Hybrid Intelligence Framework in Fashion Design:
Combining Generative AI With Fuzzy Logic

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ABSTRACT

Generative artificial intelligence (Gen AI) holds significant potential in the field of innovative design creation, offering non-trivial solutions based on big data analysis. However, its ability to improve design variants incrementally is limited. Gen AI struggles to interpret spatial parameters and make precise modifications, such as changing shapes or adding specific details. These limitations reduce Gen AI's effectiveness in tasks requiring sequential refinement and improvement. The solution proposed in the article involves hybrid intelligence, combining AI's generative strengths with human creativity. The hybrid intelligence approach enhances the quality of generated solutions while maintaining fast variant creation. It allows consistent improvement through iterative modifications, aligning the designer's concept with AI suggestions. The article explores how this methodology can be applied in fields like architecture, industrial design, and engineering, where spatial precision and gradual refinement are crucial.

INTRODUCTION

Modern generative intelligence (GenAI) models, including large language models (LLMs) and diffusion-based image generators, demonstrate impressive capabilities in producing meaningful text, realistic images, source code, and other types of content from simple text prompts (Towards AI Editorial Team, 2023). The rapid development of generative models is accompanied by an unprecedented rate

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of adoption—for example, the language model ChatGPT attracted over a million users within just five days of its launch (Cvetko, 2023).

However, generative models already face significant challenges at the image generation stage (detailed examples are provided in (Egorova & Ryzhov, 2024)), and these challenges are exacerbated when attempting personalized editing of generated outputs. Users encounter serious difficulties due to a lack of proper controllability and stable convergence when working with both LLMs and diffusion models. In many respects, generative models remain "black boxes": they produce impressive yet unpredictable results without guarantees of reproducibility or human control (Joshi et al., 2024). In particular, the stochastic nature of the generation process makes iterative image refinement practically impossible—each new generation run produces an entirely new result rather than gradually converging toward the desired image. Thus, standard regeneration approaches do not provide convergence, and the outcome differs each time, making it difficult to achieve the intended result.

To clearly demonstrate the limitations of modern generative models, authors present two representative examples of failed interactions with a system based on the well-known DALL·E 3 model (OpenAI, 2023), as shown in (Ryjov et al., 2024) (see Figures 1 and 2). In the first example, the user submits a prompt requesting a T-shirt with the word "logo" placed at the bottom of the garment. However, none of the generated outputs meet this condition, indicating the model's inability to accurately interpret spatial constraints, even when explicitly specified. In the second example, the user specifies that a dress should not include a belt, yet the model consistently ignores this instruction. Even after repeated prompt refinements, the belt continues to appear in the generated image, demonstrating the model's inability to interpret negative constraints.

Figure 1. An example of a failed interaction with generative AI: A T-shirt with the word "logo" placed at the bottom of the garment.