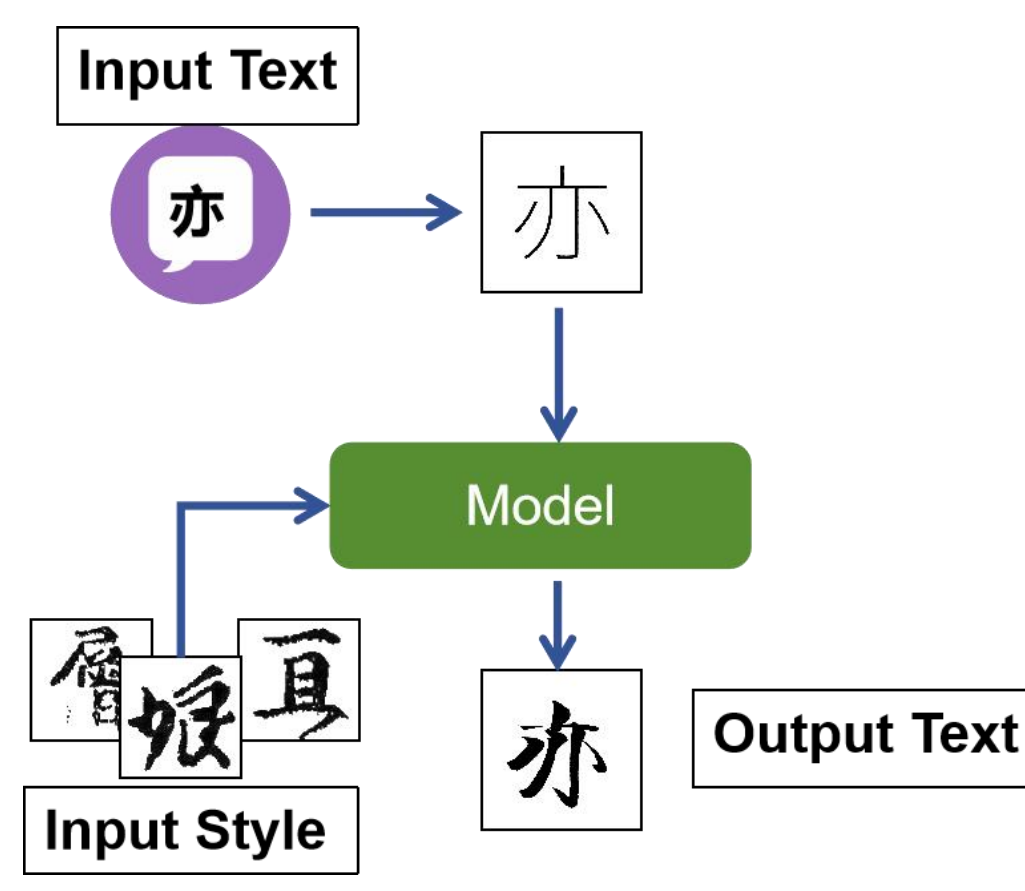


Few-shot Font Generation for Japanese Kuzushiji with Differentiable Renderer

Objective

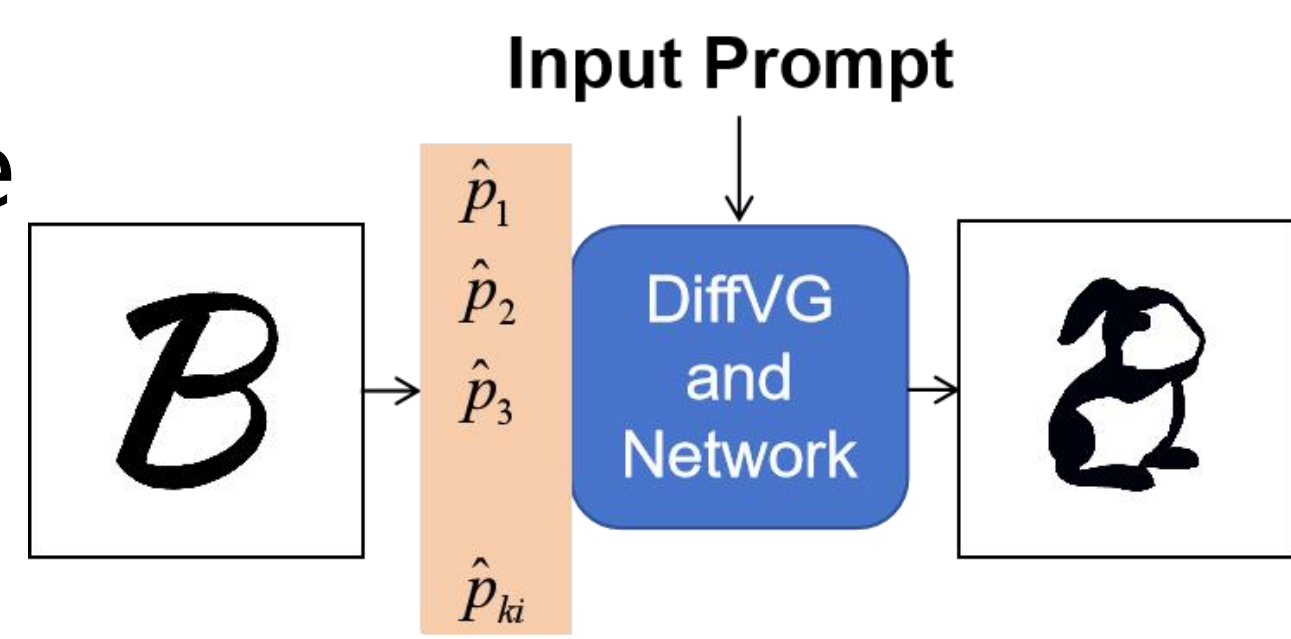
- Unlike Chinese cursive script, Kuzushiji is an **informal cursive handwriting** in ancient Japan.
- Transfer modern font to **vector-based Kuzushiji font**.



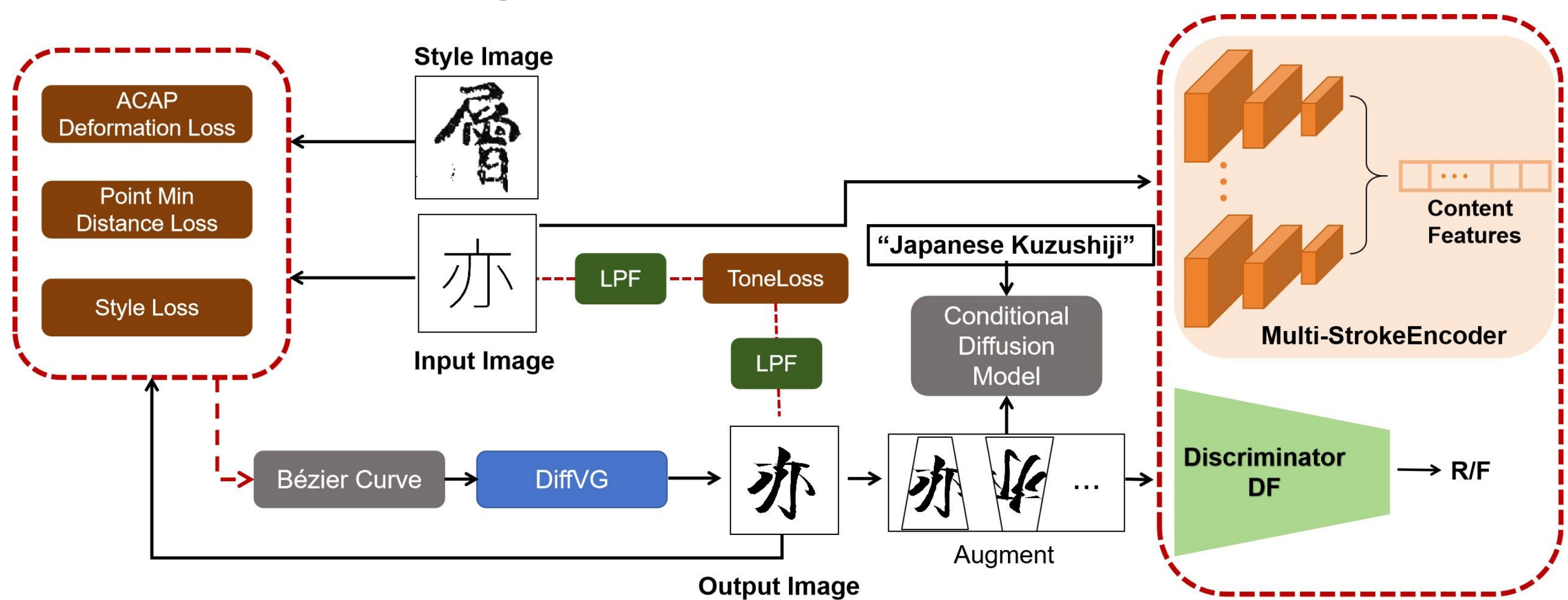
Methodology

Related work WAI[1]

- Use DiffVG to directly update vector graphics parameters.
- Transfer prompt style features to text.



- We propose a novel model to **generate vector Kuzushiji characters** using a few reference images without training.



Network

- Conditional Stable Diffusion model**
- DiffVG**
- Discriminator**
- Multiple-stroke encoder**

Main Loss Functions

1. **Style Loss**: mean squared error from style images

$$L_{style} = \sum \|G_{l,i,j}(x_s) - G_{l,i,j}(x_g)\|^2$$

$$G_l(x) = F_l(x)F_l^T(x)$$

2. **Multi-stroke ACAP Loss**:

Calculate the angle for each stroke

$$\mathcal{L}_{acap}(P, \hat{P}) = \frac{1}{k} \sum_{j=1}^k \left(\sum_{i=1}^{m_j} (\alpha_j^i - \hat{\alpha}_j^i)^2 \right)$$

3. **SDS loss [1]**:

Convey semantic concepts from the prompt to the images

$$\nabla_{\theta} \mathcal{L}_{SDS} = \mathbb{E}_{t, \epsilon} \left[w(t) (\hat{\epsilon}_{\phi}(\alpha_t x_t + \sigma_t \epsilon, y) - \epsilon) \frac{\partial z}{\partial z_{aug}} \frac{\partial x_{aug}}{\partial \theta} \right]$$

4. **Point Min Distance Loss**:

Make the distances of each point change gradually

Results

1. Kuzushiji character generation from source modern font characters



2. Comparison

Generates cleaner and more structurally accurate glyphs

	Source	CLIPFont	Word-As-Image	DG-Font	CF-Font	Fontdiffuser	Our	Target
Reference	外	外	外	外	外	外	外	外
	鏡	何	何	何	何	何	何	何
	此	此	此	此	此	此	此	此

Our results have achieved an improvement of more than 6% in LPIPS, SSIM, and FID

	LPIPS↓	SSIM↑	FID↓	RMSE↓
CLIPFont	0.4137	0.5002	1.8965	0.4318
WordAsImage	0.3903	0.4887	1.8531	0.4498
Ours	0.3634	0.5592	1.5494	0.4379
	6.89%	11.79%	16.38%	(-)

3. Ablation Studies

Full model can generate cleaner and more structurally accurate glyphs

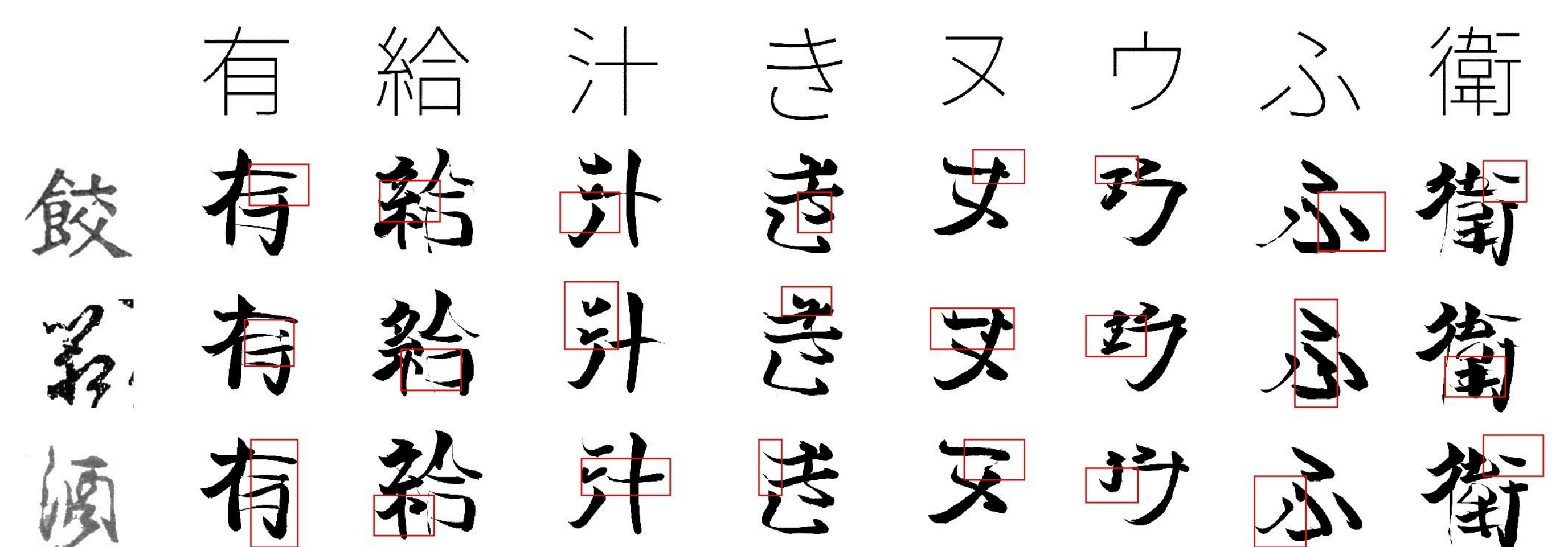
Input	WAI	+ Ldis	+ Lpoint	+ Lsty	+ Lsls(Full)
隆	隆	隆	隆	隆	隆
茲	茲	茲	茲	茲	茲
茹	茹	茹	茹	茹	茹

4. Other Results

The performance of our model in other languages



Using different style images used in the style loss



5. Future Work

- Adding other texture modules to improve the result's similarity.
- Increase the variety of different Kuzushiji work