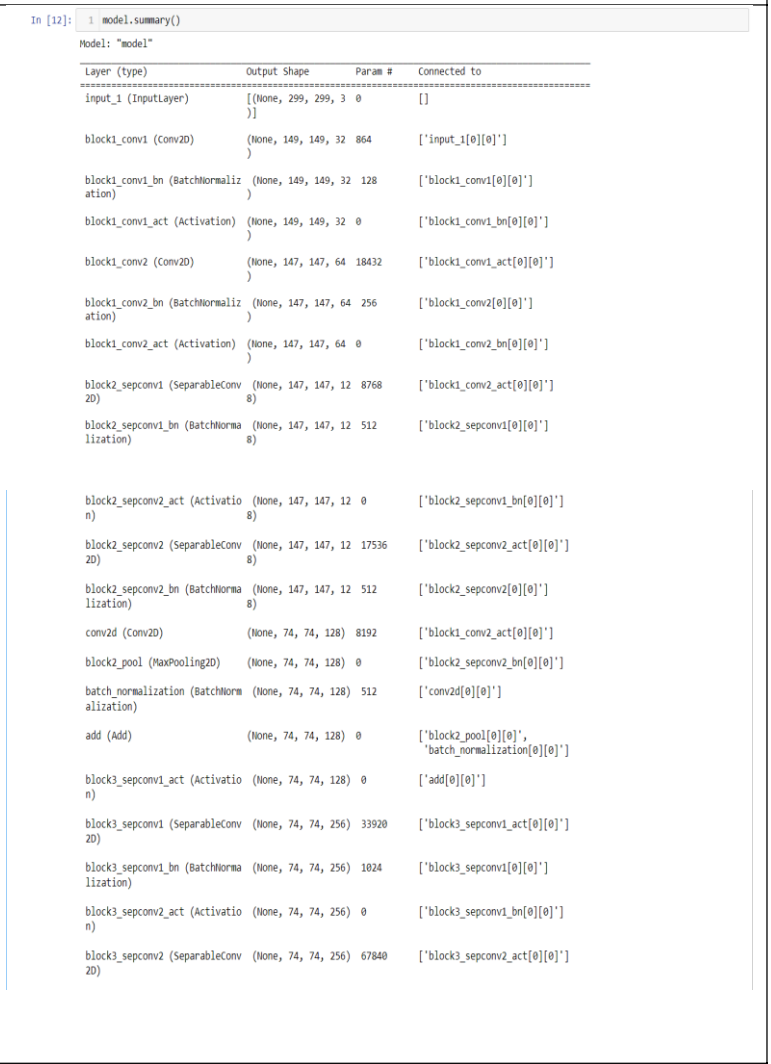
Project Development Phase
Model Performance Test

Date	15 November 2022
Team ID	PNT2022TMID43448
Project Name	Project – Deep learning Fundus image analysis for early detection of Diabetic Retinopathy
Maximum Marks	10 Marks

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

S.No.	Parameter	Values	Screenshot
1.	Model Summary	-	

```
In [12]: model.summary()

Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
input_1 (InputLayer)         [(None, 299, 299, 3)]     0         
block1_conv1 (Conv2D)        (None, 149, 149, 32)      864       
block1_conv1_bn (BatchNormalization)  (None, 149, 149, 32)  128       
block1_conv1_act (Activation)  (None, 149, 149, 32)  0         
block1_conv2 (Conv2D)        (None, 147, 147, 64)      18432     
block1_conv2_bn (BatchNormalization)  (None, 147, 147, 64)  256       
block1_conv2_act (Activation)  (None, 147, 147, 64)  0         
block2_sepconv1 (SeparableConv2D)  (None, 147, 147, 128)  8768      
block2_sepconv1_bn (BatchNormalization)  (None, 147, 147, 128)  512       
block2_sepconv2_act (Activation)  (None, 147, 147, 128)  0         
block2_sepconv2 (SeparableConv2D)  (None, 147, 147, 128)  17536     
block2_sepconv2_bn (BatchNormalization)  (None, 147, 147, 128)  512       
conv2d (Conv2D)              (None, 74, 74, 128)       8192      
block2_pool (MaxPooling2D)   (None, 74, 74, 128)       0         
batch_normalization (BatchNormalization)  (None, 74, 74, 128)  512       
add (Add)                    (None, 74, 74, 128)       0         
block3_sepconv1_act (Activation)  (None, 74, 74, 128)  0         
block3_sepconv1 (SeparableConv2D)  (None, 74, 74, 256)  33920     
block3_sepconv1_bn (BatchNormalization)  (None, 74, 74, 256)  1024      
block3_sepconv2_act (Activation)  (None, 74, 74, 256)  0         
block3_sepconv2 (SeparableConv2D)  (None, 74, 74, 256)  67840     
```

