Importing Libraries

In [30]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy
import os
import pickle
import librosa
import librosa.display
from IPython.display import Audio
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
import tensorflow as tf
from tensorflow import keras
```

In [31]:

```
df = pd.read_csv("/kaggle/input/gtzan-dataset-music-genre-classification/Data/features_3_sec.csv")
df.head()
```

Out[31]:

	filename	length	chroma_stft_mean	chroma_stft_var	rms_mean	rms_var	spectral_centroid_mean	spectral_centroid_var	spectr
0	blues.00000.0.wav	66149	0.335406	0.091048	0.130405	0.003521	1773.065032	167541.630869	1972.7
1	blues.00000.1.wav	66149	0.343065	0.086147	0.112699	0.001450	1816.693777	90525.690866	2010.0
2	blues.00000.2.wav	66149	0.346815	0.092243	0.132003	0.004620	1788.539719	111407.437613	2084.5
3	blues.00000.3.wav	66149	0.363639	0.086856	0.132565	0.002448	1655.289045	111952.284517	1960.0
4	blues.00000.4.wav	66149	0.335579	0.088129	0.143289	0.001701	1630.656199	79667.267654	1948.5

5 rows × 60 columns

In [32]:

```
df.shape
```

Out[32]:

```
(9990, 60)
```

In [33]:

```
df.dtypes
```

Out[33]:

```
filename                    object
length                       int64
chroma_stft_mean           float64
chroma_stft_var            float64
rms_mean                   float64
rms_var                    float64
spectral_centroid_mean     float64
spectral_centroid_var      float64
spectral_bandwidth_mean    float64
spectral_bandwidth_var     float64
rolloff_mean               float64
rolloff_var                float64
zero_crossing_rate_mean    float64
zero_crossing_rate_var     float64
harmony_mean               float64
harmony_var                float64
perceptr_mean              float64
perceptr_var               float64
tempo                      float64
mfcc1_mean                 float64
mfcc1_var                  float64
mfcc2_mean                 float64
mfcc2_var                  float64
mfcc3_mean                 float64
mfcc3_var                  float64
mfcc4_mean                 float64
mfcc4_var                  float64
mfcc5_mean                 float64
mfcc5_var                  float64
mfcc6_mean                 float64
mfcc6_var                  float64
mfcc7_mean                 float64
mfcc7_var                  float64
mfcc8_mean                 float64
mfcc8_var                  float64
mfcc9_mean                 float64
mfcc9_var                  float64
mfcc10_mean                float64
mfcc10_var                 float64
mfcc11_mean                float64
mfcc11_var                 float64
mfcc12_mean                float64
mfcc12_var                 float64
mfcc13_mean                float64
mfcc13_var                 float64
mfcc14_mean                float64
mfcc14_var                 float64
mfcc15_mean                float64
mfcc15_var                 float64
mfcc16_mean                float64
mfcc16_var                 float64
mfcc17_mean                float64
mfcc17_var                 float64
mfcc18_mean                float64
mfcc18_var                 float64
mfcc19_mean                float64
mfcc19_var                 float64
mfcc20_mean                float64
mfcc20_var                 float64
label                       object
dtype: object
```

In [34]:
```
df=df.drop(labels="filename",axis=1)
```

In [35]:
```
df.head()
```

Out[35]:

	length	chroma_stft_mean	chroma_stft_var	rms_mean	rms_var	spectral_centroid_mean	spectral_centroid_var	spectral_bandwidth_mean
0	66149	0.335406	0.091048	0.130405	0.003521	1773.065032	167541.630869	1972.744388
1	66149	0.343065	0.086147	0.112699	0.001450	1816.693777	90525.690866	2010.051501
2	66149	0.346815	0.092243	0.132003	0.004620	1788.539719	111407.437613	2084.565132
3	66149	0.363639	0.086856	0.132565	0.002448	1655.289045	111952.284517	1960.039988
4	66149	0.335579	0.088129	0.143289	0.001701	1630.656199	79667.267654	1948.503884

5 rows × 59 columns

Understanding the audio files

In [36]:
```
audio_recording="/kaggle/input/gtzan-dataset-music-genre-classification/Data/genres_original/country/country.0
0050.wav"
data,sr=librosa.load(audio_recording)
print(type(data),type(sr))
```

```
<class 'numpy.ndarray'> <class 'int'>
```

In [37]:
```
librosa.load(audio_recording,sr=45600)
```

Out[37]:
```
(array([ 0.04582627,  0.06254332,  0.0583379 , ..., -0.13857861,
        -0.11823352, -0.05911855], dtype=float32),
 45600)
```

With the help of IPython.display.Audio we can play audio in the notebook. It is a library used for playing the audio in the jupyterlab.

In [38]:
```
import IPython
IPython.display.Audio(data,rate=sr)
```

Out[38]:

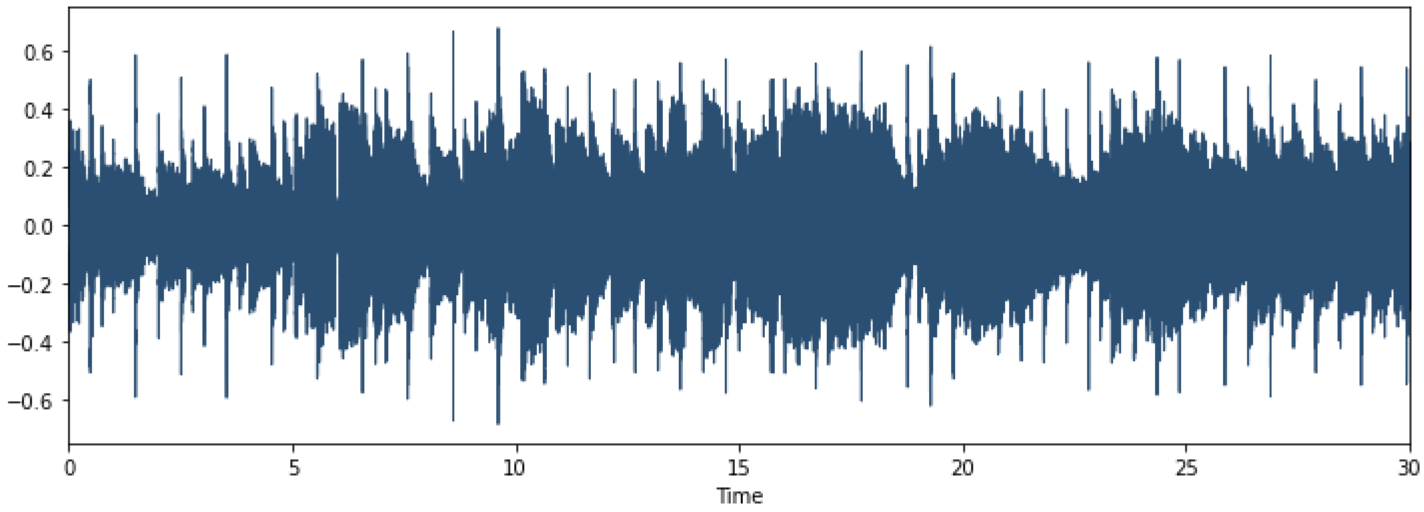
0:00 / 0:30

Visualising audio files

Plotting Raw wave files

In [39]:

```
plt.figure(figsize=(12,4))
librosa.display.waveplot(data,color="#2B4F72")
plt.show()
```



Waveforms are visual representations of sound as time on the x-axis and amplitude on the y-axis. They are great for allowing us to quickly scan the audio data and visually compare and contrast which genres might be more similar than others.

Spectrogram

A spectrogram is a visual way of representing the signal loudness of a signal over time at various frequencies present in a particular waveform. Not only can one see whether there is more or less energy at, for example, 2 Hz vs 10 Hz, but one can also see how energy levels vary over time. Spectrograms are sometimes called sonographs, voiceprints, or voicegrams. When the data is represented in a 3D plot, they may be called waterfalls. In 2-dimensional arrays, the first axis is frequency while the second axis is time

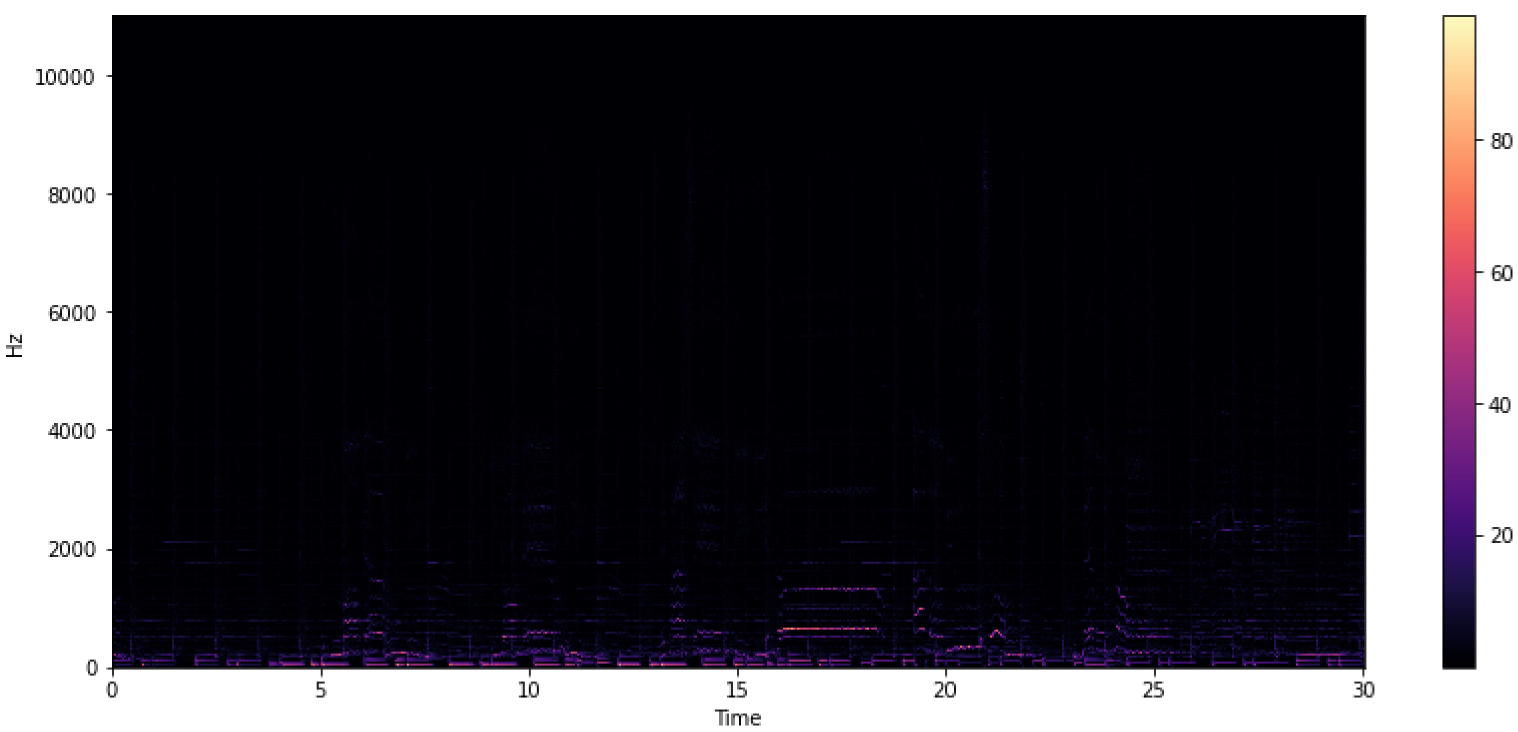
In [40]:

```
stft=librosa.stft(data)
stft_db=librosa.amplitude_to_db(abs(stft))
plt.figure(figsize=(14,6))
librosa.display.specshow(stft,sr=sr,x_axis='time',y_axis='hz')
plt.colorbar()
```

```
/opt/conda/lib/python3.7/site-packages/librosa/display.py:955: UserWarning: Trying to display complex-valu
ed input. Showing magnitude instead.
  "Trying to display complex-valued input. " "Showing magnitude instead."
```

Out[40]:

```
<matplotlib.colorbar.Colorbar at 0x7fa1000f5ad0>
```

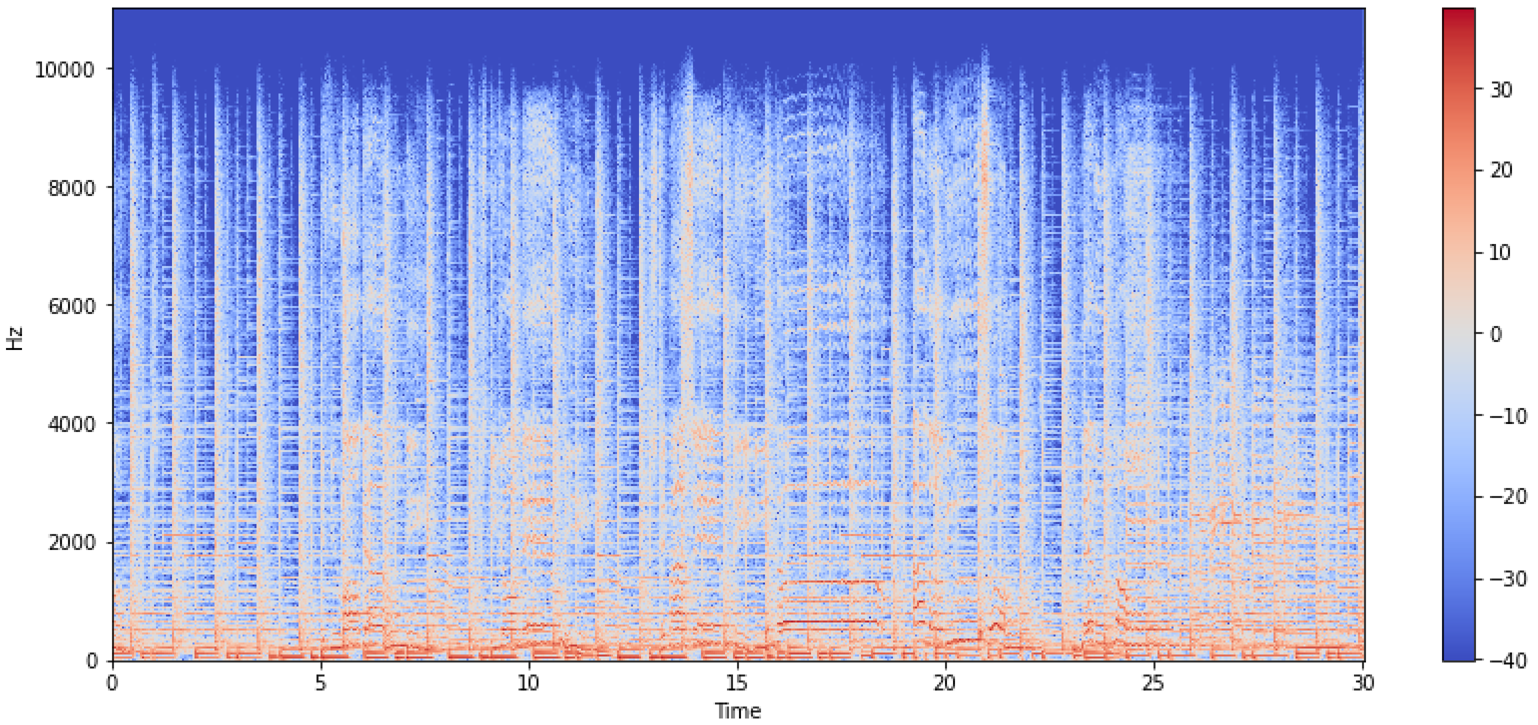


In [41]:

```
stft=librosa.stft(data)
stft_db=librosa.amplitude_to_db(abs(stft))
plt.figure(figsize=(14,6))
librosa.display.specshow(stft_db,sr=sr,x_axis='time',y_axis='hz')
plt.colorbar()
```

Out[41]:

```
<matplotlib.colorbar.Colorbar at 0x7fa100054090>
```



Spectral Roll-Off

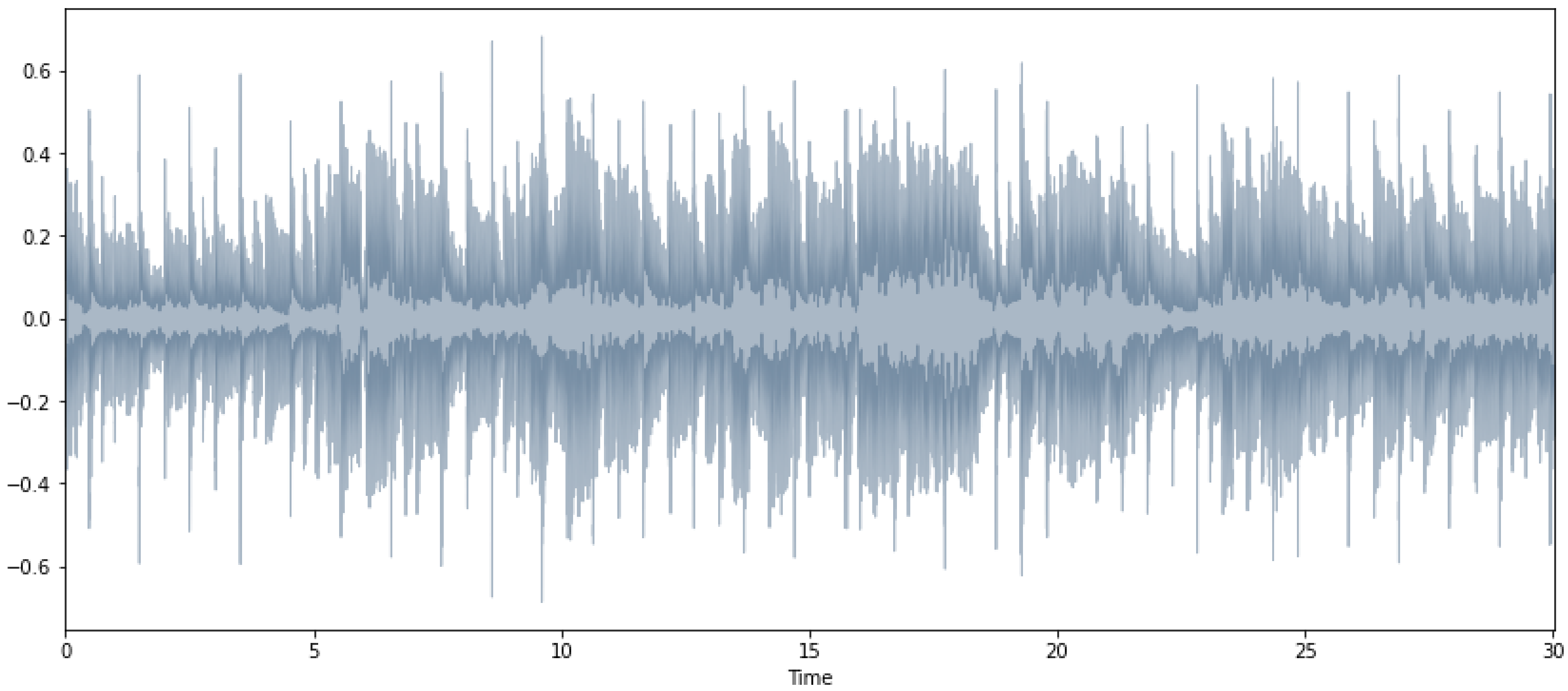
Spectral Rolloff is the frequency below which a specified percentage of the total spectral energy, e.g. 85%, lies librosa.feature.spectral_rolloff computes the rolloff frequency for each frame in a signal.

In [42]:

```
spectral_rolloff=librosa.feature.spectral_rolloff(data+0.01,sr=sr)[0]
plt.figure(figsize=(14,6))
librosa.display.waveplot(data,sr=sr,alpha=0.4,color="#2B4F72")
```

Out[42]:

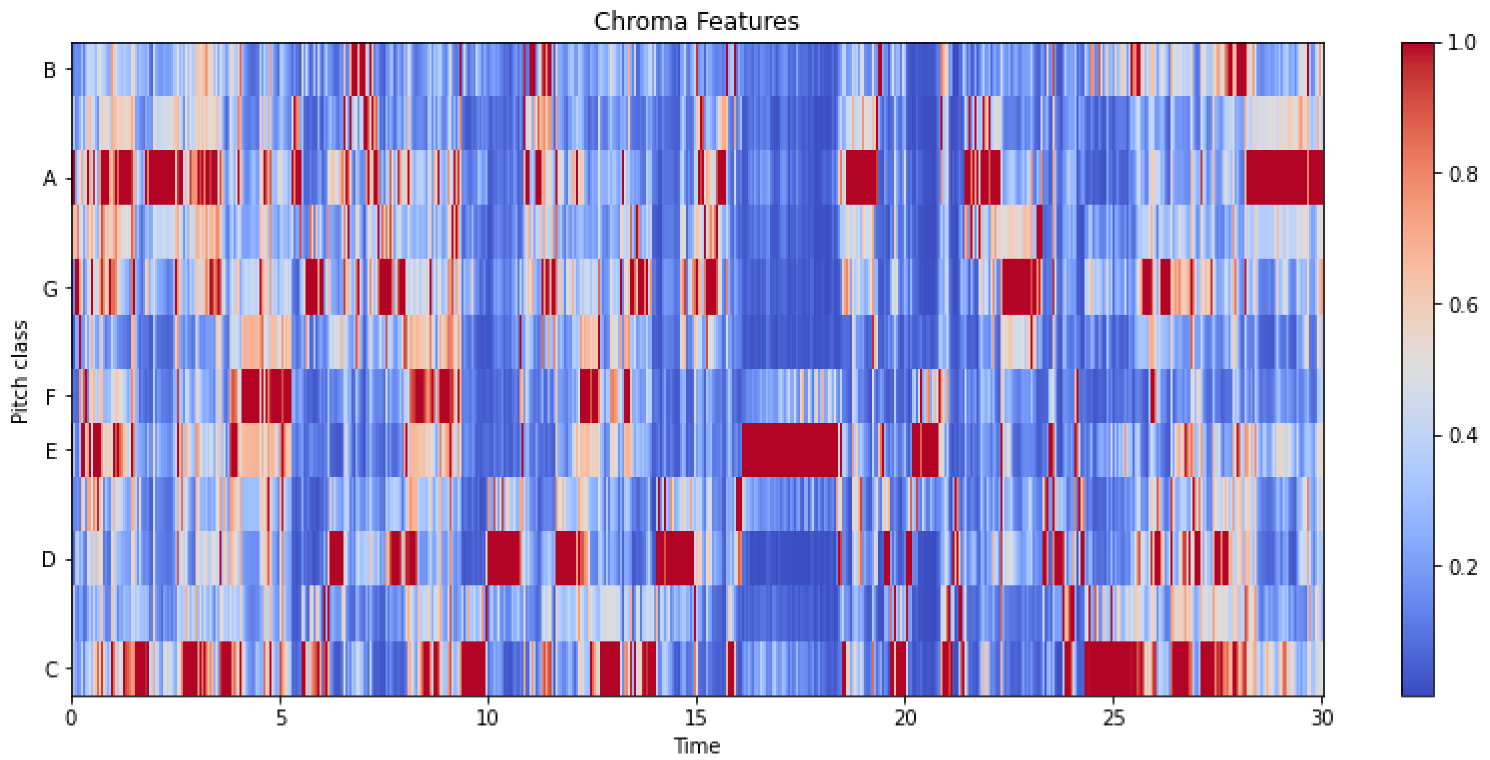
```
<matplotlib.collections.PolyCollection at 0x7fa0e876a190>
```



Chroma Feature

It is a powerful tool for analyzing music features whose pitches can be meaningfully categorized and whose tuning approximates to the equal-tempered scale. One main property of chroma features is that they capture harmonic and melodic characteristics of music while being robust to changes in timbre and instrumentation

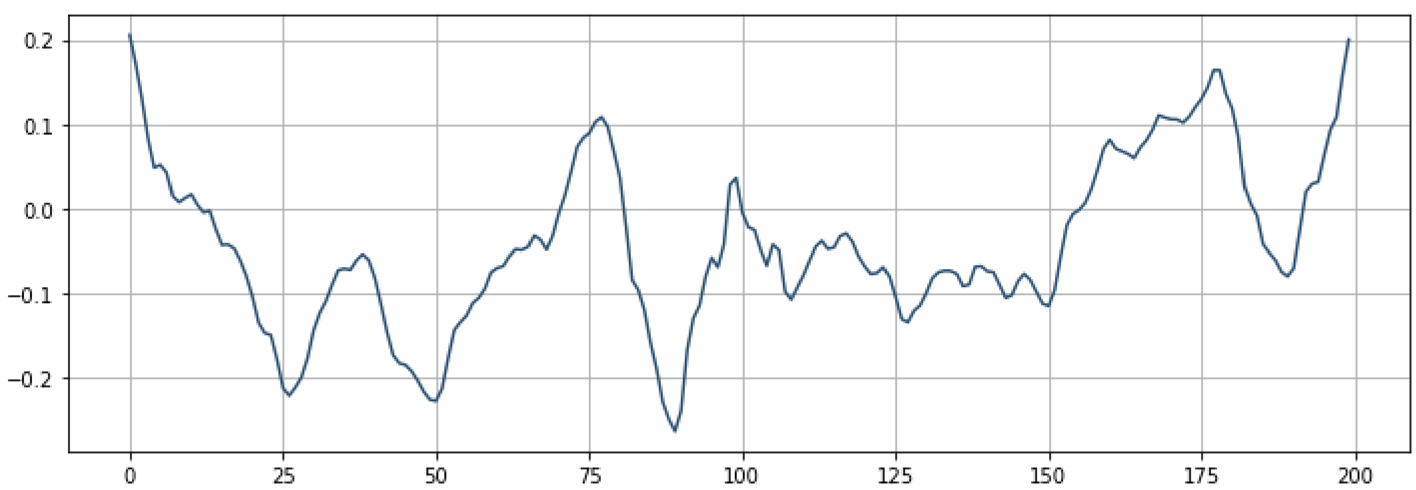
In [43]:
```
import librosa.display as lplt
chroma = librosa.feature.chroma_stft(data,sr=sr)
plt.figure(figsize=(14,6))
lplt.specshow(chroma,sr=sr,x_axis="time",y_axis="chroma",cmap="coolwarm")
plt.colorbar()
plt.title("Chroma Features")
plt.show()
```



Zero Crossing Rate

Zero crossing is said to occur if successive samples have different algebraic signs. The rate at which zero-crossings occur is a simple measure of the frequency content of a signal. Zero-crossing rate is a measure of the number of times in a given time interval/frame that the amplitude of the speech signals passes through a value of zero.

In [44]:
```
start=1000
end=1200
plt.figure(figsize=(12,4))
plt.plot(data[start:end],color="#2B4F72")
plt.grid()
```



In [45]:
```
zero_cross_rate=librosa.zero_crossings(data[start:end],pad=False)
print("the numbert of zero_crossings is :", sum(zero_cross_rate))
```

```
the numbert of zero_crossings is : 8
```

Feature Extraction

Preprocessing of data is required before we finally train the data. We will try and focus on the last column that is 'label' and will encode it with the function LabelEncoder() of sklearn.preprocessing.

In [46]:
```
class_list=df.iloc[:,-1]
converter=LabelEncoder()
```

In [47]:
```
y=converter.fit_transform(class_list)
y
```

Out[47]:
```
array([0, 0, 0, ..., 9, 9, 9])
```

In [48]:

```
print(df.iloc[:,:-1])
```

```
      length  chroma_stft_mean  chroma_stft_var  rms_mean   rms_var  \
0      66149          0.335406         0.091048  0.130405  0.003521   
1      66149          0.343065         0.086147  0.112699  0.001450   
2      66149          0.346815         0.092243  0.132003  0.004620   
3      66149          0.363639         0.086856  0.132565  0.002448   
4      66149          0.335579         0.088129  0.143289  0.001701   
...      ...               ...              ...       ...       ...   
9985   66149          0.349126         0.080515  0.050019  0.000097   
9986   66149          0.372564         0.082626  0.057897  0.000088   
9987   66149          0.347481         0.089019  0.052403  0.000701   
9988   66149          0.387527         0.084815  0.066430  0.000320   
9989   66149          0.369293         0.086759  0.050524  0.000067   

      spectral_centroid_mean  spectral_centroid_var  spectral_bandwidth_mean  \
0                1773.065032          167541.630869              1972.744388   
1                1816.693777           90525.690866              2010.051501   
2                1788.539719          111407.437613              2084.565132   
3                1655.289045          111952.284517              1960.039988   
4                1630.656199           79667.267654              1948.503884   
...                      ...                    ...                      ...   
9985             1499.083005          164266.886443              1718.707215   
9986             1847.965128          281054.935973              1906.468492   
9987             1346.157659          662956.246325              1561.859087   
9988             2084.515327          203891.039161              2018.366254   
9989             1634.330126          411429.169769              1867.422378   

      spectral_bandwidth_var  rolloff_mean  ...  mfcc16_mean  mfcc16_var  \
0              117335.771563   3714.560359  ...    -2.853603   39.687145   
1               65671.875673   3869.682242  ...     4.074709   64.748276   
2               75124.921716   3997.639160  ...     4.806280   67.336563   
3               82913.639269   3568.300218  ...    -1.359111   47.739452   
4               60204.020268   3469.992864  ...     2.092937   30.336359   
...                      ...           ...  ...          ...         ...   
9985            85931.574523   3015.559458  ...     5.773784   42.485981   
9986            99727.037054   3746.694524  ...     2.074155   32.415203   
9987           138762.841945   2442.362154  ...    -1.005473   78.228149   
9988            22860.992562   4313.266226  ...     4.123402   28.323744   
9989           119722.211518   3462.042142  ...     1.342274   38.801735   

      mfcc17_mean  mfcc17_var  mfcc18_mean  mfcc18_var  mfcc19_mean  \
0       -3.241280   36.488243     0.722209   38.099152    -5.050335   
1       -6.055294   40.677654     0.159015   51.264091    -2.837699   
2       -1.768610   28.348579     2.378768   45.717648    -1.938424   
3       -3.841155   28.337118     1.218588   34.770935    -3.580352   
4        0.664582   45.880913     1.689446   51.363583    -3.392489   
...           ...         ...          ...         ...          ...   
9985    -9.094270   38.326839    -4.246976   31.049839    -5.625813   
9986   -12.375726   66.418587    -3.081278   54.414265   -11.960546   
9987    -2.524483   21.778994     4.809936   25.980829     1.775686   
9988    -5.363541   17.209942     6.462601   21.442928     2.354765   
9989   -11.598399   58.983097    -0.178517   55.761299    -6.903252   

      mfcc19_var  mfcc20_mean  mfcc20_var  
0      33.618073    -0.243027   43.771767  
1      97.030830     5.784063   59.943081  
2      53.050835     2.517375   33.105122  
3      50.836224     3.630866   32.023678  
4      26.738789     0.536961   29.146694  
...          ...          ...         ...  
9985   48.804092     1.818823   38.966969  
9986   63.452255     0.428857   18.697033  
9987   48.582378    -0.299545   41.586990  
```

```
9988   24.843613    0.675824   12.787750
9989   39.485901   -3.412534   31.727489

[9990 rows x 58 columns]
```

Scaling the features

Standard scaler is used to standardize features by removing the mean and scaling to unit variance. The standard score of sample x is calculated as: z = (x - u) / s

In [49]:

```
from sklearn.preprocessing import StandardScaler
fit=StandardScaler()
X=fit.fit_transform(np.array(df.iloc[:,:-1],dtype=float))
```

Dividing Training and Testing Dataset

In [50]:

```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.33)
```

In [51]:

```
len(y_test)
```

Out[51]:

```
3297
```

In [52]:

```
len(y_train)
```

Out[52]:

```
6693
```

Building the model

In [53]:

```
from tensorflow.keras.models import Sequential
```

In [54]:

```
def trainModel(model,epochs,optimizer):
    batch_size=128
    model.compile(optimizer=optimizer,loss='sparse_categorical_crossentropy',metrics='accuracy')
    return model.fit(X_train,y_train,validation_data=(X_test,y_test),epochs=epochs,batch_size=batch_size)
```

In [55]:

```
def plotValidate(history):
    print("Validation Accuracy",max(history.history["val_accuracy"]))
    pd.DataFrame(history.history).plot(figsize=(12,6))
    plt.show()
```

In [56]:

```
import tensorflow as tf
```

In [57]:
```
model=tf.keras.models.Sequential([
    tf.keras.layers.Dense(512,activation='relu',input_shape=(X_train.shape[1],)),
    tf.keras.layers.Dropout(0.2),

    tf.keras.layers.Dense(256,activation='relu'),
    keras.layers.Dropout(0.2),

    tf.keras.layers.Dense(128,activation='relu'),
    tf.keras.layers.Dropout(0.2),

    tf.keras.layers.Dense(64,activation='relu'),
    tf.keras.layers.Dropout(0.2),

    tf.keras.layers.Dense(10,activation='softmax'),
])

print(model.summary())
model_history=trainModel(model=model,epochs=600,optimizer='adam')
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
dense_5 (Dense)              (None, 512)               30208     
_________________________________________________________________
dropout_4 (Dropout)          (None, 512)               0         
_________________________________________________________________
dense_6 (Dense)              (None, 256)               131328    
_________________________________________________________________
dropout_5 (Dropout)          (None, 256)               0         
_________________________________________________________________
dense_7 (Dense)              (None, 128)               32896     
_________________________________________________________________
dropout_6 (Dropout)          (None, 128)               0         
_________________________________________________________________
dense_8 (Dense)              (None, 64)                8256      
_________________________________________________________________
dropout_7 (Dropout)          (None, 64)                0         
_________________________________________________________________
dense_9 (Dense)              (None, 10)                650       
=================================================================
Total params: 203,338
Trainable params: 203,338
Non-trainable params: 0
_________________________________________________________________
None
Epoch 1/600
53/53 [==============================] - 1s 11ms/step - loss: 1.9321 - accuracy: 0.2985 - val_loss: 1.1332
- val_accuracy: 0.6078
Epoch 2/600
53/53 [==============================] - 0s 7ms/step - loss: 1.1884 - accuracy: 0.5823 - val_loss: 0.8750
- val_accuracy: 0.7106
Epoch 3/600
53/53 [==============================] - 0s 7ms/step - loss: 0.9784 - accuracy: 0.6606 - val_loss: 0.7615
- val_accuracy: 0.7392
Epoch 4/600
53/53 [==============================] - 0s 7ms/step - loss: 0.8097 - accuracy: 0.7259 - val_loss: 0.6928
- val_accuracy: 0.7680
Epoch 5/600
53/53 [==============================] - 0s 7ms/step - loss: 0.7275 - accuracy: 0.7585 - val_loss: 0.6207
- val_accuracy: 0.7892
Epoch 6/600
53/53 [==============================] - 0s 7ms/step - loss: 0.6355 - accuracy: 0.7871 - val_loss: 0.5902
- val_accuracy: 0.8044
Epoch 7/600
53/53 [==============================] - 0s 7ms/step - loss: 0.5798 - accuracy: 0.8103 - val_loss: 0.5450
- val_accuracy: 0.8147
Epoch 8/600
53/53 [==============================] - 0s 7ms/step - loss: 0.5290 - accuracy: 0.8264 - val_loss: 0.5075
- val_accuracy: 0.8356
Epoch 9/600
53/53 [==============================] - 0s 7ms/step - loss: 0.4729 - accuracy: 0.8412 - val_loss: 0.4660
- val_accuracy: 0.8499
Epoch 10/600
53/53 [==============================] - 0s 8ms/step - loss: 0.4112 - accuracy: 0.8665 - val_loss: 0.4715
- val_accuracy: 0.8493
Epoch 11/600
53/53 [==============================] - 0s 7ms/step - loss: 0.3798 - accuracy: 0.8790 - val_loss: 0.4531
- val_accuracy: 0.8532
Epoch 12/600
53/53 [==============================] - 0s 7ms/step - loss: 0.3593 - accuracy: 0.8794 - val_loss: 0.4318
```

```
- val_accuracy: 0.8626
Epoch 13/600
53/53 [==============================] - 0s 7ms/step - loss: 0.3341 - accuracy: 0.8938 - val_loss: 0.4192
- val_accuracy: 0.8608
Epoch 14/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2828 - accuracy: 0.9035 - val_loss: 0.4386
- val_accuracy: 0.8599
Epoch 15/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2817 - accuracy: 0.9087 - val_loss: 0.4007
- val_accuracy: 0.8717
Epoch 16/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2483 - accuracy: 0.9202 - val_loss: 0.4066
- val_accuracy: 0.8741
Epoch 17/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2304 - accuracy: 0.9224 - val_loss: 0.4189
- val_accuracy: 0.8665
Epoch 18/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2331 - accuracy: 0.9234 - val_loss: 0.4282
- val_accuracy: 0.8684
Epoch 19/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1988 - accuracy: 0.9347 - val_loss: 0.3926
- val_accuracy: 0.8805
Epoch 20/600
53/53 [==============================] - 0s 7ms/step - loss: 0.2330 - accuracy: 0.9203 - val_loss: 0.3947
- val_accuracy: 0.8796
Epoch 21/600
53/53 [==============================] - 0s 8ms/step - loss: 0.1787 - accuracy: 0.9430 - val_loss: 0.3824
- val_accuracy: 0.8872
Epoch 22/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1661 - accuracy: 0.9432 - val_loss: 0.3813
- val_accuracy: 0.8829
Epoch 23/600
53/53 [==============================] - 1s 10ms/step - loss: 0.1486 - accuracy: 0.9550 - val_loss: 0.3675
- val_accuracy: 0.8975
Epoch 24/600
53/53 [==============================] - 0s 8ms/step - loss: 0.1426 - accuracy: 0.9544 - val_loss: 0.3710
- val_accuracy: 0.8917
Epoch 25/600
53/53 [==============================] - 0s 8ms/step - loss: 0.1348 - accuracy: 0.9547 - val_loss: 0.3702
- val_accuracy: 0.8938
Epoch 26/600
53/53 [==============================] - 0s 8ms/step - loss: 0.1438 - accuracy: 0.9544 - val_loss: 0.3789
- val_accuracy: 0.8932
Epoch 27/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1218 - accuracy: 0.9606 - val_loss: 0.3876
- val_accuracy: 0.8926
Epoch 28/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1236 - accuracy: 0.9607 - val_loss: 0.3837
- val_accuracy: 0.8966
Epoch 29/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1180 - accuracy: 0.9597 - val_loss: 0.3705
- val_accuracy: 0.8941
Epoch 30/600
53/53 [==============================] - 0s 7ms/step - loss: 0.1103 - accuracy: 0.9658 - val_loss: 0.3699
- val_accuracy: 0.8975
Epoch 31/600
53/53 [==============================] - 0s 8ms/step - loss: 0.1247 - accuracy: 0.9597 - val_loss: 0.3703
- val_accuracy: 0.8966
Epoch 32/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0990 - accuracy: 0.9690 - val_loss: 0.4015
- val_accuracy: 0.8978
Epoch 33/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0961 - accuracy: 0.9692 - val_loss: 0.3830
```

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- val_accuracy: 0.8984
Epoch 34/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0927 - accuracy: 0.9707 - val_loss: 0.3704
- val_accuracy: 0.9026
Epoch 35/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0810 - accuracy: 0.9733 - val_loss: 0.3987
- val_accuracy: 0.8999
Epoch 36/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0834 - accuracy: 0.9738 - val_loss: 0.4190
- val_accuracy: 0.8993
Epoch 37/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0719 - accuracy: 0.9750 - val_loss: 0.4050
- val_accuracy: 0.8944
Epoch 38/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0826 - accuracy: 0.9716 - val_loss: 0.3895
- val_accuracy: 0.9026
Epoch 39/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0922 - accuracy: 0.9702 - val_loss: 0.3780
- val_accuracy: 0.9017
Epoch 40/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0873 - accuracy: 0.9717 - val_loss: 0.3984
- val_accuracy: 0.9011
Epoch 41/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0772 - accuracy: 0.9728 - val_loss: 0.4072
- val_accuracy: 0.8969
Epoch 42/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0789 - accuracy: 0.9723 - val_loss: 0.3888
- val_accuracy: 0.9014
Epoch 43/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0752 - accuracy: 0.9757 - val_loss: 0.3856
- val_accuracy: 0.9057
Epoch 44/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0598 - accuracy: 0.9795 - val_loss: 0.4272
- val_accuracy: 0.8999
Epoch 45/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0715 - accuracy: 0.9744 - val_loss: 0.4189
- val_accuracy: 0.8954
Epoch 46/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0598 - accuracy: 0.9790 - val_loss: 0.4272
- val_accuracy: 0.8999
Epoch 47/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0588 - accuracy: 0.9804 - val_loss: 0.4389
- val_accuracy: 0.8975
Epoch 48/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0648 - accuracy: 0.9797 - val_loss: 0.4376
- val_accuracy: 0.8926
Epoch 49/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0718 - accuracy: 0.9768 - val_loss: 0.3909
- val_accuracy: 0.8996
Epoch 50/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0678 - accuracy: 0.9769 - val_loss: 0.4092
- val_accuracy: 0.8978
Epoch 51/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0680 - accuracy: 0.9778 - val_loss: 0.4025
- val_accuracy: 0.8999
Epoch 52/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0615 - accuracy: 0.9800 - val_loss: 0.4348
- val_accuracy: 0.8975
Epoch 53/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0657 - accuracy: 0.9790 - val_loss: 0.3861
- val_accuracy: 0.9063
Epoch 54/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0523 - accuracy: 0.9856 - val_loss: 0.4074
```

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- val_accuracy: 0.9066
Epoch 55/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0575 - accuracy: 0.9831 - val_loss: 0.3762
- val_accuracy: 0.9123
Epoch 56/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0467 - accuracy: 0.9862 - val_loss: 0.4090
- val_accuracy: 0.8990
Epoch 57/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0690 - accuracy: 0.9802 - val_loss: 0.4305
- val_accuracy: 0.8990
Epoch 58/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0609 - accuracy: 0.9803 - val_loss: 0.4389
- val_accuracy: 0.9017
Epoch 59/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0628 - accuracy: 0.9782 - val_loss: 0.4113
- val_accuracy: 0.9039
Epoch 60/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0601 - accuracy: 0.9821 - val_loss: 0.3937
- val_accuracy: 0.9011
Epoch 61/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0490 - accuracy: 0.9837 - val_loss: 0.4293
- val_accuracy: 0.9005
Epoch 62/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0539 - accuracy: 0.9827 - val_loss: 0.4181
- val_accuracy: 0.9078
Epoch 63/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0478 - accuracy: 0.9845 - val_loss: 0.4593
- val_accuracy: 0.9005
Epoch 64/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0450 - accuracy: 0.9848 - val_loss: 0.4490
- val_accuracy: 0.9032
Epoch 65/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0407 - accuracy: 0.9854 - val_loss: 0.4505
- val_accuracy: 0.9078
Epoch 66/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0422 - accuracy: 0.9863 - val_loss: 0.4268
- val_accuracy: 0.9026
Epoch 67/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0469 - accuracy: 0.9850 - val_loss: 0.3799
- val_accuracy: 0.9029
Epoch 68/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0537 - accuracy: 0.9810 - val_loss: 0.4130
- val_accuracy: 0.9029
Epoch 69/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0565 - accuracy: 0.9832 - val_loss: 0.4057
- val_accuracy: 0.9060
Epoch 70/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0414 - accuracy: 0.9866 - val_loss: 0.4039
- val_accuracy: 0.9060
Epoch 71/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0496 - accuracy: 0.9837 - val_loss: 0.4626
- val_accuracy: 0.9029
Epoch 72/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0445 - accuracy: 0.9887 - val_loss: 0.3882
- val_accuracy: 0.9133
Epoch 73/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0372 - accuracy: 0.9892 - val_loss: 0.4198
- val_accuracy: 0.9054
Epoch 74/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0491 - accuracy: 0.9858 - val_loss: 0.4281
- val_accuracy: 0.9051
Epoch 75/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0440 - accuracy: 0.9852 - val_loss: 0.4099
```

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- val_accuracy: 0.9075
Epoch 76/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0537 - accuracy: 0.9829 - val_loss: 0.4243
- val_accuracy: 0.9084
Epoch 77/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0586 - accuracy: 0.9836 - val_loss: 0.4265
- val_accuracy: 0.8996
Epoch 78/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0494 - accuracy: 0.9864 - val_loss: 0.4083
- val_accuracy: 0.9130
Epoch 79/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0381 - accuracy: 0.9869 - val_loss: 0.4134
- val_accuracy: 0.9126
Epoch 80/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0388 - accuracy: 0.9868 - val_loss: 0.4418
- val_accuracy: 0.9045
Epoch 81/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0395 - accuracy: 0.9868 - val_loss: 0.4139
- val_accuracy: 0.9108
Epoch 82/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0568 - accuracy: 0.9793 - val_loss: 0.4221
- val_accuracy: 0.9105
Epoch 83/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0479 - accuracy: 0.9848 - val_loss: 0.4365
- val_accuracy: 0.9099
Epoch 84/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0367 - accuracy: 0.9889 - val_loss: 0.4393
- val_accuracy: 0.9029
Epoch 85/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0399 - accuracy: 0.9904 - val_loss: 0.4311
- val_accuracy: 0.9130
Epoch 86/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0305 - accuracy: 0.9884 - val_loss: 0.4042
- val_accuracy: 0.9130
Epoch 87/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0402 - accuracy: 0.9863 - val_loss: 0.4402
- val_accuracy: 0.9111
Epoch 88/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0568 - accuracy: 0.9806 - val_loss: 0.4176
- val_accuracy: 0.9060
Epoch 89/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0472 - accuracy: 0.9871 - val_loss: 0.4308
- val_accuracy: 0.9075
Epoch 90/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0365 - accuracy: 0.9882 - val_loss: 0.4626
- val_accuracy: 0.9054
Epoch 91/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0360 - accuracy: 0.9879 - val_loss: 0.4407
- val_accuracy: 0.9102
Epoch 92/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0405 - accuracy: 0.9882 - val_loss: 0.4337
- val_accuracy: 0.9078
Epoch 93/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0408 - accuracy: 0.9878 - val_loss: 0.3938
- val_accuracy: 0.9117
Epoch 94/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0288 - accuracy: 0.9897 - val_loss: 0.4160
- val_accuracy: 0.9130
Epoch 95/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0334 - accuracy: 0.9877 - val_loss: 0.4413
- val_accuracy: 0.9084
Epoch 96/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0323 - accuracy: 0.9895 - val_loss: 0.4467
```

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- val_accuracy: 0.9120
Epoch 97/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0468 - accuracy: 0.9862 - val_loss: 0.4554
- val_accuracy: 0.9069
Epoch 98/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0359 - accuracy: 0.9886 - val_loss: 0.4670
- val_accuracy: 0.9035
Epoch 99/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0510 - accuracy: 0.9824 - val_loss: 0.4387
- val_accuracy: 0.9084
Epoch 100/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0334 - accuracy: 0.9887 - val_loss: 0.4609
- val_accuracy: 0.9045
Epoch 101/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0312 - accuracy: 0.9885 - val_loss: 0.4527
- val_accuracy: 0.9060
Epoch 102/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0368 - accuracy: 0.9901 - val_loss: 0.4390
- val_accuracy: 0.9096
Epoch 103/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0385 - accuracy: 0.9884 - val_loss: 0.4958
- val_accuracy: 0.9048
Epoch 104/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0441 - accuracy: 0.9868 - val_loss: 0.4506
- val_accuracy: 0.9057
Epoch 105/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0291 - accuracy: 0.9903 - val_loss: 0.4910
- val_accuracy: 0.9042
Epoch 106/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0382 - accuracy: 0.9874 - val_loss: 0.4555
- val_accuracy: 0.9087
Epoch 107/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0340 - accuracy: 0.9910 - val_loss: 0.4697
- val_accuracy: 0.9084
Epoch 108/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0323 - accuracy: 0.9889 - val_loss: 0.4564
- val_accuracy: 0.9102
Epoch 109/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0158 - accuracy: 0.9960 - val_loss: 0.4679
- val_accuracy: 0.9069
Epoch 110/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0425 - accuracy: 0.9872 - val_loss: 0.4623
- val_accuracy: 0.9032
Epoch 111/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0310 - accuracy: 0.9903 - val_loss: 0.4410
- val_accuracy: 0.9054
Epoch 112/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0303 - accuracy: 0.9919 - val_loss: 0.4303
- val_accuracy: 0.9084
Epoch 113/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0300 - accuracy: 0.9917 - val_loss: 0.4328
- val_accuracy: 0.9054
Epoch 114/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0296 - accuracy: 0.9902 - val_loss: 0.4361
- val_accuracy: 0.9078
Epoch 115/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0266 - accuracy: 0.9921 - val_loss: 0.4342
- val_accuracy: 0.9130
Epoch 116/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0305 - accuracy: 0.9895 - val_loss: 0.4047
- val_accuracy: 0.9184
Epoch 117/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0270 - accuracy: 0.9927 - val_loss: 0.3972
```

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- val_accuracy: 0.9148
Epoch 118/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0308 - accuracy: 0.9893 - val_loss: 0.4192
- val_accuracy: 0.9133
Epoch 119/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0260 - accuracy: 0.9914 - val_loss: 0.4556
- val_accuracy: 0.9081
Epoch 120/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0264 - accuracy: 0.9912 - val_loss: 0.4413
- val_accuracy: 0.9066
Epoch 121/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0359 - accuracy: 0.9891 - val_loss: 0.4485
 - val_accuracy: 0.9054
Epoch 122/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0357 - accuracy: 0.9891 - val_loss: 0.4185
 - val_accuracy: 0.9078
Epoch 123/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0276 - accuracy: 0.9915 - val_loss: 0.4585
 - val_accuracy: 0.9078
Epoch 124/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0363 - accuracy: 0.9889 - val_loss: 0.3926
 - val_accuracy: 0.9117
Epoch 125/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0374 - accuracy: 0.9889 - val_loss: 0.4001
 - val_accuracy: 0.9217
Epoch 126/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0382 - accuracy: 0.9894 - val_loss: 0.4638
 - val_accuracy: 0.9057
Epoch 127/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0342 - accuracy: 0.9881 - val_loss: 0.4511
 - val_accuracy: 0.9099
Epoch 128/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0314 - accuracy: 0.9916 - val_loss: 0.4509
 - val_accuracy: 0.9151
Epoch 129/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0204 - accuracy: 0.9944 - val_loss: 0.4558
 - val_accuracy: 0.9114
Epoch 130/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0276 - accuracy: 0.9902 - val_loss: 0.4353
 - val_accuracy: 0.9081
Epoch 131/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0266 - accuracy: 0.9904 - val_loss: 0.4288
 - val_accuracy: 0.9154
Epoch 132/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0253 - accuracy: 0.9922 - val_loss: 0.4330
 - val_accuracy: 0.9151
Epoch 133/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0272 - accuracy: 0.9912 - val_loss: 0.4640
 - val_accuracy: 0.9145
Epoch 134/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0283 - accuracy: 0.9914 - val_loss: 0.4665
 - val_accuracy: 0.9126
Epoch 135/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0440 - accuracy: 0.9894 - val_loss: 0.4290
 - val_accuracy: 0.9099
Epoch 136/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0298 - accuracy: 0.9917 - val_loss: 0.4265
 - val_accuracy: 0.9133
Epoch 137/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0364 - accuracy: 0.9876 - val_loss: 0.4258
 - val_accuracy: 0.9148
Epoch 138/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0275 - accuracy: 0.9906 - val_loss: 0.4803
```

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 - val_accuracy: 0.9117
Epoch 139/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0268 - accuracy: 0.9921 - val_loss: 0.4598
 - val_accuracy: 0.9120
Epoch 140/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0221 - accuracy: 0.9933 - val_loss: 0.4194
 - val_accuracy: 0.9136
Epoch 141/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0206 - accuracy: 0.9947 - val_loss: 0.4564
 - val_accuracy: 0.9130
Epoch 142/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0272 - accuracy: 0.9926 - val_loss: 0.4591
 - val_accuracy: 0.9075
Epoch 143/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0256 - accuracy: 0.9918 - val_loss: 0.4806
 - val_accuracy: 0.9093
Epoch 144/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0331 - accuracy: 0.9918 - val_loss: 0.4384
 - val_accuracy: 0.9102
Epoch 145/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0254 - accuracy: 0.9903 - val_loss: 0.4511
 - val_accuracy: 0.9078
Epoch 146/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0282 - accuracy: 0.9906 - val_loss: 0.4516
 - val_accuracy: 0.9126
Epoch 147/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0314 - accuracy: 0.9887 - val_loss: 0.4432
 - val_accuracy: 0.9117
Epoch 148/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0215 - accuracy: 0.9913 - val_loss: 0.4272
 - val_accuracy: 0.9130
Epoch 149/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0246 - accuracy: 0.9926 - val_loss: 0.4606
 - val_accuracy: 0.9099
Epoch 150/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0421 - accuracy: 0.9879 - val_loss: 0.4599
 - val_accuracy: 0.9099
Epoch 151/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0259 - accuracy: 0.9923 - val_loss: 0.4538
 - val_accuracy: 0.9108
Epoch 152/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0151 - accuracy: 0.9948 - val_loss: 0.4343
 - val_accuracy: 0.9148
Epoch 153/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0234 - accuracy: 0.9925 - val_loss: 0.4643
 - val_accuracy: 0.9090
Epoch 154/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0237 - accuracy: 0.9915 - val_loss: 0.4666
 - val_accuracy: 0.9075
Epoch 155/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0335 - accuracy: 0.9876 - val_loss: 0.4421
 - val_accuracy: 0.9126
Epoch 156/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0228 - accuracy: 0.9920 - val_loss: 0.4624
 - val_accuracy: 0.9111
Epoch 157/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0369 - accuracy: 0.9868 - val_loss: 0.4729
 - val_accuracy: 0.9026
Epoch 158/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0344 - accuracy: 0.9895 - val_loss: 0.4573
 - val_accuracy: 0.9111
Epoch 159/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0214 - accuracy: 0.9932 - val_loss: 0.4649
```

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 - val_accuracy: 0.9069
Epoch 160/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0280 - accuracy: 0.9920 - val_loss: 0.4367
 - val_accuracy: 0.9154
Epoch 161/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0268 - accuracy: 0.9900 - val_loss: 0.4317
 - val_accuracy: 0.9123
Epoch 162/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0209 - accuracy: 0.9931 - val_loss: 0.4386
 - val_accuracy: 0.9130
Epoch 163/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0146 - accuracy: 0.9943 - val_loss: 0.4678
 - val_accuracy: 0.9148
Epoch 164/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0215 - accuracy: 0.9930 - val_loss: 0.4331
 - val_accuracy: 0.9166
Epoch 165/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0314 - accuracy: 0.9911 - val_loss: 0.4429
 - val_accuracy: 0.9042
Epoch 166/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0313 - accuracy: 0.9899 - val_loss: 0.4551
 - val_accuracy: 0.9096
Epoch 167/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0196 - accuracy: 0.9917 - val_loss: 0.4650
 - val_accuracy: 0.9151
Epoch 168/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0235 - accuracy: 0.9924 - val_loss: 0.4666
 - val_accuracy: 0.9108
Epoch 169/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0303 - accuracy: 0.9898 - val_loss: 0.4393
 - val_accuracy: 0.9123
Epoch 170/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0264 - accuracy: 0.9920 - val_loss: 0.4626
 - val_accuracy: 0.9069
Epoch 171/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0180 - accuracy: 0.9949 - val_loss: 0.4782
 - val_accuracy: 0.9108
Epoch 172/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0276 - accuracy: 0.9890 - val_loss: 0.4908
 - val_accuracy: 0.9078
Epoch 173/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0213 - accuracy: 0.9900 - val_loss: 0.4790
 - val_accuracy: 0.9108
Epoch 174/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0125 - accuracy: 0.9946 - val_loss: 0.4948
 - val_accuracy: 0.9114
Epoch 175/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0169 - accuracy: 0.9928 - val_loss: 0.4671
 - val_accuracy: 0.9169
Epoch 176/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0234 - accuracy: 0.9925 - val_loss: 0.4624
 - val_accuracy: 0.9117
Epoch 177/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0341 - accuracy: 0.9894 - val_loss: 0.4926
 - val_accuracy: 0.9063
Epoch 178/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0273 - accuracy: 0.9900 - val_loss: 0.4812
 - val_accuracy: 0.9102
Epoch 179/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0251 - accuracy: 0.9937 - val_loss: 0.4698
 - val_accuracy: 0.9108
Epoch 180/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0197 - accuracy: 0.9945 - val_loss: 0.4785
```

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 - val_accuracy: 0.9105
Epoch 181/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0228 - accuracy: 0.9918 - val_loss: 0.4917
 - val_accuracy: 0.9066
Epoch 182/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0175 - accuracy: 0.9937 - val_loss: 0.4990
 - val_accuracy: 0.9102
Epoch 183/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0165 - accuracy: 0.9952 - val_loss: 0.4688
 - val_accuracy: 0.9154
Epoch 184/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0221 - accuracy: 0.9929 - val_loss: 0.4891
 - val_accuracy: 0.9108
Epoch 185/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0228 - accuracy: 0.9925 - val_loss: 0.4791
 - val_accuracy: 0.9075
Epoch 186/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0228 - accuracy: 0.9924 - val_loss: 0.4440
 - val_accuracy: 0.9166
Epoch 187/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0260 - accuracy: 0.9935 - val_loss: 0.4701
 - val_accuracy: 0.9172
Epoch 188/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0270 - accuracy: 0.9917 - val_loss: 0.4964
 - val_accuracy: 0.9151
Epoch 189/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0254 - accuracy: 0.9912 - val_loss: 0.4554
 - val_accuracy: 0.9190
Epoch 190/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0180 - accuracy: 0.9954 - val_loss: 0.4770
 - val_accuracy: 0.9126
Epoch 191/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0158 - accuracy: 0.9936 - val_loss: 0.4378
 - val_accuracy: 0.9214
Epoch 192/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0221 - accuracy: 0.9937 - val_loss: 0.4572
 - val_accuracy: 0.9126
Epoch 193/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0195 - accuracy: 0.9943 - val_loss: 0.4566
 - val_accuracy: 0.9142
Epoch 194/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0347 - accuracy: 0.9914 - val_loss: 0.4435
 - val_accuracy: 0.9117
Epoch 195/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0275 - accuracy: 0.9922 - val_loss: 0.4353
 - val_accuracy: 0.9130
Epoch 196/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0161 - accuracy: 0.9964 - val_loss: 0.4393
 - val_accuracy: 0.9175
Epoch 197/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0160 - accuracy: 0.9944 - val_loss: 0.4396
 - val_accuracy: 0.9145
Epoch 198/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0161 - accuracy: 0.9934 - val_loss: 0.4561
 - val_accuracy: 0.9136
Epoch 199/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0141 - accuracy: 0.9958 - val_loss: 0.4584
 - val_accuracy: 0.9130
Epoch 200/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0222 - accuracy: 0.9914 - val_loss: 0.4891
 - val_accuracy: 0.9157
Epoch 201/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0168 - accuracy: 0.9946 - val_loss: 0.4804
```

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 - val_accuracy: 0.9126
Epoch 202/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0191 - accuracy: 0.9931 - val_loss: 0.4752
 - val_accuracy: 0.9139
Epoch 203/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0237 - accuracy: 0.9929 - val_loss: 0.4674
 - val_accuracy: 0.9142
Epoch 204/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0320 - accuracy: 0.9900 - val_loss: 0.4194
 - val_accuracy: 0.9175
Epoch 205/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0198 - accuracy: 0.9921 - val_loss: 0.4556
 - val_accuracy: 0.9117
Epoch 206/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0301 - accuracy: 0.9897 - val_loss: 0.4579
 - val_accuracy: 0.9117
Epoch 207/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0225 - accuracy: 0.9938 - val_loss: 0.4435
 - val_accuracy: 0.9108
Epoch 208/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0245 - accuracy: 0.9929 - val_loss: 0.4350
 - val_accuracy: 0.9123
Epoch 209/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0295 - accuracy: 0.9937 - val_loss: 0.4384
 - val_accuracy: 0.9108
Epoch 210/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0148 - accuracy: 0.9956 - val_loss: 0.4360
 - val_accuracy: 0.9114
Epoch 211/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0119 - accuracy: 0.9962 - val_loss: 0.4854
 - val_accuracy: 0.9148
Epoch 212/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0189 - accuracy: 0.9939 - val_loss: 0.4380
 - val_accuracy: 0.9169
Epoch 213/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0120 - accuracy: 0.9950 - val_loss: 0.4531
 - val_accuracy: 0.9169
Epoch 214/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0173 - accuracy: 0.9940 - val_loss: 0.4595
 - val_accuracy: 0.9133
Epoch 215/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0180 - accuracy: 0.9943 - val_loss: 0.4669
 - val_accuracy: 0.9136
Epoch 216/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0201 - accuracy: 0.9932 - val_loss: 0.4753
 - val_accuracy: 0.9145
Epoch 217/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0236 - accuracy: 0.9915 - val_loss: 0.4662
 - val_accuracy: 0.9111
Epoch 218/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0275 - accuracy: 0.9908 - val_loss: 0.4300
 - val_accuracy: 0.9169
Epoch 219/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0207 - accuracy: 0.9934 - val_loss: 0.4369
 - val_accuracy: 0.9117
Epoch 220/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0223 - accuracy: 0.9935 - val_loss: 0.4743
 - val_accuracy: 0.9130
Epoch 221/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0220 - accuracy: 0.9921 - val_loss: 0.4375
 - val_accuracy: 0.9166
Epoch 222/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0249 - accuracy: 0.9930 - val_loss: 0.4345
```

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 - val_accuracy: 0.9166
Epoch 223/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0173 - accuracy: 0.9933 - val_loss: 0.4532
 - val_accuracy: 0.9136
Epoch 224/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0207 - accuracy: 0.9949 - val_loss: 0.4238
 - val_accuracy: 0.9151
Epoch 225/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0144 - accuracy: 0.9948 - val_loss: 0.4655
 - val_accuracy: 0.9175
Epoch 226/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0146 - accuracy: 0.9949 - val_loss: 0.4726
 - val_accuracy: 0.9111
Epoch 227/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0163 - accuracy: 0.9945 - val_loss: 0.4993
 - val_accuracy: 0.9123
Epoch 228/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0261 - accuracy: 0.9912 - val_loss: 0.4983
 - val_accuracy: 0.9042
Epoch 229/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0203 - accuracy: 0.9936 - val_loss: 0.4742
 - val_accuracy: 0.9157
Epoch 230/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0247 - accuracy: 0.9921 - val_loss: 0.4729
 - val_accuracy: 0.9130
Epoch 231/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0208 - accuracy: 0.9935 - val_loss: 0.4701
 - val_accuracy: 0.9196
Epoch 232/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0160 - accuracy: 0.9935 - val_loss: 0.4766
 - val_accuracy: 0.9117
Epoch 233/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0245 - accuracy: 0.9914 - val_loss: 0.4376
 - val_accuracy: 0.9187
Epoch 234/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0228 - accuracy: 0.9932 - val_loss: 0.4282
 - val_accuracy: 0.9166
Epoch 235/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0168 - accuracy: 0.9924 - val_loss: 0.4553
 - val_accuracy: 0.9196
Epoch 236/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0181 - accuracy: 0.9930 - val_loss: 0.4704
 - val_accuracy: 0.9172
Epoch 237/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0189 - accuracy: 0.9940 - val_loss: 0.4494
 - val_accuracy: 0.9157
Epoch 238/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0179 - accuracy: 0.9929 - val_loss: 0.4689
 - val_accuracy: 0.9145
Epoch 239/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0201 - accuracy: 0.9942 - val_loss: 0.4721
 - val_accuracy: 0.9145
Epoch 240/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0253 - accuracy: 0.9915 - val_loss: 0.4923
 - val_accuracy: 0.9148
Epoch 241/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0304 - accuracy: 0.9921 - val_loss: 0.4690
 - val_accuracy: 0.9148
Epoch 242/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0272 - accuracy: 0.9922 - val_loss: 0.4328
 - val_accuracy: 0.9208
Epoch 243/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0253 - accuracy: 0.9916 - val_loss: 0.4339
```

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 - val_accuracy: 0.9163
Epoch 244/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0254 - accuracy: 0.9905 - val_loss: 0.3870
 - val_accuracy: 0.9214
Epoch 245/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0196 - accuracy: 0.9915 - val_loss: 0.4167
 - val_accuracy: 0.9172
Epoch 246/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0198 - accuracy: 0.9912 - val_loss: 0.4382
 - val_accuracy: 0.9184
Epoch 247/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0154 - accuracy: 0.9945 - val_loss: 0.4821
 - val_accuracy: 0.9114
Epoch 248/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0116 - accuracy: 0.9966 - val_loss: 0.4608
 - val_accuracy: 0.9184
Epoch 249/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0200 - accuracy: 0.9945 - val_loss: 0.4402
 - val_accuracy: 0.9187
Epoch 250/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0482 - accuracy: 0.9871 - val_loss: 0.4130
 - val_accuracy: 0.9163
Epoch 251/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0220 - accuracy: 0.9938 - val_loss: 0.4036
 - val_accuracy: 0.9184
Epoch 252/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0127 - accuracy: 0.9962 - val_loss: 0.4282
 - val_accuracy: 0.9199
Epoch 253/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0123 - accuracy: 0.9955 - val_loss: 0.4151
 - val_accuracy: 0.9178
Epoch 254/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0134 - accuracy: 0.9943 - val_loss: 0.4651
 - val_accuracy: 0.9136
Epoch 255/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0294 - accuracy: 0.9892 - val_loss: 0.4568
 - val_accuracy: 0.9099
Epoch 256/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0282 - accuracy: 0.9925 - val_loss: 0.4280
 - val_accuracy: 0.9193
Epoch 257/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0177 - accuracy: 0.9951 - val_loss: 0.4085
 - val_accuracy: 0.9148
Epoch 258/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0201 - accuracy: 0.9924 - val_loss: 0.4231
 - val_accuracy: 0.9133
Epoch 259/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0238 - accuracy: 0.9935 - val_loss: 0.3880
 - val_accuracy: 0.9236
Epoch 260/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0161 - accuracy: 0.9941 - val_loss: 0.3946
 - val_accuracy: 0.9242
Epoch 261/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0110 - accuracy: 0.9966 - val_loss: 0.3974
 - val_accuracy: 0.9245
Epoch 262/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0219 - accuracy: 0.9925 - val_loss: 0.4394
 - val_accuracy: 0.9151
Epoch 263/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0176 - accuracy: 0.9936 - val_loss: 0.4306
 - val_accuracy: 0.9208
Epoch 264/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0117 - accuracy: 0.9965 - val_loss: 0.4652
```

