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Text to Video Generation Using Generative AI for Interior Design Visualization

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Abstract - The emerging discipline of text-to-video synthesis combines computer vision and natural language understanding to create coherent, realistic videos that are based on written descriptions. The research is an endeavour to provide a bridge between the fields of computer vision and natural language processing by using a robust text-to-video production system. The system's main goal is to convert text prompts into visually appealing videos using pre-trained models and style transfer techniques, providing a fresh approach to content development. The method demonstrates flexibility and effectiveness by including well-known libraries like PyTorch , PyTorch Lightning, and OpenCV. The work emphasises the potential of style transfer in boosting the creative quality of visual outputs by emphasising its capability to make videos with distinct styles through rigorous experimentation. The outcomes illustrate how language clues and artistic aesthetics can be successfully combined, as well as the system's ramifications for media production, entertainment, and communication. This study adds to the rapidly changing field of text-to-video synthesis and exemplifies the fascinating opportunities that result from the fusion of artificial intelligence and the production of multimedia content.

***Key Words*:**

1. INTRODUCTION

The convergence of natural language processing (NLP) and computer vision in interior design has opened up innovative ways for users to conceptualize and visualize their design ideas. Through advancements in text-to-video synthesis, this technology enables users to describe their ideal spaces using natural language prompts, with the system generating dynamic, personalized videos that bring their ideas to life. By leveraging NLP, the system accurately interprets design preferences such as wall color, textures, furniture styles, and lighting. This interpretation allows for the precise translation of user input into a cohesive, visual representation that aligns with the user's style, whether for a cozy bedroom, modern kitchen, or spacious office.

This system's architecture combines sophisticated NLP with advanced computer vision and style transfer techniques to create a seamless, user-friendly platform. Pre-trained image and video generation models, such as Generative Adversarial Networks (GANs) and diffusion models, are employed to ensure the visual output remains both realistic and versatile across a range of design styles. Style transfer techniques further enhance the output by aligning the visuals with specific aesthetics, from minimalism to industrial or rustic, ensuring a consistent look throughout the generated video. The system also uses spatial reasoning principles to arrange room elements realistically, mimicking real-world interior design practices.

As an interactive platform, the system allows users to make real-time adjustments to design elements, providing immediate feedback for a hands-on experience. This feature empowers users to iterate on their designs with ease, similar to working alongside a professional designer. Additionally, the system can offer personalized suggestions based on user preferences and interaction history, enriching the design process with relevant recommendations. For an even more immersive experience, the platform can integrate virtual reality (VR) and augmented reality (AR) features, enabling users to explore their designed spaces in VR or preview them in their actual environment using AR. This approach not only enhances user engagement but also brings greater accessibility to interior design, making it easier for individuals to visualize, customize, and refine their ideal spaces in a dynamic, high-quality video format.

2. LITERATURE REVIEW

[1] Recipe for Scaling up Text-to-Video Generation with Text-free Videos -The paper referring to, "A Recipe for Scaling up Text-to-Video Generation with Text-free Videos" by Xiang Wang, Shiwei Zhang, Hangjie Yuan, Zhiwu Qing, Biao Gong, Yingya Zhang, Yujun Shen, Changxin Gao, and Nong Sang, likely explores advancements in text-to-video generation, particularly focusing on scaling this process effectively using a corpus of videos without text annotations. Text-to-video generation has gained significant attention in recent years as advancements in deep learning architectures, such as transformers and generative adversarial networks (GANs), have made it possible to synthesize realistic video sequences based on textual prompts. Traditionally, text-to-video models rely heavily on large annotated datasets, where video clips are paired with detailed descriptions. However, this dependency limits scalability due to the high cost and effort required for data collection and annotation. Recent studies have explored alternative approaches that leverage unlabeled or weakly labeled video data, applying techniques like self-supervised learning and contrastive learning to extract meaningful features from raw visual inputs.

