

Generative AI for Producing Detailed Maps from Aerial Imagery*

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Abstract—The objective of this project is to employ Generative AI, specifically the Pix2Pix cGAN (cycle Generative Adversarial Network), to transform satellite images into high-resolution, detailed maps. With applications in urban planning, disaster management, and environmental monitoring, generating accurate maps from aerial imagery is a critical task. Pix2Pix, a conditional GAN, has been proven effective in paired image-to-image translation tasks, making it an ideal model for this purpose. We will evaluate the model's performance using metrics like Structural Similarity Index (SSIM) and pixel-wise accuracy on datasets such as the DeepGlobe and SpaceNet satellite datasets.

Index Terms—component, formatting, style, styling, insert

I. LITERATURE REVIEW

A. Isola et al. (2017)

Pix2Pix introduced conditional GANs for paired image-to-image translation, transforming images (e.g., satellite to maps) using adversarial training. Datasets included Cityscapes and Maps, with evaluation based on SSIM and pixel accuracy.

B. Karras et al. (2019)

StyleGAN, designed for high-resolution image synthesis, introduced improvements in image generation. Although not directly related to map generation, it used CelebA and satellite datasets, evaluated by FID and Inception Score.

C. Ronneberger et al. (2015)

U-Net, widely used for biomedical segmentation, was adapted for aerial imagery feature extraction. The ISBI dataset was evaluated using Dice coefficient and Jaccard Index.

D. Zhu et al. (2020)

CycleGAN enabled unpaired image-to-image translation, using the SpaceNet dataset, evaluated by SSIM and PSNR. It offered a solution for unpaired satellite-to-map translations.

E. Qiu et al. (2021)

Denoising diffusion models improved image quality from noisy inputs. The Sentinel-2 dataset was used, evaluated by MSE and perceptual loss, contributing to detailed satellite-to-map translations.

TABLE I
SUMMARY OF LITERATURE REVIEW

Paper	Method	Dataset	Evaluation Metrics
Isola et al. (2017)	Pix2Pix (Conditional GAN)	Cityscapes, Maps	SSIM, Pixel Accuracy
Karras et al. (2019)	StyleGAN	CelebA, Satellite Images	FID, Inception Score
Ronneberger et al. (2015)	U-Net (Segmentation)	ISBI Challenge Dataset	Dice Coefficient, Jaccard Index
Zhu et al. (2020)	CycleGAN (Unpaired Image Translation)	SpaceNet	SSIM, PSNR
Qiu et al. (2021)	Denoising Diffusion Models	Sentinel-2 Aerial Images	MSE, Perceptual Loss

II. DATASETS

A. Set2Map Dataset

The Sat2Map dataset consists of paired satellite images and corresponding map tiles, specifically curated for image translation tasks. It is ideal for training the Pix2Pix GAN to learn mappings between satellite images and their corresponding map representations.

Number of Samples: Approximately 150,000 paired images

Categories: Roads, buildings, vegetation, water bodies

Image Size: 256x256 pixels

Format: RGB satellite images paired with corresponding binary map images (black-and-white).

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