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 - val_accuracy: 0.9172
Epoch 265/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0122 - accuracy: 0.9955 - val_loss: 0.4479
 - val_accuracy: 0.9214
Epoch 266/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0195 - accuracy: 0.9937 - val_loss: 0.4405
 - val_accuracy: 0.9217
Epoch 267/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0236 - accuracy: 0.9931 - val_loss: 0.4614
 - val_accuracy: 0.9190
Epoch 268/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0099 - accuracy: 0.9969 - val_loss: 0.4876
 - val_accuracy: 0.9169
Epoch 269/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0159 - accuracy: 0.9934 - val_loss: 0.4681
 - val_accuracy: 0.9157
Epoch 270/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0284 - accuracy: 0.9939 - val_loss: 0.4554
 - val_accuracy: 0.9166
Epoch 271/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0200 - accuracy: 0.9925 - val_loss: 0.4563
 - val_accuracy: 0.9151
Epoch 272/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0179 - accuracy: 0.9957 - val_loss: 0.4511
 - val_accuracy: 0.9136
Epoch 273/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0122 - accuracy: 0.9952 - val_loss: 0.4599
 - val_accuracy: 0.9169
Epoch 274/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0087 - accuracy: 0.9976 - val_loss: 0.4908
 - val_accuracy: 0.9166
Epoch 275/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0194 - accuracy: 0.9946 - val_loss: 0.4593
 - val_accuracy: 0.9151
Epoch 276/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0166 - accuracy: 0.9924 - val_loss: 0.4751
 - val_accuracy: 0.9163
Epoch 277/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0186 - accuracy: 0.9925 - val_loss: 0.4522
 - val_accuracy: 0.9136
Epoch 278/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0169 - accuracy: 0.9939 - val_loss: 0.4579
 - val_accuracy: 0.9163
Epoch 279/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0186 - accuracy: 0.9948 - val_loss: 0.4757
 - val_accuracy: 0.9157
Epoch 280/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0211 - accuracy: 0.9924 - val_loss: 0.4312
 - val_accuracy: 0.9181
Epoch 281/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0153 - accuracy: 0.9935 - val_loss: 0.4547
 - val_accuracy: 0.9208
Epoch 282/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0113 - accuracy: 0.9958 - val_loss: 0.4604
 - val_accuracy: 0.9202
Epoch 283/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0119 - accuracy: 0.9940 - val_loss: 0.4686
 - val_accuracy: 0.9221
Epoch 284/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0159 - accuracy: 0.9946 - val_loss: 0.4699
 - val_accuracy: 0.9148
Epoch 285/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0142 - accuracy: 0.9958 - val_loss: 0.4672
```

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 - val_accuracy: 0.9166
Epoch 286/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0152 - accuracy: 0.9943 - val_loss: 0.4611
 - val_accuracy: 0.9178
Epoch 287/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0108 - accuracy: 0.9953 - val_loss: 0.4890
 - val_accuracy: 0.9196
Epoch 288/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0182 - accuracy: 0.9927 - val_loss: 0.4800
 - val_accuracy: 0.9169
Epoch 289/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0114 - accuracy: 0.9951 - val_loss: 0.4976
 - val_accuracy: 0.9169
Epoch 290/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0141 - accuracy: 0.9958 - val_loss: 0.5089
 - val_accuracy: 0.9169
Epoch 291/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0155 - accuracy: 0.9945 - val_loss: 0.4854
 - val_accuracy: 0.9224
Epoch 292/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0118 - accuracy: 0.9973 - val_loss: 0.4602
 - val_accuracy: 0.9190
Epoch 293/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0129 - accuracy: 0.9936 - val_loss: 0.4532
 - val_accuracy: 0.9166
Epoch 294/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0133 - accuracy: 0.9942 - val_loss: 0.4621
 - val_accuracy: 0.9190
Epoch 295/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0116 - accuracy: 0.9952 - val_loss: 0.4823
 - val_accuracy: 0.9172
Epoch 296/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0126 - accuracy: 0.9959 - val_loss: 0.4831
 - val_accuracy: 0.9269
Epoch 297/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0114 - accuracy: 0.9960 - val_loss: 0.4937
 - val_accuracy: 0.9199
Epoch 298/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0185 - accuracy: 0.9922 - val_loss: 0.5229
 - val_accuracy: 0.9114
Epoch 299/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0220 - accuracy: 0.9925 - val_loss: 0.4816
 - val_accuracy: 0.9111
Epoch 300/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0220 - accuracy: 0.9926 - val_loss: 0.4430
 - val_accuracy: 0.9142
Epoch 301/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0186 - accuracy: 0.9938 - val_loss: 0.4745
 - val_accuracy: 0.9102
Epoch 302/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0198 - accuracy: 0.9933 - val_loss: 0.4525
 - val_accuracy: 0.9154
Epoch 303/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0125 - accuracy: 0.9960 - val_loss: 0.4702
 - val_accuracy: 0.9196
Epoch 304/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0138 - accuracy: 0.9959 - val_loss: 0.5271
 - val_accuracy: 0.9136
Epoch 305/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0133 - accuracy: 0.9956 - val_loss: 0.5179
 - val_accuracy: 0.9154
Epoch 306/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0181 - accuracy: 0.9942 - val_loss: 0.4851
```

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 - val_accuracy: 0.9224
Epoch 307/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0147 - accuracy: 0.9957 - val_loss: 0.4748
 - val_accuracy: 0.9196
Epoch 308/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0195 - accuracy: 0.9936 - val_loss: 0.4430
 - val_accuracy: 0.9166
Epoch 309/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0063 - accuracy: 0.9973 - val_loss: 0.4773
 - val_accuracy: 0.9154
Epoch 310/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0172 - accuracy: 0.9940 - val_loss: 0.4614
 - val_accuracy: 0.9163
Epoch 311/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0114 - accuracy: 0.9959 - val_loss: 0.4823
 - val_accuracy: 0.9193
Epoch 312/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0121 - accuracy: 0.9959 - val_loss: 0.4980
 - val_accuracy: 0.9199
Epoch 313/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0224 - accuracy: 0.9928 - val_loss: 0.4724
 - val_accuracy: 0.9208
Epoch 314/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0212 - accuracy: 0.9929 - val_loss: 0.5041
 - val_accuracy: 0.9157
Epoch 315/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0142 - accuracy: 0.9949 - val_loss: 0.4849
 - val_accuracy: 0.9163
Epoch 316/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0121 - accuracy: 0.9960 - val_loss: 0.4966
 - val_accuracy: 0.9142
Epoch 317/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0273 - accuracy: 0.9927 - val_loss: 0.5126
 - val_accuracy: 0.9163
Epoch 318/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0147 - accuracy: 0.9955 - val_loss: 0.4893
 - val_accuracy: 0.9178
Epoch 319/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0255 - accuracy: 0.9935 - val_loss: 0.4662
 - val_accuracy: 0.9175
Epoch 320/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0161 - accuracy: 0.9937 - val_loss: 0.4886
 - val_accuracy: 0.9202
Epoch 321/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0155 - accuracy: 0.9947 - val_loss: 0.4851
 - val_accuracy: 0.9187
Epoch 322/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0150 - accuracy: 0.9949 - val_loss: 0.5196
 - val_accuracy: 0.9199
Epoch 323/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0208 - accuracy: 0.9940 - val_loss: 0.4877
 - val_accuracy: 0.9293
Epoch 324/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0243 - accuracy: 0.9941 - val_loss: 0.4940
 - val_accuracy: 0.9142
Epoch 325/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0127 - accuracy: 0.9960 - val_loss: 0.4986
 - val_accuracy: 0.9169
Epoch 326/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0219 - accuracy: 0.9926 - val_loss: 0.4753
 - val_accuracy: 0.9169
Epoch 327/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0169 - accuracy: 0.9943 - val_loss: 0.4734
```

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 - val_accuracy: 0.9214
Epoch 328/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0132 - accuracy: 0.9939 - val_loss: 0.5120
 - val_accuracy: 0.9224
Epoch 329/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0249 - accuracy: 0.9942 - val_loss: 0.5008
 - val_accuracy: 0.9169
Epoch 330/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0170 - accuracy: 0.9939 - val_loss: 0.4555
 - val_accuracy: 0.9205
Epoch 331/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0222 - accuracy: 0.9925 - val_loss: 0.4477
 - val_accuracy: 0.9193
Epoch 332/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0131 - accuracy: 0.9958 - val_loss: 0.4422
 - val_accuracy: 0.9202
Epoch 333/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0138 - accuracy: 0.9952 - val_loss: 0.4612
 - val_accuracy: 0.9224
Epoch 334/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0127 - accuracy: 0.9963 - val_loss: 0.4426
 - val_accuracy: 0.9181
Epoch 335/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0117 - accuracy: 0.9954 - val_loss: 0.4885
 - val_accuracy: 0.9199
Epoch 336/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0202 - accuracy: 0.9955 - val_loss: 0.4901
 - val_accuracy: 0.9178
Epoch 337/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0087 - accuracy: 0.9970 - val_loss: 0.4643
 - val_accuracy: 0.9275
Epoch 338/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0201 - accuracy: 0.9941 - val_loss: 0.4546
 - val_accuracy: 0.9245
Epoch 339/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0178 - accuracy: 0.9936 - val_loss: 0.4505
 - val_accuracy: 0.9217
Epoch 340/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0118 - accuracy: 0.9961 - val_loss: 0.4799
 - val_accuracy: 0.9199
Epoch 341/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0187 - accuracy: 0.9945 - val_loss: 0.4644
 - val_accuracy: 0.9227
Epoch 342/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0160 - accuracy: 0.9946 - val_loss: 0.5135
 - val_accuracy: 0.9184
Epoch 343/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0171 - accuracy: 0.9946 - val_loss: 0.4748
 - val_accuracy: 0.9208
Epoch 344/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0219 - accuracy: 0.9951 - val_loss: 0.4359
 - val_accuracy: 0.9211
Epoch 345/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0128 - accuracy: 0.9951 - val_loss: 0.4560
 - val_accuracy: 0.9217
Epoch 346/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0171 - accuracy: 0.9957 - val_loss: 0.4749
 - val_accuracy: 0.9160
Epoch 347/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0082 - accuracy: 0.9972 - val_loss: 0.4716
 - val_accuracy: 0.9181
Epoch 348/600
53/53 [==============================] - 1s 10ms/step - loss: 0.0118 - accuracy: 0.9954 - val_loss: 0.5211
```

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- val_accuracy: 0.9151
Epoch 349/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0107 - accuracy: 0.9966 - val_loss: 0.5018
 - val_accuracy: 0.9190
Epoch 350/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0159 - accuracy: 0.9949 - val_loss: 0.4817
 - val_accuracy: 0.9202
Epoch 351/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0110 - accuracy: 0.9970 - val_loss: 0.5370
 - val_accuracy: 0.9060
Epoch 352/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0190 - accuracy: 0.9930 - val_loss: 0.4999
 - val_accuracy: 0.9163
Epoch 353/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0158 - accuracy: 0.9937 - val_loss: 0.5114
 - val_accuracy: 0.9172
Epoch 354/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0211 - accuracy: 0.9931 - val_loss: 0.4637
 - val_accuracy: 0.9202
Epoch 355/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0188 - accuracy: 0.9939 - val_loss: 0.4971
 - val_accuracy: 0.9175
Epoch 356/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0177 - accuracy: 0.9932 - val_loss: 0.5418
 - val_accuracy: 0.9142
Epoch 357/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0181 - accuracy: 0.9942 - val_loss: 0.5317
 - val_accuracy: 0.9130
Epoch 358/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0157 - accuracy: 0.9951 - val_loss: 0.5616
 - val_accuracy: 0.9145
Epoch 359/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0130 - accuracy: 0.9958 - val_loss: 0.5091
 - val_accuracy: 0.9166
Epoch 360/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0130 - accuracy: 0.9950 - val_loss: 0.5163
 - val_accuracy: 0.9211
Epoch 361/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0148 - accuracy: 0.9944 - val_loss: 0.5364
 - val_accuracy: 0.9145
Epoch 362/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0097 - accuracy: 0.9969 - val_loss: 0.5307
 - val_accuracy: 0.9160
Epoch 363/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0147 - accuracy: 0.9970 - val_loss: 0.5342
 - val_accuracy: 0.9193
Epoch 364/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0090 - accuracy: 0.9978 - val_loss: 0.5229
 - val_accuracy: 0.9205
Epoch 365/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0128 - accuracy: 0.9955 - val_loss: 0.5221
 - val_accuracy: 0.9199
Epoch 366/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0151 - accuracy: 0.9938 - val_loss: 0.5798
 - val_accuracy: 0.9114
Epoch 367/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0141 - accuracy: 0.9949 - val_loss: 0.5225
 - val_accuracy: 0.9169
Epoch 368/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0216 - accuracy: 0.9950 - val_loss: 0.5141
 - val_accuracy: 0.9181
Epoch 369/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0099 - accuracy: 0.9976 - val_loss: 0.5461
```

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 - val_accuracy: 0.9202
Epoch 370/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0104 - accuracy: 0.9966 - val_loss: 0.5404
 - val_accuracy: 0.9190
Epoch 371/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0371 - accuracy: 0.9927 - val_loss: 0.5195
 - val_accuracy: 0.9190
Epoch 372/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0150 - accuracy: 0.9955 - val_loss: 0.5177
 - val_accuracy: 0.9166
Epoch 373/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0154 - accuracy: 0.9940 - val_loss: 0.5276
 - val_accuracy: 0.9163
Epoch 374/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0119 - accuracy: 0.9963 - val_loss: 0.5391
 - val_accuracy: 0.9154
Epoch 375/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0149 - accuracy: 0.9952 - val_loss: 0.5295
 - val_accuracy: 0.9163
Epoch 376/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0212 - accuracy: 0.9936 - val_loss: 0.5120
 - val_accuracy: 0.9139
Epoch 377/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0155 - accuracy: 0.9943 - val_loss: 0.5568
 - val_accuracy: 0.9142
Epoch 378/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0123 - accuracy: 0.9965 - val_loss: 0.5449
 - val_accuracy: 0.9108
Epoch 379/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0135 - accuracy: 0.9950 - val_loss: 0.5483
 - val_accuracy: 0.9163
Epoch 380/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0189 - accuracy: 0.9941 - val_loss: 0.5398
 - val_accuracy: 0.9184
Epoch 381/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0138 - accuracy: 0.9946 - val_loss: 0.5621
 - val_accuracy: 0.9136
Epoch 382/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0263 - accuracy: 0.9939 - val_loss: 0.5761
 - val_accuracy: 0.9099
Epoch 383/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0142 - accuracy: 0.9946 - val_loss: 0.5425
 - val_accuracy: 0.9172
Epoch 384/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0135 - accuracy: 0.9955 - val_loss: 0.5144
 - val_accuracy: 0.9163
Epoch 385/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0079 - accuracy: 0.9971 - val_loss: 0.5266
 - val_accuracy: 0.9190
Epoch 386/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0057 - accuracy: 0.9982 - val_loss: 0.5418
 - val_accuracy: 0.9166
Epoch 387/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0116 - accuracy: 0.9965 - val_loss: 0.5438
 - val_accuracy: 0.9172
Epoch 388/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0095 - accuracy: 0.9950 - val_loss: 0.4994
 - val_accuracy: 0.9190
Epoch 389/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0186 - accuracy: 0.9949 - val_loss: 0.5227
 - val_accuracy: 0.9181
Epoch 390/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0064 - accuracy: 0.9978 - val_loss: 0.5473
```

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 - val_accuracy: 0.9172
Epoch 391/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0102 - accuracy: 0.9969 - val_loss: 0.5636
 - val_accuracy: 0.9151
Epoch 392/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0093 - accuracy: 0.9969 - val_loss: 0.5948
 - val_accuracy: 0.9163
Epoch 393/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0128 - accuracy: 0.9962 - val_loss: 0.5779
 - val_accuracy: 0.9184
Epoch 394/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0170 - accuracy: 0.9951 - val_loss: 0.5645
 - val_accuracy: 0.9151
Epoch 395/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0143 - accuracy: 0.9953 - val_loss: 0.5939
 - val_accuracy: 0.9151
Epoch 396/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0120 - accuracy: 0.9955 - val_loss: 0.6049
 - val_accuracy: 0.9202
Epoch 397/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0136 - accuracy: 0.9947 - val_loss: 0.5423
 - val_accuracy: 0.9193
Epoch 398/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0191 - accuracy: 0.9949 - val_loss: 0.5525
 - val_accuracy: 0.9163
Epoch 399/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0134 - accuracy: 0.9955 - val_loss: 0.5246
 - val_accuracy: 0.9172
Epoch 400/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0135 - accuracy: 0.9960 - val_loss: 0.5591
 - val_accuracy: 0.9193
Epoch 401/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0166 - accuracy: 0.9954 - val_loss: 0.5296
 - val_accuracy: 0.9114
Epoch 402/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0188 - accuracy: 0.9948 - val_loss: 0.5318
 - val_accuracy: 0.9142
Epoch 403/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0130 - accuracy: 0.9956 - val_loss: 0.5456
 - val_accuracy: 0.9199
Epoch 404/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0138 - accuracy: 0.9954 - val_loss: 0.5318
 - val_accuracy: 0.9199
Epoch 405/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0109 - accuracy: 0.9953 - val_loss: 0.5273
 - val_accuracy: 0.9175
Epoch 406/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0123 - accuracy: 0.9959 - val_loss: 0.5869
 - val_accuracy: 0.9163
Epoch 407/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0156 - accuracy: 0.9957 - val_loss: 0.5411
 - val_accuracy: 0.9217
Epoch 408/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0115 - accuracy: 0.9956 - val_loss: 0.5559
 - val_accuracy: 0.9154
Epoch 409/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0237 - accuracy: 0.9928 - val_loss: 0.5270
 - val_accuracy: 0.9208
Epoch 410/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0111 - accuracy: 0.9960 - val_loss: 0.5233
 - val_accuracy: 0.9190
Epoch 411/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0111 - accuracy: 0.9969 - val_loss: 0.5468
```

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 - val_accuracy: 0.9154
Epoch 412/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0215 - accuracy: 0.9945 - val_loss: 0.5208
 - val_accuracy: 0.9145
Epoch 413/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0073 - accuracy: 0.9973 - val_loss: 0.5405
 - val_accuracy: 0.9175
Epoch 414/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0157 - accuracy: 0.9955 - val_loss: 0.5390
 - val_accuracy: 0.9178
Epoch 415/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0095 - accuracy: 0.9957 - val_loss: 0.5294
 - val_accuracy: 0.9187
Epoch 416/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0101 - accuracy: 0.9969 - val_loss: 0.5696
 - val_accuracy: 0.9154
Epoch 417/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0174 - accuracy: 0.9939 - val_loss: 0.5376
 - val_accuracy: 0.9214
Epoch 418/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0165 - accuracy: 0.9943 - val_loss: 0.5108
 - val_accuracy: 0.9202
Epoch 419/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0137 - accuracy: 0.9963 - val_loss: 0.5460
 - val_accuracy: 0.9175
Epoch 420/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0087 - accuracy: 0.9973 - val_loss: 0.5600
 - val_accuracy: 0.9184
Epoch 421/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0185 - accuracy: 0.9940 - val_loss: 0.5104
 - val_accuracy: 0.9208
Epoch 422/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0160 - accuracy: 0.9941 - val_loss: 0.5156
 - val_accuracy: 0.9233
Epoch 423/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0130 - accuracy: 0.9960 - val_loss: 0.5250
 - val_accuracy: 0.9236
Epoch 424/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0143 - accuracy: 0.9955 - val_loss: 0.5542
 - val_accuracy: 0.9166
Epoch 425/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0133 - accuracy: 0.9962 - val_loss: 0.5406
 - val_accuracy: 0.9233
Epoch 426/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0086 - accuracy: 0.9974 - val_loss: 0.5332
 - val_accuracy: 0.9251
Epoch 427/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0085 - accuracy: 0.9970 - val_loss: 0.5753
 - val_accuracy: 0.9230
Epoch 428/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0199 - accuracy: 0.9937 - val_loss: 0.5624
 - val_accuracy: 0.9236
Epoch 429/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0156 - accuracy: 0.9969 - val_loss: 0.5308
 - val_accuracy: 0.9205
Epoch 430/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0121 - accuracy: 0.9959 - val_loss: 0.5239
 - val_accuracy: 0.9184
Epoch 431/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0162 - accuracy: 0.9937 - val_loss: 0.5584
 - val_accuracy: 0.9154
Epoch 432/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0089 - accuracy: 0.9964 - val_loss: 0.5221
```

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 - val_accuracy: 0.9208
Epoch 433/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0103 - accuracy: 0.9966 - val_loss: 0.5281
 - val_accuracy: 0.9181
Epoch 434/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0081 - accuracy: 0.9977 - val_loss: 0.5391
 - val_accuracy: 0.9175
Epoch 435/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0119 - accuracy: 0.9963 - val_loss: 0.5794
 - val_accuracy: 0.9172
Epoch 436/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0176 - accuracy: 0.9940 - val_loss: 0.5618
 - val_accuracy: 0.9184
Epoch 437/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0175 - accuracy: 0.9940 - val_loss: 0.5503
 - val_accuracy: 0.9172
Epoch 438/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0152 - accuracy: 0.9945 - val_loss: 0.5547
 - val_accuracy: 0.9172
Epoch 439/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0170 - accuracy: 0.9946 - val_loss: 0.5671
 - val_accuracy: 0.9157
Epoch 440/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0162 - accuracy: 0.9955 - val_loss: 0.5443
 - val_accuracy: 0.9178
Epoch 441/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0099 - accuracy: 0.9966 - val_loss: 0.5739
 - val_accuracy: 0.9184
Epoch 442/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0135 - accuracy: 0.9959 - val_loss: 0.5554
 - val_accuracy: 0.9148
Epoch 443/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0216 - accuracy: 0.9944 - val_loss: 0.5539
 - val_accuracy: 0.9172
Epoch 444/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0092 - accuracy: 0.9971 - val_loss: 0.5466
 - val_accuracy: 0.9187
Epoch 445/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0135 - accuracy: 0.9957 - val_loss: 0.5293
 - val_accuracy: 0.9217
Epoch 446/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0124 - accuracy: 0.9965 - val_loss: 0.5822
 - val_accuracy: 0.9205
Epoch 447/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0156 - accuracy: 0.9952 - val_loss: 0.5307
 - val_accuracy: 0.9184
Epoch 448/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0208 - accuracy: 0.9935 - val_loss: 0.5016
 - val_accuracy: 0.9160
Epoch 449/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0210 - accuracy: 0.9948 - val_loss: 0.4682
 - val_accuracy: 0.9217
Epoch 450/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0143 - accuracy: 0.9950 - val_loss: 0.4955
 - val_accuracy: 0.9208
Epoch 451/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0098 - accuracy: 0.9963 - val_loss: 0.5305
 - val_accuracy: 0.9187
Epoch 452/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0139 - accuracy: 0.9946 - val_loss: 0.4863
 - val_accuracy: 0.9224
Epoch 453/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0148 - accuracy: 0.9956 - val_loss: 0.5021
```

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 - val_accuracy: 0.9251
Epoch 454/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0074 - accuracy: 0.9969 - val_loss: 0.5099
 - val_accuracy: 0.9214
Epoch 455/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0126 - accuracy: 0.9964 - val_loss: 0.4734
 - val_accuracy: 0.9236
Epoch 456/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0114 - accuracy: 0.9970 - val_loss: 0.4812
 - val_accuracy: 0.9227
Epoch 457/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0062 - accuracy: 0.9981 - val_loss: 0.4782
 - val_accuracy: 0.9214
Epoch 458/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0071 - accuracy: 0.9981 - val_loss: 0.4903
 - val_accuracy: 0.9233
Epoch 459/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0069 - accuracy: 0.9976 - val_loss: 0.5036
 - val_accuracy: 0.9239
Epoch 460/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0125 - accuracy: 0.9950 - val_loss: 0.5118
 - val_accuracy: 0.9205
Epoch 461/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0088 - accuracy: 0.9963 - val_loss: 0.5333
 - val_accuracy: 0.9172
Epoch 462/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0129 - accuracy: 0.9965 - val_loss: 0.5330
 - val_accuracy: 0.9111
Epoch 463/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0186 - accuracy: 0.9957 - val_loss: 0.4828
 - val_accuracy: 0.9154
Epoch 464/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0082 - accuracy: 0.9968 - val_loss: 0.5116
 - val_accuracy: 0.9187
Epoch 465/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0072 - accuracy: 0.9970 - val_loss: 0.5288
 - val_accuracy: 0.9166
Epoch 466/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0233 - accuracy: 0.9943 - val_loss: 0.5038
 - val_accuracy: 0.9205
Epoch 467/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0152 - accuracy: 0.9965 - val_loss: 0.5074
 - val_accuracy: 0.9202
Epoch 468/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0137 - accuracy: 0.9959 - val_loss: 0.5220
 - val_accuracy: 0.9193
Epoch 469/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0164 - accuracy: 0.9954 - val_loss: 0.5171
 - val_accuracy: 0.9133
Epoch 470/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0124 - accuracy: 0.9954 - val_loss: 0.5418
 - val_accuracy: 0.9154
Epoch 471/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0114 - accuracy: 0.9960 - val_loss: 0.4958
 - val_accuracy: 0.9160
Epoch 472/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0090 - accuracy: 0.9969 - val_loss: 0.5342
 - val_accuracy: 0.9169
Epoch 473/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0123 - accuracy: 0.9961 - val_loss: 0.5329
 - val_accuracy: 0.9193
Epoch 474/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0060 - accuracy: 0.9981 - val_loss: 0.5483
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 - val_accuracy: 0.9233
Epoch 475/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0070 - accuracy: 0.9968 - val_loss: 0.5147
 - val_accuracy: 0.9163
Epoch 476/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0067 - accuracy: 0.9979 - val_loss: 0.5449
 - val_accuracy: 0.9227
Epoch 477/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0096 - accuracy: 0.9966 - val_loss: 0.5643
 - val_accuracy: 0.9126
Epoch 478/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0124 - accuracy: 0.9962 - val_loss: 0.5879
 - val_accuracy: 0.9175
Epoch 479/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0132 - accuracy: 0.9962 - val_loss: 0.5425
 - val_accuracy: 0.9196
Epoch 480/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0087 - accuracy: 0.9969 - val_loss: 0.5510
 - val_accuracy: 0.9202
Epoch 481/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0084 - accuracy: 0.9976 - val_loss: 0.6071
 - val_accuracy: 0.9151
Epoch 482/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0076 - accuracy: 0.9970 - val_loss: 0.6092
 - val_accuracy: 0.9208
Epoch 483/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0157 - accuracy: 0.9963 - val_loss: 0.6101
 - val_accuracy: 0.9217
Epoch 484/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0163 - accuracy: 0.9953 - val_loss: 0.5871
 - val_accuracy: 0.9172
Epoch 485/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0148 - accuracy: 0.9947 - val_loss: 0.5776
 - val_accuracy: 0.9166
Epoch 486/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0240 - accuracy: 0.9949 - val_loss: 0.5027
 - val_accuracy: 0.9193
Epoch 487/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0115 - accuracy: 0.9955 - val_loss: 0.5337
 - val_accuracy: 0.9199
Epoch 488/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0112 - accuracy: 0.9957 - val_loss: 0.5215
 - val_accuracy: 0.9196
Epoch 489/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0117 - accuracy: 0.9960 - val_loss: 0.5092
 - val_accuracy: 0.9160
Epoch 490/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0110 - accuracy: 0.9965 - val_loss: 0.5244
 - val_accuracy: 0.9199
Epoch 491/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0127 - accuracy: 0.9958 - val_loss: 0.5442
 - val_accuracy: 0.9166
Epoch 492/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0107 - accuracy: 0.9968 - val_loss: 0.5632
 - val_accuracy: 0.9202
Epoch 493/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0167 - accuracy: 0.9956 - val_loss: 0.5307
 - val_accuracy: 0.9190
Epoch 494/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0162 - accuracy: 0.9943 - val_loss: 0.5131
 - val_accuracy: 0.9190
Epoch 495/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0163 - accuracy: 0.9935 - val_loss: 0.4974
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 - val_accuracy: 0.9214
Epoch 496/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0110 - accuracy: 0.9964 - val_loss: 0.5197
 - val_accuracy: 0.9193
Epoch 497/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0216 - accuracy: 0.9969 - val_loss: 0.5224
 - val_accuracy: 0.9175
Epoch 498/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0094 - accuracy: 0.9962 - val_loss: 0.5209
 - val_accuracy: 0.9178
Epoch 499/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0106 - accuracy: 0.9959 - val_loss: 0.5462
 - val_accuracy: 0.9208
Epoch 500/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0114 - accuracy: 0.9965 - val_loss: 0.5376
 - val_accuracy: 0.9211
Epoch 501/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0071 - accuracy: 0.9970 - val_loss: 0.5851
 - val_accuracy: 0.9202
Epoch 502/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0073 - accuracy: 0.9973 - val_loss: 0.6135
 - val_accuracy: 0.9233
Epoch 503/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0100 - accuracy: 0.9975 - val_loss: 0.6127
 - val_accuracy: 0.9211
Epoch 504/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0050 - accuracy: 0.9979 - val_loss: 0.5957
 - val_accuracy: 0.9205
Epoch 505/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0072 - accuracy: 0.9971 - val_loss: 0.6173
 - val_accuracy: 0.9214
Epoch 506/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0110 - accuracy: 0.9966 - val_loss: 0.6039
 - val_accuracy: 0.9136
Epoch 507/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0185 - accuracy: 0.9945 - val_loss: 0.5580
 - val_accuracy: 0.9154
Epoch 508/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0100 - accuracy: 0.9963 - val_loss: 0.5680
 - val_accuracy: 0.9160
Epoch 509/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0149 - accuracy: 0.9970 - val_loss: 0.5774
 - val_accuracy: 0.9126
Epoch 510/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0102 - accuracy: 0.9964 - val_loss: 0.6133
 - val_accuracy: 0.9114
Epoch 511/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0172 - accuracy: 0.9959 - val_loss: 0.5432
 - val_accuracy: 0.9151
Epoch 512/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0113 - accuracy: 0.9953 - val_loss: 0.5666
 - val_accuracy: 0.9145
Epoch 513/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0206 - accuracy: 0.9941 - val_loss: 0.5255
 - val_accuracy: 0.9193
Epoch 514/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0126 - accuracy: 0.9953 - val_loss: 0.5610
 - val_accuracy: 0.9157
Epoch 515/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0126 - accuracy: 0.9957 - val_loss: 0.5456
 - val_accuracy: 0.9224
Epoch 516/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0056 - accuracy: 0.9989 - val_loss: 0.6028
```

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 - val_accuracy: 0.9172
Epoch 517/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0192 - accuracy: 0.9964 - val_loss: 0.6103
 - val_accuracy: 0.9172
Epoch 518/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0070 - accuracy: 0.9975 - val_loss: 0.5415
 - val_accuracy: 0.9214
Epoch 519/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0055 - accuracy: 0.9984 - val_loss: 0.5813
 - val_accuracy: 0.9190
Epoch 520/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0130 - accuracy: 0.9958 - val_loss: 0.5473
 - val_accuracy: 0.9160
Epoch 521/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0116 - accuracy: 0.9949 - val_loss: 0.5645
 - val_accuracy: 0.9199
Epoch 522/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0127 - accuracy: 0.9959 - val_loss: 0.5353
 - val_accuracy: 0.9242
Epoch 523/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0082 - accuracy: 0.9966 - val_loss: 0.5382
 - val_accuracy: 0.9205
Epoch 524/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0118 - accuracy: 0.9976 - val_loss: 0.5908
 - val_accuracy: 0.9172
Epoch 525/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0179 - accuracy: 0.9960 - val_loss: 0.5242
 - val_accuracy: 0.9221
Epoch 526/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0163 - accuracy: 0.9949 - val_loss: 0.5046
 - val_accuracy: 0.9202
Epoch 527/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0081 - accuracy: 0.9975 - val_loss: 0.5342
 - val_accuracy: 0.9239
Epoch 528/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0083 - accuracy: 0.9971 - val_loss: 0.5563
 - val_accuracy: 0.9214
Epoch 529/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0058 - accuracy: 0.9987 - val_loss: 0.5727
 - val_accuracy: 0.9233
Epoch 530/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0097 - accuracy: 0.9967 - val_loss: 0.5729
 - val_accuracy: 0.9214
Epoch 531/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0167 - accuracy: 0.9948 - val_loss: 0.5714
 - val_accuracy: 0.9175
Epoch 532/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0135 - accuracy: 0.9963 - val_loss: 0.5760
 - val_accuracy: 0.9187
Epoch 533/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0163 - accuracy: 0.9959 - val_loss: 0.6067
 - val_accuracy: 0.9175
Epoch 534/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0102 - accuracy: 0.9961 - val_loss: 0.5822
 - val_accuracy: 0.9163
Epoch 535/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0106 - accuracy: 0.9958 - val_loss: 0.6198
 - val_accuracy: 0.9181
Epoch 536/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0102 - accuracy: 0.9972 - val_loss: 0.6440
 - val_accuracy: 0.9160
Epoch 537/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0170 - accuracy: 0.9946 - val_loss: 0.6042
```

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 - val_accuracy: 0.9187
Epoch 538/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0108 - accuracy: 0.9953 - val_loss: 0.6178
 - val_accuracy: 0.9166
Epoch 539/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0113 - accuracy: 0.9967 - val_loss: 0.5904
 - val_accuracy: 0.9221
Epoch 540/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0185 - accuracy: 0.9945 - val_loss: 0.5639
 - val_accuracy: 0.9211
Epoch 541/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0115 - accuracy: 0.9968 - val_loss: 0.5791
 - val_accuracy: 0.9205
Epoch 542/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0152 - accuracy: 0.9945 - val_loss: 0.5513
 - val_accuracy: 0.9221
Epoch 543/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0172 - accuracy: 0.9958 - val_loss: 0.5572
 - val_accuracy: 0.9187
Epoch 544/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0132 - accuracy: 0.9957 - val_loss: 0.5423
 - val_accuracy: 0.9181
Epoch 545/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0084 - accuracy: 0.9962 - val_loss: 0.5143
 - val_accuracy: 0.9245
Epoch 546/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0111 - accuracy: 0.9966 - val_loss: 0.5413
 - val_accuracy: 0.9199
Epoch 547/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0116 - accuracy: 0.9970 - val_loss: 0.5366
 - val_accuracy: 0.9254
Epoch 548/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0096 - accuracy: 0.9966 - val_loss: 0.5329
 - val_accuracy: 0.9221
Epoch 549/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0087 - accuracy: 0.9968 - val_loss: 0.5434
 - val_accuracy: 0.9251
Epoch 550/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0098 - accuracy: 0.9959 - val_loss: 0.5439
 - val_accuracy: 0.9205
Epoch 551/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0118 - accuracy: 0.9955 - val_loss: 0.5330
 - val_accuracy: 0.9196
Epoch 552/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0103 - accuracy: 0.9969 - val_loss: 0.5550
 - val_accuracy: 0.9208
Epoch 553/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0073 - accuracy: 0.9970 - val_loss: 0.5549
 - val_accuracy: 0.9227
Epoch 554/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0202 - accuracy: 0.9947 - val_loss: 0.5047
 - val_accuracy: 0.9221
Epoch 555/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0077 - accuracy: 0.9973 - val_loss: 0.5050
 - val_accuracy: 0.9242
Epoch 556/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0081 - accuracy: 0.9964 - val_loss: 0.5325
 - val_accuracy: 0.9193
Epoch 557/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0105 - accuracy: 0.9951 - val_loss: 0.5548
 - val_accuracy: 0.9178
Epoch 558/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0051 - accuracy: 0.9986 - val_loss: 0.5786
```

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 - val_accuracy: 0.9208
Epoch 559/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0095 - accuracy: 0.9974 - val_loss: 0.5714
 - val_accuracy: 0.9211
Epoch 560/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0092 - accuracy: 0.9969 - val_loss: 0.5684
 - val_accuracy: 0.9224
Epoch 561/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0168 - accuracy: 0.9948 - val_loss: 0.5001
 - val_accuracy: 0.9242
Epoch 562/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0077 - accuracy: 0.9973 - val_loss: 0.5023
 - val_accuracy: 0.9245
Epoch 563/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0114 - accuracy: 0.9956 - val_loss: 0.5220
 - val_accuracy: 0.9248
Epoch 564/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0076 - accuracy: 0.9973 - val_loss: 0.5549
 - val_accuracy: 0.9202
Epoch 565/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0151 - accuracy: 0.9966 - val_loss: 0.5725
 - val_accuracy: 0.9178
Epoch 566/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0083 - accuracy: 0.9970 - val_loss: 0.5485
 - val_accuracy: 0.9199
Epoch 567/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0100 - accuracy: 0.9976 - val_loss: 0.5669
 - val_accuracy: 0.9205
Epoch 568/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0131 - accuracy: 0.9963 - val_loss: 0.5414
 - val_accuracy: 0.9148
Epoch 569/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0161 - accuracy: 0.9954 - val_loss: 0.5325
 - val_accuracy: 0.9175
Epoch 570/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0077 - accuracy: 0.9969 - val_loss: 0.5523
 - val_accuracy: 0.9211
Epoch 571/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0104 - accuracy: 0.9961 - val_loss: 0.5548
 - val_accuracy: 0.9178
Epoch 572/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0059 - accuracy: 0.9980 - val_loss: 0.5478
 - val_accuracy: 0.9221
Epoch 573/600
53/53 [==============================] - 0s 7ms/step - loss: 0.0128 - accuracy: 0.9947 - val_loss: 0.5796
 - val_accuracy: 0.9205
Epoch 574/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0062 - accuracy: 0.9987 - val_loss: 0.6008
 - val_accuracy: 0.9224
Epoch 575/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0073 - accuracy: 0.9975 - val_loss: 0.6200
 - val_accuracy: 0.9202
Epoch 576/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0118 - accuracy: 0.9962 - val_loss: 0.5944
 - val_accuracy: 0.9133
Epoch 577/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0152 - accuracy: 0.9938 - val_loss: 0.5469
 - val_accuracy: 0.9224
Epoch 578/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0096 - accuracy: 0.9953 - val_loss: 0.5696
 - val_accuracy: 0.9175
Epoch 579/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0121 - accuracy: 0.9966 - val_loss: 0.5573
```

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 - val_accuracy: 0.9181
Epoch 580/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0137 - accuracy: 0.9958 - val_loss: 0.5524
 - val_accuracy: 0.9233
Epoch 581/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0132 - accuracy: 0.9967 - val_loss: 0.5458
 - val_accuracy: 0.9181
Epoch 582/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0158 - accuracy: 0.9940 - val_loss: 0.5954
 - val_accuracy: 0.9157
Epoch 583/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0171 - accuracy: 0.9936 - val_loss: 0.5865
 - val_accuracy: 0.9142
Epoch 584/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0116 - accuracy: 0.9961 - val_loss: 0.5703
 - val_accuracy: 0.9169
Epoch 585/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0149 - accuracy: 0.9959 - val_loss: 0.5928
 - val_accuracy: 0.9178
Epoch 586/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0102 - accuracy: 0.9963 - val_loss: 0.5568
 - val_accuracy: 0.9172
Epoch 587/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0122 - accuracy: 0.9962 - val_loss: 0.5607
 - val_accuracy: 0.9169
Epoch 588/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0109 - accuracy: 0.9970 - val_loss: 0.5796
 - val_accuracy: 0.9178
Epoch 589/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0085 - accuracy: 0.9962 - val_loss: 0.5929
 - val_accuracy: 0.9190
Epoch 590/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0167 - accuracy: 0.9960 - val_loss: 0.6159
 - val_accuracy: 0.9163
Epoch 591/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0142 - accuracy: 0.9958 - val_loss: 0.5995
 - val_accuracy: 0.9196
Epoch 592/600
53/53 [==============================] - 0s 9ms/step - loss: 0.0106 - accuracy: 0.9963 - val_loss: 0.5805
 - val_accuracy: 0.9184
Epoch 593/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0163 - accuracy: 0.9956 - val_loss: 0.5690
 - val_accuracy: 0.9214
Epoch 594/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0156 - accuracy: 0.9965 - val_loss: 0.5711
 - val_accuracy: 0.9178
Epoch 595/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0088 - accuracy: 0.9966 - val_loss: 0.5937
 - val_accuracy: 0.9184
Epoch 596/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0169 - accuracy: 0.9960 - val_loss: 0.5362
 - val_accuracy: 0.9221
Epoch 597/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0132 - accuracy: 0.9960 - val_loss: 0.5530
 - val_accuracy: 0.9184
Epoch 598/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0053 - accuracy: 0.9983 - val_loss: 0.5592
 - val_accuracy: 0.9211
Epoch 599/600
53/53 [==============================] - 0s 8ms/step - loss: 0.0086 - accuracy: 0.9960 - val_loss: 0.5581
 - val_accuracy: 0.9166
Epoch 600/600
```

```
53/53 [==============================] - 0s 8ms/step - loss: 0.0090 - accuracy: 0.9970 - val_loss: 0.6207
 - val_accuracy: 0.9160
```

Model Evaluation

In [58]:

```
test_loss,test_acc=model.evaluate(X_test,y_test,batch_size=128)
print("The test loss is ",test_loss)
print("The best accuracy is: ",test_acc*100)
```

```
26/26 [==============================] - 0s 2ms/step - loss: 0.6207 - accuracy: 0.9160
The test loss is  0.6207043528556824
The best accuracy is:  91.59842133522034
```

For the CNN model, we had used the Adam optimizer for training the model. The epoch that was chosen for the training model is 600. All of the hidden layers are using the RELU activation function and the output layer uses the softmax function. The loss is calculated using the sparse_categorical_crossentropy function. Dropout is used to prevent overfitting. We chose the Adam optimizer because it gave us the best results after evaluating other optimizers. The model accuracy can be increased by further increasing the epochs but after a certain period, we may achieve a threshold, so the value should be determined accordingly.

The model accuracy can be increased by further increasing the epochs but after a certain period, we may achieve a threshold, so the value should be determined accordingly. The accuracy we achieved for the test set is 92.14 percent which is very decent. So we come to the conclusion that Neural Networks are very effective in machine learning models. Tensorflow is very useful in implementing Convolutional Neural Network (CNN) that helps in the classifying process.