

Medical_Segmentation

March 20, 2025

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[1]: import warnings
import os
import requests
import tarfile
import zipfile
from tqdm import tqdm
import torch
import cv2
import torchvision
import pandas as pd
import torch.nn.functional as F
import matplotlib.pyplot as plt
import numpy as np
import albumentations as A
from albumentations.pytorch import ToTensorV2
from torch import nn, optim
from torch.utils.data import Dataset, DataLoader
from sklearn.metrics import accuracy_score
from torch.optim.lr_scheduler import ReduceLROnPlateau
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[22]: import torch_directml
device = torch_directml.device()
print("DirectML device:", device)
```

DirectML device: privateuseone:0

```
[3]: # Suppress DeprecationWarnings from tarfile
warnings.filterwarnings("ignore", category=DeprecationWarning)

# Set working directory
working_dir = 'C:/Kvasir'
os.makedirs(working_dir, exist_ok=True)
os.chdir(working_dir)

# Updated dataset URL
dataset_url = "https://datasets.simula.no/downloads/kvasir-instrument.zip"
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dataset_zip = os.path.join(working_dir, "kvasir-instrument.zip")
dataset_dir = os.path.join(working_dir, "kvasir-instrument")
```

```
[4]: # Function to download the dataset with error checking
def download_dataset(url, save_path):
    if not os.path.exists(save_path):
        print("Downloading dataset...")
    response = requests.get(url, stream=True)
    total_size = int(response.headers.get('content-length', 0))
    if response.status_code == 200:
        with open(save_path, "wb") as f, tqdm(
            desc="Downloading " + os.path.basename(save_path),
            total=total_size,
            unit='iB',
            unit_scale=True,
            unit_divisor=1024,
        ) as bar:
            for chunk in response.iter_content(chunk_size=8192):
                if chunk:
                    f.write(chunk)
                    bar.update(len(chunk))
    else:
        raise Exception(f"Failed to download file: status code {response.status_code}")
```

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[5]: # Download the dataset
try:
    download_dataset(dataset_url, dataset_zip)
except Exception as e:
    print(str(e))
    print("Please check the dataset URL or your internet connection.")
    exit(1)

# Extract the dataset
if not os.path.exists(dataset_dir):
    try:
        with zipfile.ZipFile(dataset_zip, "r") as zip_ref:
            print("Extracting dataset zip file...")
            zip_ref.extractall(working_dir)
    except zipfile.BadZipFile:
        print("Error: The downloaded file is not a valid zip file.")
        print("Deleting corrupted file and retrying...")
        os.remove(dataset_zip)
        raise

print("Dataset ready!")
```

Dataset ready!

```
[6]: # Extract images and masks tar files
images_tar = os.path.join(dataset_dir, 'images.tar.gz')
masks_tar = os.path.join(dataset_dir, 'masks.tar.gz')

if os.path.exists(images_tar):
    print("Extracting images tar file...")
    with tarfile.open(images_tar, "r:gz") as tar:
        tar.extractall(path=os.path.join(dataset_dir, 'images'))

if os.path.exists(masks_tar):
    print("Extracting masks tar file...")
    with tarfile.open(masks_tar, "r:gz") as tar:
        tar.extractall(path=os.path.join(dataset_dir, 'masks'))

print("Extraction complete.")
```

Extracting images tar file...

Extracting masks tar file...

Extraction complete.

```
[7]: # Dataset directories
images_dir = os.path.join(dataset_dir, 'images', 'images')
masks_dir = os.path.join(dataset_dir, 'masks', 'masks')

# Option to use provided splits or custom split
use_provided_splits = True # Set to False to use custom split

if use_provided_splits:
    # Paths to the dataset files
    train_txt_path = os.path.join(dataset_dir, 'train.txt')
    test_txt_path = os.path.join(dataset_dir, 'test.txt')

    # Read train and test splits
    with open(train_txt_path, 'r') as f:
        train_files = f.read().splitlines()
    with open(test_txt_path, 'r') as f:
        test_files = f.read().splitlines()

    # Construct file paths
    train_images_list = [os.path.join(images_dir, f"{img_id}.jpg") for img_id in train_files]
    train_masks_list = [os.path.join(masks_dir, f"{img_id}.png") for img_id in train_files]
    test_images_list = [os.path.join(images_dir, f"{img_id}.jpg") for img_id in test_files]
    test_masks_list = [os.path.join(masks_dir, f"{img_id}.png") for img_id in test_files]
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else:
    # Custom train/test split
    train_ratio = 0.7 # 70% for training, adjust as needed

    # Get all image and mask filenames
    all_images = sorted(os.listdir(images_dir))
    all_masks = sorted(os.listdir(masks_dir))

    # Ensure the number of images and masks are equal
    assert len(all_images) == len(all_masks), "Mismatch in number of images and masks"

    # Create the custom split
    total_samples = len(all_images)
    train_size = int(train_ratio * total_samples)
    train_images_list = [os.path.join(images_dir, img) for img in all_images[:train_size]]
    train_masks_list = [os.path.join(masks_dir, mask) for mask in all_masks[:train_size]]
    test_images_list = [os.path.join(images_dir, img) for img in all_images[train_size:]]
    test_masks_list = [os.path.join(masks_dir, mask) for mask in all_masks[train_size:]]

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[8]: # Verify that images and masks are correctly paired
print("Sample image and mask paths:")
for img_path, mask_path in zip(train_images_list[:3], train_masks_list[:3]):
    print(f"Image: {img_path}, Mask: {mask_path}")

# Dataset class
class KvasirInstrumentDataset(Dataset):
    def __init__(self, images_list, masks_list, augmentations=None):
        self.images_list = images_list
        self.masks_list = masks_list
        self.augmentations = augmentations

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

    def __getitem__(self, idx):
        image_path = self.images_list[idx]
        mask_path = self.masks_list[idx]

        image = cv2.imread(image_path)
        if image is None:
            raise ValueError(f"Image not found: {image_path}")

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mask = cv2.imread(mask_path, cv2.IMREAD_GRAYSCALE)
if mask is None:
    raise ValueError(f"Mask not found: {mask_path}")

image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
mask = (mask > 0).astype(np.float32)

if self.augmentations:
    augmented = self.augmentations(image=image, mask=mask)
    image = augmented['image']
    mask = augmented['mask']
else:
    transform = A.Compose([A.Resize(256, 256), A.Normalize(),
                           ToTensorV2()])
    transformed = transform(image=image, mask=mask)
    image = transformed['image']
    mask = transformed['mask']

# Ensure mask has shape [1, H, W]
if mask.ndim == 2:
    mask = mask.unsqueeze(0)
elif mask.ndim == 3 and mask.shape[0] != 1:
    mask = mask.unsqueeze(0)

return image, mask

```

Sample image and mask paths:

Image: C:/Kvasir/kvasir-instrument/images/images\ckcvw5yhd000m3b5yutirmiad.jpg,
 Mask: C:/Kvasir/kvasir-instrument/masks/masks\ckcvw5yhd000m3b5yutirmiad.png
 Image: C:/Kvasir/kvasir-instrument/images/images\ckcvwpanj001b3b5ysxixpcxy.jpg,
 Mask: C:/Kvasir/kvasir-instrument/masks/masks\ckcvwpanj001b3b5ysxixpcxy.png
 Image: C:/Kvasir/kvasir-instrument/images/images\ckcuhbkeo000z3b5yq7v1sm0o.jpg,
 Mask: C:/Kvasir/kvasir-instrument/masks/masks\ckcuhbkeo000z3b5yq7v1sm0o.png

```
[9]: # UNet model
class UNet(nn.Module):
    def __init__(self, in_channels=3, out_channels=1, init_features=32):
        super(UNet, self).__init__()

        features = init_features
        self.encoder1 = self._block(in_channels, features)
        self.pool1 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.encoder2 = self._block(features, features * 2)
        self.pool2 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.encoder3 = self._block(features * 2, features * 4)
        self.pool3 = nn.MaxPool2d(kernel_size=2, stride=2)
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        self.encoder4 = self._block(features * 4, features * 8)
        self.pool4 = nn.MaxPool2d(kernel_size=2, stride=2)

        self.bottleneck = self._block(features * 8, features * 16)

        self.upconv4 = nn.ConvTranspose2d(features * 16, features * 8, kernel_size=2, stride=2)
        self.decoder4 = self._block((features * 8) * 2, features * 8)
        self.upconv3 = nn.ConvTranspose2d(features * 8, features * 4, kernel_size=2, stride=2)
        self.decoder3 = self._block((features * 4) * 2, features * 4)
        self.upconv2 = nn.ConvTranspose2d(features * 4, features * 2, kernel_size=2, stride=2)
        self.decoder2 = self._block((features * 2) * 2, features * 2)
        self.upconv1 = nn.ConvTranspose2d(features * 2, features, kernel_size=2, stride=2)
        self.decoder1 = self._block(features * 2, features)

        self.conv = nn.Conv2d(features, out_channels, kernel_size=1)

    def _block(self, in_channels, features):
        return nn.Sequential(
            nn.Conv2d(in_channels, features, kernel_size=3, padding=1, bias=False),
            nn.BatchNorm2d(features),
            nn.ReLU(inplace=True),
            nn.Conv2d(features, features, kernel_size=3, padding=1, bias=False),
            nn.BatchNorm2d(features),
            nn.ReLU(inplace=True)
        )

    def forward(self, x):
        enc1 = self.encoder1(x)
        enc2 = self.encoder2(self.pool1(enc1))
        enc3 = self.encoder3(self.pool2(enc2))
        enc4 = self.encoder4(self.pool3(enc3))

        bottleneck = self.bottleneck(self.pool4(enc4))

        dec4 = self.upconv4(bottleneck)
        dec4 = torch.cat((dec4, enc4), dim=1)
        dec4 = self.decoder4(dec4)
        dec3 = self.upconv3(dec4)
        dec3 = torch.cat((dec3, enc3), dim=1)
        dec3 = self.decoder3(dec3)
        dec2 = self.upconv2(dec3)
        dec2 = torch.cat((dec2, enc2), dim=1)

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    dec2 = self.decoder2(dec2)
    dec1 = self.upconv1(dec2)
    dec1 = torch.cat((dec1, enc1), dim=1)
    dec1 = self.decoder1(dec1)
    return torch.sigmoid(self.conv(dec1))

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[10]: # UNet++ Decoder with Nested Skip Connections
class UNetPlusPlusDecoder(nn.Module):
    def __init__(self, encoder_channels, decoder_channels, activation=nn.
        ReLU()):
        super(UNetPlusPlusDecoder, self).__init__()
        self.activation = activation

        # The encoder_channels are expected in the order: [layer4, layer3, □
        ↵layer2, layer1]
        self.conv0_0 = self.conv_block(encoder_channels[0], decoder_channels[0])
        self.conv1_0 = self.conv_block(encoder_channels[1], decoder_channels[1])
        self.conv1_1 = self.conv_block(decoder_channels[0] +□
        ↵decoder_channels[1], decoder_channels[1])
        self.conv2_0 = self.conv_block(encoder_channels[2], decoder_channels[2])
        self.conv2_1 = self.conv_block(decoder_channels[1] +□
        ↵decoder_channels[2], decoder_channels[2])
        self.conv2_2 = self.conv_block(decoder_channels[0] +□
        ↵decoder_channels[1] + decoder_channels[2], decoder_channels[2])

    def conv_block(self, in_channels, out_channels):
        """Creates a block of Conv2d -> BatchNorm2d -> Activation."""
        return nn.Sequential(
            nn.Conv2d(in_channels, out_channels, kernel_size=3, padding=1),
            nn.BatchNorm2d(out_channels),
            self.activation
        )

    def upsample_to_size(self, x, target_size):
        return F.interpolate(x, size=target_size, mode='bilinear', □
        ↵align_corners=True)

    def forward(self, x4, x3, x2, x1):
        # x4: deepest encoder feature (e.g., ResNet layer4: 512 channels)
        # x3: ResNet layer3 (256 channels)
        # x2: ResNet layer2 (128 channels)
        # x1: ResNet layer1 (64 channels)
        x0_0 = self.conv0_0(x4) # Process deepest feature
        x1_0 = self.conv1_0(self.upsample_to_size(x3, x2.shape[2:])) #□
        ↵Upsample x3 to x2's size

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        x1_1 = self.conv1_1(torch.cat([x1_0, self.upsample_to_size(x0_0, x1_0.
↪shape[2:])], dim=1))
        x2_0 = self.conv2_0(self.upsample_to_size(x2, x1_0.shape[2:]))  # ↴
↪Upsample x2 to x1_0's size
        x2_1 = self.conv2_1(torch.cat([x2_0, self.upsample_to_size(x1_1, x2_0.
↪shape[2:])], dim=1))
        x2_2 = self.conv2_2(torch.cat([
            x2_1,
            self.upsample_to_size(x1_1, x2_1.shape[2:]),
            self.upsample_to_size(x0_0, x2_1.shape[2:])
        ], dim=1))
    return x2_2

# UNet++ Model for Binary Segmentation
class UNetPlusPlus(nn.Module):
    def __init__(self, in_channels=3, out_channels=1, activation=nn.ReLU()):
        super(UNetPlusPlus, self).__init__()
        # Pretrained ResNet34 as the encoder
        self.encoder = torchvision.models.resnet34(pretrained=True)

        # ResNet34 produces:
        # - layer1: 64 channels
        # - layer2: 128 channels
        # - layer3: 256 channels
        # - layer4: 512 channels
        # The decoder expects encoder features in the order: [layer4, layer3, ↴
↪layer2, layer1]
        encoder_channels = [512, 256, 128, 64]
        # Define decoder channels (only first three are used in this decoder
↪design)
        decoder_channels = [256, 128, 64, 32]
        self.decoder = UNetPlusPlusDecoder(encoder_channels, decoder_channels, ↴
↪activation)
        self.segmentation_head = nn.Conv2d(decoder_channels[2], out_channels, ↴
↪kernel_size=3, padding=1)

    def forward(self, x):
        # Save original input size for output interpolation
        input_size = x.shape[2:]

        # Encoder forward pass:
        x = self.encoder.conv1(x)
        x = self.encoder.bn1(x)
        x = self.encoder.relu(x)
        x = self.encoder.maxpool(x)

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x1 = self.encoder.layer1(x) # 64 channels
x2 = self.encoder.layer2(x1) # 128 channels
x3 = self.encoder.layer3(x2) # 256 channels
x4 = self.encoder.layer4(x3) # 512 channels

# Pass features to the decoder in the order: x4, x3, x2, x1
x = self.decoder(x4, x3, x2, x1)
x = self.segmentation_head(x)
# Interpolate to match the original input size dynamically
x = F.interpolate(x, size=input_size, mode='bilinear', ↴
align_corners=True)
return torch.sigmoid(x)

```

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[11]: # Convolution block with 3x3 kernel size, Group Normalization, and ReLU
activation
class Conv3x3GNReLU(nn.Module):
    def __init__(self, in_channels, out_channels, upsample=False):
        super().__init__()
        self.upsample = upsample
        self.block = nn.Sequential(
            nn.Conv2d(in_channels, out_channels, (3, 3), stride=1, padding=1, ↴
bias=False),
            nn.GroupNorm(32, out_channels),
            nn.ReLU(inplace=True),
        )

    def forward(self, x):
        x = self.block(x)
        if self.upsample:
            x = F.interpolate(x, scale_factor=2, mode="bilinear", ↴
align_corners=True)
        return x

# Feature Pyramid Network block
class FPNBlock(nn.Module):
    def __init__(self, pyramid_channels, skip_channels):
        super().__init__()
        self.skip_conv = nn.Conv2d(skip_channels, pyramid_channels, ↴
kernel_size=1, bias=False)

    def forward(self, x, skip=None):
        x = F.interpolate(x, scale_factor=2, mode="nearest")
        if skip is not None:
            skip = self.skip_conv(skip)
            skip = F.interpolate(skip, size=x.shape[2:], mode='bilinear', ↴
align_corners=True)

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        x = x + skip
    return x

# Segmentation block with a series of convolutions and upsampling
class SegmentationBlock(nn.Module):
    def __init__(self, in_channels, out_channels, n_upsamples=0):
        super().__init__()
        blocks = [Conv3x3GNReLU(in_channels, out_channels, upsample=bool(n_upsamples))]

        if n_upsamples > 1:
            for _ in range(1, n_upsamples):
                blocks.append(Conv3x3GNReLU(out_channels, out_channels, upsample=True))

    self.block = nn.Sequential(*blocks)

    def forward(self, x):
        return self.block(x)

# Merge block to combine features using addition or concatenation
class MergeBlock(nn.Module):
    def __init__(self, policy='add'):
        super().__init__()
        self.policy = policy

    def forward(self, x):
        if self.policy == 'add':
            return sum(x)
        elif self.policy == 'cat':
            return torch.cat(x, dim=1)
        else:
            raise ValueError("`merge_policy` must be one of: ['add', 'cat']")

# FPN Decoder combining the feature pyramid with skip connections
class FPNDecoder(nn.Module):
    def __init__(self, encoder_channels, pyramid_channels=256, segmentation_channels=128, merge_policy='add'):
        super().__init__()

        self.p5 = nn.Conv2d(encoder_channels[0], pyramid_channels, kernel_size=1)
        self.p4 = FPNBlock(pyramid_channels, encoder_channels[1])
        self.p3 = FPNBlock(pyramid_channels, encoder_channels[2])
        self.p2 = FPNBlock(pyramid_channels, encoder_channels[3])

        self.seg_blocks = nn.ModuleList([

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        SegmentationBlock(pyramid_channels, segmentation_channels, ↴
↳n_upsamples=n_upsamples)
            for n_upsamples in [3, 2, 1, 0]
        ])

    self.merge = MergeBlock(merge_policy)

def forward(self, *features):
    # Reverse the features to match the FPN order
    features = features[::-1] # Now features[0] is the deepest (layer4)
    p5 = self.p5(features[0])
    p4 = self.p4(p5, features[1])
    p3 = self.p3(p4, features[2])
    p2 = self.p2(p3, features[3])

    feature_pyramid = [seg_block(p) for seg_block, p in zip(self. ↴
↳seg_blocks, [p5, p4, p3, p2])]
    x = self.merge(feature_pyramid)

    return x

# FPN main class
class FPN(nn.Module):
    def __init__(self, encoder_name='resnet34', in_channels=3, ↴
↳decoder_pyramid_channels=256, segmentation_channels=128, out_channels=1, ↴
↳activation_fn=nn.ReLU(), pretrained=True):
        super(FPN, self).__init__()

        if encoder_name not in ['resnet34', 'resnet50']:
            raise ValueError(f"Encoder {encoder_name} is not supported")

        if encoder_name == 'resnet34':
            self.encoder = torchvision.models.resnet34(pretrained=pretrained)
            # For ResNet34, expected encoder feature channels (from later ↴
↳layers):
                # layer4: 512, layer3: 256, layer2: 128, layer1: 64
                encoder_channels = [512, 256, 128, 64]
        elif encoder_name == 'resnet50':
            self.encoder = torchvision.models.resnet50(pretrained=pretrained)
            # For ResNet50:
            encoder_channels = [2048, 1024, 512, 256]

        if in_channels != 3:
            self.encoder.conv1 = nn.Conv2d(in_channels, 64, kernel_size=7, ↴
↳stride=2, padding=3, bias=False)

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        self.decoder = FPNDecoder(encoder_channels,
        ↪pyramid_channels=decoder_pyramid_channels,
        ↪segmentation_channels=segmentation_channels, merge_policy='add')
        self.segmentation_head = nn.Conv2d(segmentation_channels, out_channels,
        ↪kernel_size=1)

    def forward(self, x):
        input_size = x.shape[2:]
        features = []
        # Run the encoder and collect features
        # Initial layers: conv1 -> bn1 -> relu -> maxpool
        x = self.encoder.conv1(x)
        x = self.encoder.bn1(x)
        x = self.encoder.relu(x)
        x = self.encoder.maxpool(x)
        # Collect features from layers 1 to 4
        x1 = self.encoder.layer1(x) # 64 channels
        x2 = self.encoder.layer2(x1) # 128 channels
        x3 = self.encoder.layer3(x2) # 256 channels
        x4 = self.encoder.layer4(x3) # 512 channels (or 2048 for ResNet50)

        # Assemble features
        features = [x1, x2, x3, x4]

        # Pass the features through the FPN decoder
        x = self.decoder(*features)
        # Pass the result through the segmentation head
        x = self.segmentation_head(x)
        # Dynamically upscale to the original input size
        x = F.interpolate(x, size=input_size, mode='bilinear',
        ↪align_corners=True)
        return torch.sigmoid(x)

```

[12]: # Define augmentations

```

augmentations = A.Compose([
    A.HorizontalFlip(p=0.5),
    A.VerticalFlip(p=0.5),
    A.RandomRotate90(p=0.5),
    A.RandomBrightnessContrast(p=0.2),
    A.GaussNoise(p=0.2),
    A.Resize(256, 256),
    A.Normalize(),
    ToTensorV2()
])

# No augmentations (only resize, normalize, and convert to tensor)
no_augmentations = A.Compose([

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        A.Resize(256, 256),
        A.Normalize(),
        ToTensorV2()
    ])

def compute_metrics(preds, targets, smooth=1e-6):
    preds = preds.view(-1).cpu().numpy()
    targets = targets.view(-1).cpu().numpy()
    intersection = (preds * targets).sum()
    union = preds.sum() + targets.sum() - intersection
    dice = (2. * intersection + smooth) / (preds.sum() + targets.sum() + smooth)
    iou = (intersection + smooth) / (union + smooth)
    acc = accuracy_score(targets, preds)
    return dice, iou, acc

```

```

[13]: def train_model(model,
                    train_loader,
                    val_loader,
                    optimizer,
                    scheduler,
                    criterion,
                    num_epochs=20,
                    patience=5):
    history = {
        'train_loss': [], 'val_loss': [],
        'train_dice': [], 'val_dice': [],
        'train_iou': [], 'val_iou': [],
        'train_acc': [], 'val_acc': [],
        'test_loss': [], 'test_dice': [],
        'test_iou': [], 'test_acc': []
    }

    best_val_loss = float('inf')
    patience_counter = 0

    for epoch in range(num_epochs):
        # Training Phase
        model.train()
        train_loss, train_dice, train_iou, train_acc = 0, 0, 0, 0

        for images, masks in tqdm(train_loader, desc=f"Training Epoch {epoch+1}/{num_epochs}", unit="batch", leave=False):
            images, masks = images.to(device), masks.to(device)
            optimizer.zero_grad()
            outputs = model(images)
            loss = criterion(outputs, masks)
            loss.backward()

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optimizer.step()

preds = (outputs > 0.5).float()
dice, iou, acc = compute_metrics(preds, masks)
train_loss += loss.item()
train_dice += dice
train_iou += iou
train_acc += acc

train_loss /= len(train_loader)
train_dice /= len(train_loader)
train_iou /= len(train_loader)
train_acc /= len(train_loader)

# Validation Phase
val_loss, val_dice, val_iou, val_acc = 0, 0, 0, 0
model.eval()
with torch.no_grad():
    for images, masks in tqdm(val_loader, desc=f"Validation Epoch_{epoch+1}/{num_epochs}", unit="batch", leave=False):
        images, masks = images.to(device), masks.to(device)
        outputs = model(images)
        loss = criterion(outputs, masks)
        preds = (outputs > 0.5).float()
        dice, iou, acc = compute_metrics(preds, masks)
        val_loss += loss.item()
        val_dice += dice
        val_iou += iou
        val_acc += acc

    val_loss /= len(val_loader)
    val_dice /= len(val_loader)
    val_iou /= len(val_loader)
    val_acc /= len(val_loader)

# Logging / History
history['train_loss'].append(train_loss)
history['val_loss'].append(val_loss)
history['train_dice'].append(train_dice)
history['val_dice'].append(val_dice)
history['train_iou'].append(train_iou)
history['val_iou'].append(val_iou)
history['train_acc'].append(train_acc)
history['val_acc'].append(val_acc)

```

```

# Scheduler & Early Stopping
scheduler.step(val_loss)

current_lr = optimizer.param_groups[0]['lr']
print(f"Current Learning Rate: {current_lr}")

if val_loss < best_val_loss:
    best_val_loss = val_loss
    patience_counter = 0
    torch.save(model.state_dict(), os.path.join(working_dir, "best_model.pth"))
else:
    patience_counter += 1

print(f"EarlyStopping counter: {patience_counter} out of {patience}")
if patience_counter >= patience:
    print(f"Early stopping at epoch {epoch+1}")
    break

# Print Epoch Metrics
print(f"Epoch {epoch + 1}/{num_epochs} - "
      f"Training Loss: {train_loss:.4f} - "
      f"Validation Loss: {val_loss:.4f} - "
      f"Training Acc: {train_acc*100:.2f}% - "
      f"Validation Acc: {val_acc*100:.2f}% - "
      f"Training Dice: {train_dice:.4f} - "
      f"Validation Dice: {val_dice:.4f} - "
      f"Training IoU: {train_iou:.4f} - "
      f"Validation IoU: {val_iou:.4f} ")

# Visualize predictions every 10 epochs
if (epoch + 1) % 10 == 0:
    visualize_predictions(model, val_loader)

return history

```

```
[14]: def visualize_predictions(model, dataloader, num_samples=3):
    model.eval()
    images, masks = next(iter(dataloader))
    images = images.to(device)
    outputs = model(images)
    preds = (outputs > 0.5).float().cpu().numpy()
    images = images.cpu().numpy()
    masks = masks.cpu().numpy()

    for i in range(num_samples):
        image = np.transpose(images[i], (1, 2, 0))
```

```

        image = (image - image.min()) / (image.max() - image.min()) #U
    ↵Normalize for display
    mask = masks[i][0]
    pred = preds[i][0]

    fig, axs = plt.subplots(1, 3, figsize=(15, 5))
    axs[0].imshow(image)
    axs[0].set_title('Original Image')
    axs[0].axis('off')

    axs[1].imshow(mask, cmap='gray')
    axs[1].set_title('Ground Truth Mask')
    axs[1].axis('off')

    axs[2].imshow(pred, cmap='gray')
    axs[2].set_title('Predicted Mask')
    axs[2].axis('off')

    plt.show()

def plot_metrics(history, title_suffix=''):
    epochs = range(1, len(history['train_loss']) + 1)

    plt.figure(figsize=(20, 5))

    # Loss plot
    plt.subplot(1, 4, 1)
    plt.plot(epochs, history['train_loss'], 'b', label='Training Loss')
    plt.plot(epochs, history['val_loss'], 'r', label='Validation Loss')
    plt.title('Loss over Epochs' + title_suffix)
    plt.xlabel('Epoch')
    plt.ylabel('Loss')
    plt.legend()

    # Accuracy plot
    plt.subplot(1, 4, 2)
    plt.plot(epochs, history['train_acc'], 'b', label='Training Accuracy')
    plt.plot(epochs, history['val_acc'], 'r', label='Validation Accuracy')
    plt.title('Accuracy over Epochs' + title_suffix)
    plt.xlabel('Epoch')
    plt.ylabel('Accuracy')
    plt.legend()

    # Dice Coefficient plot
    plt.subplot(1, 4, 3)
    plt.plot(epochs, history['train_dice'], 'b', label='Training Dice')
    plt.plot(epochs, history['val_dice'], 'r', label='Validation Dice')

```

```

plt.title('Dice Coefficient over Epochs' + title_suffix)
plt.xlabel('Epoch')
plt.ylabel('Dice Coefficient')
plt.legend()

# IoU plot
plt.subplot(1, 4, 4)
plt.plot(epochs, history['train_iou'], 'b', label='Training IoU')
plt.plot(epochs, history['val_iou'], 'r', label='Validation IoU')
plt.title('IoU over Epochs' + title_suffix)
plt.xlabel('Epoch')
plt.ylabel('IoU')
plt.legend()

plt.tight_layout()
plt.show()

```

```

[15]: def run_experiment(model_fn, optimizer_fn, scheduler_fn, augmentations,
                     experiment_name,
                     num_epochs=60, batch_size=8, patience=5):
    print(f"\nRunning experiment: {experiment_name}")

    # Load datasets with given augmentations
    train_dataset = KvasirInstrumentDataset(train_images_list,
                                             train_masks_list, augmentations)
    valid_dataset = KvasirInstrumentDataset(test_images_list, test_masks_list,
                                             augmentations=no_augmentations)
    test_dataset = KvasirInstrumentDataset(test_images_list, test_masks_list,
                                           augmentations=no_augmentations)

    # Data loaders
    train_loader = DataLoader(train_dataset, batch_size=batch_size,
                              shuffle=True, num_workers=0)
    valid_loader = DataLoader(valid_dataset, batch_size=batch_size,
                              shuffle=False, num_workers=0)
    test_loader = DataLoader(test_dataset, batch_size=batch_size,
                            shuffle=False, num_workers=0)

    # Initialize model using the provided model function and move to device
    model = model_fn().to(device)

    # Create optimizer using provided function that accepts model parameters
    optimizer = optimizer_fn(model.parameters())

    # Initialize scheduler with the optimizer
    scheduler = scheduler_fn(optimizer)

```

```

# Loss criterion
criterion = nn.BCELoss()

# Train the model .
history = train_model(
    model,
    train_loader,
    valid_loader,
    optimizer,
    scheduler,
    criterion,
    num_epochs=num_epochs,
    patience=patience
)

# After training, load the best model and evaluate on the test set
best_model = model_fn().to(device)
best_model.load_state_dict(torch.load(os.path.join(working_dir, 'best_model.
pth')))
best_model.eval()

test_loss, test_dice, test_iou, test_acc = 0, 0, 0, 0
with torch.no_grad():
    for images, masks in test_loader:
        images, masks = images.to(device), masks.to(device)
        outputs = best_model(images)
        loss = criterion(outputs, masks)
        preds = (outputs > 0.5).float()
        dice, iou, acc = compute_metrics(preds, masks)
        test_loss += loss.item()
        test_dice += dice
        test_iou += iou
        test_acc += acc

    test_loss /= len(test_loader)
    test_dice /= len(test_loader)
    test_iou /= len(test_loader)
    test_acc /= len(test_loader)

# Plot training metrics
plot_metrics(history, title_suffix=f' ({experiment_name})')

# Visualize predictions on the validation set
visualize_predictions(model, valid_loader)

# Determine the best epoch based on minimum validation loss

```

```

    best_epoch = min(range(len(history['val_loss'])), key=lambda i:_
↪history['val_loss'][i]) + 1

    # Collect key metrics from the best epoch
    best_metrics = {
        'Model': experiment_name,
        'Best Epoch': best_epoch,
        'Train Loss': history['train_loss'][best_epoch - 1],
        'Validation Loss': history['val_loss'][best_epoch - 1],
        'Train Accuracy': history['train_acc'][best_epoch - 1],
        'Validation Accuracy': history['val_acc'][best_epoch - 1],
        'Train Dice': history['train_dice'][best_epoch - 1],
        'Validation Dice': history['val_dice'][best_epoch - 1],
        'Train IoU': history['train_iou'][best_epoch - 1],
        'Validation IoU': history['val_iou'][best_epoch - 1],
        'Test Loss': test_loss,
        'Test Accuracy': test_acc,
        'Test Dice': test_dice,
        'Test IoU': test_iou
    }

    return history, best_metrics

```

```
[17]: def get_unet():
    return UNet()

def get_unetpp():
    return UNetPlusPlus()

def get_fpn():
    return FPN()
```

```
[32]: optimizer_adam = lambda params: optim.Adam(params, lr=0.1)

scheduler_plateau = lambda optimizer: ReduceLROnPlateau(optimizer, mode='min',_
↪factor=0.5, patience=2)

# Run experiments and store results
results = []

# Experiment 1: FPN with RMSprop, Exponential scheduler, and augmentations
_, metrics3 = run_experiment(model_fn=get_fpn,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau ,
                             augmentations=no_augmentations,
                             experiment_name='FPN + Adam + Plateau + No_
↪Augmentation')
```

```

results.append(metrics3)

# Experiment 2: UNet with Adam, Plateau scheduler, and augmentations

_, metrics1 = run_experiment(model_fn=get_unetpp,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau,
                             augmentations=no_augmentations,
                             experiment_name='UNet++ + Adam + Plateau + No ↵
                             ↵Augmentation')
results.append(metrics1)

# Experiment 3: UNet++ with SGD, Step scheduler, no augmentation

_, metrics2 = run_experiment(model_fn=get_unet,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau,
                             augmentations=no_augmentations,
                             experiment_name='UNet + Adam + Plateau + No ↵
                             ↵Augmentation')
results.append(metrics2)

# Create a summary table using pandas DataFrame
summary_df = pd.DataFrame(results)
print("\nSummary of Experiments:")
print(summary_df)

# Visualize the summary table using matplotlib
fig, ax = plt.subplots(figsize=(12, 4))
ax.axis('tight')
ax.axis('off')
table = ax.table(cellText=summary_df.values, colLabels=summary_df.columns, ↵
    ↵loc='center')
table.auto_set_font_size(False)
table.set_fontsize(10)
table.auto_set_column_width(col=list(range(len(summary_df.columns))))
plt.title("Experiment Results Summary")
plt.show()

```

```

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use  
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.  
warnings.warn(msg)
```

```
Running experiment: FPN + Adam + Plateau + No Augmentation
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 0 out of 5  
Epoch 1/60 - Training Loss: 1.1224 - Validation Loss: 0.1889 - Training Acc:  
89.39% - Validation Acc: 90.69% - Training Dice: 0.0043 - Validation Dice:  
0.0000 - Training IoU: 0.0025 - Validation IoU: 0.0000
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 0 out of 5  
Epoch 2/60 - Training Loss: 0.1560 - Validation Loss: 0.1339 - Training Acc:  
93.75% - Validation Acc: 95.24% - Training Dice: 0.6353 - Validation Dice:  
0.7282 - Training IoU: 0.4861 - Validation IoU: 0.5789
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 0 out of 5  
Epoch 3/60 - Training Loss: 0.1298 - Validation Loss: 0.1192 - Training Acc:  
95.00% - Validation Acc: 95.43% - Training Dice: 0.7301 - Validation Dice:  
0.7245 - Training IoU: 0.5833 - Validation IoU: 0.5728
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 1 out of 5  
Epoch 4/60 - Training Loss: 0.1225 - Validation Loss: 0.1552 - Training Acc:  
95.25% - Validation Acc: 93.54% - Training Dice: 0.7483 - Validation Dice:  
0.7182 - Training IoU: 0.6049 - Validation IoU: 0.5688
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 2 out of 5  
Epoch 5/60 - Training Loss: 0.1195 - Validation Loss: 0.1348 - Training Acc:  
95.43% - Validation Acc: 94.31% - Training Dice: 0.7606 - Validation Dice:  
0.7478 - Training IoU: 0.6201 - Validation IoU: 0.6037
```

```
Current Learning Rate: 0.1  
EarlyStopping counter: 0 out of 5  
Epoch 6/60 - Training Loss: 0.1068 - Validation Loss: 0.0861 - Training Acc:
```

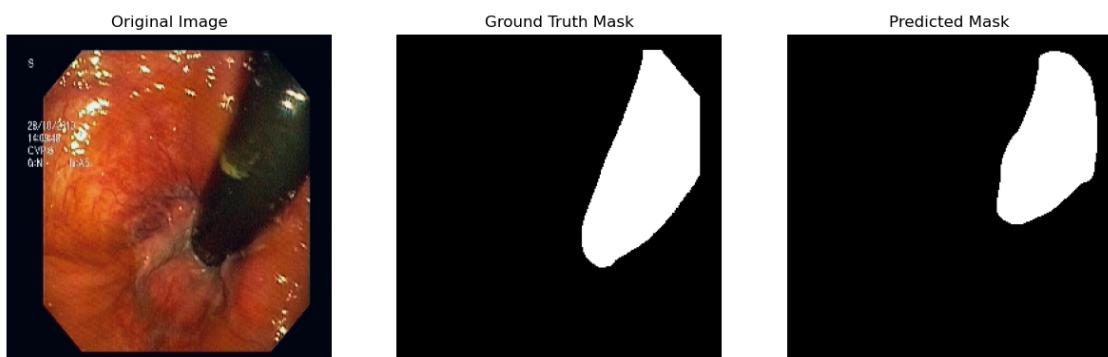
95.94% - Validation Acc: 96.86% - Training Dice: 0.7971 - Validation Dice: 0.8212 - Training IoU: 0.6668 - Validation IoU: 0.6999

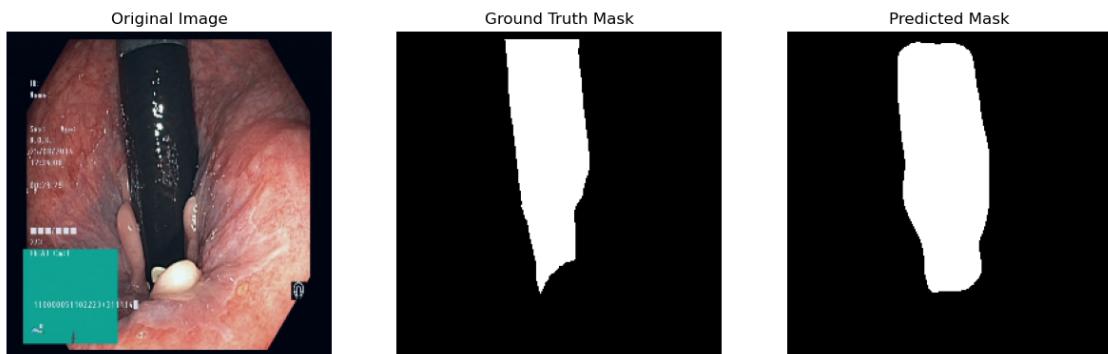
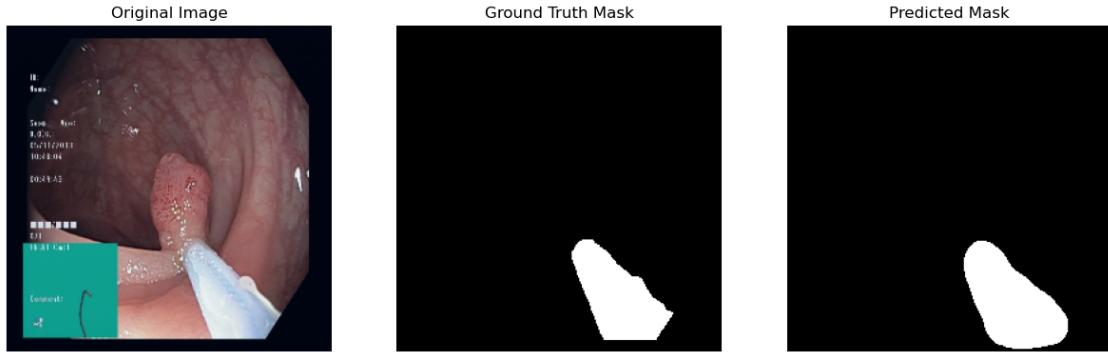
Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 7/60 - Training Loss: 0.1104 - Validation Loss: 0.0863 - Training Acc: 95.78% - Validation Acc: 97.11% - Training Dice: 0.7815 - Validation Dice: 0.8359 - Training IoU: 0.6471 - Validation IoU: 0.7194

Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.0980 - Validation Loss: 0.0764 - Training Acc: 96.32% - Validation Acc: 97.42% - Training Dice: 0.8100 - Validation Dice: 0.8547 - Training IoU: 0.6856 - Validation IoU: 0.7476

Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.1002 - Validation Loss: 0.0912 - Training Acc: 96.19% - Validation Acc: 96.81% - Training Dice: 0.8030 - Validation Dice: 0.8255 - Training IoU: 0.6778 - Validation IoU: 0.7082

Current Learning Rate: 0.1
EarlyStopping counter: 2 out of 5
Epoch 10/60 - Training Loss: 0.0929 - Validation Loss: 0.0838 - Training Acc: 96.39% - Validation Acc: 96.76% - Training Dice: 0.8150 - Validation Dice: 0.8356 - Training IoU: 0.6923 - Validation IoU: 0.7203





Current Learning Rate: 0.05

EarlyStopping counter: 3 out of 5

Epoch 11/60 - Training Loss: 0.0917 - Validation Loss: 0.0937 - Training Acc: 96.52% - Validation Acc: 96.69% - Training Dice: 0.8209 - Validation Dice: 0.8049 - Training IoU: 0.7021 - Validation IoU: 0.6772

Current Learning Rate: 0.05

EarlyStopping counter: 0 out of 5

Epoch 12/60 - Training Loss: 0.0817 - Validation Loss: 0.0633 - Training Acc: 97.00% - Validation Acc: 97.94% - Training Dice: 0.8444 - Validation Dice: 0.8865 - Training IoU: 0.7355 - Validation IoU: 0.7979

Current Learning Rate: 0.05

EarlyStopping counter: 1 out of 5

Epoch 13/60 - Training Loss: 0.0791 - Validation Loss: 0.0675 - Training Acc: 97.07% - Validation Acc: 97.89% - Training Dice: 0.8476 - Validation Dice: 0.8811 - Training IoU: 0.7416 - Validation IoU: 0.7889

