In [1]:

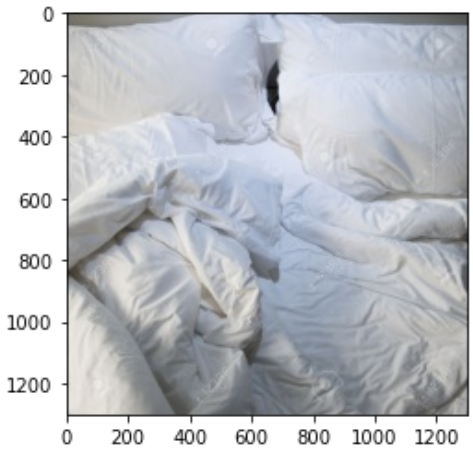
```
import tensorflow as tf
from tensorflow.keras import datasets, layers, models
from keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt
import numpy as np
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras.preprocessing import image
import keras
import cv2
from PIL import ImageFile
from tensorflow.keras import datasets, layers, models
import matplotlib.pyplot as plt
%matplotlib inline
from keras.utils import to_categorical
from sklearn.model_selection import train_test_split
import pandas as pd
```

In [2]:

```
ImageFile.LOAD_TRUNCATED_IMAGES = True
img = image.load_img("Datasets/HumanActivityDataset/train/Control/24905349-close-up-of-messy-bedding-sheets-and-pillow.jpg")
plt.imshow(img)

cv2.imread("Datasets/HumanActivityDataset/train/Control/24905349-close-up-of-messy-bedding-sheets-and-pillow.jpg").shape

train = ImageDataGenerator(rescale = 1/255)
validation = ImageDataGenerator(rescale = 1/255)
```



In [3]:

```
train_dataset = train.flow_from_directory("Datasets/HumanActivityDataset/train/",
                                          target_size = (32,32),
                                             batch_size =3,
                                           class_mode =  "sparse"
                                          )

validation_dataset = validation.flow_from_directory("Datasets/HumanActivityDataset/validation/",
                                          target_size = (32,32),
                                             batch_size =3,
                                           class_mode =  "sparse"
                                          )
```

```
Found 4273 images belonging to 6 classes.
Found 58 images belonging to 6 classes.
```

In [4]:

```
train_dataset.class_indices
train_dataset.classes
```

Out[4]:

```
array([0, 0, 0, ..., 5, 5, 5])
```

In [5]:

```
validation_dataset.class_indices
validation_dataset.classes
```

Out[5]:

```
array([0, 0, 0, 0, 1, 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 4, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5])
```

In [11]:

```
cnn = models.Sequential([
    tf.keras.layers.Conv2D(32,(3,3),activation="relu",input_shape=(32,32,3)),
    tf.keras.layers.MaxPool2D(2,2),


    tf.keras.layers.Conv2D(64,(3,3),activation="relu"),
    tf.keras.layers.MaxPool2D(2,2),

    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(64,activation="relu"),
    tf.keras.layers.Dense(6,activation="softmax")
])
```

In [12]:

```
cnn.compile(optimizer="adam",
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
```

In [13]:

```
history1 =cnn.fit(train_dataset,
       steps_per_epoch = 50,
       batch_size = 3,
       epochs = 100,
       validation_data = validation_dataset

)
```

```
Epoch 1/100
50/50 [==============================] - 1s 25ms/step - loss: 1.7974 - accuracy: 0.2667 -
val_loss: 1.6228 - val_accuracy: 0.6897
Epoch 2/100
50/50 [==============================] - 1s 25ms/step - loss: 1.7762 - accuracy: 0.2200 -
val_loss: 1.5305 - val_accuracy: 0.6897
Epoch 3/100
50/50 [==============================] - 1s 18ms/step - loss: 1.7557 - accuracy: 0.2133 -
val_loss: 1.6678 - val_accuracy: 0.3793
Epoch 4/100
50/50 [==============================] - 2s 40ms/step - loss: 1.7676 - accuracy: 0.2467 -
val_loss: 1.7039 - val_accuracy: 0.3793
Epoch 5/100
50/50 [==============================] - 2s 41ms/step - loss: 1.6750 - accuracy: 0.3000 -
val_loss: 1.3850 - val_accuracy: 0.6552
Epoch 6/100
50/50 [==============================] - 2s 44ms/step - loss: 1.5863 - accuracy: 0.3533 -
val_loss: 1.6687 - val_accuracy: 0.2586
Epoch 7/100
50/50 [==============================] - 1s 24ms/step - loss: 1.6206 - accuracy: 0.3581 -
val_loss: 1.6392 - val_accuracy: 0.2414
```

```
Epoch 8/100
50/50 [==============================] - 0s 8ms/step - loss: 1.6285 - accuracy: 0.3067 -
val_loss: 1.5624 - val_accuracy: 0.3276
Epoch 9/100
50/50 [==============================] - 1s 20ms/step - loss: 1.6109 - accuracy: 0.3733 -
val_loss: 1.8354 - val_accuracy: 0.1379
Epoch 10/100
50/50 [==============================] - 2s 33ms/step - loss: 1.6958 - accuracy: 0.2867 -
val_loss: 1.6498 - val_accuracy: 0.2069
Epoch 11/100
50/50 [==============================] - 2s 37ms/step - loss: 1.5906 - accuracy: 0.3800 -
val_loss: 1.5348 - val_accuracy: 0.3448
Epoch 12/100
50/50 [==============================] - 2s 46ms/step - loss: 1.4397 - accuracy: 0.4392 -
val_loss: 2.1342 - val_accuracy: 0.0862
Epoch 13/100
50/50 [==============================] - 2s 43ms/step - loss: 1.5683 - accuracy: 0.3667 -
val_loss: 2.0672 - val_accuracy: 0.1034
Epoch 14/100
50/50 [==============================] - 1s 23ms/step - loss: 1.5149 - accuracy: 0.3667 -
val_loss: 1.6152 - val_accuracy: 0.2069
Epoch 15/100
50/50 [==============================] - 4s 71ms/step - loss: 1.4205 - accuracy: 0.4467 -
val_loss: 1.6955 - val_accuracy: 0.1724
Epoch 16/100
50/50 [==============================] - 4s 76ms/step - loss: 1.4491 - accuracy: 0.4800 -
val_loss: 1.5162 - val_accuracy: 0.2931
Epoch 17/100
50/50 [==============================] - 2s 32ms/step - loss: 1.4699 - accuracy: 0.4200 -
val_loss: 1.6328 - val_accuracy: 0.2414
Epoch 18/100
50/50 [==============================] - 3s 53ms/step - loss: 1.5367 - accuracy: 0.4133 -
val_loss: 1.4464 - val_accuracy: 0.4310
Epoch 19/100
50/50 [==============================] - 1s 21ms/step - loss: 1.4034 - accuracy: 0.4667 -
val_loss: 1.9697 - val_accuracy: 0.1379
Epoch 20/100
50/50 [==============================] - 2s 34ms/step - loss: 1.3143 - accuracy: 0.5200 -
val_loss: 1.8158 - val_accuracy: 0.1552
Epoch 21/100
50/50 [==============================] - 0s 8ms/step - loss: 1.3924 - accuracy: 0.4800 -
val_loss: 1.5338 - val_accuracy: 0.2931
Epoch 22/100
50/50 [==============================] - 1s 16ms/step - loss: 1.3824 - accuracy: 0.4200 -
val_loss: 1.5937 - val_accuracy: 0.3621
Epoch 23/100
50/50 [==============================] - 0s 10ms/step - loss: 1.3406 - accuracy: 0.4933 -
val_loss: 1.6354 - val_accuracy: 0.2414
Epoch 24/100
50/50 [==============================] - 4s 81ms/step - loss: 1.3986 - accuracy: 0.4000 -
val_loss: 1.8779 - val_accuracy: 0.1379
Epoch 25/100