[2] VideoGen: A Reference-Guided Latent Diffusion Approach for High Definition Text-to-Video Generation - In recent years, text-to-video (T2V) generation has garnered significant research interest, owing to advances in deep learning and the success of text-to-image (T2I)

generation models like DALL-E, Stable Diffusion, and Imagen. Early approaches in T2V generation, such as Sync-DRAW and extensions of GANs, laid foundational methods for generating video content, while later models like GODIVA, NUWA, and CogVideo began leveraging advancements in large-scale transformer architectures and variational autoencoders (VAEs) to improve quality and temporal coherence. These early methods, however, faced challenges in achieving high-definition visual fidelity and smooth motion over time, largely due to limited text-video pair datasets.

To address these limitations, recent approaches have incorporated T2I models into the T2V generation pipeline. For example, Make-A-Video and Imagen Video demonstrated that pretrained T2I models could be adapted to video by modifying latent diffusion processes, or by using image-text pairs to enhance video quality. VideoGen, proposed by Li et al., builds on this by introducing a reference-guided latent diffusion approach that uses a high-quality image generated from a T2I model as a reference for guiding video creation. This approach not only enables improved visual fidelity but also allows the diffusion model to focus on learning temporal dynamics rather than solely visual details, enhancing motion consistency.

[3] Content based lecture video retrieval using speech and video text information-The field of Video Question Answering (Video QA) has rapidly advanced as researchers work to develop systems capable of interpreting complex video content to answer natural language questions. Video QA requires an understanding of both static visual elements and temporal dynamics, such as actions and interactions. Datasets like Video-QA, MSVD-QA, and ActivityNet-QA provide large-scale annotated video-question-answer (VQA) pairs, essential for training these systems. However, the high cost of manual annotation has driven researchers to explore automated methods, such as Caption Question Generation (CapQG), which derives QA pairs from video captions instead of directly analyzing video content. While CapQG has enabled the development of large datasets, it assumes captions are fully representative of videos, a limitation that often results in information loss and decreased question relevance

[4] T2V Bench:benchmarking temporal dynamics for text to video generation-The paper "Predicting Visual Features from Text for Image and Video Caption Retrieval" by Jianfeng Dong, Xirong Li, and Cees G. M. Snoek presents a novel approach to address the challenges of retrieving captions that best describe the content of images and videos. Unlike existing methodologies that rely on a joint latent subspace for aligning visual and textual data, the authors propose a framework that operates exclusively within a visual feature space. This innovative approach is embodied in their deep neural network architecture, Word2VisualVec (W2VV), which learns to predict visual feature representations directly from textual input. By utilizing multi-scale sentence vectorization to create textual embeddings, the model can translate these embeddings into visual features through a multi-layer perceptron. The generalization of W2VV for video caption retrieval further enhances its capability, allowing it to predict both 3D convolutional neural network features and visual-audio representations from textual descriptions.

[5] Predicting visual features from Text for image and video caption retrieval-Video captioning has gained considerable attention in recent years due to the rapid proliferation of online video content and the need for automated systems to generate meaningful textual descriptions. Early approaches primarily relied on deterministic models that generated a single caption based on visual input, often failing to capture the inherent variability and complexity of how different individuals interpret the same video. As a result, recent advancements have increasingly embraced deep learning techniques, particularly encoder-decoder architectures that leverage Convolutional Neural Networks (CNNs) for visual feature extraction and Recurrent Neural Networks (RNNs), such as Long Short Term Memory (LSTM) networks, for sequential language modeling. Despite their effectiveness, these traditional models often produce deterministic outputs, limiting their ability to reflect the multifaceted nature of video content and subjective interpretations

[6]Video question answering techniques, benchmark datasets and evaluation matrices leveraging video capturing-Video Question Answering (Video-QA) is an emerging area of research that builds upon video captioning techniques to facilitate the understanding and querying of video content. While human beings can effortlessly interpret and describe videos, enabling machines to perform similar tasks poses significant challenges. Video captioning involves not only the generation of meaningful textual descriptions from video data but also an understanding of its semantics, which necessitates the collaboration of both computer vision and natural language processing fields. The ability to generate captions enables further applications such as video retrieval, summarization, and notably, question answering. Traditional methods in video-QA initially relied on text extraction from video content, which proved limited due to the sparsity of textual information across various domains. Consequently, a shift towards content-based methods emerged, focusing on the identification and localization of objects and actions within the visual data to retrieve more relevant results.

[7] Sounding video generator: a unified framework for text-guided sounding video generation-The growing prevalence of e-lecturing and the increasing volume of lecture video content necessitate the development of efficient retrieval methods that allow users to access specific information quickly. Traditional video retrieval systems typically rely on manually created metadata, which can be subjective and time-consuming. Recent studies highlight the need for automated approaches that leverage multimedia analysis techniques to enhance video indexing and search capabilities. Techniques such as Optical Character Recognition (OCR) and Automatic Speech Recognition (ASR) have emerged as promising solutions for extracting textual information from lecture videos, providing rich

metadata that can facilitate more accurate and effective content-based search and retrieval.

[8] Evaluating Text-to-Visual Generation with Image-to-Text Generation-Despite significant progress in generative A I, comprehensive evaluation remains challenging because of the lack of effective metrics and the standardized benchmarks. the widely-used CLIP Score measures the alignment between a (generated) image and text prompt, but it fails to produce reliable scores for complex prompts involving compositions of objects, attributes, and relations. One reason is that text encoders of CLIP can notoriously act as a “bag of words”, conflating prompts such as "the horse is eating the grass" with "the grass is eating the horse". To address this, we introduce the VQA Score, which uses a visual-question-answering (VQA) model to produce an alignment score by computing the probability of a "Yes" answer to a simple "Does this figure show {text}?" question.

3. PROBLEM STATEMENT

With the increasing demand for dynamic multimedia content in entertainment, education, and digital communication, there is a significant need for systems that can automatically generate visually appealing videos from textual prompts. However, current text-to-video generation solutions primarily produce simplistic animations that often lack aesthetic quality and fail to capture complex stylistic elements. They struggle to blend linguistic cues with visual output effectively, resulting in videos that lack diversity in artistic style and depth of representation.

This project addresses these limitations by developing an AI-driven text-to-video synthesis system that uses advanced style transfer techniques alongside pre-trained models. The goal is to convert descriptive text into compelling video content with diverse artistic styles. Utilizing tools such as PyTorch, PyTorch Lightning, and OpenCV, the system translates textual descriptions into frames, applies various artistic styles, and assembles these frames into fluid video sequences. This solution is intended to enable greater flexibility, creativity, and personalization in media production, providing a valuable tool for fields that rely on innovative content creation

4. PROPOSED SYSTEM

Overview: The Text to Video Interior Design System enables users to input text descriptions of their desired interior design. The system utilizes Natural Language Processing (NLP) and Visual Transformer Models to generate a visual representation of the design, along with corresponding video content that showcases the design concept.

Key Features:

1. User Friendly Input: Users can describe their design preferences through natural language.

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2. NLP Processing: Converts user input into actionable data or the design process.

3. Image Analysis: Utilizes YOLO/CNN for object detection in room images.

4. Video Generation: Creates dynamic visual outputs based on the design model.

5. Visual Transformer Integration: Enhances image rendering with sophisticated visual representations.

System Design Components:

1. User Input Module: Interface where users enter their design descriptions.

2. NLP Engine: Processes and interprets the user input.

3. Mapper: Converts processed data into a structured format.

4. Visual Transformer Model: Generates high quality images and video content based on the mapped data.

5. Room Image Processing: Utilizes YOLO/CNN for identifying and categorizing objects in room images.

Data Flow: User Input → NLP Engine → Mapper → Visual Transformer Model → Design Output (Video)

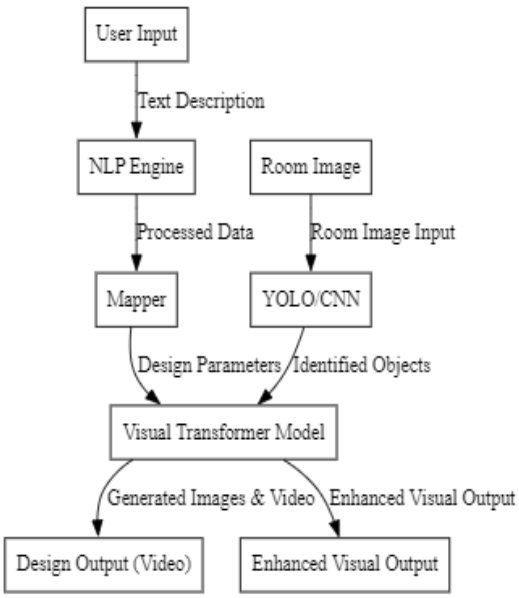

Fig 1: System Architecture

5. RESULTS AND DISCUSSION

The developed text-to-video generation system for interior design visualization allows users to input text prompts and images to generate interior design outputs in multiple formats, including images, GIFs, and videos. The system leverages generative AI models to interpret text descriptions and refine input images, creating detailed and aesthetically coherent room designs. Users can customize the output using adjustable parameters such as strength (which controls how much the AI alters the input image) and guidance scale (which determines the balance between user input and AI creativity). The results show that the system can effectively generate visually appealing interiors that align with the given prompts. However, while basic layouts and styles are well represented, complex spatial arrangements and lighting effects still require refinement. Additionally, enhancing images within the platform offers flexibility, but achieving highly detailed realism can sometimes be challenging. Future improvements, including better 3D object placement, fine-tuned texture rendering, and interactive design refinements, could further enhance the accuracy and usability of the system.

The home page is given below

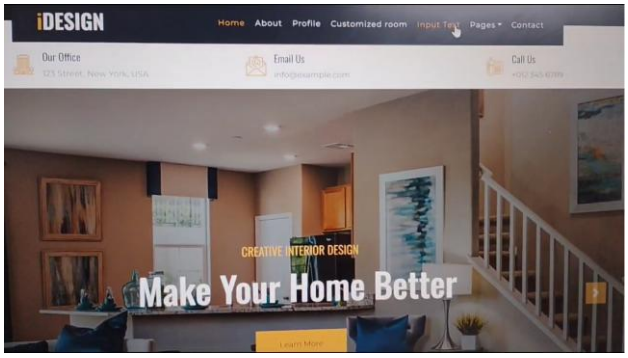

Fig 2: Home Page

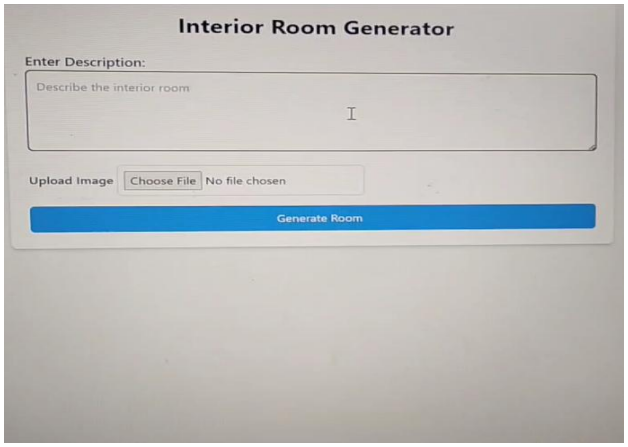

Fig 3: Input text Page

The login page is given below:

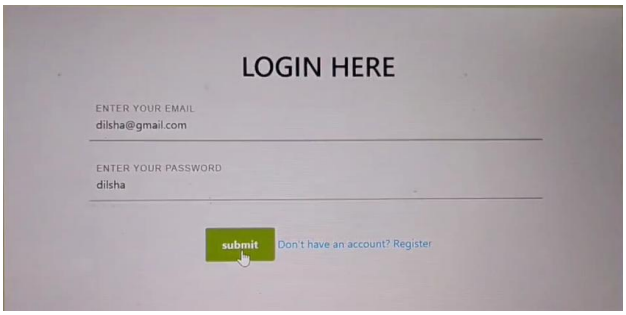

Fig 4:login Page

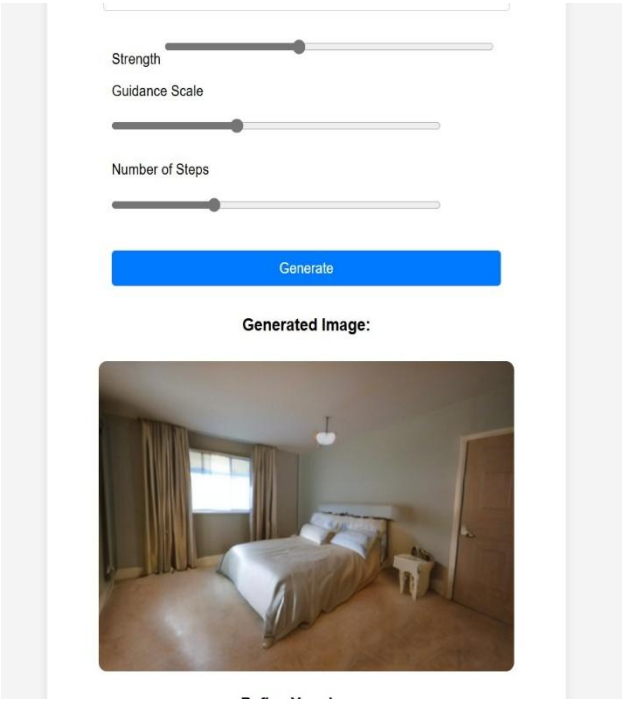

Fig 6: Image description Page

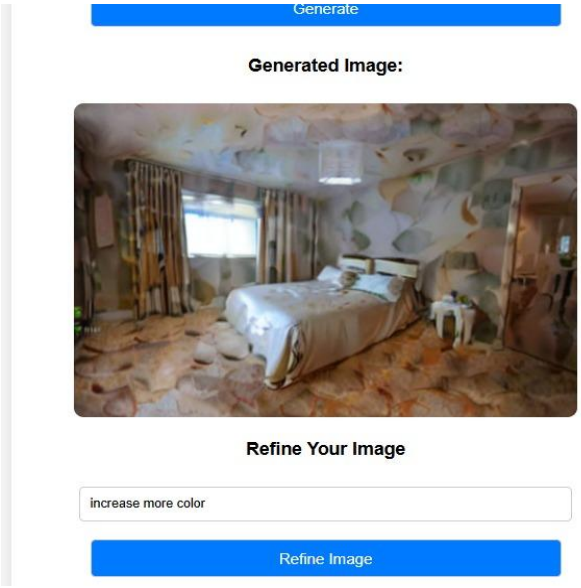

Fig 4: Generated Image Page

6. CONCLUSION

The Text-to-Video Interior Design System represents a significant advancement in how users can engage with interior design concepts. By effectively bridging the gap between user preferences and visual representation, this system empowers individuals to transform abstract ideas into concrete visualizations.

Through the integration of Natural Language Processing (NLP), the system enables users to communicate their design visions in natural, conversational language. This intuitive input method reduces barriers to entry, allowing a broader audience, including those without technical design skills, to express their preferences easily.

The use of advanced visual modeling techniques, particularly the Visual Transformer Model, enhances the accuracy and quality of the generated visuals. This technology not only processes the user's text input but also analyzes and incorporates contextual design elements, creating a cohesive and aesthetically pleasing representation of the desired space. By employing YOLO/CNN for object detection, the system ensures that specific elements within a room are recognized and integrated into the final output, providing a tailored experience that meets individual needs. Moreover, the dynamic nature of video output allows users to experience their designs in a more immersive way. This not only enhances user engagement but also aids in the decision-making process by providing a realistic preview of how their design choices would translate into actual spaces. Users can visualize the interplay of colors, textures, and layouts, which can significantly influence their final decisions.

The system's capability to generate detailed design outputs fosters creativity and encourages exploration of various design possibilities. As users interact with the platform, they can refine their preferences, ultimately leading to more satisfying and personalized design outcomes.

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