```
Epoch 1/100
121/121 [==============================] - 40s 186ms/step - loss: 1.9940 - sparse_categorical_accuracy:
0.3845 - val_loss: 3.6716 - val_sparse_categorical_accuracy: 0.0557
Epoch 2/100
121/121 [==============================] - 18s 150ms/step - loss: 1.4629 - sparse_categorical_accuracy:
0.5279 - val_loss: 3.7020 - val_sparse_categorical_accuracy: 0.1276
Epoch 3/100
121/121 [==============================] - 19s 160ms/step - loss: 1.2689 - sparse_categorical_accuracy:
0.5921 - val_loss: 3.6487 - val_sparse_categorical_accuracy: 0.1562
Epoch 4/100
121/121 [==============================] - 20s 161ms/step - loss: 1.1161 - sparse_categorical_accuracy:
0.6413 - val_loss: 3.1852 - val_sparse_categorical_accuracy: 0.2292
Epoch 5/100
121/121 [==============================] - 20s 167ms/step - loss: 0.9757 - sparse_categorical_accuracy:
0.6869 - val_loss: 1.5834 - val_sparse_categorical_accuracy: 0.5339
Epoch 6/100
121/121 [==============================] - 20s 164ms/step - loss: 0.8848 - sparse_categorical_accuracy:
0.7166 - val_loss: 1.4792 - val_sparse_categorical_accuracy: 0.5422
Epoch 7/100
121/121 [==============================] - 19s 160ms/step - loss: 0.7462 - sparse_categorical_accuracy:
0.7561 - val_loss: 2.0724 - val_sparse_categorical_accuracy: 0.4573
Epoch 8/100
121/121 [==============================] - 19s 156ms/step - loss: 0.6472 - sparse_categorical_accuracy:
0.7917 - val_loss: 1.5901 - val_sparse_categorical_accuracy: 0.5427
Epoch 9/100
121/121 [==============================] - 19s 161ms/step - loss: 0.5229 - sparse_categorical_accuracy:
0.8268 - val_loss: 1.4837 - val_sparse_categorical_accuracy: 0.5938
Epoch 10/100
121/121 [==============================] - 20s 161ms/step - loss: 0.3949 - sparse_categorical_accuracy:
0.8690 - val_loss: 1.8543 - val_sparse_categorical_accuracy: 0.5776
Epoch 11/100
121/121 [==============================] - 19s 158ms/step - loss: 0.3622 - sparse_categorical_accuracy:
0.8796 - val_loss: 2.1543 - val_sparse_categorical_accuracy: 0.5146
Epoch 12/100
121/121 [==============================] - 19s 158ms/step - loss: 0.2431 - sparse_categorical_accuracy:
0.9191 - val_loss: 1.8827 - val_sparse_categorical_accuracy: 0.5594
Epoch 13/100
121/121 [==============================] - 20s 163ms/step - loss: 0.1804 - sparse_categorical_accuracy:
0.9401 - val_loss: 2.0185 - val_sparse_categorical_accuracy: 0.5901
Epoch 14/100
121/121 [==============================] - 19s 158ms/step - loss: 0.1511 - sparse_categorical_accuracy:
0.9483 - val_loss: 1.9855 - val_sparse_categorical_accuracy: 0.5865
Epoch 15/100
```

121/121 [==============================] - 19s 159ms/step - loss: 0.1328 - sparse_categorical_accuracy: 0.9543 - val_loss: 3.1363 - val_sparse_categorical_accuracy: 0.4755

Epoch 16/100

121/121 [==============================] - 20s 163ms/step - loss: 0.0961 - sparse_categorical_accuracy: 0.9694 - val_loss: 2.1906 - val_sparse_categorical_accuracy: 0.5865

Epoch 17/100

121/121 [==============================] - 19s 160ms/step - loss: 0.1159 - sparse_categorical_accuracy: 0.9638 - val_loss: 1.7876 - val_sparse_categorical_accuracy: 0.6589

Epoch 18/100

121/121 [==============================] - 19s 159ms/step - loss: 0.0735 - sparse_categorical_accuracy: 0.9762 - val_loss: 1.9923 - val_sparse_categorical_accuracy: 0.6302

Epoch 19/100

121/121 [==============================] - 19s 159ms/step - loss: 0.0646 - sparse_categorical_accuracy: 0.9780 - val_loss: 1.9949 - val_sparse_categorical_accuracy: 0.6094

Epoch 20/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0624 - sparse_categorical_accuracy: 0.9800 - val_loss: 2.3632 - val_sparse_categorical_accuracy: 0.5766

Epoch 21/100

121/121 [==============================] - 20s 164ms/step - loss: 0.0686 - sparse_categorical_accuracy: 0.9782 - val_loss: 2.0175 - val_sparse_categorical_accuracy: 0.6120

Epoch 22/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0470 - sparse_categorical_accuracy: 0.9840 - val_loss: 1.8534 - val_sparse_categorical_accuracy: 0.6573

Epoch 23/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0459 - sparse_categorical_accuracy: 0.9849 - val_loss: 2.1132 - val_sparse_categorical_accuracy: 0.6109

Epoch 24/100

121/121 [==============================] - 20s 164ms/step - loss: 0.0332 - sparse_categorical_accuracy: 0.9895 - val_loss: 2.3013 - val_sparse_categorical_accuracy: 0.5839

Epoch 25/100

121/121 [==============================] - 19s 161ms/step - loss: 0.0849 - sparse_categorical_accuracy: 0.9744 - val_loss: 2.0718 - val_sparse_categorical_accuracy: 0.6099

Epoch 26/100

121/121 [==============================] - 20s 165ms/step - loss: 0.1045 - sparse_categorical_accuracy: 0.9694 - val_loss: 4.9778 - val_sparse_categorical_accuracy: 0.3672

Epoch 27/100

121/121 [==============================] - 19s 161ms/step - loss: 0.0654 - sparse_categorical_accuracy: 0.9784 - val_loss: 2.1556 - val_sparse_categorical_accuracy: 0.6427

Epoch 28/100

121/121 [==============================] - 20s 161ms/step - loss: 0.0523 - sparse_categorical_accuracy: 0.9836 - val_loss: 2.5312 - val_sparse_categorical_accuracy: 0.5719

Epoch 29/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0386 - sparse_categorical_accuracy: 0.9867 - val_loss: 3.0061 - val_sparse_categorical_accuracy: 0.5323

```
Epoch 30/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0416 - sparse_categorical_accuracy:
0.9860 - val_loss: 2.6129 - val_sparse_categorical_accuracy: 0.5854
Epoch 31/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0614 - sparse_categorical_accuracy:
0.9804 - val_loss: 2.5854 - val_sparse_categorical_accuracy: 0.6156
Epoch 32/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0495 - sparse_categorical_accuracy:
0.9855 - val_loss: 2.0282 - val_sparse_categorical_accuracy: 0.6641
Epoch 33/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0245 - sparse_categorical_accuracy:
0.9922 - val_loss: 2.7663 - val_sparse_categorical_accuracy: 0.5589
Epoch 34/100
121/121 [==============================] - 19s 161ms/step - loss: 0.0282 - sparse_categorical_accuracy:
0.9913 - val_loss: 2.5301 - val_sparse_categorical_accuracy: 0.6099
Epoch 35/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0320 - sparse_categorical_accuracy:
0.9888 - val_loss: 2.1223 - val_sparse_categorical_accuracy: 0.6198
Epoch 36/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0491 - sparse_categorical_accuracy:
0.9857 - val_loss: 2.4149 - val_sparse_categorical_accuracy: 0.6167
Epoch 37/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0285 - sparse_categorical_accuracy:
0.9913 - val_loss: 2.3503 - val_sparse_categorical_accuracy: 0.5990
Epoch 38/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0251 - sparse_categorical_accuracy:
0.9921 - val_loss: 2.1355 - val_sparse_categorical_accuracy: 0.6406
Epoch 39/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0426 - sparse_categorical_accuracy:
0.9870 - val_loss: 4.4876 - val_sparse_categorical_accuracy: 0.4734
Epoch 40/100
121/121 [==============================] - 20s 161ms/step - loss: 0.0603 - sparse_categorical_accuracy:
0.9842 - val_loss: 2.9076 - val_sparse_categorical_accuracy: 0.5443
Epoch 41/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0385 - sparse_categorical_accuracy:
0.9899 - val_loss: 2.0798 - val_sparse_categorical_accuracy: 0.6542
Epoch 42/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0355 - sparse_categorical_accuracy:
0.9893 - val_loss: 2.5032 - val_sparse_categorical_accuracy: 0.6104
Epoch 43/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0438 - sparse_categorical_accuracy:
0.9864 - val_loss: 2.9624 - val_sparse_categorical_accuracy: 0.5500
Epoch 44/100
```

121/121 [==============================] - 20s 165ms/step - loss: 0.0278 - sparse_categorical_accuracy: 0.9914 - val_loss: 2.0232 - val_sparse_categorical_accuracy: 0.6615

Epoch 45/100

121/121 [==============================] - 20s 161ms/step - loss: 0.0260 - sparse_categorical_accuracy: 0.9931 - val_loss: 2.0563 - val_sparse_categorical_accuracy: 0.6557

Epoch 46/100

121/121 [==============================] - 20s 165ms/step - loss: 0.0175 - sparse_categorical_accuracy: 0.9942 - val_loss: 2.3021 - val_sparse_categorical_accuracy: 0.6495

Epoch 47/100

121/121 [==============================] - 20s 165ms/step - loss: 0.0132 - sparse_categorical_accuracy: 0.9955 - val_loss: 2.0691 - val_sparse_categorical_accuracy: 0.6609

Epoch 48/100

121/121 [==============================] - 20s 165ms/step - loss: 0.0217 - sparse_categorical_accuracy: 0.9927 - val_loss: 2.9435 - val_sparse_categorical_accuracy: 0.5839

Epoch 49/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0281 - sparse_categorical_accuracy: 0.9911 - val_loss: 2.3930 - val_sparse_categorical_accuracy: 0.6349

Epoch 50/100

121/121 [==============================] - 19s 161ms/step - loss: 0.0325 - sparse_categorical_accuracy: 0.9893 - val_loss: 2.4208 - val_sparse_categorical_accuracy: 0.6255

Epoch 51/100

121/121 [==============================] - 19s 161ms/step - loss: 0.0531 - sparse_categorical_accuracy: 0.9857 - val_loss: 3.2672 - val_sparse_categorical_accuracy: 0.5172

Epoch 52/100

121/121 [==============================] - 19s 160ms/step - loss: 0.0242 - sparse_categorical_accuracy: 0.9913 - val_loss: 2.1438 - val_sparse_categorical_accuracy: 0.6604

Epoch 53/100

121/121 [==============================] - 20s 165ms/step - loss: 0.0197 - sparse_categorical_accuracy: 0.9935 - val_loss: 2.7704 - val_sparse_categorical_accuracy: 0.5964

Epoch 54/100

121/121 [==============================] - 21s 170ms/step - loss: 0.0213 - sparse_categorical_accuracy: 0.9926 - val_loss: 2.5211 - val_sparse_categorical_accuracy: 0.6167

Epoch 55/100

121/121 [==============================] - 20s 168ms/step - loss: 0.0157 - sparse_categorical_accuracy: 0.9951 - val_loss: 2.2919 - val_sparse_categorical_accuracy: 0.6516

Epoch 56/100

121/121 [==============================] - 20s 165ms/step - loss: 0.1153 - sparse_categorical_accuracy: 0.9667 - val_loss: 4.6427 - val_sparse_categorical_accuracy: 0.3870

Epoch 57/100

121/121 [==============================] - 20s 162ms/step - loss: 0.0885 - sparse_categorical_accuracy: 0.9767 - val_loss: 2.3301 - val_sparse_categorical_accuracy: 0.6016