50/50 [==============================] - 2s 37ms/step - loss: 1.4030 - accuracy: 0.4333 -
val_loss: 1.9376 - val_accuracy: 0.0862
Epoch 26/100
50/50 [==============================] - 1s 29ms/step - loss: 1.3753 - accuracy: 0.4867 -
val_loss: 1.4882 - val_accuracy: 0.3103
Epoch 27/100
50/50 [==============================] - 3s 62ms/step - loss: 1.2557 - accuracy: 0.5000 -
val_loss: 2.0861 - val_accuracy: 0.0690
Epoch 28/100
50/50 [==============================] - 1s 29ms/step - loss: 1.3760 - accuracy: 0.4667 -
val_loss: 1.6172 - val_accuracy: 0.3448
Epoch 29/100
50/50 [==============================] - 2s 37ms/step - loss: 1.2958 - accuracy: 0.5000 -
val_loss: 1.2503 - val_accuracy: 0.5517
Epoch 30/100
50/50 [==============================] - 1s 25ms/step - loss: 1.2605 - accuracy: 0.4733 -
val_loss: 1.8746 - val_accuracy: 0.1552
Epoch 31/100
50/50 [==============================] - 1s 28ms/step - loss: 1.3621 - accuracy: 0.4933 -
val_loss: 1.6634 - val_accuracy: 0.2069
Epoch 32/100
```

```
Epoch 32/100
50/50 [==============================] - 2s 47ms/step - loss: 1.3615 - accuracy: 0.4667 -
val_loss: 1.2980 - val_accuracy: 0.4483
Epoch 33/100
50/50 [==============================] - 3s 65ms/step - loss: 1.2063 - accuracy: 0.5533 -
val_loss: 1.8693 - val_accuracy: 0.2241
Epoch 34/100
50/50 [==============================] - 1s 17ms/step - loss: 1.2220 - accuracy: 0.5200 -
val_loss: 1.6073 - val_accuracy: 0.2241
Epoch 35/100
50/50 [==============================] - 1s 25ms/step - loss: 1.3963 - accuracy: 0.5000 -
val_loss: 1.8165 - val_accuracy: 0.1724
Epoch 36/100
50/50 [==============================] - 1s 24ms/step - loss: 1.2020 - accuracy: 0.5800 -
val_loss: 2.1218 - val_accuracy: 0.1724
Epoch 37/100
50/50 [==============================] - 3s 55ms/step - loss: 1.3585 - accuracy: 0.4867 -
val_loss: 1.8229 - val_accuracy: 0.2241
Epoch 38/100
50/50 [==============================] - 1s 30ms/step - loss: 1.3234 - accuracy: 0.5000 -
val_loss: 1.3747 - val_accuracy: 0.3448
Epoch 39/100
50/50 [==============================] - 2s 37ms/step - loss: 1.2451 - accuracy: 0.4933 -
val_loss: 1.4094 - val_accuracy: 0.4138
Epoch 40/100
50/50 [==============================] - 3s 53ms/step - loss: 1.2568 - accuracy: 0.4867 -
val_loss: 1.4879 - val_accuracy: 0.3448
Epoch 41/100
50/50 [==============================] - 2s 48ms/step - loss: 1.1688 - accuracy: 0.5667 -
val_loss: 1.5405 - val_accuracy: 0.3621
Epoch 42/100
50/50 [==============================] - 1s 15ms/step - loss: 1.0940 - accuracy: 0.6067 -
val_loss: 1.7306 - val_accuracy: 0.2414
Epoch 43/100
50/50 [==============================] - 1s 16ms/step - loss: 1.1362 - accuracy: 0.5600 -
val_loss: 1.5112 - val_accuracy: 0.3276
Epoch 44/100
50/50 [==============================] - 1s 28ms/step - loss: 1.2364 - accuracy: 0.5133 -
val_loss: 1.2736 - val_accuracy: 0.5172
Epoch 45/100
50/50 [==============================] - 1s 24ms/step - loss: 1.1287 - accuracy: 0.6133 -
val_loss: 1.2978 - val_accuracy: 0.5517
Epoch 46/100
50/50 [==============================] - 3s 59ms/step - loss: 1.0556 - accuracy: 0.6133 -
val_loss: 1.2605 - val_accuracy: 0.5517
Epoch 47/100
50/50 [==============================] - 2s 48ms/step - loss: 1.0833 - accuracy: 0.5667 -
val_loss: 1.4318 - val_accuracy: 0.4138
Epoch 48/100
50/50 [==============================] - 2s 46ms/step - loss: 1.1146 - accuracy: 0.5867 -
val_loss: 1.8585 - val_accuracy: 0.2241
Epoch 49/100
50/50 [==============================] - 1s 25ms/step - loss: 1.1322 - accuracy: 0.5667 -
val_loss: 2.1911 - val_accuracy: 0.1379
Epoch 50/100
50/50 [==============================] - 2s 43ms/step - loss: 1.2516 - accuracy: 0.5600 -
val_loss: 1.3754 - val_accuracy: 0.4138
Epoch 51/100
50/50 [==============================] - 0s 9ms/step - loss: 1.1753 - accuracy: 0.5533 -
val_loss: 1.3737 - val_accuracy: 0.4310
Epoch 52/100
50/50 [==============================] - 2s 48ms/step - loss: 1.1449 - accuracy: 0.5600 -
val_loss: 1.6067 - val_accuracy: 0.2759
Epoch 53/100
50/50 [==============================] - 2s 32ms/step - loss: 1.0681 - accuracy: 0.5933 -
val_loss: 1.7440 - val_accuracy: 0.1724
Epoch 54/100
50/50 [==============================] - 2s 49ms/step - loss: 1.1189 - accuracy: 0.6067 -
val_loss: 1.4564 - val_accuracy: 0.3966
Epoch 55/100
50/50 [==============================] - 0s 8ms/step - loss: 1.1964 - accuracy: 0.5333 -
val_loss: 1.8268 - val_accuracy: 0.1897
Epoch 56/100
```

```
Epoch 56/100
50/50 [==============================] - 2s 49ms/step - loss: 1.0280 - accuracy: 0.6333 -
val_loss: 1.9461 - val_accuracy: 0.2241
Epoch 57/100
50/50 [==============================] - 4s 72ms/step - loss: 1.0512 - accuracy: 0.6600 -
val_loss: 1.2720 - val_accuracy: 0.5000
Epoch 58/100
50/50 [==============================] - 2s 35ms/step - loss: 1.1142 - accuracy: 0.6200 -
val_loss: 1.8338 - val_accuracy: 0.2586
Epoch 59/100
50/50 [==============================] - 2s 32ms/step - loss: 1.0687 - accuracy: 0.6284 -
val_loss: 1.5597 - val_accuracy: 0.3448
Epoch 60/100
50/50 [==============================] - 1s 29ms/step - loss: 1.0527 - accuracy: 0.6200 -
val_loss: 1.6705 - val_accuracy: 0.2759
Epoch 61/100
50/50 [==============================] - 2s 32ms/step - loss: 1.0469 - accuracy: 0.6467 -
val_loss: 2.0894 - val_accuracy: 0.2241
Epoch 62/100
50/50 [==============================] - 1s 25ms/step - loss: 1.0522 - accuracy: 0.6000 -
val_loss: 1.6932 - val_accuracy: 0.3103
Epoch 63/100
50/50 [==============================] - 1s 29ms/step - loss: 0.8998 - accuracy: 0.6667 -
val_loss: 1.5816 - val_accuracy: 0.3276
Epoch 64/100
50/50 [==============================] - 2s 31ms/step - loss: 1.0276 - accuracy: 0.6200 -
val_loss: 1.7942 - val_accuracy: 0.3103
Epoch 65/100
50/50 [==============================] - 3s 54ms/step - loss: 1.0244 - accuracy: 0.6733 -
val_loss: 1.7454 - val_accuracy: 0.3621
Epoch 66/100
50/50 [==============================] - 2s 42ms/step - loss: 1.0645 - accuracy: 0.5933 -
val_loss: 1.4983 - val_accuracy: 0.4138
Epoch 67/100
50/50 [==============================] - 3s 67ms/step - loss: 1.1970 - accuracy: 0.5667 -
val_loss: 1.7694 - val_accuracy: 0.2931
Epoch 68/100
50/50 [==============================] - 2s 47ms/step - loss: 0.9316 - accuracy: 0.6800 -
val_loss: 1.4595 - val_accuracy: 0.4138
Epoch 69/100
50/50 [==============================] - 1s 19ms/step - loss: 0.9475 - accuracy: 0.6467 -
val_loss: 1.5752 - val_accuracy: 0.3621
Epoch 70/100
50/50 [==============================] - 3s 56ms/step - loss: 0.9553 - accuracy: 0.6333 -
val_loss: 1.6912 - val_accuracy: 0.3276
Epoch 71/100
50/50 [==============================] - 3s 60ms/step - loss: 1.0649 - accuracy: 0.6600 -
val_loss: 1.5796 - val_accuracy: 0.3621
Epoch 72/100
50/50 [==============================] - 1s 24ms/step - loss: 0.8839 - accuracy: 0.7000 -
val_loss: 1.7159 - val_accuracy: 0.3793
Epoch 73/100
50/50 [==============================] - 2s 49ms/step - loss: 1.0040 - accuracy: 0.6400 -
val_loss: 1.9150 - val_accuracy: 0.2241
Epoch 74/100
50/50 [==============================] - 2s 42ms/step - loss: 0.7790 - accuracy: 0.7467 -
val_loss: 1.7992 - val_accuracy: 0.2759
Epoch 75/100
50/50 [==============================] - 2s 35ms/step - loss: 0.8757 - accuracy: 0.7200 -
val_loss: 1.4726 - val_accuracy: 0.4483
Epoch 76/100
50/50 [==============================] - 2s 49ms/step - loss: 0.9324 - accuracy: 0.6667 -
val_loss: 1.6388 - val_accuracy: 0.3793
Epoch 77/100
50/50 [==============================] - 2s 43ms/step - loss: 0.8271 - accuracy: 0.6933 -
val_loss: 1.6428 - val_accuracy: 0.3793
Epoch 78/100
50/50 [==============================] - 1s 28ms/step - loss: 1.0590 - accuracy: 0.6267 -
val_loss: 1.6258 - val_accuracy: 0.3448
Epoch 79/100
50/50 [==============================] - 3s 61ms/step - loss: 0.9341 - accuracy: 0.6467 -
val_loss: 1.9060 - val_accuracy: 0.3276
Epoch 80/100
```

```
Epoch 80/100
50/50 [==============================] - 2s 36ms/step - loss: 0.8216 - accuracy: 0.7067 -
val_loss: 1.8347 - val_accuracy: 0.3621
Epoch 81/100
50/50 [==============================] - 2s 47ms/step - loss: 0.9646 - accuracy: 0.6733 -
val_loss: 1.6317 - val_accuracy: 0.3621
Epoch 82/100
50/50 [==============================] - 1s 28ms/step - loss: 0.9112 - accuracy: 0.6733 -
val_loss: 1.7121 - val_accuracy: 0.3103
Epoch 83/100
50/50 [==============================] - 2s 45ms/step - loss: 0.9882 - accuracy: 0.6267 -
val_loss: 1.4306 - val_accuracy: 0.4483
Epoch 84/100
50/50 [==============================] - 2s 41ms/step - loss: 0.9163 - accuracy: 0.6933 -
val_loss: 2.2827 - val_accuracy: 0.2069
Epoch 85/100
50/50 [==============================] - 1s 20ms/step - loss: 1.0116 - accuracy: 0.6267 -
val_loss: 1.9028 - val_accuracy: 0.3276
Epoch 86/100
50/50 [==============================] - 4s 76ms/step - loss: 0.9079 - accuracy: 0.6467 -
val_loss: 1.3095 - val_accuracy: 0.4828
Epoch 87/100
50/50 [==============================] - 2s 45ms/step - loss: 0.9839 - accuracy: 0.6400 -
val_loss: 1.1660 - val_accuracy: 0.6379
Epoch 88/100
50/50 [==============================] - 1s 11ms/step - loss: 0.9070 - accuracy: 0.6800 -
val_loss: 1.9287 - val_accuracy: 0.3276
Epoch 89/100
50/50 [==============================] - 1s 19ms/step - loss: 0.8756 - accuracy: 0.7067 -
val_loss: 1.5176 - val_accuracy: 0.4483
Epoch 90/100
50/50 [==============================] - 2s 31ms/step - loss: 1.0474 - accuracy: 0.6467 -
val_loss: 2.0874 - val_accuracy: 0.1897
Epoch 91/100
50/50 [==============================] - 2s 43ms/step - loss: 0.9012 - accuracy: 0.6600 -
val_loss: 1.6678 - val_accuracy: 0.4310
Epoch 92/100
50/50 [==============================] - 2s 34ms/step - loss: 0.7967 - accuracy: 0.7067 -
val_loss: 1.7235 - val_accuracy: 0.3448
Epoch 93/100
50/50 [==============================] - 1s 14ms/step - loss: 0.9012 - accuracy: 0.6467 -
val_loss: 2.1576 - val_accuracy: 0.2241
Epoch 94/100
50/50 [==============================] - 3s 62ms/step - loss: 0.8741 - accuracy: 0.6867 -
val_loss: 2.0341 - val_accuracy: 0.1897
Epoch 95/100
50/50 [==============================] - 0s 9ms/step - loss: 0.8254 - accuracy: 0.6867 -
val_loss: 1.8771 - val_accuracy: 0.3448
Epoch 96/100
50/50 [==============================] - 2s 48ms/step - loss: 0.8393 - accuracy: 0.7000 -
val_loss: 1.9594 - val_accuracy: 0.2586
Epoch 97/100
50/50 [==============================] - 2s 36ms/step - loss: 0.7781 - accuracy: 0.7400 -
val_loss: 1.5258 - val_accuracy: 0.4483
Epoch 98/100
50/50 [==============================] - 4s 82ms/step - loss: 0.8999 - accuracy: 0.6600 -
val_loss: 2.1497 - val_accuracy: 0.2586
Epoch 99/100
50/50 [==============================] - 2s 46ms/step - loss: 0.7932 - accuracy: 0.6800 -
val_loss: 1.7290 - val_accuracy: 0.3621
Epoch 100/100
50/50 [==============================] - 1s 26ms/step - loss: 0.9077 - accuracy: 0.6733 -
val_loss: 1.5437 - val_accuracy: 0.4483
```

