```
Epoch 1/100
121/121 [==============================] - 34s 145ms/step - loss: 1.8715 - sparse_categorical_accuracy:
0.4127 - val_loss: 3.5062 - val_sparse_categorical_accuracy: 0.0667
Epoch 2/100
121/121 [==============================] - 15s 123ms/step - loss: 1.3821 - sparse_categorical_accuracy:
0.5553 - val_loss: 3.2738 - val_sparse_categorical_accuracy: 0.1698
Epoch 3/100
121/121 [==============================] - 14s 117ms/step - loss: 1.1935 - sparse_categorical_accuracy:
0.6133 - val_loss: 3.8725 - val_sparse_categorical_accuracy: 0.1177
Epoch 4/100
121/121 [==============================] - 15s 122ms/step - loss: 1.0591 - sparse_categorical_accuracy:
0.6546 - val_loss: 1.8469 - val_sparse_categorical_accuracy: 0.4339
Epoch 5/100
121/121 [==============================] - 14s 118ms/step - loss: 0.9068 - sparse_categorical_accuracy:
0.7051 - val_loss: 1.9822 - val_sparse_categorical_accuracy: 0.4276
Epoch 6/100
121/121 [==============================] - 15s 123ms/step - loss: 0.7979 - sparse_categorical_accuracy:
0.7409 - val_loss: 1.2588 - val_sparse_categorical_accuracy: 0.6281
Epoch 7/100
121/121 [==============================] - 14s 119ms/step - loss: 0.6767 - sparse_categorical_accuracy:
0.7777 - val_loss: 2.4234 - val_sparse_categorical_accuracy: 0.4187
Epoch 8/100
121/121 [==============================] - 14s 119ms/step - loss: 0.5636 - sparse_categorical_accuracy:
0.8158 - val_loss: 1.6789 - val_sparse_categorical_accuracy: 0.5542
Epoch 9/100
121/121 [==============================] - 15s 120ms/step - loss: 0.4356 - sparse_categorical_accuracy:
0.8543 - val_loss: 1.6319 - val_sparse_categorical_accuracy: 0.5891
Epoch 10/100
121/121 [==============================] - 15s 121ms/step - loss: 0.3207 - sparse_categorical_accuracy:
0.8951 - val_loss: 1.7636 - val_sparse_categorical_accuracy: 0.5708
Epoch 11/100
121/121 [==============================] - 15s 120ms/step - loss: 0.2435 - sparse_categorical_accuracy:
0.9175 - val_loss: 2.3969 - val_sparse_categorical_accuracy: 0.5484
Epoch 12/100
121/121 [==============================] - 15s 121ms/step - loss: 0.1701 - sparse_categorical_accuracy:
0.9441 - val_loss: 2.2807 - val_sparse_categorical_accuracy: 0.5510
Epoch 13/100
121/121 [==============================] - 15s 121ms/step - loss: 0.1409 - sparse_categorical_accuracy:
0.9519 - val_loss: 2.5994 - val_sparse_categorical_accuracy: 0.5594
Epoch 14/100
121/121 [==============================] - 15s 122ms/step - loss: 0.1239 - sparse_categorical_accuracy:
0.9586 - val_loss: 2.1818 - val_sparse_categorical_accuracy: 0.5464
Epoch 15/100
```

121/121 [==============================] - 15s 121ms/step - loss: 0.0983 - sparse_categorical_accuracy: 0.9676 - val_loss: 2.2923 - val_sparse_categorical_accuracy: 0.5833

Epoch 16/100

121/121 [==============================] - 15s 122ms/step - loss: 0.0847 - sparse_categorical_accuracy: 0.9716 - val_loss: 2.2447 - val_sparse_categorical_accuracy: 0.5979

Epoch 17/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0817 - sparse_categorical_accuracy: 0.9730 - val_loss: 2.1224 - val_sparse_categorical_accuracy: 0.5917

Epoch 18/100

121/121 [==============================] - 15s 122ms/step - loss: 0.0603 - sparse_categorical_accuracy: 0.9795 - val_loss: 2.2300 - val_sparse_categorical_accuracy: 0.6391

Epoch 19/100

121/121 [==============================] - 15s 122ms/step - loss: 0.0781 - sparse_categorical_accuracy: 0.9738 - val_loss: 2.2422 - val_sparse_categorical_accuracy: 0.6396

Epoch 20/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0536 - sparse_categorical_accuracy: 0.9821 - val_loss: 1.8998 - val_sparse_categorical_accuracy: 0.6432

Epoch 21/100

121/121 [==============================] - 15s 122ms/step - loss: 0.0356 - sparse_categorical_accuracy: 0.9883 - val_loss: 2.1157 - val_sparse_categorical_accuracy: 0.6214

