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# Automated image generation using GANs

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**Abstract**
The project is to leverage Generative Adversarial Networks (GANs) to create realistic and diverse outfit designs. This involves training a GAN model to generate high-quality images of clothing items, enabling the generation of new outfits based on textual description. By feeding the model a dataset of various fashion images, the GAN learns to produce unique outfit combinations.
This project aims to innovate the fashion industry by automating and enhancing outfit design processes, improving user experiences in virtual try-on applications, and offering personalized fashion suggestions.
**Problem Statement:** Generating high-quality images from text is a key challenge in AI and fashion. GANs provide sharper images compared to other generative models but face challenges with complex datasets.
**Implications for Fashion Industry:** Streamlines design processes by reducing time and resources. Helps designers explore new creative directions with AI-generated ideas.
This paper explores the application of Generative Adversarial Networks (GANs) in transforming the fashion industry by enabling the generation of realistic fashion images from textual descriptions. By training GANs on a diverse dataset of fashion images and associated text, the model bridges the gap between language and visuals, offering a powerful tool for designers, retailers, and consumers. The proposed system demonstrates the potential to accelerate design processes, enhance creativity, and provide personalized fashion solutions, such as virtual try-ons and customized garment visualization. While the results are promising, challenges like high computational costs and potential biases in data remain, requiring further research to ensure fairness and inclusivity. This work highlights the fusion of AI and fashion as a step toward democratizing design, empowering smaller brands and independent creators, and revolutionizing the way fashion concepts are developed and experienced.

**Keywords:** Adversarial Networks, AI, GANs, image generation

## Introduction

The merging of artificial intelligence (AI) and the fashion industry is opening up new ways to create designs, making the process faster and more accessible. One exciting development in this area is the ability to generate fashion images directly from text descriptions. This means you can simply describe a piece of clothing or an outfit in words, and AI can turn that description into a detailed image.
This project focuses on using a special type of AI called generative adversarial networks (GANs) to create fashion images based on text. To do this, we'll train the AI on a large collection of fashion images and detailed descriptions, so it learns how to generate realistic and stylish fashion images based on a simple description. Over time, we want to build a system that can create high-quality, visually appealing images that reflect the style and details of the description provided.
The potential uses for this technology are vast and exciting. For designers, it can help speed up the creative process by automatically generating design ideas from text, which could save hours of work. For shoppers, it could personalize fashion recommendations based on their individual tastes. Imagine describing the kind of outfit you want and instantly seeing different looks based on your preferences. This AI could also improve online shopping by allowing customers to "try on" clothes virtually, helping them see how different items would look on them before making a purchase. On e-commerce platforms, it can help generate high-quality product images that look professional and attractive, which could lead to more sales.
Our main goal is to make fashion design more accessible. By using AI to turn words into images, we want to help anyone—whether they're a professional designer or just a fashion enthusiast—bring their creative ideas to life, even without advanced design skills.
To achieve this, we will use GANs, which are deep learning models made up of two parts: a generator and a discriminator. The generator creates images based on the text description, while the discriminator checks whether the images look realistic. These two parts work together in a back-and-forth process, continually improving the images over time. Through this process, the AI will learn how to produce images that match the style and details of the description as closely as possible. We believe that this research has the potential to make a big impact on the fashion world. By speeding up design processes, offering personalized recommendations, and improving online shopping, AI could change the way we approach fashion. It could make it easier for anyone to create and experiment with new trends, helping shape the future of fashion design.
To make sure we're successful, we will carefully choose a diverse set of fashion images and descriptions to train the AI. We'll also test different methods for training the GAN to make it as effective as possible. We will constantly evaluate the images it generates, checking for quality and variety, to ensure the system is working as intended.

Our project will also be mindful of the ethical implications of AI in fashion. We'll address any biases that might be present in the dataset or the images it generates, making sure that the technology promotes fairness and inclusivity. It's important that the AI is used in a way that represents all people and their diverse styles.

Ultimately, we want this project to push the boundaries of AI and fashion, creating a world where technology and creativity come together to help people express themselves in new and exciting ways. By making design tools more accessible, we can help people everywhere bring their fashion ideas to life, from anywhere, with just a few words. This could change how we design, shop for, and think about fashion in the future.

