In [4]:
```
import tensorflow as tf
import numpy as np
from tensorflow import keras
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.layers import Dense, Dropout, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications import VGG16
import matplotlib.pyplot as plt
```

In [7]:
```
dataset_dir = "C:\\Users\\Arman Sayyed\\Desktop\\DLL\\Object Detection(Ass6)\\caltech-101-img"
```

In [8]:
```
dataset_datagen = ImageDataGenerator(
    rescale = 1.0/255
)
```

In [9]:
```
batch_size = 2000
dataset_generator = dataset_datagen.flow_from_directory(
    dataset_dir,
    target_size=(64,64),
    batch_size = batch_size,
    class_mode = 'categorical'
)
```

```
Found 9144 images belonging to 102 classes.
```

In [11]:
```
x_train, y_train = dataset_generator[0]
x_test, y_test = dataset_generator[1]
print(len(x_train))
print(len(x_test))
```

```
2000
2000
```

In [12]:
```
from tensorflow.keras.optimizers import Adam
```

In [14]:
```
weights_path = "vgg16_weights_tf_dim_ordering_tf_kernels_notop.h5"
base_model = VGG16(weights = weights_path, include_top=False, input_shape=(64,64,3))
```

```
WARNING:tensorflow:From C:\Users\Arman Sayyed\AppData\Local\Programs\Python\Python39\lib\site-packages\keras
\src\backend.py:1398: The name tf.executing_eagerly_outside_functions is deprecated. Please use tf.compat.v
1.executing_eagerly_outside_functions instead.

WARNING:tensorflow:From C:\Users\Arman Sayyed\AppData\Local\Programs\Python\Python39\lib\site-packages\keras
\src\layers\pooling\max_pooling2d.py:161: The name tf.nn.max_pool is deprecated. Please use tf.nn.max_pool2d
instead.
```

