

# Ninja Codes: Neurally Generated Fiducial Markers for Stealthy 6-DoF Tracking

## Supplementary Material

### 7. Project Website

Video and other additional material regarding our work can be found on our project website, at the following URL:  
<https://sento.net/research/ninjacodes>

### 8. Ninja Code Examples

Figures 9 and 10 are high-resolution images of Ninja Codes used in our experiments, in digital and printed forms.



Figure 9. The 25 digital images used to evaluate code detection performance, each with a single Ninja Code (here, generated using the  $NC_{300}$  encoder) placed at the center.



Figure 10. The ten poster boards used to evaluate 6-DoF tracking performance, with four Ninja Codes (generated using the  $NC_{200}$  encoder) placed at the corners.

### 9. Prototype Codes

Figure 11 shows several examples of prototype Ninja Codes used in the visual conspicuity test.

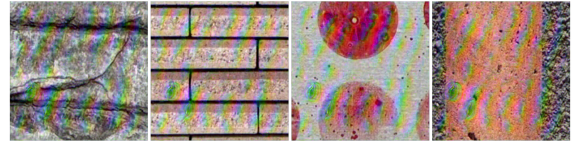


Figure 11. Prototype Ninja Codes used to assess visual conspicuity, exhibiting more salient visual artifacts compared to the newer  $NC_x$  encoders.

### 10. Extensions Details

Figure 12 shows the reverse encoder reconstructing original cover images from Ninja Codes, albeit with some loss of fine detail. Figure 13 shows our custom photographic tool used to assist color calibration. (The codes in Figure 8 were created using this tool.)

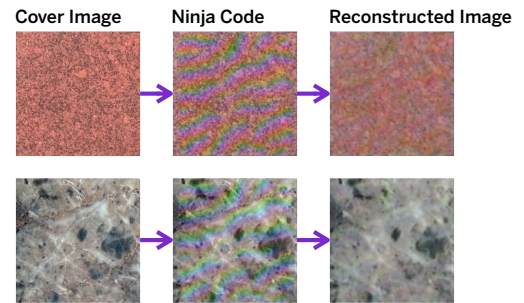


Figure 12. A U-Net based reverse encoder that takes a Ninja Code as input and attempts to reconstruct the cover image.

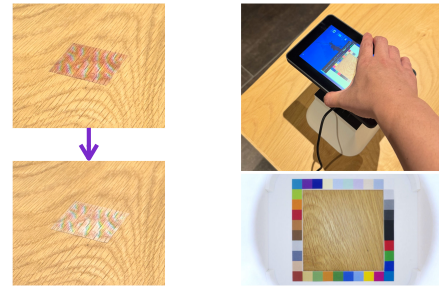


Figure 13. Faulty color calibration resulting in color discontinuity (left). A photographic tool that captures texture images under controlled LED lighting (right).