**Literature survey**

1. **1."Lost Your Style? Navigating with Semantic-Level Approach for Text-to-Outfit Retrieval**

This paper explores a semantic-level approach to text-to-outfit retrieval, which aims to enhance the accuracy of fashion recommendations by focusing on understanding the meaning behind textual descriptions. By using advanced semantic analysis, the system better interprets user input and retrieves outfits that match their style preferences. The approach seeks to overcome traditional limitations in fashion recommendation systems, which often rely on keyword-based searches, by offering more context-aware and relevant outfit suggestions based on the deeper meaning of the user's descriptions.

2. "**Custom Outfit Generation Using Generative Adversarial Network**"

This study focuses on the use of Generative Adversarial Networks (GANs) for generating custom outfits based on user specifications. The model leverages GANs to create unique fashion designs by learning from a vast dataset of existing fashion images. By taking in textual or visual inputs from users, the system is able to produce customized clothing combinations that meet specific preferences, opening up possibilities for personalized fashion creation and offering users a way to experiment with new styles.

3. **"Fashion Outfit Recommendation and Transformation Using Generative Adversarial Network Methods"**

This paper investigates the use of GANs for fashion outfit recommendation and transformation. It introduces a system that not only recommends outfits based on user input but can also modify or transform existing outfits into new combinations based on evolving style preferences. The model relies on GANs to generate high-quality, fashion-forward suggestions and alterations, allowing users to explore diverse styles while ensuring the outputs are both relevant and visually appealing.

4. **"Perhsonalized Fashion Outfit Generation with User Coordination Preference Learning**"

This research proposes a method for personalized fashion outfit generation that incorporates user coordination preferences. By learning from a user's specific style and coordination preferences, the system generates outfits that not only match individual tastes but also consider how different items of clothing work together. The model's ability to understand coordination patterns—such as color matching, fabric types, and garment combinations—ensures the generation of outfits that are both personalized and cohesive.

5. **"Clothing Fashion Image Generation From Text Using Artificial Intelligence"**

This paper discusses the application of artificial intelligence, specifically deep learning models, to generate fashion images from textual descriptions. By training a model on a large dataset of fashion images and their corresponding descriptions, the system learns to generate realistic clothing images that match user-provided text prompts. This approach has significant potential in fashion design, e-commerce, and personalized styling, offering a new way to visualize clothing concepts directly from text without the need for manual design.

6. **"Multimodal Garment Designer: Human-Centric Latent Diffusion Models for Fashion Image Editing"**

This paper introduces a human-centric fashion image editing system using latent diffusion models, which allows users to modify and customize clothing designs. The model leverages multimodal inputs, combining textual descriptions, sketches, and garment images to create high-quality fashion images. By incorporating user preferences and feedback, the system offers a more intuitive and personalized way to edit fashion designs. This approach aims to enhance creativity and efficiency in fashion design, making it easier for both designers and consumers to visualize customized clothing options.

7. **"Text-Driven Fashion Image Manipulation with GANs"**

This paper explores the use of Generative Adversarial Networks (GANs) to manipulate fashion images based on textual descriptions. The system can take a textual prompt describing a clothing item and modify an existing fashion image accordingly, allowing for the generation of new designs or alterations to existing ones. This technology allows for the transformation of fashion images with a high level of detail and realism, making it easier to experiment with different styles, patterns, and colors, thereby offering significant potential for design innovation and personalization in fashion.

8. **"Toward Intelligent Design: An AI-Based Fashion Designer Using Generative Adversarial Networks Aided by Sketch and Rendering Generators"**

This research focuses on creating an AI-based fashion designer using GANs, which integrates sketch and rendering generators to assist in fashion design. The model allows users to generate detailed clothing designs from simple sketches and descriptions, enhancing the creative process and offering a new method for generating realistic fashion images. By using AI to assist with sketch generation and rendering, the system simplifies the fashion design process and provides designers with innovative tools to explore new concepts efficiently and effectively.

9. "**Developing an AI-Based Automated Fashion Design System: Reflecting the Work Process of Fashion Designers"**

This paper discusses the development of an AI-based automated fashion design system that mimics the work

process of human fashion designers. The system aims to automate aspects of the design process, such as creating clothing patterns and selecting materials, while maintaining the creativity and aesthetic considerations that designers typically bring to the table. By reflecting the decision-making and iterative nature of the design process, the system aims to support fashion designers in speeding up production times and increasing the efficiency of design workflows while allowing for creative expression.