In [18]:
```
for layers in base_model.layers:
    layers.trainable = False

for layers in base_model.layers[len(base_model.layers)-2:]:
    layers.trainable = True

x = Flatten()(base_model.output)
x = Dense(512, activation='relu')(x)
x = Dropout(0.3)(x)

predictions = Dense(102, activation='softmax')(x)

model = Model(inputs = base_model.inputs, outputs = predictions)
model.compile(optimizer=Adam(learning_rate = 0.001), loss='categorical_crossentropy', metrics = ['accuracy'])
model.fit(x_train, y_train, batch_size=64 , epochs = 20, validation_data =(x_test, y_test))
```

```
Epoch 1/20
WARNING:tensorflow:From C:\Users\Arman Sayyed\AppData\Local\Programs\Python\Python39\lib\site-packages\keras
\src\utils\tf_utils.py:492: The name tf.ragged.RaggedTensorValue is deprecated. Please use tf.compat.v1.ragg
ed.RaggedTensorValue instead.

WARNING:tensorflow:From C:\Users\Arman Sayyed\AppData\Local\Programs\Python\Python39\lib\site-packages\keras
\src\engine\base_layer_utils.py:384: The name tf.executing_eagerly_outside_functions is deprecated. Please u
se tf.compat.v1.executing_eagerly_outside_functions instead.

32/32 [==============================] - 33s 1s/step - loss: 3.1138 - accuracy: 0.3640 - val_loss: 2.2745 -
val_accuracy: 0.5015
Epoch 2/20
32/32 [==============================] - 31s 967ms/step - loss: 1.7909 - accuracy: 0.5795 - val_loss: 1.8636
- val_accuracy: 0.5700
Epoch 3/20
32/32 [==============================] - 31s 988ms/step - loss: 1.1761 - accuracy: 0.6995 - val_loss: 1.7739
- val_accuracy: 0.5830
Epoch 4/20
32/32 [==============================] - 31s 968ms/step - loss: 0.7669 - accuracy: 0.7970 - val_loss: 1.6305
- val_accuracy: 0.6265
Epoch 5/20
32/32 [==============================] - 31s 969ms/step - loss: 0.4598 - accuracy: 0.8750 - val_loss: 1.6539
- val_accuracy: 0.6255
Epoch 6/20
32/32 [==============================] - 30s 955ms/step - loss: 0.3190 - accuracy: 0.9180 - val_loss: 1.6440
- val_accuracy: 0.6355
Epoch 7/20
32/32 [==============================] - 32s 1s/step - loss: 0.2013 - accuracy: 0.9430 - val_loss: 1.6612 -
val_accuracy: 0.6560
Epoch 8/20
32/32 [==============================] - 34s 1s/step - loss: 0.1284 - accuracy: 0.9690 - val_loss: 1.7367 -
val_accuracy: 0.6450
Epoch 9/20
32/32 [==============================] - 36s 1s/step - loss: 0.0726 - accuracy: 0.9835 - val_loss: 1.8390 -
val_accuracy: 0.6520
Epoch 10/20
32/32 [==============================] - 36s 1s/step - loss: 0.0723 - accuracy: 0.9815 - val_loss: 1.9085 -
val_accuracy: 0.6365
Epoch 11/20
32/32 [==============================] - 35s 1s/step - loss: 0.0364 - accuracy: 0.9915 - val_loss: 1.8770 -
val_accuracy: 0.6555
Epoch 12/20
32/32 [==============================] - 36s 1s/step - loss: 0.0741 - accuracy: 0.9875 - val_loss: 1.7767 -
```

```
val_accuracy: 0.6535
Epoch 13/20
32/32 [==============================] - 35s 1s/step - loss: 0.0363 - accuracy: 0.9920 - val_loss: 1.9249 -
val_accuracy: 0.6440
Epoch 14/20
32/32 [==============================] - 37s 1s/step - loss: 0.0360 - accuracy: 0.9900 - val_loss: 1.9400 -
val_accuracy: 0.6465
Epoch 15/20
32/32 [==============================] - 37s 1s/step - loss: 0.0561 - accuracy: 0.9850 - val_loss: 1.8808 -
val_accuracy: 0.6410
Epoch 16/20
32/32 [==============================] - 40s 1s/step - loss: 0.0308 - accuracy: 0.9935 - val_loss: 2.0862 -
val_accuracy: 0.6350
Epoch 17/20
32/32 [==============================] - 35s 1s/step - loss: 0.0261 - accuracy: 0.9955 - val_loss: 1.9474 -
val_accuracy: 0.6420
Epoch 18/20
32/32 [==============================] - 36s 1s/step - loss: 0.0190 - accuracy: 0.9965 - val_loss: 2.0678 -
val_accuracy: 0.6475
Epoch 19/20
32/32 [==============================] - 36s 1s/step - loss: 0.0479 - accuracy: 0.9885 - val_loss: 1.9933 -
val_accuracy: 0.6350
Epoch 20/20
32/32 [==============================] - 35s 1s/step - loss: 0.0318 - accuracy: 0.9905 - val_loss: 2.0252 -
val_accuracy: 0.6320
```

Out[18]:
```
<keras.src.callbacks.History at 0x18a44384d30>
```

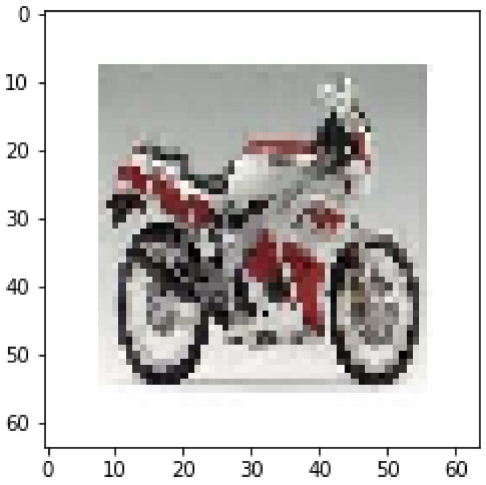
In [20]:
```
predict = model.predict(x_test)
```

```
63/63 [==============================] - 18s 285ms/step
```

In [22]:
```
labels = list(dataset_generator.class_indices.keys())
```

In [23]:
```
n = 887
plt.imshow(x_test[n])
print("Predicted : ", labels[np.argmax(predict[n])])
print("Actual : ", labels[np.argmax(y_test[n])])
```

```
Predicted :  Motorbikes
Actual :  Motorbikes
```



In [ ]: