FYP

TextPixs (Text to Image)

Research Based Project

Syeda Anshrah Gillani (1337-2021)
Umema Mujeeb (2396-2021)
Maheen Ali (1589-2021)

Internal Supervisor
Sir Osama Ahmed Khan
External Supervisor & Project Sponsor
Mirza Samad Ahmed Baig

Department of Computing, FEST
Hamdard University

Summary

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Problem Statement

"Accurate image generation and text rendering within images remains a significant challenge, limiting applications in educational tools, design automation, and digital art. Issues include ambiguity in text prompts, alignment challenges, and lack of robust loss functions for text fidelity."

Objective

- Enhance rendering of image via text-to-image generation using state-of-the-art techniques.
- Improve text fidelity and visual quality in generated images.
- Develop a novel hybrid architecture with semantic alignment and text rendering loss.

FYP Scope

- To address limitations in existing models like GANs, transformers, and diffusion models.

- Focus on text fidelity improvements to advance applications in content creation, advertising, and human-computer interactions.

Literature Review (Gap analysis)

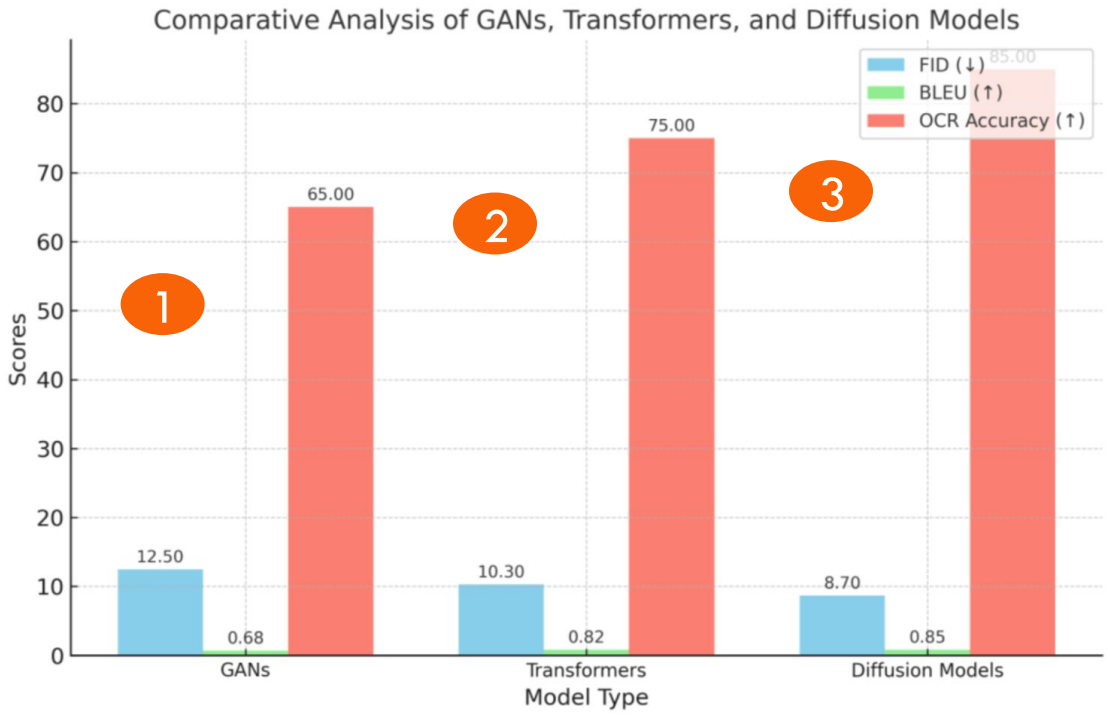
In summary, the gap analysis across all three members' research reveals several key areas for improvement in the text-to-image field, such as:

1. Annotation and Dataset Complexity:
Reducing reliance on annotated data and exploring semi-supervised methods.

2. Text-Image Coherence:
Enhancing the connection between the textual input and visual features, especially for complex or abstract text.

3. Evaluation Metrics:
Developing more comprehensive evaluation methods that go beyond quantitative metrics and incorporate subjective, human-centered assessment.

Literature Review (Comparative Analysis)



LEGEND

FID (Fréchet Inception Distance):
Measures the quality and realism of generated images by comparing their distribution to real images.

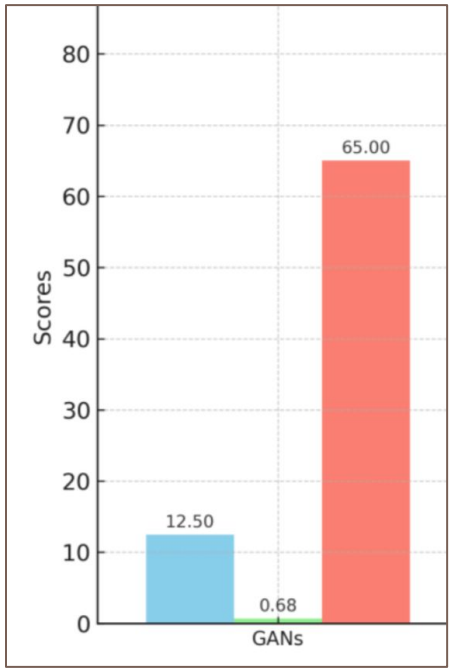
BLEU (Bilingual Evaluation Understudy):
Evaluates the accuracy of machine-translated text by comparing it to human references using n-gram overlap.

OCR Accuracy:
Assesses how accurately an Optical Character Recognition (OCR) system converts scanned text into digital text.

Figure 4: Bar graph showing the comparative analysis of GANs, Transformers, and Diffusion Models based on FID, BLEU, and OCR accuracy. The graph highlights the performance differences across the three model types.

Literature Review (Comparative Analysis)

1



GANS - Random samples generated for human faces.

Literature Review (Comparative Analysis)

2

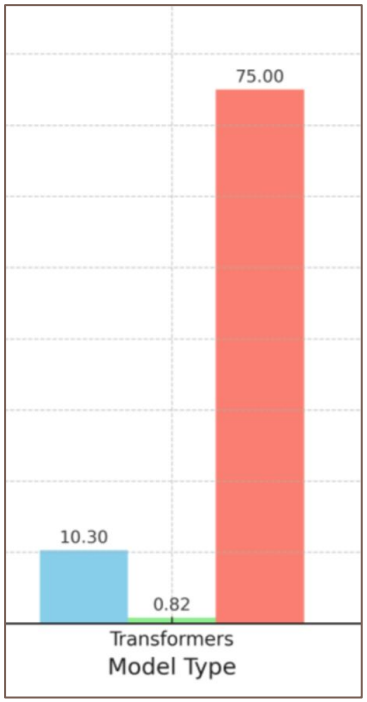


Image Transformer

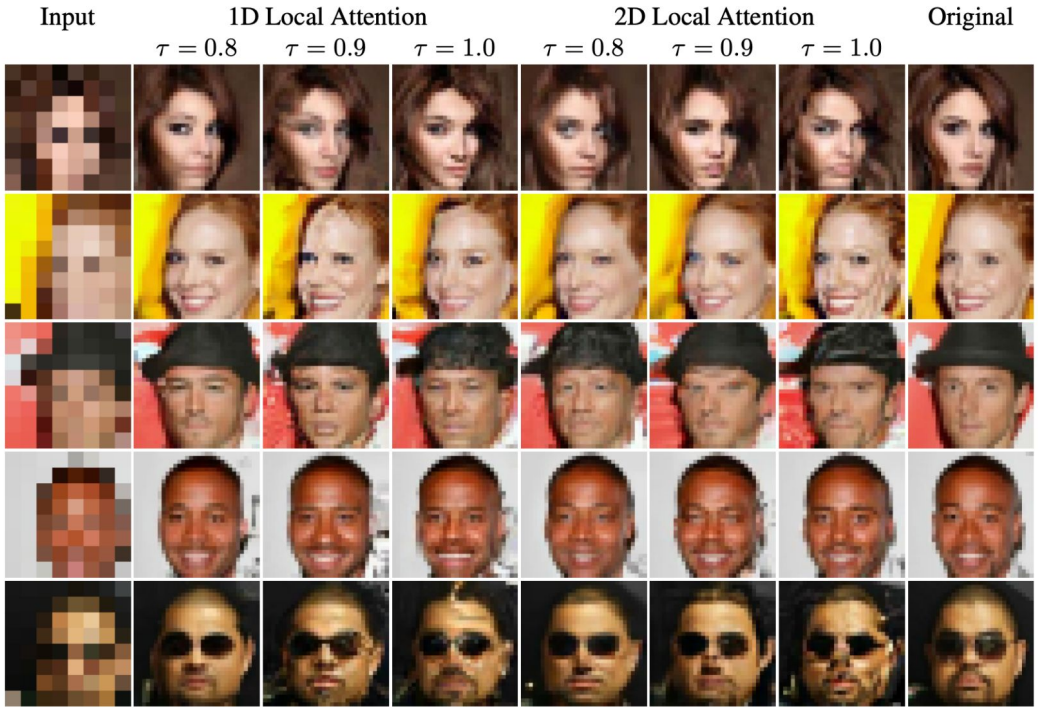
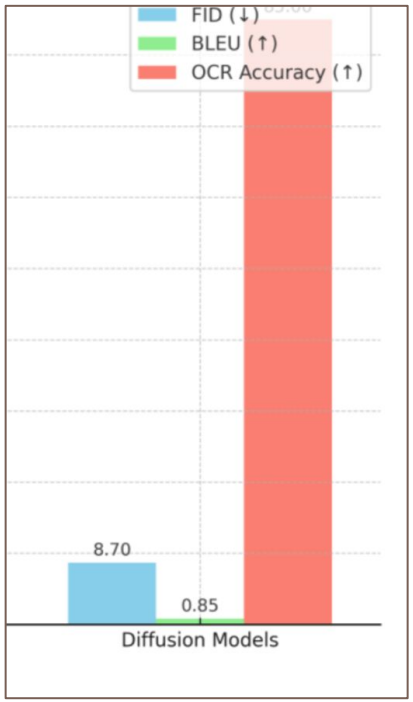


Table 6. Images from our 1D and 2D local attention super-resolution models trained on CelebA, sampled with different temperatures. 2D local attention with $\tau = 0.9$ scored highest in our human evaluation study.

TRANSFORMERS - Random samples generated for human faces.

Literature Review (Comparative Analysis)

3



Multi-Modal-Driven Face Generation

DIFFUSION - Random samples generated for human faces.