In [14]:

```
cnn.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
```

```
conv2d_2 (Conv2D)            (None, 30, 30, 32)        896
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 15, 15, 32)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 13, 13, 64)        18496
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 6, 6, 64)          0
_________________________________________________________________
flatten_1 (Flatten)          (None, 2304)              0
_________________________________________________________________
dense_2 (Dense)              (None, 64)                147520
_________________________________________________________________
dense_3 (Dense)              (None, 6)                 390
=================================================================
Total params: 167,302
Trainable params: 167,302
Non-trainable params: 0
_________________________________________________________________
```

In [15]:

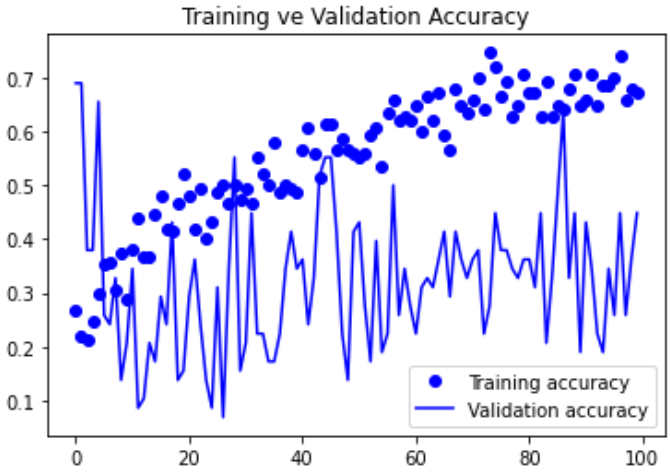
```
import matplotlib.pyplot as plt
%matplotlib inline

accuracy = history1.history['accuracy']
val_accuracy = history1.history['val_accuracy']
loss = history1.history['loss']
val_loss = history1.history['val_loss']
epochs = range(len(accuracy))

plt.plot(epochs, accuracy, 'bo', label='Training accuracy')
plt.plot(epochs, val_accuracy, 'b', label='Validation accuracy')
plt.title('Training ve Validation Accuracy')
plt.legend()
plt.figure()
```

Out[15]:

```
<Figure size 432x288 with 0 Axes>
```




```
<Figure size 432x288 with 0 Axes>
```

In [ ]: