

## A Appendix

### A.1 Reshuffle

The Reshuffle operation in Equation 7 leverages Gauss-Jordan elimination-based method, which first introduced in [5]. This step is based on two core mathematical properties of Reed-Solomon encoding: systematicity and XOR closure. The systematic property ensures that the original data is directly represented in the encoding structure, allowing modifications to data bits to precisely control corresponding pixel changes. The XOR closure property guarantees that the result of an XOR operation between any two valid encoded blocks remains a legitimate encoded state.

Specifically, to achieve finer-grained image control, we employ a controllable pixel expansion technique based on Gauss-Jordan elimination. First, the QR code's encoding space is modeled as a vector space, constructing a basis matrix that encompasses all possible valid encoding combinations. Subsequently, row transformation optimization is performed using Gauss-Jordan elimination to restructure the matrix and expand the range of controllable pixels. Priority is given to low-contrast regions (as they cause minimal visual interference), while strategically sacrificing some high-contrast regions. Finally, noise equalization is applied to uniformly distribute the remaining uncontrollable error-correction bits across the entire QR code space, effectively preventing concentrated noise from disrupting the artistic effect. For more details, please refer to the QArt [5].

### A.2 Simulated QR Decoder

Simulated QR Decoder  $\mathcal{D}_{qr}$  in paragraph Evolve HLG is a tool that emulates the decoding process of QR codes. It simulates the behavior of a real QR code decoder but offers greater flexibility by allowing control over the criteria for judging erroneous modules. This capability helps models learn to generate more robust QR codes.

The decoder begins by sampling the QR code. This process employs Gaussian kernel convolution to simulate the optical sampling characteristics of physical decoder. The mathematical expression of Gaussian kernel convolution is:

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \quad (12)$$

where  $\sigma$  is the standard deviation of the Gaussian kernel, controlling the sampling range, achieving optical behavior simulation and noise suppression through weighted averaging.

The sampling operation simultaneously accomplishes two core tasks: extracting encoded information from individual modules and generating a feature map through spatial integration. The value of each module  $F_{i,j}$  in the feature map is calculated as:

$$F_{i,j} = \sum_{(i,j) \in \Omega_k} Q(i, j) \cdot G_{M_k}(i, j; \sigma) \quad (13)$$

where,  $Q(i, j)$  represents the pixel intensity at position  $(i, j)$  within the QR code module.  $G_{M_k}(i, j; \sigma)$  denotes the Gaussian sampling probability at location  $(i, j)$  relative to module  $M_k$ 's center.

The sampled feature map then undergoes binarization to convert pixel values into binary states (0 or 1), replicating the threshold determination mechanism of physical decoders. The system employs adaptive thresholding based on module color:

$$T_b = T + \eta, T_w = T - \eta \quad (14)$$

where  $T$  represents the standard binarization threshold of physical decoders,  $T_b$  represents the black modules and  $T_w$  represents the white modules.  $\eta$  denotes the robustness parameter that controls error module detection criteria.

This differential thresholding approach enhances recognition accuracy by making black modules more likely to be identified as black (1) and white modules as white (0). The final step involves module correctness verification, where any discrepancy between the binarized color and the expected ideal color flags the module as erroneous. For more details, please refer to the Artcoder [32].

### A.3 Scannability Loss Function

The Scannability Loss Function in Equation 11 is one of the core components used to optimize the scanning robustness of generated QR codes. By combining multiple sub-loss functions, it ensures that

Base

Output

Base

Output

Figure 6: Suboptimal cases of AnimateQR. Base represents the video sequences generated by AnimateDiff under identical parameter configurations. Output represents our results.

the generated QR codes maintain aesthetic appeal while remaining accurately decodable by standard scanners.

The Scannability Loss Function combines three key components Marker Loss ( $\mathcal{L}_m$ ), Code Loss ( $\mathcal{L}_c$ ) and Harmonizing Loss ( $\mathcal{L}_h$ ) to balance aesthetics and functionality.

Marker Loss ( $\mathcal{L}_m$ ) preserves critical QR patterns (like Finder/Alignment markers) by enforcing pixel-ratio constraints via MSE.

$$\mathcal{L}_m = |\mathcal{K}_{cc} \odot (Q_y - I^b)|_2^2 \quad (15)$$

where  $\mathcal{K}_{cc}$  is a binary mask for cross-center regions of finder/alignment patterns,  $Q_y$  is the luminance channel of generated QR code, and  $I^b$  is the blueprint image.

Code Loss ( $\mathcal{L}_c$ ) optimizes module values in data regions for accurate binary decoding, using methods like SSLayer [32].

$$\mathcal{L}_c = \frac{1}{N} \sum_{k=1}^N \max(0, \delta - |v_k - T(\mathcal{M}_k)|) \quad (16)$$

where  $v_k$  is the average intensity of module  $k$  in the generated image.  $T(\mathcal{M}_k)$  is the target threshold ( $T_b$  or  $T_w$ ) for module  $k$ 's binary value  $\mathcal{M}_k$ .  $\delta$  is a margin parameter (typically 0.1).

Harmonizing Loss ( $\mathcal{L}_h$ ) maintains visual fidelity to the input style through Wasserstein distances on VGG-19 features.

$$\mathcal{L}_h = \sum_{i \in S} W_2(f_i(Q), f_i(I^s)) \quad (17)$$

where  $S = 1, 6, 11, 18, 25$  denotes VGG-19 layers and  $W_2$  is the Wasserstein distance [1].

Weighted together ( $\lambda_1 \mathcal{L}_m + \lambda_2 \mathcal{L}_c + \lambda_3 \mathcal{L}_h$ ), this function refines latent codes via gradient ascent (400 Adam iterations) to produce QR codes that are both scannable and visually aligned with user-defined aesthetics. For more details, please refer to the Text2QR [35].

## B Bad cases

As shown in Figure 6, we present some suboptimal cases. It can be observed that unnatural artifacts tend to occur when the motion amplitude of the animated QR Code becomes excessively large.

## C Additional Visual Comparisons

In Table 5 6 7, we show more results of AnimateQR. Table 8 presents pertinent prompts and models associated with the generation of the samples shown in main paper.

Table 5: More results of AnimateQr.

Model	Parameter	Output
rabbit	prompt: enma ai, hair down, hair black, bangs, eyes red, masterpiece, best quality, ultra-detailed, illustration, 1girl, solo, highres, photorealistic, ultra high res, (Original illustration composition) seed: 888888888 cfg: 8 motion scale: 1.1	
526Mix V1.5	prompt: painting of a cute cozy cottagecore wood log cottage on a golden field, soft warm sunlight, tree, soft autumn colors, flowers, epic composition seed: 888888888 cfg: 8 motion scale: 1.1	
CarDos Anime	prompt: 1girl, solo, cherry blossom, hanami, pink flower, white flower, spring season, wisteria, petals, flower, plum blossoms, outdoors, falling petals, black eyes, upper body, from side seed: 2975646847 cfg: 8 motion scale: 1.0	
ToonYou	prompt: (masterpiece, best quality), 1girl, solo, elf, mist, sundress, forest, sitting, in water, waterfall, looking at viewer, blurry foreground, dappled sunlight, moss, (intricate, lotus, mushroom) seed: 3863956878 cfg: 8 motion scale: 1.0	
Cetus-Mix	prompt: rain,death,1girl,reaper,weapon,night seed: 888888888 cfg: 8 motion scale: 1.1	
Cetus-Mix	prompt: rain,death,1girl,reaper,weapon,night seed: 1526317991 cfg: 8 motion scale: 1.1	

Table 6: More results of AnimateQr.

Model	Parameter	Output
rabbit	prompt: enma ai, hair down, hair black, bangs, eyes red, masterpiece, best quality, ultra-detailed, illustration, 1girl, solo, highres, photorealistic, ultra high res, (Original illustration composition) seed: 1526317991 cfg: 8 motion scale: 1.1	
rabbit	prompt: enma ai, hair down, hair black, bangs, eyes red, masterpiece, best quality, ultra-detailed, illustration, 1girl, solo, highres, photorealistic, ultra high res, (Original illustration composition) seed: 2975646847 cfg: 8 motion scale: 1.1	
Cetus-Mix	prompt: rain,death,1girl,reaper,weapon,night seed: 2975646847 cfg: 8 motion scale: 1.1	
Realistic Vision V6.0 B1	prompt: unreal engine 5 render, jungle, river, flowers, extremely detailed, colorful seed: 2975646847 cfg: 8 motion scale: 1.1	
526Mix V1.5	prompt: painting of a cute cozy cottagecore wood log cottage on a golden field, soft warm sunlight, tree, soft autumn colors, flowers, epic composition seed: 2914620472 cfg: 8 motion scale: 0.9	
CarDos Anime	prompt:dvArchModern style, underwater city, house, submerged, green ocean water, fossils, underwater ruins, photorealistic, hyperrealistic, 4k, shadows, depth, volumetric light, dramatic light, diffused light, desaturated, low contrast, hdr, fine details, subtle details, cracks, plants, fish, sun rays, god rays seed: 2914620472 cfg: 11.5 motion scale: 1.1	

Table 7: More results of AnimateQr.

Model	Prompt	Output
CarDos Anime	prompt: dvArchVictorian style, epic overgrown, victorian house, landscape architecture render, rubble, photo realistic, orante, super detailed, intricate, dramatic, sunset lighting, shadows seed: 3204244827 cfg: 7 motion scale: 1.1	
526Mix V1.5	prompt: dvArchVictorian style, epic overgrown, victorian house, landscape architecture render, rubble, photo realistic, orante, super detailed, intricate, dramatic, sunset lighting, shadows seed: 1815888375 cfg: 7 motion scale: 1.1	
Realistic Vision V6.0 B1	prompt: unreal engine 5 render, jungle, river, flowers, extremely detailed, colorful seed: 888888888 cfg: 8 motion scale: 1.1	

Table 8: Model and Prompts for generated QR codes in the paper.

Sample	Model	Prompt
Figure 1 Col 1	<b>Cetus-Mix</b>	1girl,night city,rain,coat,hands in pockets
Figure 1 Col 2	<b>Realistic Vision V6.0 B1</b>	unreal engine 5 render, jungle, river, flowers, extremely detailed, colorful
Figure 1 Col 3	<b>CarDos Anime</b>	1girl, solo, cherry blossom, hanami, pink flower, white flower, spring season, wisteria, petals, flower, plum blossoms, outdoors, falling petals, black eyes, upper body, from side
Figure 1 Col 4	<b>CarDos Anime</b>	dvArchVictorian style, epic overgrown, victorian house, landscape architecture render, rubble, photo realistic, orante, super detailed, intricate, dramatic, sunset lighting, shadows
Figure 1 Col 5	<b>rabbit</b>	enma ai, hair down, hair black, bangs, eyes red, masterpiece, best quality, ultra-detailed, illustration, 1girl, solo, highres, photorealistic, ultra high res, (Original illustration composition), Movie poster
Figure 3 Row 1 Col 1	<b>Cetus-Mix</b>	rain,death,1girl,reaper,weapon,night
Figure 3 Row 1 Col 2	<b>DreamShaper</b>	(anime coloring, anime screencap, ghibli, mappa, anime style), 1girl, hatsune miku, white gown, angel, angel wings, golden halo, dark background, upper body, (closed mouth:1.2), looking at viewer, arms behind back, blue theme, stars, starry night
Figure 3 Row 2 Col 1	<b>526Mix V1.5</b>	painting of a cute cozy cottagecore wood log cottage on a golden field, soft warm sunlight, tree, soft autumn colors, flowers, epic composition
Figure 3 Row 2 Col 2	<b>RCNZ Cartoon 3d</b>	cute teddy bear riding a tractor
Figure 4 Row 2	<b>FantasticMix</b>	Wonderful city, 8k, highly detailed,(masterpiece), Castle, town, (papercut), (huge big moon), (made of white paper), artisana handmade, professional result, realistic, clouds, moonlight
Figure 4 Row 1	<b>ReV Animated</b>	The arsenal is on a pedestal on the desk where the tweezers and pliers and props, mini(ttp), (8k, RAW photo, best quality, masterpiece:1.2), miniature, landscape, isometric, in a box