Challenges in existing systems

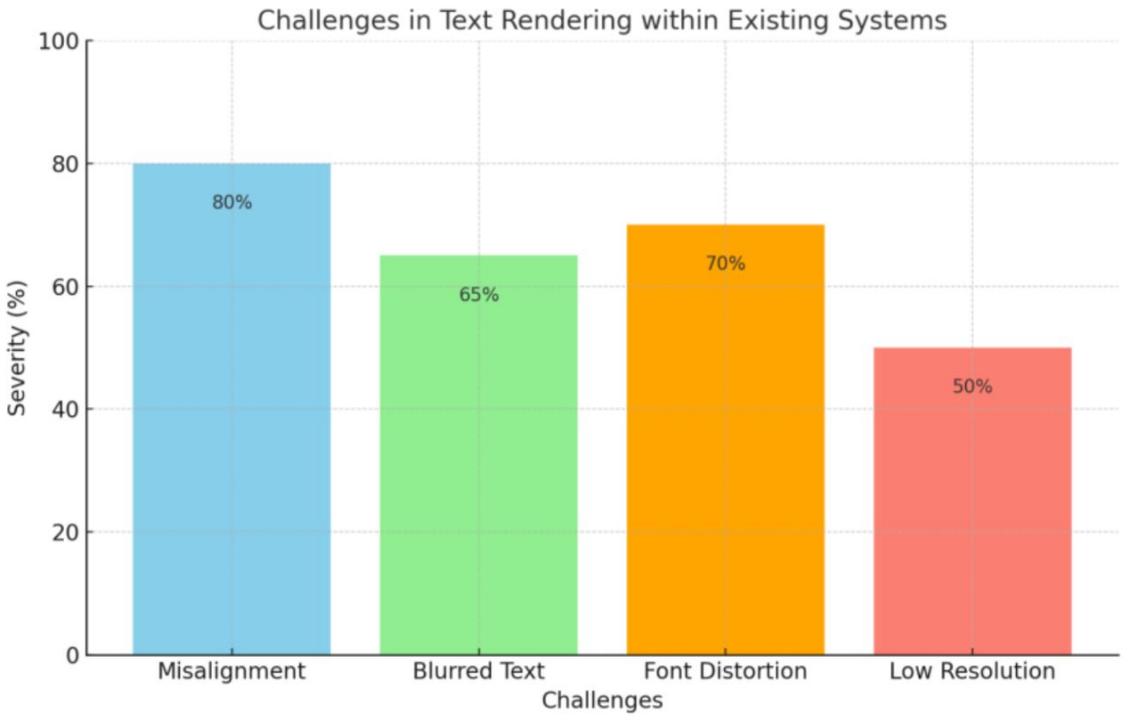
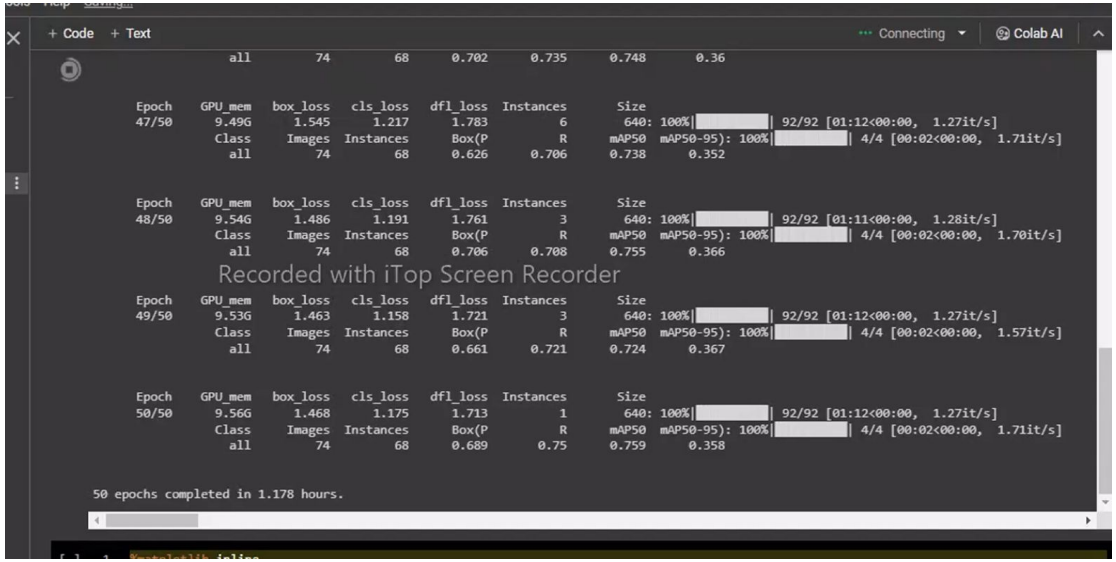


Figure 1: Illustration of text rendering challenges in existing systems, highlighting issues such as misalignment, blurred text, font distortion, and low resolution.

Model Training / Fine-Tuning

Result

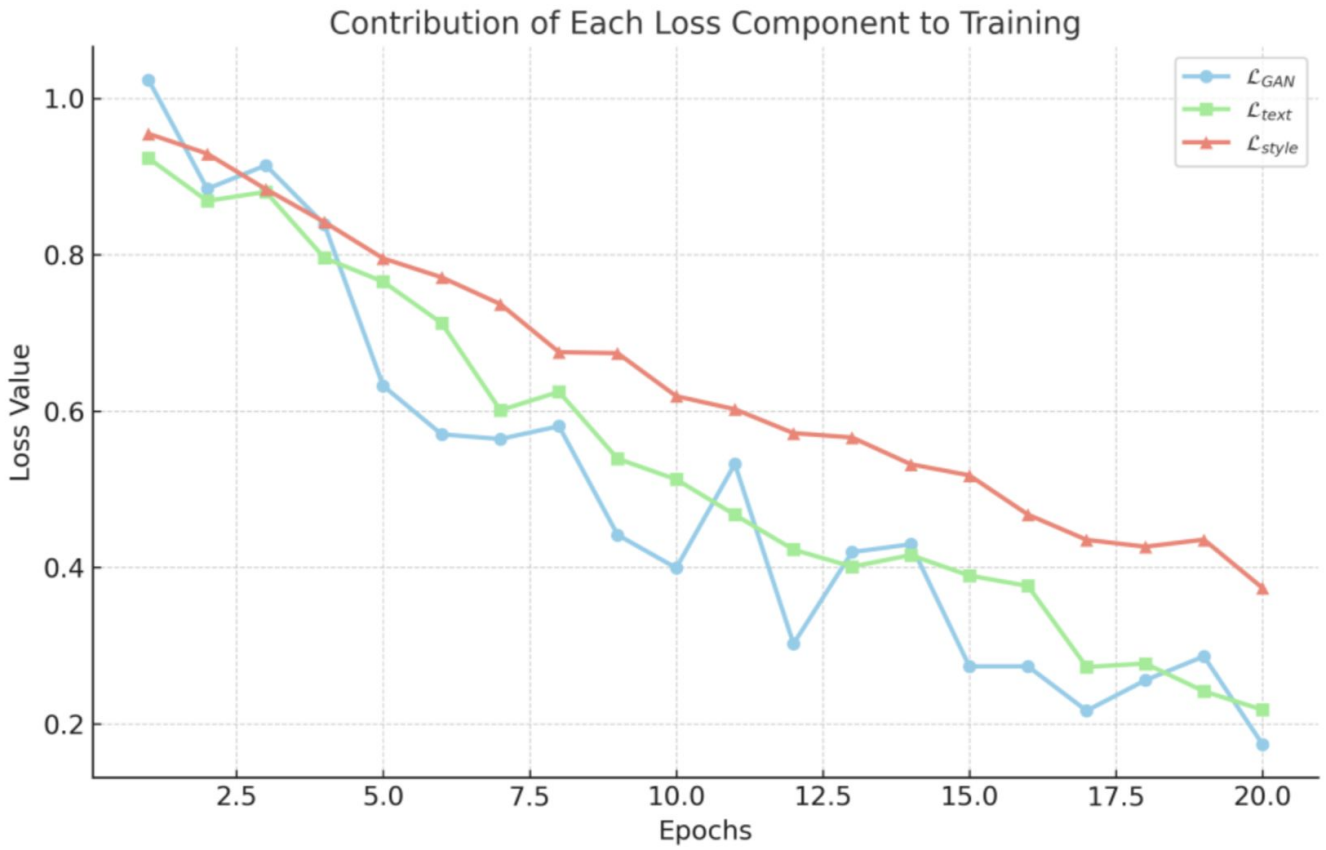
Fine Tuning / Training



Medium dataset (~50k-100k samples) → 20-70 epochs

Prompt:
Generate a logo for project named “Textpixs” for uiux purpose.

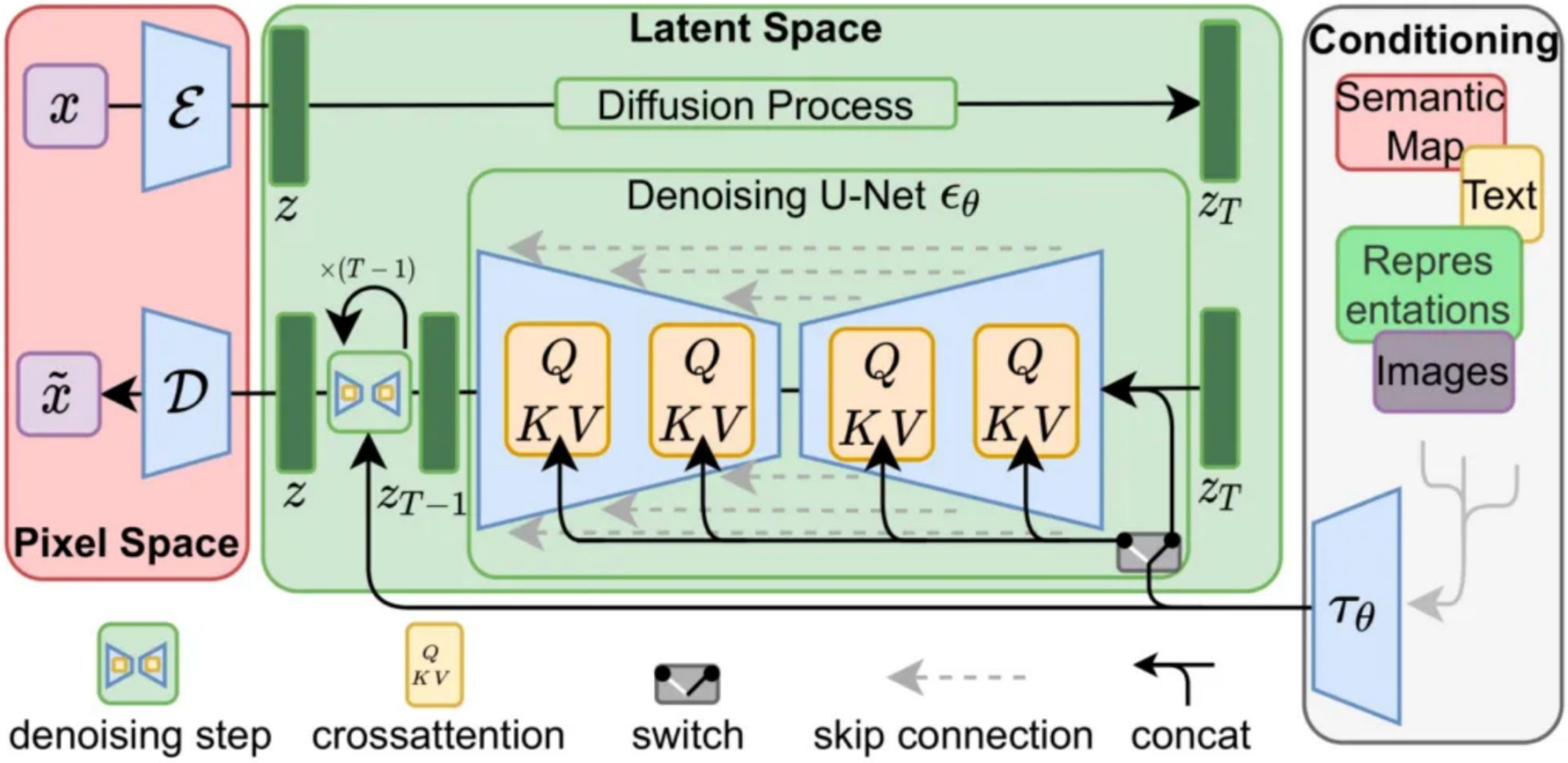
Contribution of each loss component to training



LEGEND

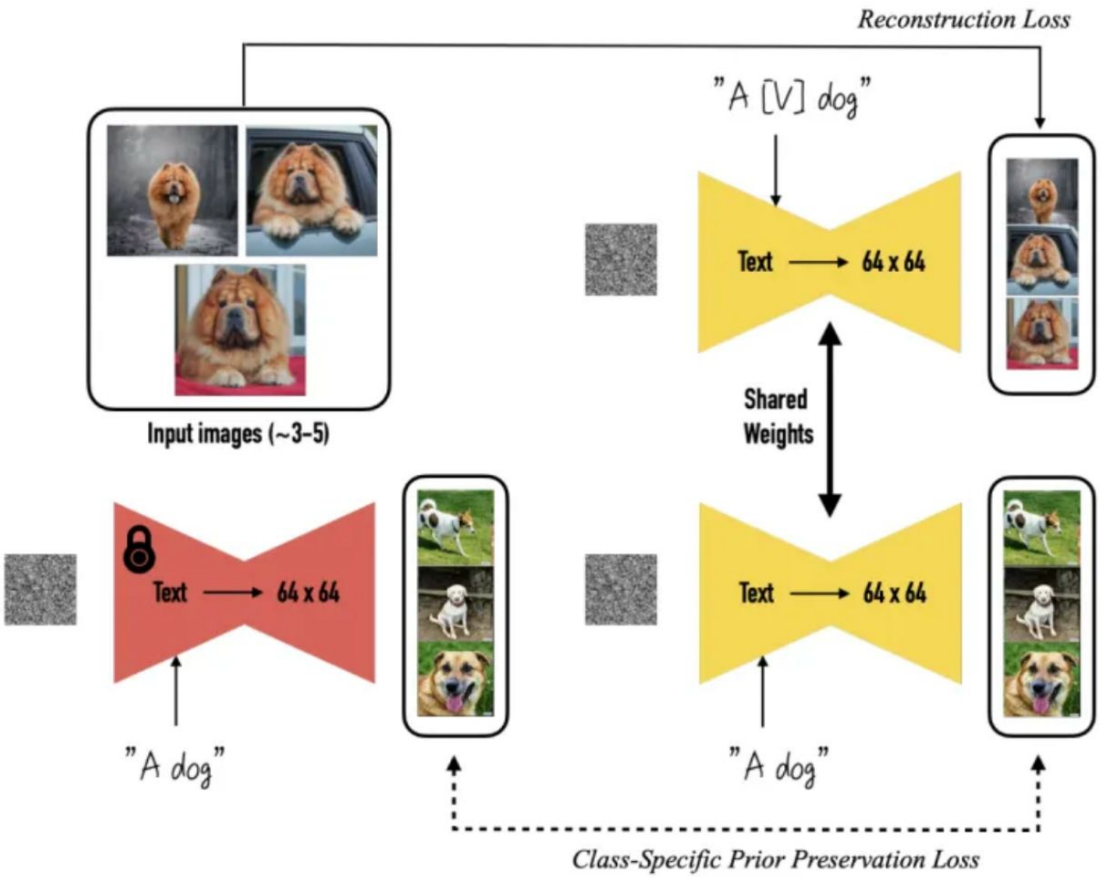
- LGAN : Adversarial loss for image synthesis.
- Ltext: Text rendering loss.
- Lstyle: Style consistency loss.

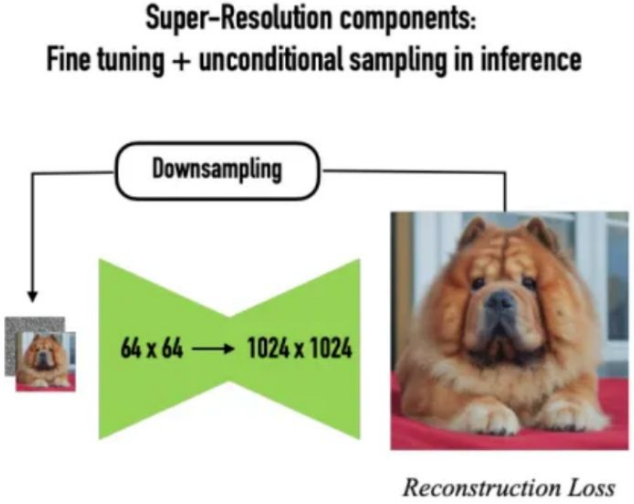
How it works - Architecture



Architecture of Stable Diffusion Model

How it works - Architecture





Fine tuning a stable diffusion model

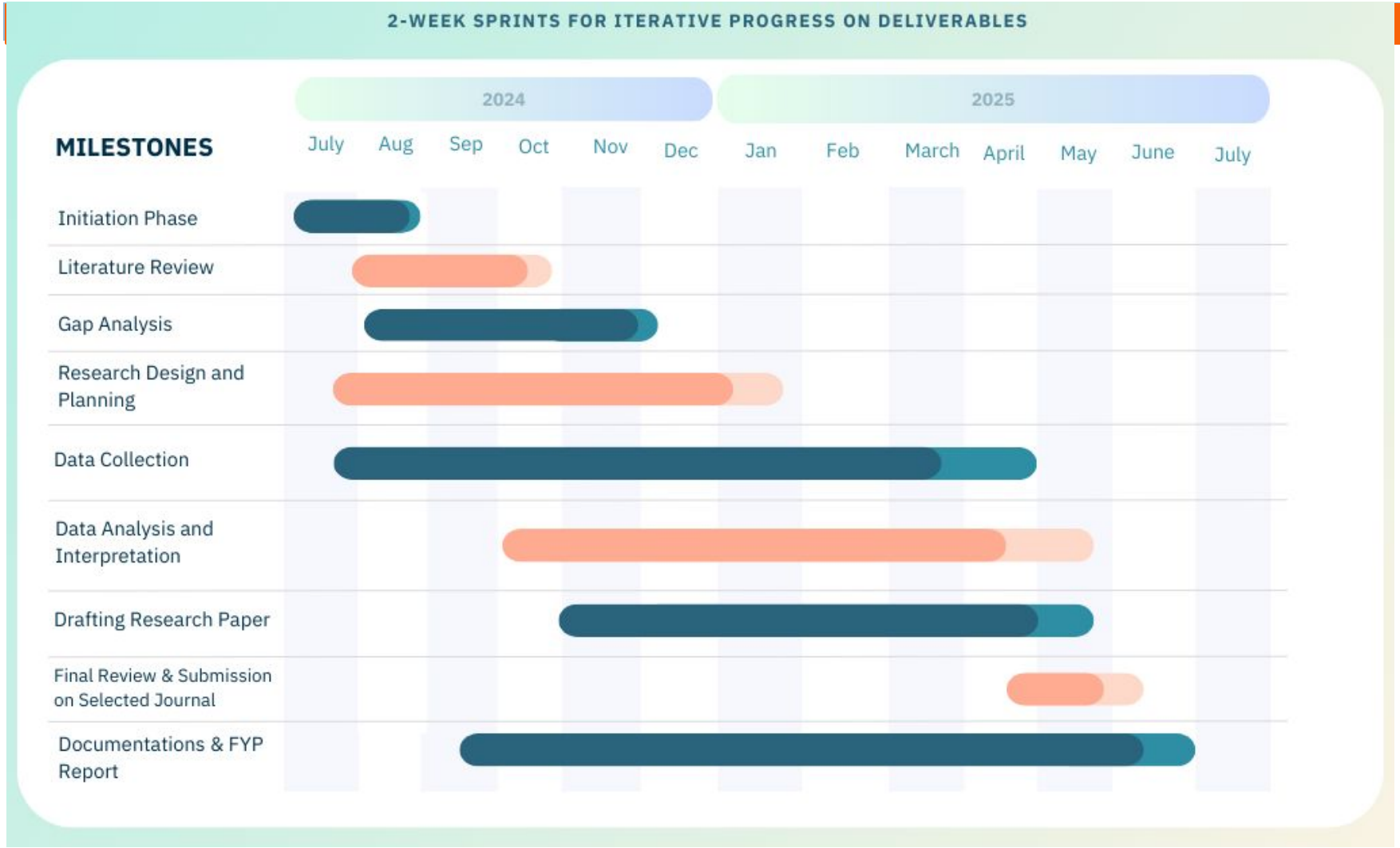
Our Methodology

- The Agile Scrum methodology is ideally suited for the "Text Pixs" project, aiming to advance text-to-image generation technology.

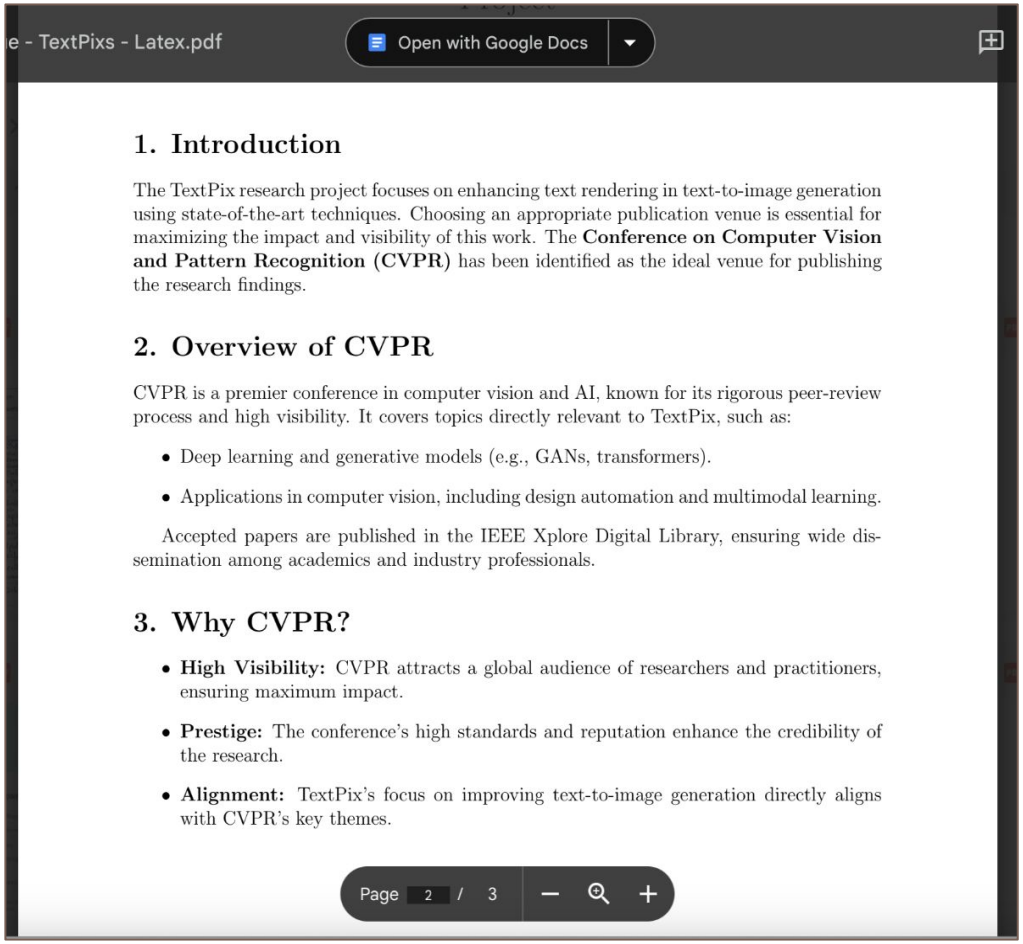
WHY?