Epoch 58/100

121/121 [==============================] - 20s 165ms/step - loss: 0.0287 - sparse_categorical_accuracy: 0.9908 - val_loss: 2.0390 - val_sparse_categorical_accuracy: 0.6500

```
Epoch 59/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0086 - sparse_categorical_accuracy:
0.9972 - val_loss: 2.3954 - val_sparse_categorical_accuracy: 0.6406
Epoch 60/100
121/121 [==============================] - 19s 161ms/step - loss: 0.0058 - sparse_categorical_accuracy:
0.9980 - val_loss: 1.8009 - val_sparse_categorical_accuracy: 0.6891
Epoch 61/100
121/121 [==============================] - 20s 162ms/step - loss: 0.0024 - sparse_categorical_accuracy:
0.9995 - val_loss: 1.9706 - val_sparse_categorical_accuracy: 0.6849
Epoch 62/100
121/121 [==============================] - 20s 161ms/step - loss: 0.0055 - sparse_categorical_accuracy:
0.9983 - val_loss: 2.4022 - val_sparse_categorical_accuracy: 0.6552
Epoch 63/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0110 - sparse_categorical_accuracy:
0.9968 - val_loss: 2.8060 - val_sparse_categorical_accuracy: 0.6016
Epoch 64/100
121/121 [==============================] - 20s 165ms/step - loss: 0.0174 - sparse_categorical_accuracy:
0.9949 - val_loss: 2.5268 - val_sparse_categorical_accuracy: 0.6521
Epoch 65/100
121/121 [==============================] - 19s 160ms/step - loss: 0.0246 - sparse_categorical_accuracy:
0.9909 - val_loss: 3.3196 - val_sparse_categorical_accuracy: 0.5740
Epoch 66/100
121/121 [==============================] - 19s 161ms/step - loss: 0.0384 - sparse_categorical_accuracy:
0.9874 - val_loss: 2.9586 - val_sparse_categorical_accuracy: 0.5901
Epoch 67/100
121/121 [==============================] - 20s 163ms/step - loss: 0.0196 - sparse_categorical_accuracy:
0.9944 - val_loss: 2.7390 - val_sparse_categorical_accuracy: 0.6115
Epoch 68/100
121/121 [==============================] - 21s 171ms/step - loss: 0.0085 - sparse_categorical_accuracy:
0.9975 - val_loss: 1.9626 - val_sparse_categorical_accuracy: 0.6818
Epoch 69/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0115 - sparse_categorical_accuracy:
0.9968 - val_loss: 2.4033 - val_sparse_categorical_accuracy: 0.6547
Epoch 70/100
121/121 [==============================] - 20s 167ms/step - loss: 0.0108 - sparse_categorical_accuracy:
0.9966 - val_loss: 2.3266 - val_sparse_categorical_accuracy: 0.6578
Epoch 71/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0275 - sparse_categorical_accuracy:
0.9930 - val_loss: 5.6356 - val_sparse_categorical_accuracy: 0.4021
Epoch 72/100
121/121 [==============================] - 20s 164ms/step - loss: 0.0787 - sparse_categorical_accuracy:
0.9769 - val_loss: 2.3039 - val_sparse_categorical_accuracy: 0.6307
Epoch 73/100
```

121/121 [==============================] - 20s 169ms/step - loss: 0.0116 - sparse_categorical_accuracy: 0.9964 - val_loss: 2.2529 - val_sparse_categorical_accuracy: 0.6375

Epoch 74/100

121/121 [==============================] - 20s 164ms/step - loss: 0.0038 - sparse_categorical_accuracy: 0.9992 - val_loss: 1.8088 - val_sparse_categorical_accuracy: 0.7000

Epoch 75/100

121/121 [==============================] - 20s 164ms/step - loss: 8.5822e-04 - sparse_categorical_accuracy: 0.9998 - val_loss: 2.0087 - val_sparse_categorical_accuracy: 0.6745

Epoch 76/100

121/121 [==============================] - 20s 164ms/step - loss: 2.9757e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.7659 - val_sparse_categorical_accuracy: 0.7177

Epoch 77/100

121/121 [==============================] - 20s 164ms/step - loss: 0.1289 - sparse_categorical_accuracy: 0.9619 - val_loss: 2.6622 - val_sparse_categorical_accuracy: 0.5760

Epoch 78/100

121/121 [==============================] - 20s 169ms/step - loss: 0.0417 - sparse_categorical_accuracy: 0.9892 - val_loss: 2.0976 - val_sparse_categorical_accuracy: 0.6589

Epoch 79/100

121/121 [==============================] - 21s 170ms/step - loss: 0.0092 - sparse_categorical_accuracy: 0.9967 - val_loss: 1.9774 - val_sparse_categorical_accuracy: 0.6807

Epoch 80/100

121/121 [==============================] - 20s 164ms/step - loss: 0.0044 - sparse_categorical_accuracy: 0.9990 - val_loss: 2.0659 - val_sparse_categorical_accuracy: 0.6693

Epoch 81/100

121/121 [==============================] - 20s 169ms/step - loss: 0.0035 - sparse_categorical_accuracy: 0.9990 - val_loss: 1.9747 - val_sparse_categorical_accuracy: 0.6958

Epoch 82/100

121/121 [==============================] - 20s 164ms/step - loss: 0.0018 - sparse_categorical_accuracy: 0.9997 - val_loss: 1.9662 - val_sparse_categorical_accuracy: 0.6984

Epoch 83/100

121/121 [==============================] - 20s 164ms/step - loss: 5.8888e-04 - sparse_categorical_accuracy: 0.9999 - val_loss: 1.9460 - val_sparse_categorical_accuracy: 0.7000

Epoch 84/100

121/121 [==============================] - 20s 168ms/step - loss: 2.5179e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.8976 - val_sparse_categorical_accuracy: 0.7115

Epoch 85/100

121/121 [==============================] - 20s 165ms/step - loss: 2.4719e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9422 - val_sparse_categorical_accuracy: 0.7005

Epoch 86/100

121/121 [==============================] - 20s 168ms/step - loss: 2.5959e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9229 - val_sparse_categorical_accuracy: 0.7141

Epoch 87/100

121/121 [==============================] - 20s 164ms/step - loss: 1.1156e-04 - sparse_categorical_accuracy: 1.0000 - val_loss: 1.9528 - val_sparse_categorical_accuracy: 0.7177

```
Epoch 88/100
121/121 [==============================] - 20s 169ms/step - loss: 9.7196e-05 - sparse_categorical_accuracy:
1.0000 - val_loss: 1.9535 - val_sparse_categorical_accuracy: 0.7120
Epoch 89/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0029 - sparse_categorical_accuracy:
0.9999 - val_loss: 1.9722 - val_sparse_categorical_accuracy: 0.7036
Epoch 90/100
121/121 [==============================] - 20s 169ms/step - loss: 0.0714 - sparse_categorical_accuracy:
0.9773 - val_loss: 5.0125 - val_sparse_categorical_accuracy: 0.4833
Epoch 91/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0674 - sparse_categorical_accuracy:
0.9793 - val_loss: 2.3288 - val_sparse_categorical_accuracy: 0.5932
Epoch 92/100
121/121 [==============================] - 20s 164ms/step - loss: 0.0380 - sparse_categorical_accuracy:
0.9882 - val_loss: 1.9320 - val_sparse_categorical_accuracy: 0.6609
Epoch 93/100
121/121 [==============================] - 20s 164ms/step - loss: 0.0116 - sparse_categorical_accuracy:
0.9963 - val_loss: 2.5040 - val_sparse_categorical_accuracy: 0.5792
Epoch 94/100
121/121 [==============================] - 20s 167ms/step - loss: 0.0074 - sparse_categorical_accuracy:
0.9974 - val_loss: 2.1843 - val_sparse_categorical_accuracy: 0.6693
Epoch 95/100
121/121 [==============================] - 20s 164ms/step - loss: 0.0038 - sparse_categorical_accuracy:
0.9990 - val_loss: 2.4020 - val_sparse_categorical_accuracy: 0.6125
Epoch 96/100
121/121 [==============================] - 20s 164ms/step - loss: 0.0029 - sparse_categorical_accuracy:
0.9990 - val_loss: 2.5202 - val_sparse_categorical_accuracy: 0.6422
Epoch 97/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0021 - sparse_categorical_accuracy:
0.9995 - val_loss: 2.1715 - val_sparse_categorical_accuracy: 0.6568
Epoch 98/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0066 - sparse_categorical_accuracy:
0.9980 - val_loss: 2.2187 - val_sparse_categorical_accuracy: 0.6703
Epoch 99/100
121/121 [==============================] - 20s 167ms/step - loss: 0.0185 - sparse_categorical_accuracy:
0.9944 - val_loss: 3.2798 - val_sparse_categorical_accuracy: 0.5224
Epoch 100/100
121/121 [==============================] - 20s 168ms/step - loss: 0.0232 - sparse_categorical_accuracy:
0.9921 - val_loss: 2.6944 - val_sparse_categorical_accuracy: 0.6021
Model: "shallow_res_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_66 (Conv2D)          multiple                  9472
```

```
batch_normalization_66 (Bat  multiple                  256
chNormalization)

activation_54 (Activation)   multiple                  0

max_pooling2d_4 (MaxPooling  multiple                  0
2D)

sequential_4 (Sequential)    (None, 4, 4, 512)         18565504

global_average_pooling2d_4   multiple                  0
(GlobalAveragePooling2D)

dense_4 (Dense)              multiple                  7695

=================================================================
Total params: 18,582,927
Trainable params: 18,568,719
Non-trainable params: 14,208
_________________________________________________________________
```