			block3_sepconv2_bn (BatchNorma lization) (None, 74, 74, 256) 1024 ['block3_sepconv2[0][0]'] conv2d_1 (Conv2D) (None, 37, 37, 256) 32768 ['add[0][0]'] block3_pool (MaxPooling2D) (None, 37, 37, 256) 0 ['block3_sepconv2_bn[0][0]'] batch_normalization_1 (BatchNo rmalization) (None, 37, 37, 256) 1024 ['conv2d_1[0][0]'] add_1 (Add) (None, 37, 37, 256) 0 ['block3_pool[0][0]', 'batch_normalization_1[0][0]'] block4_sepconv1_act (Activatio n) (None, 37, 37, 256) 0 ['add_1[0][0]'] block4_sepconv1 (SeparableConv 2D) (None, 37, 37, 728) 188672 ['block4_sepconv1_act[0][0]'] block4_sepconv1_bn (BatchNorma lization) (None, 37, 37, 728) 2912 ['block4_sepconv1[0][0]'] block4_sepconv2_act (Activatio n) (None, 37, 37, 728) 0 ['block4_sepconv1_bn[0][0]'] block4_sepconv2 (SeparableConv 2D) (None, 37, 37, 728) 536536 ['block4_sepconv2_act[0][0]'] block4_sepconv2_bn (BatchNorma lization) (None, 37, 37, 728) 2912 ['block4_sepconv2[0][0]'] conv2d_2 (Conv2D) (None, 19, 19, 728) 186368 ['add_1[0][0]'] block4_pool (MaxPooling2D) (None, 19, 19, 728) 0 ['block4_sepconv2_bn[0][0]'] batch_normalization_2 (BatchNo rmalization) (None, 19, 19, 728) 2912 ['conv2d_2[0][0]'] add_2 (Add) (None, 19, 19, 728) 0 ['block4_pool[0][0]', 'batch_normalization_2[0][0]'] block5_sepconv1_act (Activatio n) (None, 19, 19, 728) 0 ['add_2[0][0]'] block5_sepconv1 (SeparableConv 2D) (None, 19, 19, 728) 536536 ['block5_sepconv1_act[0][0]'] block5_sepconv1_bn (BatchNorma lization) (None, 19, 19, 728) 2912 ['block5_sepconv1[0][0]'] block5_sepconv2_act (Activatio n) (None, 19, 19, 728) 0 ['block5_sepconv1_bn[0][0]'] block5_sepconv2 (SeparableConv 2D) (None, 19, 19, 728) 536536 ['block5_sepconv2_act[0][0]'] block5_sepconv2_bn (BatchNorma lization) (None, 19, 19, 728) 2912 ['block5_sepconv2[0][0]'] block5_sepconv3_act (Activatio n) (None, 19, 19, 728) 0 ['block5_sepconv2_bn[0][0]'] block5_sepconv3 (SeparableConv 2D) (None, 19, 19, 728) 536536 ['block5_sepconv3_act[0][0]'] block5_sepconv3_bn (BatchNorma lization) (None, 19, 19, 728) 2912 ['block5_sepconv3[0][0]'] add_3 (Add) (None, 19, 19, 728) 0 ['block5_sepconv3_bn[0][0]', 'add_2[0][0]']

```
block6_sepconv1_act (Activatio  (None, 19, 19, 728)  0          ['add_3[0][0]']
n)

block6_sepconv1 (SeparableConv  (None, 19, 19, 728)  536536     ['block6_sepconv1_act[0][0]']
2D)

block6_sepconv1_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block6_sepconv1[0][0]']
lization)

block6_sepconv2_act (Activatio  (None, 19, 19, 728)  0          ['block6_sepconv1_bn[0][0]']
n)

block6_sepconv2 (SeparableConv  (None, 19, 19, 728)  536536     ['block6_sepconv2_act[0][0]']
2D)

block6_sepconv2_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block6_sepconv2[0][0]']
lization)

block6_sepconv3_act (Activatio  (None, 19, 19, 728)  0          ['block6_sepconv2_bn[0][0]']
n)

block6_sepconv3 (SeparableConv  (None, 19, 19, 728)  536536     ['block6_sepconv3_act[0][0]']
2D)

block6_sepconv3_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block6_sepconv3[0][0]']
lization)

add_4 (Add)                     (None, 19, 19, 728)  0          ['block6_sepconv3_bn[0][0]',
                                                                 'add_3[0][0]']

block7_sepconv1_act (Activatio  (None, 19, 19, 728)  0          ['add_4[0][0]']

n)

block7_sepconv1 (SeparableConv  (None, 19, 19, 728)  536536     ['block7_sepconv1_act[0][0]']
2D)

block7_sepconv1_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block7_sepconv1[0][0]']
lization)

block7_sepconv2_act (Activatio  (None, 19, 19, 728)  0          ['block7_sepconv1_bn[0][0]']
n)

block7_sepconv2 (SeparableConv  (None, 19, 19, 728)  536536     ['block7_sepconv2_act[0][0]']
2D)

block7_sepconv2_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block7_sepconv2[0][0]']
lization)

block7_sepconv3_act (Activatio  (None, 19, 19, 728)  0          ['block7_sepconv2_bn[0][0]']
n)

block7_sepconv3 (SeparableConv  (None, 19, 19, 728)  536536     ['block7_sepconv3_act[0][0]']
2D)

block7_sepconv3_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block7_sepconv3[0][0]']
lization)

add_5 (Add)                     (None, 19, 19, 728)  0          ['block7_sepconv3_bn[0][0]',
                                                                 'add_4[0][0]']

block8_sepconv1_act (Activatio  (None, 19, 19, 728)  0          ['add_5[0][0]']
n)

block8_sepconv1 (SeparableConv  (None, 19, 19, 728)  536536     ['block8_sepconv1_act[0][0]']
2D)

block8_sepconv1_bn (BatchNorma  (None, 19, 19, 728)  2912       ['block8_sepconv1[0][0]']
lization)

block8_sepconv2_act (Activatio  (None, 19, 19, 728)  0          ['block8_sepconv1_bn[0][0]']
n)
```

```
block8_sepconv2 (SeparableConv  (None, 19, 19, 728)  536536    ['block8_sepconv2_act[0][0]']
2D)

block8_sepconv2_bn (BatchNorma  (None, 19, 19, 728)  2912      ['block8_sepconv2[0][0]']
lization)

block8_sepconv3_act (Activatio  (None, 19, 19, 728)  0         ['block8_sepconv2_bn[0][0]']
n)

block8_sepconv3 (SeparableConv  (None, 19, 19, 728)  536536    ['block8_sepconv3_act[0][0]']
2D)

block8_sepconv3_bn (BatchNorma  (None, 19, 19, 728)  2912      ['block8_sepconv3[0][0]']
lization)

add_6 (Add)                     (None, 19, 19, 728)  0         ['block8_sepconv3_bn[0][0]',
                                                                'add_5[0][0]']

block9_sepconv1_act (Activatio  (None, 19, 19, 728)  0         ['add_6[0][0]']
n)

block9_sepconv1 (SeparableConv  (None, 19, 19, 728)  536536    ['block9_sepconv1_act[0][0]']
2D)

block9_sepconv1_bn (BatchNorma  (None, 19, 19, 728)  2912      ['block9_sepconv1[0][0]']
lization)

block9_sepconv2_act (Activatio  (None, 19, 19, 728)  0         ['block9_sepconv1_bn[0][0]']
n)

block9_sepconv2 (SeparableConv  (None, 19, 19, 728)  536536    ['block9_sepconv2_act[0][0]']
2D)

block9_sepconv2_bn (BatchNorma  (None, 19, 19, 728)  2912      ['block9_sepconv2[0][0]']
lization)
```

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block9_sepconv3_act (Activatio  (None, 19, 19, 728)  0         ['block9_sepconv2_bn[0][0]']
n)

block9_sepconv3 (SeparableConv  (None, 19, 19, 728)  536536    ['block9_sepconv3_act[0][0]']
2D)

block9_sepconv3_bn (BatchNorma  (None, 19, 19, 728)  2912      ['block9_sepconv3[0][0]']
lization)

add_7 (Add)                     (None, 19, 19, 728)  0         ['block9_sepconv3_bn[0][0]',
                                                                'add_6[0][0]']

block10_sepconv1_act (Activati  (None, 19, 19, 728)  0         ['add_7[0][0]']
on)

block10_sepconv1 (SeparableCon  (None, 19, 19, 728)  536536    ['block10_sepconv1_act[0][0]']
v2D)

block10_sepconv1_bn (BatchNorm  (None, 19, 19, 728)  2912      ['block10_sepconv1[0][0]']
alization)

block10_sepconv2_act (Activati  (None, 19, 19, 728)  0         ['block10_sepconv1_bn[0][0]']
on)

block10_sepconv2 (SeparableCon  (None, 19, 19, 728)  536536    ['block10_sepconv2_act[0][0]']
v2D)

block10_sepconv2_bn (BatchNorm  (None, 19, 19, 728)  2912      ['block10_sepconv2[0][0]']
alization)

block10_sepconv3_act (Activati  (None, 19, 19, 728)  0         ['block10_sepconv2_bn[0][0]']
on)
```

			block10_sepconv3 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block10_sepconv3_act[0][0]'] block10_sepconv3_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block10_sepconv3[0][0]'] add_8 (Add) (None, 19, 19, 728) 0 ['block10_sepconv3_bn[0][0]', 'add_7[0][0]'] block11_sepconv1_act (Activation) (None, 19, 19, 728) 0 ['add_8[0][0]'] block11_sepconv1 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block11_sepconv1_act[0][0]'] block11_sepconv1_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block11_sepconv1[0][0]'] block11_sepconv2_act (Activation) (None, 19, 19, 728) 0 ['block11_sepconv1_bn[0][0]'] block11_sepconv2 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block11_sepconv2_act[0][0]'] block11_sepconv2_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block11_sepconv2[0][0]'] block11_sepconv3_act (Activation) (None, 19, 19, 728) 0 ['block11_sepconv2_bn[0][0]'] block11_sepconv3 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block11_sepconv3_act[0][0]'] block11_sepconv3_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block11_sepconv3[0][0]'] add_9 (Add) (None, 19, 19, 728) 0 ['block11_sepconv3_bn[0][0]', 'add_8[0][0]'] block12_sepconv1_act (Activation) (None, 19, 19, 728) 0 ['add_9[0][0]'] block12_sepconv1 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block12_sepconv1_act[0][0]'] block12_sepconv1_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block12_sepconv1[0][0]'] block12_sepconv2_act (Activation) (None, 19, 19, 728) 0 ['block12_sepconv1_bn[0][0]'] block12_sepconv2 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block12_sepconv2_act[0][0]'] block12_sepconv2_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block12_sepconv2[0][0]'] block12_sepconv3_act (Activation) (None, 19, 19, 728) 0 ['block12_sepconv2_bn[0][0]'] block12_sepconv3 (SeparableConv2D) (None, 19, 19, 728) 536536 ['block12_sepconv3_act[0][0]'] block12_sepconv3_bn (BatchNormalization) (None, 19, 19, 728) 2912 ['block12_sepconv3[0][0]'] add_10 (Add) (None, 19, 19, 728) 0 ['block12_sepconv3_bn[0][0]', 'add_9[0][0]'] block13_sepconv1_act (Activation) (None, 19, 19, 728) 0 ['add_10[0][0]']

```
block13_sepconv1 (SeparableCon  (None, 19, 19, 728)  536536     ['block13_sepconv1_act[0][0]']
v2D)

block13_sepconv1_bn (BatchNorm  (None, 19, 19, 728)  2912       ['block13_sepconv1[0][0]']
alization)

block13_sepconv2_act (Activati  (None, 19, 19, 728)  0          ['block13_sepconv1_bn[0][0]']
on)

block13_sepconv2 (SeparableCon  (None, 19, 19, 1024  752024     ['block13_sepconv2_act[0][0]']
v2D)                            )

block13_sepconv2_bn (BatchNorm  (None, 19, 19, 1024  4096       ['block13_sepconv2[0][0]']
alization)                      )

conv2d_3 (Conv2D)               (None, 10, 10, 1024  745472     ['add_10[0][0]']
                                )

block13_pool (MaxPooling2D)     (None, 10, 10, 1024  0          ['block13_sepconv2_bn[0][0]']
                                )

batch_normalization_3 (BatchNo  (None, 10, 10, 1024  4096       ['conv2d_3[0][0]']
rmalization)                    )

add_11 (Add)                    (None, 10, 10, 1024  0          ['block13_pool[0][0]',
                                )                                'batch_normalization_3[0][0]']

block14_sepconv1 (SeparableCon  (None, 10, 10, 1536  1582080    ['add_11[0][0]']
v2D)                            )

block14_sepconv1_bn (BatchNorm  (None, 10, 10, 1536  6144       ['block14_sepconv1[0][0]']
alization)                      )

block14_sepconv1_act (Activati  (None, 10, 10, 1536  0          ['block14_sepconv1_bn[0][0]']
on)                             )
```

```
block14_sepconv2 (SeparableCon  (None, 10, 10, 2048  3159552    ['block14_sepconv1_act[0][0]']
v2D)                            )

block14_sepconv2_bn (BatchNorm  (None, 10, 10, 2048  8192       ['block14_sepconv2[0][0]']
alization)                      )

block14_sepconv2_act (Activati  (None, 10, 10, 2048  0          ['block14_sepconv2_bn[0][0]']
on)                             )

flatten (Flatten)               (None, 204800)       0          ['block14_sepconv2_act[0][0]']

dense (Dense)                   (None, 5)            1024005    ['flatten[0][0]']

==================================================================================================
Total params: 21,885,485
Trainable params: 1,024,005
Non-trainable params: 20,861,480
__________________________________________________________________________________________________
```

2.	Accuracy	Training Accuracy – 0.8229
		
		Validation Accuracy - 0.8542
			In [19]:
			`r = model.fit_generator(training_set,`
			`validation_data=test_set,`
			`epochs=30,`
			`steps_per_epoch=len(training_set)//32,`
			`validation_steps=len(test_set)//32`
			`)`
			
			C:\Users\SRI SAI\AppData\Local\Temp\ipykernel_7336\2721303376.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.
			r = model.fit_generator(training_set,
			
			Epoch 1/30
			3/3 [==========] - 75s 29s/step - loss: 2.6565 - accuracy: 0.8021 - val_loss: 3.1720 - val_accuracy: 0.7500
			Epoch 2/30
			3/3 [==========] - 58s 23s/step - loss: 3.3913 - accuracy: 0.7708 - val_loss: 2.9005 - val_accuracy: 0.7500
			Epoch 3/30
			3/3 [==========] - 55s 22s/step - loss: 3.5876 - accuracy: 0.7396 - val_loss: 2.6472 - val_accuracy: 0.7917
			Epoch 4/30
			3/3 [==========] - 55s 22s/step - loss: 2.8447 - accuracy: 0.7604 - val_loss: 4.0986 - val_accuracy: 0.7708
			Epoch 5/30
			3/3 [==========] - 54s 22s/step - loss: 3.9040 - accuracy: 0.7604 - val_loss: 2.7981 - val_accuracy: 0.7188
			Epoch 6/30
			3/3 [==========] - 55s 22s/step - loss: 2.1252 - accuracy: 0.8333 - val_loss: 2.0358 - val_accuracy: 0.8021
			Epoch 7/30
			3/3 [==========] - 49s 22s/step - loss: 3.1932 - accuracy: 0.7692 - val_loss: 2.9658 - val_accuracy: 0.7708
			Epoch 8/30
			3/3 [==========] - 53s 21s/step - loss: 5.5181 - accuracy: 0.7396 - val_loss: 2.7313 - val_accuracy: 0.7812
			Epoch 9/30
			3/3 [==========] - 52s 21s/step - loss: 2.6200 - accuracy: 0.8125 - val_loss: 2.4544 - val_accuracy: 0.6875
			Epoch 10/30
			3/3 [==========] - 52s 20s/step - loss: 2.3717 - accuracy: 0.7917 - val_loss: 3.0723 - val_accuracy: 0.6979
			Epoch 11/30
			3/3 [==========] - 53s 21s/step - loss: 3.2614 - accuracy: 0.7500 - val_loss: 2.3165 - val_accuracy: 0.8125
			Epoch 12/30
			3/3 [==========] - 52s 20s/step - loss: 4.0855 - accuracy: 0.6875 - val_loss: 3.2525 - val_accuracy: 0.7812
			Epoch 13/30
			3/3 [==========] - 51s 21s/step - loss: 3.0122 - accuracy: 0.8229 - val_loss: 2.4100 - val_accuracy: 0.7500
			Epoch 14/30
			3/3 [==========] - 50s 20s/step - loss: 2.5197 - accuracy: 0.7604 - val_loss: 1.2110 - val_accuracy: 0.8229
			Epoch 15/30
			3/3 [==========] - 52s 20s/step - loss: 3.1242 - accuracy: 0.7917 - val_loss: 3.1027 - val_accuracy: 0.7292
			Epoch 16/30
			3/3 [==========] - 50s 20s/step - loss: 3.3930 - accuracy: 0.7396 - val_loss: 1.5712 - val_accuracy: 0.8750
			Epoch 17/30
			3/3 [==========] - 53s 21s/step - loss: 2.5512 - accuracy: 0.7812 - val_loss: 1.9767 - val_accuracy: 0.7812
			Epoch 18/30
			3/3 [==========] - 50s 20s/step - loss: 2.0621 - accuracy: 0.8229 - val_loss: 2.6166 - val_accuracy: 0.6875
			Epoch 19/30
			3/3 [==========] - 51s 20s/step - loss: 4.3960 - accuracy: 0.7083 - val_loss: 2.5433 - val_accuracy: 0.7396
			Epoch 20/30
			3/3 [==========] - 52s 21s/step - loss: 1.6552 - accuracy: 0.8438 - val_loss: 3.4086 - val_accuracy: 0.7083
			Epoch 21/30
			3/3 [==========] - 52s 20s/step - loss: 3.8576 - accuracy: 0.7917 - val_loss: 3.9289 - val_accuracy: 0.8021
			Epoch 22/30
			3/3 [==========] - 49s 19s/step - loss: 3.0081 - accuracy: 0.7292 - val_loss: 2.4708 - val_accuracy: 0.7396
			Epoch 23/30
			3/3 [==========] - 49s 20s/step - loss: 2.1175 - accuracy: 0.7812 - val_loss: 1.4821 - val_accuracy: 0.8125
			Epoch 24/30
			3/3 [==========] - 54s 22s/step - loss: 3.0934 - accuracy: 0.7500 - val_loss: 2.5336 - val_accuracy: 0.7917
			Epoch 25/30
			3/3 [==========] - 51s 23s/step - loss: 3.4418 - accuracy: 0.7821 - val_loss: 3.1132 - val_accuracy: 0.7917
			Epoch 26/30
			3/3 [==========] - 54s 21s/step - loss: 1.6937 - accuracy: 0.8229 - val_loss: 1.6791 - val_accuracy: 0.8438
			Epoch 27/30
			3/3 [==========] - 51s 20s/step - loss: 3.0819 - accuracy: 0.7917 - val_loss: 2.6662 - val_accuracy: 0.7604
			Epoch 28/30
			3/3 [==========] - 53s 21s/step - loss: 3.1102 - accuracy: 0.7500 - val_loss: 1.7582 - val_accuracy: 0.7604
			Epoch 29/30
			3/3 [==========] - 53s 20s/step - loss: 2.0389 - accuracy: 0.7917 - val_loss: 2.2502 - val_accuracy: 0.7500
			Epoch 30/30
			3/3 [==========] - 53s 21s/step - loss: 2.8220 - accuracy: 0.8229 - val_loss: 1.1712 - val_accuracy: 0.8542

3.	Confidence Score (Only Yolo Projects)	Class Detected - Confidence Score -	