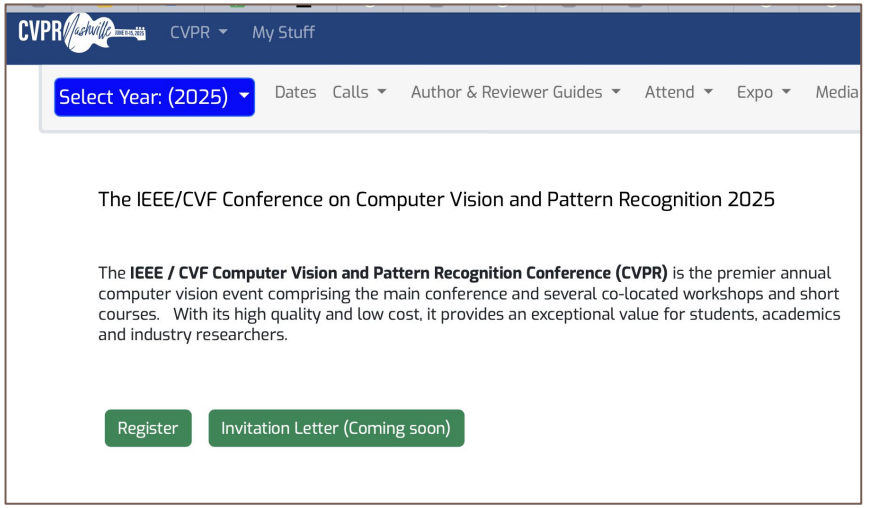
- Agile Scrum is chosen because it facilitates flexibility, iterative development, and continuous feedback loops, which are essential for refining the Recurrent Convolutional Generative Adversarial Network (RC-GAN). The project involves diverse tasks such as data preprocessing, model refinement, and performance evaluation, each requiring focused development cycles. By breaking down these tasks into manageable sprints, the team can prioritize effectively and adjust strategies based on evolving requirements and feedback. This iterative approach ensures that the RC-GAN model can evolve dynamically, meeting the project's goals of enhancing image fidelity and semantic accuracy.

Our Project Plan

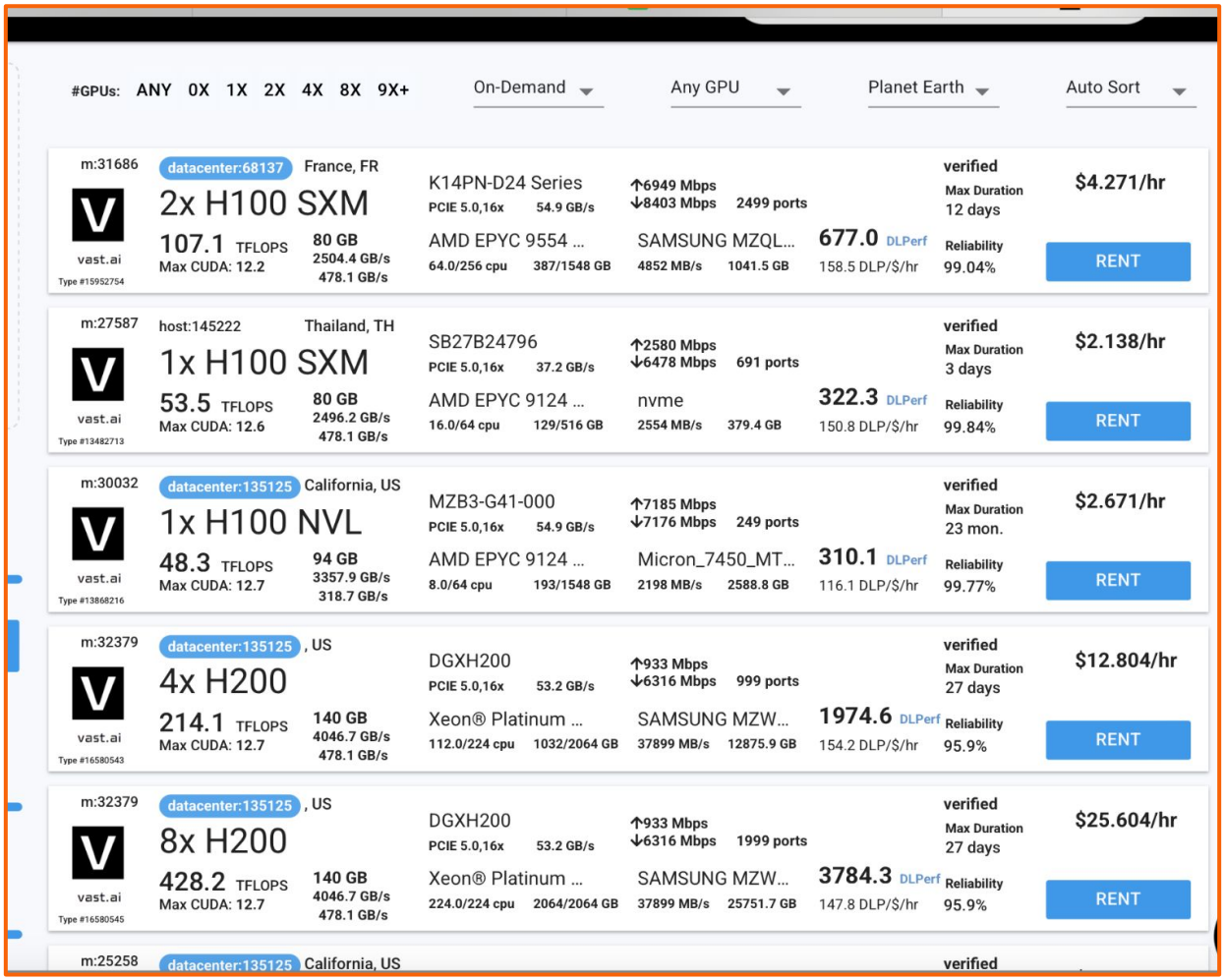


Selected Publication Venue - CVPR





Budget / Costing - Vast.ai



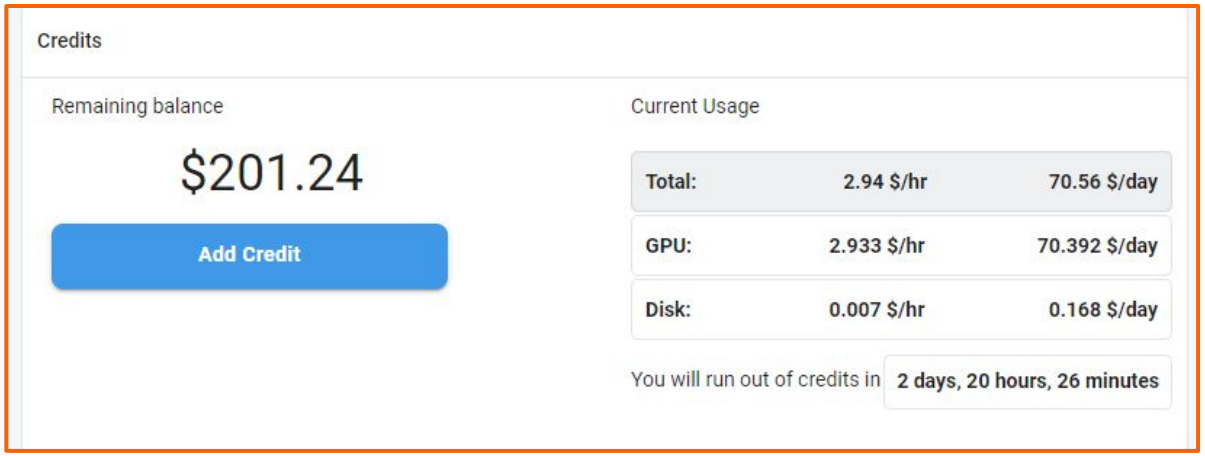
Budget / Costing

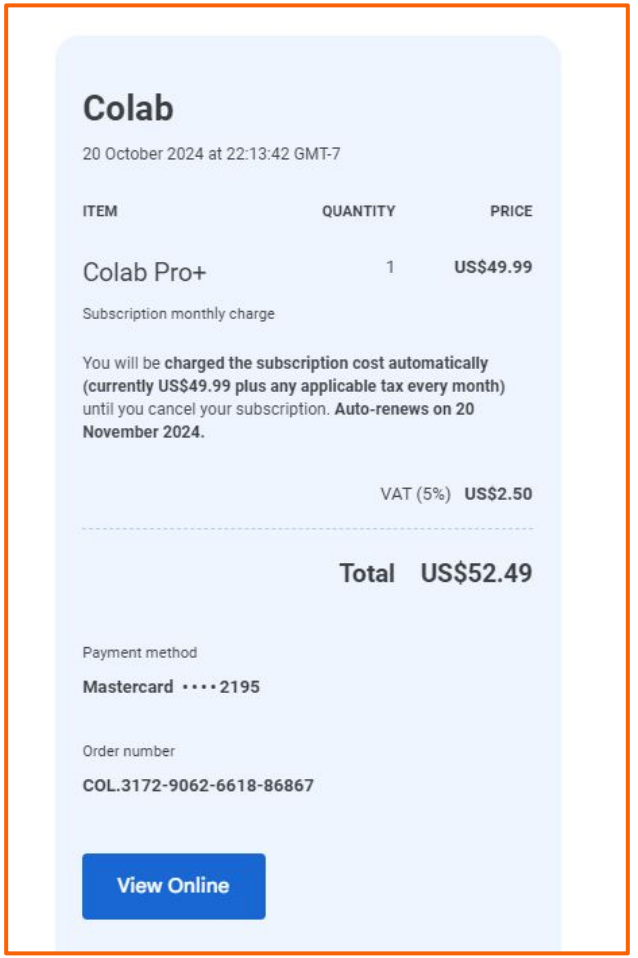
1. GPU/Vast.ai

   We initially added $700 this semester in vast.ai

2. Colab Pro+

   Subscribed to colab pro+ for daily heavy tasks





Budget / Costing

- **Cloud GPU Cost Detail:**
- **Nebius H100 SXM 5 GPU:** $3.15 per hour
  - **Estimated Usage:** 500 - 1,000 hours
  - **Cost Range:** $1,575 - $3,150
- **Total Cost: $4,675 - $11,700**

Category	Item	Estimated Cost
Hardware and Software	High-Performance Laptop/Desktop	$1,200 - $2,500
	Dedicated GPU	$800 - $2,500
	Cloud Computing Credits	$1,575 - $3,150
	Software Licenses	$200 - $400
	Storage Devices	$100 - $300
Data and Resources	Dataset Acquisition	$100 - $500
	Data Annotation	$200 - $600
Team and Development	Research Materials	$50 - $150
	Conference and Workshop Fees	$100 - $300
Miscellaneous	Printing and Stationery	$50 - $100
	Travel Expenses	$100 - $300
	Contingency	$200 - $400
Total		$4,675 - $11,700

FYP Deliverables

FYP-I

- Project Proposal, Scope and Plan
- Definition Literature
- Gap/Comparative Analysis
- Model Selection and Initial Training
- Research Paper Draft
- Selection of Publishing Venue
- Feedback Incorporation

FYP-II

- Feedback Incorporation
- Algorithm refinement and improvement
- Documentation of Research
- Algorithm Testing and Validation
- Final Research Draft.
- Submission to Journal for Publication
- Final Research
- Final Presentation and Submission

Some References

References

1. **Ramesh et al. (2021)**: *Zero-Shot Text-to-Image Generation*. arXiv:2102.12092
2. **Xu et al. (2018)**: *AttnGAN: Fine-Grained Text-to-Image Generation with Attentional GANs*. CVPR
3. **Saharia et al. (2022)**: *Photorealistic Text-to-Image Diffusion Models*. arXiv:2205.11487
4. **Goodfellow et al. (2014)**: *Generative Adversarial Networks (GANs)*. arXiv:1406.2661
5. **Zhang et al. (2017)**: *StackGAN: Text to Photo-Realistic Image Synthesis with Stacked GANs*. ICCV
6. **Dosovitskiy et al. (2021)**: *An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale*. ICLR

THANK YOU!