**10. "Outfit GAN: Learning Compatible Items for Generative Fashion Outfits"**

OutfitGAN introduces a GAN-based model designed to generate compatible fashion outfits by learning the relationships between different clothing items. The system uses deep learning techniques to generate outfit combinations that are visually appealing and contextually appropriate based on individual items of clothing. This model allows for the automatic generation of stylish and coordinated outfits, which can be useful in personalized fashion recommendations, virtual styling assistants, and e-commerce platforms, where users can receive outfit suggestions tailored to their preferences and needs.

**11. "ClothGAN: Generation of Fashionable Dunhuang Clothes Using Generative Adversarial Networks"**

ClothGAN focuses on using Generative Adversarial Networks (GANs) to generate fashionable clothing designs inspired by Dunhuang, an ancient culture known for its unique art and fashion. The model uses deep learning techniques to capture the intricate patterns and styles seen in Dunhuang artifacts and apply them to modern fashion contexts. By training the GAN on a dataset of historical clothing and design elements, ClothGAN aims to bring traditional styles into contemporary fashion design, blending cultural heritage with modern creativity.

**12. "Fashion Outfit Design Image Synthesis Using Comparative Study of Generative Adversarial Networks"**

This paper compares various Generative Adversarial Networks (GANs) for fashion outfit design image synthesis. The study explores different GAN architectures to determine which produces the most realistic and aesthetically pleasing fashion outfits. By synthesizing fashion outfit images from a range of input sources—such as sketches or textual descriptions—the paper evaluates how different GAN models can be leveraged to create new, on-trend outfit combinations. The comparative analysis helps in understanding the strengths and weaknesses of different approaches to automatic fashion design generation.

**13. "Text-to-Image Synthesis for Fashion Design"**

This paper discusses the use of text-to-image synthesis in fashion design, where textual descriptions of clothing are transformed into detailed, high-quality fashion images. The model interprets written prompts, such as descriptions of garment types, colors, or patterns, and generates corresponding fashion visuals. By automating this process, the technology allows designers to quickly prototype ideas and visualize concepts without the need for manual illustrations, speeding up the design cycle and providing greater flexibility in fashion creation.

**14. "Text to Image Generation of Fashion Clothing"**

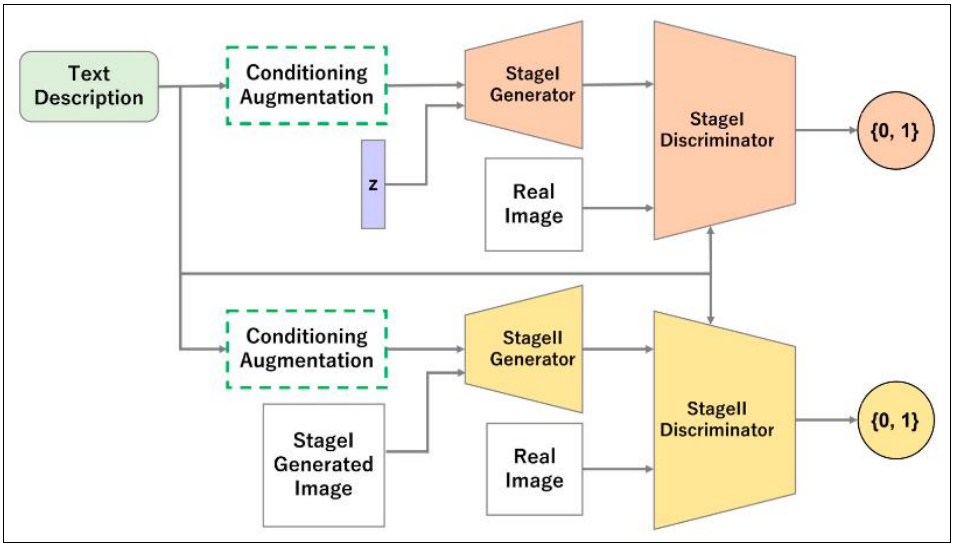
This research focuses on the generation of fashion clothing images directly from textual descriptions using AI and deep learning models. The model interprets various aspects of the text, including garment styles, colors, and textures, to create realistic clothing images. This technology can be used for a range of applications, such as creating visual prototypes for designers or generating clothing suggestions for online shopping platforms. By bridging the gap between text and visuals, it simplifies and streamlines the fashion design process.

**Methodologies**

In recent years, the fashion industry has embraced generative methods for image creation [6, 7, 8], driven by advances in computer vision and machine learning. Leveraging techniques such as generative adversarial networks (GANs) and variational autoencoders (VAEs), these methods are revolutionizing fashion design and retail, enabling personalized clothing design, virtual try-on experiences, and innovative approaches to advertising and marketing. The earlier mentioned works on diffusion methods, like Isolated Diffusion by Jingyuan Zhu *et al.* [9], focus on addressing the issue of Concept Bleeding to improve the quality of image generation. Meanwhile, E D I T - VA L proposed by Samyadeep Basu *et al.* [10]. offers an image editing technique with conversational features. GAN-based methods such as AttnGAN by Tao Xu *et al.* [11], introduce attention mechanisms to generate images from text descriptions, enhancing the model's ability to focus on specific details and improve realism. Scott Reed *et al.* [12, 13], explore image generation based on the semantic context of text descriptions, resulting in detailed images. Furthermore, within the fashion community, FashionAttGAN by Qing Ping *et al.* [14] intro-duces a novel approach for fashion image editing using MultiObjective Generative Adversarial Networks (GANs). This model enables precise manipulation of fashion attributes like color, pat-tern, and style within images. Leveraging attention mechanisms, Fashion-AttGAN achieves realistic results by focusing on relevant areas during attribute editing. Proposed by the same authors, InGAN [15] facilitates virtual try-on experiences and fashion editing by seamlessly integrating clothing items onto individuals within existing images. The model employs advanced techniques in GANs and conditional image synthesis to deliver realistic and visually appealing outcomes. While our work shares similarities with previously published methods like StackGAN, we aim to address domain-specific problem to the fashion industry.

Stacked Generative Adversarial Networks StackGAN-v2 has a series of multi-scale image distributions. It consists of multiple generators (Gs) and discriminators (Ds) in a tree-like structure, where the image quality gradually increases from low-resolution to high-resolution from different branches of tree. At each branch, generator tries to capture the image distribution whereas the discriminator estimates whether the sample image came from training dataset or generated by the generator by calculating corresponding probabilities of those steps. All the generators are trained jointly so that they can approximate the multiple

distributions, while the generators & the discriminators are trained in an alternative manner. 4.1. Multi-scale image distributions approximation StackGAN-v2 can adapt the noise vector z ~pnoise because of its tree structure. The p is taken as the standard normal distribution. The latent variable z are reshaped into hidden features layer by layer.




**3.1:** Fig Architecture of image generation through stages using stackGAN

**Attentional GAN**

Current GAN-based models for text-to-image generation [20, 18, 36, 37] typically encode the whole-sentence text description into a single vector as the condition for image generation, but lack fine-grained word level information. In this section, we propose a novel attention model that enables the generative network to draw different subregions of the image conditioned on words that are most relevant to those sub-regions.

Most recently proposed text-to-image synthesis methods are based on Generative Adversarial Networks (GANs) [6]. A commonly used approach is to encode the whole text description into a global sentence vector as the condition for GAN-based image generation [20, 18, 36, 37]. Although impressive results have been presented, conditioning GAN.Most recently proposed text-to-image synthesis methods are based on Generative Adversarial Networks (GANs) [6]. A commonly used approach is to encode the whole text description into a global sentence vector as the condition for GAN-based image generation [20, 18, 36, 37]. Although impressive results have been presented, conditioning GAN

