Endoscopy Image Processing & Classification

Sujal, AI20BTECH11020
Artificial Intellegince
Indian Institute of Technology Hyderabad, Telangana, India

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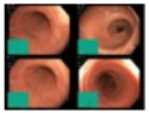
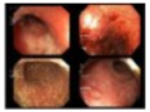
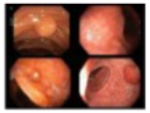
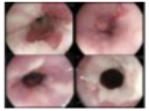
INTRODUCTION

- Diagnosing gastrointestinal diseases of images taken with the Wireless Capsule Endoscopy (WCE) method.
- Capture visual images of the GI tract.
- The classification of images taken using the WCE method, into four classes: polyps, ulcerative colitis, esophagitis, and normal
- Comparing EfficientNetB2 Model & InceptionNetv3 Model.

Dataset

Table 1. Dataset specifications.

Raw samples	Class	Train	Validation	Test	Total
	Normal	800	500	200	1500
	Ulcer	800	500	200	1500
	Polyps	800	500	200	1500
	Esophagitis	800	500	200	1500
Total		**3,200**	**2,000**	**800**	**6,000**

Dataset size: 1.2GB

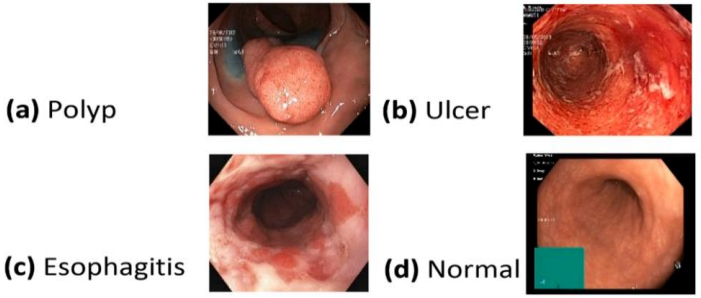


Figure 2. Gastrointestinal conditions: polyp (a), ulcerative colitis (b), esophagitis (c), healthy gastrointestinal tract (d)

Pre-processing by using Keras' "ImageDataGenerator"

- Images are resized to 224 x 224 x 3 pixels.
- train(53.3%), validate(33.3%) and test(13.3%) images.

Augmentation	Value
Horizontal flip	True
Rotation Range	15
Shear Range	0.2
Zoom Range	0.2
Height shift	0.1
Width shift	0.1

Table 1. Data augmentation settings

Model Implementation

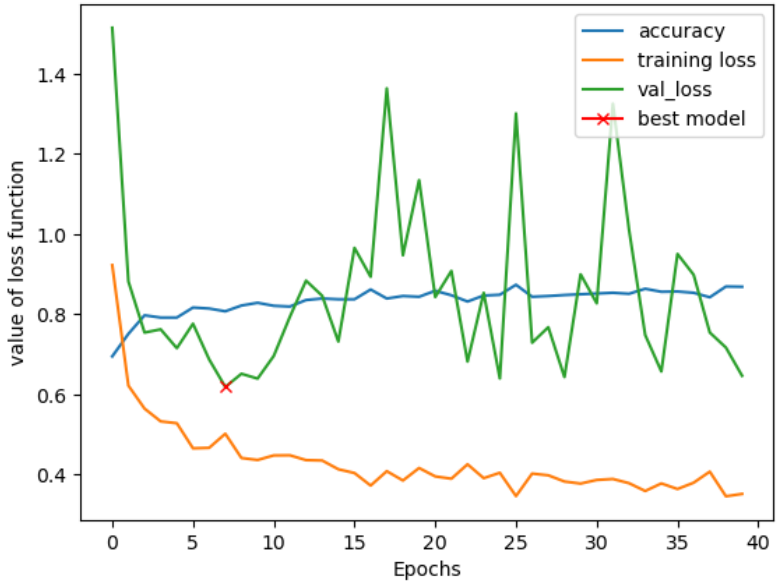
- Using transfer learning by using pre-trained models on ImageNet.
- InceptionNetv3 and EfficientNetB2 to extract features from an image.
- Use the **Adam optimizer** due to it converge faster and more efficiently.
- Record all metrics like accuracy, Precision, Recall and AUC at each epoch.

InceptionNet Vs EfficientNet

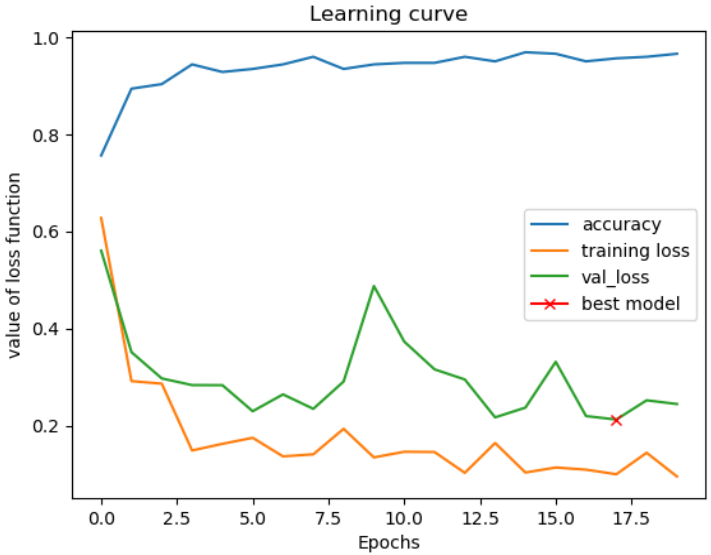
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 inception_v3 (Functional)   (None, 5, 5, 2048)        21802784

 flatten (Flatten)           (None, 51200)             0

 dense (Dense)               (None, 512)               26214912

 batch_normalization_94 (Bat  (None, 512)              2048
 chNormalization)

 gaussian_noise (GaussianNoi  (None, 512)              0
 se)

 dropout (Dropout)           (None, 512)               0

 dense_1 (Dense)             (None, 4)                 2052

=================================================================
Total params: 48,021,796
Trainable params: 26,217,988
Non-trainable params: 21,803,808
_________________________________________________________________
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 efficientnetb2 (Functional)  (None, 7, 7, 1408)       7768569

 gaussian_noise (GaussianNoi  (None, 7, 7, 1408)       0
 se)

 global_average_pooling2d (G  (None, 1408)             0
 lobalAveragePooling2D)

 dense (Dense)               (None, 256)               360704

 batch_normalization (BatchN  (None, 256)              1024
 ormalization)

 gaussian_noise_1 (GaussianN  (None, 256)              0
 oise)

 dropout (Dropout)           (None, 256)               0

 dense_1 (Dense)             (None, 4)                 1028

=================================================================
Total params: 8,131,325
Trainable params: 362,244
Non-trainable params: 7,769,081
_________________________________________________________________
```

Training:



InceptionNetV3 epochs : 40

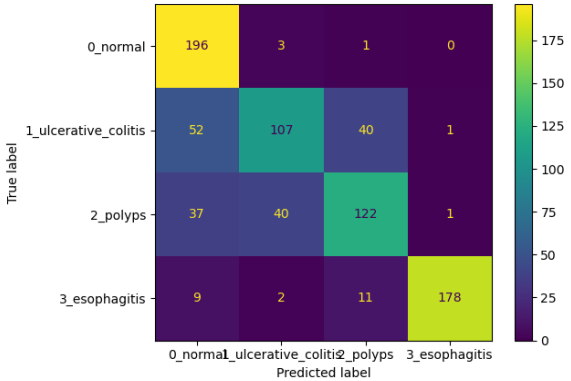


EfficientNetB2 epoch : 20

Results using Test data

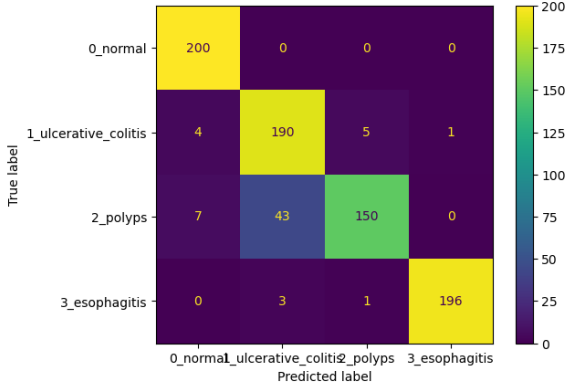
	precision	recall	f1-score
normal cells	0.70	0.97	0.81
ulcerative colitis cells	0.79	0.62	0.70
polyps cells	0.75	0.66	0.70
esophagitis cells	0.96	0.91	0.94
Average	0.80	0.79	0.79

Table 2. Classification Report of inceptionV3 model on Test data



	precision	recall	f1-score
normal cells	0.94	1.00	0.97
ulcerative colitis cells	0.85	0.96	0.90
polyps cells	0.98	0.81	0.88
esophagitis cells	0.99	0.98	0.99
Average	0.94	0.94	0.94

Table 3. Classification Report of EfficientNetB2 model on Test data



Conclusion

- EfficientNetB2 with an accuracy of 94%, perform better than InceptionNetV3, with an accuracy of 79%.
- InceptionNetv3 uses a combination of convolutional layers, max-pooling layers, and fully connected layers.
- EfficientNetB2 uses a compound scaling method to balance the network's depth, width, and resolution.
- EfficientNetB2 requires less training time than InceptionNetv3 due to its efficient architecture and compound scaling method.
- EfficientNetB2 has a smaller model size compared to InceptionNetv3, making it easier to deploy on resource-constrained devices.

References

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- EfficientNetV2: https://www.tensorflow.org/api_docs/python/tf/keras/applications/efficientnet_v2/EfficientNetV2L