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Semantic Draw: Towards Real-Time Interactive Content Creation from Image Diffusion Models

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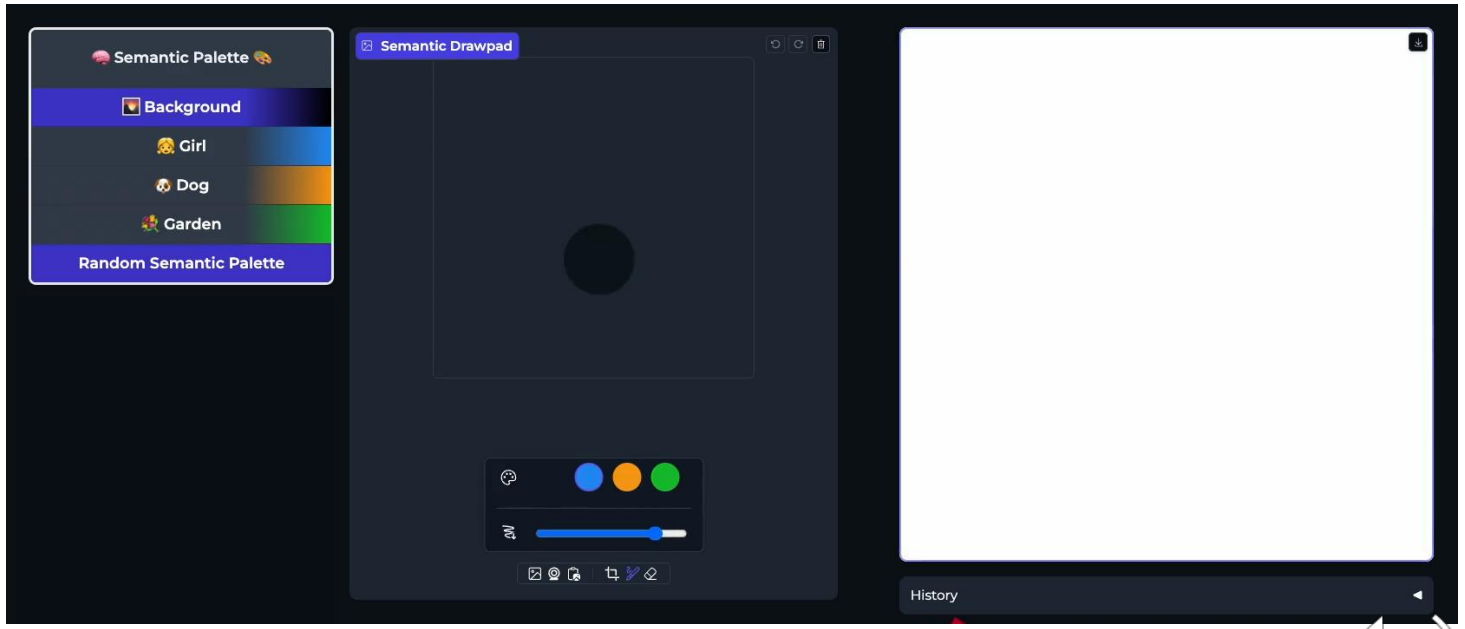
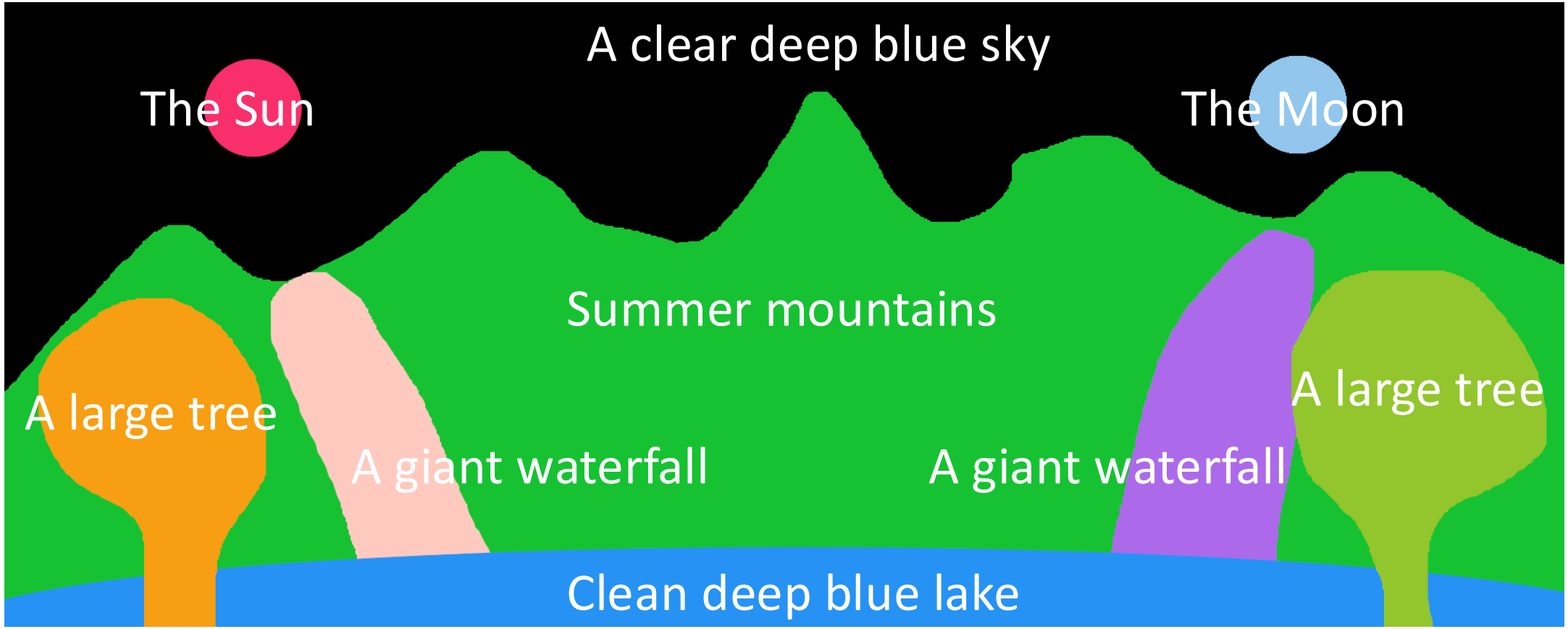
Seoul National University



Motivation

Irworobongdo, Korean royal folding screen, Joseon Dynasty.

Motivation



1280 X 768 prototyping of Irworobongdo with 9 prompt-mask pairs.

Motivation

SLOW!

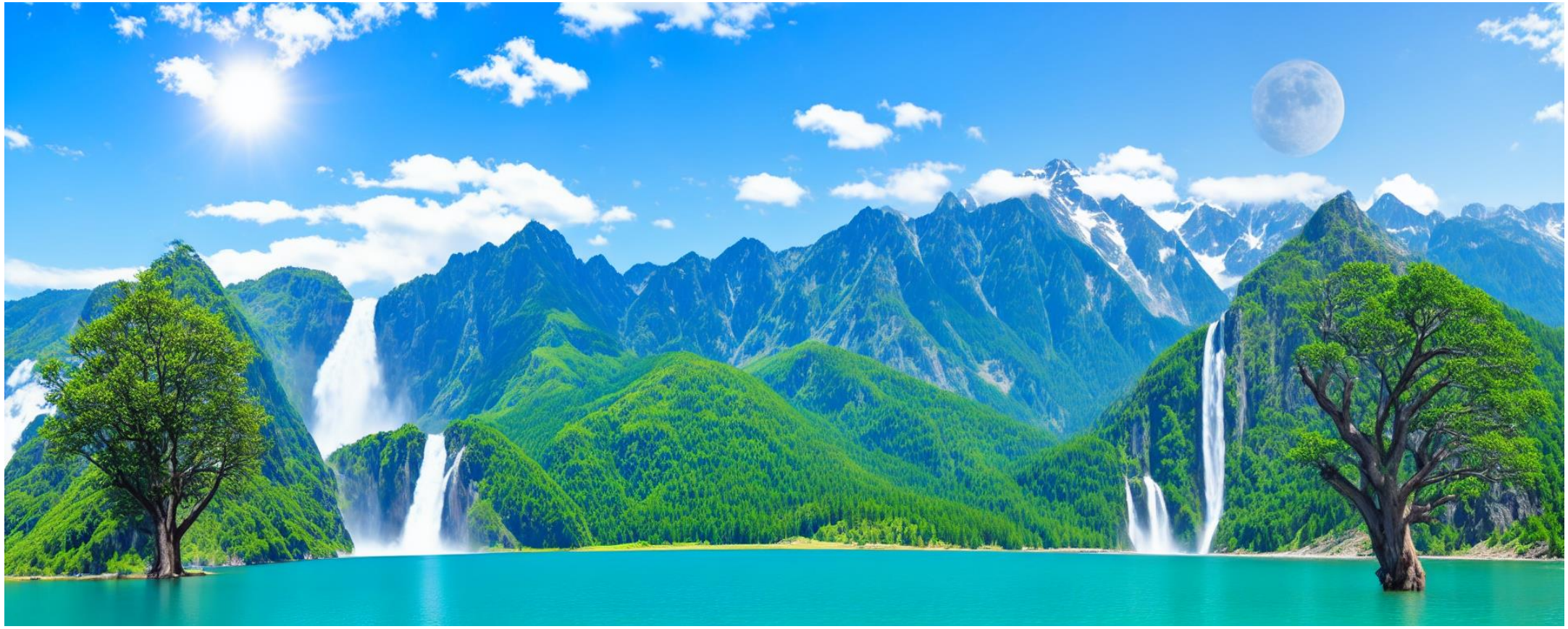
Inconsistent!

MultiDiffusion, took 51 minute 39 seconds.

Motivation

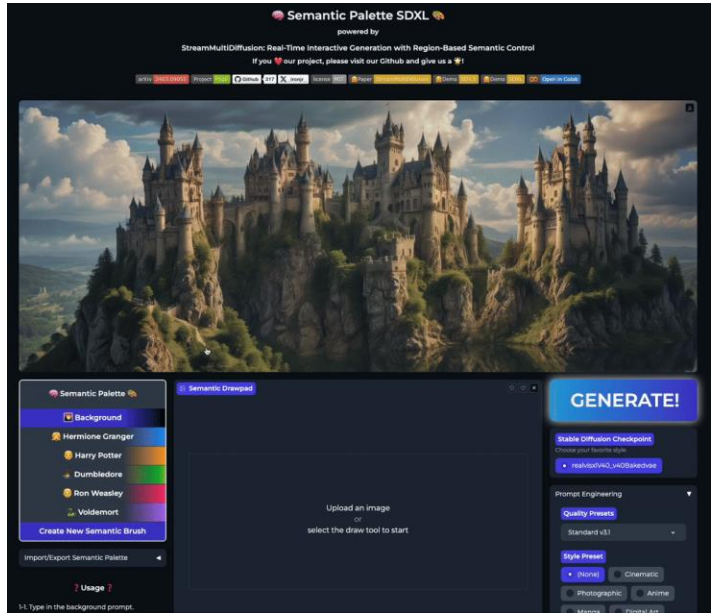
MD + LCM, took 4 minute 47 seconds.

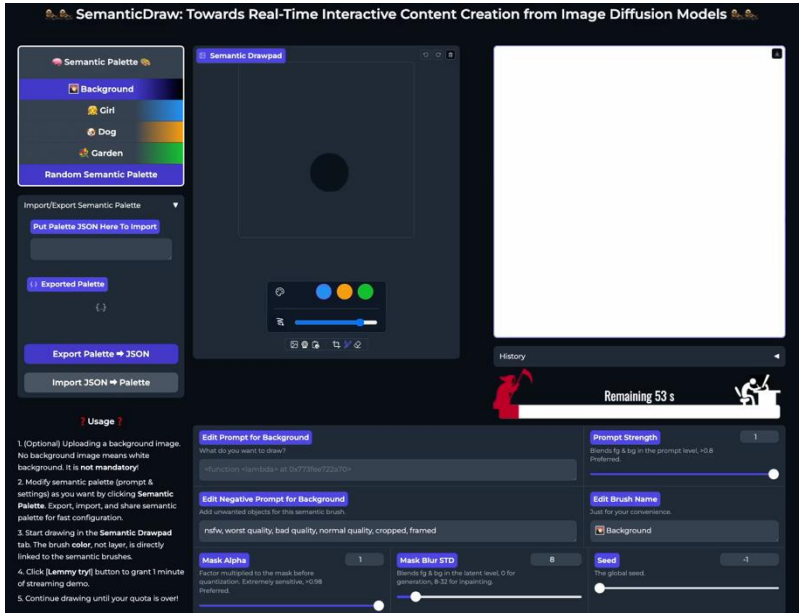
Motivation



Ours, took 59 seconds.

Our Solution





Establish compatibility:

Up to 50x faster

multi-prompt generation

Maximize throughput with

Multi-Prompt Stream Batch

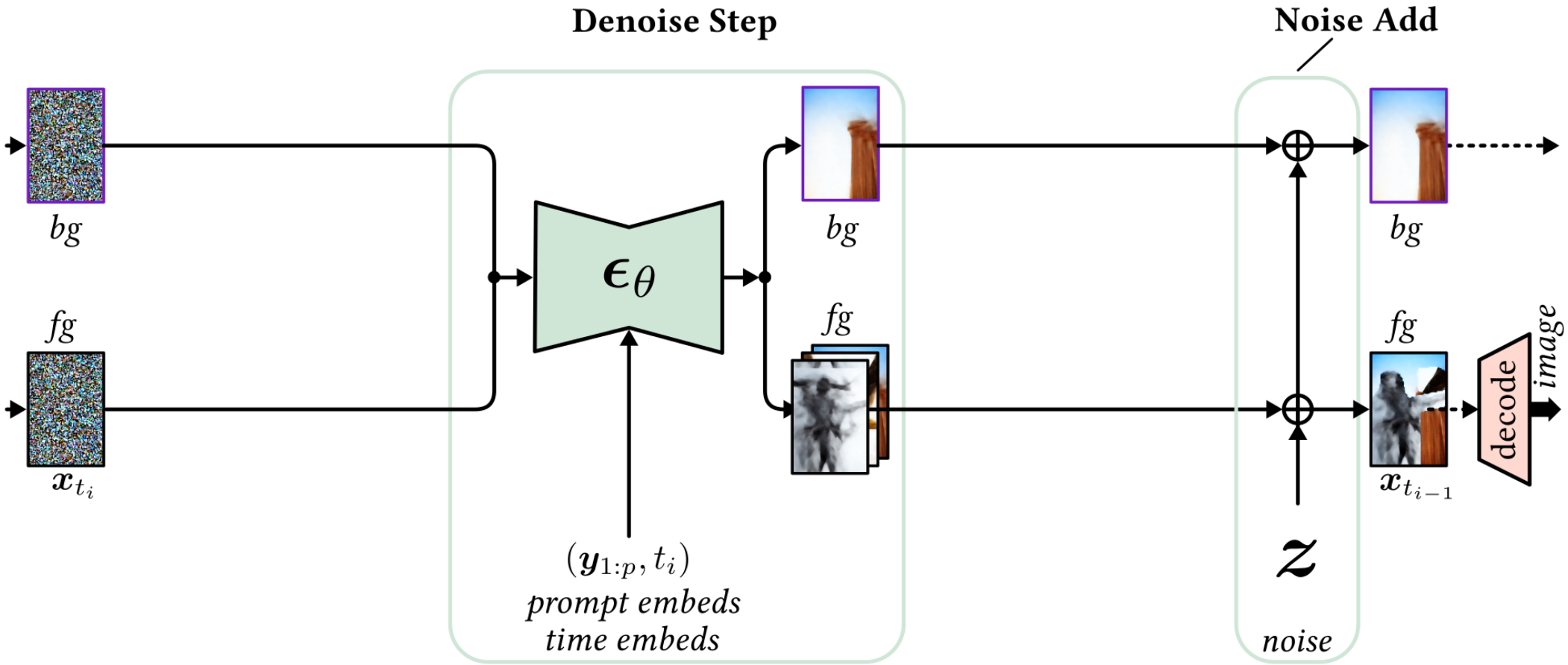
pipeline architecture

New Drawing Paradigm:

Semantic Draw

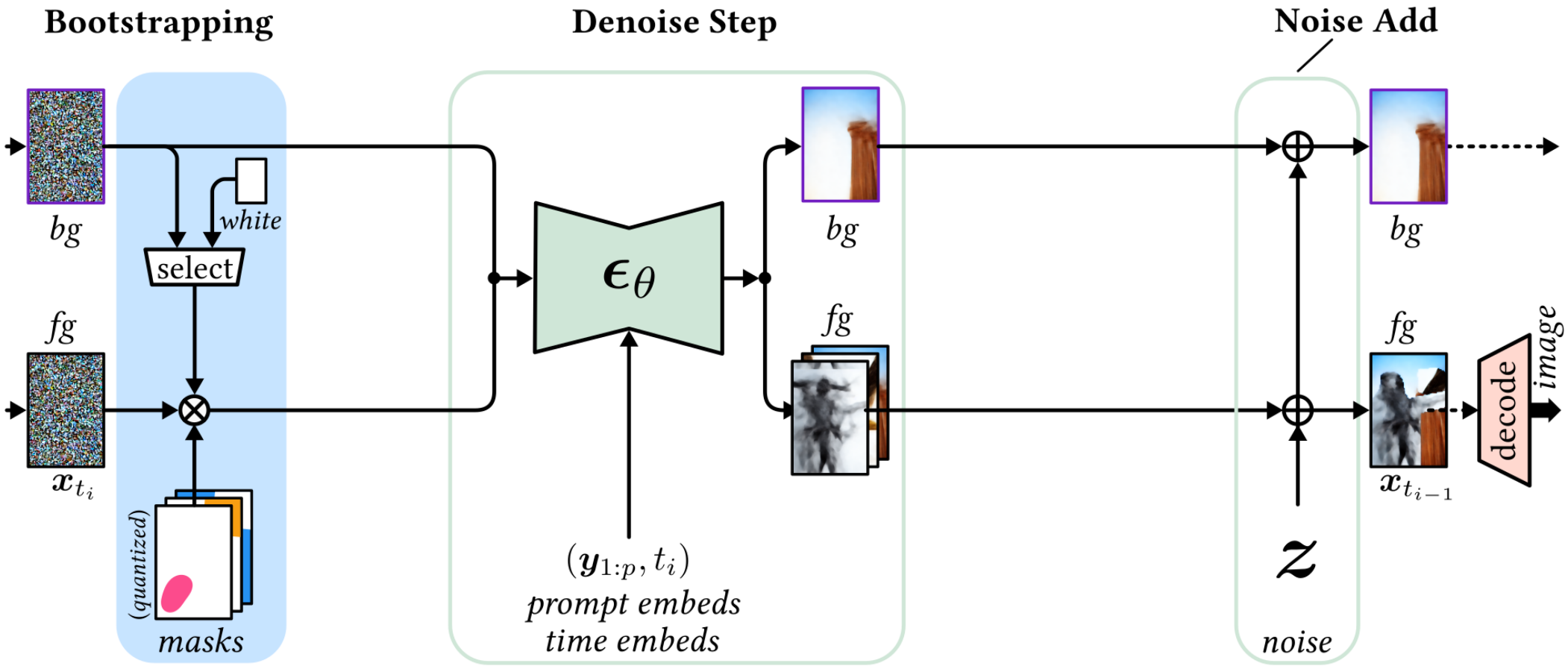
with demo applications

Method: Redesigning the Pipeline



(a) Any image diffusion pipeline can be augmented with our compatibility module.

Method: Redesigning the Pipeline



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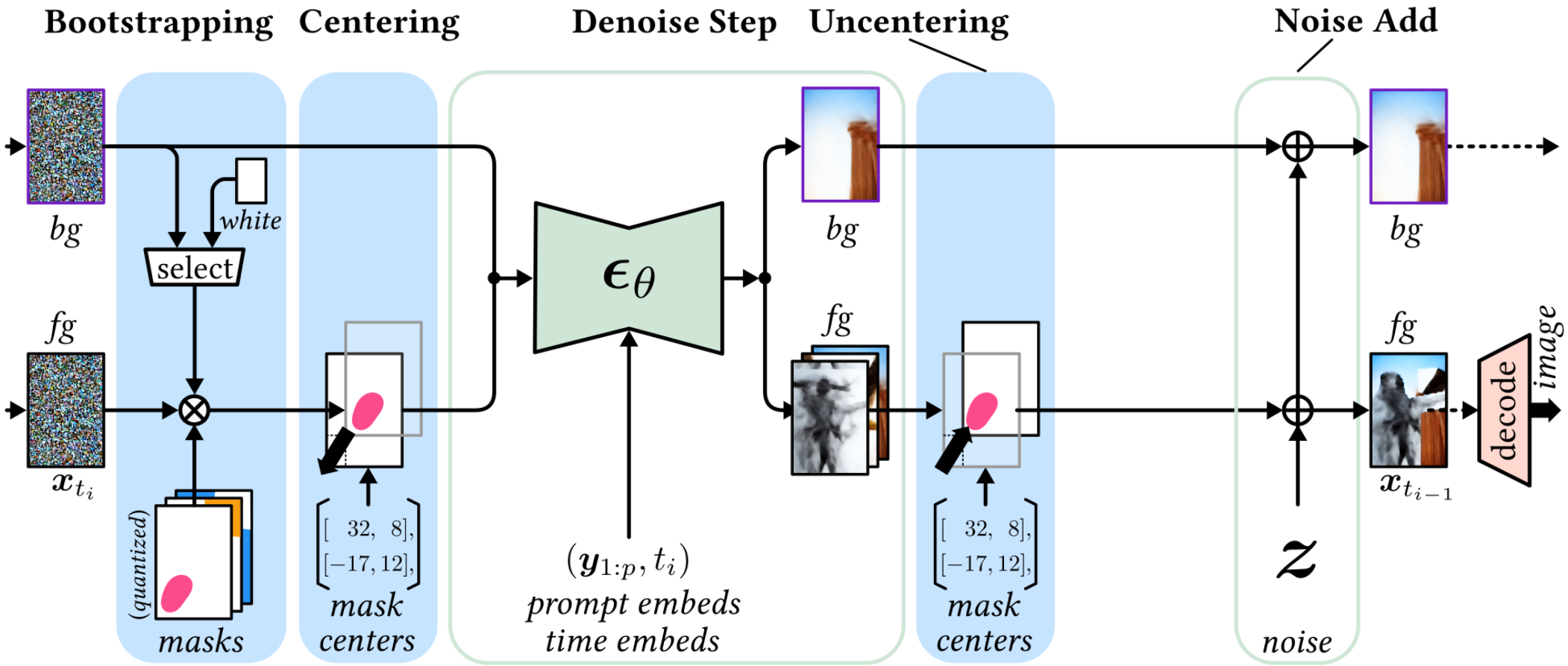

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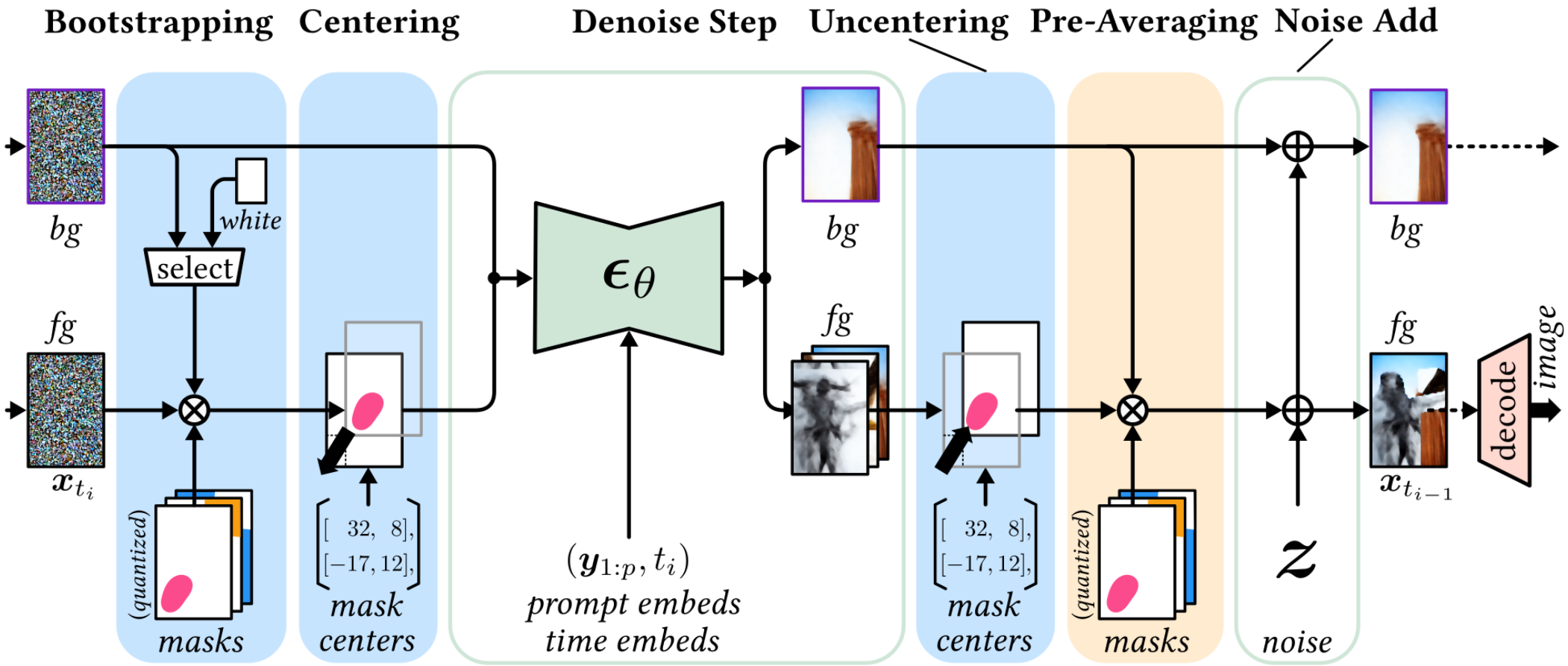

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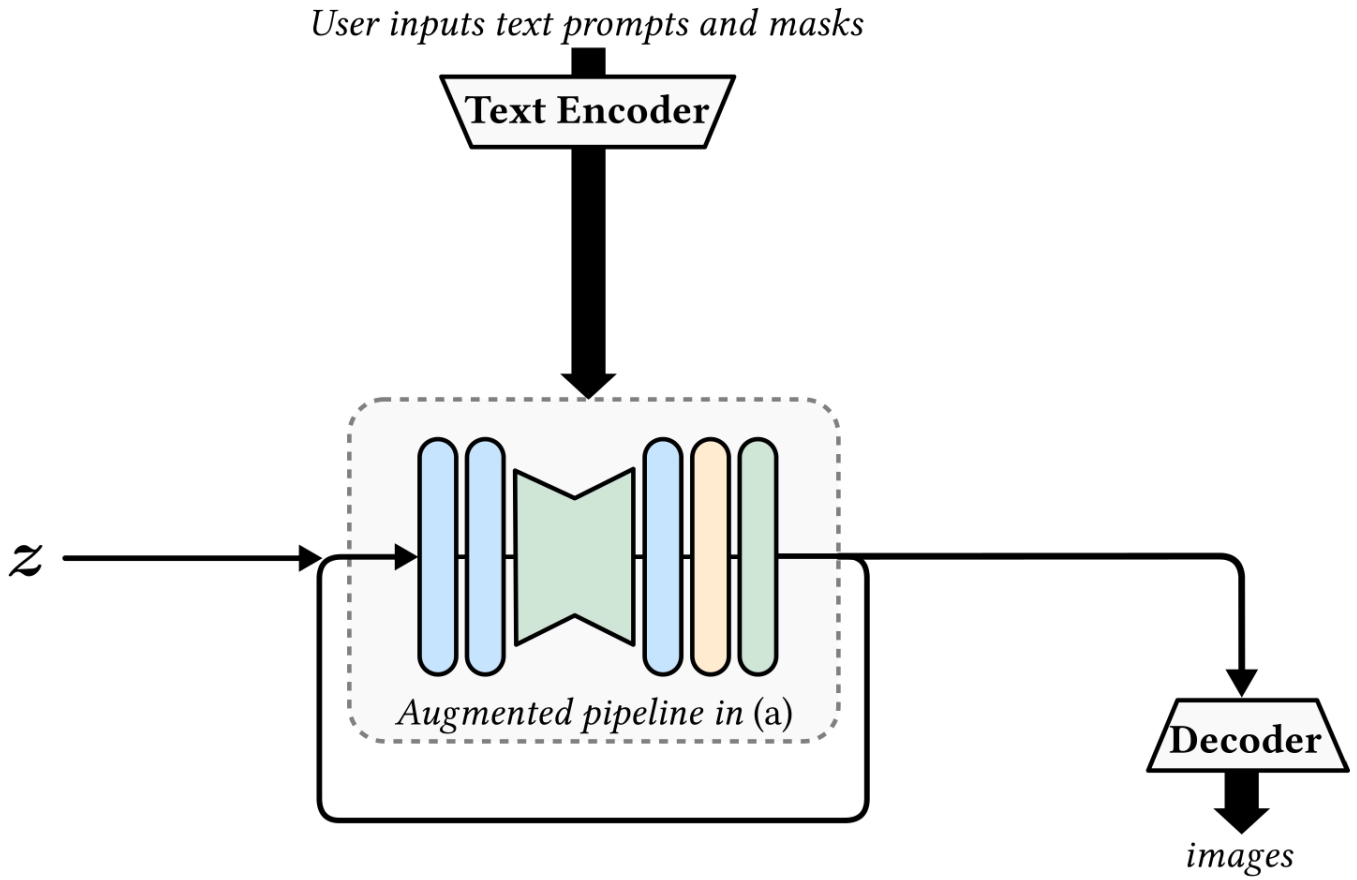
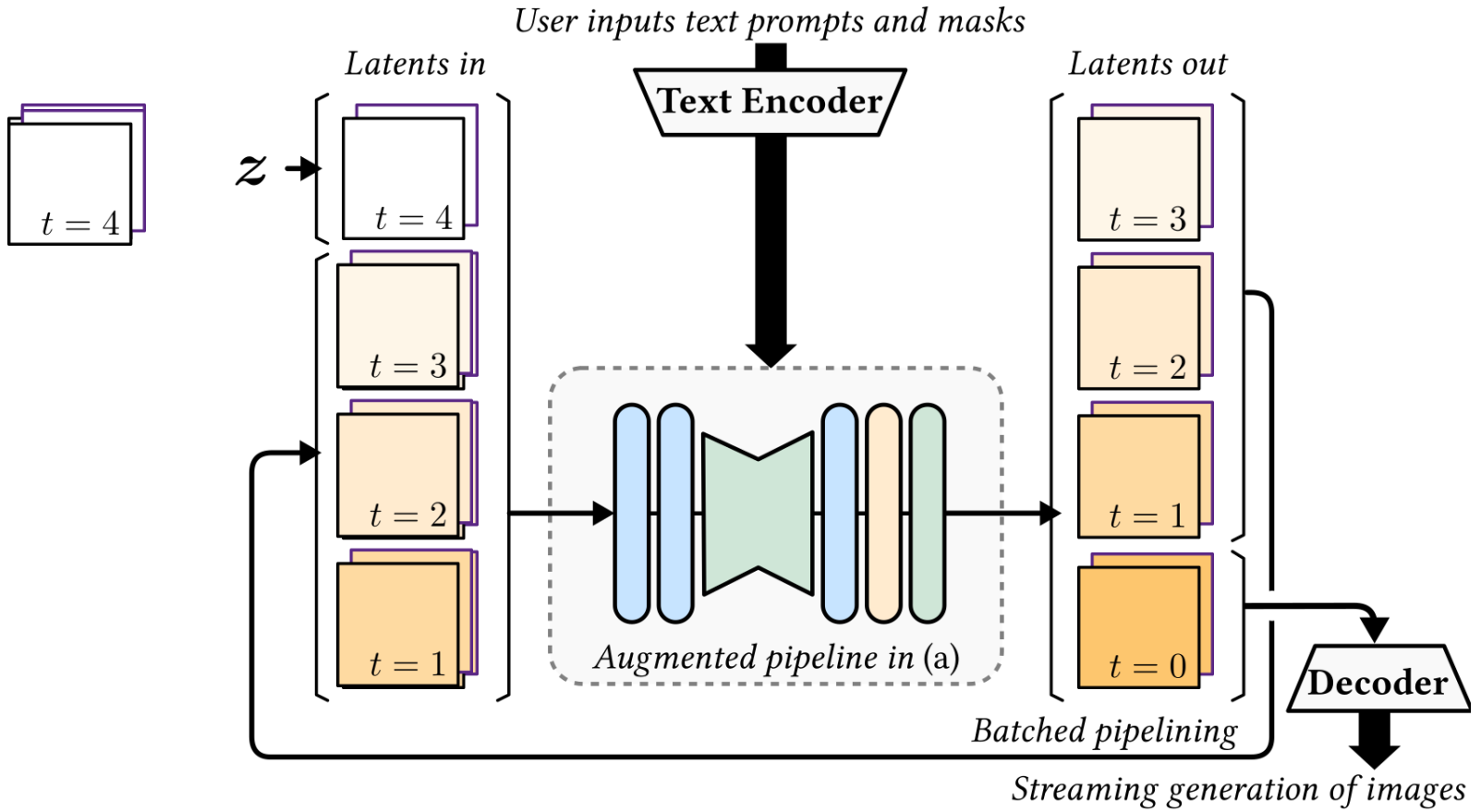


(b) Streaming by aggregating the regional latents of different timesteps. Cache data to remove redundancy.

Method



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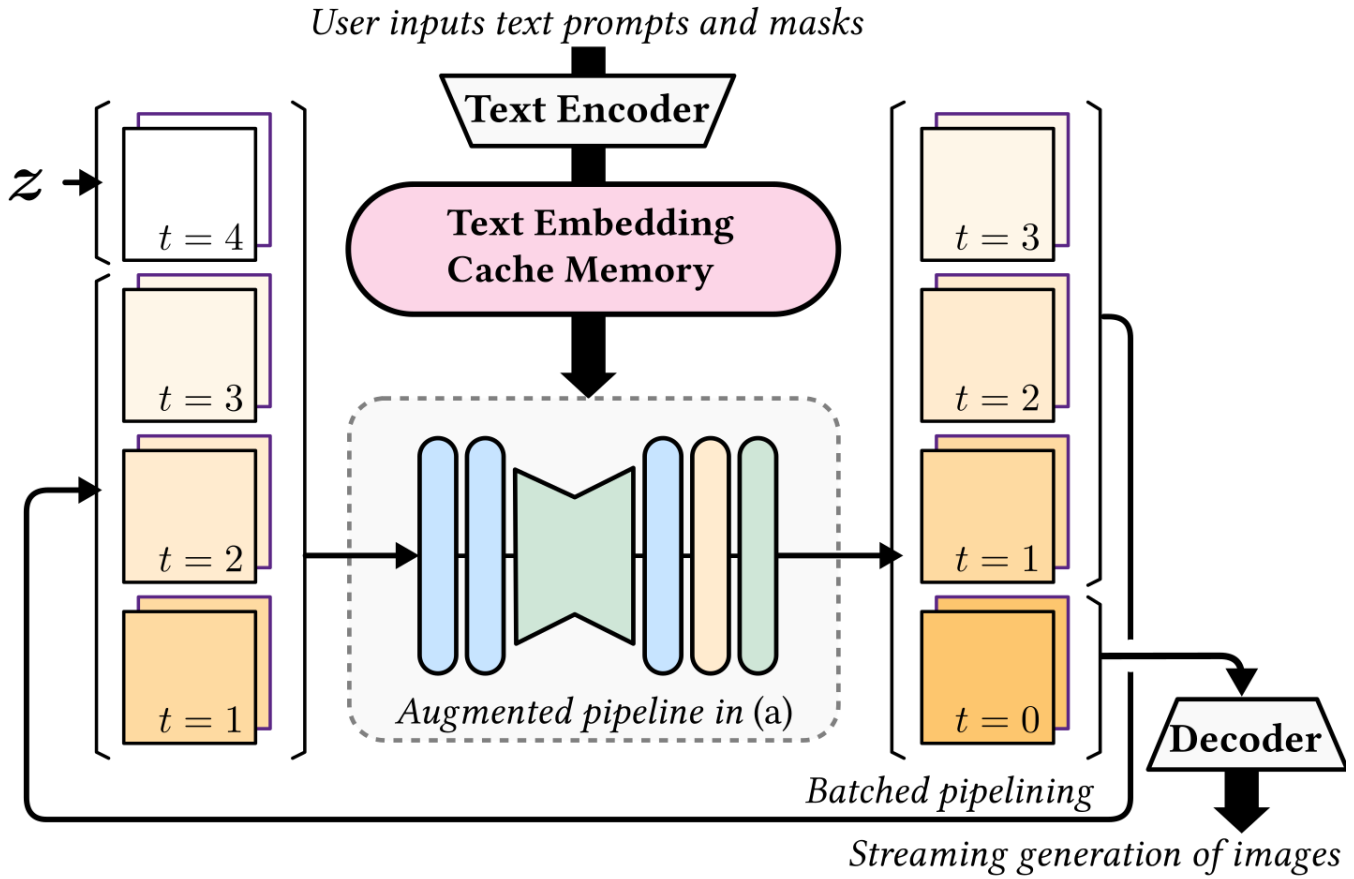


(b) Streaming by aggregating the regional latents of different timesteps. Cache data to remove redundancy.

Results

- New wine in new wineskin; New powerful tools like diffusion models deserves new type of applications.

Method	Sampler	FID ↓	IS ↑	$CLIP_{fg}$ ↑	$CLIP_{bg}$ ↑	Time (s) ↓
SD1.5 (512 × 512)						
MultiDiffusion (Ref.)	DDIM [47]	70.93	16.24	24.09	27.55	14.1
MultiDiffusion (MD)	LCM [31]	270.55	2.653	22.53	19.63	1.7
SemanticDraw (Ours)	LCM [31]	93.93	14.12	24.14	24.00	1.3

Method	Sampler	FID ↓	IS ↑	$CLIP_{fg}$ ↑	$CLIP_{bg}$ ↑	Time (s) ↓
SDXL (1024 × 1024)						
MultiDiffusion (Ref.)	DDIM [47]	73.77	16.31	24.16	28.11	50.6
MultiDiffusion (MD)	EulerDiscrete [18]	572.95	1.328	21.02	17.36	4.3
SemanticDraw (Ours)	EulerDiscrete [18]	84.27	15.04	24.19	24.22	3.6

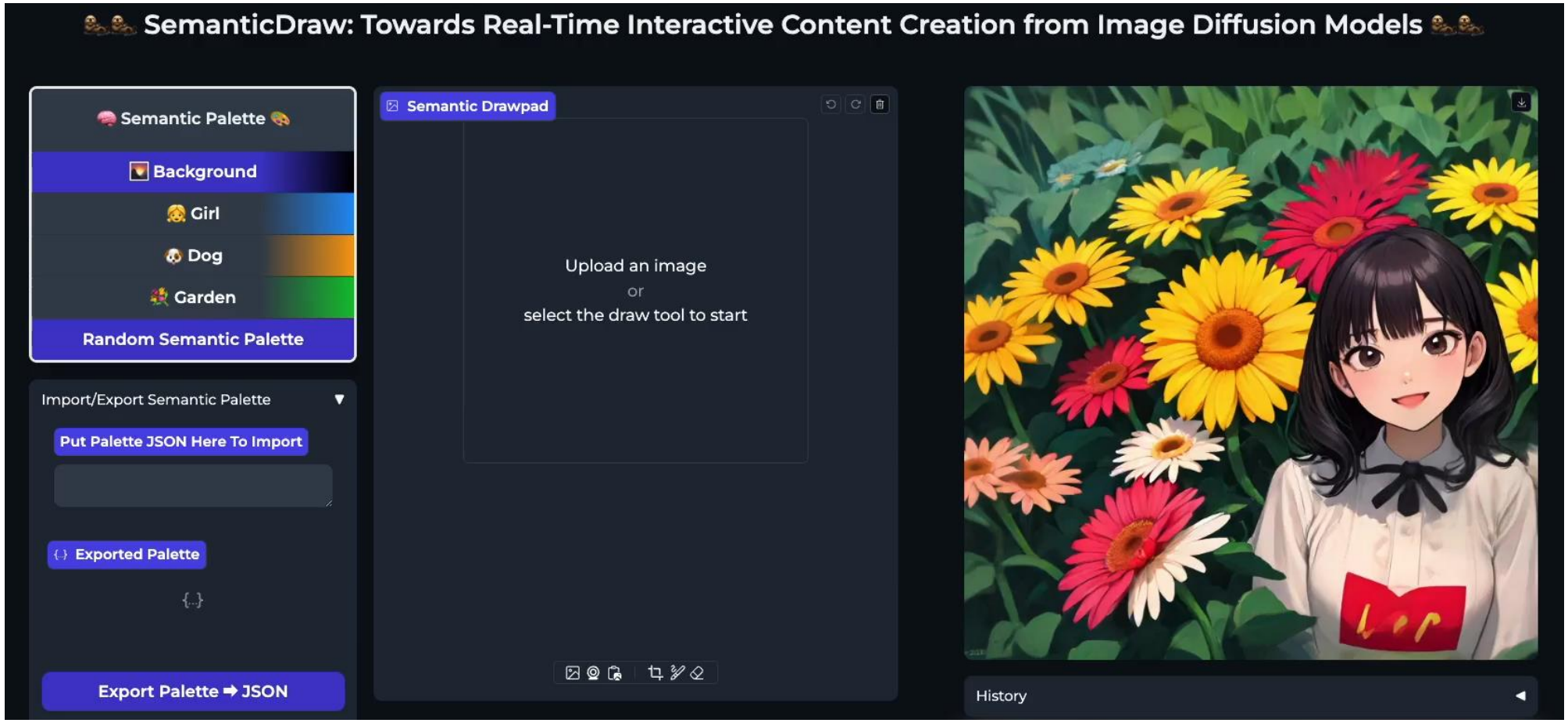
Method	Sampler	FID ↓	IS ↑	$CLIP_{fg}$ ↑	$CLIP_{bg}$ ↑	Time (s) ↓
SD1.5 (512 × 512)						
MultiDiffusion (Ref.)	DDIM [47]	70.93	16.24	24.09	27.55	14.1
MultiDiffusion (MD)	Hyper-SD [40]	168.34	10.12	20.08	15.90	1.7
SemanticDraw (Ours)	Hyper-SD [40]	98.60	14.90	24.48	23.31	1.3

Method	Sampler	FID ↓	IS ↑	$CLIP_{fg}$ ↑	$CLIP_{bg}$ ↑	Time (s) ↓
SD3 (1024 × 1024)						
MultiDiffusion (Ref.)	FlowMatch [9]	166.42	8.517	20.66	16.39	46.3
MultiDiffusion (MD)	FlashFlowMatch [7]	209.36	5.347	19.83	14.48	4.0
SemanticDraw (Ours)	FlashFlowMatch [7]	79.2	17.41	23.59	27.83	3.2

Results

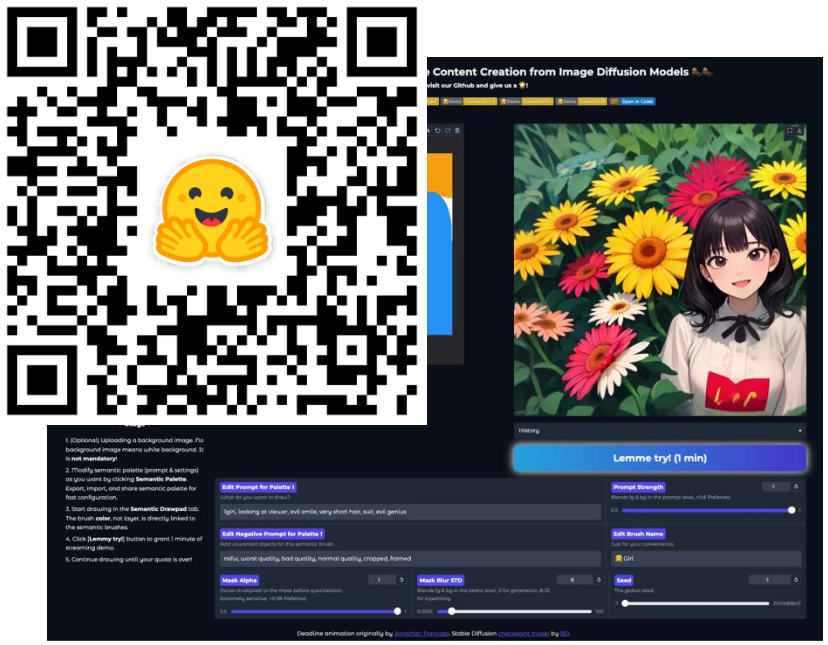
Ours, took 59 seconds.

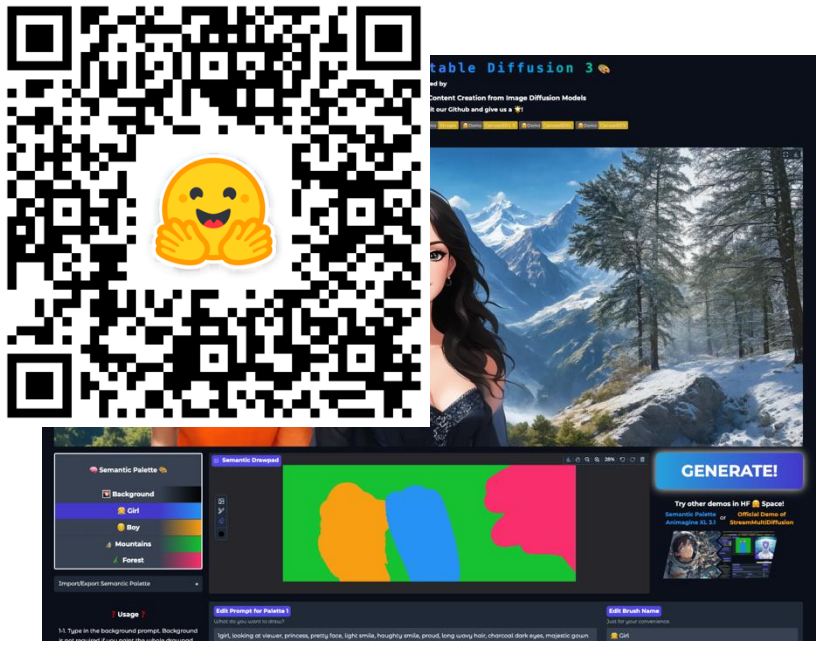
Application



Take Home Message

- New wine in new wineskin; New powerful tools like diffusion models deserves new type of applications.





Thank You

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