Epoch 22/100

121/121 [==============================] - 15s 122ms/step - loss: 0.0665 - sparse_categorical_accuracy: 0.9769 - val_loss: 2.7880 - val_sparse_categorical_accuracy: 0.5880

Epoch 23/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0593 - sparse_categorical_accuracy: 0.9793 - val_loss: 2.7386 - val_sparse_categorical_accuracy: 0.5932

Epoch 24/100

121/121 [==============================] - 15s 125ms/step - loss: 0.0534 - sparse_categorical_accuracy: 0.9813 - val_loss: 1.9075 - val_sparse_categorical_accuracy: 0.6531

Epoch 25/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0476 - sparse_categorical_accuracy: 0.9840 - val_loss: 2.6104 - val_sparse_categorical_accuracy: 0.5672

Epoch 26/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0304 - sparse_categorical_accuracy: 0.9901 - val_loss: 2.2684 - val_sparse_categorical_accuracy: 0.6594

Epoch 27/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0331 - sparse_categorical_accuracy: 0.9885 - val_loss: 2.5232 - val_sparse_categorical_accuracy: 0.6135

Epoch 28/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0501 - sparse_categorical_accuracy: 0.9842 - val_loss: 2.7195 - val_sparse_categorical_accuracy: 0.6089

Epoch 29/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0396 - sparse_categorical_accuracy: 0.9867 - val_loss: 4.8122 - val_sparse_categorical_accuracy: 0.4557

```
Epoch 30/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0294 - sparse_categorical_accuracy:
0.9905 - val_loss: 2.0642 - val_sparse_categorical_accuracy: 0.6641
Epoch 31/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0264 - sparse_categorical_accuracy:
0.9915 - val_loss: 2.2407 - val_sparse_categorical_accuracy: 0.6385
Epoch 32/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0483 - sparse_categorical_accuracy:
0.9834 - val_loss: 2.7951 - val_sparse_categorical_accuracy: 0.5724
Epoch 33/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0584 - sparse_categorical_accuracy:
0.9810 - val_loss: 4.9148 - val_sparse_categorical_accuracy: 0.4349
Epoch 34/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0557 - sparse_categorical_accuracy:
0.9816 - val_loss: 3.0398 - val_sparse_categorical_accuracy: 0.5458
Epoch 35/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0229 - sparse_categorical_accuracy:
0.9930 - val_loss: 2.0821 - val_sparse_categorical_accuracy: 0.6557
Epoch 36/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0126 - sparse_categorical_accuracy:
0.9966 - val_loss: 2.6492 - val_sparse_categorical_accuracy: 0.5813
Epoch 37/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0091 - sparse_categorical_accuracy:
0.9974 - val_loss: 2.9558 - val_sparse_categorical_accuracy: 0.5854
Epoch 38/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0216 - sparse_categorical_accuracy:
0.9930 - val_loss: 2.4491 - val_sparse_categorical_accuracy: 0.6344
Epoch 39/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0680 - sparse_categorical_accuracy:
0.9773 - val_loss: 4.5511 - val_sparse_categorical_accuracy: 0.4667
Epoch 40/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0746 - sparse_categorical_accuracy:
0.9757 - val_loss: 3.2696 - val_sparse_categorical_accuracy: 0.5547
Epoch 41/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0373 - sparse_categorical_accuracy:
0.9882 - val_loss: 2.1111 - val_sparse_categorical_accuracy: 0.6526
Epoch 42/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0161 - sparse_categorical_accuracy:
0.9948 - val_loss: 2.7851 - val_sparse_categorical_accuracy: 0.5771
Epoch 43/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0160 - sparse_categorical_accuracy:
0.9948 - val_loss: 2.1659 - val_sparse_categorical_accuracy: 0.6682
Epoch 44/100
```

121/121 [==============================] - 15s 123ms/step - loss: 0.0098 - sparse_categorical_accuracy: 0.9969 - val_loss: 2.1009 - val_sparse_categorical_accuracy: 0.6885

Epoch 45/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0157 - sparse_categorical_accuracy: 0.9951 - val_loss: 2.2049 - val_sparse_categorical_accuracy: 0.6583

Epoch 46/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0389 - sparse_categorical_accuracy: 0.9875 - val_loss: 2.7155 - val_sparse_categorical_accuracy: 0.6026

Epoch 47/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0530 - sparse_categorical_accuracy: 0.9820 - val_loss: 3.1319 - val_sparse_categorical_accuracy: 0.5531

Epoch 48/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0380 - sparse_categorical_accuracy: 0.9885 - val_loss: 2.9116 - val_sparse_categorical_accuracy: 0.5854

Epoch 49/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0202 - sparse_categorical_accuracy: 0.9924 - val_loss: 2.6182 - val_sparse_categorical_accuracy: 0.6130

Epoch 50/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0275 - sparse_categorical_accuracy: 0.9906 - val_loss: 3.0110 - val_sparse_categorical_accuracy: 0.5734

Epoch 51/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0391 - sparse_categorical_accuracy: 0.9868 - val_loss: 3.7124 - val_sparse_categorical_accuracy: 0.5208

Epoch 52/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0424 - sparse_categorical_accuracy: 0.9866 - val_loss: 2.8714 - val_sparse_categorical_accuracy: 0.5745

Epoch 53/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0211 - sparse_categorical_accuracy: 0.9935 - val_loss: 2.7707 - val_sparse_categorical_accuracy: 0.5948

Epoch 54/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0193 - sparse_categorical_accuracy: 0.9935 - val_loss: 2.6184 - val_sparse_categorical_accuracy: 0.6281

Epoch 55/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0113 - sparse_categorical_accuracy: 0.9964 - val_loss: 2.2209 - val_sparse_categorical_accuracy: 0.6651

Epoch 56/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0078 - sparse_categorical_accuracy: 0.9978 - val_loss: 2.9569 - val_sparse_categorical_accuracy: 0.5917

Epoch 57/100

121/121 [==============================] - 15s 123ms/step - loss: 0.0101 - sparse_categorical_accuracy: 0.9970 - val_loss: 2.3002 - val_sparse_categorical_accuracy: 0.6599

Epoch 58/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0085 - sparse_categorical_accuracy: 0.9973 - val_loss: 2.6971 - val_sparse_categorical_accuracy: 0.6057

```
Epoch 59/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0124 - sparse_categorical_accuracy:
0.9964 - val_loss: 4.0214 - val_sparse_categorical_accuracy: 0.5354
Epoch 60/100
121/121 [==============================] - 15s 125ms/step - loss: 0.0375 - sparse_categorical_accuracy:
0.9880 - val_loss: 3.1198 - val_sparse_categorical_accuracy: 0.5891
Epoch 61/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0585 - sparse_categorical_accuracy:
0.9813 - val_loss: 2.8581 - val_sparse_categorical_accuracy: 0.5859
Epoch 62/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0312 - sparse_categorical_accuracy:
0.9899 - val_loss: 2.3880 - val_sparse_categorical_accuracy: 0.6604
Epoch 63/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0212 - sparse_categorical_accuracy:
0.9938 - val_loss: 2.5355 - val_sparse_categorical_accuracy: 0.6339
Epoch 64/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0320 - sparse_categorical_accuracy:
0.9895 - val_loss: 3.1446 - val_sparse_categorical_accuracy: 0.5865
Epoch 65/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0138 - sparse_categorical_accuracy:
0.9953 - val_loss: 2.4248 - val_sparse_categorical_accuracy: 0.6521
Epoch 66/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0038 - sparse_categorical_accuracy:
0.9989 - val_loss: 2.1680 - val_sparse_categorical_accuracy: 0.6698
Epoch 67/100
121/121 [==============================] - 15s 124ms/step - loss: 0.0019 - sparse_categorical_accuracy:
0.9994 - val_loss: 1.9786 - val_sparse_categorical_accuracy: 0.6901
Epoch 68/100
121/121 [==============================] - 15s 124ms/step - loss: 7.5106e-04 - sparse_categorical_accuracy:
0.9999 - val_loss: 2.1420 - val_sparse_categorical_accuracy: 0.6760
Epoch 69/100
121/121 [==============================] - 15s 124ms/step - loss: 3.9492e-04 - sparse_categorical_accuracy:
0.9999 - val_loss: 2.0803 - val_sparse_categorical_accuracy: 0.6932
Epoch 70/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0034 - sparse_categorical_accuracy:
0.9992 - val_loss: 3.4269 - val_sparse_categorical_accuracy: 0.5568
Epoch 71/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0377 - sparse_categorical_accuracy:
0.9870 - val_loss: 3.7777 - val_sparse_categorical_accuracy: 0.5432
Epoch 72/100
121/121 [==============================] - 15s 123ms/step - loss: 0.0913 - sparse_categorical_accuracy:
0.9709 - val_loss: 2.5310 - val_sparse_categorical_accuracy: 0.6266
Epoch 73/100
```

121/121 [==============================] - 15s 124ms/step - loss: 0.0288 - sparse_categorical_accuracy: 0.9901 - val_loss: 2.6993 - val_sparse_categorical_accuracy: 0.5958

Epoch 74/100

121/121 [==============================] - 15s 124ms/step - loss: 0.0091 - sparse_categorical_accuracy: 0.9975 - val_loss: 2.1111 - val_sparse_categorical_accuracy: 0.6620

Epoch 75/100

121/121 [==============================] - 15s 125ms/step - loss: 0.0020 - sparse_categorical_accuracy: 0.9997 - val_loss: 1.9367 - val_sparse_categorical_accuracy: 0.7089

Epoch 76/100

121/121 [==============================] - 15s 124ms/step - loss: 4.3584e-04 - sparse_categorical_accuracy: 0.9999 - val_loss: 1.9306 - val_sparse_categorical_accuracy: 0.7109

Epoch 77/100

121/121 [==============================] - 15s 124ms/step - loss: 2.4572e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9162 - val_sparse_categorical_accuracy: 0.7115

Epoch 78/100

121/121 [==============================] - 15s 123ms/step - loss: 1.5261e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9178 - val_sparse_categorical_accuracy: 0.7099

Epoch 79/100

121/121 [==============================] - 15s 124ms/step - loss: 1.0069e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9095 - val_sparse_categorical_accuracy: 0.7104

Epoch 80/100

121/121 [==============================] - 15s 124ms/step - loss: 6.8329e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9134 - val_sparse_categorical_accuracy: 0.7130

Epoch 81/100

121/121 [==============================] - 15s 124ms/step - loss: 6.3348e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9191 - val_sparse_categorical_accuracy: 0.7130

Epoch 82/100

121/121 [==============================] - 15s 125ms/step - loss: 5.2754e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9307 - val_sparse_categorical_accuracy: 0.7115

Epoch 83/100

121/121 [==============================] - 15s 124ms/step - loss: 6.0473e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9344 - val_sparse_categorical_accuracy: 0.7167

Epoch 84/100

121/121 [==============================] - 15s 124ms/step - loss: 5.2715e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9404 - val_sparse_categorical_accuracy: 0.7135

Epoch 85/100

121/121 [==============================] - 15s 124ms/step - loss: 4.4811e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9444 - val_sparse_categorical_accuracy: 0.7109

Epoch 86/100

121/121 [==============================] - 15s 124ms/step - loss: 5.6145e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9448 - val_sparse_categorical_accuracy: 0.7146

Epoch 87/100

121/121 [==============================] - 15s 124ms/step - loss: 3.3961e-05 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9503 - val_sparse_categorical_accuracy: 0.7104

```
Epoch 88/100
121/121 [==============================] - 15s 124ms/step - loss: 2.5877e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9525 - val_sparse_categorical_accuracy: 0.7161
Epoch 89/100
121/121 [==============================] - 15s 125ms/step - loss: 3.0505e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9554 - val_sparse_categorical_accuracy: 0.7130
Epoch 90/100
121/121 [==============================] - 15s 124ms/step - loss: 2.3975e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9592 - val_sparse_categorical_accuracy: 0.7146
Epoch 91/100
121/121 [==============================] - 15s 123ms/step - loss: 2.2609e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9654 - val_sparse_categorical_accuracy: 0.7161
Epoch 92/100
121/121 [==============================] - 15s 124ms/step - loss: 2.3479e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9677 - val_sparse_categorical_accuracy: 0.7177
Epoch 93/100
121/121 [==============================] - 16s 131ms/step - loss: 2.0606e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9708 - val_sparse_categorical_accuracy: 0.7161
Epoch 94/100
121/121 [==============================] - 16s 133ms/step - loss: 2.2174e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9810 - val_sparse_categorical_accuracy: 0.7141
Epoch 95/100
121/121 [==============================] - 15s 126ms/step - loss: 3.1248e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9947 - val_sparse_categorical_accuracy: 0.7151
Epoch 96/100
121/121 [==============================] - 15s 124ms/step - loss: 2.7743e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9963 - val_sparse_categorical_accuracy: 0.7161
Epoch 97/100
121/121 [==============================] - 16s 130ms/step - loss: 1.9443e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 2.0010 - val_sparse_categorical_accuracy: 0.7177
Epoch 98/100
121/121 [==============================] - 15s 125ms/step - loss: 1.5903e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9975 - val_sparse_categorical_accuracy: 0.7182
Epoch 99/100
121/121 [==============================] - 15s 124ms/step - loss: 1.7533e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 2.0212 - val_sparse_categorical_accuracy: 0.7135
Epoch 100/100
121/121 [==============================] - 15s 123ms/step - loss: 1.4230e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 2.0074 - val_sparse_categorical_accuracy: 0.7172
Model: "shallow_res_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_46 (Conv2D)          multiple                  9472
```

```
batch_normalization_46 (Bat  multiple                  256
chNormalization)

activation_37 (Activation)   multiple                  0

max_pooling2d_3 (MaxPooling  multiple                  0
2D)

sequential_3 (Sequential)    (None, 4, 4, 512)         11181184

global_average_pooling2d_3   multiple                  0
(GlobalAveragePooling2D)

dense_3 (Dense)              multiple                  7695

=================================================================
Total params: 11,198,607
Trainable params: 11,189,007
Non-trainable params: 9,600
_________________________________________________________________
```