```
Current Learning Rate: 0.05
EarlyStopping counter: 2 out of 5
Epoch 14/60 - Training Loss: 0.0722 - Validation Loss: 0.0714 - Training Acc:
97.33% - Validation Acc: 97.58% - Training Dice: 0.8602 - Validation Dice:
0.8668 - Training IoU: 0.7604 - Validation IoU: 0.7672
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 3 out of 5
Epoch 15/60 - Training Loss: 0.0695 - Validation Loss: 0.0968 - Training Acc:
97.46% - Validation Acc: 96.75% - Training Dice: 0.8680 - Validation Dice:
0.8026 - Training IoU: 0.7706 - Validation IoU: 0.6787
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 0 out of 5
Epoch 16/60 - Training Loss: 0.0640 - Validation Loss: 0.0623 - Training Acc:
97.62% - Validation Acc: 97.94% - Training Dice: 0.8781 - Validation Dice:
0.8884 - Training IoU: 0.7860 - Validation IoU: 0.8012
```

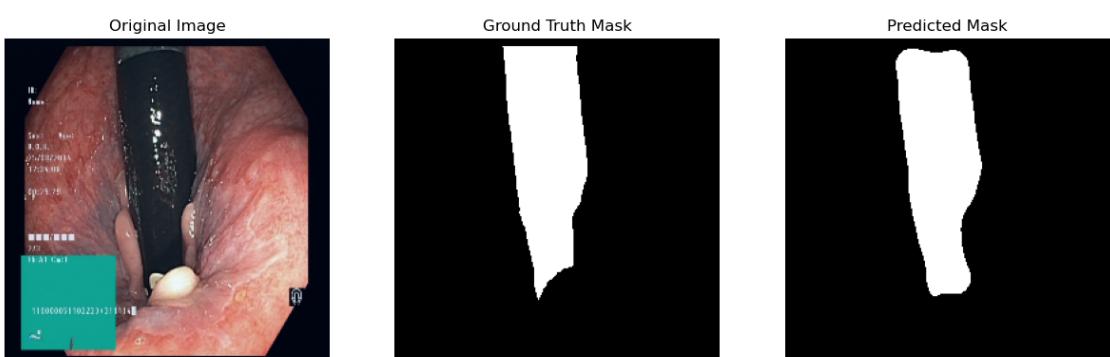
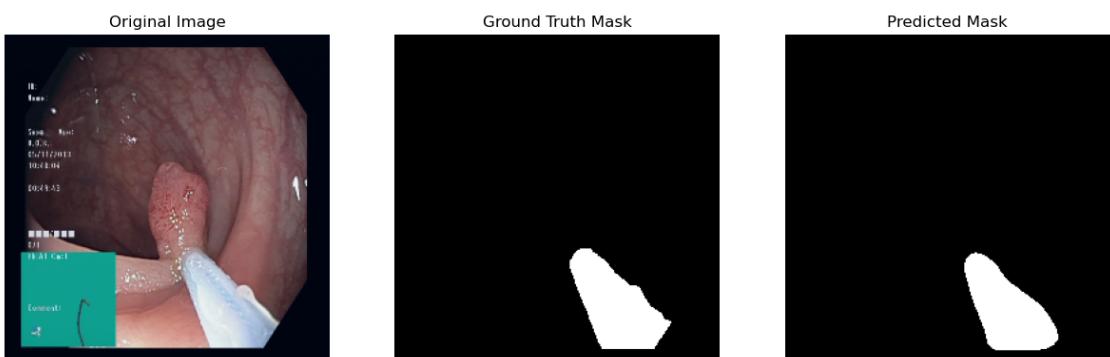
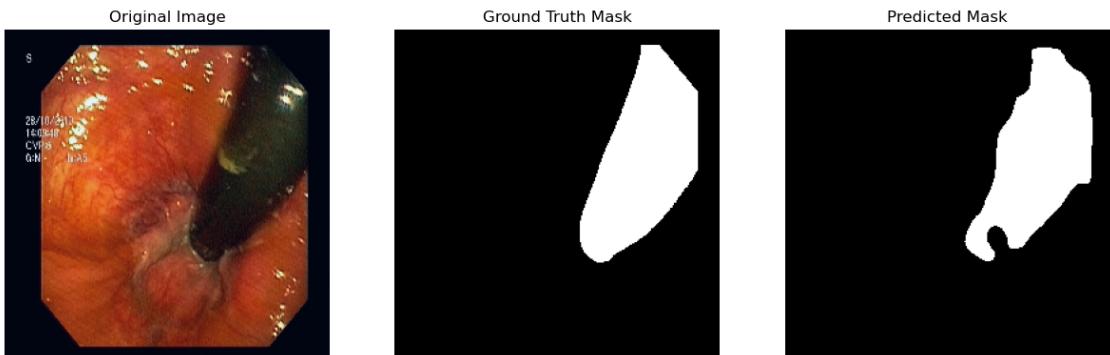
```
Current Learning Rate: 0.025
EarlyStopping counter: 0 out of 5
Epoch 17/60 - Training Loss: 0.0575 - Validation Loss: 0.0583 - Training Acc:
97.87% - Validation Acc: 98.11% - Training Dice: 0.8912 - Validation Dice:
0.8947 - Training IoU: 0.8065 - Validation IoU: 0.8119
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 1 out of 5
Epoch 18/60 - Training Loss: 0.0552 - Validation Loss: 0.0676 - Training Acc:
97.95% - Validation Acc: 97.81% - Training Dice: 0.8941 - Validation Dice:
0.8800 - Training IoU: 0.8115 - Validation IoU: 0.7880
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 2 out of 5
Epoch 19/60 - Training Loss: 0.0513 - Validation Loss: 0.0593 - Training Acc:
98.11% - Validation Acc: 98.13% - Training Dice: 0.9013 - Validation Dice:
0.8981 - Training IoU: 0.8229 - Validation IoU: 0.8168
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 3 out of 5
Epoch 20/60 - Training Loss: 0.0531 - Validation Loss: 0.0625 - Training Acc:
```

98.02% - Validation Acc: 97.97% - Training Dice: 0.8990 - Validation Dice: 0.8867 - Training IoU: 0.8195 - Validation IoU: 0.7980



Current Learning Rate: 0.0125
EarlyStopping counter: 0 out of 5
Epoch 21/60 - Training Loss: 0.0472 - Validation Loss: 0.0579 - Training Acc: 98.22% - Validation Acc: 98.22% - Training Dice: 0.9087 - Validation Dice:

```
0.9013 - Training IoU: 0.8342 - Validation IoU: 0.8220
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 1 out of 5
Epoch 22/60 - Training Loss: 0.0423 - Validation Loss: 0.0587 - Training Acc: 98.45% - Validation Acc: 98.12% - Training Dice: 0.9199 - Validation Dice: 0.8987 - Training IoU: 0.8529 - Validation IoU: 0.8177
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 2 out of 5
Epoch 23/60 - Training Loss: 0.0393 - Validation Loss: 0.0609 - Training Acc: 98.55% - Validation Acc: 98.14% - Training Dice: 0.9253 - Validation Dice: 0.8995 - Training IoU: 0.8618 - Validation IoU: 0.8193
```

```
Current Learning Rate: 0.00625
EarlyStopping counter: 3 out of 5
Epoch 24/60 - Training Loss: 0.0384 - Validation Loss: 0.0592 - Training Acc: 98.57% - Validation Acc: 98.29% - Training Dice: 0.9278 - Validation Dice: 0.9065 - Training IoU: 0.8664 - Validation IoU: 0.8305
```

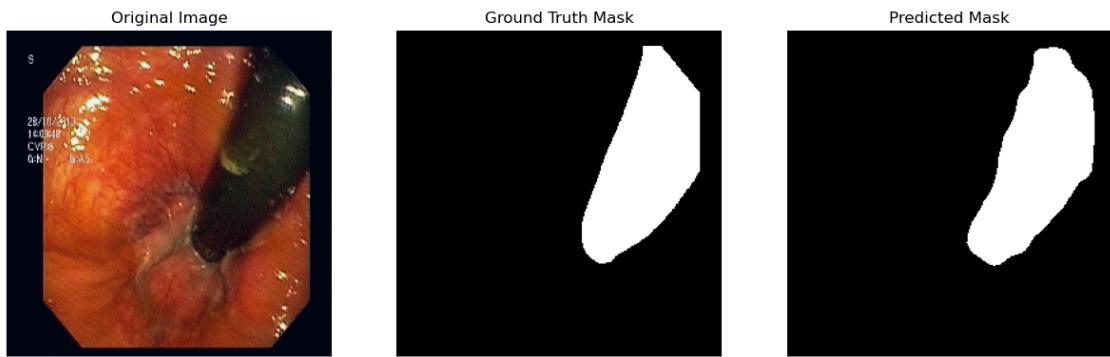
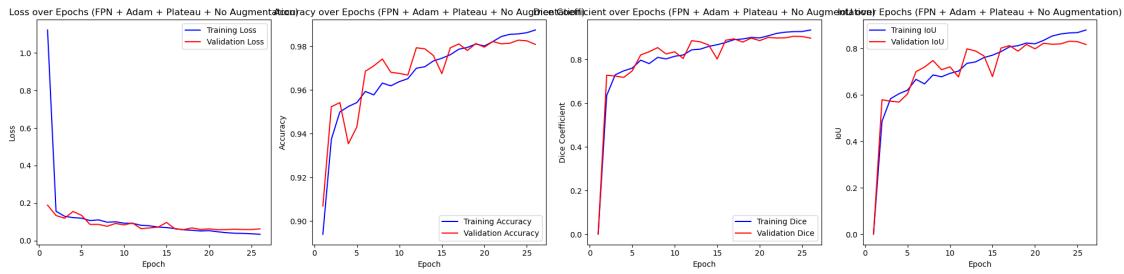
```
Current Learning Rate: 0.00625
EarlyStopping counter: 4 out of 5
Epoch 25/60 - Training Loss: 0.0364 - Validation Loss: 0.0591 - Training Acc: 98.63% - Validation Acc: 98.25% - Training Dice: 0.9284 - Validation Dice: 0.9054 - Training IoU: 0.8678 - Validation IoU: 0.8290
```

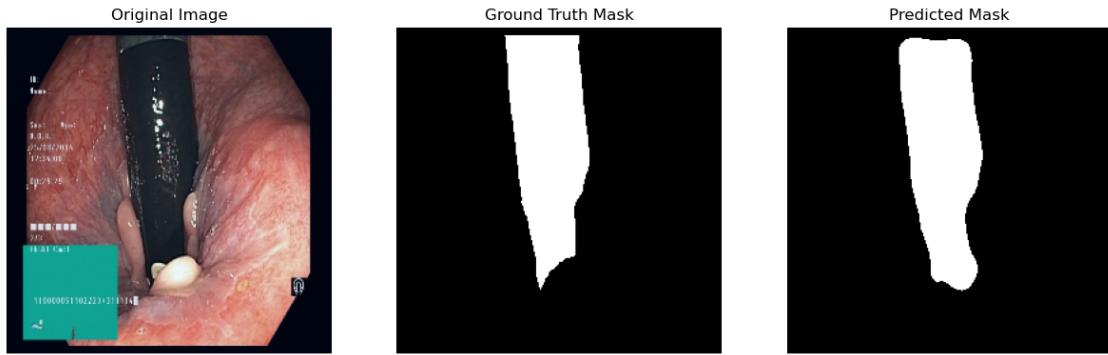
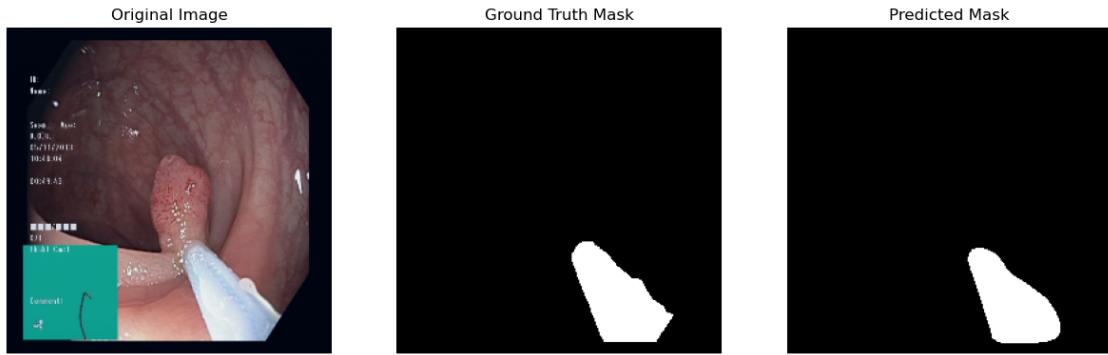
```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-packages\torchvision\models\_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' instead.
    warnings.warn(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-packages\torchvision\models\_utils.py:223: 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=ResNet34_Weights.IMAGENET1K_V1`. You can also use `weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)
C:\Users\Mike\AppData\Local\Temp\ipykernel_14796\279954375.py:42: FutureWarning: You are using `torch.load` with `weights_only=False` (the current default value), which uses the default pickle module implicitly. It is possible to construct malicious pickle data which will execute arbitrary code during unpickling (See https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
```

more details). In a future release, the default value for `weights_only` will be flipped to `True`. This limits the functions that could be executed during unpickling. Arbitrary objects will no longer be allowed to be loaded via this mode unless they are explicitly allowlisted by the user via `torch.serialization.add_safe_globals`. We recommend you start setting `weights_only=True` for any use case where you don't have full control of the loaded file. Please open an issue on GitHub for any issues related to this experimental feature.

```
best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))
```

Current Learning Rate: 0.00625
 EarlyStopping counter: 5 out of 5
 Early stopping at epoch 26





```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.

    warnings.warn(msg)
```

Running experiment: UNet++ + Adam + Plateau + No Augmentation

Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.4979 - Validation Loss: 0.3708 - Training Acc: 89.50% - Validation Acc: 90.69% - Training Dice: 0.0035 - Validation Dice: 0.0000 - Training IoU: 0.0019 - Validation IoU: 0.0000

```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1806 - Validation Loss: 0.3474 - Training Acc:
92.43% - Validation Acc: 93.88% - Training Dice: 0.4941 - Validation Dice:
0.6231 - Training IoU: 0.3640 - Validation IoU: 0.4609
```

```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 3/60 - Training Loss: 0.1569 - Validation Loss: 0.1631 - Training Acc:
93.70% - Validation Acc: 93.38% - Training Dice: 0.6713 - Validation Dice:
0.6899 - Training IoU: 0.5156 - Validation IoU: 0.5343
```

```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.1396 - Validation Loss: 0.1610 - Training Acc:
94.59% - Validation Acc: 92.83% - Training Dice: 0.7269 - Validation Dice:
0.7058 - Training IoU: 0.5756 - Validation IoU: 0.5529
```

```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 5/60 - Training Loss: 0.1313 - Validation Loss: 0.1206 - Training Acc:
95.01% - Validation Acc: 95.41% - Training Dice: 0.7392 - Validation Dice:
0.7364 - Training IoU: 0.5972 - Validation IoU: 0.5851
```

```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 6/60 - Training Loss: 0.1218 - Validation Loss: 0.1147 - Training Acc:
95.34% - Validation Acc: 96.09% - Training Dice: 0.7637 - Validation Dice:
0.7827 - Training IoU: 0.6245 - Validation IoU: 0.6477
```

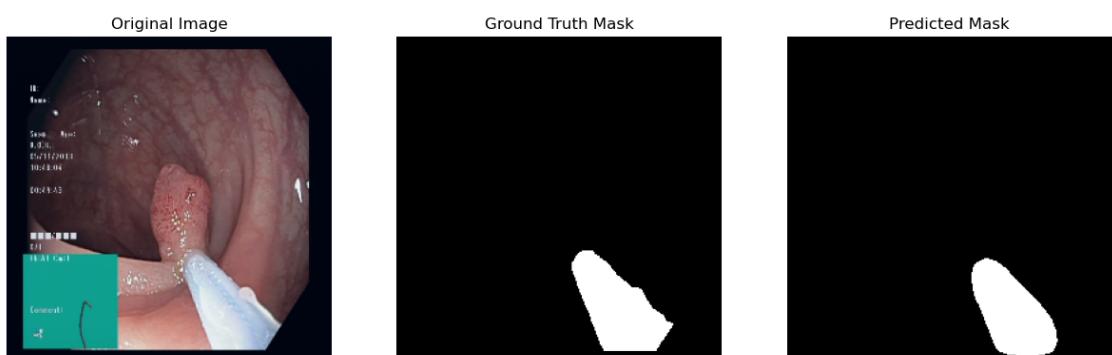
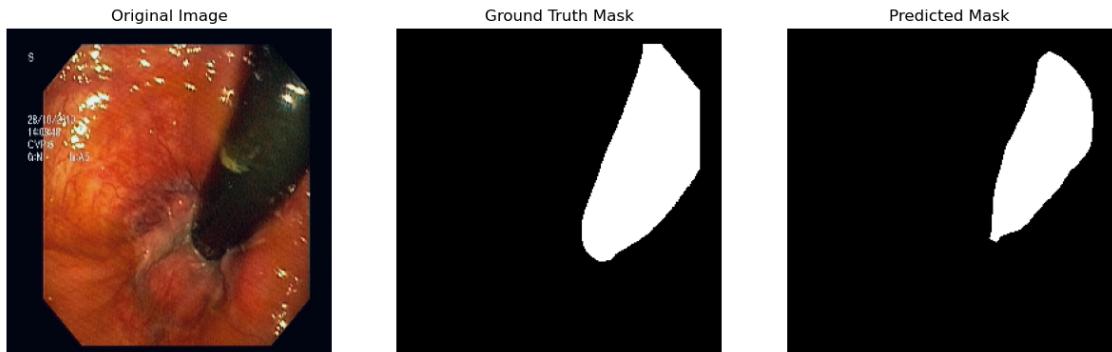
```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 7/60 - Training Loss: 0.1240 - Validation Loss: 0.1043 - Training Acc:
95.32% - Validation Acc: 96.12% - Training Dice: 0.7623 - Validation Dice:
0.7810 - Training IoU: 0.6236 - Validation IoU: 0.6447
```

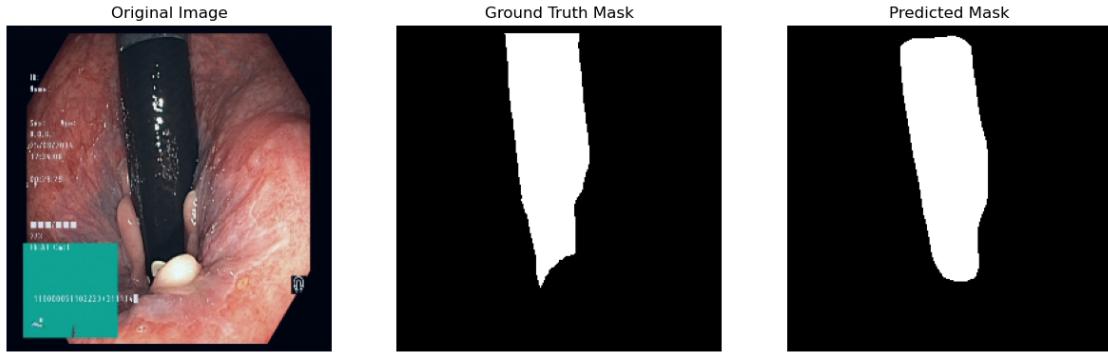
```
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.1125 - Validation Loss: 0.0985 - Training Acc:
```

95.81% - Validation Acc: 96.38% - Training Dice: 0.7819 - Validation Dice: 0.8056 - Training IoU: 0.6469 - Validation IoU: 0.6772

Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.1040 - Validation Loss: 0.1553 - Training Acc: 96.09% - Validation Acc: 94.63% - Training Dice: 0.7972 - Validation Dice: 0.6303 - Training IoU: 0.6703 - Validation IoU: 0.4658

Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 10/60 - Training Loss: 0.0981 - Validation Loss: 0.0861 - Training Acc: 96.29% - Validation Acc: 96.97% - Training Dice: 0.8098 - Validation Dice: 0.8195 - Training IoU: 0.6857 - Validation IoU: 0.6959





```

Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 11/60 - Training Loss: 0.0962 - Validation Loss: 0.1733 - Training Acc:
96.40% - Validation Acc: 94.96% - Training Dice: 0.8154 - Validation Dice:
0.6445 - Training IoU: 0.6938 - Validation IoU: 0.4825

```

```

Current Learning Rate: 0.1
EarlyStopping counter: 2 out of 5
Epoch 12/60 - Training Loss: 0.1003 - Validation Loss: 0.0995 - Training Acc:
96.40% - Validation Acc: 96.65% - Training Dice: 0.8147 - Validation Dice:
0.8039 - Training IoU: 0.6928 - Validation IoU: 0.6758

```

```

Current Learning Rate: 0.05
EarlyStopping counter: 3 out of 5
Epoch 13/60 - Training Loss: 0.0958 - Validation Loss: 0.1027 - Training Acc:
96.42% - Validation Acc: 96.09% - Training Dice: 0.8142 - Validation Dice:
0.7981 - Training IoU: 0.6932 - Validation IoU: 0.6692

```

```

Current Learning Rate: 0.05
EarlyStopping counter: 0 out of 5
Epoch 14/60 - Training Loss: 0.0814 - Validation Loss: 0.0721 - Training Acc:
96.98% - Validation Acc: 97.43% - Training Dice: 0.8455 - Validation Dice:
0.8611 - Training IoU: 0.7360 - Validation IoU: 0.7582

```

```

Current Learning Rate: 0.05
EarlyStopping counter: 1 out of 5
Epoch 15/60 - Training Loss: 0.0780 - Validation Loss: 0.0932 - Training Acc:
97.09% - Validation Acc: 96.49% - Training Dice: 0.8519 - Validation Dice:
0.8024 - Training IoU: 0.7457 - Validation IoU: 0.6743

```

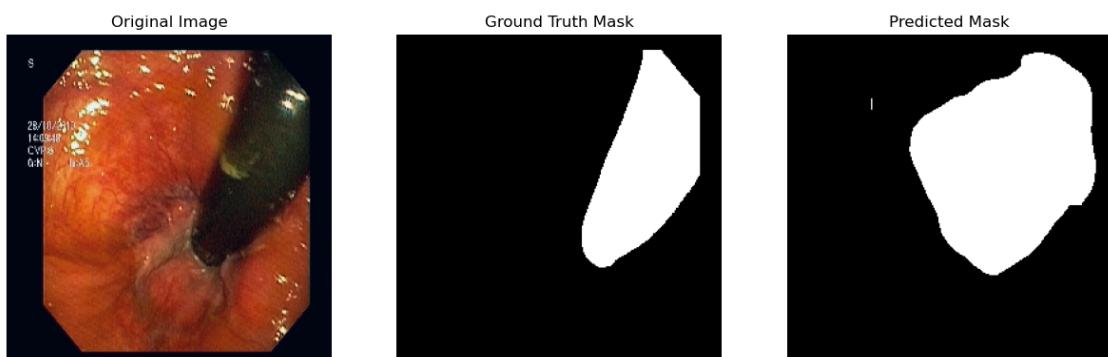
```
Current Learning Rate: 0.05
EarlyStopping counter: 2 out of 5
Epoch 16/60 - Training Loss: 0.0737 - Validation Loss: 0.0754 - Training Acc: 97.31% - Validation Acc: 97.43% - Training Dice: 0.8602 - Validation Dice: 0.8608 - Training IoU: 0.7585 - Validation IoU: 0.7578
```

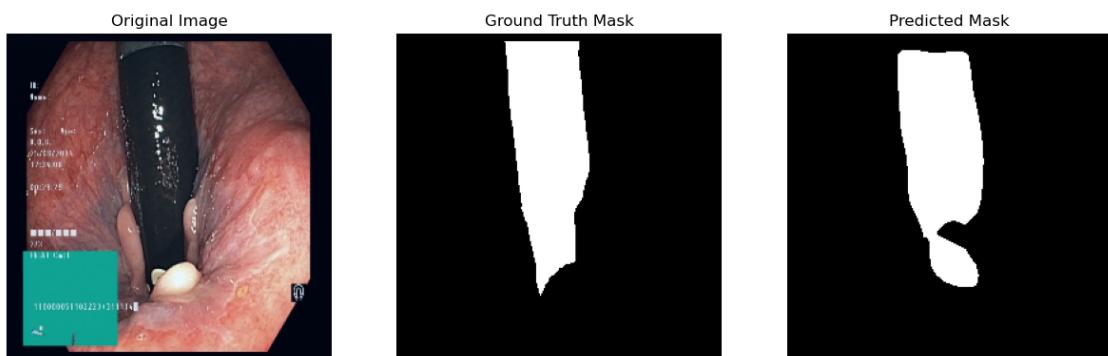
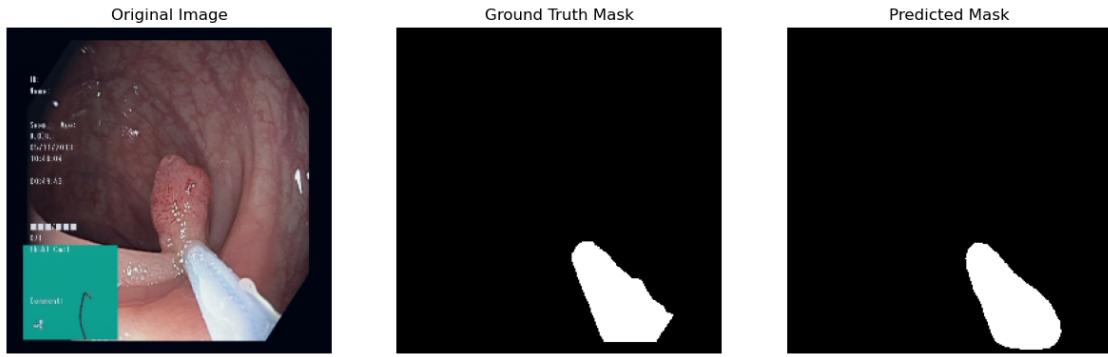
```
Current Learning Rate: 0.05
EarlyStopping counter: 0 out of 5
Epoch 17/60 - Training Loss: 0.0716 - Validation Loss: 0.0686 - Training Acc: 97.38% - Validation Acc: 97.79% - Training Dice: 0.8654 - Validation Dice: 0.8767 - Training IoU: 0.7669 - Validation IoU: 0.7823
```

```
Current Learning Rate: 0.05
EarlyStopping counter: 1 out of 5
Epoch 18/60 - Training Loss: 0.0726 - Validation Loss: 0.0816 - Training Acc: 97.28% - Validation Acc: 97.14% - Training Dice: 0.8567 - Validation Dice: 0.8486 - Training IoU: 0.7535 - Validation IoU: 0.7390
```

```
Current Learning Rate: 0.05
EarlyStopping counter: 0 out of 5
Epoch 19/60 - Training Loss: 0.0686 - Validation Loss: 0.0658 - Training Acc: 97.45% - Validation Acc: 97.72% - Training Dice: 0.8698 - Validation Dice: 0.8720 - Training IoU: 0.7727 - Validation IoU: 0.7748
```

```
Current Learning Rate: 0.05
EarlyStopping counter: 1 out of 5
Epoch 20/60 - Training Loss: 0.0685 - Validation Loss: 0.1043 - Training Acc: 97.41% - Validation Acc: 96.42% - Training Dice: 0.8663 - Validation Dice: 0.8099 - Training IoU: 0.7675 - Validation IoU: 0.6840
```





Current Learning Rate: 0.05

EarlyStopping counter: 2 out of 5

Epoch 21/60 - Training Loss: 0.0683 - Validation Loss: 0.0833 - Training Acc: 97.52% - Validation Acc: 97.28% - Training Dice: 0.8719 - Validation Dice: 0.8313 - Training IoU: 0.7759 - Validation IoU: 0.7186

Current Learning Rate: 0.025

EarlyStopping counter: 3 out of 5

Epoch 22/60 - Training Loss: 0.0680 - Validation Loss: 0.0726 - Training Acc: 97.60% - Validation Acc: 97.50% - Training Dice: 0.8766 - Validation Dice: 0.8565 - Training IoU: 0.7831 - Validation IoU: 0.7515

Current Learning Rate: 0.025

EarlyStopping counter: 0 out of 5

Epoch 23/60 - Training Loss: 0.0558 - Validation Loss: 0.0586 - Training Acc: 97.97% - Validation Acc: 98.18% - Training Dice: 0.8958 - Validation Dice: 0.8993 - Training IoU: 0.8131 - Validation IoU: 0.8188

```
Current Learning Rate: 0.025
EarlyStopping counter: 0 out of 5
Epoch 24/60 - Training Loss: 0.0504 - Validation Loss: 0.0569 - Training Acc: 98.17% - Validation Acc: 98.26% - Training Dice: 0.9046 - Validation Dice: 0.9042 - Training IoU: 0.8284 - Validation IoU: 0.8273
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 1 out of 5
Epoch 25/60 - Training Loss: 0.0507 - Validation Loss: 0.0607 - Training Acc: 98.17% - Validation Acc: 98.08% - Training Dice: 0.9059 - Validation Dice: 0.8911 - Training IoU: 0.8296 - Validation IoU: 0.8047
```

```
Current Learning Rate: 0.025
EarlyStopping counter: 2 out of 5
Epoch 26/60 - Training Loss: 0.0585 - Validation Loss: 0.0649 - Training Acc: 97.80% - Validation Acc: 97.84% - Training Dice: 0.8865 - Validation Dice: 0.8848 - Training IoU: 0.8009 - Validation IoU: 0.7954
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 3 out of 5
Epoch 27/60 - Training Loss: 0.0533 - Validation Loss: 0.0636 - Training Acc: 98.04% - Validation Acc: 98.15% - Training Dice: 0.8983 - Validation Dice: 0.8967 - Training IoU: 0.8183 - Validation IoU: 0.8144
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 4 out of 5
Epoch 28/60 - Training Loss: 0.0447 - Validation Loss: 0.0608 - Training Acc: 98.36% - Validation Acc: 98.25% - Training Dice: 0.9153 - Validation Dice: 0.9035 - Training IoU: 0.8456 - Validation IoU: 0.8263

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.

    warnings.warn(msg)
C:\Users\Mike\AppData\Local\Temp\ipykernel_14796\279954375.py:42: FutureWarning:
```

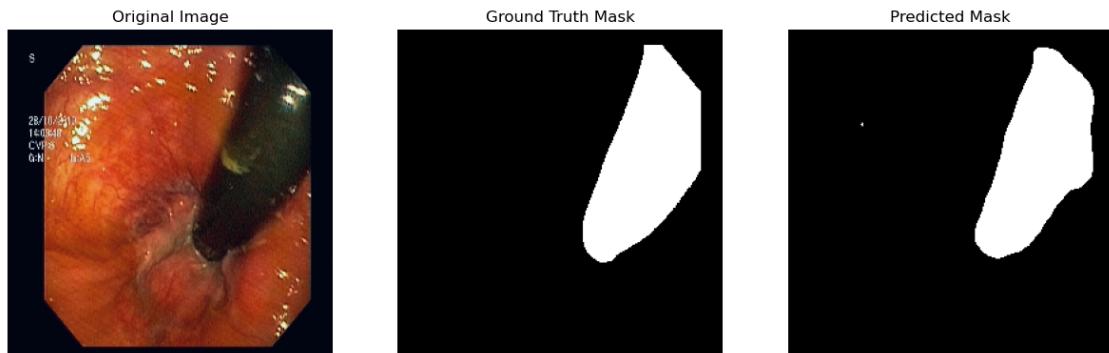
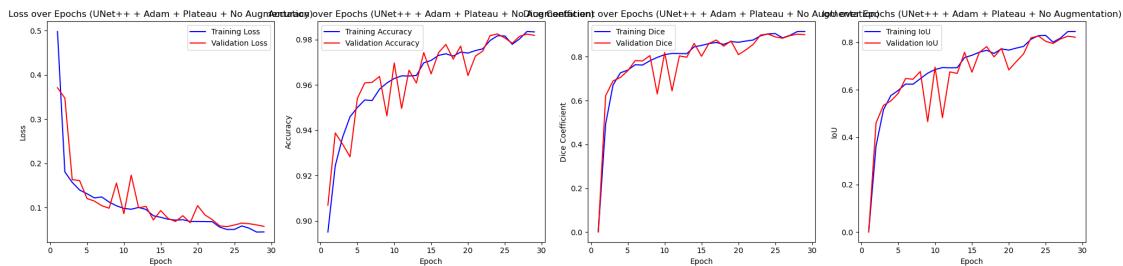
You are using `torch.load` with `weights_only=False` (the current default value), which uses the default pickle module implicitly. It is possible to construct malicious pickle data which will execute arbitrary code during unpickling (See <https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models> for more details). In a future release, the default value for `weights_only` will be flipped to `True`. This limits the functions that could be executed during unpickling. Arbitrary objects will no longer be allowed to be loaded via this mode unless they are explicitly allowlisted by the user via `torch.serialization.add_safe_globals`. We recommend you start setting `weights_only=True` for any use case where you don't have full control of the loaded file. Please open an issue on GitHub for any issues related to this experimental feature.

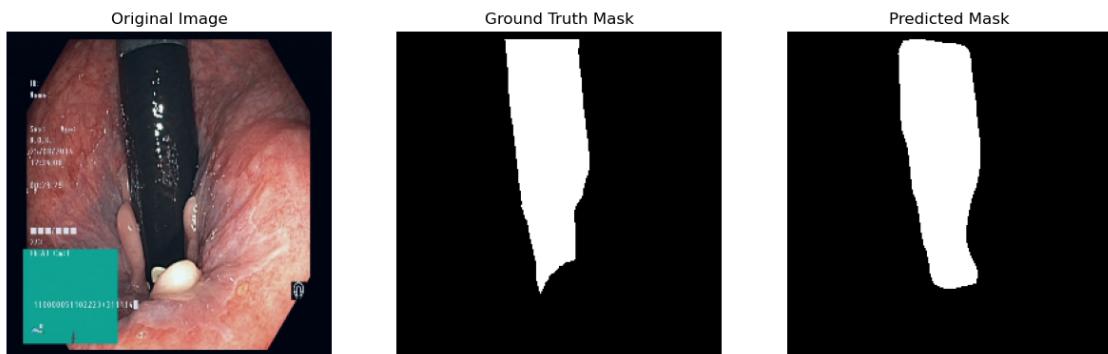
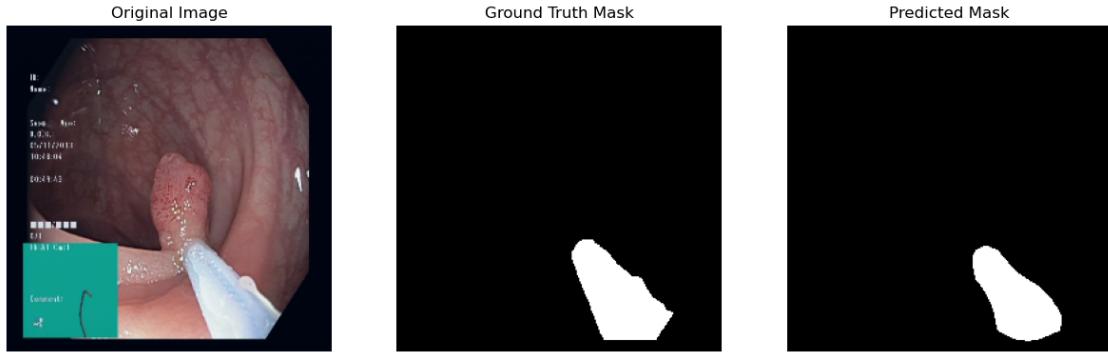
```
best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))
```

Current Learning Rate: 0.0125

EarlyStopping counter: 5 out of 5

Early stopping at epoch 29





Running experiment: UNet + Adam + Plateau + No Augmentation

Current Learning Rate: 0.1
 EarlyStopping counter: 0 out of 5
 Epoch 1/60 - Training Loss: 0.2299 - Validation Loss: 0.4526 - Training Acc: 90.20% - Validation Acc: 74.37% - Training Dice: 0.0930 - Validation Dice: 0.4157 - Training IoU: 0.0696 - Validation IoU: 0.2654

Current Learning Rate: 0.1
 EarlyStopping counter: 1 out of 5
 Epoch 2/60 - Training Loss: 0.1369 - Validation Loss: 1.1560 - Training Acc: 94.63% - Validation Acc: 67.37% - Training Dice: 0.7138 - Validation Dice: 0.3289 - Training IoU: 0.5655 - Validation IoU: 0.1991

Current Learning Rate: 0.1
 EarlyStopping counter: 0 out of 5
 Epoch 3/60 - Training Loss: 0.1321 - Validation Loss: 0.1386 - Training Acc:

94.93% - Validation Acc: 94.55% - Training Dice: 0.7317 - Validation Dice: 0.7567 - Training IoU: 0.5911 - Validation IoU: 0.6160

Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.1122 - Validation Loss: 0.1078 - Training Acc: 95.71% - Validation Acc: 96.01% - Training Dice: 0.7770 - Validation Dice: 0.7758 - Training IoU: 0.6440 - Validation IoU: 0.6371

Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 5/60 - Training Loss: 0.1174 - Validation Loss: 0.3450 - Training Acc: 95.41% - Validation Acc: 85.51% - Training Dice: 0.7586 - Validation Dice: 0.5279 - Training IoU: 0.6211 - Validation IoU: 0.3621

Current Learning Rate: 0.1
EarlyStopping counter: 2 out of 5
Epoch 6/60 - Training Loss: 0.1112 - Validation Loss: 0.1153 - Training Acc: 95.77% - Validation Acc: 95.40% - Training Dice: 0.7815 - Validation Dice: 0.7183 - Training IoU: 0.6482 - Validation IoU: 0.5696

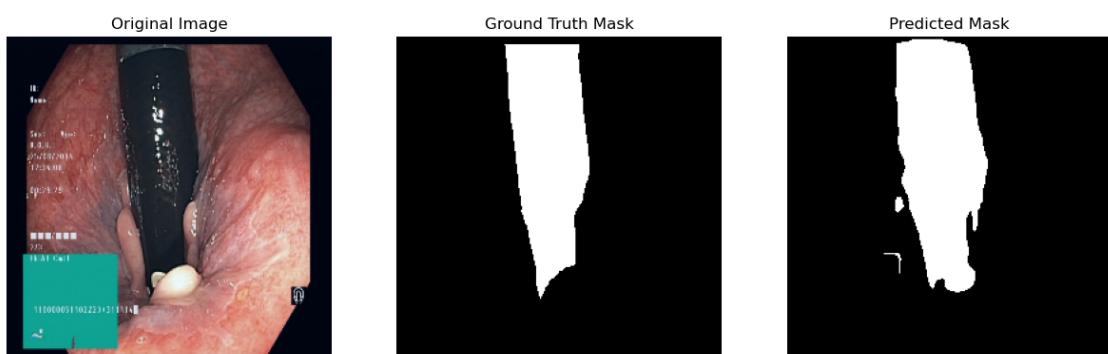
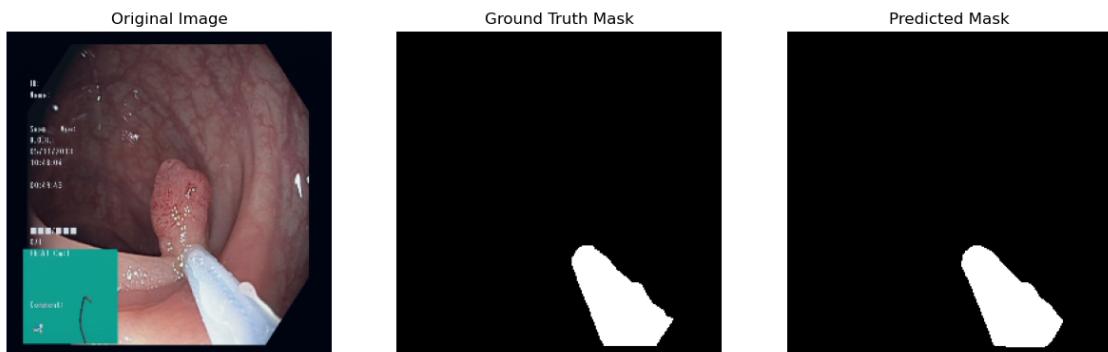
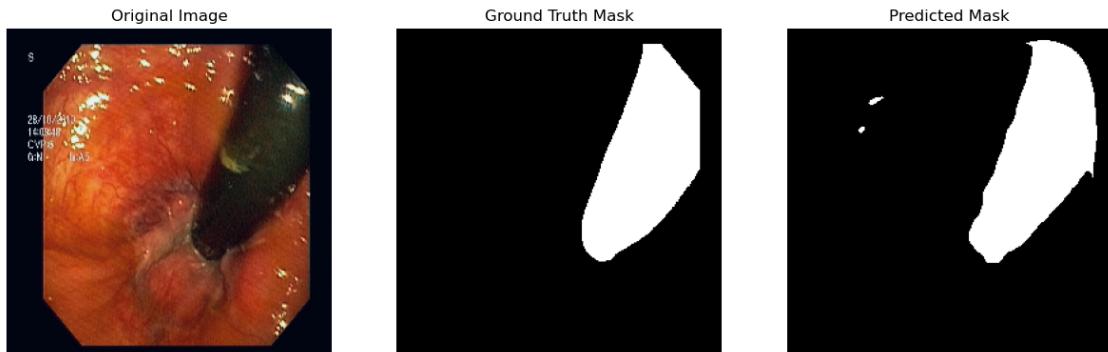
Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5
Epoch 7/60 - Training Loss: 0.1034 - Validation Loss: 0.0895 - Training Acc: 95.92% - Validation Acc: 96.57% - Training Dice: 0.7848 - Validation Dice: 0.7893 - Training IoU: 0.6523 - Validation IoU: 0.6546

Current Learning Rate: 0.1
EarlyStopping counter: 1 out of 5
Epoch 8/60 - Training Loss: 0.1029 - Validation Loss: 0.1123 - Training Acc: 95.97% - Validation Acc: 95.69% - Training Dice: 0.7908 - Validation Dice: 0.7549 - Training IoU: 0.6599 - Validation IoU: 0.6115

Current Learning Rate: 0.1
EarlyStopping counter: 2 out of 5
Epoch 9/60 - Training Loss: 0.1058 - Validation Loss: 0.8775 - Training Acc: 96.06% - Validation Acc: 76.06% - Training Dice: 0.7934 - Validation Dice: 0.4263 - Training IoU: 0.6653 - Validation IoU: 0.2737

Current Learning Rate: 0.1
EarlyStopping counter: 0 out of 5

Epoch 10/60 - Training Loss: 0.1045 - Validation Loss: 0.0823 - Training Acc: 96.11% - Validation Acc: 97.09% - Training Dice: 0.7957 - Validation Dice: 0.8514 - Training IoU: 0.6683 - Validation IoU: 0.7447



Current Learning Rate: 0.1

EarlyStopping counter: 1 out of 5

Epoch 11/60 - Training Loss: 0.0978 - Validation Loss: 0.1128 - Training Acc:

96.44% - Validation Acc: 96.93% - Training Dice: 0.8161 - Validation Dice: 0.8097 - Training IoU: 0.6957 - Validation IoU: 0.6856

Current Learning Rate: 0.1
EarlyStopping counter: 2 out of 5
Epoch 12/60 - Training Loss: 0.0955 - Validation Loss: 0.1205 - Training Acc: 96.50% - Validation Acc: 95.15% - Training Dice: 0.8197 - Validation Dice: 0.7753 - Training IoU: 0.7025 - Validation IoU: 0.6359

Current Learning Rate: 0.05
EarlyStopping counter: 3 out of 5
Epoch 13/60 - Training Loss: 0.1036 - Validation Loss: 0.1547 - Training Acc: 96.15% - Validation Acc: 94.87% - Training Dice: 0.7996 - Validation Dice: 0.6837 - Training IoU: 0.6749 - Validation IoU: 0.5276

Current Learning Rate: 0.05
EarlyStopping counter: 4 out of 5
Epoch 14/60 - Training Loss: 0.0925 - Validation Loss: 0.0835 - Training Acc: 96.55% - Validation Acc: 96.76% - Training Dice: 0.8196 - Validation Dice: 0.8198 - Training IoU: 0.7016 - Validation IoU: 0.6988

Current Learning Rate: 0.05
EarlyStopping counter: 0 out of 5
Epoch 15/60 - Training Loss: 0.0843 - Validation Loss: 0.0634 - Training Acc: 96.85% - Validation Acc: 97.75% - Training Dice: 0.8390 - Validation Dice: 0.8705 - Training IoU: 0.7282 - Validation IoU: 0.7732

Current Learning Rate: 0.05
EarlyStopping counter: 1 out of 5
Epoch 16/60 - Training Loss: 0.0828 - Validation Loss: 0.0715 - Training Acc: 96.88% - Validation Acc: 97.26% - Training Dice: 0.8394 - Validation Dice: 0.8569 - Training IoU: 0.7278 - Validation IoU: 0.7530

Current Learning Rate: 0.05
EarlyStopping counter: 2 out of 5
Epoch 17/60 - Training Loss: 0.0810 - Validation Loss: 0.0656 - Training Acc: 96.94% - Validation Acc: 97.65% - Training Dice: 0.8440 - Validation Dice: 0.8600 - Training IoU: 0.7347 - Validation IoU: 0.7571

Current Learning Rate: 0.025
EarlyStopping counter: 3 out of 5

Epoch 18/60 - Training Loss: 0.0803 - Validation Loss: 0.0655 - Training Acc: 96.94% - Validation Acc: 97.55% - Training Dice: 0.8446 - Validation Dice: 0.8620 - Training IoU: 0.7362 - Validation IoU: 0.7600

Current Learning Rate: 0.025

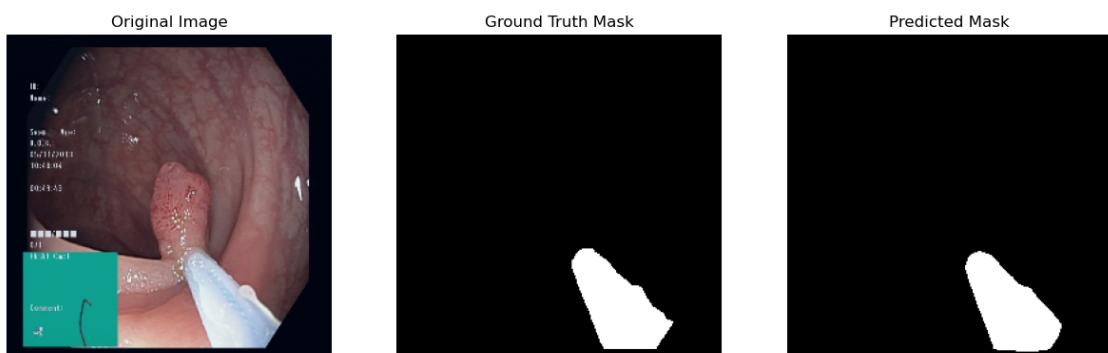
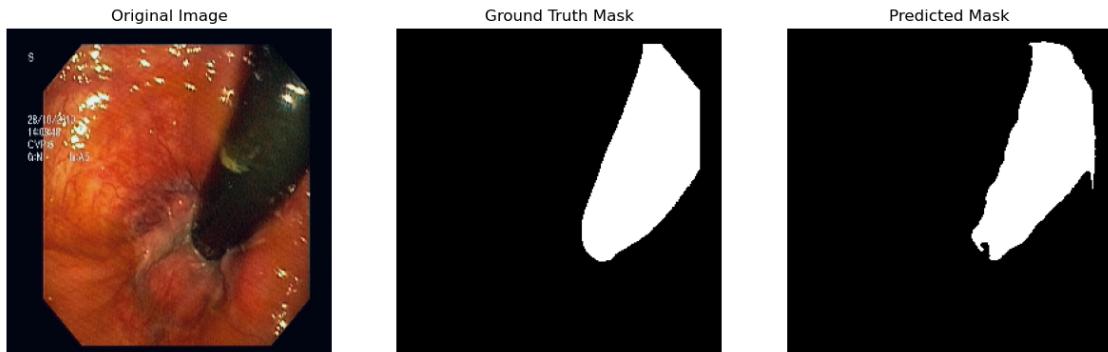
EarlyStopping counter: 0 out of 5

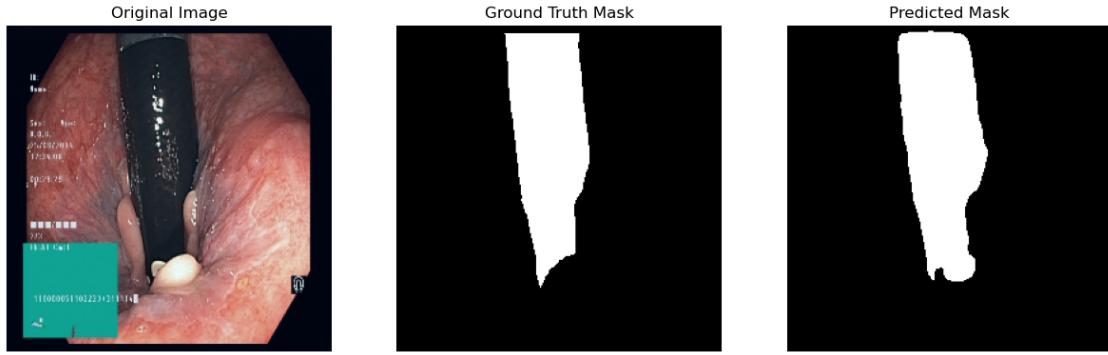
Epoch 19/60 - Training Loss: 0.0729 - Validation Loss: 0.0588 - Training Acc: 97.28% - Validation Acc: 97.90% - Training Dice: 0.8588 - Validation Dice: 0.8791 - Training IoU: 0.7563 - Validation IoU: 0.7855

Current Learning Rate: 0.025

EarlyStopping counter: 0 out of 5

Epoch 20/60 - Training Loss: 0.0732 - Validation Loss: 0.0569 - Training Acc: 97.27% - Validation Acc: 97.98% - Training Dice: 0.8600 - Validation Dice: 0.8876 - Training IoU: 0.7576 - Validation IoU: 0.7995





```

Current Learning Rate: 0.025
EarlyStopping counter: 1 out of 5
Epoch 21/60 - Training Loss: 0.0737 - Validation Loss: 0.1584 - Training Acc:
97.23% - Validation Acc: 93.70% - Training Dice: 0.8569 - Validation Dice:
0.7289 - Training IoU: 0.7563 - Validation IoU: 0.5781

```

```

Current Learning Rate: 0.025
EarlyStopping counter: 0 out of 5
Epoch 22/60 - Training Loss: 0.0723 - Validation Loss: 0.0544 - Training Acc:
97.30% - Validation Acc: 98.11% - Training Dice: 0.8615 - Validation Dice:
0.8923 - Training IoU: 0.7618 - Validation IoU: 0.8069

```

```

Current Learning Rate: 0.025
EarlyStopping counter: 1 out of 5
Epoch 23/60 - Training Loss: 0.0685 - Validation Loss: 0.0616 - Training Acc:
97.40% - Validation Acc: 97.85% - Training Dice: 0.8682 - Validation Dice:
0.8777 - Training IoU: 0.7706 - Validation IoU: 0.7835

```

```

Current Learning Rate: 0.025
EarlyStopping counter: 2 out of 5
Epoch 24/60 - Training Loss: 0.0689 - Validation Loss: 0.1198 - Training Acc:
97.37% - Validation Acc: 95.43% - Training Dice: 0.8666 - Validation Dice:
0.7807 - Training IoU: 0.7683 - Validation IoU: 0.6441

```

```

Current Learning Rate: 0.0125
EarlyStopping counter: 3 out of 5
Epoch 25/60 - Training Loss: 0.0699 - Validation Loss: 0.0557 - Training Acc:
97.35% - Validation Acc: 98.00% - Training Dice: 0.8640 - Validation Dice:
0.8892 - Training IoU: 0.7653 - Validation IoU: 0.8020

```

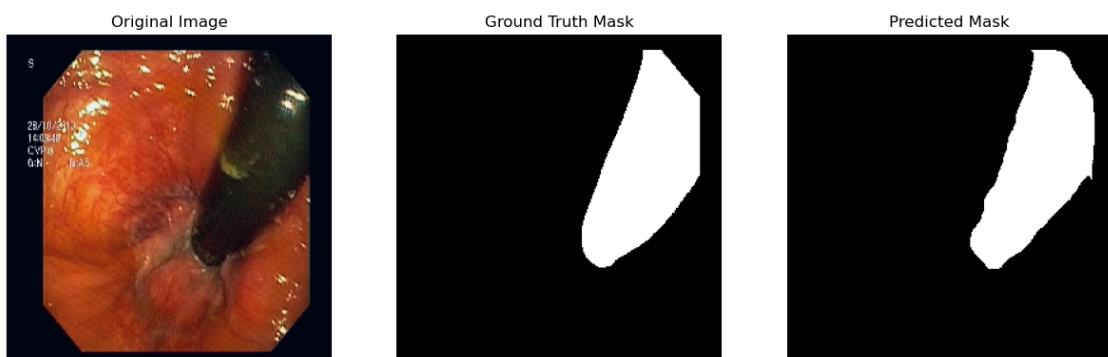
```
Current Learning Rate: 0.0125
EarlyStopping counter: 0 out of 5
Epoch 26/60 - Training Loss: 0.0636 - Validation Loss: 0.0513 - Training Acc: 97.55% - Validation Acc: 98.19% - Training Dice: 0.8734 - Validation Dice: 0.8995 - Training IoU: 0.7787 - Validation IoU: 0.8187
```

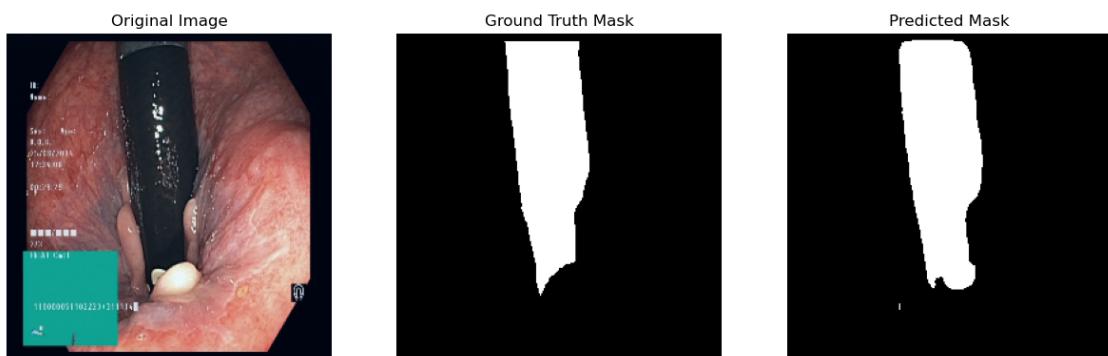
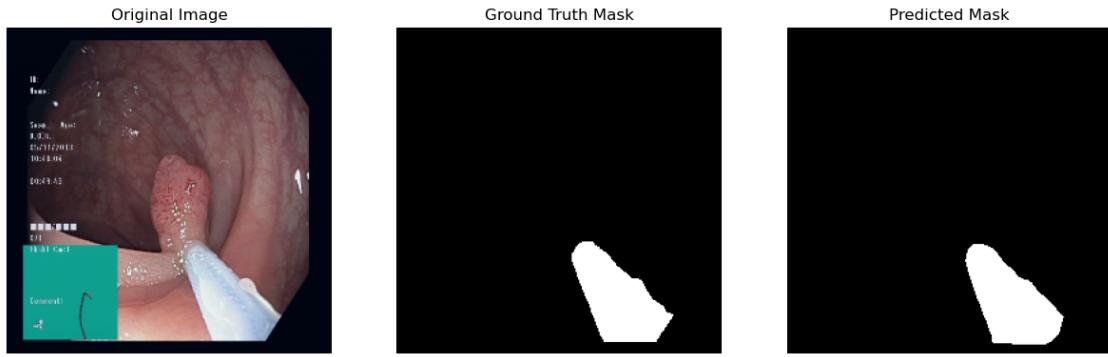
```
Current Learning Rate: 0.0125
EarlyStopping counter: 1 out of 5
Epoch 27/60 - Training Loss: 0.0649 - Validation Loss: 0.0559 - Training Acc: 97.56% - Validation Acc: 97.93% - Training Dice: 0.8767 - Validation Dice: 0.8872 - Training IoU: 0.7846 - Validation IoU: 0.7991
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 0 out of 5
Epoch 28/60 - Training Loss: 0.0606 - Validation Loss: 0.0492 - Training Acc: 97.66% - Validation Acc: 98.31% - Training Dice: 0.8804 - Validation Dice: 0.9057 - Training IoU: 0.7900 - Validation IoU: 0.8289
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 1 out of 5
Epoch 29/60 - Training Loss: 0.0611 - Validation Loss: 0.0506 - Training Acc: 97.66% - Validation Acc: 98.24% - Training Dice: 0.8785 - Validation Dice: 0.8994 - Training IoU: 0.7894 - Validation IoU: 0.8189
```

```
Current Learning Rate: 0.0125
EarlyStopping counter: 2 out of 5
Epoch 30/60 - Training Loss: 0.0614 - Validation Loss: 0.0501 - Training Acc: 97.63% - Validation Acc: 98.24% - Training Dice: 0.8769 - Validation Dice: 0.9006 - Training IoU: 0.7856 - Validation IoU: 0.8209
```





```

Current Learning Rate: 0.00625
EarlyStopping counter: 3 out of 5
Epoch 31/60 - Training Loss: 0.0585 - Validation Loss: 0.0559 - Training Acc:
97.80% - Validation Acc: 97.94% - Training Dice: 0.8863 - Validation Dice:
0.8881 - Training IoU: 0.7994 - Validation IoU: 0.8004

```

```

Current Learning Rate: 0.00625
EarlyStopping counter: 0 out of 5
Epoch 32/60 - Training Loss: 0.0593 - Validation Loss: 0.0484 - Training Acc:
97.74% - Validation Acc: 98.25% - Training Dice: 0.8829 - Validation Dice:
0.9035 - Training IoU: 0.7958 - Validation IoU: 0.8252

```

```

Current Learning Rate: 0.00625
EarlyStopping counter: 0 out of 5
Epoch 33/60 - Training Loss: 0.0562 - Validation Loss: 0.0463 - Training Acc:
97.90% - Validation Acc: 98.38% - Training Dice: 0.8916 - Validation Dice:
0.9093 - Training IoU: 0.8077 - Validation IoU: 0.8348

```

Current Learning Rate: 0.00625
EarlyStopping counter: 1 out of 5
Epoch 34/60 - Training Loss: 0.0545 - Validation Loss: 0.0478 - Training Acc: 97.93% - Validation Acc: 98.27% - Training Dice: 0.8944 - Validation Dice: 0.9059 - Training IoU: 0.8115 - Validation IoU: 0.8295

Current Learning Rate: 0.00625
EarlyStopping counter: 0 out of 5
Epoch 35/60 - Training Loss: 0.0542 - Validation Loss: 0.0460 - Training Acc: 97.92% - Validation Acc: 98.38% - Training Dice: 0.8940 - Validation Dice: 0.9093 - Training IoU: 0.8110 - Validation IoU: 0.8350

Current Learning Rate: 0.00625
EarlyStopping counter: 1 out of 5
Epoch 36/60 - Training Loss: 0.0524 - Validation Loss: 0.0476 - Training Acc: 98.01% - Validation Acc: 98.26% - Training Dice: 0.8970 - Validation Dice: 0.9056 - Training IoU: 0.8160 - Validation IoU: 0.8290

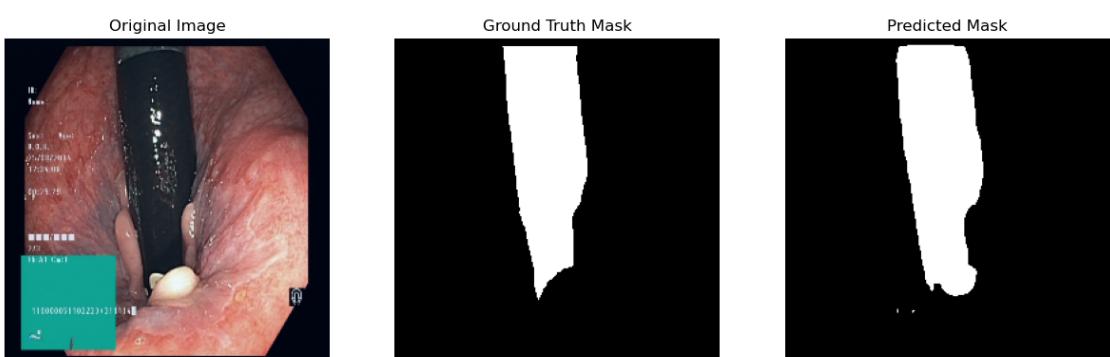
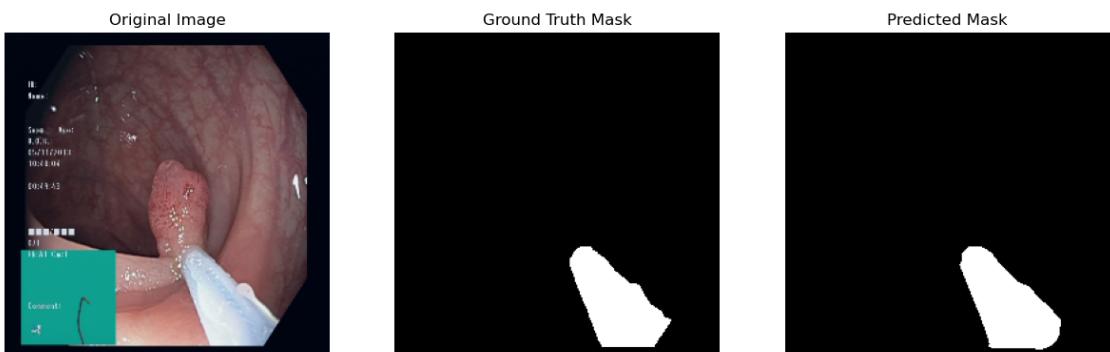
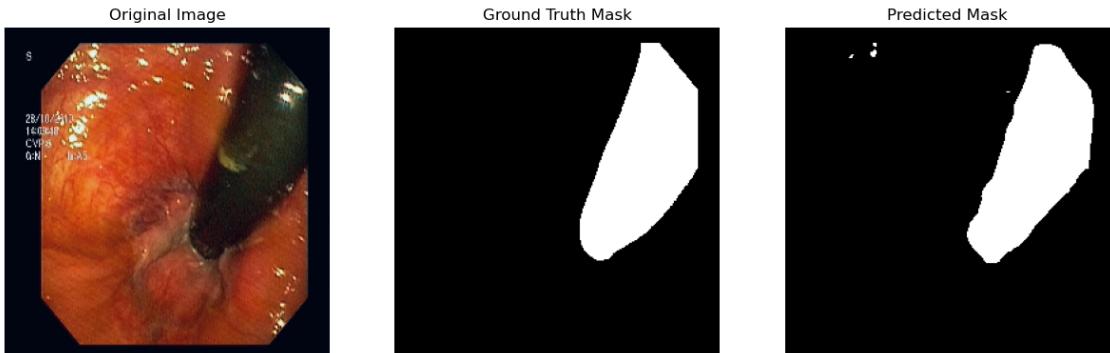
Current Learning Rate: 0.00625
EarlyStopping counter: 2 out of 5
Epoch 37/60 - Training Loss: 0.0525 - Validation Loss: 0.0499 - Training Acc: 97.97% - Validation Acc: 98.32% - Training Dice: 0.8946 - Validation Dice: 0.9047 - Training IoU: 0.8125 - Validation IoU: 0.8273

Current Learning Rate: 0.003125
EarlyStopping counter: 3 out of 5
Epoch 38/60 - Training Loss: 0.0533 - Validation Loss: 0.0471 - Training Acc: 97.94% - Validation Acc: 98.35% - Training Dice: 0.8939 - Validation Dice: 0.9087 - Training IoU: 0.8120 - Validation IoU: 0.8338

Current Learning Rate: 0.003125
EarlyStopping counter: 4 out of 5
Epoch 39/60 - Training Loss: 0.0504 - Validation Loss: 0.0466 - Training Acc: 98.07% - Validation Acc: 98.39% - Training Dice: 0.9008 - Validation Dice: 0.9113 - Training IoU: 0.8215 - Validation IoU: 0.8382

Current Learning Rate: 0.003125
EarlyStopping counter: 0 out of 5
Epoch 40/60 - Training Loss: 0.0495 - Validation Loss: 0.0458 - Training Acc:

98.11% - Validation Acc: 98.38% - Training Dice: 0.9019 - Validation Dice: 0.9113 - Training IoU: 0.8239 - Validation IoU: 0.8382



Current Learning Rate: 0.003125
EarlyStopping counter: 1 out of 5
Epoch 41/60 - Training Loss: 0.0473 - Validation Loss: 0.0467 - Training Acc: 98.19% - Validation Acc: 98.39% - Training Dice: 0.9074 - Validation Dice:

0.9101 - Training IoU: 0.8325 - Validation IoU: 0.8362

Current Learning Rate: 0.003125

EarlyStopping counter: 2 out of 5

Epoch 42/60 - Training Loss: 0.0490 - Validation Loss: 0.0459 - Training Acc: 98.13% - Validation Acc: 98.40% - Training Dice: 0.9047 - Validation Dice: 0.9109 - Training IoU: 0.8283 - Validation IoU: 0.8376

Current Learning Rate: 0.0015625

EarlyStopping counter: 3 out of 5

Epoch 43/60 - Training Loss: 0.0473 - Validation Loss: 0.0459 - Training Acc: 98.20% - Validation Acc: 98.42% - Training Dice: 0.9069 - Validation Dice: 0.9119 - Training IoU: 0.8314 - Validation IoU: 0.8393

Current Learning Rate: 0.0015625

EarlyStopping counter: 0 out of 5

Epoch 44/60 - Training Loss: 0.0486 - Validation Loss: 0.0458 - Training Acc: 98.14% - Validation Acc: 98.41% - Training Dice: 0.9045 - Validation Dice: 0.9126 - Training IoU: 0.8286 - Validation IoU: 0.8404

Current Learning Rate: 0.0015625

EarlyStopping counter: 0 out of 5

Epoch 45/60 - Training Loss: 0.0469 - Validation Loss: 0.0453 - Training Acc: 98.23% - Validation Acc: 98.41% - Training Dice: 0.9088 - Validation Dice: 0.9117 - Training IoU: 0.8344 - Validation IoU: 0.8390

Current Learning Rate: 0.0015625

EarlyStopping counter: 1 out of 5

Epoch 46/60 - Training Loss: 0.0474 - Validation Loss: 0.0457 - Training Acc: 98.17% - Validation Acc: 98.40% - Training Dice: 0.9054 - Validation Dice: 0.9120 - Training IoU: 0.8296 - Validation IoU: 0.8396

Current Learning Rate: 0.0015625

EarlyStopping counter: 2 out of 5

Epoch 47/60 - Training Loss: 0.0464 - Validation Loss: 0.0459 - Training Acc: 98.22% - Validation Acc: 98.41% - Training Dice: 0.9072 - Validation Dice: 0.9115 - Training IoU: 0.8337 - Validation IoU: 0.8388

Current Learning Rate: 0.00078125

EarlyStopping counter: 3 out of 5

Epoch 48/60 - Training Loss: 0.0473 - Validation Loss: 0.0459 - Training Acc:

```
98.20% - Validation Acc: 98.38% - Training Dice: 0.9073 - Validation Dice:  
0.9110 - Training IoU: 0.8324 - Validation IoU: 0.8379
```

```
Current Learning Rate: 0.00078125
```

```
EarlyStopping counter: 4 out of 5
```

```
Epoch 49/60 - Training Loss: 0.0456 - Validation Loss: 0.0457 - Training Acc:  
98.27% - Validation Acc: 98.41% - Training Dice: 0.9104 - Validation Dice:  
0.9120 - Training IoU: 0.8378 - Validation IoU: 0.8394
```

```
C:\Users\Mike\AppData\Local\Temp\ipykernel_14796\279954375.py:42: FutureWarning:  
You are using `torch.load` with `weights_only=False` (the current default  
value), which uses the default pickle module implicitly. It is possible to  
construct malicious pickle data which will execute arbitrary code during  
unpickling (See
```

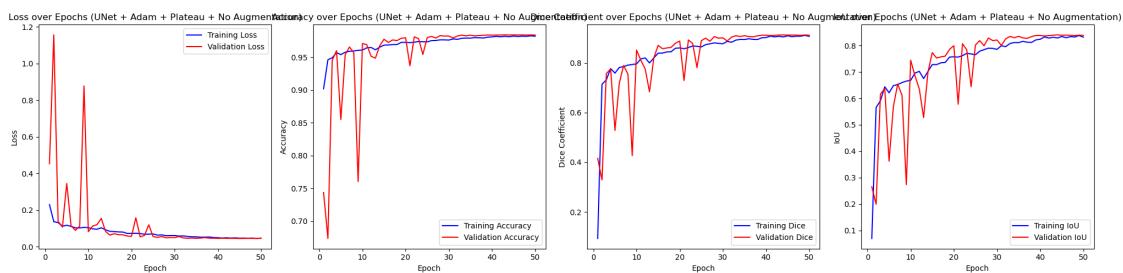
```
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for  
more details). In a future release, the default value for `weights_only` will be  
flipped to `True`. This limits the functions that could be executed during  
unpickling. Arbitrary objects will no longer be allowed to be loaded via this  
mode unless they are explicitly allowlisted by the user via  
`torch.serialization.add_safe_globals`. We recommend you start setting  
`weights_only=True` for any use case where you don't have full control of the  
loaded file. Please open an issue on GitHub for any issues related to this  
experimental feature.
```

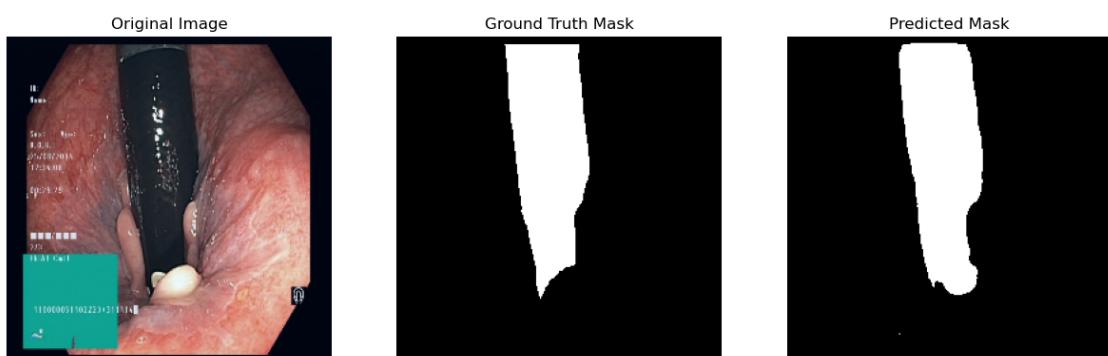
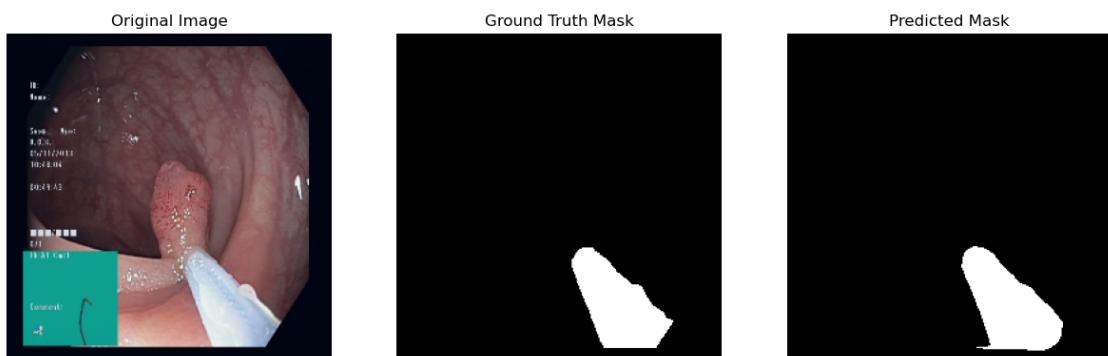
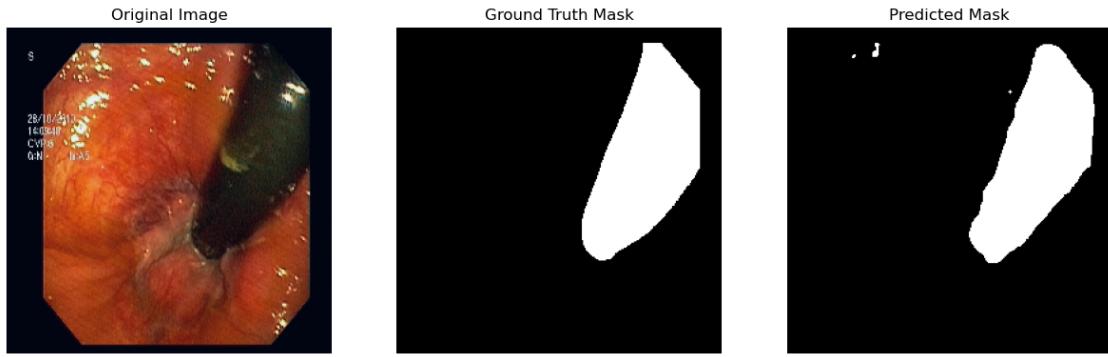
```
    best_model.load_state_dict(torch.load(os.path.join(working_dir,  
'best_model.pth')))
```

```
Current Learning Rate: 0.00078125
```

```
EarlyStopping counter: 5 out of 5
```

```
Early stopping at epoch 50
```





Summary of Experiments:

		Model	Best Epoch	Train Loss	\
0	FPN + Adam + Plateau + No Augmentation		21	0.047184	
1	UNet++ + Adam + Plateau + No Augmentation		24	0.050442	
2	UNet + Adam + Plateau + No Augmentation		45	0.046909	

Validation Loss Train Accuracy Validation Accuracy Train Dice \

0	0.057946	0.982218	0.982206	0.908703				
1	0.056936	0.981731	0.982551	0.904646				
2	0.045350	0.982311	0.984123	0.908782				
Validation Dice Train IoU Validation IoU Test Loss Test Accuracy \								
0	0.901302	0.834231	0.821954	0.057946	0.982206			
1	0.904158	0.828401	0.827272	0.056936	0.982551			
2	0.911668	0.834437	0.839042	0.045350	0.984123			
Test Dice Test IoU								
0	0.901302	0.821954						
1	0.904158	0.827272						
2	0.911668	0.839042						

Experiment Results Summary

Model	Batch Epoch	Train Loss	Validation Loss	Train Accuracy	Validation Accuracy	Train IoU	Validation IoU	Test Loss	Test Accuracy	Test IoU		
FPN + Adam + Plateau + No Augmentation	21	0.04718377952421227	0.0514551726000894	0.9821786964891	0.982056644600769	0.982070269510064	0.9820501816575	0.834720998107951	0.971951929178247	0.9822056612000894	0.98219521816575	0.8212513987078247
UNet++ + Adam + Plateau + No Augmentation	241	0.05044742250140209	0.05650445113050785	0.981717531355207	0.98205111539318801	0.982424501005133	0.98415813805542	0.83421367738213	0.971225195918433	0.98205113207932593	0.982151772000880	0.8217225299518471
UNet + Adam + Plateau + No Augmentation	471	0.0450071558391974	0.0510250207987626	0.98211312512013	0.98221799902605	0.982772331720203	0.9826212102273	0.83422136711526	0.971042120599433	0.982150205200208	0.982117724702231	0.820424255000208

```
[21]: optimizer_adam = lambda params: optim.Adam(params, lr=0.01)

scheduler_plateau = lambda optimizer: ReduceLROnPlateau(optimizer, mode='min', factor=0.5, patience=2)

# Run experiments and store results
results = []

# Experiment 1: FPN with Adam, Plateau scheduler, and augmentations
_, metrics3 = run_experiment(model_fn=get_fpn,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau ,
                             augmentations=augmentations,
                             experiment_name='FPN(0.01) + Augmentation')
results.append(metrics3)

# Experiment 2: UNet with Adam, Plateau scheduler, and augmentations
_, metrics1 = run_experiment(model_fn=get_unetpp,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau,
                             augmentations=augmentations,
                             experiment_name='UNet++(0.01) + Augmentation')
results.append(metrics1)

# Experiment 3: UNet++ with Adam, Plateau scheduler, and augmentations
```

```

_, metrics2 = run_experiment(model_fn=get_unet,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau,
                             augmentations=augmentations,
                             experiment_name='UNet(0.01) + Augmentation')

results.append(metrics2)

# Create a summary table using pandas DataFrame
summary_df = pd.DataFrame(results)
print("\nSummary of Experiments:")
print(summary_df)

# Visualize the summary table using matplotlib
fig, ax = plt.subplots(figsize=(12, 4))
ax.axis('tight')
ax.axis('off')
table = ax.table(cellText=summary_df.values, colLabels=summary_df.columns, loc='center')
table.auto_set_font_size(False)
table.set_fontsize(10)
table.auto_set_column_width(col=list(range(len(summary_df.columns))))
plt.title("Experiment Results Summary")
plt.show()

```

```

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMGNET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)

```

Running experiment: FPN(0.01) + Augmentation

```

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.3369 - Validation Loss: 0.3328 - Training Acc:
88.98% - Validation Acc: 90.09% - Training Dice: 0.0896 - Validation Dice:
0.0456 - Training IoU: 0.0545 - Validation IoU: 0.0246

```

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1939 - Validation Loss: 0.1723 - Training Acc: 92.56% - Validation Acc: 94.06% - Training Dice: 0.5356 - Validation Dice: 0.6403 - Training IoU: 0.3788 - Validation IoU: 0.4792

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 3/60 - Training Loss: 0.1604 - Validation Loss: 0.1361 - Training Acc: 93.85% - Validation Acc: 95.25% - Training Dice: 0.6495 - Validation Dice: 0.7275 - Training IoU: 0.4887 - Validation IoU: 0.5792

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 4/60 - Training Loss: 0.1442 - Validation Loss: 0.1436 - Training Acc: 94.48% - Validation Acc: 94.73% - Training Dice: 0.6909 - Validation Dice: 0.6913 - Training IoU: 0.5377 - Validation IoU: 0.5339

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 5/60 - Training Loss: 0.1263 - Validation Loss: 0.0862 - Training Acc: 95.18% - Validation Acc: 96.87% - Training Dice: 0.7317 - Validation Dice: 0.8242 - Training IoU: 0.5855 - Validation IoU: 0.7036

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 6/60 - Training Loss: 0.1267 - Validation Loss: 0.0909 - Training Acc: 95.23% - Validation Acc: 96.67% - Training Dice: 0.7407 - Validation Dice: 0.8052 - Training IoU: 0.5949 - Validation IoU: 0.6786

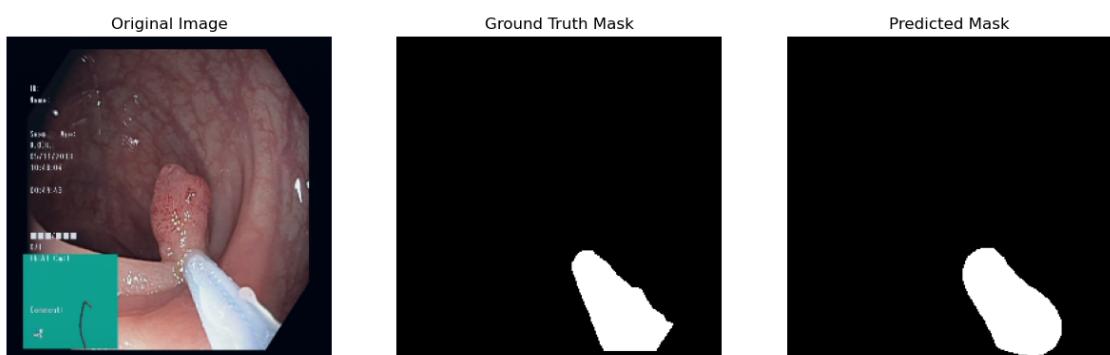
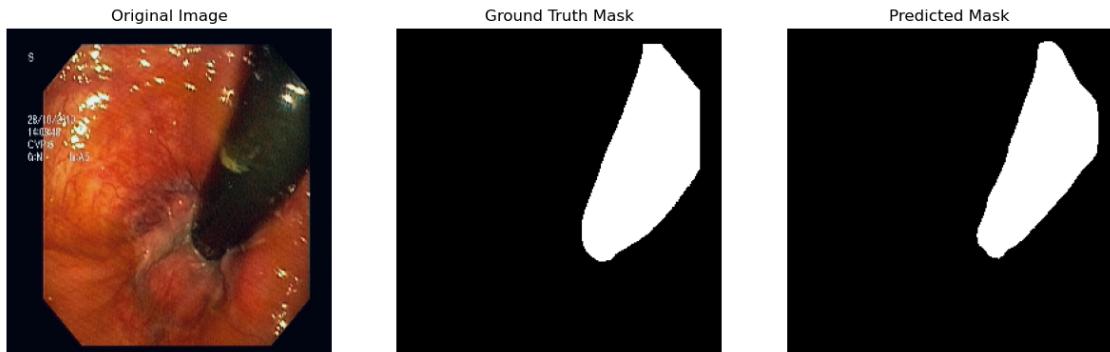
Current Learning Rate: 0.01
EarlyStopping counter: 2 out of 5
Epoch 7/60 - Training Loss: 0.1289 - Validation Loss: 0.0949 - Training Acc: 95.01% - Validation Acc: 96.23% - Training Dice: 0.7239 - Validation Dice: 0.7898 - Training IoU: 0.5739 - Validation IoU: 0.6558

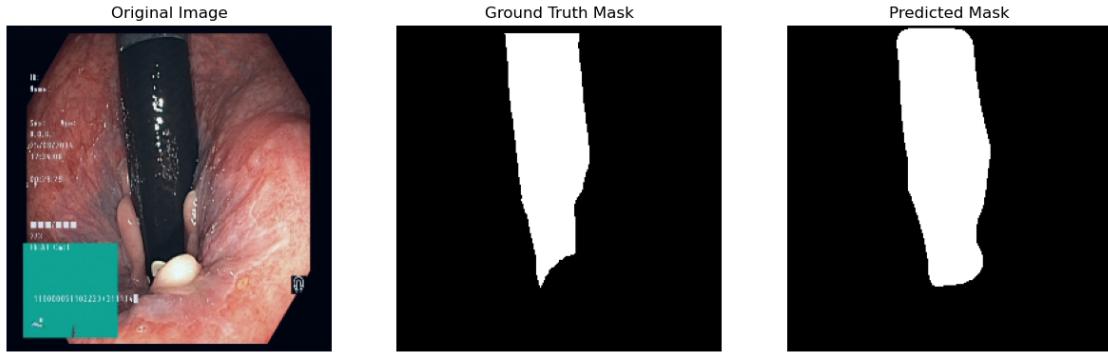
Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.1203 - Validation Loss: 0.0849 - Training Acc:

95.38% - Validation Acc: 96.87% - Training Dice: 0.7523 - Validation Dice: 0.8043 - Training IoU: 0.6081 - Validation IoU: 0.6755

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.1218 - Validation Loss: 0.1034 - Training Acc: 95.37% - Validation Acc: 95.87% - Training Dice: 0.7506 - Validation Dice: 0.7567 - Training IoU: 0.6101 - Validation IoU: 0.6152

Current Learning Rate: 0.01
EarlyStopping counter: 2 out of 5
Epoch 10/60 - Training Loss: 0.1170 - Validation Loss: 0.1002 - Training Acc: 95.41% - Validation Acc: 96.41% - Training Dice: 0.7547 - Validation Dice: 0.8233 - Training IoU: 0.6120 - Validation IoU: 0.7051





```

Current Learning Rate: 0.005
EarlyStopping counter: 3 out of 5
Epoch 11/60 - Training Loss: 0.1118 - Validation Loss: 0.1375 - Training Acc:
95.78% - Validation Acc: 94.29% - Training Dice: 0.7765 - Validation Dice:
0.7358 - Training IoU: 0.6415 - Validation IoU: 0.5889

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 12/60 - Training Loss: 0.0997 - Validation Loss: 0.0835 - Training Acc:
96.23% - Validation Acc: 97.03% - Training Dice: 0.8006 - Validation Dice:
0.8174 - Training IoU: 0.6739 - Validation IoU: 0.6946

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 13/60 - Training Loss: 0.1044 - Validation Loss: 0.0747 - Training Acc:
96.04% - Validation Acc: 97.31% - Training Dice: 0.7875 - Validation Dice:
0.8428 - Training IoU: 0.6564 - Validation IoU: 0.7323

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 1 out of 5
Epoch 14/60 - Training Loss: 0.1020 - Validation Loss: 0.0838 - Training Acc:
96.03% - Validation Acc: 96.79% - Training Dice: 0.7908 - Validation Dice:
0.8320 - Training IoU: 0.6589 - Validation IoU: 0.7167

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 15/60 - Training Loss: 0.1008 - Validation Loss: 0.0725 - Training Acc:
96.10% - Validation Acc: 97.26% - Training Dice: 0.7934 - Validation Dice:
0.8422 - Training IoU: 0.6636 - Validation IoU: 0.7319

```

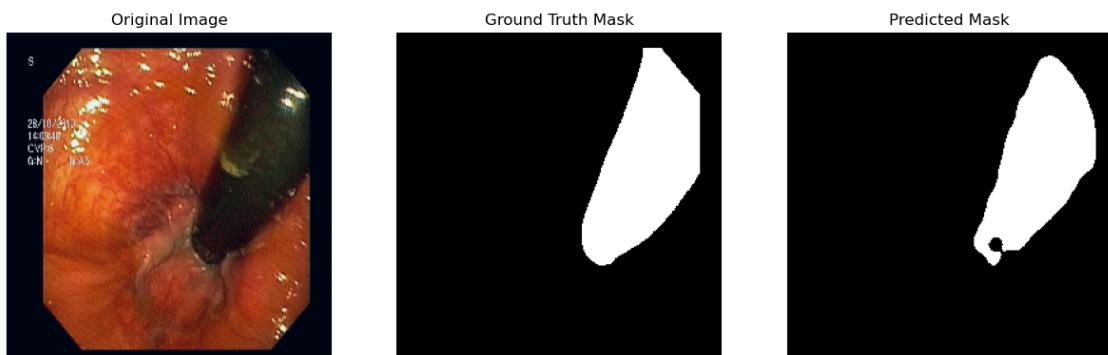
```
Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 16/60 - Training Loss: 0.0990 - Validation Loss: 0.0631 - Training Acc: 96.13% - Validation Acc: 97.81% - Training Dice: 0.7978 - Validation Dice: 0.8806 - Training IoU: 0.6717 - Validation IoU: 0.7886
```

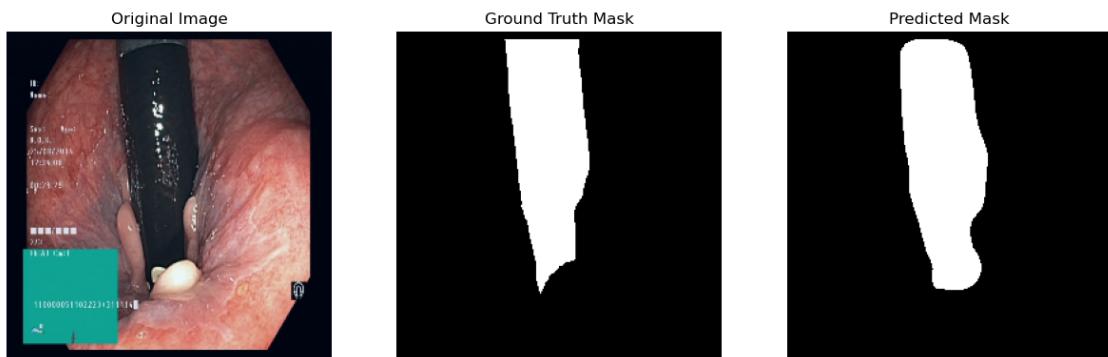
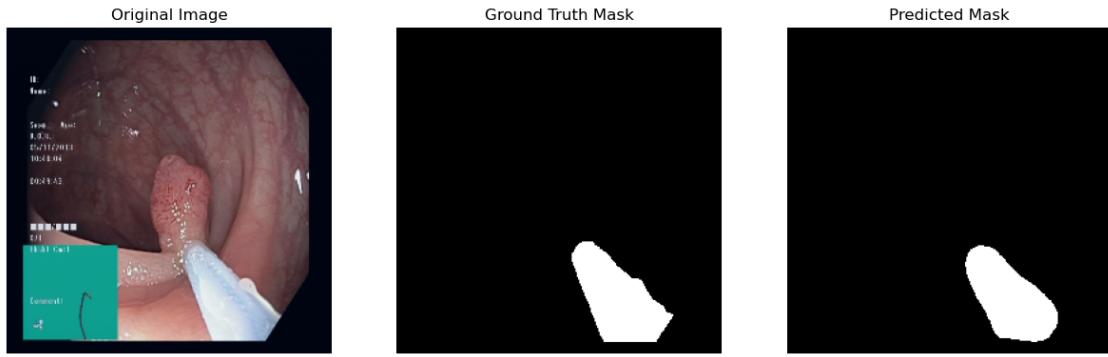
```
Current Learning Rate: 0.005
EarlyStopping counter: 1 out of 5
Epoch 17/60 - Training Loss: 0.0970 - Validation Loss: 0.0762 - Training Acc: 96.32% - Validation Acc: 97.20% - Training Dice: 0.8072 - Validation Dice: 0.8315 - Training IoU: 0.6856 - Validation IoU: 0.7156
```

```
Current Learning Rate: 0.005
EarlyStopping counter: 2 out of 5
Epoch 18/60 - Training Loss: 0.0870 - Validation Loss: 0.0679 - Training Acc: 96.75% - Validation Acc: 97.43% - Training Dice: 0.8322 - Validation Dice: 0.8596 - Training IoU: 0.7172 - Validation IoU: 0.7571
```

```
Current Learning Rate: 0.0025
EarlyStopping counter: 3 out of 5
Epoch 19/60 - Training Loss: 0.0957 - Validation Loss: 0.0735 - Training Acc: 96.38% - Validation Acc: 97.41% - Training Dice: 0.8085 - Validation Dice: 0.8491 - Training IoU: 0.6848 - Validation IoU: 0.7397
```

```
Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 20/60 - Training Loss: 0.0879 - Validation Loss: 0.0606 - Training Acc: 96.61% - Validation Acc: 97.92% - Training Dice: 0.8223 - Validation Dice: 0.8810 - Training IoU: 0.7047 - Validation IoU: 0.7898
```





Current Learning Rate: 0.0025

EarlyStopping counter: 0 out of 5

Epoch 21/60 - Training Loss: 0.0860 - Validation Loss: 0.0587 - Training Acc: 96.72% - Validation Acc: 97.94% - Training Dice: 0.8285 - Validation Dice: 0.8885 - Training IoU: 0.7125 - Validation IoU: 0.8013

Current Learning Rate: 0.0025

EarlyStopping counter: 1 out of 5

Epoch 22/60 - Training Loss: 0.0816 - Validation Loss: 0.0616 - Training Acc: 96.91% - Validation Acc: 97.83% - Training Dice: 0.8361 - Validation Dice: 0.8804 - Training IoU: 0.7262 - Validation IoU: 0.7898

Current Learning Rate: 0.0025

EarlyStopping counter: 2 out of 5

Epoch 23/60 - Training Loss: 0.0819 - Validation Loss: 0.0607 - Training Acc: 96.89% - Validation Acc: 97.82% - Training Dice: 0.8398 - Validation Dice: 0.8821 - Training IoU: 0.7293 - Validation IoU: 0.7918

Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 24/60 - Training Loss: 0.0781 - Validation Loss: 0.0557 - Training Acc: 97.08% - Validation Acc: 98.04% - Training Dice: 0.8463 - Validation Dice: 0.8931 - Training IoU: 0.7386 - Validation IoU: 0.8092

Current Learning Rate: 0.0025
EarlyStopping counter: 1 out of 5
Epoch 25/60 - Training Loss: 0.0768 - Validation Loss: 0.0588 - Training Acc: 97.12% - Validation Acc: 97.98% - Training Dice: 0.8496 - Validation Dice: 0.8881 - Training IoU: 0.7427 - Validation IoU: 0.8011

Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 26/60 - Training Loss: 0.0769 - Validation Loss: 0.0546 - Training Acc: 96.94% - Validation Acc: 98.08% - Training Dice: 0.8404 - Validation Dice: 0.8971 - Training IoU: 0.7285 - Validation IoU: 0.8152

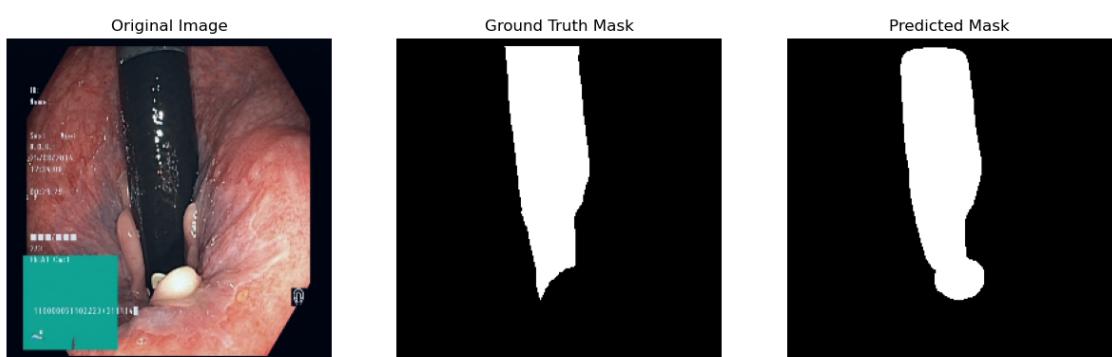
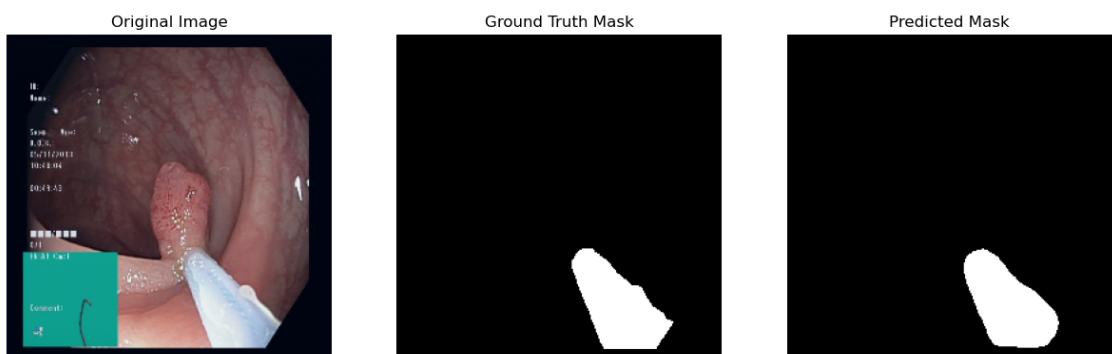
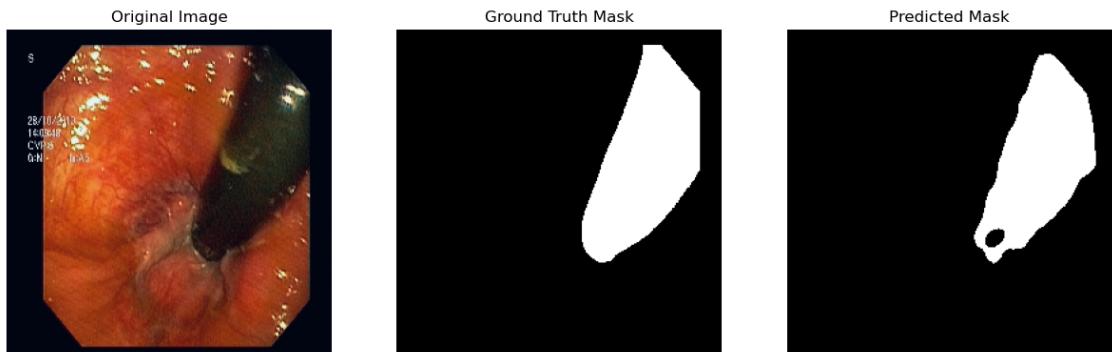
Current Learning Rate: 0.0025
EarlyStopping counter: 1 out of 5
Epoch 27/60 - Training Loss: 0.0731 - Validation Loss: 0.0617 - Training Acc: 97.30% - Validation Acc: 97.80% - Training Dice: 0.8574 - Validation Dice: 0.8710 - Training IoU: 0.7549 - Validation IoU: 0.7748

Current Learning Rate: 0.0025
EarlyStopping counter: 2 out of 5
Epoch 28/60 - Training Loss: 0.0737 - Validation Loss: 0.0625 - Training Acc: 97.18% - Validation Acc: 97.71% - Training Dice: 0.8551 - Validation Dice: 0.8698 - Training IoU: 0.7513 - Validation IoU: 0.7744

Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 29/60 - Training Loss: 0.0743 - Validation Loss: 0.0535 - Training Acc: 97.10% - Validation Acc: 98.22% - Training Dice: 0.8490 - Validation Dice: 0.9011 - Training IoU: 0.7429 - Validation IoU: 0.8219

Current Learning Rate: 0.0025
EarlyStopping counter: 1 out of 5
Epoch 30/60 - Training Loss: 0.0750 - Validation Loss: 0.0555 - Training Acc:

97.11% - Validation Acc: 98.05% - Training Dice: 0.8481 - Validation Dice: 0.8910 - Training IoU: 0.7425 - Validation IoU: 0.8059



Current Learning Rate: 0.0025
EarlyStopping counter: 2 out of 5
Epoch 31/60 - Training Loss: 0.0728 - Validation Loss: 0.0603 - Training Acc: 97.29% - Validation Acc: 97.75% - Training Dice: 0.8589 - Validation Dice:

0.8816 - Training IoU: 0.7562 - Validation IoU: 0.7904

Current Learning Rate: 0.00125
EarlyStopping counter: 3 out of 5
Epoch 32/60 - Training Loss: 0.0670 - Validation Loss: 0.0592 - Training Acc: 97.50% - Validation Acc: 97.96% - Training Dice: 0.8681 - Validation Dice: 0.8862 - Training IoU: 0.7706 - Validation IoU: 0.7980

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 33/60 - Training Loss: 0.0692 - Validation Loss: 0.0502 - Training Acc: 97.35% - Validation Acc: 98.31% - Training Dice: 0.8629 - Validation Dice: 0.9065 - Training IoU: 0.7643 - Validation IoU: 0.8306

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 34/60 - Training Loss: 0.0667 - Validation Loss: 0.0478 - Training Acc: 97.48% - Validation Acc: 98.29% - Training Dice: 0.8677 - Validation Dice: 0.9070 - Training IoU: 0.7720 - Validation IoU: 0.8317

Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 35/60 - Training Loss: 0.0628 - Validation Loss: 0.0497 - Training Acc: 97.70% - Validation Acc: 98.28% - Training Dice: 0.8810 - Validation Dice: 0.9058 - Training IoU: 0.7925 - Validation IoU: 0.8297

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 36/60 - Training Loss: 0.0620 - Validation Loss: 0.0473 - Training Acc: 97.69% - Validation Acc: 98.38% - Training Dice: 0.8811 - Validation Dice: 0.9114 - Training IoU: 0.7901 - Validation IoU: 0.8390

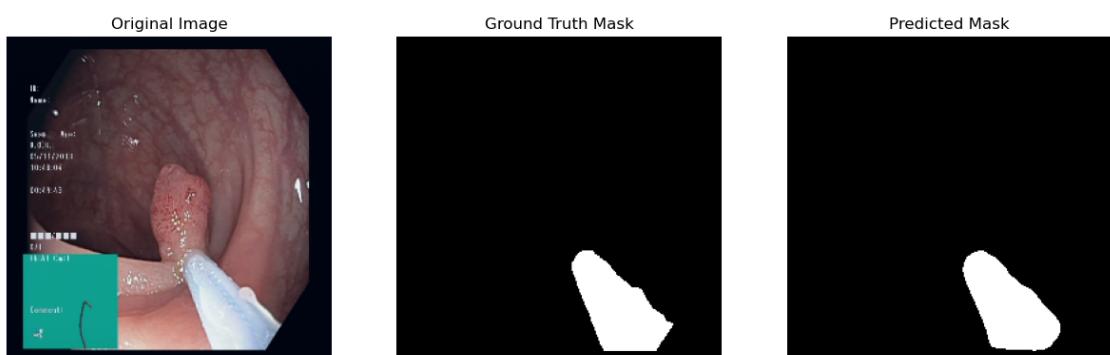
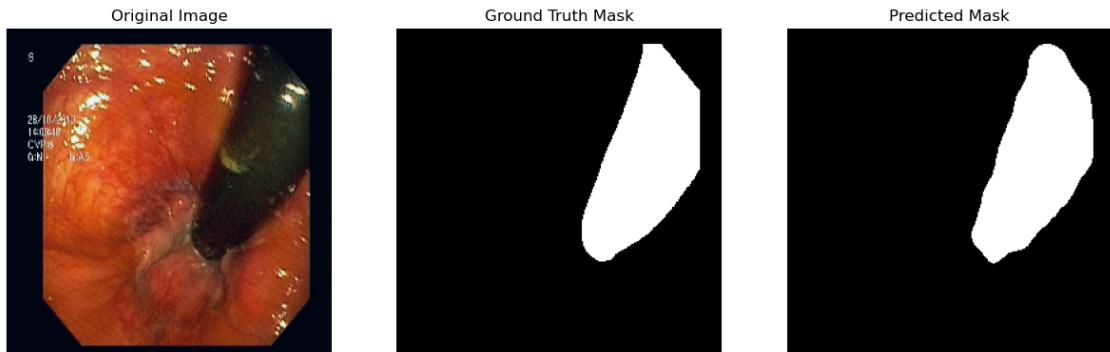
Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 37/60 - Training Loss: 0.0615 - Validation Loss: 0.0515 - Training Acc: 97.72% - Validation Acc: 98.21% - Training Dice: 0.8816 - Validation Dice: 0.9025 - Training IoU: 0.7911 - Validation IoU: 0.8244

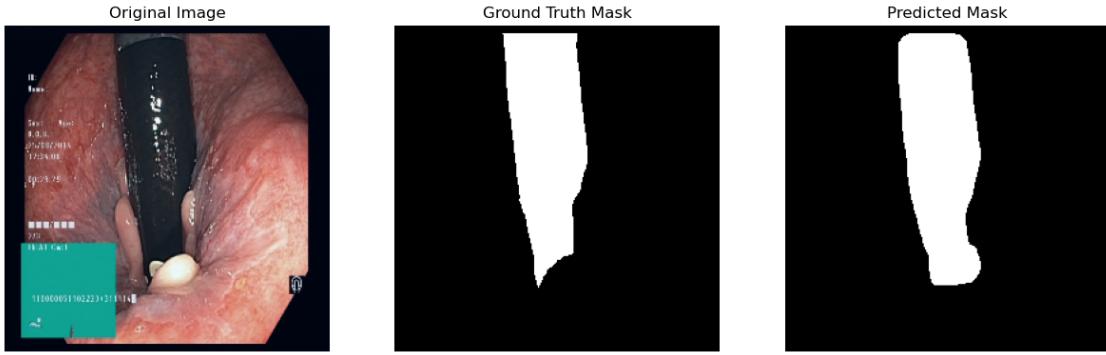
Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 38/60 - Training Loss: 0.0595 - Validation Loss: 0.0493 - Training Acc:

97.76% - Validation Acc: 98.32% - Training Dice: 0.8828 - Validation Dice: 0.9049 - Training IoU: 0.7951 - Validation IoU: 0.8292

Current Learning Rate: 0.000625
EarlyStopping counter: 3 out of 5
Epoch 39/60 - Training Loss: 0.0625 - Validation Loss: 0.0504 - Training Acc: 97.67% - Validation Acc: 98.38% - Training Dice: 0.8791 - Validation Dice: 0.9104 - Training IoU: 0.7878 - Validation IoU: 0.8369

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 40/60 - Training Loss: 0.0594 - Validation Loss: 0.0470 - Training Acc: 97.73% - Validation Acc: 98.41% - Training Dice: 0.8808 - Validation Dice: 0.9130 - Training IoU: 0.7911 - Validation IoU: 0.8414





```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 41/60 - Training Loss: 0.0542 - Validation Loss: 0.0489 - Training Acc:
97.96% - Validation Acc: 98.32% - Training Dice: 0.8936 - Validation Dice:
0.9084 - Training IoU: 0.8107 - Validation IoU: 0.8343

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 42/60 - Training Loss: 0.0546 - Validation Loss: 0.0469 - Training Acc:
97.99% - Validation Acc: 98.33% - Training Dice: 0.8958 - Validation Dice:
0.9093 - Training IoU: 0.8136 - Validation IoU: 0.8355

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 43/60 - Training Loss: 0.0533 - Validation Loss: 0.0455 - Training Acc:
97.96% - Validation Acc: 98.33% - Training Dice: 0.8931 - Validation Dice:
0.9102 - Training IoU: 0.8100 - Validation IoU: 0.8368

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 44/60 - Training Loss: 0.0519 - Validation Loss: 0.0460 - Training Acc:
98.02% - Validation Acc: 98.47% - Training Dice: 0.8983 - Validation Dice:
0.9146 - Training IoU: 0.8181 - Validation IoU: 0.8443

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 45/60 - Training Loss: 0.0509 - Validation Loss: 0.0448 - Training Acc:
98.05% - Validation Acc: 98.41% - Training Dice: 0.8973 - Validation Dice:
0.9128 - Training IoU: 0.8165 - Validation IoU: 0.8411

```

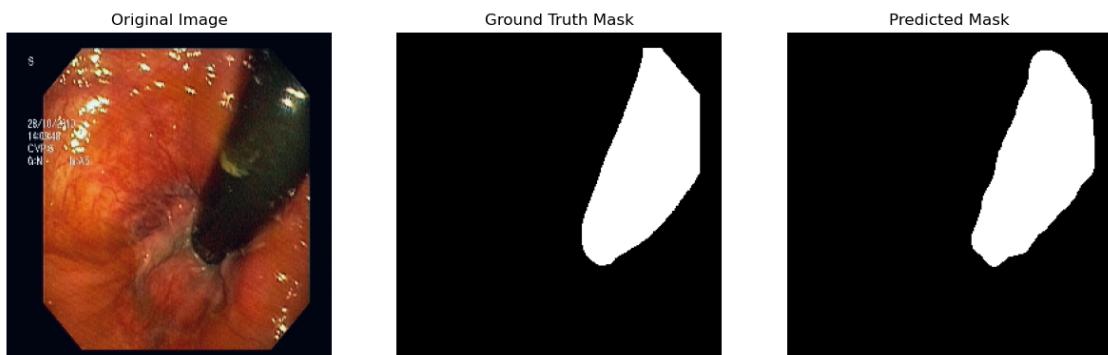
```
Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 46/60 - Training Loss: 0.0502 - Validation Loss: 0.0453 - Training Acc: 98.07% - Validation Acc: 98.46% - Training Dice: 0.9024 - Validation Dice: 0.9159 - Training IoU: 0.8237 - Validation IoU: 0.8465
```

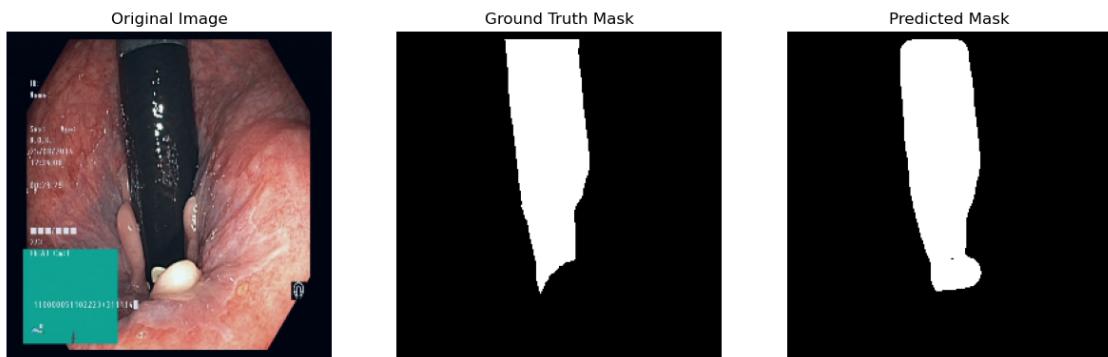
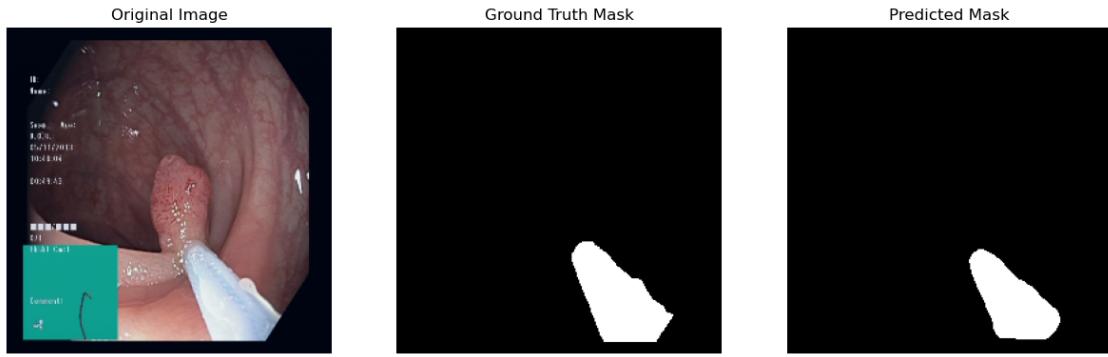
```
Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 47/60 - Training Loss: 0.0495 - Validation Loss: 0.0444 - Training Acc: 98.11% - Validation Acc: 98.48% - Training Dice: 0.9009 - Validation Dice: 0.9163 - Training IoU: 0.8221 - Validation IoU: 0.8472
```

```
Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 48/60 - Training Loss: 0.0505 - Validation Loss: 0.0434 - Training Acc: 98.08% - Validation Acc: 98.50% - Training Dice: 0.9011 - Validation Dice: 0.9177 - Training IoU: 0.8225 - Validation IoU: 0.8493
```

```
Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 49/60 - Training Loss: 0.0478 - Validation Loss: 0.0435 - Training Acc: 98.21% - Validation Acc: 98.51% - Training Dice: 0.9073 - Validation Dice: 0.9171 - Training IoU: 0.8319 - Validation IoU: 0.8485
```

```
Current Learning Rate: 0.000625
EarlyStopping counter: 2 out of 5
Epoch 50/60 - Training Loss: 0.0497 - Validation Loss: 0.0498 - Training Acc: 98.17% - Validation Acc: 98.34% - Training Dice: 0.9019 - Validation Dice: 0.9070 - Training IoU: 0.8256 - Validation IoU: 0.8319
```





```

Current Learning Rate: 0.0003125
EarlyStopping counter: 3 out of 5
Epoch 51/60 - Training Loss: 0.0525 - Validation Loss: 0.0482 - Training Acc:
98.03% - Validation Acc: 98.42% - Training Dice: 0.8951 - Validation Dice:
0.9106 - Training IoU: 0.8150 - Validation IoU: 0.8377

```

```

Current Learning Rate: 0.0003125
EarlyStopping counter: 4 out of 5
Epoch 52/60 - Training Loss: 0.0491 - Validation Loss: 0.0447 - Training Acc:
98.16% - Validation Acc: 98.54% - Training Dice: 0.9044 - Validation Dice:
0.9192 - Training IoU: 0.8273 - Validation IoU: 0.8518

```

```

Current Learning Rate: 0.0003125
EarlyStopping counter: 0 out of 5
Epoch 53/60 - Training Loss: 0.0468 - Validation Loss: 0.0431 - Training Acc:
98.22% - Validation Acc: 98.54% - Training Dice: 0.9073 - Validation Dice:
0.9192 - Training IoU: 0.8342 - Validation IoU: 0.8520

```

Current Learning Rate: 0.0003125
EarlyStopping counter: 1 out of 5
Epoch 54/60 - Training Loss: 0.0464 - Validation Loss: 0.0447 - Training Acc: 98.26% - Validation Acc: 98.43% - Training Dice: 0.9111 - Validation Dice: 0.9148 - Training IoU: 0.8388 - Validation IoU: 0.8449

Current Learning Rate: 0.0003125
EarlyStopping counter: 0 out of 5
Epoch 55/60 - Training Loss: 0.0438 - Validation Loss: 0.0429 - Training Acc: 98.36% - Validation Acc: 98.54% - Training Dice: 0.9146 - Validation Dice: 0.9197 - Training IoU: 0.8446 - Validation IoU: 0.8531

Current Learning Rate: 0.0003125
EarlyStopping counter: 1 out of 5
Epoch 56/60 - Training Loss: 0.0459 - Validation Loss: 0.0432 - Training Acc: 98.26% - Validation Acc: 98.53% - Training Dice: 0.9097 - Validation Dice: 0.9194 - Training IoU: 0.8368 - Validation IoU: 0.8525

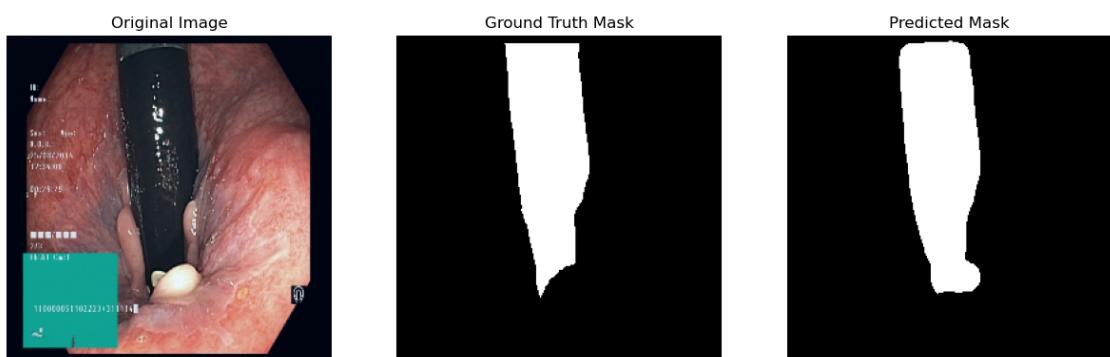
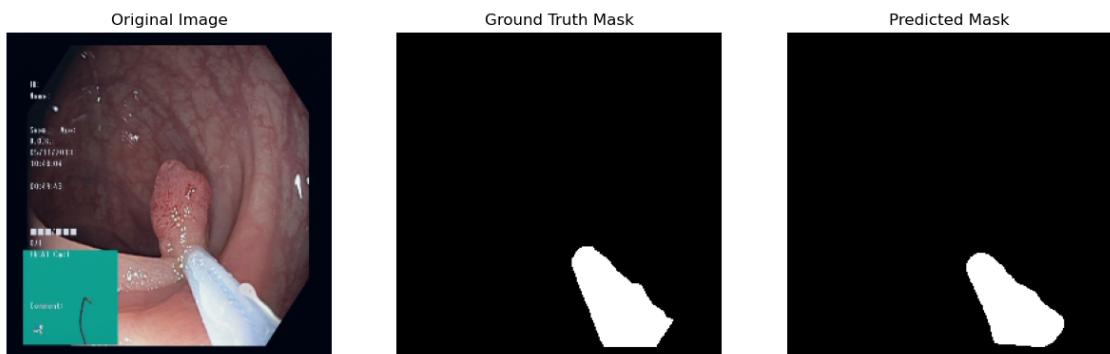
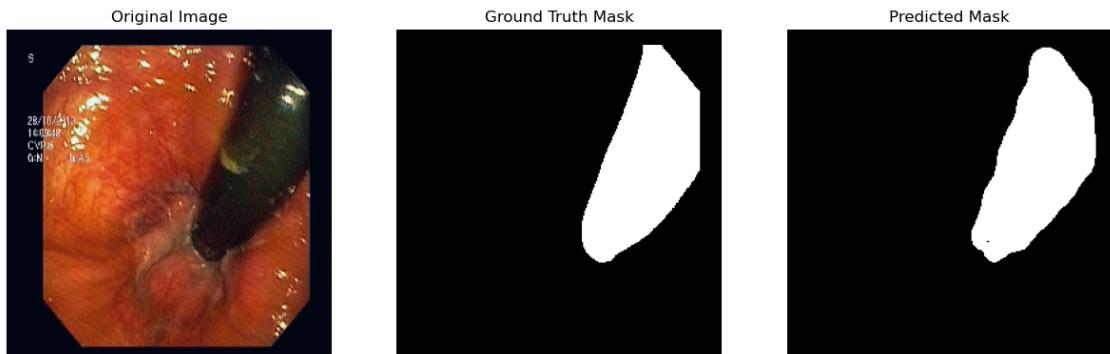
Current Learning Rate: 0.0003125
EarlyStopping counter: 0 out of 5
Epoch 57/60 - Training Loss: 0.0453 - Validation Loss: 0.0427 - Training Acc: 98.29% - Validation Acc: 98.51% - Training Dice: 0.9124 - Validation Dice: 0.9181 - Training IoU: 0.8410 - Validation IoU: 0.8504

Current Learning Rate: 0.0003125
EarlyStopping counter: 1 out of 5
Epoch 58/60 - Training Loss: 0.0436 - Validation Loss: 0.0450 - Training Acc: 98.37% - Validation Acc: 98.47% - Training Dice: 0.9160 - Validation Dice: 0.9153 - Training IoU: 0.8470 - Validation IoU: 0.8456

Current Learning Rate: 0.0003125
EarlyStopping counter: 0 out of 5
Epoch 59/60 - Training Loss: 0.0419 - Validation Loss: 0.0419 - Training Acc: 98.40% - Validation Acc: 98.53% - Training Dice: 0.9168 - Validation Dice: 0.9200 - Training IoU: 0.8481 - Validation IoU: 0.8536

Current Learning Rate: 0.0003125
EarlyStopping counter: 1 out of 5
Epoch 60/60 - Training Loss: 0.0440 - Validation Loss: 0.0434 - Training Acc:

98.32% - Validation Acc: 98.46% - Training Dice: 0.9138 - Validation Dice: 0.9163 - Training IoU: 0.8436 - Validation IoU: 0.8476



```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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.
```

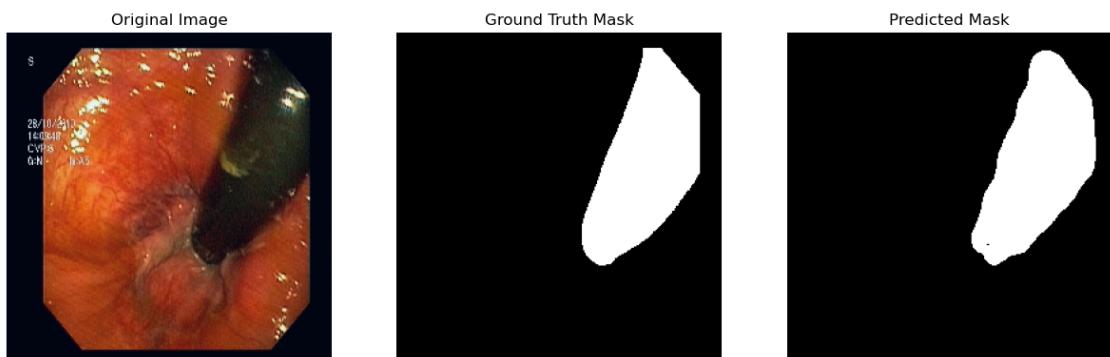
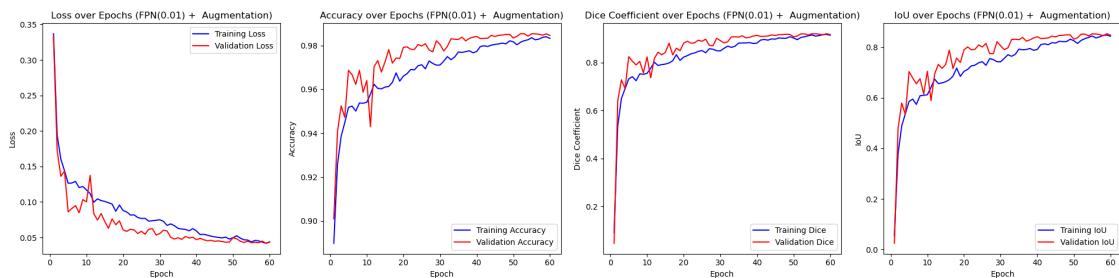
```

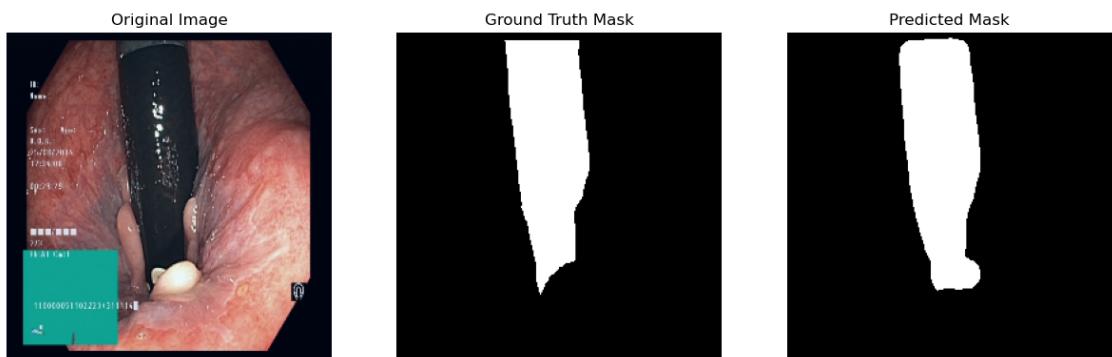
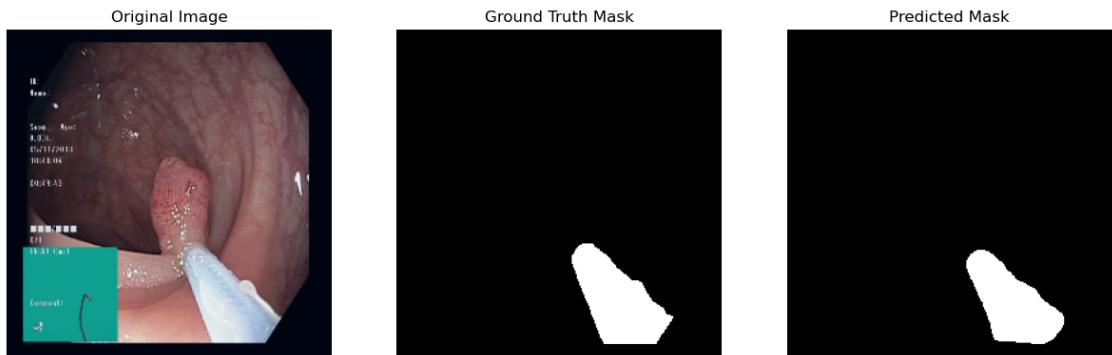
warnings.warn(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-
packages\torchvision\models\_utils.py:223: UserWarning: Arguments other than a
weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed
in the future. The current behavior is equivalent to passing
`weights=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.

    warnings.warn(msg)
C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default
value), which uses the default pickle module implicitly. It is possible to
construct malicious pickle data which will execute arbitrary code during
unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
more details). In a future release, the default value for `weights_only` will be
flipped to `True`. This limits the functions that could be executed during
unpickling. Arbitrary objects will no longer be allowed to be loaded via this
mode unless they are explicitly allowlisted by the user via
`torch.serialization.add_safe_globals`. We recommend you start setting
`weights_only=True` for any use case where you don't have full control of the
loaded file. Please open an issue on GitHub for any issues related to this
experimental feature.

    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))


```





```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)
```

Running experiment: UNet++(0.01) + Augmentation

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.2729 - Validation Loss: 0.7021 - Training Acc:

89.31% - Validation Acc: 90.69% - Training Dice: 0.0052 - Validation Dice: 0.0015 - Training IoU: 0.0028 - Validation IoU: 0.0008

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1832 - Validation Loss: 0.2056 - Training Acc: 91.90% - Validation Acc: 92.03% - Training Dice: 0.4138 - Validation Dice: 0.3754 - Training IoU: 0.2850 - Validation IoU: 0.2369

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 3/60 - Training Loss: 0.1704 - Validation Loss: 0.1505 - Training Acc: 93.05% - Validation Acc: 93.56% - Training Dice: 0.6240 - Validation Dice: 0.6982 - Training IoU: 0.4665 - Validation IoU: 0.5467

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.1555 - Validation Loss: 0.1317 - Training Acc: 93.64% - Validation Acc: 95.26% - Training Dice: 0.6717 - Validation Dice: 0.6822 - Training IoU: 0.5165 - Validation IoU: 0.5216

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 5/60 - Training Loss: 0.1488 - Validation Loss: 0.1222 - Training Acc: 94.07% - Validation Acc: 94.79% - Training Dice: 0.6904 - Validation Dice: 0.6949 - Training IoU: 0.5345 - Validation IoU: 0.5416

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 6/60 - Training Loss: 0.1428 - Validation Loss: 0.1102 - Training Acc: 94.32% - Validation Acc: 95.27% - Training Dice: 0.6971 - Validation Dice: 0.7517 - Training IoU: 0.5454 - Validation IoU: 0.6112

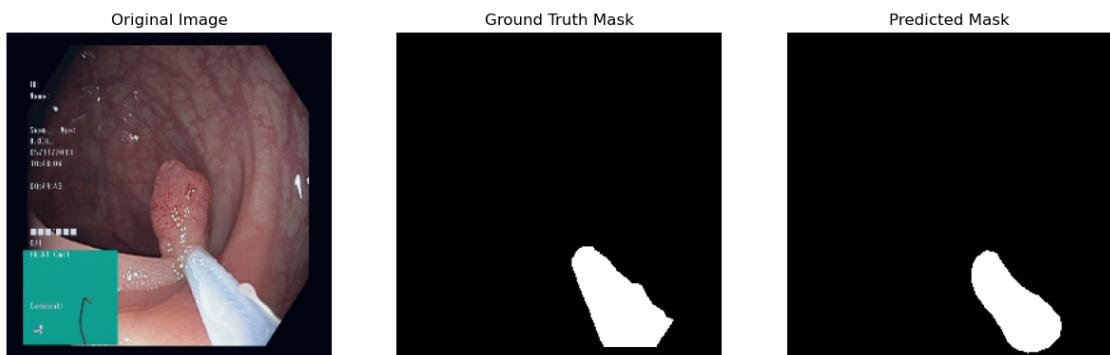
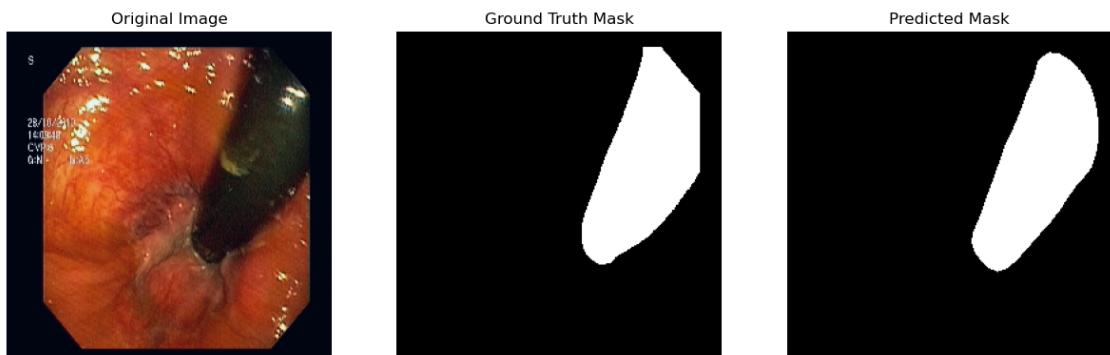
Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 7/60 - Training Loss: 0.1269 - Validation Loss: 0.0865 - Training Acc: 94.95% - Validation Acc: 96.55% - Training Dice: 0.7358 - Validation Dice: 0.8157 - Training IoU: 0.5876 - Validation IoU: 0.6920

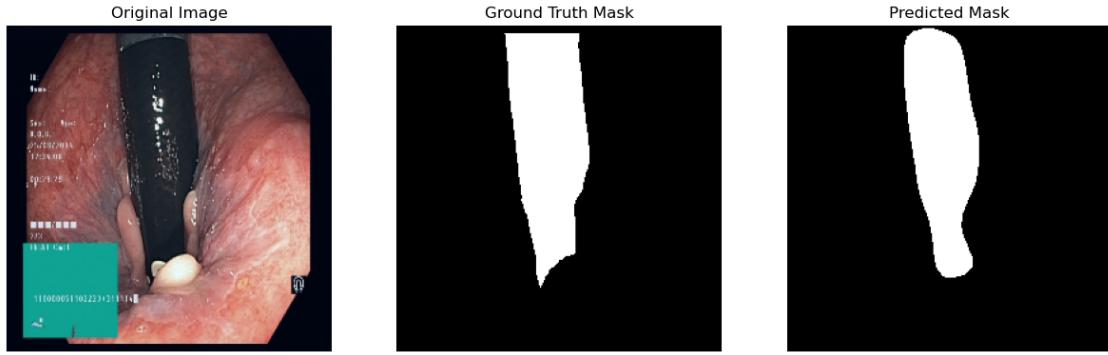
Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5

```
Epoch 8/60 - Training Loss: 0.1228 - Validation Loss: 0.0877 - Training Acc: 95.21% - Validation Acc: 96.49% - Training Dice: 0.7496 - Validation Dice: 0.7959 - Training IoU: 0.6059 - Validation IoU: 0.6646
```

```
Current Learning Rate: 0.01
EarlyStopping counter: 2 out of 5
Epoch 9/60 - Training Loss: 0.1188 - Validation Loss: 0.1144 - Training Acc: 95.21% - Validation Acc: 95.59% - Training Dice: 0.7408 - Validation Dice: 0.6973 - Training IoU: 0.5938 - Validation IoU: 0.5409
```

```
Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 10/60 - Training Loss: 0.1138 - Validation Loss: 0.0806 - Training Acc: 95.54% - Validation Acc: 96.75% - Training Dice: 0.7620 - Validation Dice: 0.8272 - Training IoU: 0.6237 - Validation IoU: 0.7092
```





```

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 11/60 - Training Loss: 0.1147 - Validation Loss: 0.1045 - Training Acc:
95.44% - Validation Acc: 95.63% - Training Dice: 0.7637 - Validation Dice:
0.7929 - Training IoU: 0.6236 - Validation IoU: 0.6620

```

```

Current Learning Rate: 0.01
EarlyStopping counter: 2 out of 5
Epoch 12/60 - Training Loss: 0.1135 - Validation Loss: 0.1457 - Training Acc:
95.56% - Validation Acc: 93.59% - Training Dice: 0.7628 - Validation Dice:
0.6026 - Training IoU: 0.6229 - Validation IoU: 0.4358

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 3 out of 5
Epoch 13/60 - Training Loss: 0.1160 - Validation Loss: 0.1108 - Training Acc:
95.46% - Validation Acc: 95.51% - Training Dice: 0.7551 - Validation Dice:
0.7653 - Training IoU: 0.6147 - Validation IoU: 0.6242

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 14/60 - Training Loss: 0.0991 - Validation Loss: 0.0768 - Training Acc:
96.18% - Validation Acc: 97.05% - Training Dice: 0.7972 - Validation Dice:
0.8192 - Training IoU: 0.6694 - Validation IoU: 0.6962

```

```

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 15/60 - Training Loss: 0.0932 - Validation Loss: 0.0728 - Training Acc:
96.32% - Validation Acc: 97.25% - Training Dice: 0.8095 - Validation Dice:
0.8492 - Training IoU: 0.6844 - Validation IoU: 0.7406

```

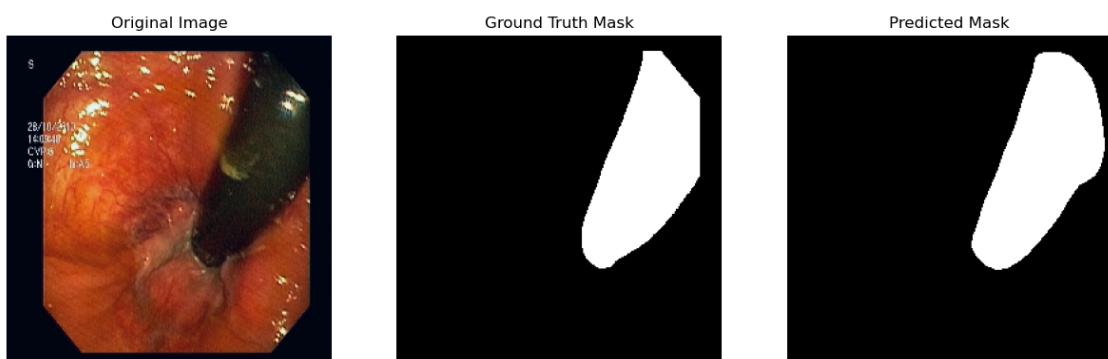
Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 16/60 - Training Loss: 0.0894 - Validation Loss: 0.0689 - Training Acc: 96.54% - Validation Acc: 97.28% - Training Dice: 0.8224 - Validation Dice: 0.8502 - Training IoU: 0.7024 - Validation IoU: 0.7416

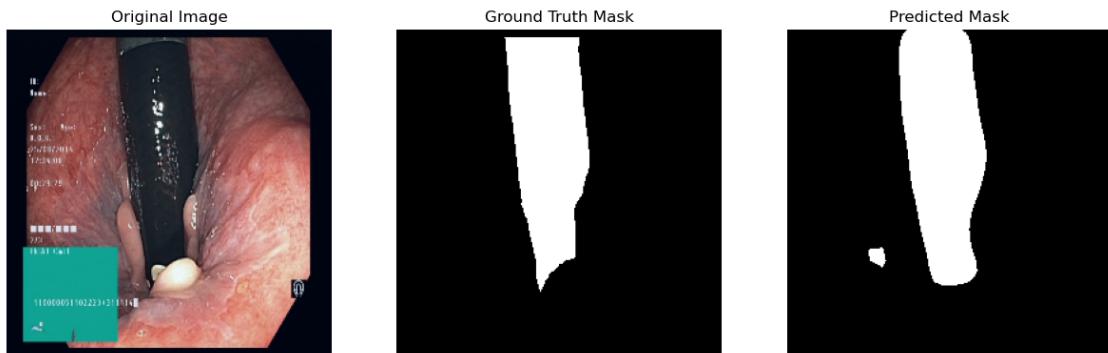
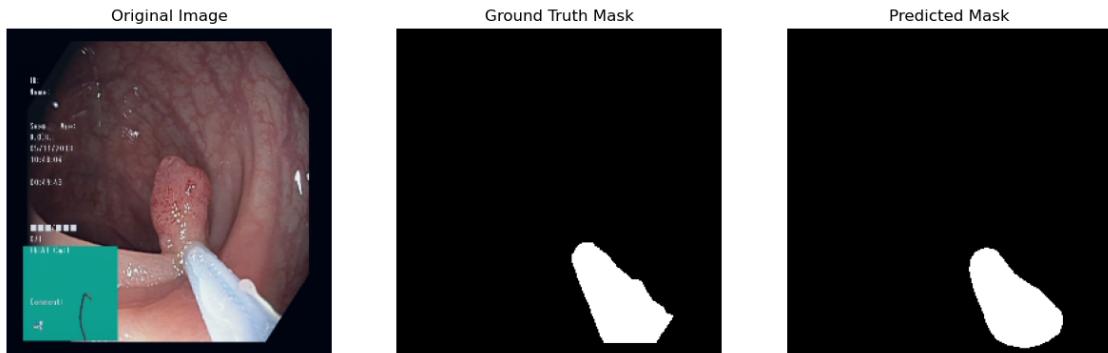
Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 17/60 - Training Loss: 0.0865 - Validation Loss: 0.0601 - Training Acc: 96.63% - Validation Acc: 97.81% - Training Dice: 0.8228 - Validation Dice: 0.8794 - Training IoU: 0.7048 - Validation IoU: 0.7858

Current Learning Rate: 0.005
EarlyStopping counter: 1 out of 5
Epoch 18/60 - Training Loss: 0.0874 - Validation Loss: 0.0663 - Training Acc: 96.66% - Validation Acc: 97.44% - Training Dice: 0.8274 - Validation Dice: 0.8595 - Training IoU: 0.7120 - Validation IoU: 0.7559

Current Learning Rate: 0.005
EarlyStopping counter: 2 out of 5
Epoch 19/60 - Training Loss: 0.0888 - Validation Loss: 0.0618 - Training Acc: 96.63% - Validation Acc: 97.64% - Training Dice: 0.8236 - Validation Dice: 0.8670 - Training IoU: 0.7049 - Validation IoU: 0.7672

Current Learning Rate: 0.0025
EarlyStopping counter: 3 out of 5
Epoch 20/60 - Training Loss: 0.0872 - Validation Loss: 0.0754 - Training Acc: 96.69% - Validation Acc: 97.16% - Training Dice: 0.8268 - Validation Dice: 0.8519 - Training IoU: 0.7095 - Validation IoU: 0.7449





```

Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 21/60 - Training Loss: 0.0825 - Validation Loss: 0.0542 - Training Acc:
96.86% - Validation Acc: 97.95% - Training Dice: 0.8331 - Validation Dice:
0.8870 - Training IoU: 0.7188 - Validation IoU: 0.7986

```

```

Current Learning Rate: 0.0025
EarlyStopping counter: 1 out of 5
Epoch 22/60 - Training Loss: 0.0767 - Validation Loss: 0.0545 - Training Acc:
97.08% - Validation Acc: 97.97% - Training Dice: 0.8470 - Validation Dice:
0.8904 - Training IoU: 0.7400 - Validation IoU: 0.8041

```

```

Current Learning Rate: 0.0025
EarlyStopping counter: 2 out of 5
Epoch 23/60 - Training Loss: 0.0807 - Validation Loss: 0.0603 - Training Acc:

```

96.94% - Validation Acc: 97.77% - Training Dice: 0.8380 - Validation Dice: 0.8772 - Training IoU: 0.7267 - Validation IoU: 0.7834

Current Learning Rate: 0.00125
EarlyStopping counter: 3 out of 5
Epoch 24/60 - Training Loss: 0.0753 - Validation Loss: 0.0561 - Training Acc: 97.13% - Validation Acc: 97.88% - Training Dice: 0.8487 - Validation Dice: 0.8789 - Training IoU: 0.7427 - Validation IoU: 0.7862

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 25/60 - Training Loss: 0.0688 - Validation Loss: 0.0526 - Training Acc: 97.32% - Validation Acc: 98.05% - Training Dice: 0.8573 - Validation Dice: 0.8918 - Training IoU: 0.7555 - Validation IoU: 0.8066

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 26/60 - Training Loss: 0.0697 - Validation Loss: 0.0496 - Training Acc: 97.29% - Validation Acc: 98.13% - Training Dice: 0.8560 - Validation Dice: 0.8975 - Training IoU: 0.7534 - Validation IoU: 0.8156

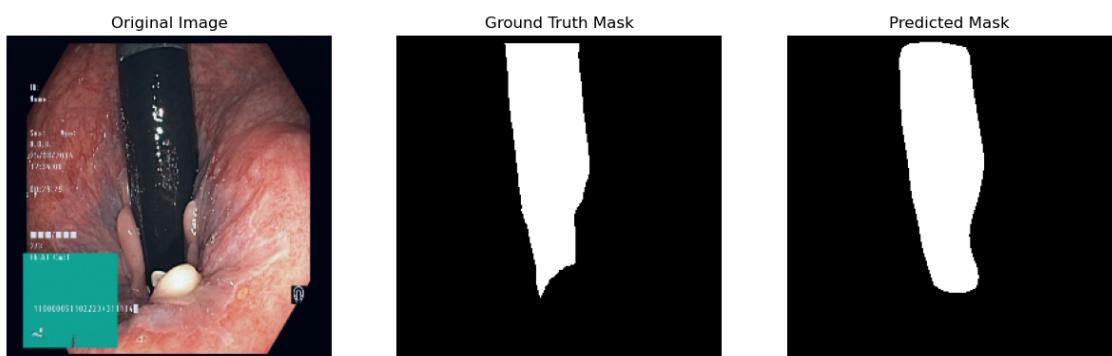
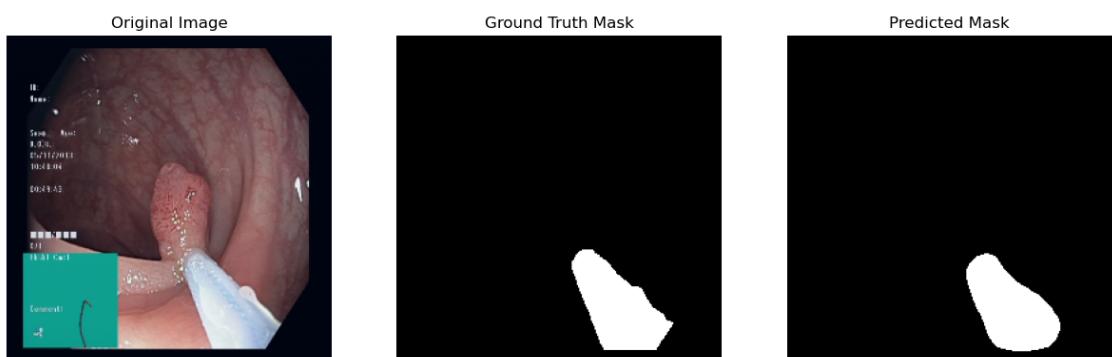
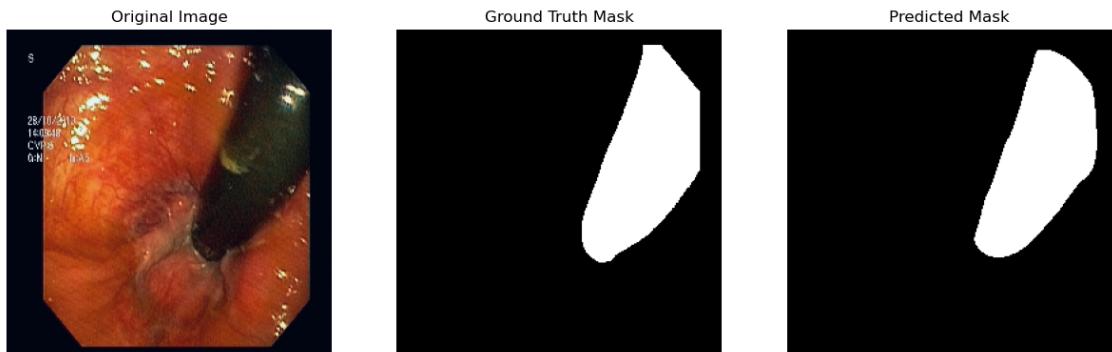
Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 27/60 - Training Loss: 0.0670 - Validation Loss: 0.0521 - Training Acc: 97.37% - Validation Acc: 98.01% - Training Dice: 0.8626 - Validation Dice: 0.8890 - Training IoU: 0.7623 - Validation IoU: 0.8023

Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 28/60 - Training Loss: 0.0681 - Validation Loss: 0.0504 - Training Acc: 97.36% - Validation Acc: 98.11% - Training Dice: 0.8628 - Validation Dice: 0.8945 - Training IoU: 0.7628 - Validation IoU: 0.8105

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 29/60 - Training Loss: 0.0678 - Validation Loss: 0.0488 - Training Acc: 97.41% - Validation Acc: 98.19% - Training Dice: 0.8641 - Validation Dice: 0.8988 - Training IoU: 0.7646 - Validation IoU: 0.8175

Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5

Epoch 30/60 - Training Loss: 0.0665 - Validation Loss: 0.0516 - Training Acc: 97.48% - Validation Acc: 98.03% - Training Dice: 0.8677 - Validation Dice: 0.8932 - Training IoU: 0.7699 - Validation IoU: 0.8094



Current Learning Rate: 0.00125

```
EarlyStopping counter: 0 out of 5
Epoch 31/60 - Training Loss: 0.0668 - Validation Loss: 0.0466 - Training Acc: 97.44% - Validation Acc: 98.27% - Training Dice: 0.8641 - Validation Dice: 0.9041 - Training IoU: 0.7667 - Validation IoU: 0.8264
```

```
Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 32/60 - Training Loss: 0.0642 - Validation Loss: 0.0468 - Training Acc: 97.55% - Validation Acc: 98.25% - Training Dice: 0.8740 - Validation Dice: 0.9032 - Training IoU: 0.7792 - Validation IoU: 0.8254
```

```
Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 33/60 - Training Loss: 0.0657 - Validation Loss: 0.0516 - Training Acc: 97.51% - Validation Acc: 98.12% - Training Dice: 0.8643 - Validation Dice: 0.8949 - Training IoU: 0.7686 - Validation IoU: 0.8106
```

```
Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 34/60 - Training Loss: 0.0613 - Validation Loss: 0.0453 - Training Acc: 97.63% - Validation Acc: 98.31% - Training Dice: 0.8778 - Validation Dice: 0.9066 - Training IoU: 0.7849 - Validation IoU: 0.8308
```

```
Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 35/60 - Training Loss: 0.0587 - Validation Loss: 0.0468 - Training Acc: 97.72% - Validation Acc: 98.22% - Training Dice: 0.8805 - Validation Dice: 0.9023 - Training IoU: 0.7901 - Validation IoU: 0.8242
```

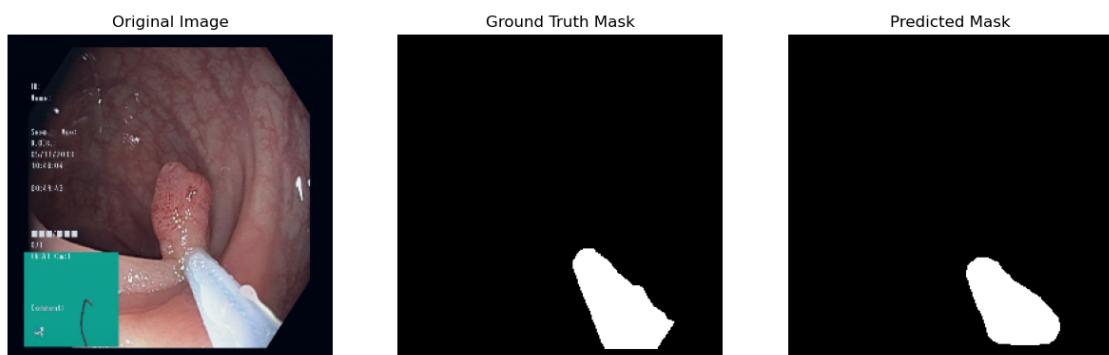
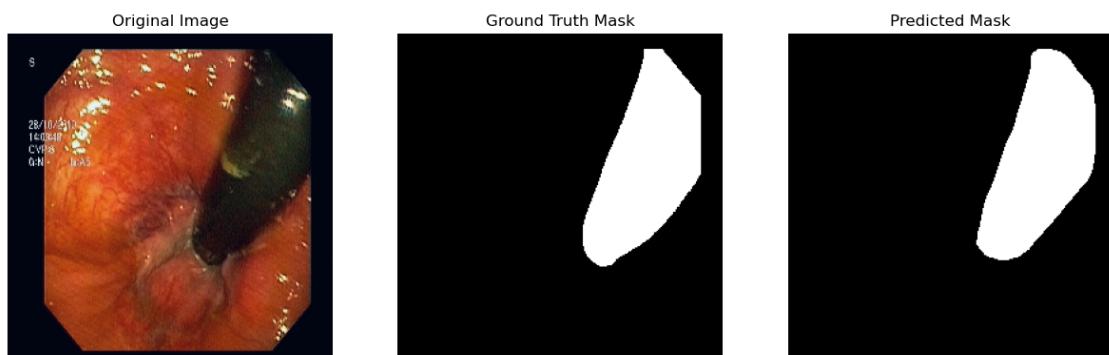
```
Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 36/60 - Training Loss: 0.0660 - Validation Loss: 0.0462 - Training Acc: 97.52% - Validation Acc: 98.24% - Training Dice: 0.8725 - Validation Dice: 0.9012 - Training IoU: 0.7783 - Validation IoU: 0.8219
```

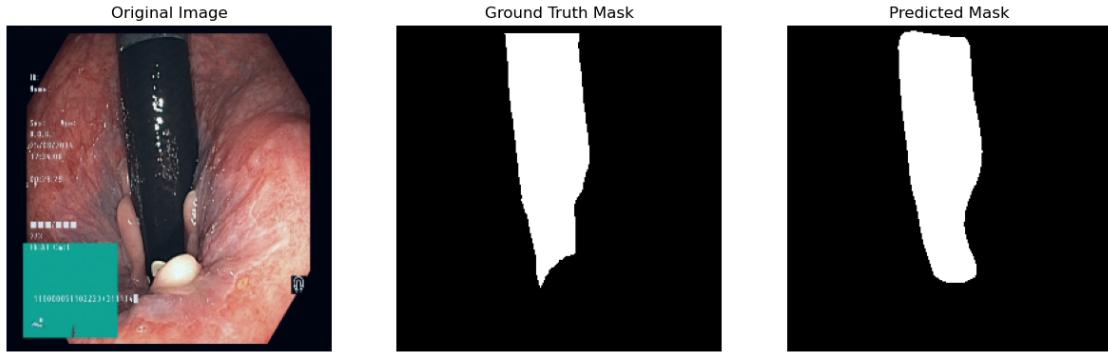
```
Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 37/60 - Training Loss: 0.0600 - Validation Loss: 0.0438 - Training Acc: 97.66% - Validation Acc: 98.35% - Training Dice: 0.8759 - Validation Dice: 0.9085 - Training IoU: 0.7827 - Validation IoU: 0.8339
```

Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 38/60 - Training Loss: 0.0585 - Validation Loss: 0.0442 - Training Acc: 97.78% - Validation Acc: 98.31% - Training Dice: 0.8844 - Validation Dice: 0.9055 - Training IoU: 0.7958 - Validation IoU: 0.8289

Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 39/60 - Training Loss: 0.0608 - Validation Loss: 0.0545 - Training Acc: 97.66% - Validation Acc: 98.04% - Training Dice: 0.8757 - Validation Dice: 0.8950 - Training IoU: 0.7821 - Validation IoU: 0.8123

Current Learning Rate: 0.000625
EarlyStopping counter: 3 out of 5
Epoch 40/60 - Training Loss: 0.0585 - Validation Loss: 0.0454 - Training Acc: 97.79% - Validation Acc: 98.27% - Training Dice: 0.8865 - Validation Dice: 0.9037 - Training IoU: 0.7994 - Validation IoU: 0.8266





```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 41/60 - Training Loss: 0.0560 - Validation Loss: 0.0416 - Training Acc:
97.85% - Validation Acc: 98.43% - Training Dice: 0.8893 - Validation Dice:
0.9135 - Training IoU: 0.8031 - Validation IoU: 0.8425

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 42/60 - Training Loss: 0.0534 - Validation Loss: 0.0415 - Training Acc:
97.95% - Validation Acc: 98.42% - Training Dice: 0.8932 - Validation Dice:
0.9127 - Training IoU: 0.8096 - Validation IoU: 0.8412

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 43/60 - Training Loss: 0.0557 - Validation Loss: 0.0417 - Training Acc:
97.84% - Validation Acc: 98.41% - Training Dice: 0.8884 - Validation Dice:
0.9105 - Training IoU: 0.8028 - Validation IoU: 0.8373

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 44/60 - Training Loss: 0.0543 - Validation Loss: 0.0410 - Training Acc:
97.90% - Validation Acc: 98.45% - Training Dice: 0.8910 - Validation Dice:
0.9141 - Training IoU: 0.8063 - Validation IoU: 0.8435

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 45/60 - Training Loss: 0.0538 - Validation Loss: 0.0425 - Training Acc:
97.99% - Validation Acc: 98.37% - Training Dice: 0.8970 - Validation Dice:
0.9095 - Training IoU: 0.8153 - Validation IoU: 0.8360

```

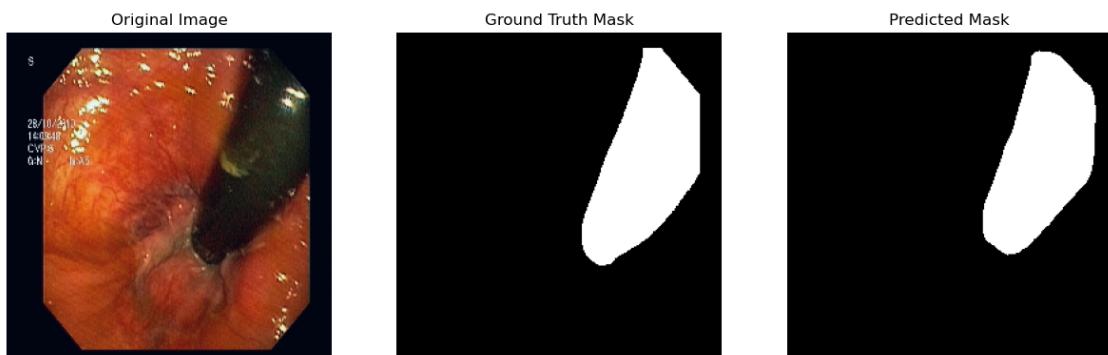
```
Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 46/60 - Training Loss: 0.0526 - Validation Loss: 0.0401 - Training Acc: 97.99% - Validation Acc: 98.46% - Training Dice: 0.8972 - Validation Dice: 0.9142 - Training IoU: 0.8160 - Validation IoU: 0.8436
```

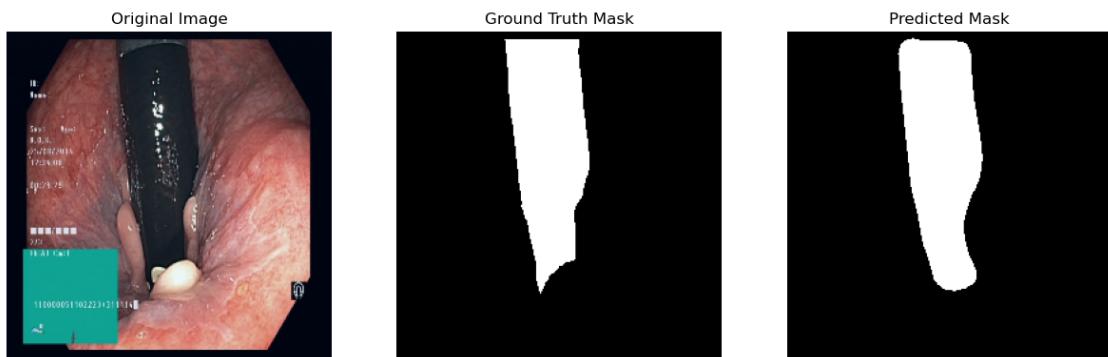
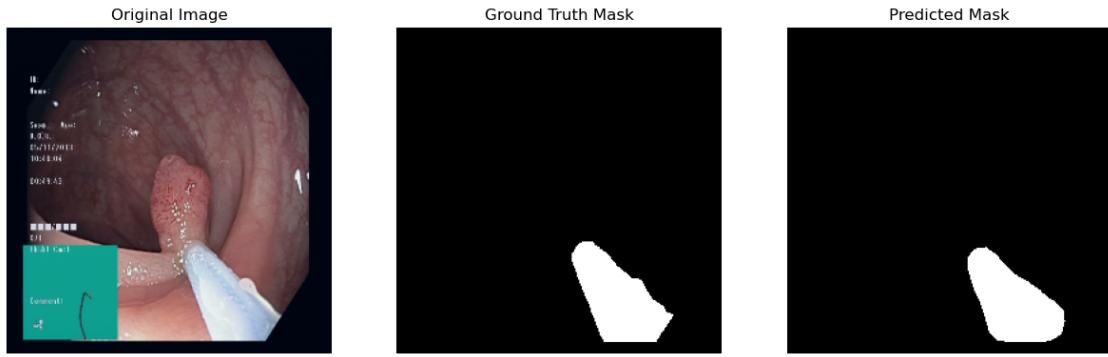
```
Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 47/60 - Training Loss: 0.0510 - Validation Loss: 0.0412 - Training Acc: 98.04% - Validation Acc: 98.45% - Training Dice: 0.8973 - Validation Dice: 0.9145 - Training IoU: 0.8167 - Validation IoU: 0.8445
```

```
Current Learning Rate: 0.000625
EarlyStopping counter: 2 out of 5
Epoch 48/60 - Training Loss: 0.0525 - Validation Loss: 0.0413 - Training Acc: 98.03% - Validation Acc: 98.43% - Training Dice: 0.8996 - Validation Dice: 0.9116 - Training IoU: 0.8194 - Validation IoU: 0.8398
```

```
Current Learning Rate: 0.0003125
EarlyStopping counter: 3 out of 5
Epoch 49/60 - Training Loss: 0.0503 - Validation Loss: 0.0437 - Training Acc: 98.08% - Validation Acc: 98.31% - Training Dice: 0.9003 - Validation Dice: 0.9077 - Training IoU: 0.8211 - Validation IoU: 0.8335
```

```
Current Learning Rate: 0.0003125
EarlyStopping counter: 0 out of 5
Epoch 50/60 - Training Loss: 0.0479 - Validation Loss: 0.0392 - Training Acc: 98.16% - Validation Acc: 98.49% - Training Dice: 0.9036 - Validation Dice: 0.9162 - Training IoU: 0.8267 - Validation IoU: 0.8470
```





Current Learning Rate: 0.0003125
 EarlyStopping counter: 0 out of 5
 Epoch 51/60 - Training Loss: 0.0473 - Validation Loss: 0.0378 - Training Acc: 98.16% - Validation Acc: 98.55% - Training Dice: 0.9026 - Validation Dice: 0.9190 - Training IoU: 0.8259 - Validation IoU: 0.8519

Current Learning Rate: 0.0003125
 EarlyStopping counter: 1 out of 5
 Epoch 52/60 - Training Loss: 0.0501 - Validation Loss: 0.0385 - Training Acc: 98.03% - Validation Acc: 98.56% - Training Dice: 0.8957 - Validation Dice: 0.9208 - Training IoU: 0.8154 - Validation IoU: 0.8547

Current Learning Rate: 0.0003125
 EarlyStopping counter: 2 out of 5
 Epoch 53/60 - Training Loss: 0.0468 - Validation Loss: 0.0384 - Training Acc: 98.21% - Validation Acc: 98.59% - Training Dice: 0.9065 - Validation Dice: 0.9217 - Training IoU: 0.8311 - Validation IoU: 0.8561

```

Current Learning Rate: 0.00015625
EarlyStopping counter: 3 out of 5
Epoch 54/60 - Training Loss: 0.0482 - Validation Loss: 0.0394 - Training Acc:
98.16% - Validation Acc: 98.51% - Training Dice: 0.9043 - Validation Dice:
0.9163 - Training IoU: 0.8274 - Validation IoU: 0.8473

Current Learning Rate: 0.00015625
EarlyStopping counter: 4 out of 5
Epoch 55/60 - Training Loss: 0.0475 - Validation Loss: 0.0387 - Training Acc:
98.18% - Validation Acc: 98.56% - Training Dice: 0.9067 - Validation Dice:
0.9198 - Training IoU: 0.8315 - Validation IoU: 0.8531

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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.

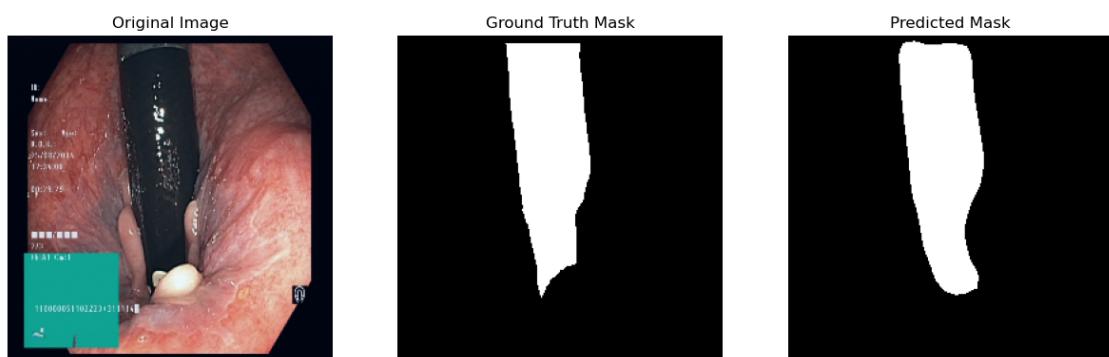
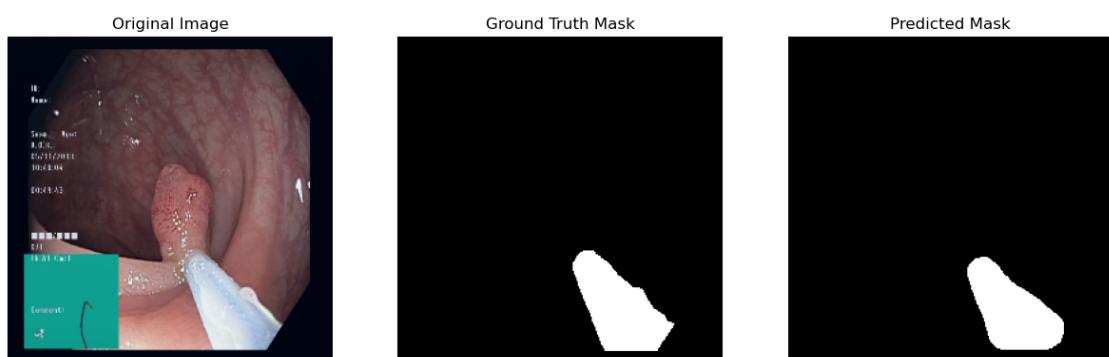
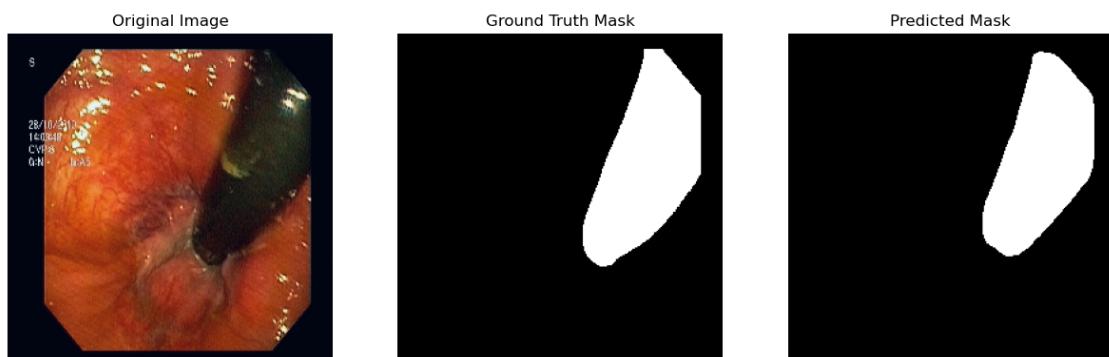
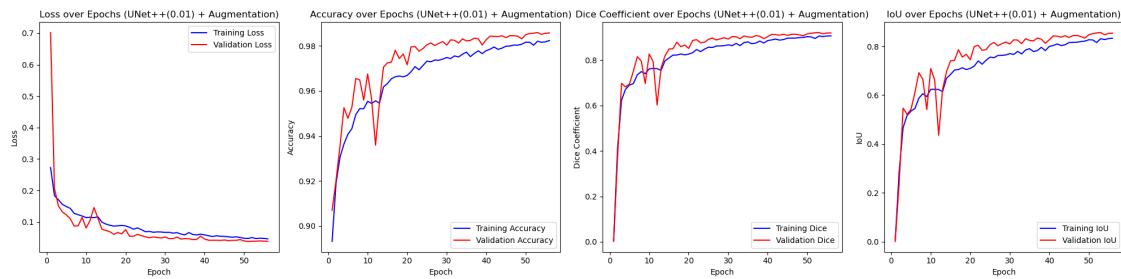
    warnings.warn(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-
packages\torchvision\models\_utils.py:223: UserWarning: Arguments other than a
weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed
in the future. The current behavior is equivalent to passing
`weights=ResNet34_Weights.IMGNET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.

    warnings.warn(msg)
C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default
value), which uses the default pickle module implicitly. It is possible to
construct malicious pickle data which will execute arbitrary code during
unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
more details). In a future release, the default value for `weights_only` will be
flipped to `True`. This limits the functions that could be executed during
unpickling. Arbitrary objects will no longer be allowed to be loaded via this
mode unless they are explicitly allowlisted by the user via
`torch.serialization.add_safe_globals`. We recommend you start setting
`weights_only=True` for any use case where you don't have full control of the
loaded file. Please open an issue on GitHub for any issues related to this
experimental feature.

    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))

Current Learning Rate: 0.00015625
EarlyStopping counter: 5 out of 5
Early stopping at epoch 56

```



Running experiment: UNet(0.01) + Augmentation

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.2531 - Validation Loss: 0.6617 - Training Acc: 89.74% - Validation Acc: 84.21% - Training Dice: 0.1295 - Validation Dice: 0.2928 - Training IoU: 0.0903 - Validation IoU: 0.1753

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1673 - Validation Loss: 0.2141 - Training Acc: 93.14% - Validation Acc: 90.20% - Training Dice: 0.6155 - Validation Dice: 0.6198 - Training IoU: 0.4524 - Validation IoU: 0.4569

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 3/60 - Training Loss: 0.1736 - Validation Loss: 0.2762 - Training Acc: 93.05% - Validation Acc: 93.82% - Training Dice: 0.5888 - Validation Dice: 0.6040 - Training IoU: 0.4331 - Validation IoU: 0.4421

Current Learning Rate: 0.01
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.1563 - Validation Loss: 0.1080 - Training Acc: 93.72% - Validation Acc: 95.74% - Training Dice: 0.6628 - Validation Dice: 0.7283 - Training IoU: 0.5029 - Validation IoU: 0.5767

Current Learning Rate: 0.01
EarlyStopping counter: 1 out of 5
Epoch 5/60 - Training Loss: 0.1553 - Validation Loss: 0.1568 - Training Acc: 93.71% - Validation Acc: 93.15% - Training Dice: 0.6565 - Validation Dice: 0.6909 - Training IoU: 0.4988 - Validation IoU: 0.5348

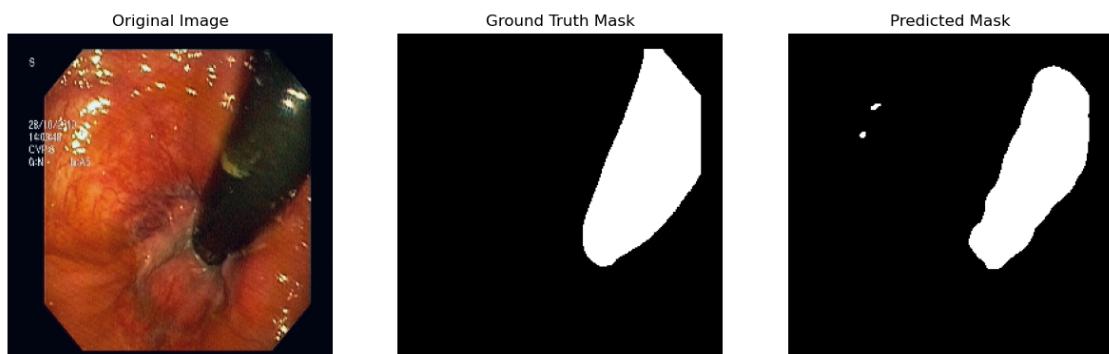
Current Learning Rate: 0.01
EarlyStopping counter: 2 out of 5
Epoch 6/60 - Training Loss: 0.1430 - Validation Loss: 0.1516 - Training Acc: 94.37% - Validation Acc: 93.62% - Training Dice: 0.6919 - Validation Dice: 0.6800 - Training IoU: 0.5377 - Validation IoU: 0.5248

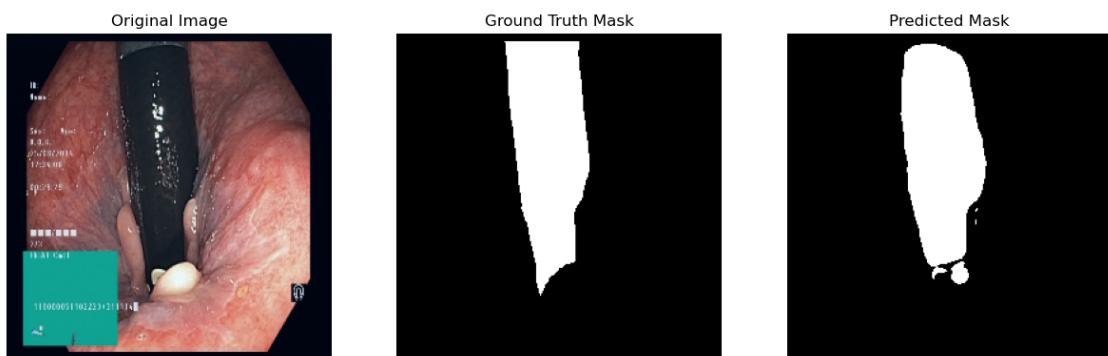
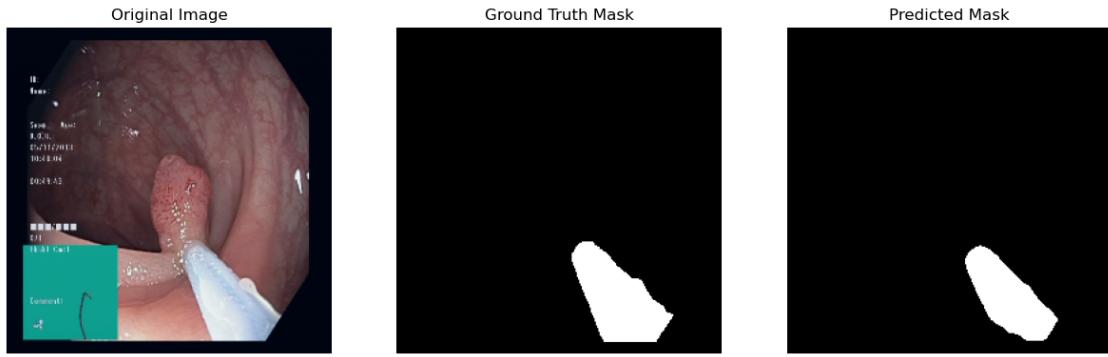
Current Learning Rate: 0.005
EarlyStopping counter: 3 out of 5
Epoch 7/60 - Training Loss: 0.1381 - Validation Loss: 0.1335 - Training Acc: 94.62% - Validation Acc: 94.78% - Training Dice: 0.7051 - Validation Dice: 0.5984 - Training IoU: 0.5530 - Validation IoU: 0.4361

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.1260 - Validation Loss: 0.0993 - Training Acc: 95.03% - Validation Acc: 96.02% - Training Dice: 0.7310 - Validation Dice: 0.7814 - Training IoU: 0.5845 - Validation IoU: 0.6467

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 9/60 - Training Loss: 0.1218 - Validation Loss: 0.0930 - Training Acc: 95.33% - Validation Acc: 96.48% - Training Dice: 0.7507 - Validation Dice: 0.8171 - Training IoU: 0.6085 - Validation IoU: 0.6947

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 10/60 - Training Loss: 0.1179 - Validation Loss: 0.0835 - Training Acc: 95.39% - Validation Acc: 96.85% - Training Dice: 0.7536 - Validation Dice: 0.8032 - Training IoU: 0.6131 - Validation IoU: 0.6738





Current Learning Rate: 0.005

EarlyStopping counter: 1 out of 5

Epoch 11/60 - Training Loss: 0.1158 - Validation Loss: 0.0991 - Training Acc: 95.46% - Validation Acc: 96.32% - Training Dice: 0.7623 - Validation Dice: 0.8100 - Training IoU: 0.6245 - Validation IoU: 0.6840

Current Learning Rate: 0.005

EarlyStopping counter: 0 out of 5

Epoch 12/60 - Training Loss: 0.1147 - Validation Loss: 0.0760 - Training Acc: 95.57% - Validation Acc: 97.11% - Training Dice: 0.7654 - Validation Dice: 0.8389 - Training IoU: 0.6259 - Validation IoU: 0.7254

Current Learning Rate: 0.005

EarlyStopping counter: 1 out of 5

Epoch 13/60 - Training Loss: 0.1108 - Validation Loss: 0.0816 - Training Acc: 95.67% - Validation Acc: 97.05% - Training Dice: 0.7694 - Validation Dice: 0.8252 - Training IoU: 0.6327 - Validation IoU: 0.7043

Current Learning Rate: 0.005
EarlyStopping counter: 2 out of 5
Epoch 14/60 - Training Loss: 0.1169 - Validation Loss: 0.0772 - Training Acc: 95.47% - Validation Acc: 97.27% - Training Dice: 0.7601 - Validation Dice: 0.8513 - Training IoU: 0.6231 - Validation IoU: 0.7436

Current Learning Rate: 0.005
EarlyStopping counter: 0 out of 5
Epoch 15/60 - Training Loss: 0.1069 - Validation Loss: 0.0743 - Training Acc: 95.85% - Validation Acc: 97.30% - Training Dice: 0.7811 - Validation Dice: 0.8561 - Training IoU: 0.6467 - Validation IoU: 0.7506

Current Learning Rate: 0.005
EarlyStopping counter: 1 out of 5
Epoch 16/60 - Training Loss: 0.1129 - Validation Loss: 0.0863 - Training Acc: 95.58% - Validation Acc: 96.82% - Training Dice: 0.7696 - Validation Dice: 0.8286 - Training IoU: 0.6318 - Validation IoU: 0.7104

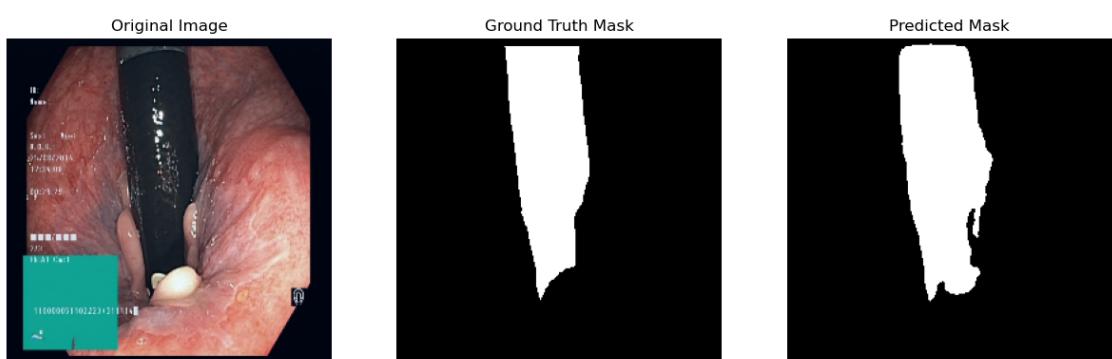
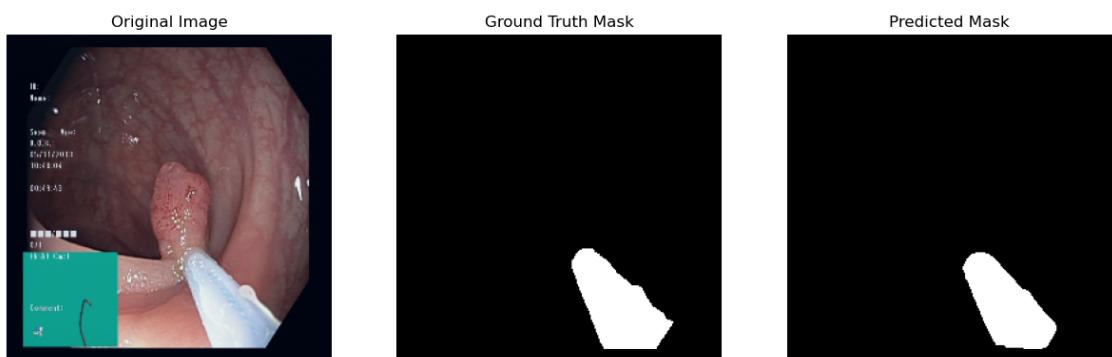
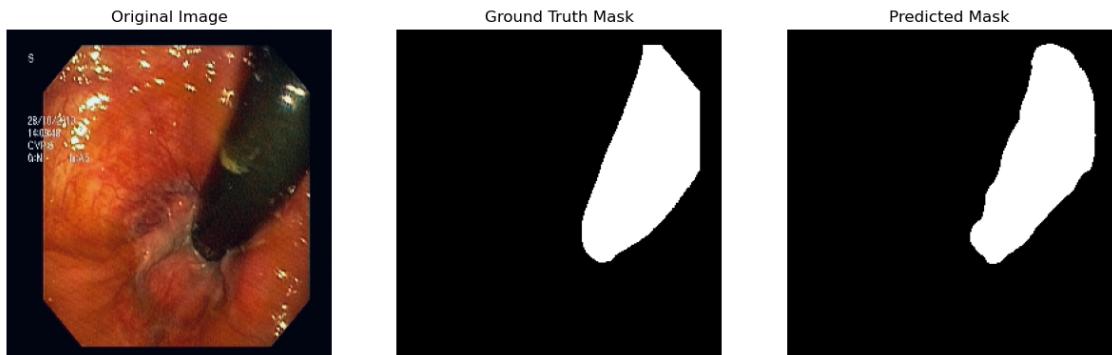
Current Learning Rate: 0.005
EarlyStopping counter: 2 out of 5
Epoch 17/60 - Training Loss: 0.1129 - Validation Loss: 0.0933 - Training Acc: 95.58% - Validation Acc: 96.30% - Training Dice: 0.7719 - Validation Dice: 0.8057 - Training IoU: 0.6338 - Validation IoU: 0.6800

Current Learning Rate: 0.0025
EarlyStopping counter: 3 out of 5
Epoch 18/60 - Training Loss: 0.1080 - Validation Loss: 0.0809 - Training Acc: 95.85% - Validation Acc: 96.92% - Training Dice: 0.7835 - Validation Dice: 0.8344 - Training IoU: 0.6516 - Validation IoU: 0.7192

Current Learning Rate: 0.0025
EarlyStopping counter: 0 out of 5
Epoch 19/60 - Training Loss: 0.1035 - Validation Loss: 0.0653 - Training Acc: 95.93% - Validation Acc: 97.65% - Training Dice: 0.7875 - Validation Dice: 0.8703 - Training IoU: 0.6570 - Validation IoU: 0.7724

Current Learning Rate: 0.0025
EarlyStopping counter: 1 out of 5
Epoch 20/60 - Training Loss: 0.1012 - Validation Loss: 0.0718 - Training Acc:

96.17% - Validation Acc: 97.36% - Training Dice: 0.7980 - Validation Dice: 0.8601 - Training IoU: 0.6719 - Validation IoU: 0.7579



Current Learning Rate: 0.0025
EarlyStopping counter: 2 out of 5
Epoch 21/60 - Training Loss: 0.1031 - Validation Loss: 0.0674 - Training Acc: 96.03% - Validation Acc: 97.62% - Training Dice: 0.7949 - Validation Dice:

0.8677 - Training IoU: 0.6681 - Validation IoU: 0.7681

Current Learning Rate: 0.00125
EarlyStopping counter: 3 out of 5
Epoch 22/60 - Training Loss: 0.0982 - Validation Loss: 0.0773 - Training Acc: 96.11% - Validation Acc: 97.18% - Training Dice: 0.8007 - Validation Dice: 0.8299 - Training IoU: 0.6725 - Validation IoU: 0.7117

Current Learning Rate: 0.00125
EarlyStopping counter: 0 out of 5
Epoch 23/60 - Training Loss: 0.0929 - Validation Loss: 0.0632 - Training Acc: 96.41% - Validation Acc: 97.73% - Training Dice: 0.8147 - Validation Dice: 0.8752 - Training IoU: 0.6909 - Validation IoU: 0.7801

Current Learning Rate: 0.00125
EarlyStopping counter: 1 out of 5
Epoch 24/60 - Training Loss: 0.0970 - Validation Loss: 0.0690 - Training Acc: 96.27% - Validation Acc: 97.59% - Training Dice: 0.8085 - Validation Dice: 0.8662 - Training IoU: 0.6857 - Validation IoU: 0.7656

Current Learning Rate: 0.00125
EarlyStopping counter: 2 out of 5
Epoch 25/60 - Training Loss: 0.0886 - Validation Loss: 0.0655 - Training Acc: 96.62% - Validation Acc: 97.74% - Training Dice: 0.8259 - Validation Dice: 0.8753 - Training IoU: 0.7084 - Validation IoU: 0.7807

Current Learning Rate: 0.000625
EarlyStopping counter: 3 out of 5
Epoch 26/60 - Training Loss: 0.0921 - Validation Loss: 0.0657 - Training Acc: 96.44% - Validation Acc: 97.60% - Training Dice: 0.8157 - Validation Dice: 0.8641 - Training IoU: 0.6938 - Validation IoU: 0.7638

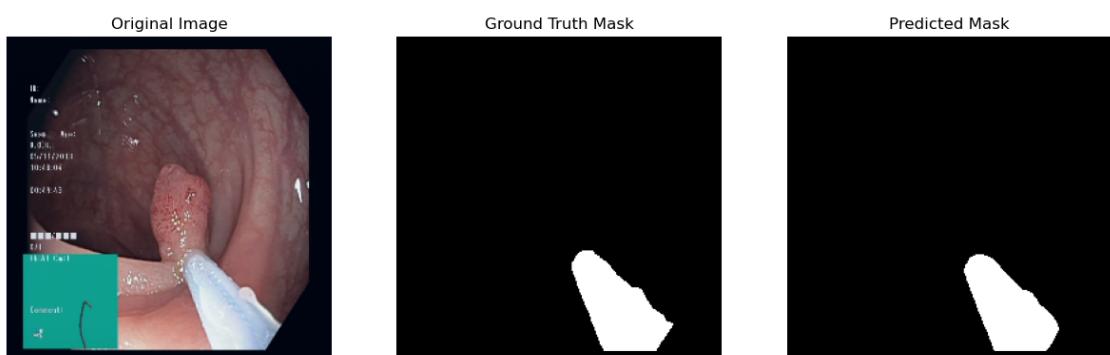
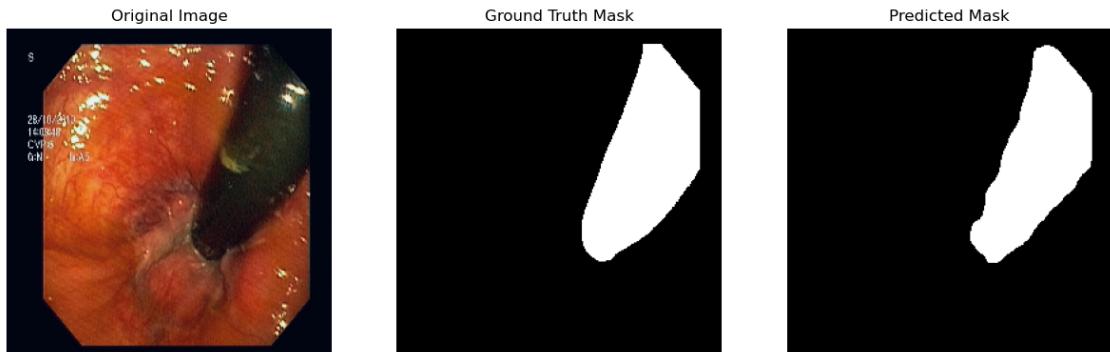
Current Learning Rate: 0.000625
EarlyStopping counter: 4 out of 5
Epoch 27/60 - Training Loss: 0.0884 - Validation Loss: 0.0637 - Training Acc: 96.57% - Validation Acc: 97.83% - Training Dice: 0.8193 - Validation Dice: 0.8781 - Training IoU: 0.6999 - Validation IoU: 0.7845

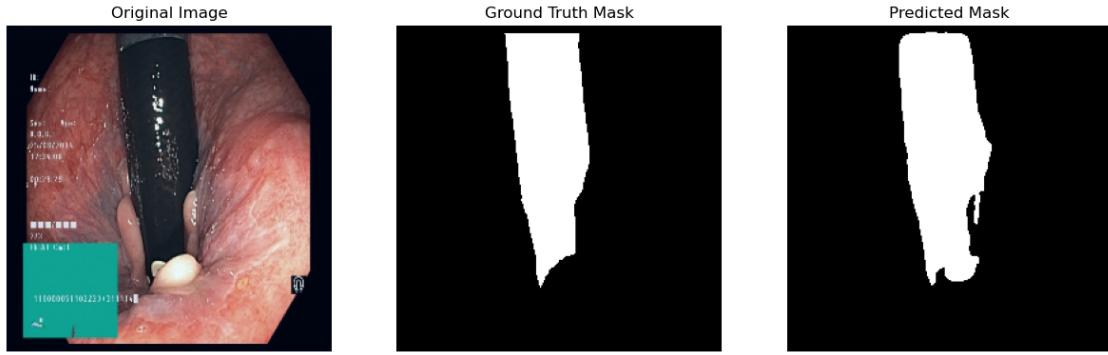
Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 28/60 - Training Loss: 0.0868 - Validation Loss: 0.0626 - Training Acc:

96.69% - Validation Acc: 97.84% - Training Dice: 0.8306 - Validation Dice: 0.8809 - Training IoU: 0.7154 - Validation IoU: 0.7890

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 29/60 - Training Loss: 0.0873 - Validation Loss: 0.0623 - Training Acc: 96.71% - Validation Acc: 97.85% - Training Dice: 0.8313 - Validation Dice: 0.8822 - Training IoU: 0.7161 - Validation IoU: 0.7912

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 30/60 - Training Loss: 0.0932 - Validation Loss: 0.0641 - Training Acc: 96.39% - Validation Acc: 97.79% - Training Dice: 0.8141 - Validation Dice: 0.8794 - Training IoU: 0.6942 - Validation IoU: 0.7871





```

Current Learning Rate: 0.000625
EarlyStopping counter: 2 out of 5
Epoch 31/60 - Training Loss: 0.0872 - Validation Loss: 0.0656 - Training Acc:
96.68% - Validation Acc: 97.71% - Training Dice: 0.8265 - Validation Dice:
0.8752 - Training IoU: 0.7094 - Validation IoU: 0.7803

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 32/60 - Training Loss: 0.0868 - Validation Loss: 0.0614 - Training Acc:
96.64% - Validation Acc: 97.88% - Training Dice: 0.8294 - Validation Dice:
0.8820 - Training IoU: 0.7134 - Validation IoU: 0.7906

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 33/60 - Training Loss: 0.0831 - Validation Loss: 0.0622 - Training Acc:
96.77% - Validation Acc: 97.85% - Training Dice: 0.8347 - Validation Dice:
0.8825 - Training IoU: 0.7207 - Validation IoU: 0.7919

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 0 out of 5
Epoch 34/60 - Training Loss: 0.0901 - Validation Loss: 0.0608 - Training Acc:
96.54% - Validation Acc: 97.91% - Training Dice: 0.8208 - Validation Dice:
0.8837 - Training IoU: 0.7016 - Validation IoU: 0.7933

```

```

Current Learning Rate: 0.000625
EarlyStopping counter: 1 out of 5
Epoch 35/60 - Training Loss: 0.0863 - Validation Loss: 0.0618 - Training Acc:
96.68% - Validation Acc: 97.87% - Training Dice: 0.8302 - Validation Dice:
0.8824 - Training IoU: 0.7144 - Validation IoU: 0.7914

```

```
Current Learning Rate: 0.000625
EarlyStopping counter: 2 out of 5
Epoch 36/60 - Training Loss: 0.0858 - Validation Loss: 0.0609 - Training Acc: 96.73% - Validation Acc: 97.89% - Training Dice: 0.8294 - Validation Dice: 0.8823 - Training IoU: 0.7134 - Validation IoU: 0.7910
```

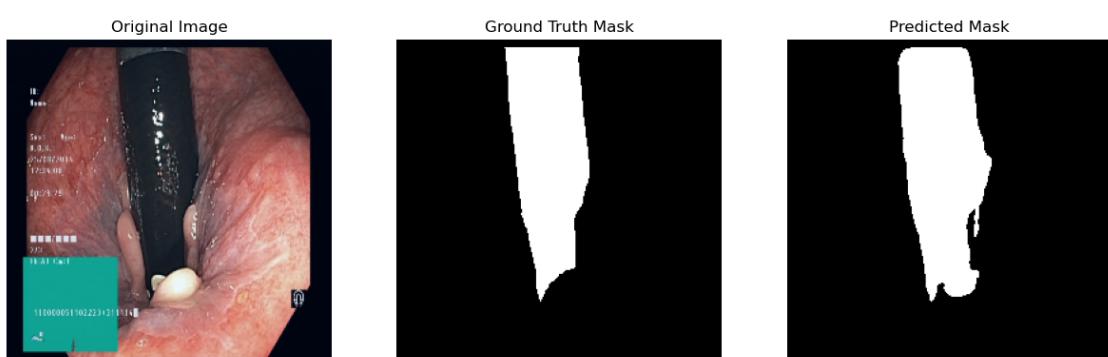
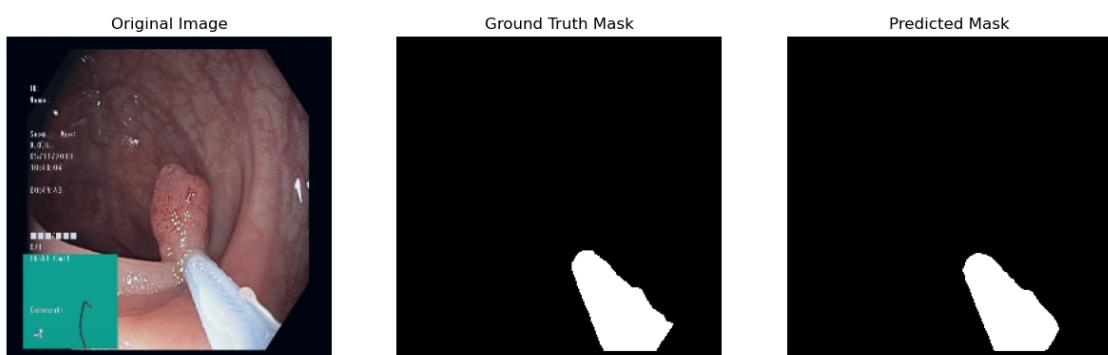
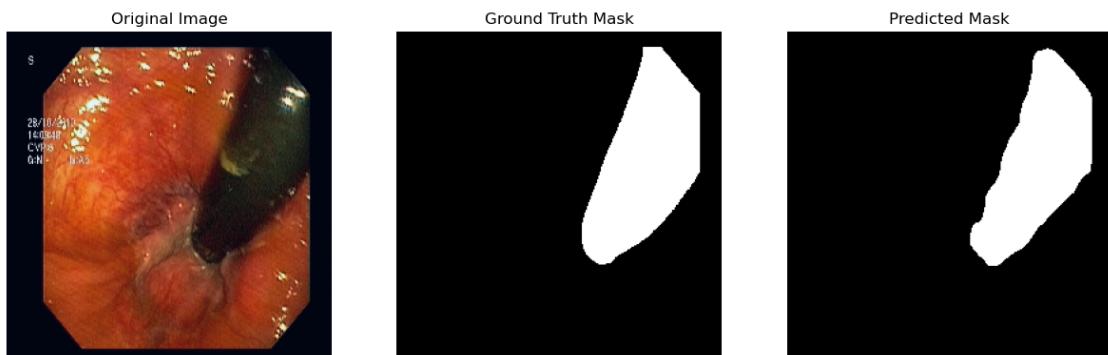
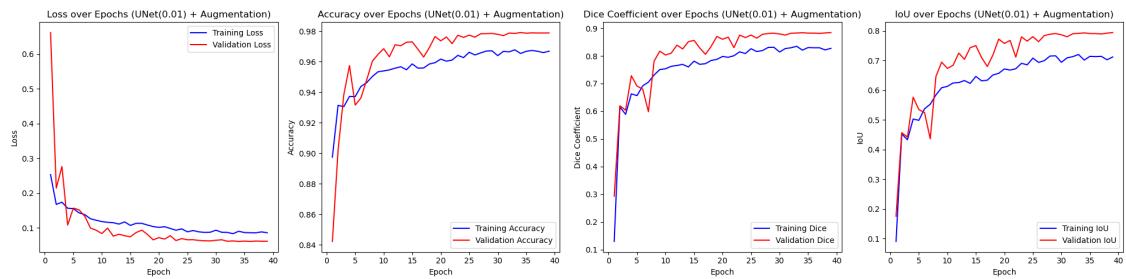
```
Current Learning Rate: 0.0003125
EarlyStopping counter: 3 out of 5
Epoch 37/60 - Training Loss: 0.0856 - Validation Loss: 0.0619 - Training Acc: 96.68% - Validation Acc: 97.88% - Training Dice: 0.8295 - Validation Dice: 0.8815 - Training IoU: 0.7144 - Validation IoU: 0.7898
```

```
Current Learning Rate: 0.0003125
EarlyStopping counter: 4 out of 5
Epoch 38/60 - Training Loss: 0.0882 - Validation Loss: 0.0614 - Training Acc: 96.59% - Validation Acc: 97.88% - Training Dice: 0.8215 - Validation Dice: 0.8829 - Training IoU: 0.7027 - Validation IoU: 0.7925
```

```
C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default value), which uses the default pickle module implicitly. It is possible to construct malicious pickle data which will execute arbitrary code during unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for more details). In a future release, the default value for `weights_only` will be flipped to `True`. This limits the functions that could be executed during unpickling. Arbitrary objects will no longer be allowed to be loaded via this mode unless they are explicitly allowlisted by the user via `torch.serialization.add_safe_globals`. We recommend you start setting `weights_only=True` for any use case where you don't have full control of the loaded file. Please open an issue on GitHub for any issues related to this experimental feature.
```

```
    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))
```

```
Current Learning Rate: 0.0003125
EarlyStopping counter: 5 out of 5
Early stopping at epoch 39
```



Summary of Experiments:

	Model	Best Epoch	Train Loss	Validation Loss	\	
0	FPN(0.01) + Augmentation	59	0.041879	0.041943		
1	UNet++(0.01) + Augmentation	51	0.047286	0.037779		
2	UNet(0.01) + Augmentation	34	0.090064	0.060798		
Train Accuracy	Validation Accuracy	Train Dice	Validation Dice	\		
0	0.983996	0.985328	0.916836	0.920027		
1	0.981630	0.985524	0.902644	0.919024		
2	0.965395	0.979062	0.820812	0.883732		
Train IoU	Validation IoU	Test Loss	Test Accuracy	Test Dice	Test IoU	
0	0.848070	0.853637	0.041943	0.985328	0.920027	0.853637
1	0.825935	0.851916	0.037779	0.985524	0.919024	0.851916
2	0.701626	0.793338	0.060798	0.979062	0.883732	0.793338

Experiment Results Summary

Model	Best Epoch	Train Loss	Validation Loss	Train Accuracy	Validation Accuracy	Train Dice	Validation Dice	Train IoU	Validation IoU	Test Loss	Test Accuracy	Test Dice	Test IoU
FPN(0.01) + Augmentation	59	0.041879	0.041943	0.983996	0.985328	0.916836	0.920027	0.848070	0.853637	0.041943	0.985328	0.920027	0.853637
UNet++(0.01) + Augmentation	51	0.047286	0.037779	0.981630	0.985524	0.902644	0.919024	0.825935	0.851916	0.037779	0.985524	0.919024	0.851916
UNet(0.01) + Augmentation	34	0.090064	0.060798	0.965395	0.979062	0.820812	0.883732	0.701626	0.793338	0.060798	0.979062	0.883732	0.793338

```
[20]: optimizer_adam = lambda params: optim.Adam(params, lr=1e-3)

scheduler_plateau = lambda optimizer: ReduceLROnPlateau(optimizer, mode='min', ↴
    factor=0.5, patience=2)

# Run experiments and store results
results = []

# Experiment 1: FPN with Adam, Plateau scheduler, and augmentations
_, metrics3 = run_experiment(model_fn=get_fpn,
                                optimizer_fn=optimizer_adam,
                                scheduler_fn=scheduler_plateau ,
                                augmentations=augmentations,
                                experiment_name='FPN + Augmentation')
results.append(metrics3)

# Experiment 2: UNet with Adam, Plateau scheduler, and augmentations
_, metrics1 = run_experiment(model_fn=get_unetpp,
```

```

        optimizer_fn=optimizer_adam,
        scheduler_fn=scheduler_plateau,
        augmentations=augmentations,
        experiment_name='UNet++ + Augmentation')
results.append(metrics1)

# Experiment 3: UNet++ with Adam, Plateau scheduler, and augmentations
_, metrics2 = run_experiment(model_fn=get_unet,
                             optimizer_fn=optimizer_adam,
                             scheduler_fn=scheduler_plateau,
                             augmentations=augmentations,
                             experiment_name='UNet + Augmentation')
results.append(metrics2)

# Create a summary table using pandas DataFrame
summary_df = pd.DataFrame(results)
print("\nSummary of Experiments:")
print(summary_df)

# Visualize the summary table using matplotlib
fig, ax = plt.subplots(figsize=(12, 4))
ax.axis('tight')
ax.axis('off')
table = ax.table(cellText=summary_df.values, colLabels=summary_df.columns, cellLoc='center')
table.auto_set_font_size(False)
table.set_fontsize(10)
table.auto_set_column_width(col=list(range(len(summary_df.columns))))
plt.title("Experiment Results Summary")
plt.show()

```

```

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)

```

Running experiment: FPN + Adam + Plateau + Augmentation

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.2077 - Validation Loss: 0.1300 - Training Acc: 92.85% - Validation Acc: 95.21% - Training Dice: 0.5509 - Validation Dice: 0.7691 - Training IoU: 0.4205 - Validation IoU: 0.6295
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1098 - Validation Loss: 0.0698 - Training Acc: 95.75% - Validation Acc: 97.42% - Training Dice: 0.7738 - Validation Dice: 0.8487 - Training IoU: 0.6391 - Validation IoU: 0.7387
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 3/60 - Training Loss: 0.0906 - Validation Loss: 0.0665 - Training Acc: 96.56% - Validation Acc: 97.53% - Training Dice: 0.8179 - Validation Dice: 0.8506 - Training IoU: 0.6978 - Validation IoU: 0.7442
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.0846 - Validation Loss: 0.0631 - Training Acc: 96.79% - Validation Acc: 97.58% - Training Dice: 0.8328 - Validation Dice: 0.8495 - Training IoU: 0.7176 - Validation IoU: 0.7411
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 5/60 - Training Loss: 0.0743 - Validation Loss: 0.0715 - Training Acc: 97.26% - Validation Acc: 97.22% - Training Dice: 0.8588 - Validation Dice: 0.8352 - Training IoU: 0.7564 - Validation IoU: 0.7209
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 6/60 - Training Loss: 0.0798 - Validation Loss: 0.0493 - Training Acc: 97.04% - Validation Acc: 98.28% - Training Dice: 0.8450 - Validation Dice: 0.9052 - Training IoU: 0.7384 - Validation IoU: 0.8279
```

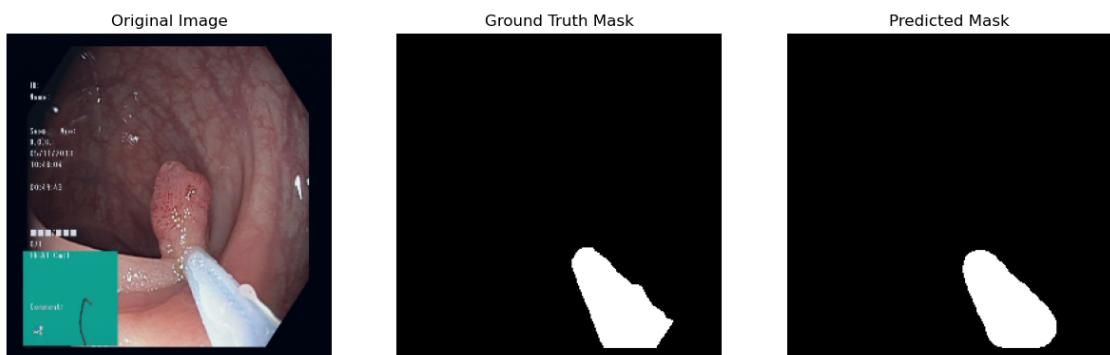
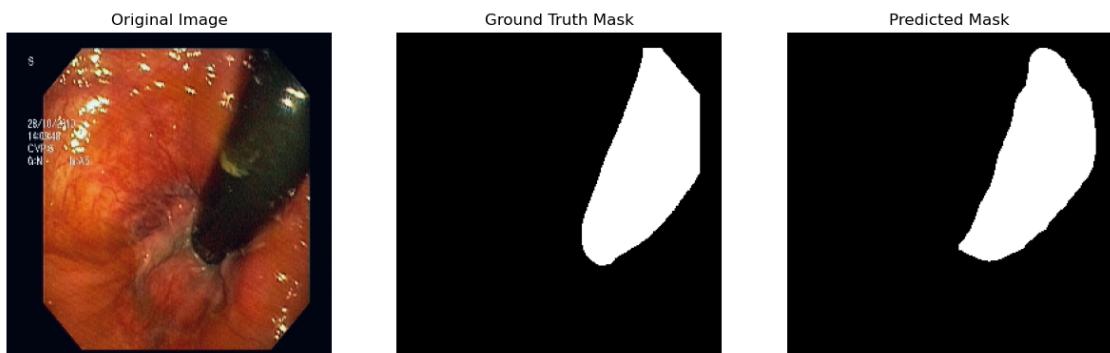
```
Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 7/60 - Training Loss: 0.0675 - Validation Loss: 0.0501 - Training Acc:
```

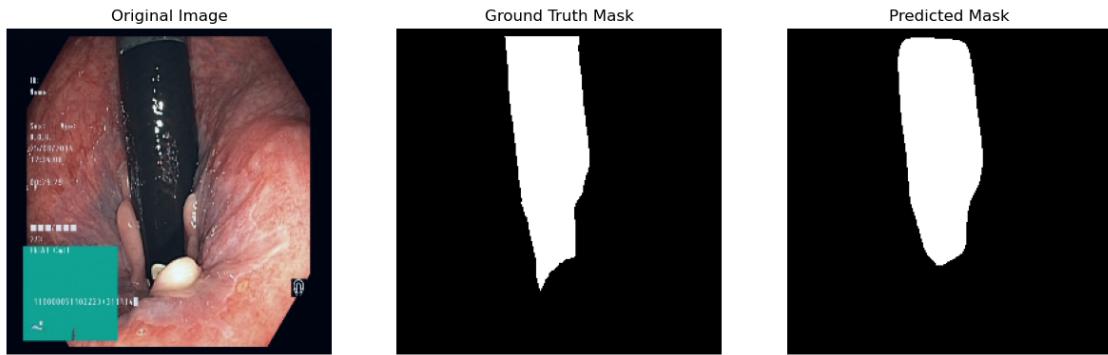
97.46% - Validation Acc: 98.26% - Training Dice: 0.8684 - Validation Dice: 0.9034 - Training IoU: 0.7711 - Validation IoU: 0.8258

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.0685 - Validation Loss: 0.0458 - Training Acc: 97.41% - Validation Acc: 98.44% - Training Dice: 0.8657 - Validation Dice: 0.9147 - Training IoU: 0.7695 - Validation IoU: 0.8445

Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.0600 - Validation Loss: 0.0471 - Training Acc: 97.79% - Validation Acc: 98.31% - Training Dice: 0.8854 - Validation Dice: 0.9080 - Training IoU: 0.7987 - Validation IoU: 0.8331

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 10/60 - Training Loss: 0.0496 - Validation Loss: 0.0438 - Training Acc: 98.18% - Validation Acc: 98.45% - Training Dice: 0.9064 - Validation Dice: 0.9156 - Training IoU: 0.8311 - Validation IoU: 0.8459





Current Learning Rate: 0.001

EarlyStopping counter: 1 out of 5

Epoch 11/60 - Training Loss: 0.0672 - Validation Loss: 0.0744 - Training Acc: 97.47% - Validation Acc: 97.18% - Training Dice: 0.8685 - Validation Dice: 0.8618 - Training IoU: 0.7714 - Validation IoU: 0.7610

Current Learning Rate: 0.001

EarlyStopping counter: 2 out of 5

Epoch 12/60 - Training Loss: 0.0624 - Validation Loss: 0.0526 - Training Acc: 97.70% - Validation Acc: 98.11% - Training Dice: 0.8800 - Validation Dice: 0.9010 - Training IoU: 0.7906 - Validation IoU: 0.8223

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 13/60 - Training Loss: 0.0526 - Validation Loss: 0.0425 - Training Acc: 98.14% - Validation Acc: 98.49% - Training Dice: 0.9037 - Validation Dice: 0.9164 - Training IoU: 0.8267 - Validation IoU: 0.8480

Current Learning Rate: 0.001

EarlyStopping counter: 1 out of 5

Epoch 14/60 - Training Loss: 0.0484 - Validation Loss: 0.0447 - Training Acc: 98.24% - Validation Acc: 98.40% - Training Dice: 0.9089 - Validation Dice: 0.9123 - Training IoU: 0.8359 - Validation IoU: 0.8400

Current Learning Rate: 0.001

EarlyStopping counter: 2 out of 5

```
Epoch 15/60 - Training Loss: 0.0534 - Validation Loss: 0.0436 - Training Acc: 98.04% - Validation Acc: 98.47% - Training Dice: 0.8984 - Validation Dice: 0.9163 - Training IoU: 0.8202 - Validation IoU: 0.8474
```

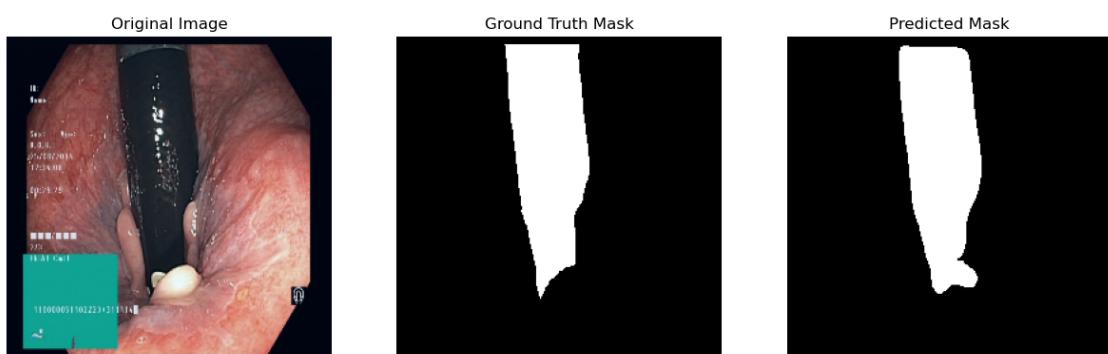
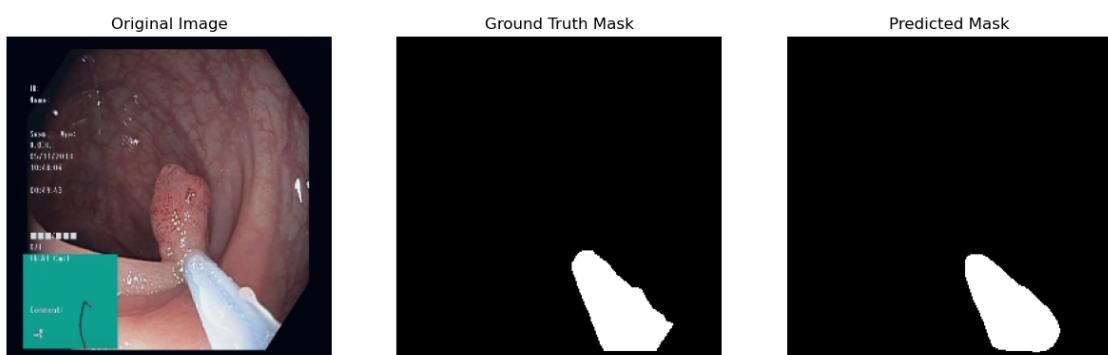
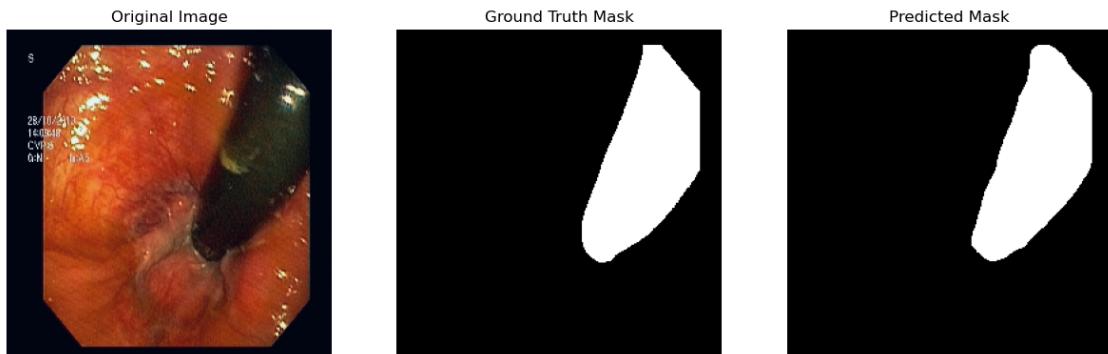
```
Current Learning Rate: 0.0005
EarlyStopping counter: 3 out of 5
Epoch 16/60 - Training Loss: 0.0487 - Validation Loss: 0.0444 - Training Acc: 98.24% - Validation Acc: 98.32% - Training Dice: 0.9085 - Validation Dice: 0.9041 - Training IoU: 0.8343 - Validation IoU: 0.8278
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 17/60 - Training Loss: 0.0444 - Validation Loss: 0.0400 - Training Acc: 98.33% - Validation Acc: 98.50% - Training Dice: 0.9140 - Validation Dice: 0.9192 - Training IoU: 0.8443 - Validation IoU: 0.8523
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 18/60 - Training Loss: 0.0374 - Validation Loss: 0.0327 - Training Acc: 98.56% - Validation Acc: 98.81% - Training Dice: 0.9268 - Validation Dice: 0.9358 - Training IoU: 0.8652 - Validation IoU: 0.8803
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 19/60 - Training Loss: 0.0383 - Validation Loss: 0.0324 - Training Acc: 98.62% - Validation Acc: 98.86% - Training Dice: 0.9286 - Validation Dice: 0.9380 - Training IoU: 0.8685 - Validation IoU: 0.8845
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 20/60 - Training Loss: 0.0375 - Validation Loss: 0.0364 - Training Acc: 98.64% - Validation Acc: 98.76% - Training Dice: 0.9309 - Validation Dice: 0.9322 - Training IoU: 0.8723 - Validation IoU: 0.8743
```



Current Learning Rate: 0.0005

EarlyStopping counter: 2 out of 5

Epoch 21/60 - Training Loss: 0.0379 - Validation Loss: 0.0395 - Training Acc: 98.56% - Validation Acc: 98.69% - Training Dice: 0.9262 - Validation Dice: 0.9252 - Training IoU: 0.8656 - Validation IoU: 0.8630

Current Learning Rate: 0.00025
EarlyStopping counter: 3 out of 5
Epoch 22/60 - Training Loss: 0.0381 - Validation Loss: 0.0353 - Training Acc: 98.57% - Validation Acc: 98.68% - Training Dice: 0.9278 - Validation Dice: 0.9271 - Training IoU: 0.8669 - Validation IoU: 0.8660

Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 23/60 - Training Loss: 0.0317 - Validation Loss: 0.0313 - Training Acc: 98.82% - Validation Acc: 98.83% - Training Dice: 0.9394 - Validation Dice: 0.9361 - Training IoU: 0.8867 - Validation IoU: 0.8814

Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 24/60 - Training Loss: 0.0307 - Validation Loss: 0.0309 - Training Acc: 98.84% - Validation Acc: 98.86% - Training Dice: 0.9405 - Validation Dice: 0.9374 - Training IoU: 0.8889 - Validation IoU: 0.8833

Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 25/60 - Training Loss: 0.0298 - Validation Loss: 0.0302 - Training Acc: 98.90% - Validation Acc: 98.86% - Training Dice: 0.9433 - Validation Dice: 0.9372 - Training IoU: 0.8936 - Validation IoU: 0.8830

Current Learning Rate: 0.00025
EarlyStopping counter: 1 out of 5
Epoch 26/60 - Training Loss: 0.0291 - Validation Loss: 0.0351 - Training Acc: 98.90% - Validation Acc: 98.75% - Training Dice: 0.9440 - Validation Dice: 0.9302 - Training IoU: 0.8947 - Validation IoU: 0.8712

Current Learning Rate: 0.00025
EarlyStopping counter: 2 out of 5
Epoch 27/60 - Training Loss: 0.0301 - Validation Loss: 0.0310 - Training Acc: 98.88% - Validation Acc: 98.86% - Training Dice: 0.9409 - Validation Dice: 0.9384 - Training IoU: 0.8905 - Validation IoU: 0.8853

Current Learning Rate: 0.000125
EarlyStopping counter: 3 out of 5
Epoch 28/60 - Training Loss: 0.0272 - Validation Loss: 0.0308 - Training Acc: 98.96% - Validation Acc: 98.85% - Training Dice: 0.9462 - Validation Dice: 0.9370 - Training IoU: 0.8987 - Validation IoU: 0.8829

```

Current Learning Rate: 0.000125
EarlyStopping counter: 4 out of 5
Epoch 29/60 - Training Loss: 0.0262 - Validation Loss: 0.0304 - Training Acc: 98.99% - Validation Acc: 98.89% - Training Dice: 0.9482 - Validation Dice: 0.9392 - Training IoU: 0.9023 - Validation IoU: 0.8865

C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.

    warnings.warn(msg)

C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default
value), which uses the default pickle module implicitly. It is possible to
construct malicious pickle data which will execute arbitrary code during
unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
more details). In a future release, the default value for `weights_only` will be
flipped to `True`. This limits the functions that could be executed during
unpickling. Arbitrary objects will no longer be allowed to be loaded via this
mode unless they are explicitly allowlisted by the user via
`torch.serialization.add_safe_globals`. We recommend you start setting
`weights_only=True` for any use case where you don't have full control of the
loaded file. Please open an issue on GitHub for any issues related to this
experimental feature.

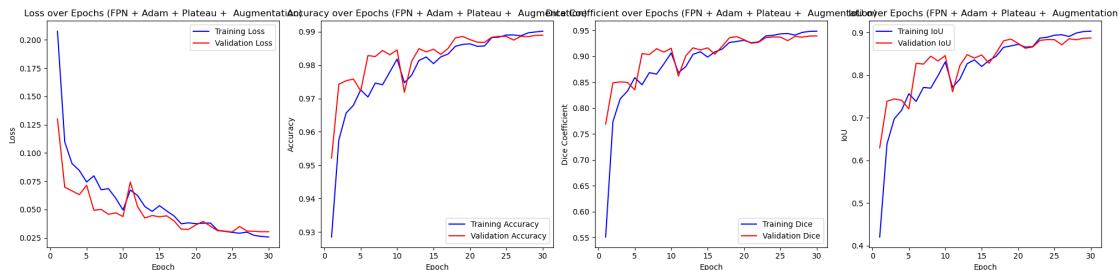
    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))

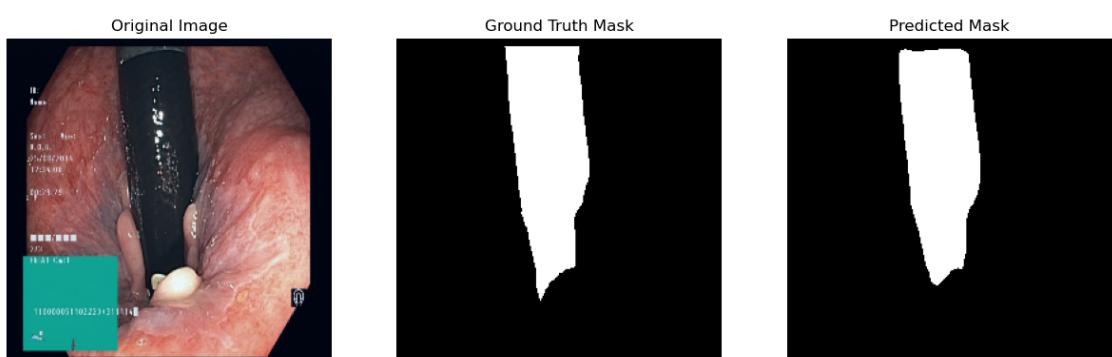
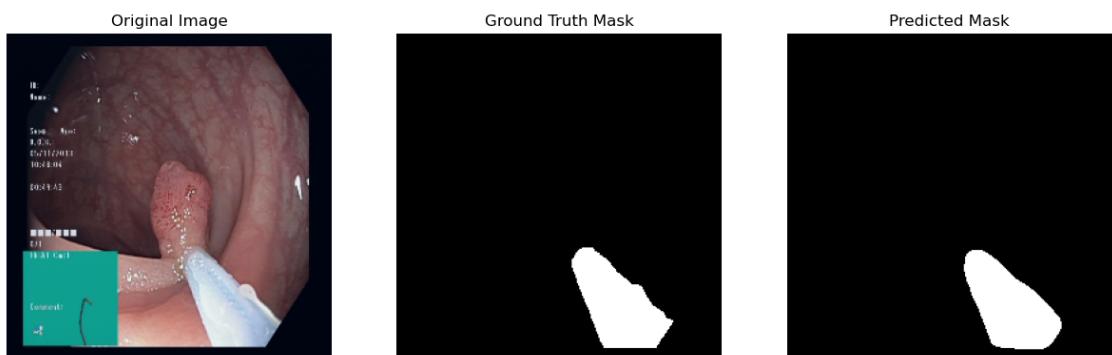
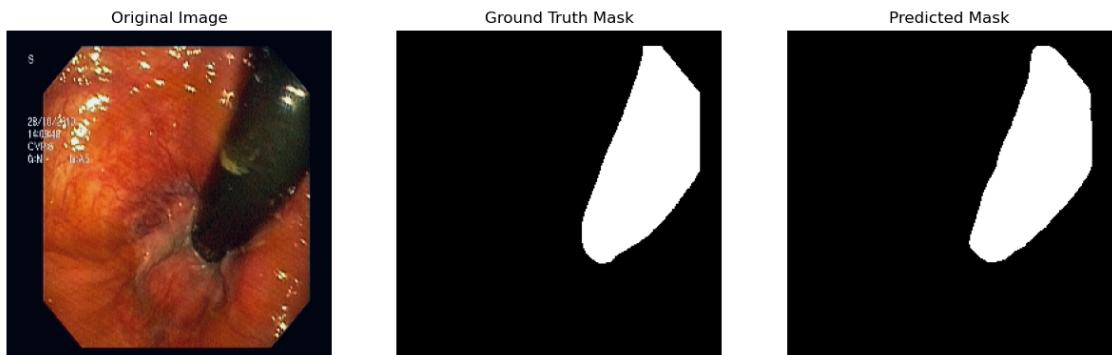

```

```

Current Learning Rate: 0.000125
EarlyStopping counter: 5 out of 5
Early stopping at epoch 30

```





```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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(
```

```
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\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=ResNet34_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)
```

```
Running experiment: UNet++ + Adam + Plateau + Augmentation
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 1/60 - Training Loss: 0.2038 - Validation Loss: 0.0846 - Training Acc:
92.15% - Validation Acc: 96.95% - Training Dice: 0.6091 - Validation Dice:
0.8088 - Training IoU: 0.4658 - Validation IoU: 0.6820
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 2/60 - Training Loss: 0.1110 - Validation Loss: 0.0668 - Training Acc:
95.73% - Validation Acc: 97.65% - Training Dice: 0.7783 - Validation Dice:
0.8667 - Training IoU: 0.6446 - Validation IoU: 0.7666
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 3/60 - Training Loss: 0.1032 - Validation Loss: 0.0777 - Training Acc:
96.07% - Validation Acc: 96.96% - Training Dice: 0.7975 - Validation Dice:
0.8485 - Training IoU: 0.6703 - Validation IoU: 0.7391
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 4/60 - Training Loss: 0.0866 - Validation Loss: 0.0622 - Training Acc:
96.74% - Validation Acc: 97.75% - Training Dice: 0.8340 - Validation Dice:
0.8789 - Training IoU: 0.7187 - Validation IoU: 0.7867
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 5/60 - Training Loss: 0.0839 - Validation Loss: 0.0589 - Training Acc:
96.75% - Validation Acc: 97.91% - Training Dice: 0.8310 - Validation Dice:
0.8815 - Training IoU: 0.7173 - Validation IoU: 0.7890
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
```

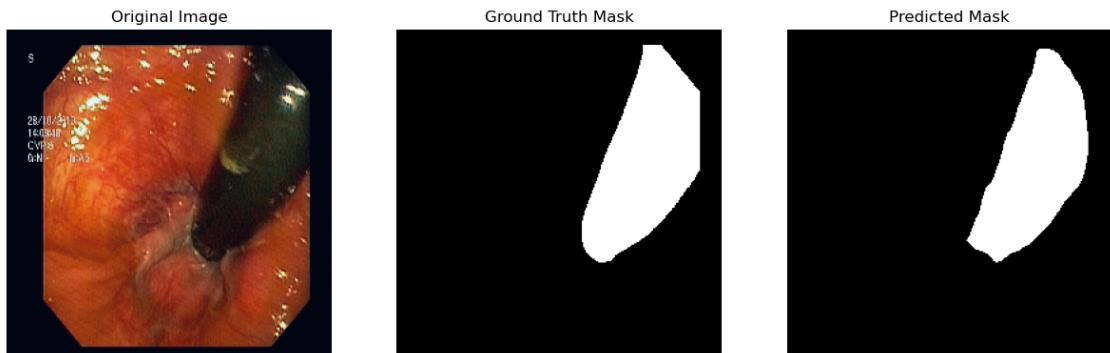
```
Epoch 6/60 - Training Loss: 0.0778 - Validation Loss: 0.0935 - Training Acc: 97.16% - Validation Acc: 96.53% - Training Dice: 0.8531 - Validation Dice: 0.7728 - Training IoU: 0.7496 - Validation IoU: 0.6376
```

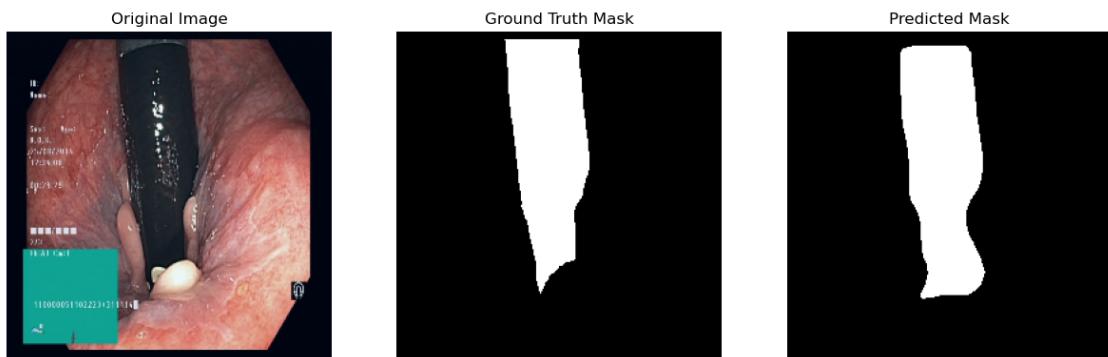
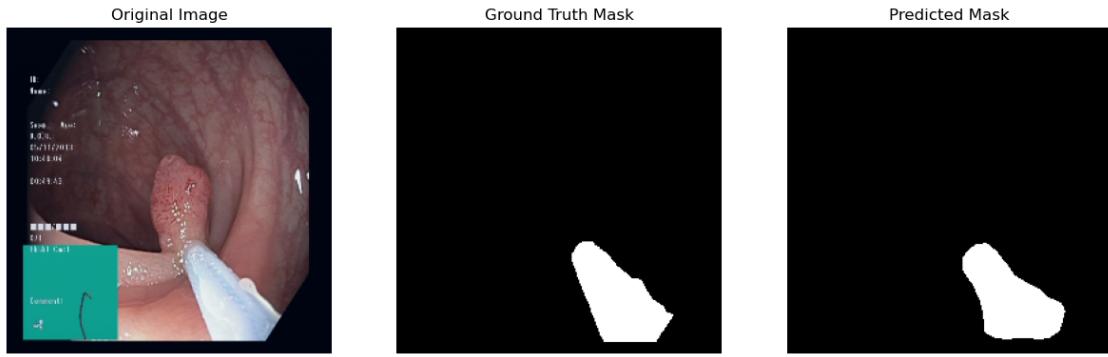
```
Current Learning Rate: 0.001
EarlyStopping counter: 2 out of 5
Epoch 7/60 - Training Loss: 0.0731 - Validation Loss: 0.0704 - Training Acc: 97.26% - Validation Acc: 97.23% - Training Dice: 0.8575 - Validation Dice: 0.8355 - Training IoU: 0.7554 - Validation IoU: 0.7209
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 8/60 - Training Loss: 0.0630 - Validation Loss: 0.0458 - Training Acc: 97.73% - Validation Acc: 98.32% - Training Dice: 0.8819 - Validation Dice: 0.9052 - Training IoU: 0.7929 - Validation IoU: 0.8280
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.0722 - Validation Loss: 0.0632 - Training Acc: 97.31% - Validation Acc: 97.79% - Training Dice: 0.8623 - Validation Dice: 0.8788 - Training IoU: 0.7644 - Validation IoU: 0.7869
```

```
Current Learning Rate: 0.001
EarlyStopping counter: 2 out of 5
Epoch 10/60 - Training Loss: 0.0674 - Validation Loss: 0.0608 - Training Acc: 97.48% - Validation Acc: 97.77% - Training Dice: 0.8696 - Validation Dice: 0.8793 - Training IoU: 0.7757 - Validation IoU: 0.7865
```





Current Learning Rate: 0.0005

EarlyStopping counter: 3 out of 5

Epoch 11/60 - Training Loss: 0.0623 - Validation Loss: 0.0658 - Training Acc: 97.70% - Validation Acc: 97.50% - Training Dice: 0.8806 - Validation Dice: 0.8754 - Training IoU: 0.7909 - Validation IoU: 0.7824

Current Learning Rate: 0.0005

EarlyStopping counter: 0 out of 5

Epoch 12/60 - Training Loss: 0.0571 - Validation Loss: 0.0429 - Training Acc: 97.87% - Validation Acc: 98.53% - Training Dice: 0.8912 - Validation Dice: 0.9160 - Training IoU: 0.8073 - Validation IoU: 0.8465

Current Learning Rate: 0.0005

EarlyStopping counter: 0 out of 5

Epoch 13/60 - Training Loss: 0.0470 - Validation Loss: 0.0398 - Training Acc: 98.29% - Validation Acc: 98.73% - Training Dice: 0.9100 - Validation Dice: 0.9302 - Training IoU: 0.8390 - Validation IoU: 0.8707

Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 14/60 - Training Loss: 0.0412 - Validation Loss: 0.0384 - Training Acc: 98.48% - Validation Acc: 98.70% - Training Dice: 0.9207 - Validation Dice: 0.9269 - Training IoU: 0.8552 - Validation IoU: 0.8651

Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 15/60 - Training Loss: 0.0444 - Validation Loss: 0.0409 - Training Acc: 98.34% - Validation Acc: 98.61% - Training Dice: 0.9146 - Validation Dice: 0.9221 - Training IoU: 0.8450 - Validation IoU: 0.8567

Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 16/60 - Training Loss: 0.0405 - Validation Loss: 0.0366 - Training Acc: 98.50% - Validation Acc: 98.72% - Training Dice: 0.9216 - Validation Dice: 0.9278 - Training IoU: 0.8566 - Validation IoU: 0.8667

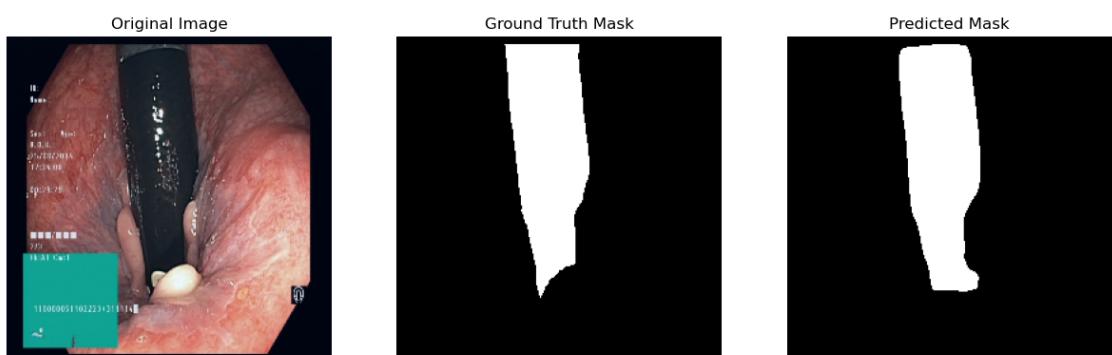
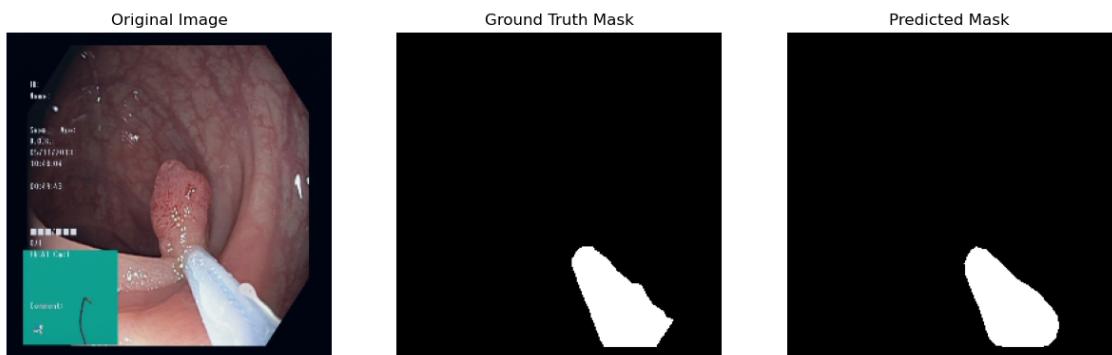
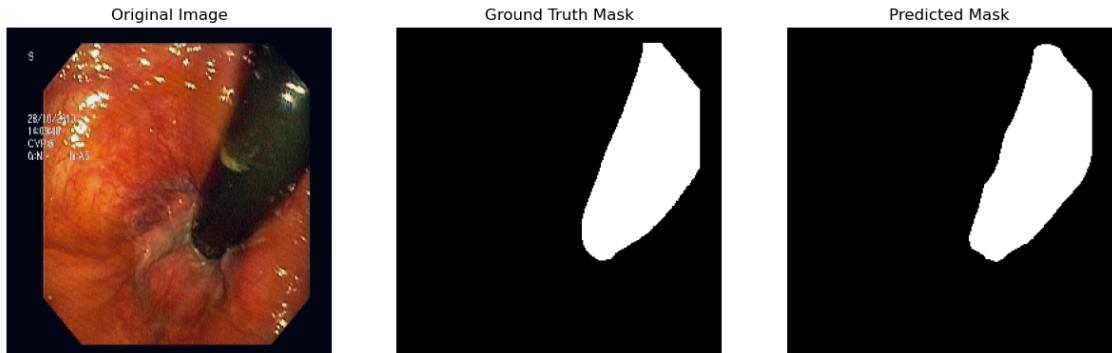
Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 17/60 - Training Loss: 0.0469 - Validation Loss: 0.0454 - Training Acc: 98.23% - Validation Acc: 98.38% - Training Dice: 0.9096 - Validation Dice: 0.9076 - Training IoU: 0.8369 - Validation IoU: 0.8324

Current Learning Rate: 0.0005
EarlyStopping counter: 2 out of 5
Epoch 18/60 - Training Loss: 0.0495 - Validation Loss: 0.0372 - Training Acc: 98.17% - Validation Acc: 98.64% - Training Dice: 0.9044 - Validation Dice: 0.9263 - Training IoU: 0.8283 - Validation IoU: 0.8640

Current Learning Rate: 0.00025
EarlyStopping counter: 3 out of 5
Epoch 19/60 - Training Loss: 0.0395 - Validation Loss: 0.0400 - Training Acc: 98.51% - Validation Acc: 98.56% - Training Dice: 0.9234 - Validation Dice: 0.9215 - Training IoU: 0.8589 - Validation IoU: 0.8558

Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 20/60 - Training Loss: 0.0383 - Validation Loss: 0.0347 - Training Acc:

98.62% - Validation Acc: 98.79% - Training Dice: 0.9285 - Validation Dice:
0.9326 - Training IoU: 0.8686 - Validation IoU: 0.8749



Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 21/60 - Training Loss: 0.0359 - Validation Loss: 0.0340 - Training Acc:
98.68% - Validation Acc: 98.82% - Training Dice: 0.9320 - Validation Dice:

0.9351 - Training IoU: 0.8735 - Validation IoU: 0.8793

Current Learning Rate: 0.00025
EarlyStopping counter: 1 out of 5
Epoch 22/60 - Training Loss: 0.0348 - Validation Loss: 0.0365 - Training Acc: 98.74% - Validation Acc: 98.78% - Training Dice: 0.9370 - Validation Dice: 0.9322 - Training IoU: 0.8824 - Validation IoU: 0.8741

Current Learning Rate: 0.00025
EarlyStopping counter: 2 out of 5
Epoch 23/60 - Training Loss: 0.0372 - Validation Loss: 0.0354 - Training Acc: 98.58% - Validation Acc: 98.79% - Training Dice: 0.9267 - Validation Dice: 0.9325 - Training IoU: 0.8654 - Validation IoU: 0.8748

Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 24/60 - Training Loss: 0.0328 - Validation Loss: 0.0336 - Training Acc: 98.75% - Validation Acc: 98.83% - Training Dice: 0.9354 - Validation Dice: 0.9352 - Training IoU: 0.8799 - Validation IoU: 0.8795

Current Learning Rate: 0.00025
EarlyStopping counter: 1 out of 5
Epoch 25/60 - Training Loss: 0.0290 - Validation Loss: 0.0344 - Training Acc: 98.92% - Validation Acc: 98.83% - Training Dice: 0.9457 - Validation Dice: 0.9356 - Training IoU: 0.8974 - Validation IoU: 0.8802

Current Learning Rate: 0.00025
EarlyStopping counter: 2 out of 5
Epoch 26/60 - Training Loss: 0.0301 - Validation Loss: 0.0391 - Training Acc: 98.87% - Validation Acc: 98.64% - Training Dice: 0.9418 - Validation Dice: 0.9226 - Training IoU: 0.8910 - Validation IoU: 0.8581

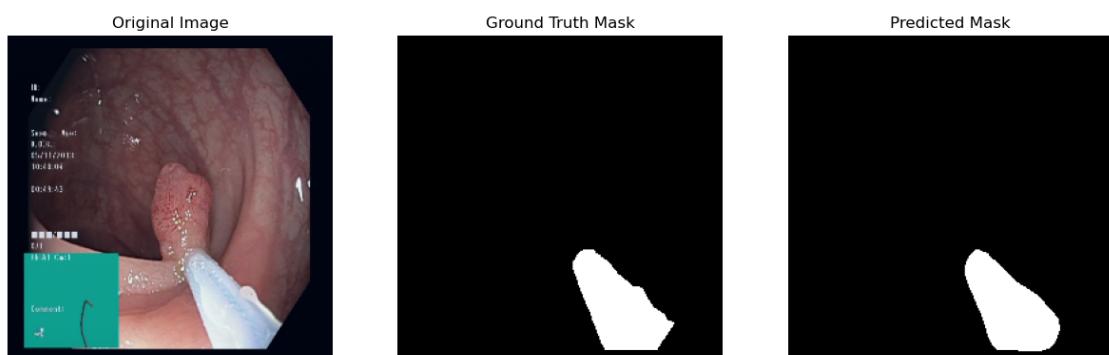
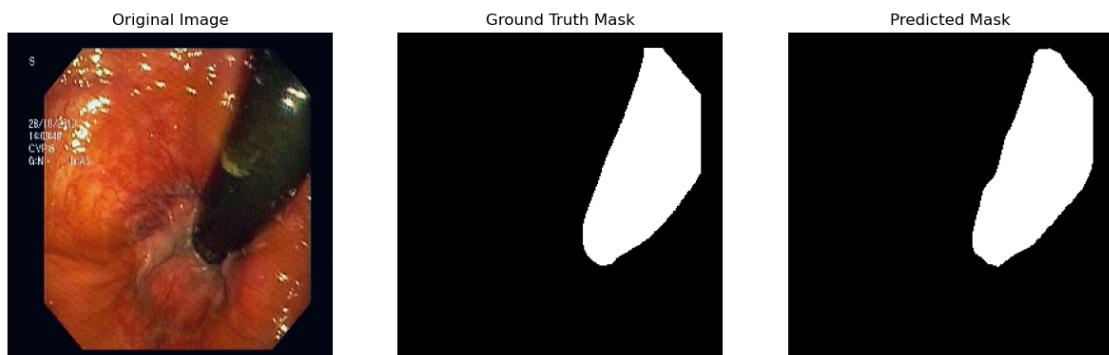
Current Learning Rate: 0.000125
EarlyStopping counter: 3 out of 5
Epoch 27/60 - Training Loss: 0.0333 - Validation Loss: 0.0346 - Training Acc: 98.75% - Validation Acc: 98.84% - Training Dice: 0.9363 - Validation Dice: 0.9359 - Training IoU: 0.8812 - Validation IoU: 0.8806

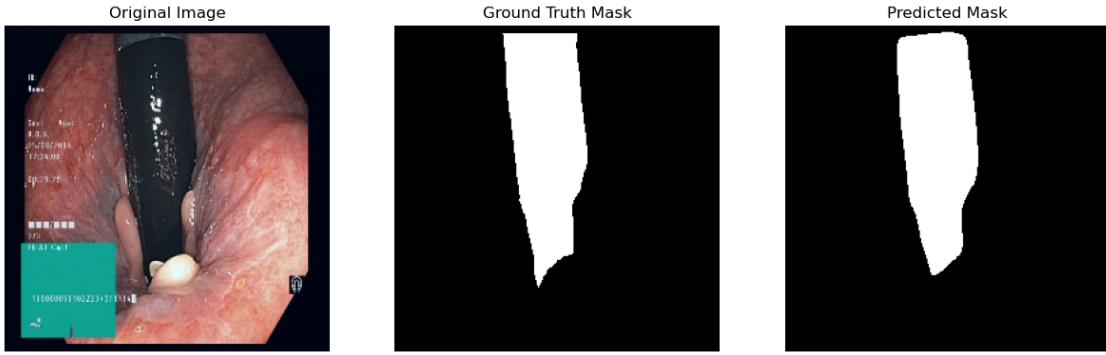
Current Learning Rate: 0.000125
EarlyStopping counter: 0 out of 5
Epoch 28/60 - Training Loss: 0.0319 - Validation Loss: 0.0334 - Training Acc:

98.75% - Validation Acc: 98.86% - Training Dice: 0.9353 - Validation Dice: 0.9363 - Training IoU: 0.8799 - Validation IoU: 0.8813

Current Learning Rate: 0.000125
EarlyStopping counter: 0 out of 5
Epoch 29/60 - Training Loss: 0.0278 - Validation Loss: 0.0313 - Training Acc: 98.96% - Validation Acc: 98.92% - Training Dice: 0.9465 - Validation Dice: 0.9402 - Training IoU: 0.8988 - Validation IoU: 0.8881

Current Learning Rate: 0.000125
EarlyStopping counter: 1 out of 5
Epoch 30/60 - Training Loss: 0.0251 - Validation Loss: 0.0315 - Training Acc: 99.03% - Validation Acc: 98.88% - Training Dice: 0.9499 - Validation Dice: 0.9386 - Training IoU: 0.9051 - Validation IoU: 0.8853





```

Current Learning Rate: 0.000125
EarlyStopping counter: 0 out of 5
Epoch 31/60 - Training Loss: 0.0286 - Validation Loss: 0.0309 - Training Acc:
98.91% - Validation Acc: 98.95% - Training Dice: 0.9439 - Validation Dice:
0.9423 - Training IoU: 0.8948 - Validation IoU: 0.8922

```

```

Current Learning Rate: 0.000125
EarlyStopping counter: 1 out of 5
Epoch 32/60 - Training Loss: 0.0295 - Validation Loss: 0.0342 - Training Acc:
98.87% - Validation Acc: 98.86% - Training Dice: 0.9423 - Validation Dice:
0.9367 - Training IoU: 0.8919 - Validation IoU: 0.8823

```

```

Current Learning Rate: 0.000125
EarlyStopping counter: 2 out of 5
Epoch 33/60 - Training Loss: 0.0266 - Validation Loss: 0.0325 - Training Acc:
98.98% - Validation Acc: 98.87% - Training Dice: 0.9473 - Validation Dice:
0.9375 - Training IoU: 0.9004 - Validation IoU: 0.8837

```

```

Current Learning Rate: 6.25e-05
EarlyStopping counter: 3 out of 5
Epoch 34/60 - Training Loss: 0.0268 - Validation Loss: 0.0345 - Training Acc:
98.99% - Validation Acc: 98.87% - Training Dice: 0.9482 - Validation Dice:
0.9372 - Training IoU: 0.9022 - Validation IoU: 0.8833

```

```

Current Learning Rate: 6.25e-05
EarlyStopping counter: 4 out of 5
Epoch 35/60 - Training Loss: 0.0280 - Validation Loss: 0.0334 - Training Acc:
98.91% - Validation Acc: 98.89% - Training Dice: 0.9446 - Validation Dice:
0.9389 - Training IoU: 0.8962 - Validation IoU: 0.8859

```

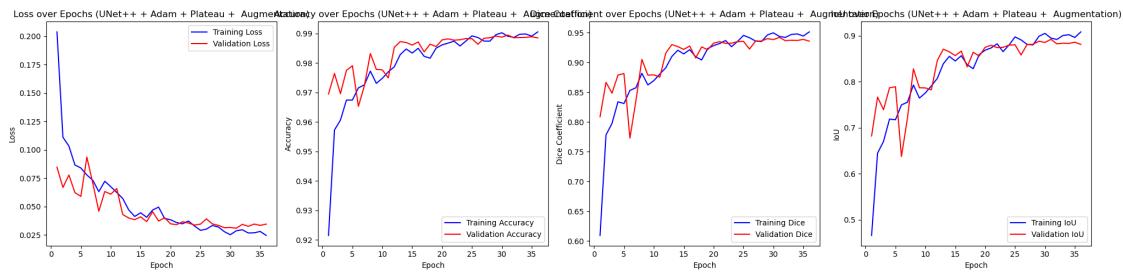
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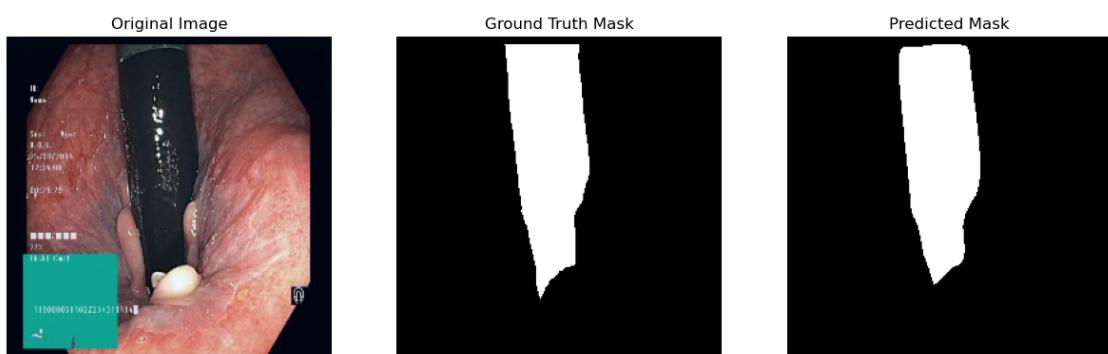
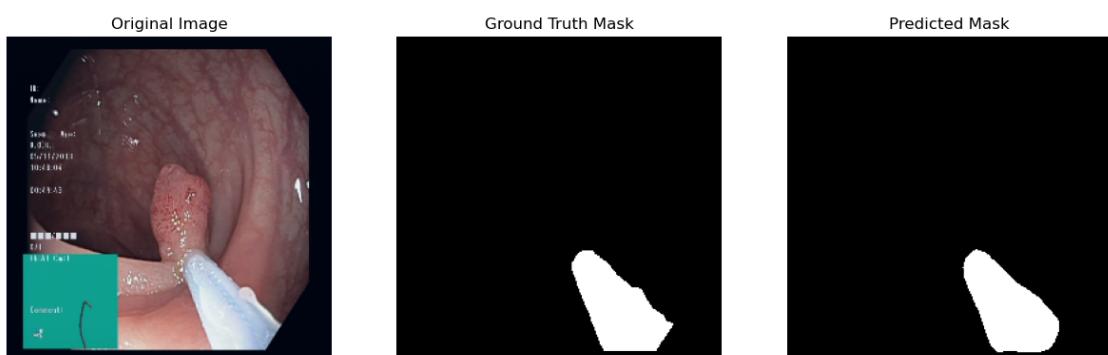
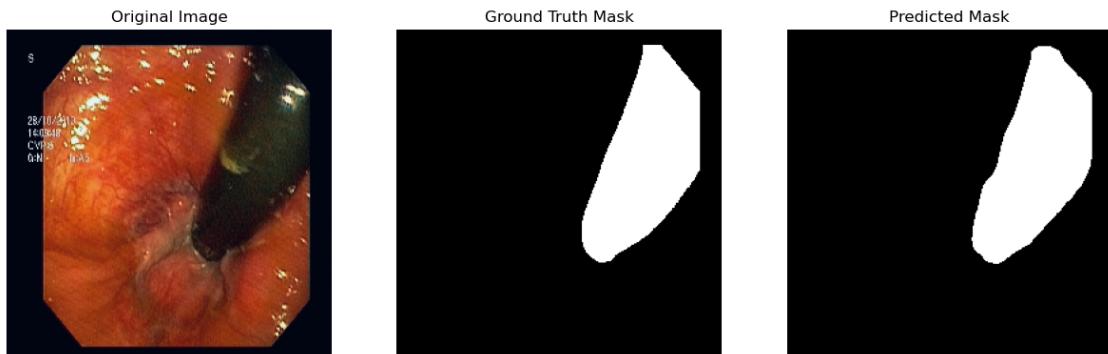
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-
packages\torchvision\models\_utils.py:208: UserWarning: The parameter
'pretrained' is deprecated since 0.13 and may be removed in the future, please
use 'weights' instead.
    warnings.warn(
C:\Users\Mike\anaconda3\envs\MedicalSGMN\lib\site-
packages\torchvision\models\_utils.py:223: 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=ResNet34_Weights.IMGNET1K_V1`. You can also use
`weights=ResNet34_Weights.DEFAULT` to get the most up-to-date weights.
    warnings.warn(msg)
C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default
value), which uses the default pickle module implicitly. It is possible to
construct malicious pickle data which will execute arbitrary code during
unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
more details). In a future release, the default value for `weights_only` will be
flipped to `True`. This limits the functions that could be executed during
unpickling. Arbitrary objects will no longer be allowed to be loaded via this
mode unless they are explicitly allowlisted by the user via
`torch.serialization.add_safe_globals`. We recommend you start setting
`weights_only=True` for any use case where you don't have full control of the
loaded file. Please open an issue on GitHub for any issues related to this
experimental feature.

    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))

Current Learning Rate: 6.25e-05
EarlyStopping counter: 5 out of 5
Early stopping at epoch 36

```





Running experiment: UNet + Adam + Plateau + Augmentation

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 1/60 - Training Loss: 0.4529 - Validation Loss: 0.3339 - Training Acc: 85.76% - Validation Acc: 92.94% - Training Dice: 0.4667 - Validation Dice:

0.5104 - Training IoU: 0.3148 - Validation IoU: 0.3583

Current Learning Rate: 0.001

EarlyStopping counter: 1 out of 5

Epoch 2/60 - Training Loss: 0.2779 - Validation Loss: 0.3496 - Training Acc: 92.59% - Validation Acc: 87.29% - Training Dice: 0.5817 - Validation Dice: 0.5218 - Training IoU: 0.4227 - Validation IoU: 0.3584

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 3/60 - Training Loss: 0.2010 - Validation Loss: 0.1514 - Training Acc: 93.53% - Validation Acc: 95.71% - Training Dice: 0.6698 - Validation Dice: 0.7187 - Training IoU: 0.5121 - Validation IoU: 0.5703

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 4/60 - Training Loss: 0.1619 - Validation Loss: 0.1262 - Training Acc: 94.50% - Validation Acc: 95.64% - Training Dice: 0.7104 - Validation Dice: 0.7067 - Training IoU: 0.5616 - Validation IoU: 0.5497

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 5/60 - Training Loss: 0.1501 - Validation Loss: 0.0926 - Training Acc: 94.65% - Validation Acc: 96.57% - Training Dice: 0.7110 - Validation Dice: 0.7911 - Training IoU: 0.5618 - Validation IoU: 0.6571

Current Learning Rate: 0.001

EarlyStopping counter: 0 out of 5

Epoch 6/60 - Training Loss: 0.1331 - Validation Loss: 0.0859 - Training Acc: 95.02% - Validation Acc: 97.14% - Training Dice: 0.7440 - Validation Dice: 0.8395 - Training IoU: 0.5985 - Validation IoU: 0.7250

Current Learning Rate: 0.001

EarlyStopping counter: 1 out of 5

Epoch 7/60 - Training Loss: 0.1209 - Validation Loss: 0.0937 - Training Acc: 95.46% - Validation Acc: 96.70% - Training Dice: 0.7615 - Validation Dice: 0.8207 - Training IoU: 0.6212 - Validation IoU: 0.7004

Current Learning Rate: 0.001

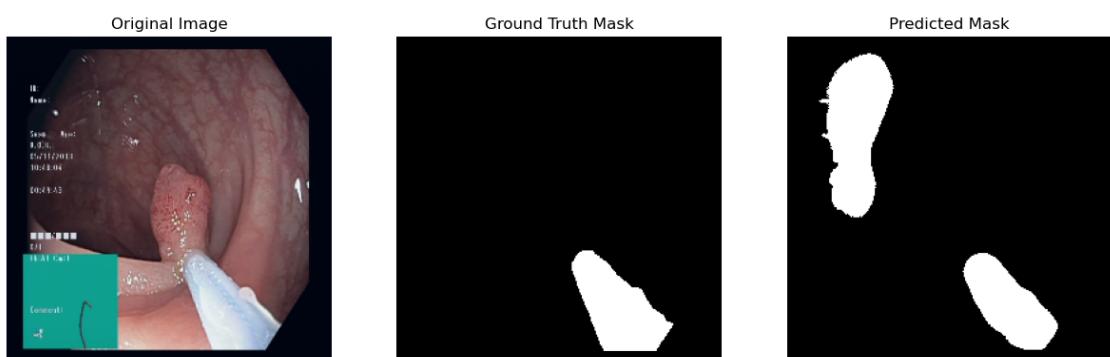
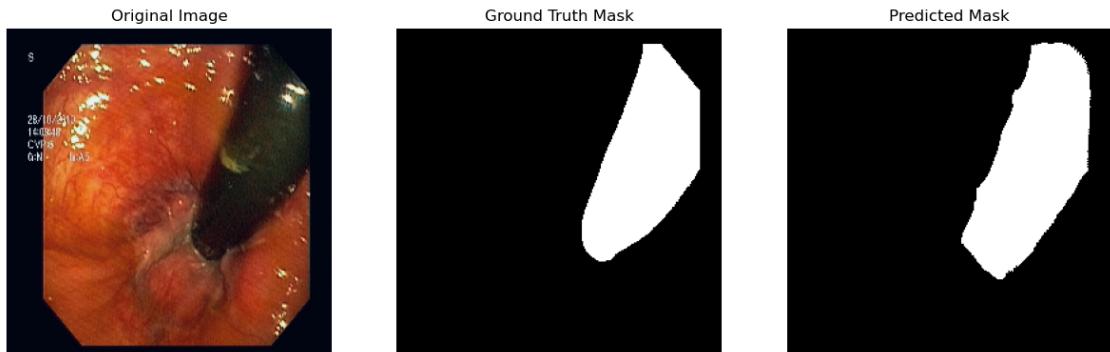
EarlyStopping counter: 0 out of 5

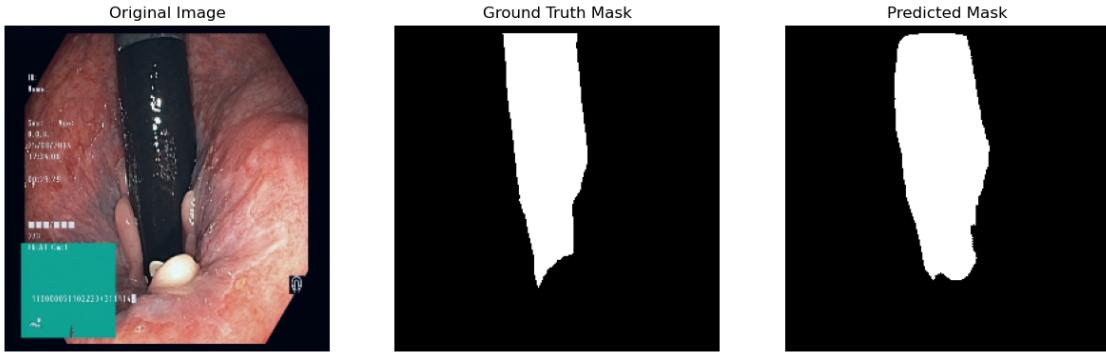
Epoch 8/60 - Training Loss: 0.1190 - Validation Loss: 0.0825 - Training Acc:

95.50% - Validation Acc: 96.91% - Training Dice: 0.7612 - Validation Dice: 0.8395 - Training IoU: 0.6207 - Validation IoU: 0.7263

Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 9/60 - Training Loss: 0.1234 - Validation Loss: 0.0858 - Training Acc: 95.35% - Validation Acc: 96.71% - Training Dice: 0.7576 - Validation Dice: 0.8163 - Training IoU: 0.6171 - Validation IoU: 0.6926

Current Learning Rate: 0.001
EarlyStopping counter: 2 out of 5
Epoch 10/60 - Training Loss: 0.1148 - Validation Loss: 0.1576 - Training Acc: 95.66% - Validation Acc: 93.58% - Training Dice: 0.7697 - Validation Dice: 0.7141 - Training IoU: 0.6315 - Validation IoU: 0.5635





```

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 11/60 - Training Loss: 0.1264 - Validation Loss: 0.0782 - Training Acc:
95.06% - Validation Acc: 97.26% - Training Dice: 0.7375 - Validation Dice:
0.8418 - Training IoU: 0.5927 - Validation IoU: 0.7289

```

```

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 12/60 - Training Loss: 0.1132 - Validation Loss: 0.0759 - Training Acc:
95.60% - Validation Acc: 97.33% - Training Dice: 0.7724 - Validation Dice:
0.8567 - Training IoU: 0.6365 - Validation IoU: 0.7517

```

```

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 13/60 - Training Loss: 0.1074 - Validation Loss: 0.0700 - Training Acc:
95.85% - Validation Acc: 97.37% - Training Dice: 0.7874 - Validation Dice:
0.8578 - Training IoU: 0.6556 - Validation IoU: 0.7532

```

```

Current Learning Rate: 0.001
EarlyStopping counter: 0 out of 5
Epoch 14/60 - Training Loss: 0.1072 - Validation Loss: 0.0685 - Training Acc:
95.85% - Validation Acc: 97.56% - Training Dice: 0.7830 - Validation Dice:
0.8577 - Training IoU: 0.6489 - Validation IoU: 0.7531

```

```

Current Learning Rate: 0.001
EarlyStopping counter: 1 out of 5
Epoch 15/60 - Training Loss: 0.1045 - Validation Loss: 0.0695 - Training Acc:
95.92% - Validation Acc: 97.42% - Training Dice: 0.7916 - Validation Dice:
0.8638 - Training IoU: 0.6588 - Validation IoU: 0.7632

```

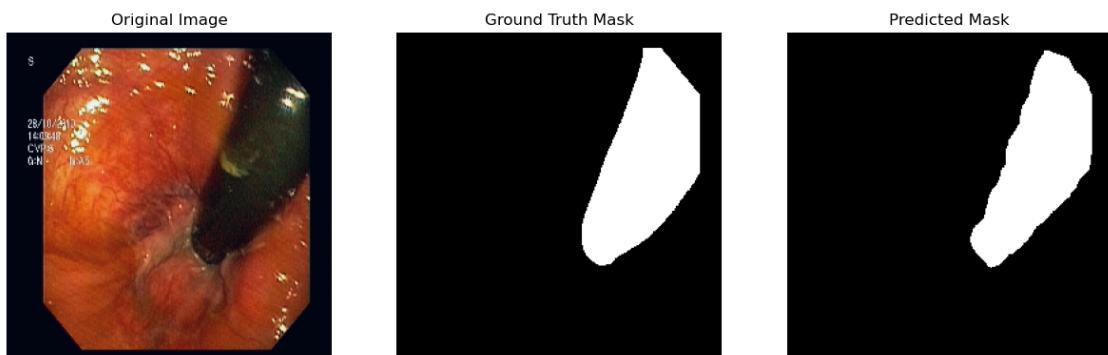
```
Current Learning Rate: 0.001
EarlyStopping counter: 2 out of 5
Epoch 16/60 - Training Loss: 0.1062 - Validation Loss: 0.1007 - Training Acc:
95.89% - Validation Acc: 96.49% - Training Dice: 0.7882 - Validation Dice:
0.7893 - Training IoU: 0.6571 - Validation IoU: 0.6571
```

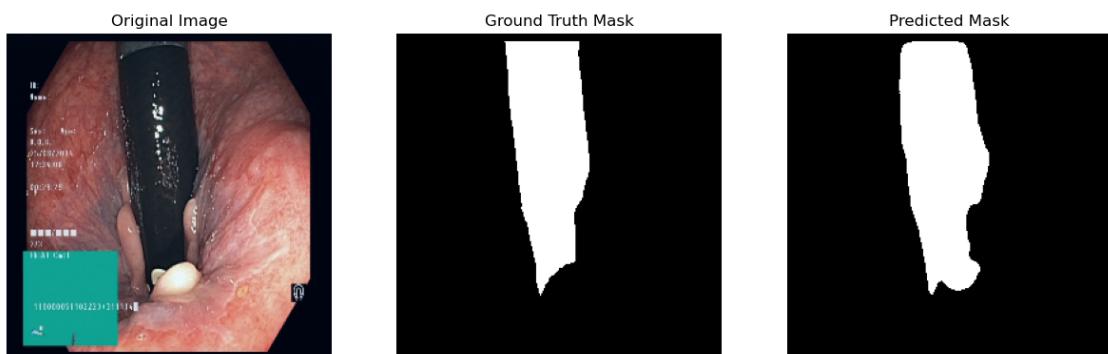
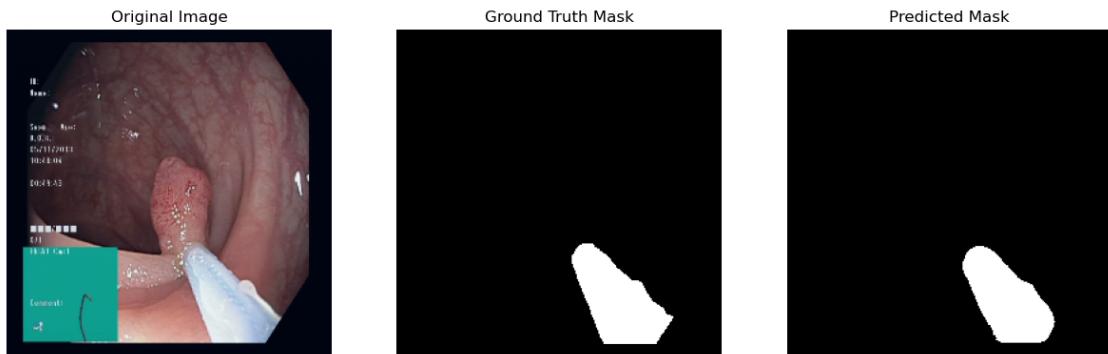
```
Current Learning Rate: 0.0005
EarlyStopping counter: 3 out of 5
Epoch 17/60 - Training Loss: 0.1011 - Validation Loss: 0.0762 - Training Acc:
96.09% - Validation Acc: 97.20% - Training Dice: 0.7984 - Validation Dice:
0.8529 - Training IoU: 0.6699 - Validation IoU: 0.7461
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 18/60 - Training Loss: 0.0983 - Validation Loss: 0.0619 - Training Acc:
96.22% - Validation Acc: 97.77% - Training Dice: 0.8022 - Validation Dice:
0.8784 - Training IoU: 0.6745 - Validation IoU: 0.7850
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 19/60 - Training Loss: 0.0956 - Validation Loss: 0.0650 - Training Acc:
96.20% - Validation Acc: 97.66% - Training Dice: 0.8057 - Validation Dice:
0.8651 - Training IoU: 0.6808 - Validation IoU: 0.7640
```

```
Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 20/60 - Training Loss: 0.0932 - Validation Loss: 0.0608 - Training Acc:
96.40% - Validation Acc: 97.80% - Training Dice: 0.8133 - Validation Dice:
0.8807 - Training IoU: 0.6895 - Validation IoU: 0.7885
```





Current Learning Rate: 0.0005

EarlyStopping counter: 1 out of 5

Epoch 21/60 - Training Loss: 0.0939 - Validation Loss: 0.0618 - Training Acc: 96.40% - Validation Acc: 97.75% - Training Dice: 0.8125 - Validation Dice: 0.8773 - Training IoU: 0.6918 - Validation IoU: 0.7830

Current Learning Rate: 0.0005

EarlyStopping counter: 2 out of 5

Epoch 22/60 - Training Loss: 0.0923 - Validation Loss: 0.0612 - Training Acc: 96.42% - Validation Acc: 97.83% - Training Dice: 0.8175 - Validation Dice: 0.8786 - Training IoU: 0.6965 - Validation IoU: 0.7848

Current Learning Rate: 0.0005

EarlyStopping counter: 0 out of 5

Epoch 23/60 - Training Loss: 0.0959 - Validation Loss: 0.0578 - Training Acc: 96.33% - Validation Acc: 97.85% - Training Dice: 0.8078 - Validation Dice: 0.8812 - Training IoU: 0.6853 - Validation IoU: 0.7891

Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 24/60 - Training Loss: 0.0888 - Validation Loss: 0.0616 - Training Acc: 96.58% - Validation Acc: 97.82% - Training Dice: 0.8234 - Validation Dice: 0.8766 - Training IoU: 0.7043 - Validation IoU: 0.7817

Current Learning Rate: 0.0005
EarlyStopping counter: 2 out of 5
Epoch 25/60 - Training Loss: 0.0906 - Validation Loss: 0.0631 - Training Acc: 96.44% - Validation Acc: 97.65% - Training Dice: 0.8149 - Validation Dice: 0.8689 - Training IoU: 0.6933 - Validation IoU: 0.7695

Current Learning Rate: 0.0005
EarlyStopping counter: 0 out of 5
Epoch 26/60 - Training Loss: 0.0883 - Validation Loss: 0.0566 - Training Acc: 96.59% - Validation Acc: 97.97% - Training Dice: 0.8246 - Validation Dice: 0.8876 - Training IoU: 0.7084 - Validation IoU: 0.7995

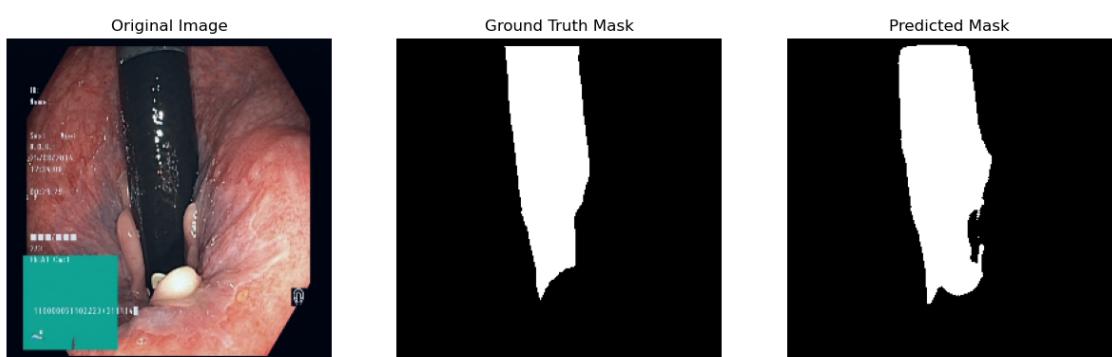
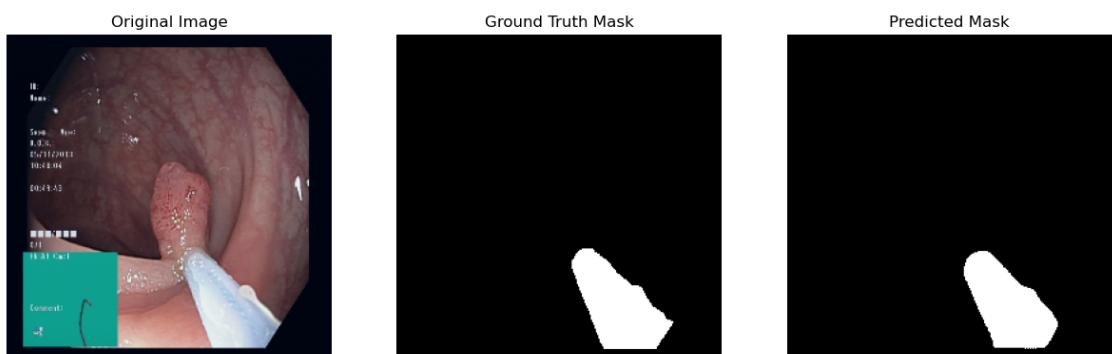
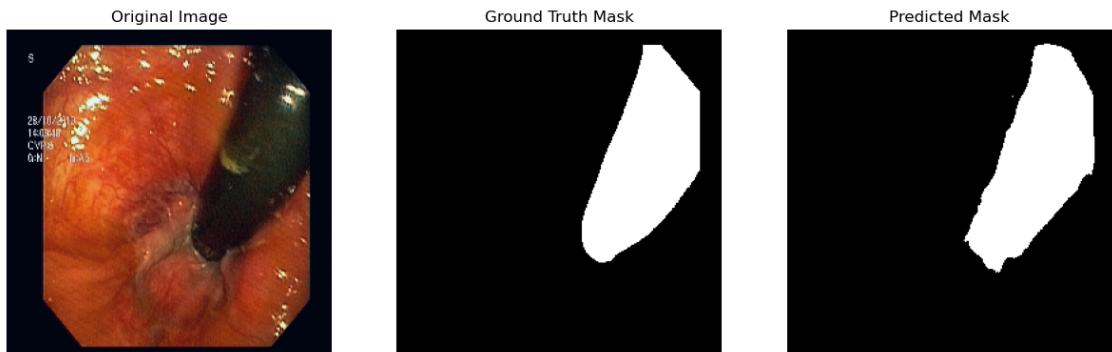
Current Learning Rate: 0.0005
EarlyStopping counter: 1 out of 5
Epoch 27/60 - Training Loss: 0.0889 - Validation Loss: 0.0590 - Training Acc: 96.49% - Validation Acc: 97.88% - Training Dice: 0.8171 - Validation Dice: 0.8837 - Training IoU: 0.6974 - Validation IoU: 0.7933

Current Learning Rate: 0.0005
EarlyStopping counter: 2 out of 5
Epoch 28/60 - Training Loss: 0.0891 - Validation Loss: 0.0643 - Training Acc: 96.57% - Validation Acc: 97.65% - Training Dice: 0.8243 - Validation Dice: 0.8753 - Training IoU: 0.7056 - Validation IoU: 0.7809

Current Learning Rate: 0.00025
EarlyStopping counter: 3 out of 5
Epoch 29/60 - Training Loss: 0.0870 - Validation Loss: 0.0572 - Training Acc: 96.70% - Validation Acc: 97.98% - Training Dice: 0.8260 - Validation Dice: 0.8869 - Training IoU: 0.7104 - Validation IoU: 0.7985

Current Learning Rate: 0.00025
EarlyStopping counter: 4 out of 5
Epoch 30/60 - Training Loss: 0.0849 - Validation Loss: 0.0665 - Training Acc:

96.74% - Validation Acc: 97.57% - Training Dice: 0.8323 - Validation Dice: 0.8733 - Training IoU: 0.7180 - Validation IoU: 0.7779



Current Learning Rate: 0.00025
EarlyStopping counter: 0 out of 5
Epoch 31/60 - Training Loss: 0.0836 - Validation Loss: 0.0533 - Training Acc: 96.79% - Validation Acc: 98.12% - Training Dice: 0.8317 - Validation Dice:

0.8977 - Training IoU: 0.7168 - Validation IoU: 0.8159

Current Learning Rate: 0.00025
EarlyStopping counter: 1 out of 5
Epoch 32/60 - Training Loss: 0.0820 - Validation Loss: 0.0576 - Training Acc: 96.85% - Validation Acc: 97.92% - Training Dice: 0.8397 - Validation Dice: 0.8871 - Training IoU: 0.7293 - Validation IoU: 0.7992

Current Learning Rate: 0.00025
EarlyStopping counter: 2 out of 5
Epoch 33/60 - Training Loss: 0.0842 - Validation Loss: 0.0560 - Training Acc: 96.68% - Validation Acc: 98.00% - Training Dice: 0.8283 - Validation Dice: 0.8878 - Training IoU: 0.7127 - Validation IoU: 0.7997

Current Learning Rate: 0.000125
EarlyStopping counter: 3 out of 5
Epoch 34/60 - Training Loss: 0.0801 - Validation Loss: 0.0604 - Training Acc: 96.91% - Validation Acc: 97.77% - Training Dice: 0.8396 - Validation Dice: 0.8706 - Training IoU: 0.7282 - Validation IoU: 0.7727

Current Learning Rate: 0.000125
EarlyStopping counter: 0 out of 5
Epoch 35/60 - Training Loss: 0.0778 - Validation Loss: 0.0533 - Training Acc: 97.02% - Validation Acc: 98.08% - Training Dice: 0.8494 - Validation Dice: 0.8936 - Training IoU: 0.7428 - Validation IoU: 0.8092

Current Learning Rate: 0.000125
EarlyStopping counter: 1 out of 5
Epoch 36/60 - Training Loss: 0.0772 - Validation Loss: 0.0547 - Training Acc: 97.01% - Validation Acc: 97.96% - Training Dice: 0.8486 - Validation Dice: 0.8877 - Training IoU: 0.7417 - Validation IoU: 0.7999

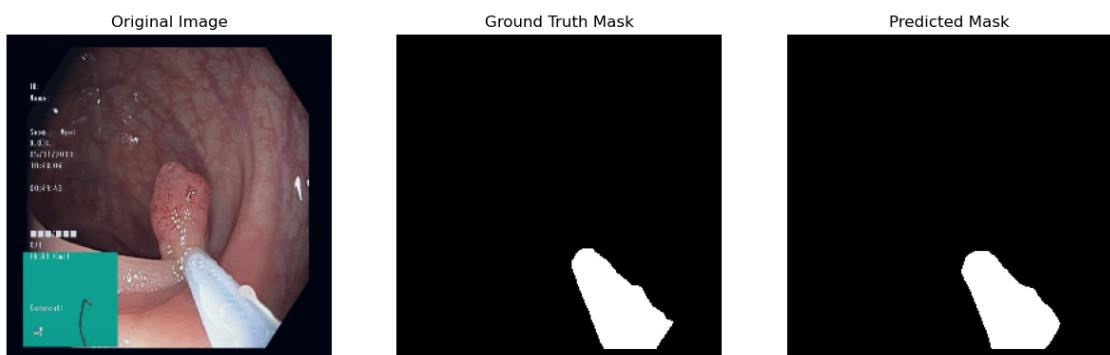
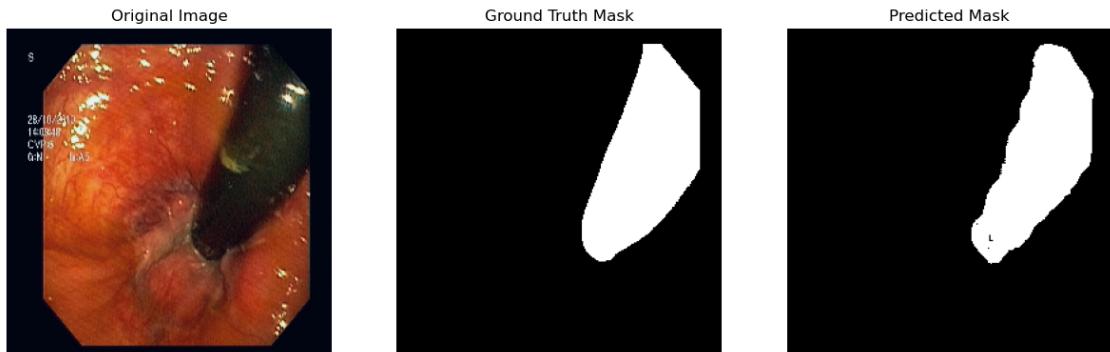
Current Learning Rate: 0.000125
EarlyStopping counter: 0 out of 5
Epoch 37/60 - Training Loss: 0.0800 - Validation Loss: 0.0504 - Training Acc: 96.90% - Validation Acc: 98.19% - Training Dice: 0.8385 - Validation Dice: 0.8994 - Training IoU: 0.7285 - Validation IoU: 0.8189

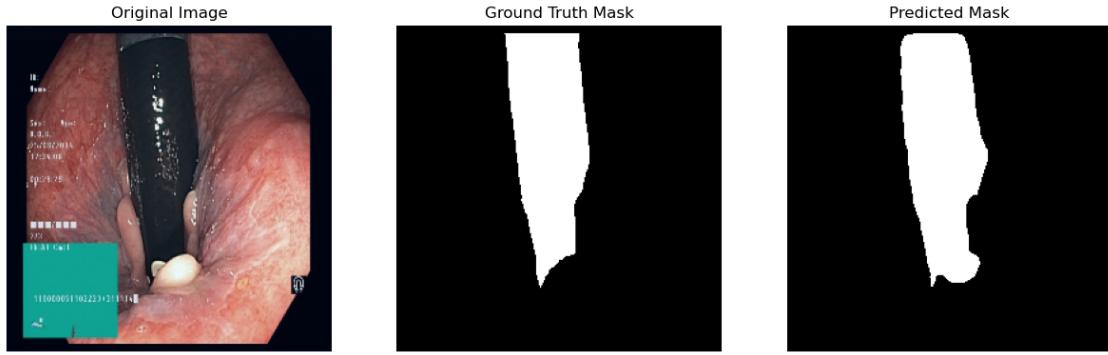
Current Learning Rate: 0.000125
EarlyStopping counter: 1 out of 5
Epoch 38/60 - Training Loss: 0.0798 - Validation Loss: 0.0538 - Training Acc:

96.93% - Validation Acc: 98.10% - Training Dice: 0.8413 - Validation Dice: 0.8956 - Training IoU: 0.7310 - Validation IoU: 0.8127

Current Learning Rate: 0.000125
EarlyStopping counter: 2 out of 5
Epoch 39/60 - Training Loss: 0.0784 - Validation Loss: 0.0565 - Training Acc: 96.99% - Validation Acc: 97.92% - Training Dice: 0.8446 - Validation Dice: 0.8873 - Training IoU: 0.7361 - Validation IoU: 0.7998

Current Learning Rate: 6.25e-05
EarlyStopping counter: 3 out of 5
Epoch 40/60 - Training Loss: 0.0766 - Validation Loss: 0.0518 - Training Acc: 97.05% - Validation Acc: 98.16% - Training Dice: 0.8491 - Validation Dice: 0.8967 - Training IoU: 0.7424 - Validation IoU: 0.8144



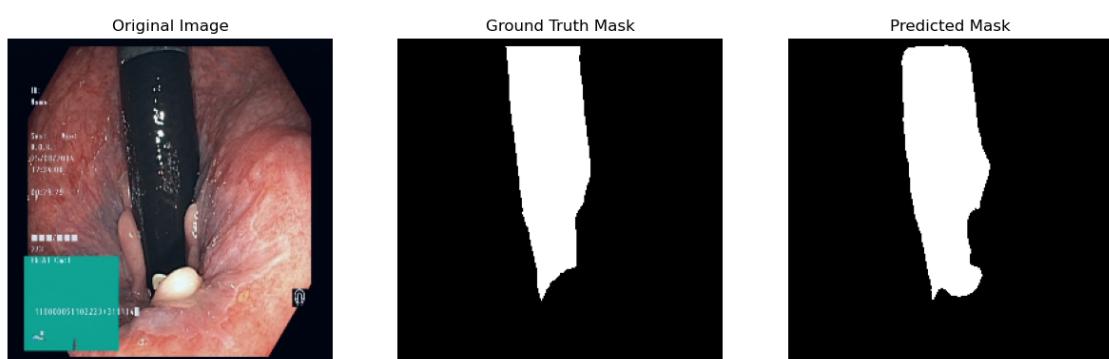
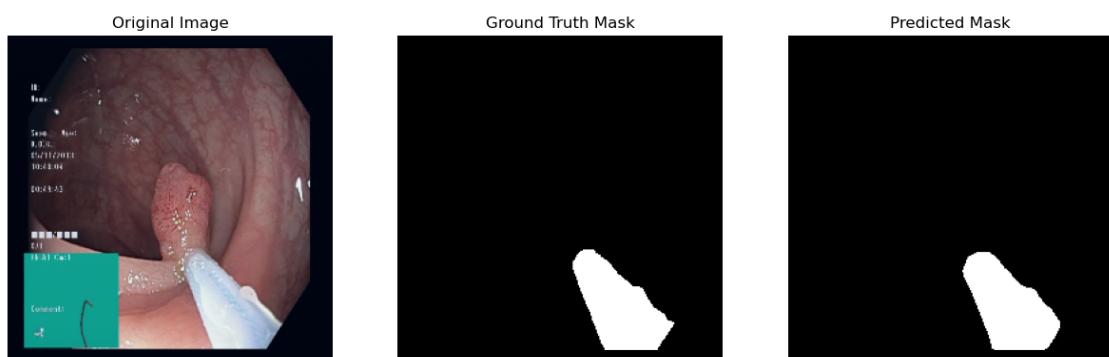
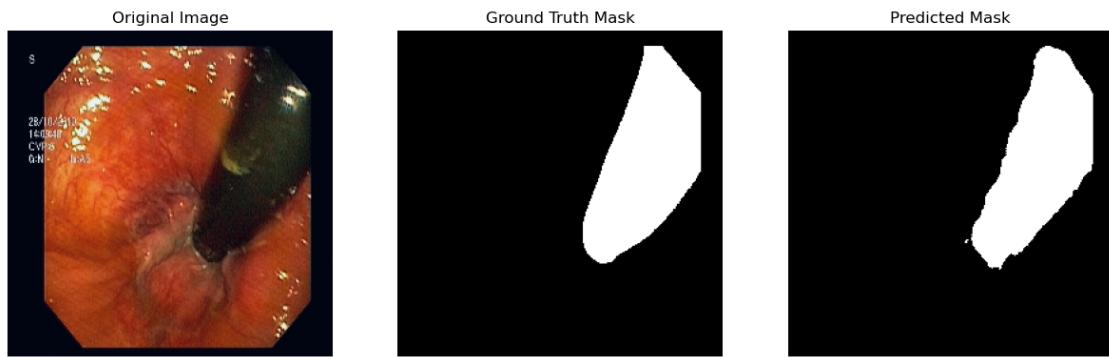
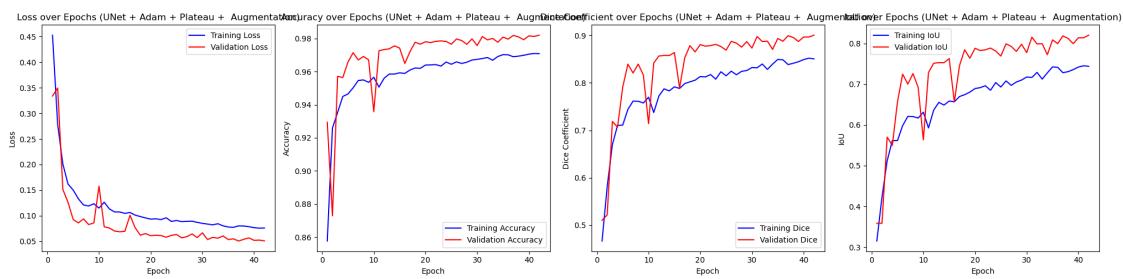


```

Current Learning Rate: 6.25e-05
EarlyStopping counter: 4 out of 5
Epoch 41/60 - Training Loss: 0.0756 - Validation Loss: 0.0523 - Training Acc:
97.09% - Validation Acc: 98.13% - Training Dice: 0.8520 - Validation Dice:
0.8965 - Training IoU: 0.7455 - Validation IoU: 0.8142
C:\Users\Mike\AppData\Local\Temp\ipykernel_11792\279954375.py:42: FutureWarning:
You are using `torch.load` with `weights_only=False` (the current default
value), which uses the default pickle module implicitly. It is possible to
construct malicious pickle data which will execute arbitrary code during
unpickling (See
https://github.com/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for
more details). In a future release, the default value for `weights_only` will be
flipped to `True`. This limits the functions that could be executed during
unpickling. Arbitrary objects will no longer be allowed to be loaded via this
mode unless they are explicitly allowlisted by the user via
`torch.serialization.add_safe_globals`. We recommend you start setting
`weights_only=True` for any use case where you don't have full control of the
loaded file. Please open an issue on GitHub for any issues related to this
experimental feature.
    best_model.load_state_dict(torch.load(os.path.join(working_dir,
'best_model.pth')))

Current Learning Rate: 6.25e-05
EarlyStopping counter: 5 out of 5
Early stopping at epoch 42

```



Summary of Experiments:

	Model	Best Epoch	Train Loss	\		
0	FPN + Adam + Plateau + Augmentation	25	0.029768			
1	UNet++ + Adam + Plateau + Augmentation	31	0.028620			
2	UNet + Adam + Plateau + Augmentation	37	0.080022			
	Validation Loss	Train Accuracy	Validation Accuracy	Train Dice	\	
0	0.030163	0.988987	0.988568	0.943302		
1	0.030852	0.989107	0.989509	0.943888		
2	0.050424	0.968974	0.981851	0.838549		
	Validation Dice	Train IoU	Validation IoU	Test Loss	Test Accuracy	\
0	0.937200	0.893584	0.883019	0.030163	0.988568	
1	0.942326	0.894811	0.892157	0.030852	0.989509	
2	0.899390	0.728528	0.818920	0.050424	0.981851	
	Test Dice	Test IoU				
0	0.937200	0.883019				
1	0.942326	0.892157				
2	0.899390	0.818920				

Experiment Results Summary

	Model	Best Epoch	Train Loss	Validation Loss	Train Dice	Validation Dice	Test Loss	Test Dice	Test Accuracy	\	
	FPN + Adam + Plateau + Augmentation	25	0.0297674245942548	0.030163000000000003	0.9889874000000001	0.9885680000000001	0.030163000000000003	0.9889874000000001	0.9885680000000001	0.9372009745071241	0.9372009745071241
	UNet++ + Adam + Plateau + Augmentation	31	0.0286197847935848	0.030852000000000003	0.9891070000000001	0.9895090000000001	0.030852000000000003	0.9891070000000001	0.9895090000000001	0.9433020000000001	0.9433020000000001
	UNet + Adam + Plateau + Augmentation	37	0.0504247357350571	0.0504247357350571	0.9689740000000001	0.9818510000000001	0.0504247357350571	0.9818510000000001	0.9818510000000001	0.8385490000000001	0.8385490000000001