others, ensuring maximum flexibility.

Blueprint Generation

Upon approving the generated design, users receive accurate 3D models of each new furniture piece for practical implementation.

Smart Wall Repainting

When recoloring rooms, the system intelligently repaints only the walls, preserving ceilings and architectural details.

> This project offers unprecedented novelty by integrating multimodal input, object-aware editing, and practical 3D model output in a single, intuitive workflow.

Models & Methods: Our Technical Pipeline

Our system employs a sophisticated multi-stage pipeline, leveraging cutting-edge AI models to achieve seamless and realistic interior redesigns.

01

Image Analysis & Segmentation

Utilizing models like SAM or Mask2Former to accurately segment rooms into distinct components: walls, floor, ceiling, and individual furniture pieces.

02

Semantic Editing & Generation

Diffusion models, potentially enhanced with ControlNet, will generate new elements or modify existing ones while maintaining layout consistency and realism.

03

Layout Consistency & Inpainting

Advanced inpainting techniques ensure that removed objects leave no artifacts, and new furniture seamlessly integrates with the existing room geometry.

04

3D Model Reconstruction

Specialized 3D reconstruction models convert generated furniture designs into high-fidelity 3D blueprints, ready for manufacturing or architectural planning.

Data Specification & Generation

1

Interior Design Datasets

Leveraging large-scale public and proprietary datasets containing diverse room images, furniture types, and architectural styles.

2

Segmentation Datasets

Annotated datasets providing pixel-level segmentation masks for room elements and furniture, crucial for models like SAM.

3

3D Object Datasets

Extensive libraries of 3D furniture models for training reconstruction models and ensuring accurate blueprint generation.

Labeling & Annotation

- Room segmentation: Walls, floors, ceilings, and objects.
- Furniture classes: Categorizing different furniture types.
- Style & mood tags: Semantic labels for text prompts.

Synthetic Data Generation

We will synthesize diverse room layouts, style-variant furniture, and pair them with generated images and descriptive prompts to augment our training data, enhancing model robustness and creativity.

Metrics & KPIs: Measuring Success

Final Output Evaluation

CLIPScore

Measures alignment between the edited room and the user's input prompt, ensuring the generated output matches the desired stylistic and thematic changes.

FID/KID Scores

Evaluates the realism and visual quality of the generated room image by comparing its distribution to real-world interior design photos.

Room Consistency (SSIM/LPIPS)

Verifies the preservation of the room's original layout and structural elements during the editing process, minimizing unintended distortions.

Stage-Specific Quality Metrics

3D Reconstruction

- PSNR, SSIM for image-to-3D accuracy
- Camera pose accuracy
- Mesh completeness

Rendering Quality

- Geometric fidelity
- Normal-map consistency
- Lighting accuracy

Room Editing/Inpainting

- Seam quality (no visible blending artifacts)
- Layout preservation
- Furniture placement accuracy
- Wall color fidelity

3D Furniture Models

- Chamfer Distance for shape similarity
- Mesh smoothness and watertightness
- Texture quality
- Blueprint accuracy

Measurement Protocols & Ground Truth

→ Comparison to Original User Images

Benchmarking generated outputs against the initial user-provided images and prompts for relevance and transformation accuracy.

→ Mask Annotations

Utilizing pixel-level mask annotations for walls, ceilings, and furniture as ground truth for segmentation and layout consistency metrics.

→ Depth Maps

Incorporating depth maps (when available) to validate 3D spatial accuracy and object placement within the generated scenes.