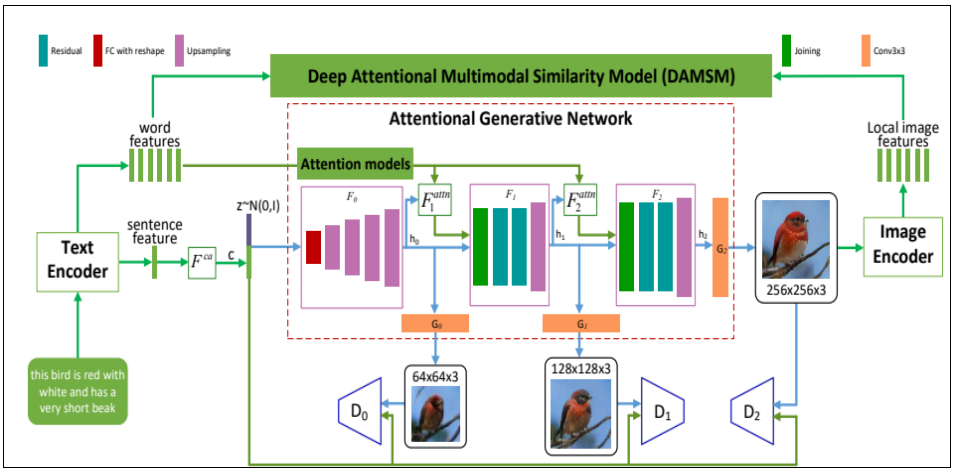
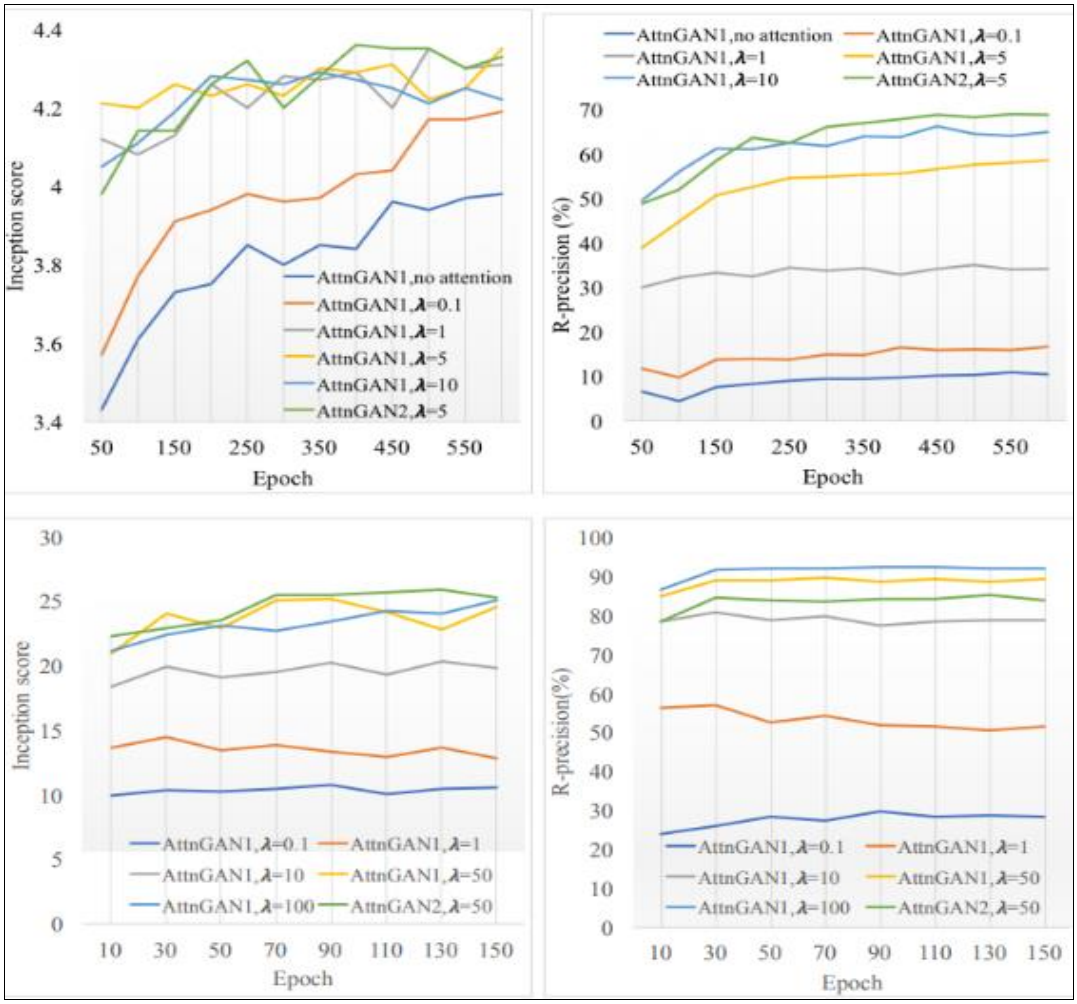



**Fig 3.2:** The architecture of the proposed AttnGAN. Each attention model automatically retrieves the conditions (most relevant word vectors) for generating different sub-regions of image

**Comparison**

Besides StackGAN-v2 [37], the proposed attention mechanisms can also be applied to the widely used DCGAN framework [17]. On the CUB dataset, we build an AttnDCGAN and a vanilla DCGAN. While the vanilla DCGAN conditioned only on the sentence vector (without the proposed attention mechanisms) is shown unable to generate plausible 256×256 images, our AttnDCGAN is able to generate realistic images. The AttnDCGAN achieves 4.12±.05 inception score and 38.45±4.26% R-precision. The vanilla DCGAN only achieves 2.47±.01 inception score and 3.69±1.82% R-precision because of severe mode collapse. The comparison result further demonstrates the effectiveness of the proposed attention mechanisms.

Figure 3. Inception scores and R-precision rates by our AttnGAN and its variants at different epochs on CUB (top) and COCO (bottom) test sets. For the text-to-image synthesis task, R = 1.




| Method | inception score | R-precision (%) |
|---|---|---|
| AttnGAN1, no attention | 3.98 ± .04 10.37± 5.88 | 3.98 ± .04 10.37± 5.88 |
| AttnGAN1, λ = 0.1 | 4.19 ± .06 16.55± 4.83 | 4.19 ± .06 16.55± 4.83 |
| AttnGAN1, λ = 1 | 4.35 ± .05 34.96± 4.02 | 4.35 ± .05 34.96± 4.02 |
| AttnGAN1, λ = 5 | 4.35 ± .04 58.65± 5.41 | 4.35 ± .04 58.65± 5.41 |
| AttnGAN1, λ = 10 | 4.29 ± .05 63.87± 4.85 | 4.29 ± .05 63.87± 4.85 |
| AttnGAN2, λ = 5 | 4.36 ± .03 67.82 ± 4.43 | 4.36 ± .03 67.82 ± 4.43 |
| AttnGAN2, λ = 50 | 25.89 ± .47 85.47 ± 3.69 | 25.89 ± .47 85.47 ± 3.69 |

Table 3.3 The best inception score and the corresponding Rprecision rate of each AttnGAN model on CUB (top six rows) and COCO (the last row) test sets.

In order to guarantee the image quality, we find the best value of λ for each dataset by increasing the value of λ until the overall inception score is starting to drop on a held-out validation set. "AttnGAN1" models are built for searching the best λ, based on which a "AttnGAN2" model is built to generate higher resolution images. Due to GPU memory constraints, we did not try the AttnGAN with three attention models. As the result, our final model for CUB and COCO is "AttnGAN2, λ=5" and "AttnGAN2, λ=50", respectively. The final λ of the COCO dataset turns out to be much larger than that of the CUB dataset, indicating that the proposed LDAMSM is especially important for generating complex scenarios like those in the COCO dataset.

## UML Diagrams

**Use case diagram**: use case diagram describing the interaction between a user and a system for generating images, likely using artificial intelligence methods such as GANs (Generative Adversarial Networks). Here's the breakdown of the elements in bullet points:

### Actors

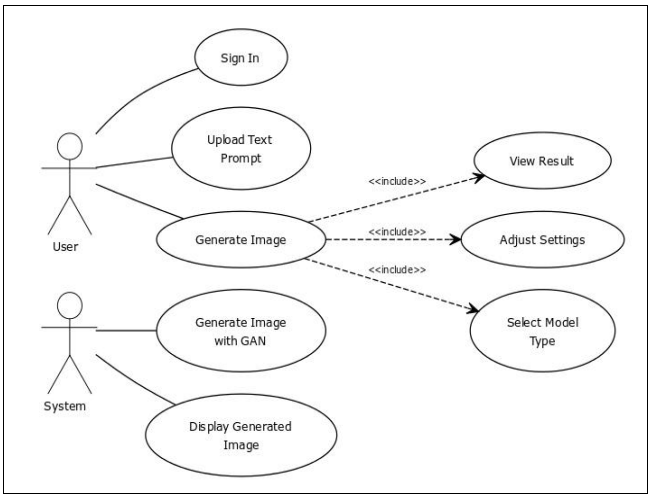



**Fig 4.1:** use case diagram

**User**
- Can sign in.
- Uploads a text prompt to generate images.
- Views the results.
- Adjusts settings (e.g., image size, resolution, or style).
- Selects the model type for generating images.

**System**
- Handles the process of generating images using GANs.
- Displays the generated images.

**Use Cases**
**Sign In:** Allows the user to access the system.

**Upload Text Prompt**: User provides a description or text input as the basis for generating an image.

**Generate Image**
- Central functionality where the system creates an image based on the user's input.
- Includes optional sub-functions:

**View Result:** View the image generated by the system.
**Generate Image with GAN:** The system uses GANs to create a more realistic or specific type of image.

**Display Generated Image:** The final output, showing the image to the user**.**

**Activity diagram:** workflow diagram that outlines the process for generating images based on input.

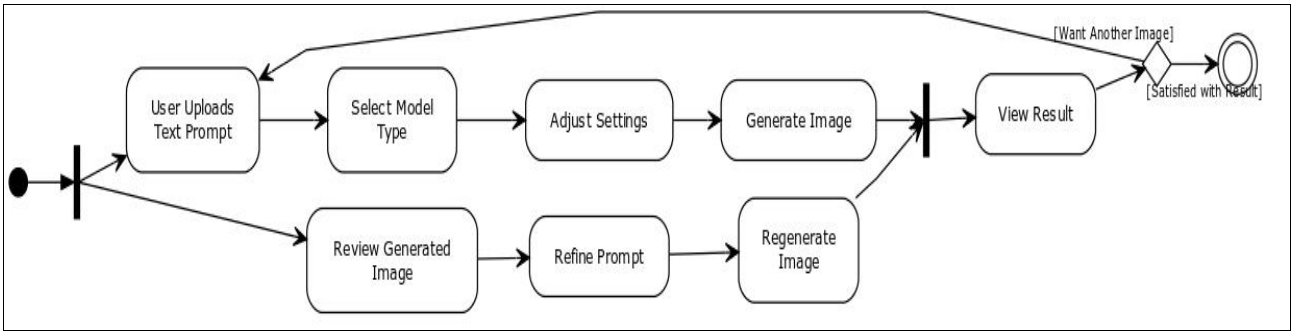



**Fig 4.2:** activity diagram

**Start**: The process begins with the user uploading a text prompt.

**Select Model Type**: The user chooses the type of model (e.g., GAN, diffusion model) for generating the image.

**Adjust Settings:** The user modifies parameters like resolution, style, or other generation settings.

**Generate Image:** The system processes the prompt and settings to create the image.

**View Result:** The generated image is displayed to the user for review.

**Decision Point**
- Satisfied with Result: If the user is happy with the output, they end the process or opt to create another image.

**Want Another Image:** If the user is dissatisfied, they can refine the prompt, regenerate the image with adjustments.

**Regenerate Image:** The refined prompt or settings are used to produce another image.

**End:** The process concludes after the user is satisfied with the result.

**Class diagram**
**This is a class diagram for an AI-based image generation system. Key components are**
**Customer (User)**
- Attributes: username, email, password.
- Action: submitPrompt(prompt).

**TextPrompt**
- Attributes: content, style, timestamp.
- Method: validate ().

**ImageGenerationRequest**
- Attributes: id, status.
- Methods: process Request (), generateImage ().

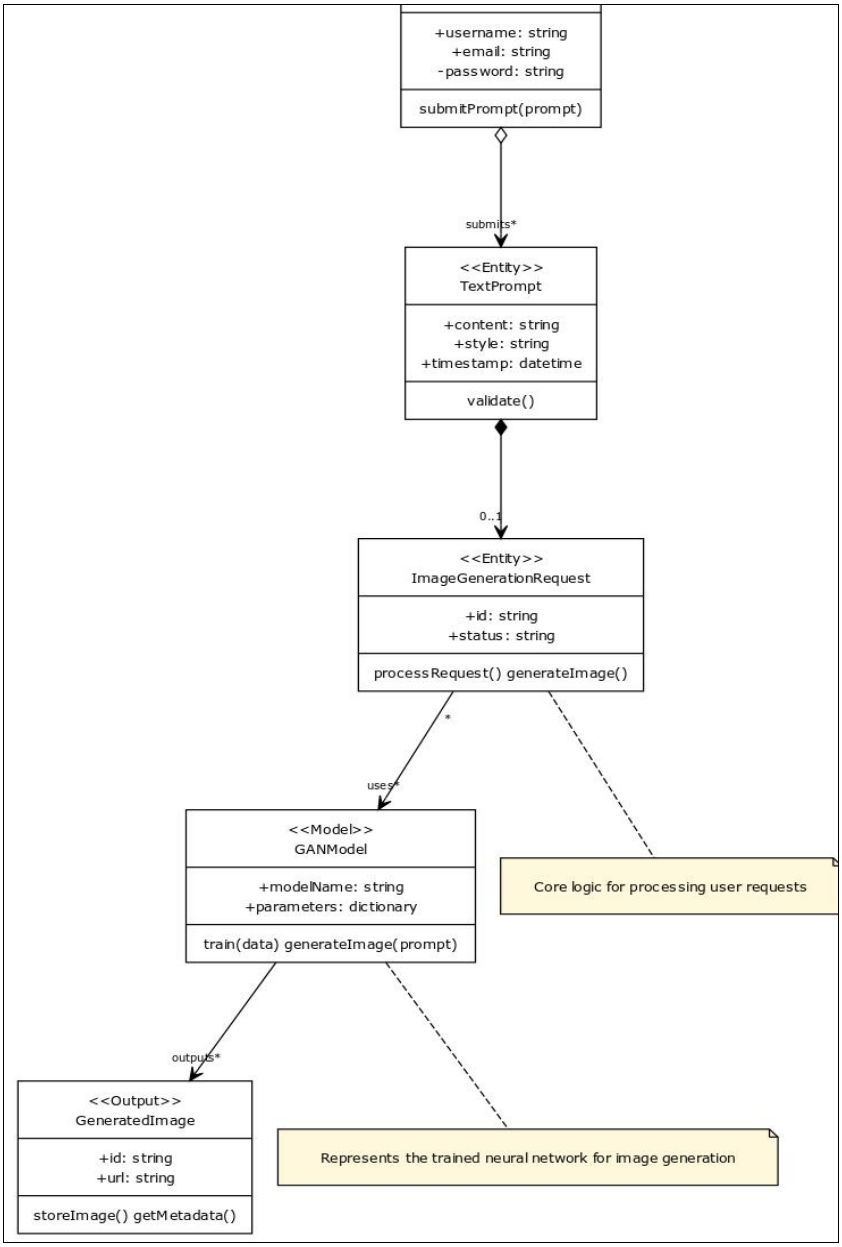
**GAN Model**
- Methods: train(data), generateImage(prompt).

**GeneratedImage**
- Attributes: id, url.
- Methods: storeImage (), getMetadata ().

Fig 4.3 class diagram

**Conclusion**
This project highlights the transformative potential of Generative Adversarial Networks (GANs) in the fashion industry by demonstrating a system capable of generating fashion images from textual descriptions. Our system, trained on a comprehensive dataset of fashion images and descriptions, successfully bridges the gap between textual prompts and visual outputs, enabling users to visualize fashion concepts without requiring advanced design skills. The implications for designers, retailers, and consumers are substantial, offering benefits such as accelerated design processes, improved personalization, and enhanced online shopping experiences.
While the project has shown promising results, there are challenges to address, including the high computational

resources required for training GANs and the ethical considerations related to bias in fashion data. Addressing these issues will be critical in ensuring that the technology promotes fairness, inclusivity, and accessibility. Our research provides a strong foundation for future advancements in AI-driven fashion, paving the way for a world where technology and creativity converge. This convergence has the potential to make fashion design accessible to a wider audience, empowering people to express themselves through fashion in new, innovative ways. With continued development, AI could reshape the fashion industry, creating tools that allow anyone to bring their fashion ideas to life with just a few words, ultimately shaping the future of fashion design and retail




**Attributes:** Modelname, parameters.

**Future scope**

The integration of AI and fashion design opens many exciting avenues for future advancements. As our project progresses, there is potential to incorporate advanced deep learning architectures, such as multimodal transformers, to enhance the alignment between textual descriptions and generated images. This would allow for even more nuanced interpretations of descriptions, resulting in fashion images that better capture user intent. Additionally, future work could focus on adding customization options, allowing users to make specific modifications to generated images, such as adjusting colors, patterns, or garment details. By implementing real-time user interaction, the system could offer instant feedback and refinement, creating a more dynamic and personalized experience.

Our project also has applications beyond design. By partnering with e-commerce platforms, we could bring features like virtual try-on and personalized fashion recommendations directly to consumers, improving the online shopping experience and potentially increasing sales conversion rates. The system could be expanded to offer a broader range of fashion styles, including those inspired by various cultures and body types, promoting inclusivity and diversity in generated designs. Further, incorporating user feedback loops would allow the model to learn and adapt over time, enhancing its ability to generate images that

resonate with a wide variety of individual preferences and fashion trends.

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