IMPORTING LIBRARIES

In [83]:
```
import os
from pdf2image import convert_from_path
from PIL import Image
import cv2
import numpy as np
from tqdm import tqdm
import pytesseract
import json
import torch
import torch.nn as nn
import torch.nn.functional as F
import torchvision.transforms as T
from torch.utils.data import Dataset, DataLoader
import torchvision.models
import torch.optim as optim
import torch.nn as nn
from transformers import BertTokenizer, BertModel
import docx
import torchvision.transforms as transforms
import torchvision.models as models
import matplotlib.pyplot as plt
import torchvision
import torch.optim as optim
import seaborn as sns
from skimage.metrics import structural_similarity as ssim
```

CONVERTING PDF PAGES TO IMAGES

In [2]:
```
PDF_DIR = "/home/aniketj/GSOC_TASK1/PDFs/"   # Directory containing PDFs
IMAGE_DIR = "/home/aniketj/GSOC_TASK1//IMAGES/"     # Output directory for i
os.makedirs(IMAGE_DIR, exist_ok=True)
```

In [3]:
```
def pdf_to_images(pdf_path, output_folder, dpi=200):
    """Convert PDF pages to images one by one, reducing image size issues.""
    images = convert_from_path(pdf_path, dpi=dpi, fmt="jpeg")
    image_paths = []

    for i, img in enumerate(images):
        img = img.convert("RGB")
        img_path = os.path.join(output_folder, f"{os.path.basename(pdf_path)
        img.save(img_path, "JPEG", quality=85)
        image_paths.append(img_path)

    return image_paths
```

In [4]:
```
for pdf in os.listdir(PDF_DIR):
    if pdf.endswith(".pdf"):
        pdf_to_images(os.path.join(PDF_DIR, pdf), IMAGE_DIR, dpi=200)

print("PDF to Image Conversion Done")
```

```
/home/aniketj/anaconda3/envs/soc/lib/python3.10/site-packages/PIL/Image.py:3
402: DecompressionBombWarning: Image size (94080000 pixels) exceeds limit of
89478485 pixels, could be decompression bomb DOS attack.
  warnings.warn(
PDF to Image Conversion Done
```

In [ ]:

PROCESSING IMAGES

In [5]:
```
PROCESSED_DIR = "/home/aniketj/GSOC_TASK1/PROCESSED_IMAGES/"
os.makedirs(PROCESSED_DIR, exist_ok=True)
```

In [ ]:
```
def preprocess_image(image_path, output_folder):
    img = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    img = cv2.GaussianBlur(img, (5, 5), 0)
    _, binary = cv2.threshold(img, 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OT

    processed_path = os.path.join(output_folder, os.path.basename(image_path
    cv2.imwrite(processed_path, binary)
    return processed_path
```

In [7]:
```
for img_file in tqdm(os.listdir(IMAGE_DIR), desc="Processing Images"):
    if img_file.endswith(".jpg"):
        preprocess_image(os.path.join(IMAGE_DIR, img_file), PROCESSED_DIR)

print("Image Preprocessing Done")
```

```
Processing Images: 100%|██████████| 57/57 [00:12<00:00,  4.42it/s]
Image Preprocessing Done
```

EXTRACTING TEXT REGIONS

In [8]:
```
pytesseract.pytesseract.tesseract_cmd = r'/home/aniketj/anaconda3/envs/soc/b
```

In [9]:
```
TEXT_REGION_DIR = "/home/aniketj/GSOC_TASK1/TEXT_REGIONS/"
os.makedirs(TEXT_REGION_DIR, exist_ok=True)
```

In [10]:
```
def extract_text_regions(image_path, output_folder, visualize=False):

    img = cv2.imread(image_path)
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    d = pytesseract.image_to_data(gray, output_type=pytesseract.Output.DICT)

    for i in range(len(d["text"])):
        if int(d["conf"][i]) > 50:
            (x, y, w, h) = (d["left"][i], d["top"][i], d["width"][i], d["hei
            cv2.rectangle(img, (x, y), (x + w, y + h), (0, 255, 0), 2)  # Gr

    processed_path = os.path.join(output_folder, os.path.basename(image_path
    cv2.imwrite(processed_path, img)
```

```
    if visualize:
        cv2.imshow("Text Detection", img)
        cv2.waitKey(0)
        cv2.destroyAllWindows()

    return processed_path
```

In [11]:
```
for img_file in tqdm(os.listdir(PROCESSED_DIR), desc="Extracting Text Regior
    if img_file.endswith(".jpg"):
        extract_text_regions(os.path.join(PROCESSED_DIR, img_file), TEXT_REG

print("Text Region Extraction Done")
```

```
Extracting Text Regions: 100%|██████████| 57/57 [04:10<00:00,  4.40s/it]
Text Region Extraction Done
```

EXTRACTING BOUNDING BOXES

In [14]:
```
JSON_OUTPUT = "/home/aniketj/GSOC_TASK1/BOUNDING_BOXES.json"
bounding_boxes = {}

def extract_bounding_boxes(image_path):
    """Extract text bounding box coordinates using OCR."""
    img = cv2.imread(image_path)
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    d = pytesseract.image_to_data(gray, output_type=pytesseract.Output.DICT)

    boxes = []

    for i in range(len(d["text"])):
        if int(d["conf"][i]) > 50:
            x, y, w, h = d["left"][i], d["top"][i], d["width"][i], d["height
            boxes.append({"x": x, "y": y, "width": w, "height": h})

    return boxes
```

In [ ]:
```
for img_file in tqdm(os.listdir(TEXT_REGION_DIR), desc="Extracting Bounding
    if img_file.endswith(".jpg"):
        img_path = os.path.join(TEXT_REGION_DIR, img_file)
        bounding_boxes[img_file] = extract_bounding_boxes(img_path)


with open(JSON_OUTPUT, "w") as f:
    json.dump(bounding_boxes, f, indent=4)

print(f"Bounding boxes saved to {JSON_OUTPUT}")
```

```
Extracting Bounding Boxes: 100%|██████████| 57/57 [03:40<00:00,  3.87s/it]
Bounding boxes saved to /home/aniketj/GSOC_TASK1/BOUNDING_BOXES.json
```

CREATING MASKS

In [16]:
```
MASK_DIR = "/home/aniketj/GSOC_TASK1/MASKS/"
os.makedirs(MASK_DIR, exist_ok=True)

def create_segmentation_mask(image_path, boxes, mask_output_path):
    img = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    mask = np.zeros_like(img)

    for box in boxes:
        x1, y1, x2, y2 = box["x"], box["y"], box["x"] + box["width"], box["y
        cv2.rectangle(mask, (x1, y1), (x2, y2), 255, -1)


    cv2.imwrite(mask_output_path, mask)

for img_name, boxes in tqdm(bounding_boxes.items(), desc="Creating Masks"):
    img_path = os.path.join(PROCESSED_DIR, img_name)
    mask_path = os.path.join(MASK_DIR, img_name)
    create_segmentation_mask(img_path, boxes, mask_path)

print(f"Masks saved in {MASK_DIR}")
```

```
Creating Masks: 100%|██████████| 57/57 [00:07<00:00,  7.59it/s]
Masks saved in /home/aniketj/GSOC_TASK1/MASKS/
```

CREATING DATASET

In [ ]:
```
transform = T.Compose([
    T.ToPILImage(),
    T.Resize((512, 512)),
    T.Grayscale(num_output_channels=3),
    T.ToTensor(),
    T.Normalize(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5])
])


class LayoutSegmentationDataset(Dataset):
    def __init__(self, img_dir, mask_dir, transform=None):
        self.img_dir = img_dir
        self.mask_dir = mask_dir
        self.transform = transform
        self.img_files = sorted(os.listdir(img_dir))

    def __len__(self):
        return len(self.img_files)


    def __getitem__(self, idx):
        img_name = self.img_files[idx]
        img_path = os.path.join(self.img_dir, img_name)
        mask_path = os.path.join(self.mask_dir, img_name)

        # Load Image & Mask
        image = cv2.imread(img_path, cv2.IMREAD_GRAYSCALE)
        mask = cv2.imread(mask_path, cv2.IMREAD_GRAYSCALE)
```

```
        # Ensure both are resized to (512, 512)
        image = cv2.resize(image, (512, 512), interpolation=cv2.INTER_LINEAR
        mask = cv2.resize(mask, (512, 512), interpolation=cv2.INTER_NEAREST)


        if self.transform:
            image = self.transform(image)

        mask = torch.tensor(mask, dtype=torch.float32).unsqueeze(0) / 255.0

        return image, mask



dataset = LayoutSegmentationDataset(PROCESSED_DIR, MASK_DIR, transform)
dataloader = DataLoader(dataset, batch_size=4, shuffle=True)

print(f"Dataset Ready: {len(dataset)} images with segmentation masks")
```

```
Dataset Ready: 57 images with segmentation masks
```

MODEL

In [18]:
```
class UNet(nn.Module):
    def __init__(self):
        super(UNet, self).__init__()
        self.encoder = models.resnet18(pretrained=True)
        self.encoder = nn.Sequential(*list(self.encoder.children())[:-2])

        self.upconv1 = nn.ConvTranspose2d(512, 256, kernel_size=2, stride=2)
        self.upconv2 = nn.ConvTranspose2d(256, 128, kernel_size=2, stride=2)
        self.upconv3 = nn.ConvTranspose2d(128, 64, kernel_size=2, stride=2)

        self.final_conv = nn.Conv2d(64, 1, kernel_size=1)


    def forward(self, x):
        x = self.encoder(x)
        x = self.upconv1(x)
        x = self.upconv2(x)
        x = self.upconv3(x)
        x = self.final_conv(x)


        x = F.interpolate(x, size=(512, 512), mode="bilinear", align_corners

        return torch.sigmoid(x)
```

In [19]:
```
device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
model = UNet().to(device)

print(device)
```

```
/home/aniketj/anaconda3/envs/soc/lib/python3.10/site-packages/torchvision/models/_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' instead.
  warnings.warn(
/home/aniketj/anaconda3/envs/soc/lib/python3.10/site-packages/torchvision/models/_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed in the future. The current behavior is equivalent to passing `weights=ResNet18_Weights.IMAGENET1K_V1`. You can also use `weights=ResNet18_Weights.DEFAULT` to get the most up-to-date weights.
  warnings.warn(msg)
cuda:0
```

TRAINING

In [21]:
```python
def dice_loss(pred, target, smooth=1.0):
    pred = pred.view(-1)
    target = target.view(-1)
    intersection = (pred * target).sum()
    return 1 - ((2. * intersection + smooth) / (pred.sum() + target.sum() +

criterion = lambda pred, target: 0.5 * nn.BCELoss()(pred, target) + 0.5 * di
optimizer = optim.Adam(model.parameters(), lr=1e-4)

num_epochs = 500

for epoch in range(num_epochs):
    model.train()
    running_loss = 0.0

    for images, masks in tqdm(dataloader, desc=f"Epoch {epoch+1}/{num_epochs
        images = images.to(device)
        masks = masks.to(device)

        optimizer.zero_grad()
        outputs = model(images)

        loss = criterion(outputs, masks)
        loss.backward()
        optimizer.step()

        running_loss += loss.item()

    print(f"Epoch {epoch+1}/{num_epochs}, Loss: {running_loss / len(dataloac

print("Training Complete!")
```

```
Epoch 1/500: 100%|██████████| 15/15 [00:11<00:00,  1.33it/s]
Epoch 1/500, Loss: 0.6386181354522705
Epoch 2/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 2/500, Loss: 0.5589231888453166
Epoch 3/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 3/500, Loss: 0.45664413770039874
Epoch 4/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 4/500, Loss: 0.38541125059127807
```

```
Epoch 5/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 5/500, Loss: 0.3840756972630819
Epoch 6/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 6/500, Loss: 0.44757611950238546
Epoch 7/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 7/500, Loss: 0.35455089012781776
Epoch 8/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 8/500, Loss: 0.35095605850219724
Epoch 9/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 9/500, Loss: 0.42055274347464244
Epoch 10/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 10/500, Loss: 0.40525071918964384
Epoch 11/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 11/500, Loss: 0.35704340736071266
Epoch 12/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 12/500, Loss: 0.35184013346831006
Epoch 13/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 13/500, Loss: 0.33770579000314077
Epoch 14/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 14/500, Loss: 0.3319876194000244
Epoch 15/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 15/500, Loss: 0.32484277089436847
Epoch 16/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 16/500, Loss: 0.3020004540681839
Epoch 17/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 17/500, Loss: 0.3005298122763634
Epoch 18/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 18/500, Loss: 0.31644591490427654
Epoch 19/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 19/500, Loss: 0.3979170699914297
Epoch 20/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 20/500, Loss: 0.37295029759407045
Epoch 21/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 21/500, Loss: 0.3099796175956726
Epoch 22/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 22/500, Loss: 0.2882749398549398
Epoch 23/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 23/500, Loss: 0.3561051805814107
Epoch 24/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 24/500, Loss: 0.33909256954987843
Epoch 25/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 25/500, Loss: 0.2839425623416901
Epoch 26/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 26/500, Loss: 0.2767721970876058
Epoch 27/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 27/500, Loss: 0.26594756841659545
Epoch 28/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 28/500, Loss: 0.2571233073870341
Epoch 29/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
```

```
Epoch 29/500, Loss: 0.2656966696182887
Epoch 30/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 30/500, Loss: 0.25501919984817506
Epoch 31/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 31/500, Loss: 0.2483934909105301
Epoch 32/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 32/500, Loss: 0.2961262067159017
Epoch 33/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 33/500, Loss: 0.2470734695593516
Epoch 34/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 34/500, Loss: 0.2813884675502777
Epoch 35/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 35/500, Loss: 0.23239265580972035
Epoch 36/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 36/500, Loss: 0.22692698041598003
Epoch 37/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 37/500, Loss: 0.22638175239165623
Epoch 38/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 38/500, Loss: 0.21938716818888981
Epoch 39/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 39/500, Loss: 0.21124121646086375
Epoch 40/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 40/500, Loss: 0.21081677426894505
Epoch 41/500: 100%|██████████| 15/15 [00:10<00:00,  1.47it/s]
Epoch 41/500, Loss: 0.20574236313501995
Epoch 42/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 42/500, Loss: 0.21221024692058563
Epoch 43/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 43/500, Loss: 0.28581602225701014
Epoch 44/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 44/500, Loss: 0.2115467295050621
Epoch 45/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 45/500, Loss: 0.2168542077143987
Epoch 46/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 46/500, Loss: 0.22342989593744278
Epoch 47/500: 100%|██████████| 15/15 [00:11<00:00,  1.32it/s]
Epoch 47/500, Loss: 0.1987858215967814
Epoch 48/500: 100%|██████████| 15/15 [00:10<00:00,  1.36it/s]
Epoch 48/500, Loss: 0.19351042608420055
Epoch 49/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 49/500, Loss: 0.18248449563980101
Epoch 50/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 50/500, Loss: 0.17948387761910756
Epoch 51/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 51/500, Loss: 0.18439272443453472
Epoch 52/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 52/500, Loss: 0.178195758163929
Epoch 53/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 53/500, Loss: 0.26296830326318743
```

```
Epoch 54/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 54/500, Loss: 0.18076157023509343
Epoch 55/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 55/500, Loss: 0.25103544890880586
Epoch 56/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 56/500, Loss: 0.17152674595514933
Epoch 57/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 57/500, Loss: 0.2573688124616941
Epoch 58/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 58/500, Loss: 0.2036633570988973
Epoch 59/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 59/500, Loss: 0.20163697600364686
Epoch 60/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 60/500, Loss: 0.1761226793130239
Epoch 61/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 61/500, Loss: 0.16775515427192053
Epoch 62/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 62/500, Loss: 0.1578695744276047
Epoch 63/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 63/500, Loss: 0.15607071320215862
Epoch 64/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 64/500, Loss: 0.178225543598334
Epoch 65/500: 100%|██████████| 15/15 [00:11<00:00,  1.33it/s]
Epoch 65/500, Loss: 0.151103612780571
Epoch 66/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 66/500, Loss: 0.17370045284430186
Epoch 67/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 67/500, Loss: 0.15161432872215908
Epoch 68/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 68/500, Loss: 0.14920372888445854
Epoch 69/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 69/500, Loss: 0.14629804491996765
Epoch 70/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 70/500, Loss: 0.1438504045208295
Epoch 71/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 71/500, Loss: 0.14730865557988485
Epoch 72/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 72/500, Loss: 0.1437756150960922
Epoch 73/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 73/500, Loss: 0.14328886220852535
Epoch 74/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 74/500, Loss: 0.14731632471084594
Epoch 75/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 75/500, Loss: 0.13916960209608079
Epoch 76/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 76/500, Loss: 0.14173280944426855
Epoch 77/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 77/500, Loss: 0.1392308716972669
Epoch 78/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
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Epoch 78/500, Loss: 0.140737214187781
Epoch 79/500: 100%|██████████| 15/15 [00:10<00:00, 1.42it/s]
Epoch 79/500, Loss: 0.1395820274949074
Epoch 80/500: 100%|██████████| 15/15 [00:11<00:00, 1.33it/s]
Epoch 80/500, Loss: 0.1635759527484576
Epoch 81/500: 100%|██████████| 15/15 [00:10<00:00, 1.38it/s]
Epoch 81/500, Loss: 0.15279423495133718
Epoch 82/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 82/500, Loss: 0.12793449610471724
Epoch 83/500: 100%|██████████| 15/15 [00:10<00:00, 1.42it/s]
Epoch 83/500, Loss: 0.12782512654860814
Epoch 84/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 84/500, Loss: 0.12752623098591964
Epoch 85/500: 100%|██████████| 15/15 [00:10<00:00, 1.44it/s]
Epoch 85/500, Loss: 0.1265127698580424
Epoch 86/500: 100%|██████████| 15/15 [00:10<00:00, 1.38it/s]
Epoch 86/500, Loss: 0.12818374534447988
Epoch 87/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 87/500, Loss: 0.15326463878154756
Epoch 88/500: 100%|██████████| 15/15 [00:10<00:00, 1.41it/s]
Epoch 88/500, Loss: 0.12075198019544284
Epoch 89/500: 100%|██████████| 15/15 [00:10<00:00, 1.41it/s]
Epoch 89/500, Loss: 0.12605890333652497
Epoch 90/500: 100%|██████████| 15/15 [00:10<00:00, 1.38it/s]
Epoch 90/500, Loss: 0.12066627815365791
Epoch 91/500: 100%|██████████| 15/15 [00:10<00:00, 1.39it/s]
Epoch 91/500, Loss: 0.11902723958094914
Epoch 92/500: 100%|██████████| 15/15 [00:10<00:00, 1.46it/s]
Epoch 92/500, Loss: 0.12317261969049771
Epoch 93/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 93/500, Loss: 0.12065265377362569
Epoch 94/500: 100%|██████████| 15/15 [00:10<00:00, 1.42it/s]
Epoch 94/500, Loss: 0.12206688870986303
Epoch 95/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 95/500, Loss: 0.1138670692841212
Epoch 96/500: 100%|██████████| 15/15 [00:11<00:00, 1.34it/s]
Epoch 96/500, Loss: 0.11608585764964421
Epoch 97/500: 100%|██████████| 15/15 [00:10<00:00, 1.41it/s]
Epoch 97/500, Loss: 0.12197335809469223
Epoch 98/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 98/500, Loss: 0.14737630337476731
Epoch 99/500: 100%|██████████| 15/15 [00:11<00:00, 1.36it/s]
Epoch 99/500, Loss: 0.13114157070716223
Epoch 100/500: 100%|██████████| 15/15 [00:10<00:00, 1.39it/s]
Epoch 100/500, Loss: 0.17036555111408233
Epoch 101/500: 100%|██████████| 15/15 [00:10<00:00, 1.41it/s]
Epoch 101/500, Loss: 0.12394509812196096
Epoch 102/500: 100%|██████████| 15/15 [00:10<00:00, 1.40it/s]
Epoch 102/500, Loss: 0.13860679864883424

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Epoch 103/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 103/500, Loss: 0.1263192931811015
Epoch 104/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 104/500, Loss: 0.1180378129084905
Epoch 105/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 105/500, Loss: 0.11523678749799729
Epoch 106/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 106/500, Loss: 0.11159338653087617
Epoch 107/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 107/500, Loss: 0.10821940898895263
Epoch 108/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 108/500, Loss: 0.14711607520778974
Epoch 109/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 109/500, Loss: 0.10092853307723999
Epoch 110/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 110/500, Loss: 0.106905268629392
Epoch 111/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 111/500, Loss: 0.10092952325940133
Epoch 112/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 112/500, Loss: 0.10405460645755132
Epoch 113/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 113/500, Loss: 0.09859271223346393
Epoch 114/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 114/500, Loss: 0.125077789525191
Epoch 115/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 115/500, Loss: 0.09683101897438368
Epoch 116/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 116/500, Loss: 0.09684794743855794
Epoch 117/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 117/500, Loss: 0.09610663577914239
Epoch 118/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 118/500, Loss: 0.09527880996465683
Epoch 119/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 119/500, Loss: 0.11786089688539506
Epoch 120/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 120/500, Loss: 0.09073584377765656
Epoch 121/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 121/500, Loss: 0.09385044773419698
Epoch 122/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 122/500, Loss: 0.09646683434645335
Epoch 123/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 123/500, Loss: 0.09417037864526114
Epoch 124/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 124/500, Loss: 0.11391246306399504
Epoch 125/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 125/500, Loss: 0.1114308180908362
Epoch 126/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 126/500, Loss: 0.09360660687088966
Epoch 127/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
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Epoch 127/500, Loss: 0.0871580551067988
Epoch 128/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 128/500, Loss: 0.1145106221238772
Epoch 129/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 129/500, Loss: 0.08415846675634384
Epoch 130/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 130/500, Loss: 0.10946067596475283
Epoch 131/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 131/500, Loss: 0.08253426005442938
Epoch 132/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 132/500, Loss: 0.08545685609181722
Epoch 133/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 133/500, Loss: 0.08703693350156148
Epoch 134/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 134/500, Loss: 0.08371282853186131
Epoch 135/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 135/500, Loss: 0.08861362586418788
Epoch 136/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 136/500, Loss: 0.08528506085276603
Epoch 137/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 137/500, Loss: 0.08762675002217293
Epoch 138/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 138/500, Loss: 0.08433919002612432
Epoch 139/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 139/500, Loss: 0.10582939833402634
Epoch 140/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 140/500, Loss: 0.07930622721711794
Epoch 141/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 141/500, Loss: 0.08162892336646715
Epoch 142/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 142/500, Loss: 0.08162723903854688
Epoch 143/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 143/500, Loss: 0.0838221974670887
Epoch 144/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 144/500, Loss: 0.10314814696709315
Epoch 145/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 145/500, Loss: 0.08013218219081561
Epoch 146/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 146/500, Loss: 0.08225966158012549
Epoch 147/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 147/500, Loss: 0.08241847331325212
Epoch 148/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 148/500, Loss: 0.07766707514723142
Epoch 149/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 149/500, Loss: 0.077277272939682
Epoch 150/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 150/500, Loss: 0.08534776493906975
Epoch 151/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 151/500, Loss: 0.08938181561728319
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Epoch 152/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 152/500, Loss: 0.10828002244234085
Epoch 153/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 153/500, Loss: 0.1024794747432073
Epoch 154/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 154/500, Loss: 0.0785818034162124
Epoch 155/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 155/500, Loss: 0.08022575825452805
Epoch 156/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 156/500, Loss: 0.07681001896659533
Epoch 157/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 157/500, Loss: 0.08341428115963936
Epoch 158/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 158/500, Loss: 0.0804639125863711
Epoch 159/500: 100%|██████████| 15/15 [00:11<00:00,  1.31it/s]
Epoch 159/500, Loss: 0.30243899424870807
Epoch 160/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 160/500, Loss: 0.1927834207812945
Epoch 161/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 161/500, Loss: 0.14638400028149287
Epoch 162/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 162/500, Loss: 0.12136287788550058
Epoch 163/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 163/500, Loss: 0.11462717155615489
Epoch 164/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 164/500, Loss: 0.1042308509349823
Epoch 165/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 165/500, Loss: 0.09720947941144308
Epoch 166/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 166/500, Loss: 0.14500084444880484
Epoch 167/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 167/500, Loss: 0.09284146825472514
Epoch 168/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 168/500, Loss: 0.08656819264094034
Epoch 169/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 169/500, Loss: 0.08622618168592452
Epoch 170/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 170/500, Loss: 0.07922064413626989
Epoch 171/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 171/500, Loss: 0.08035025422771772
Epoch 172/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 172/500, Loss: 0.08000729829072953
Epoch 173/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 173/500, Loss: 0.07581872045993805
Epoch 174/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 174/500, Loss: 0.07457210794091225
Epoch 175/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 175/500, Loss: 0.07327854558825493
Epoch 176/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
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Epoch 176/500, Loss: 0.07155894761284193
Epoch 177/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 177/500, Loss: 0.11012167409062386
Epoch 178/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 178/500, Loss: 0.07865745897094409
Epoch 179/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 179/500, Loss: 0.08038546741008759
Epoch 180/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 180/500, Loss: 0.11183224717777598
Epoch 181/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 181/500, Loss: 0.07669180035591125
Epoch 182/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 182/500, Loss: 0.07379709457357725
Epoch 183/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 183/500, Loss: 0.07492585157354673
Epoch 184/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 184/500, Loss: 0.07027639547983805
Epoch 185/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 185/500, Loss: 0.07991492003202438
Epoch 186/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 186/500, Loss: 0.07195642118652662
Epoch 187/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 187/500, Loss: 0.07237987282375495
Epoch 188/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 188/500, Loss: 0.06869791820645332
Epoch 189/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 189/500, Loss: 0.08351018130779267
Epoch 190/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 190/500, Loss: 0.07767768750588099
Epoch 191/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 191/500, Loss: 0.07774194777011871
Epoch 192/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 192/500, Loss: 0.2324026624361674
Epoch 193/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 193/500, Loss: 0.10530343800783157
Epoch 194/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 194/500, Loss: 0.0997018372019132
Epoch 195/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 195/500, Loss: 0.12442352200547854
Epoch 196/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 196/500, Loss: 0.10682271346449852
Epoch 197/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 197/500, Loss: 0.09547968109448751
Epoch 198/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 198/500, Loss: 0.08476152271032333
Epoch 199/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 199/500, Loss: 0.0776085818807284
Epoch 200/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 200/500, Loss: 0.0802090309560299
```

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Epoch 201/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 201/500, Loss: 0.10991440390547116
Epoch 202/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 202/500, Loss: 0.07370493287841479
Epoch 203/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 203/500, Loss: 0.07300435329476992
Epoch 204/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 204/500, Loss: 0.07505503396193186
Epoch 205/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 205/500, Loss: 0.0704729954401652
Epoch 206/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 206/500, Loss: 0.068716183056434
Epoch 207/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 207/500, Loss: 0.06728128716349602
Epoch 208/500: 100%|██████████| 15/15 [00:10<00:00,  1.36it/s]
Epoch 208/500, Loss: 0.06829010074337323
Epoch 209/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 209/500, Loss: 0.06655812871952851
Epoch 210/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 210/500, Loss: 0.06559926743308703
Epoch 211/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 211/500, Loss: 0.06812608328958353
Epoch 212/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 212/500, Loss: 0.06705707311630249
Epoch 213/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 213/500, Loss: 0.06452377860744794
Epoch 214/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 214/500, Loss: 0.06653754189610481
Epoch 215/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 215/500, Loss: 0.07897000138958295
Epoch 216/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 216/500, Loss: 0.07393417035539945
Epoch 217/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 217/500, Loss: 0.07105759729941687
Epoch 218/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 218/500, Loss: 0.07016112878918648
Epoch 219/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 219/500, Loss: 0.0626983014245828
Epoch 220/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 220/500, Loss: 0.06393899371226629
Epoch 221/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 221/500, Loss: 0.10218318899472555
Epoch 222/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 222/500, Loss: 0.06636595763266087
Epoch 223/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 223/500, Loss: 0.10480408916870752
Epoch 224/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 224/500, Loss: 0.06943331261475881
Epoch 225/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
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Epoch 225/500, Loss: 0.06960152561465899
Epoch 226/500: 100%|██████████| 15/15 [00:11<00:00,  1.33it/s]
Epoch 226/500, Loss: 0.0676572340230147
Epoch 227/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 227/500, Loss: 0.06009149899085363
Epoch 228/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 228/500, Loss: 0.06399428819616636
Epoch 229/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 229/500, Loss: 0.062297260264555614
Epoch 230/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 230/500, Loss: 0.059067103639245035
Epoch 231/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 231/500, Loss: 0.061251333852608995
Epoch 232/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 232/500, Loss: 0.055834090958038964
Epoch 233/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 233/500, Loss: 0.06248880252242088
Epoch 234/500: 100%|██████████| 15/15 [00:11<00:00,  1.30it/s]
Epoch 234/500, Loss: 0.057084167997042336
Epoch 235/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 235/500, Loss: 0.06250254921615124
Epoch 236/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 236/500, Loss: 0.06088469848036766
Epoch 237/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 237/500, Loss: 0.06561665832996369
Epoch 238/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 238/500, Loss: 0.06247332642475764
Epoch 239/500: 100%|██████████| 15/15 [00:10<00:00,  1.47it/s]
Epoch 239/500, Loss: 0.06131761260330677
Epoch 240/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 240/500, Loss: 0.06022415533661842
Epoch 241/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 241/500, Loss: 0.05717614889144897
Epoch 242/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 242/500, Loss: 0.05824542529881001
Epoch 243/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 243/500, Loss: 0.055565895636876424
Epoch 244/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 244/500, Loss: 0.05940698298315207
Epoch 245/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 245/500, Loss: 0.05959837796787421
Epoch 246/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 246/500, Loss: 0.058595191687345505
Epoch 247/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 247/500, Loss: 0.05662030590077241
Epoch 248/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 248/500, Loss: 0.05709053451816241
Epoch 249/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 249/500, Loss: 0.05572252323230108
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Epoch 250/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 250/500, Loss: 0.05608512200415135
Epoch 251/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 251/500, Loss: 0.05596168717990319
Epoch 252/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 252/500, Loss: 0.057859269281228386
Epoch 253/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 253/500, Loss: 0.09727366020282109
Epoch 254/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 254/500, Loss: 0.05545422248542309
Epoch 255/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 255/500, Loss: 0.05425101468960444
Epoch 256/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 256/500, Loss: 0.053966961801052094
Epoch 257/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 257/500, Loss: 0.057833588868379596
Epoch 258/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 258/500, Loss: 0.05874700173735618
Epoch 259/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 259/500, Loss: 0.05534808325270812
Epoch 260/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 260/500, Loss: 0.05149670566121737
Epoch 261/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 261/500, Loss: 0.05387268885970116
Epoch 262/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 262/500, Loss: 0.05214151752491792
Epoch 263/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 263/500, Loss: 0.0550813074534138
Epoch 264/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 264/500, Loss: 0.05474333055317402
Epoch 265/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 265/500, Loss: 0.05224396288394928
Epoch 266/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 266/500, Loss: 0.05153761357069016
Epoch 267/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 267/500, Loss: 0.049466742450992265
Epoch 268/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 268/500, Loss: 0.05110929881532987
Epoch 269/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 269/500, Loss: 0.0490846121062835
Epoch 270/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 270/500, Loss: 0.0803631647179524
Epoch 271/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 271/500, Loss: 0.04732041917741299
Epoch 272/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 272/500, Loss: 0.05256253108382225
Epoch 273/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 273/500, Loss: 0.048767251148819926
Epoch 274/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
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Epoch 274/500, Loss: 0.053400503223141035
Epoch 275/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 275/500, Loss: 0.053500943506757416
Epoch 276/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 276/500, Loss: 0.05331736865142981
Epoch 277/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 277/500, Loss: 0.05032301396131515
Epoch 278/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 278/500, Loss: 0.04812743241588275
Epoch 279/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 279/500, Loss: 0.05195992290973663
Epoch 280/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 280/500, Loss: 0.04906751910845439
Epoch 281/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 281/500, Loss: 0.07703381838897864
Epoch 282/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 282/500, Loss: 0.04714958369731903
Epoch 283/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 283/500, Loss: 0.04610460686186949
Epoch 284/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 284/500, Loss: 0.048315272231896716
Epoch 285/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 285/500, Loss: 0.04987277649343014
Epoch 286/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 286/500, Loss: 0.05014675458272298
Epoch 287/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 287/500, Loss: 0.0486686905225118
Epoch 288/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 288/500, Loss: 0.04413902908563614
Epoch 289/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 289/500, Loss: 0.050327062917252384
Epoch 290/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 290/500, Loss: 0.07519855921467146
Epoch 291/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 291/500, Loss: 0.044496389230092366
Epoch 292/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 292/500, Loss: 0.04614136666059494
Epoch 293/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 293/500, Loss: 0.04651466558376948
Epoch 294/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 294/500, Loss: 0.04468340612947941
Epoch 295/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 295/500, Loss: 0.04340667799115181
Epoch 296/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 296/500, Loss: 0.04435124608377616
Epoch 297/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 297/500, Loss: 0.044798198714852334
Epoch 298/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 298/500, Loss: 0.04306548945605755
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Epoch 299/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 299/500, Loss: 0.07270334400236607
Epoch 300/500: 100%|██████████| 15/15 [00:10<00:00,  1.48it/s]
Epoch 300/500, Loss: 0.07986930335561435
Epoch 301/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 301/500, Loss: 0.05681936964392662
Epoch 302/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 302/500, Loss: 0.0547401949763298
Epoch 303/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 303/500, Loss: 0.054247172301014265
Epoch 304/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 304/500, Loss: 0.05028749058643977
Epoch 305/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 305/500, Loss: 0.049642974883317946
Epoch 306/500: 100%|██████████| 15/15 [00:11<00:00,  1.35it/s]
Epoch 306/500, Loss: 0.04815506661931674
Epoch 307/500: 100%|██████████| 15/15 [00:11<00:00,  1.34it/s]
Epoch 307/500, Loss: 0.04586285961170991
Epoch 308/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 308/500, Loss: 0.07311101543406645
Epoch 309/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 309/500, Loss: 0.042723217606544496
Epoch 310/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 310/500, Loss: 0.06895095196863016
Epoch 311/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 311/500, Loss: 0.04280044970413049
Epoch 312/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 312/500, Loss: 0.040297357365489006
Epoch 313/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 313/500, Loss: 0.04262977254887422
Epoch 314/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 314/500, Loss: 0.04357542656362057
Epoch 315/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 315/500, Loss: 0.04186663975318273
Epoch 316/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 316/500, Loss: 0.04111923227707545
Epoch 317/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 317/500, Loss: 0.042319370433688164
Epoch 318/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 318/500, Loss: 0.04386867582798004
Epoch 319/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 319/500, Loss: 0.04104196640352408
Epoch 320/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 320/500, Loss: 0.0578688982874155
Epoch 321/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 321/500, Loss: 0.04834086348613103
Epoch 322/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 322/500, Loss: 0.04838969198366006
Epoch 323/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
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Epoch 323/500, Loss: 0.044530049835642176
Epoch 324/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 324/500, Loss: 0.047552256658673284
Epoch 325/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 325/500, Loss: 0.04184009345869223
Epoch 326/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 326/500, Loss: 0.04333085554341475
Epoch 327/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 327/500, Loss: 0.041793048630158106
Epoch 328/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 328/500, Loss: 0.04004165803392728
Epoch 329/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 329/500, Loss: 0.043099885309735936
Epoch 330/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 330/500, Loss: 0.04193597249686718
Epoch 331/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 331/500, Loss: 0.04179579329987367
Epoch 332/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 332/500, Loss: 0.0413284712781508 76
Epoch 333/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 333/500, Loss: 0.03889485225081444
Epoch 334/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 334/500, Loss: 0.03807096555829048
Epoch 335/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 335/500, Loss: 0.07261260623733203
Epoch 336/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 336/500, Loss: 0.04597857967019081
Epoch 337/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 337/500, Loss: 0.045217716197172804
Epoch 338/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 338/500, Loss: 0.04061075846354167
Epoch 339/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 339/500, Loss: 0.040409494067231815
Epoch 340/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 340/500, Loss: 0.04011641355852286
Epoch 341/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 341/500, Loss: 0.039828469355901085
Epoch 342/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 342/500, Loss: 0.038090434049566586
Epoch 343/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 343/500, Loss: 0.07079314850270749
Epoch 344/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 344/500, Loss: 0.040906850496927896
Epoch 345/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 345/500, Loss: 0.03806260960797469
Epoch 346/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 346/500, Loss: 0.03694837596267462
Epoch 347/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 347/500, Loss: 0.03963330549498399
```

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Epoch 348/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 348/500, Loss: 0.03791185605029265
Epoch 349/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 349/500, Loss: 0.037706091751654944
Epoch 350/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 350/500, Loss: 0.03824732812742392
Epoch 351/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 351/500, Loss: 0.03490223077436288
Epoch 352/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 352/500, Loss: 0.03646911978721619
Epoch 353/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 353/500, Loss: 0.03754289671778679
Epoch 354/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 354/500, Loss: 0.03996261656284332
Epoch 355/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 355/500, Loss: 0.037791947027047475
Epoch 356/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 356/500, Loss: 0.03494654217114051
Epoch 357/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 357/500, Loss: 0.035929267605145775
Epoch 358/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 358/500, Loss: 0.06277235373854637
Epoch 359/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 359/500, Loss: 0.03544200795392195
Epoch 360/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 360/500, Loss: 0.034528410310546556
Epoch 361/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 361/500, Loss: 0.03594855976601442
Epoch 362/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 362/500, Loss: 0.033090375239650 41
Epoch 363/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 363/500, Loss: 0.03511304408311844
Epoch 364/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 364/500, Loss: 0.03489661638935407
Epoch 365/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 365/500, Loss: 0.06402019585172335
Epoch 366/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 366/500, Loss: 0.03437273018062115
Epoch 367/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 367/500, Loss: 0.036429014429450034
Epoch 368/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 368/500, Loss: 0.033938463280598324
Epoch 369/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 369/500, Loss: 0.03367228644589583
Epoch 370/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 370/500, Loss: 0.032364084695776306
Epoch 371/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 371/500, Loss: 0.03448367255429427
Epoch 372/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
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Epoch 372/500, Loss: 0.03374679510792097
Epoch 373/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 373/500, Loss: 0.03255805615335703
Epoch 374/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 374/500, Loss: 0.05977217194934686
Epoch 375/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 375/500, Loss: 0.03408165605117877
Epoch 376/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 376/500, Loss: 0.03276428828636805
Epoch 377/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 377/500, Loss: 0.03388576321303845
Epoch 378/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 378/500, Loss: 0.03572811267028252
Epoch 379/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 379/500, Loss: 0.06078363948812087
Epoch 380/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 380/500, Loss: 0.03236061284939448
Epoch 381/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 381/500, Loss: 0.03163877514501413
Epoch 382/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 382/500, Loss: 0.03308493755757809
Epoch 383/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 383/500, Loss: 0.06031056971599658
Epoch 384/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 384/500, Loss: 0.0593504828090469
Epoch 385/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 385/500, Loss: 0.035391725103060406
Epoch 386/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 386/500, Loss: 0.0333385068923235
Epoch 387/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 387/500, Loss: 0.03403298941751321
Epoch 388/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 388/500, Loss: 0.0332473541299502
Epoch 389/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 389/500, Loss: 0.03781218479077021
Epoch 390/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 390/500, Loss: 0.032690111982325715
Epoch 391/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 391/500, Loss: 0.036046740350623926
Epoch 392/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 392/500, Loss: 0.03433918120960395
Epoch 393/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 393/500, Loss: 0.034509703144431116
Epoch 394/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 394/500, Loss: 0.03381706041594346
Epoch 395/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 395/500, Loss: 0.03530872153739135
Epoch 396/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 396/500, Loss: 0.03176204736034075
```

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Epoch 397/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 397/500, Loss: 0.032490982798238595
Epoch 398/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 398/500, Loss: 0.03129792995750904
Epoch 399/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 399/500, Loss: 0.031537466185788315
Epoch 400/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 400/500, Loss: 0.058311271294951436
Epoch 401/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 401/500, Loss: 0.03168603405356407
Epoch 402/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 402/500, Loss: 0.03410114410022894
Epoch 403/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 403/500, Loss: 0.02936266139149666
Epoch 404/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 404/500, Loss: 0.03184355466316144
Epoch 405/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 405/500, Loss: 0.05861653027435144
Epoch 406/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 406/500, Loss: 0.032221241543690 36
Epoch 407/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 407/500, Loss: 0.029788506031036378
Epoch 408/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 408/500, Loss: 0.030964227579534053
Epoch 409/500: 100%|██████████| 15/15 [00:10<00:00,  1.36it/s]
Epoch 409/500, Loss: 0.05738835309942563
Epoch 410/500: 100%|██████████| 15/15 [00:10<00:00,  1.36it/s]
Epoch 410/500, Loss: 0.031168620909253757
Epoch 411/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 411/500, Loss: 0.030348038052519163
Epoch 412/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 412/500, Loss: 0.03323531672358513
Epoch 413/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 413/500, Loss: 0.030775291472673418
Epoch 414/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 414/500, Loss: 0.056445048004388806
Epoch 415/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 415/500, Loss: 0.056861925249298416
Epoch 416/500: 100%|██████████| 15/15 [00:10<00:00,  1.47it/s]
Epoch 416/500, Loss: 0.05699674847225348
Epoch 417/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 417/500, Loss: 0.030089468384782474
Epoch 418/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 418/500, Loss: 0.05574231743812561
Epoch 419/500: 100%|██████████| 15/15 [00:11<00:00,  1.36it/s]
Epoch 419/500, Loss: 0.05548312353591124
Epoch 420/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 420/500, Loss: 0.028237655324240527
Epoch 421/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
```

```
Epoch 421/500, Loss: 0.028705001125733057
Epoch 422/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 422/500, Loss: 0.03136552938570579
Epoch 423/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 423/500, Loss: 0.05682621772090594
Epoch 424/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 424/500, Loss: 0.056291820108890535
Epoch 425/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 425/500, Loss: 0.02823536694049835
Epoch 426/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 426/500, Loss: 0.026592612949510416
Epoch 427/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 427/500, Loss: 0.05785237786670526
Epoch 428/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 428/500, Loss: 0.0293771676098307
Epoch 429/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 429/500, Loss: 0.029150403601427875
Epoch 430/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 430/500, Loss: 0.031478553699950375
Epoch 431/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 431/500, Loss: 0.02716843274732431
Epoch 432/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 432/500, Loss: 0.03009546423951785
Epoch 433/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 433/500, Loss: 0.05667542051523924
Epoch 434/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 434/500, Loss: 0.02938502182563146
Epoch 435/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 435/500, Loss: 0.05518601958950361
Epoch 436/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 436/500, Loss: 0.02838391357411941
Epoch 437/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 437/500, Loss: 0.028732027423878512
Epoch 438/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 438/500, Loss: 0.027657412799696128
Epoch 439/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 439/500, Loss: 0.029995546179513135
Epoch 440/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 440/500, Loss: 0.028262240625917912
Epoch 441/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 441/500, Loss: 0.02958224012205998
Epoch 442/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 442/500, Loss: 0.02923054719964663
Epoch 443/500: 100%|██████████| 15/15 [00:10<00:00,  1.37it/s]
Epoch 443/500, Loss: 0.028191906958818437
Epoch 444/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 444/500, Loss: 0.026862101381023726
Epoch 445/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 445/500, Loss: 0.055717990112801395
```

```
Epoch 446/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 446/500, Loss: 0.027098328868548075
Epoch 447/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 447/500, Loss: 0.05353638716042042
Epoch 448/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 448/500, Loss: 0.026697640741864 84
Epoch 449/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 449/500, Loss: 0.029246651877959568
Epoch 450/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 450/500, Loss: 0.030722565886874994
Epoch 451/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 451/500, Loss: 0.029634547606110572
Epoch 452/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 452/500, Loss: 0.02822998755921 92
Epoch 453/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 453/500, Loss: 0.05542478176454703
Epoch 454/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 454/500, Loss: 0.029284209447602 43
Epoch 455/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 455/500, Loss: 0.027022572482625642
Epoch 456/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 456/500, Loss: 0.026916036941111 09
Epoch 457/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 457/500, Loss: 0.028916169578830402
Epoch 458/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 458/500, Loss: 0.05567818904916445
Epoch 459/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 459/500, Loss: 0.026726598913470904
Epoch 460/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 460/500, Loss: 0.026218367864688237
Epoch 461/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 461/500, Loss: 0.027577995757261 91
Epoch 462/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 462/500, Loss: 0.055560506011048956
Epoch 463/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 463/500, Loss: 0.027648125713070234
Epoch 464/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 464/500, Loss: 0.026842507099111877
Epoch 465/500: 100%|██████████| 15/15 [00:10<00:00,  1.46it/s]
Epoch 465/500, Loss: 0.05559017000099023
Epoch 466/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 466/500, Loss: 0.026177376260360083
Epoch 467/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 467/500, Loss: 0.027622766606509686
Epoch 468/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 468/500, Loss: 0.026313466764986516
Epoch 469/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 469/500, Loss: 0.026530473058422408
Epoch 470/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
```

```
Epoch 470/500, Loss: 0.028790962913384042
Epoch 471/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 471/500, Loss: 0.028108652991553146
Epoch 472/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 472/500, Loss: 0.027174692725141843
Epoch 473/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 473/500, Loss: 0.0524682130664587
Epoch 474/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 474/500, Loss: 0.02626446677992741
Epoch 475/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 475/500, Loss: 0.029088302236050367
Epoch 476/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 476/500, Loss: 0.02818195354193449
Epoch 477/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 477/500, Loss: 0.02637130195895831
Epoch 478/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 478/500, Loss: 0.02578535433858633
Epoch 479/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 479/500, Loss: 0.028803328797221184
Epoch 480/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 480/500, Loss: 0.026547591760754587
Epoch 481/500: 100%|██████████| 15/15 [00:10<00:00,  1.43it/s]
Epoch 481/500, Loss: 0.0279685008029143
Epoch 482/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 482/500, Loss: 0.026761651411652564
Epoch 483/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 483/500, Loss: 0.027853313336769738
Epoch 484/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 484/500, Loss: 0.054296286590397355
Epoch 485/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 485/500, Loss: 0.05365607080360254
Epoch 486/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 486/500, Loss: 0.024421273916959762
Epoch 487/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 487/500, Loss: 0.027449164104958377
Epoch 488/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 488/500, Loss: 0.026325064649184545
Epoch 489/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 489/500, Loss: 0.025827926211059095
Epoch 490/500: 100%|██████████| 15/15 [00:10<00:00,  1.39it/s]
Epoch 490/500, Loss: 0.026618347937862077
Epoch 491/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 491/500, Loss: 0.05241042760511239
Epoch 492/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 492/500, Loss: 0.023813122448821864
Epoch 493/500: 100%|██████████| 15/15 [00:10<00:00,  1.40it/s]
Epoch 493/500, Loss: 0.024319583798448244
Epoch 494/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 494/500, Loss: 0.02492320251961549
```

```
Epoch 495/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 495/500, Loss: 0.025847996150453887
Epoch 496/500: 100%|██████████| 15/15 [00:10<00:00,  1.45it/s]
Epoch 496/500, Loss: 0.028763352458675704
Epoch 497/500: 100%|██████████| 15/15 [00:10<00:00,  1.41it/s]
Epoch 497/500, Loss: 0.025566989245514076
Epoch 498/500: 100%|██████████| 15/15 [00:10<00:00,  1.38it/s]
Epoch 498/500, Loss: 0.025411946947375932
Epoch 499/500: 100%|██████████| 15/15 [00:10<00:00,  1.44it/s]
Epoch 499/500, Loss: 0.02664865888655186
Epoch 500/500: 100%|██████████| 15/15 [00:10<00:00,  1.42it/s]
Epoch 500/500, Loss: 0.05252122661719719
Training Complete!
```

SAVING MODEL

In [22]:
```
torch.save(model.state_dict(), "/home/aniketj/GSOC_TASK1/layout_recognition_
print("Model saved successfully!")
```

```
Model saved successfully!
```

LAYOUT RECOGNITION ON TEST IMAGES

In [29]:
```
TEST_IMAGES_DIR = "/home/aniketj/GSOC_TASK1/TEST_IMAGES/"  # Folder with tes
RESULTS_DIR = "/home/aniketj/GSOC_TASK1/PREDICTION_RESULT/"  # Output folder
os.makedirs(RESULTS_DIR, exist_ok=True)

transform = T.Compose([
    T.ToPILImage(),
    T.Resize((512, 512)),
    T.Grayscale(num_output_channels=3),  # Convert 1-channel grayscale to 3-
    T.ToTensor(),
    T.Normalize(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5])  # Normalize for
])
```

In [30]:
```
def predict_layout(image_path):
    img = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    if img is None:
        print(f"Could not read {image_path}")
        return

    img_resized = transform(img).unsqueeze(0).to(device)
    with torch.no_grad():
        pred_mask = model(img_resized)

    pred_mask = pred_mask.squeeze().cpu().numpy()
    pred_mask = (pred_mask > 0.5).astype(np.uint8) * 255

    result_path = os.path.join(RESULTS_DIR, os.path.basename(image_path))
    cv2.imwrite(result_path, pred_mask)
    print(f"Saved predicted mask: {result_path}")
```

```
for img_file in os.listdir(TEST_IMAGES_DIR):
    if img_file.endswith(".jpg") or img_file.endswith(".png"):
        predict_layout(os.path.join(TEST_IMAGES_DIR, img_file))
```

```
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/452.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/285.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/8.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/9.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/11.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/843.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/616.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/99.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/13.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/14.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/93.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/776.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/268.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/274.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/609.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/12.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/15.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/529.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/284.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/779.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/339.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/318.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/778.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/364.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/291.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/108.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/530.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTION_RESULT/845.jpg
```

CREATING OVERLAYS

In [ ]:

```
OVERLAY_DIR = "/home/aniketj/GSOC_TASK1/OVERLAYS/"
os.makedirs(OVERLAY_DIR, exist_ok=True)


def overlay_prediction(image_path, mask_path):
    img = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    mask = cv2.imread(mask_path, cv2.IMREAD_GRAYSCALE)

    if img is None or mask is None:
        print(f"Could not load {image_path} or {mask_path}")
        return

    mask = cv2.resize(mask, (img.shape[1], img.shape[0]))
    mask = cv2.cvtColor(mask, cv2.COLOR_GRAY2BGR)
    img = cv2.cvtColor(img, cv2.COLOR_GRAY2BGR)
    overlay = cv2.addWeighted(img, 0.7, mask, 0.3, 0)
    overlay_path = os.path.join(OVERLAY_DIR, os.path.basename(image_path))
    cv2.imwrite(overlay_path, overlay)
    print(f"Overlay saved: {overlay_path}")
```

```
for img_file in os.listdir(TEST_IMAGES_DIR):
    if img_file.endswith(".jpg") or img_file.endswith(".png"):
        mask_file = os.path.join(RESULTS_DIR, img_file)
        overlay_prediction(os.path.join(TEST_IMAGES_DIR, img_file), mask_fil
```

```
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/452.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/285.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/8.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/9.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/11.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/843.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/616.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/99.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/13.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/14.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/93.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/776.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/268.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/274.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/609.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/12.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/15.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/529.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/284.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/779.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/339.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/318.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/778.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/364.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/291.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/108.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/530.jpg
Overlay saved: /home/aniketj/GSOC_TASK1/OVERLAYS/845.jpg
```

In [ ]:

```
PREDICTED_MASKS_DIR = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS/"
TESTING_DIR = "/home/aniketj/GSOC_TASK1/PROCESSED_IMAGES"
os.makedirs(PREDICTED_MASKS_DIR, exist_ok=True)
def predict_layout(image_path):
    img = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    if img is None:
        print(f"Could not read {image_path}")
        return

    img_resized = transform(img).unsqueeze(0).to(device)
    with torch.no_grad():
        pred_mask = model(img_resized)

    pred_mask = pred_mask.squeeze().cpu().numpy()
    pred_mask = (pred_mask > 0.5).astype(np.uint8) * 255

    result_path = os.path.join(PREDICTED_MASKS_DIR, os.path.basename(image_p
    cv2.imwrite(result_path, pred_mask)
    print(f"Saved predicted mask: {result_path}")


for img_file in os.listdir(TESTING_DIR):
```

```
    if img_file.endswith(".jpg") or img_file.endswith(".png"):
        predict_layout(os.path.join(TESTING_DIR, img_file))
```

```
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_8.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_15.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_2.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_11.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_11.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_1.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_8.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_8.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_10.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_9.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_14.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_7.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_8.jpg
```

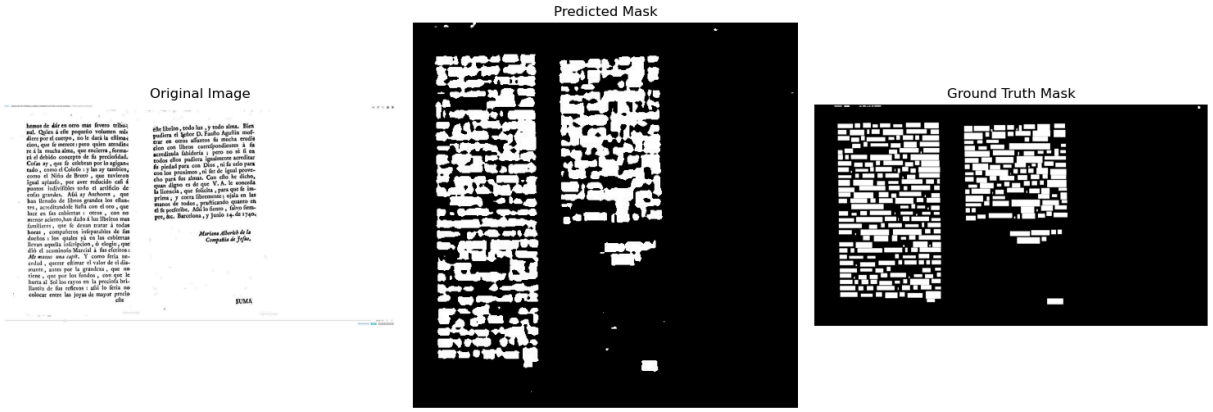
```
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_7.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_7.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_12.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_9.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_13.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_2.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_10.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_16.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_1.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_3.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_2.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_6.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_2.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_1.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_5.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_2.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_4.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstru
ccion_page_1.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/EzcarayVozes_
page_9.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page
_7.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_1.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/MendoPrincipe
perfecto_page_9.jpg
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/Constitucione
ssinodalesCalahorra_page_2.jpg
```

```
Saved predicted mask: /home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas
generales_page_1.jpg
```

In [4]:
```python
def plot_layout_comparison(original_path, pred_path, true_path):
    original = cv2.imread(original_path, cv2.IMREAD_COLOR)
    pred_mask = cv2.imread(pred_path, cv2.IMREAD_GRAYSCALE)
    true_mask = cv2.imread(true_path, cv2.IMREAD_GRAYSCALE)
    fig, axes = plt.subplots(1, 3, figsize=(15, 5))
    axes[0].imshow(cv2.cvtColor(original, cv2.COLOR_BGR2RGB))
    axes[0].set_title("Original Image")
    axes[1].imshow(pred_mask, cmap='gray')
    axes[1].set_title("Predicted Mask")
    axes[2].imshow(true_mask, cmap='gray')
    axes[2].set_title("Ground Truth Mask")
    for ax in axes:
        ax.axis('off')
    plt.tight_layout()
    plt.show()


def compute_ssim(pred, target):
    h, w = target.shape[:2]
    pred_resized = cv2.resize(pred, (w, h), interpolation=cv2.INTER_NEAREST)
    return ssim(pred_resized, target, data_range=1.0)
```

VISUALIZATIONS

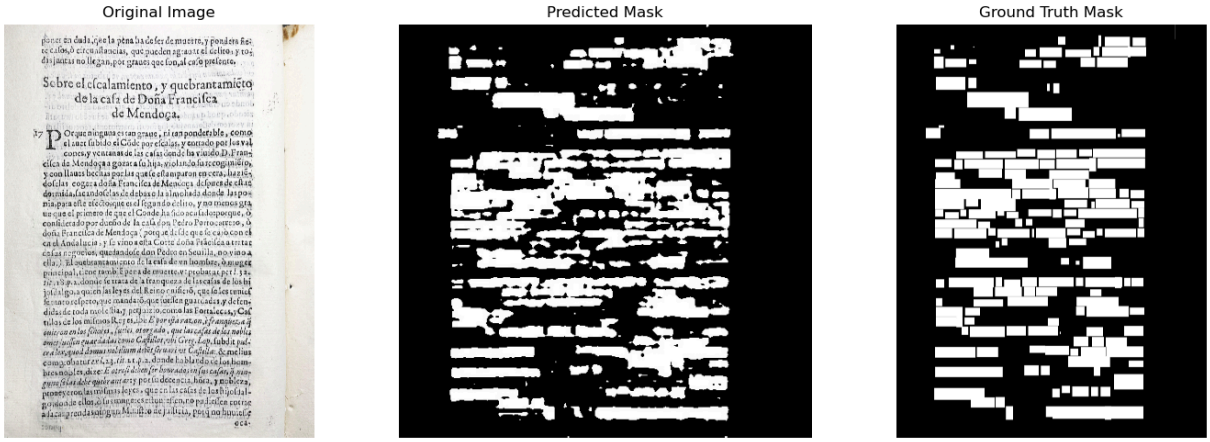
In [97]:
```python
original_image_path = "/home/aniketj/GSOC_TASK1/IMAGES/BuendiaInstruccion_pa
true_mask_path = "/home/aniketj/GSOC_TASK1/MASKS/BuendiaInstruccion_page_5.j
pred_mask_path = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS/BuendiaInstruccic
pred_mask = cv2.imread(pred_mask_path, cv2.IMREAD_GRAYSCALE)
true_mask = cv2.imread(true_mask_path, cv2.IMREAD_GRAYSCALE)
true_mask = cv2.resize(true_mask, (pred_mask.shape[1], pred_mask.shape[0]))

plot_layout_comparison(original_image_path,pred_mask_path,true_mask_path)
ssim_score = compute_ssim(pred_mask, true_mask)
print(f"SSIM Score: {ssim_score:.4f}")
```




```
SSIM Score: 0.7542
```

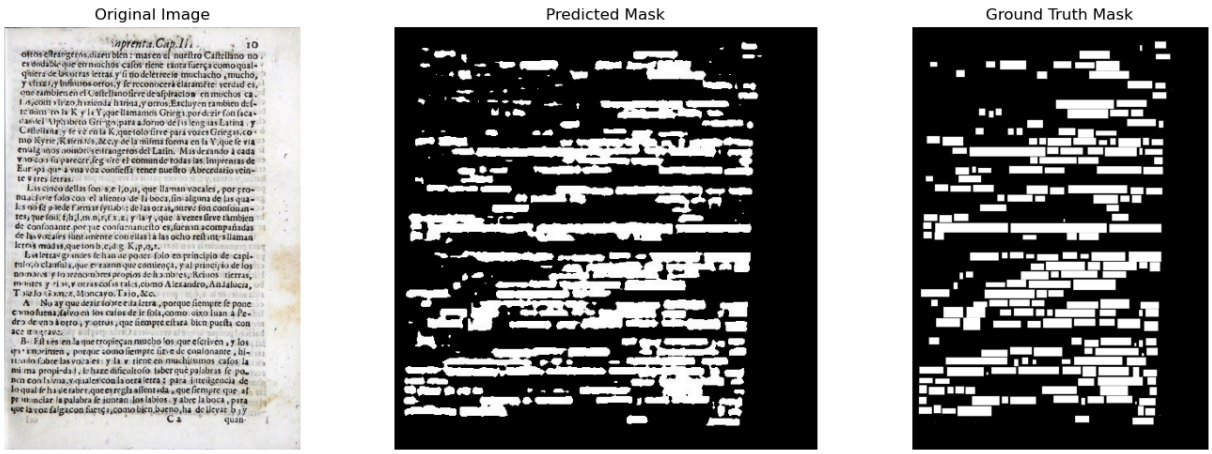
In [98]:
```python
original_image_path = "/home/aniketj/GSOC_TASK1/IMAGES/PORCONES_page_8.jpg"
true_mask_path = "/home/aniketj/GSOC_TASK1/MASKS/PORCONES_page_8.jpg"
pred_mask_path = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS/PORCONES_page_8.j
```

```
pred_mask = cv2.imread(pred_mask_path, cv2.IMREAD_GRAYSCALE)
true_mask = cv2.imread(true_mask_path, cv2.IMREAD_GRAYSCALE)
pred_mask = cv2.resize(pred_mask, (true_mask.shape[1], true_mask.shape[0]))

plot_layout_comparison(original_image_path,pred_mask_path,true_mask_path)
ssim_score = compute_ssim(pred_mask, true_mask)
print(f"SSIM Score: {ssim_score:.4f}")
```




```
SSIM Score: 0.7471
```

In [99]:
```
original_image_path = "/home/aniketj/GSOC_TASK1/IMAGES/ParedesReglas general
true_mask_path = "/home/aniketj/GSOC_TASK1/MASKS/ParedesReglas generales_pag
pred_mask_path = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS/ParedesReglas ger
pred_mask = cv2.imread(pred_mask_path, cv2.IMREAD_GRAYSCALE)
true_mask = cv2.imread(true_mask_path, cv2.IMREAD_GRAYSCALE)
pred_mask = cv2.resize(pred_mask, (true_mask.shape[1], true_mask.shape[0]))

plot_layout_comparison(original_image_path,pred_mask_path,true_mask_path)
ssim_score = compute_ssim(pred_mask, true_mask)
print(f"SSIM Score: {ssim_score:.4f}")
```

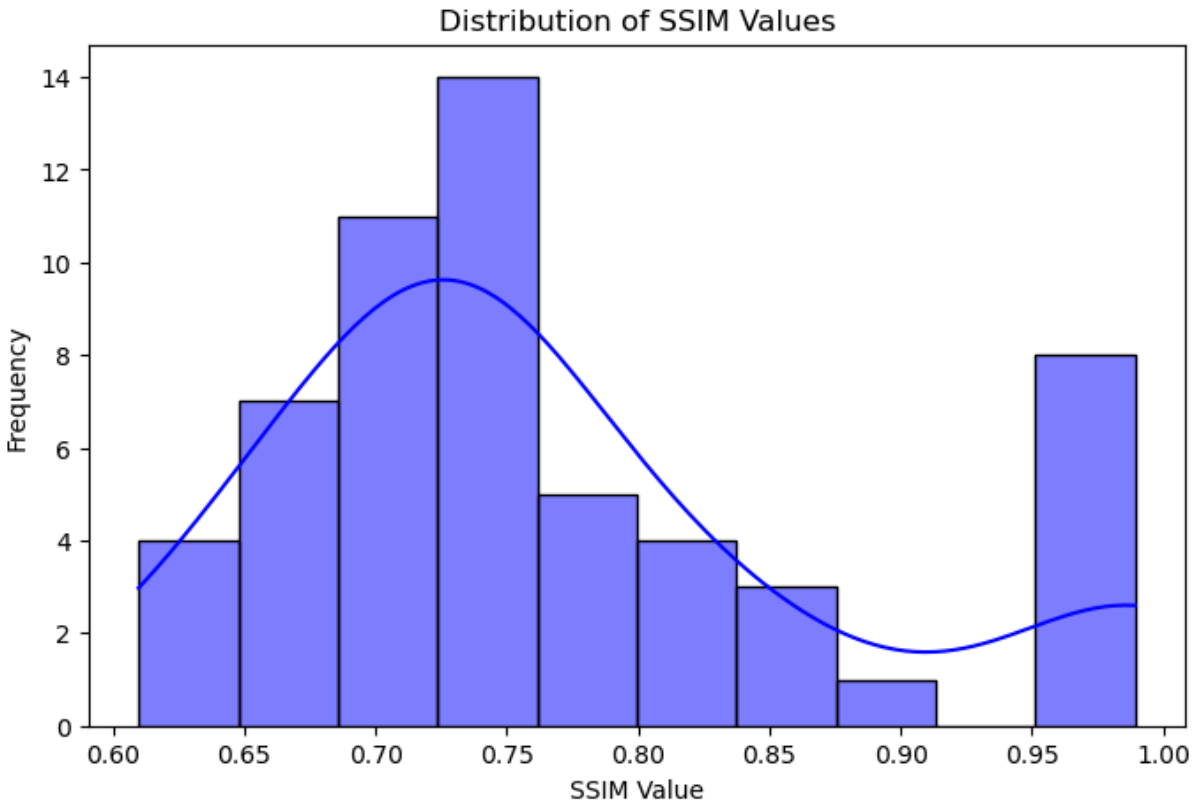



```
SSIM Score: 0.6622
```

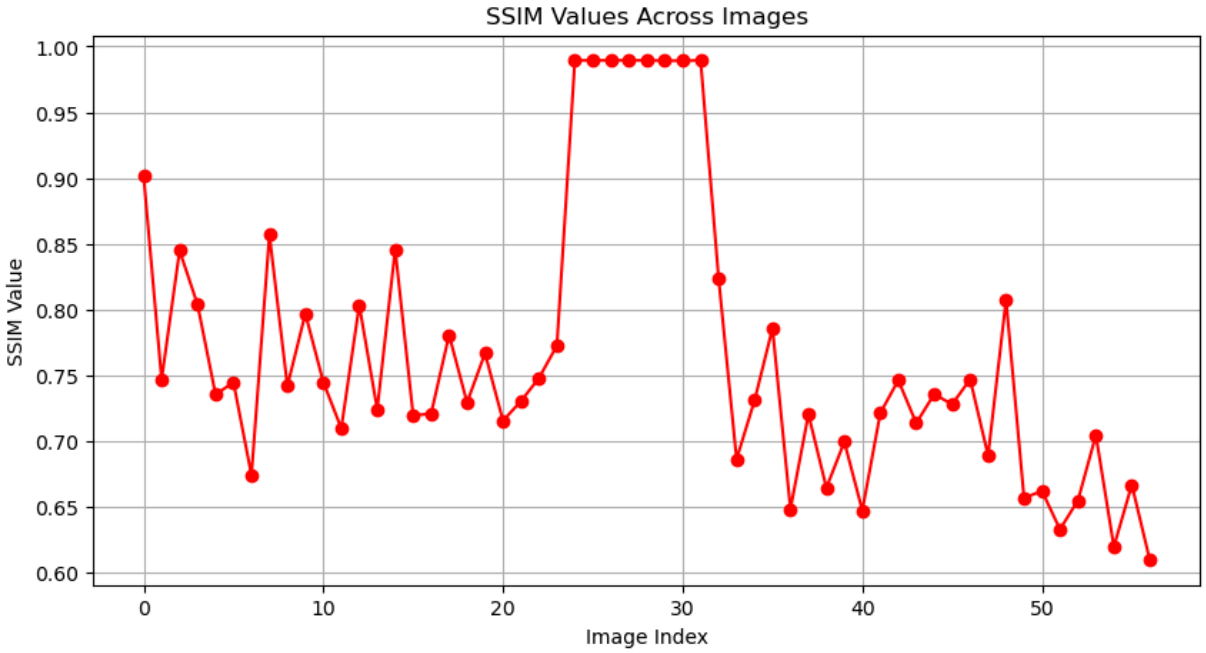
In [ ]:
```
ssim_scores = []


real_imgs = "/home/aniketj/GSOC_TASK1/MASKS"
generated_imgs = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS"
```

```
real_images = sorted(os.listdir(real_imgs))
generate_images = sorted(os.listdir(generated_imgs))


for real, generated in zip(real_images, generate_images):
    real_img_path = os.path.join(real_imgs, real)
    generated_img_path = os.path.join(generated_imgs, generated)

    pred_mask = cv2.imread(generated_img_path, cv2.IMREAD_GRAYSCALE)
    true_mask = cv2.imread(real_img_path, cv2.IMREAD_GRAYSCALE)
    pred_mask = cv2.resize(pred_mask, (true_mask.shape[1], true_mask.shape[0
    ssim_score = compute_ssim(pred_mask, true_mask)
    ssim_scores.append(ssim_score)
```

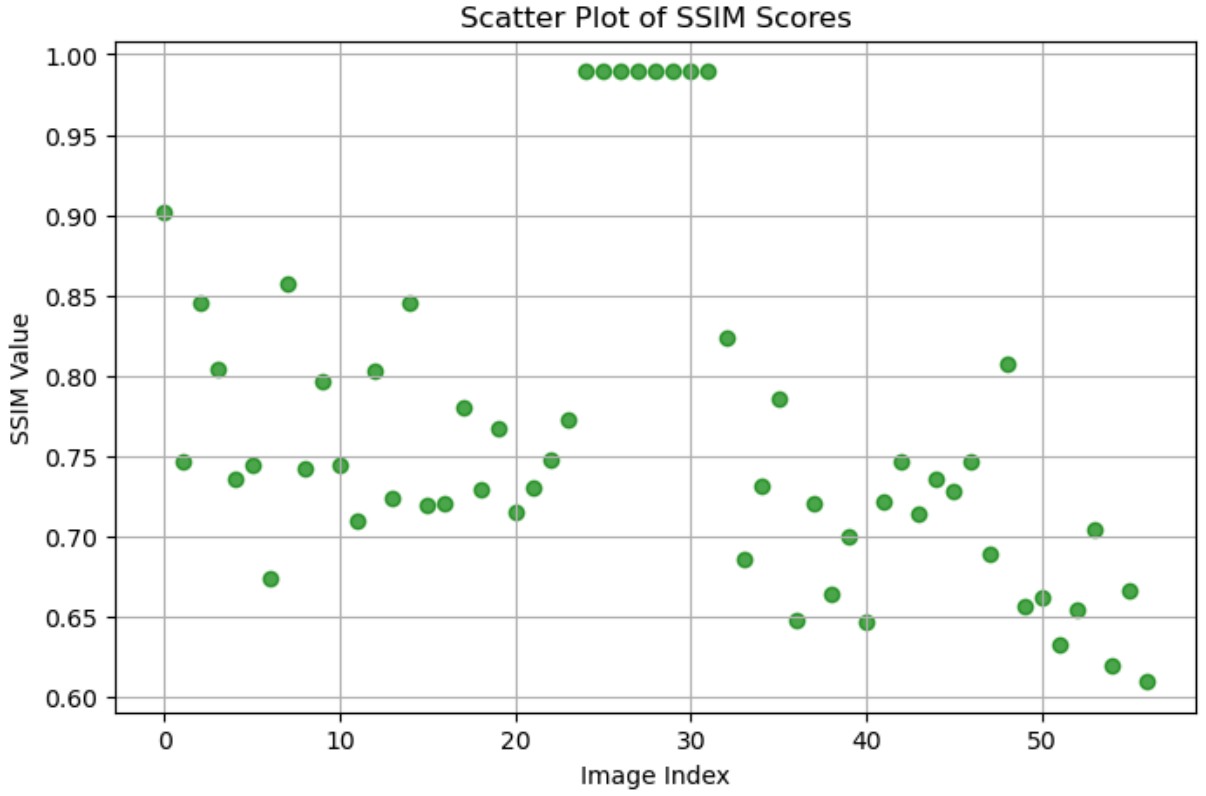
In [88]:
```
import seaborn as sns

plt.figure(figsize=(8, 5))
sns.histplot(ssim_scores, bins=10, kde=True, color='blue')
plt.xlabel("SSIM Value")
plt.ylabel("Frequency")
plt.title("Distribution of SSIM Values")
plt.show()
```



In [91]:
```
plt.figure(figsize=(10, 5))
plt.plot(ssim_scores, marker='o', linestyle='-', color='red')
plt.xlabel("Image Index")
plt.ylabel("SSIM Value")
plt.title("SSIM Values Across Images")
plt.grid()
plt.show()
```



In [92]:
```
plt.figure(figsize=(8, 5))
plt.scatter(range(len(ssim_scores)), ssim_scores, color='green', alpha=0.7)
plt.xlabel("Image Index")
plt.ylabel("SSIM Value")
plt.title("Scatter Plot of SSIM Scores")
plt.grid()
plt.show()
```



In [ ]:
```
def load_image(image_path):
    img = cv2.imread(image_path)
```

```
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    img = cv2.resize(img, (256, 256))
    img = np.transpose(img, (2, 0, 1)) / 255.0 * 2 - 1
    img = torch.tensor(img, dtype=torch.float32).unsqueeze(0)
    return img
```

In [ ]:
```
def calculate_ssim(img1_path, img2_path):
    img1 = cv2.imread(img1_path, cv2.IMREAD_GRAYSCALE)
    img2 = cv2.imread(img2_path, cv2.IMREAD_GRAYSCALE)

    if img1 is None:
        raise FileNotFoundError(f"Could not load image: {img1_path}")
    if img2 is None:
        raise FileNotFoundError(f"Could not load image: {img2_path}")


    if img1.shape != img2.shape:
        img2 = cv2.resize(img2, (img1.shape[1], img1.shape[0]))

    score, _ = ssim(img1, img2, full=True)
    return score
```

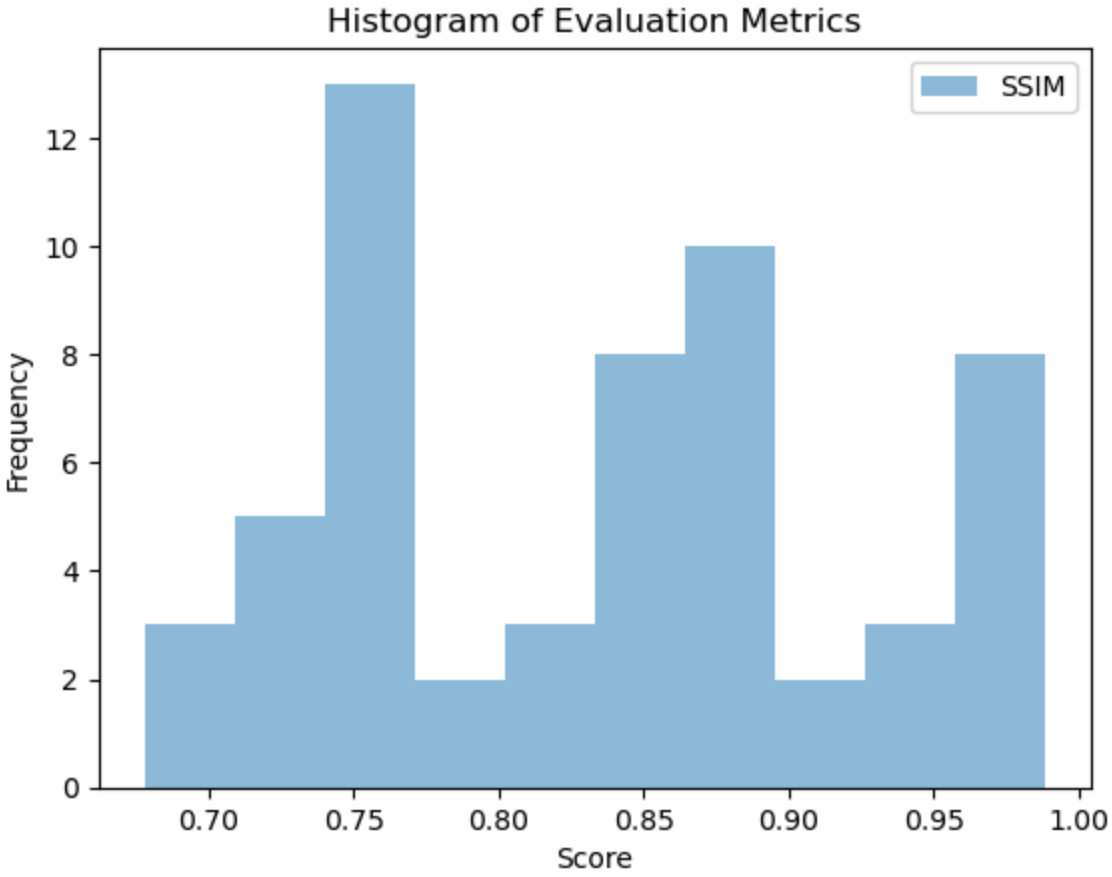
In [ ]:
```
ssim_scores = []


real_imgs = "/home/aniketj/GSOC_TASK1/MASKS/"
generated_imgs = "/home/aniketj/GSOC_TASK1/PREDICTED_MASKS/"


real_images = sorted(os.listdir(real_imgs))
generate_images = sorted(os.listdir(generated_imgs))


for real, generated in zip(real_images, generate_images):
    real_img_path = os.path.join(real_imgs, real)
    generated_img_path = os.path.join(generated_imgs, generated)


    real_image = load_image(real_img_path)
    fake_image = load_image(generated_img_path)

    ssim_score = calculate_ssim(generated_img_path , real_img_path)
    ssim_scores.append(ssim_score)
```

In [9]:
```
import statistics
mean = statistics.mean(ssim_scores)
median = statistics.median(ssim_scores)
minimum = min(ssim_scores)
maximum = max(ssim_scores)
print(f"SSIM : Average = {mean:.6f}, Median = {median:.6f}, Min = {minimum:.
```

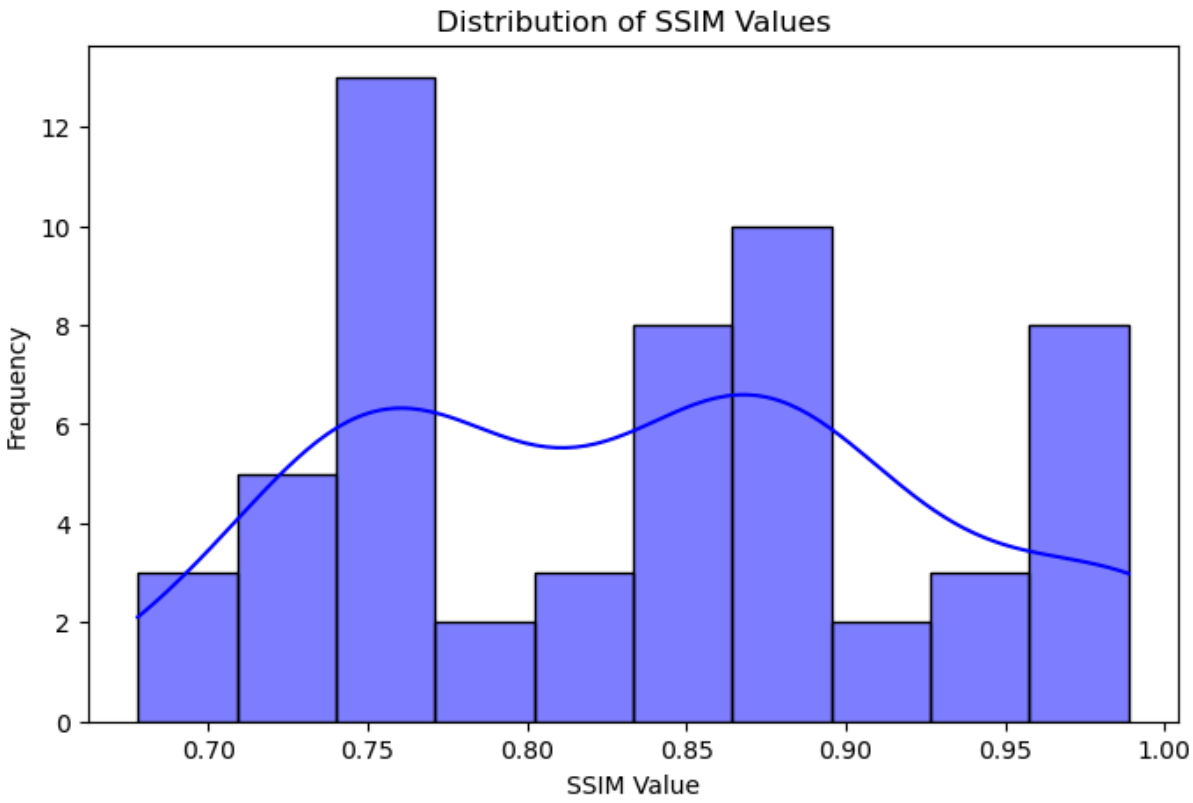
```
SSIM : Average = 0.838045, Median = 0.857945, Min = 0.677889, Max = 0.988759
```

In [10]:
```
plt.hist(ssim_scores, bins=10, alpha=0.5, label='SSIM')
plt.title('Histogram of Evaluation Metrics')
plt.xlabel('Score')
```

```
plt.ylabel('Frequency')
plt.legend()
plt.show()
```



In [11]:
```
plt.figure(figsize=(8, 5))
sns.histplot(ssim_scores, bins=10, kde=True, color='blue')
plt.xlabel("SSIM Value")
plt.ylabel("Frequency")
plt.title("Distribution of SSIM Values")
plt.show()
```



In [12]:
```
plt.figure(figsize=(8, 5))
plt.scatter(range(len(ssim_scores)), ssim_scores, color='green', alpha=0.7)
plt.xlabel("Image Index")
plt.ylabel("SSIM Value")
plt.title("Scatter Plot of SSIM Scores")
plt.grid()
plt.show()
```

In [ ]: