In [16]:

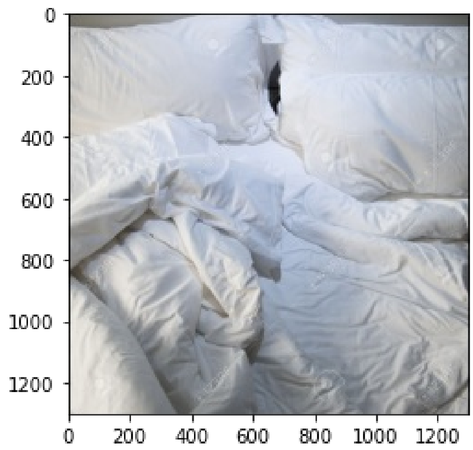
```
import tensorflow as tf
from tensorflow.keras import datasets, layers, models
from keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt
import numpy as np
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers 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 [17]:

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

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

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



In [25]:

```
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/valida
tion/",
                                          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 [26]:

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

Out[26]:

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

In [27]:

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

Out[27]:

```
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 [28]:

```
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(32,(3,3),activation="relu"),
    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 [29]:

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

In [30]:

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

)
```

```
Epoch 1/100
50/50 [==============================] - 2s 41ms/step - loss: 1.8083 - accuracy: 0.1933 -
val_loss: 1.7079 - val_accuracy: 0.6897
Epoch 2/100
50/50 [==============================] - 2s 34ms/step - loss: 1.7985 - accuracy: 0.2000 -
val_loss: 1.6646 - val_accuracy: 0.6897
Epoch 3/100
50/50 [==============================] - 1s 22ms/step - loss: 1.7965 - accuracy: 0.1933 -
val_loss: 1.7100 - val_accuracy: 0.6897
Epoch 4/100
50/50 [==============================] - 2s 36ms/step - loss: 1.7823 - accuracy: 0.2467 -
val_loss: 1.6560 - val_accuracy: 0.6897
Epoch 5/100
50/50 [==============================] - 1s 26ms/step - loss: 1.7836 - accuracy: 0.2533 -
val_loss: 1.6705 - val_accuracy: 0.6897
Epoch 6/100
50/50 [==============================] - 3s 58ms/step - loss: 1.7524 - accuracy: 0.2467 -
val_loss: 1.6854 - val_accuracy: 0.6897
Epoch 7/100
```

```
50/50 [==============================] - 2s 38ms/step - loss: 1.7680 - accuracy: 0.1800 -
val_loss: 1.6584 - val_accuracy: 0.6034
Epoch 8/100
50/50 [==============================] - 2s 31ms/step - loss: 1.7555 - accuracy: 0.2133 -
val_loss: 1.6819 - val_accuracy: 0.5345
Epoch 9/100
50/50 [==============================] - 1s 26ms/step - loss: 1.7716 - accuracy: 0.2267 -
val_loss: 1.7344 - val_accuracy: 0.3103
Epoch 10/100
50/50 [==============================] - 1s 10ms/step - loss: 1.7374 - accuracy: 0.2467 -
val_loss: 1.6322 - val_accuracy: 0.6724
Epoch 11/100
50/50 [==============================] - 1s 18ms/step - loss: 1.7338 - accuracy: 0.2333 -
val_loss: 1.9702 - val_accuracy: 0.0172
Epoch 12/100
50/50 [==============================] - 2s 46ms/step - loss: 1.6947 - accuracy: 0.3267 -
val_loss: 1.5192 - val_accuracy: 0.3621
Epoch 13/100
50/50 [==============================] - 2s 37ms/step - loss: 1.6799 - accuracy: 0.2838 -
val_loss: 1.6752 - val_accuracy: 0.0862
Epoch 14/100
50/50 [==============================] - 2s 44ms/step - loss: 1.6396 - accuracy: 0.3000 -
val_loss: 1.5264 - val_accuracy: 0.2586
Epoch 15/100
50/50 [==============================] - 2s 40ms/step - loss: 1.6542 - accuracy: 0.2933 -
val_loss: 1.4987 - val_accuracy: 0.2586
Epoch 16/100
50/50 [==============================] - 3s 50ms/step - loss: 1.6342 - accuracy: 0.3267 -
val_loss: 1.5880 - val_accuracy: 0.3103
Epoch 17/100
50/50 [==============================] - 2s 40ms/step - loss: 1.5511 - accuracy: 0.3733 -
val_loss: 1.6499 - val_accuracy: 0.1379
Epoch 18/100
50/50 [==============================] - 1s 10ms/step - loss: 1.4896 - accuracy: 0.4200 -
val_loss: 1.5067 - val_accuracy: 0.2414
Epoch 19/100
50/50 [==============================] - 2s 44ms/step - loss: 1.6095 - accuracy: 0.3133 -
val_loss: 1.7026 - val_accuracy: 0.1724
Epoch 20/100
50/50 [==============================] - 2s 41ms/step - loss: 1.5980 - accuracy: 0.3867 -
val_loss: 1.8586 - val_accuracy: 0.1034
Epoch 21/100
50/50 [==============================] - 3s 52ms/step - loss: 1.5970 - accuracy: 0.3533 -
val_loss: 1.7378 - val_accuracy: 0.0690
Epoch 22/100
50/50 [==============================] - 2s 43ms/step - loss: 1.5100 - accuracy: 0.4267 -
val_loss: 1.6230 - val_accuracy: 0.2586
Epoch 23/100
50/50 [==============================] - 2s 50ms/step - loss: 1.5721 - accuracy: 0.3600 -
val_loss: 1.3907 - val_accuracy: 0.5000
Epoch 24/100
50/50 [==============================] - 3s 50ms/step - loss: 1.4922 - accuracy: 0.4200 -
val_loss: 1.5795 - val_accuracy: 0.3276
Epoch 25/100
50/50 [==============================] - 1s 27ms/step - loss: 1.5221 - accuracy: 0.3667 -
val_loss: 1.5722 - val_accuracy: 0.3448
Epoch 26/100
50/50 [==============================] - 2s 34ms/step - loss: 1.4701 - accuracy: 0.4200 -
val_loss: 1.4183 - val_accuracy: 0.5000
Epoch 27/100
50/50 [==============================] - 1s 17ms/step - loss: 1.4717 - accuracy: 0.4533 -
val_loss: 1.4356 - val_accuracy: 0.4310
Epoch 28/100
50/50 [==============================] - 2s 33ms/step - loss: 1.4841 - accuracy: 0.3867 -
val_loss: 1.4300 - val_accuracy: 0.4138
Epoch 29/100
50/50 [==============================] - 2s 42ms/step - loss: 1.4488 - accuracy: 0.4133 -
val_loss: 1.8508 - val_accuracy: 0.1379
Epoch 30/100
50/50 [==============================] - 1s 25ms/step - loss: 1.4794 - accuracy: 0.4000 -
val_loss: 1.3862 - val_accuracy: 0.5000
Epoch 31/100
```

```
50/50 [==============================] - 3s 54ms/step - loss: 1.5180 - accuracy: 0.3533 -
val_loss: 1.5708 - val_accuracy: 0.2586
Epoch 32/100
50/50 [==============================] - 2s 35ms/step - loss: 1.3866 - accuracy: 0.4267 -
val_loss: 1.4585 - val_accuracy: 0.3966
Epoch 33/100
50/50 [==============================] - 2s 42ms/step - loss: 1.5165 - accuracy: 0.3733 -
val_loss: 1.5243 - val_accuracy: 0.1724
Epoch 34/100
50/50 [==============================] - 0s 7ms/step - loss: 1.4052 - accuracy: 0.4867 -
val_loss: 2.0111 - val_accuracy: 0.1207
Epoch 35/100
50/50 [==============================] - 2s 32ms/step - loss: 1.4415 - accuracy: 0.4400 -
val_loss: 1.5958 - val_accuracy: 0.2759
Epoch 36/100
50/50 [==============================] - 2s 37ms/step - loss: 1.3552 - accuracy: 0.4733 -
val_loss: 1.5965 - val_accuracy: 0.2586
Epoch 37/100
50/50 [==============================] - 3s 55ms/step - loss: 1.4782 - accuracy: 0.4333 -
val_loss: 1.6451 - val_accuracy: 0.1552
Epoch 38/100
50/50 [==============================] - 2s 30ms/step - loss: 1.4496 - accuracy: 0.4733 -
val_loss: 1.7533 - val_accuracy: 0.1207
Epoch 39/100
50/50 [==============================] - 1s 24ms/step - loss: 1.3679 - accuracy: 0.5133 -
val_loss: 1.4317 - val_accuracy: 0.3621
Epoch 40/100
50/50 [==============================] - 2s 38ms/step - loss: 1.4030 - accuracy: 0.4333 -
val_loss: 1.6077 - val_accuracy: 0.2931
Epoch 41/100
50/50 [==============================] - 2s 44ms/step - loss: 1.3740 - accuracy: 0.4800 -
val_loss: 1.5382 - val_accuracy: 0.3966
Epoch 42/100
50/50 [==============================] - 1s 24ms/step - loss: 1.3328 - accuracy: 0.4733 -
val_loss: 1.4707 - val_accuracy: 0.3621
Epoch 43/100
50/50 [==============================] - 1s 25ms/step - loss: 1.3196 - accuracy: 0.4533 -
val_loss: 1.4716 - val_accuracy: 0.4310
Epoch 44/100
50/50 [==============================] - 1s 12ms/step - loss: 1.3040 - accuracy: 0.4467 -
val_loss: 1.3684 - val_accuracy: 0.4828
Epoch 45/100
50/50 [==============================] - 1s 26ms/step - loss: 1.3790 - accuracy: 0.4933 -
val_loss: 1.6778 - val_accuracy: 0.3621
Epoch 46/100
50/50 [==============================] - 2s 35ms/step - loss: 1.3213 - accuracy: 0.4600 -
val_loss: 1.6391 - val_accuracy: 0.2586
Epoch 47/100
50/50 [==============================] - 1s 18ms/step - loss: 1.3264 - accuracy: 0.4867 -
val_loss: 1.3508 - val_accuracy: 0.5345
Epoch 48/100
50/50 [==============================] - 0s 7ms/step - loss: 1.4617 - accuracy: 0.4533 -
val_loss: 1.7648 - val_accuracy: 0.2414
Epoch 49/100
50/50 [==============================] - 2s 36ms/step - loss: 1.3582 - accuracy: 0.4200 -
val_loss: 1.3652 - val_accuracy: 0.4828
Epoch 50/100
50/50 [==============================] - 1s 25ms/step - loss: 1.2792 - accuracy: 0.5067 -
val_loss: 1.3937 - val_accuracy: 0.4655
Epoch 51/100
50/50 [==============================] - 1s 18ms/step - loss: 1.1650 - accuracy: 0.5800 -
val_loss: 1.6358 - val_accuracy: 0.3276
Epoch 52/100
50/50 [==============================] - 1s 11ms/step - loss: 1.3354 - accuracy: 0.4800 -
val_loss: 1.3467 - val_accuracy: 0.4310
Epoch 53/100
50/50 [==============================] - 3s 54ms/step - loss: 1.2878 - accuracy: 0.5000 -
val_loss: 1.3714 - val_accuracy: 0.4828
Epoch 54/100
50/50 [==============================] - 3s 52ms/step - loss: 1.3235 - accuracy: 0.4867 -
val_loss: 1.5614 - val_accuracy: 0.3448
Epoch 55/100
```

```
50/50 [==============================] - 1s 16ms/step - loss: 1.1525 - accuracy: 0.5467 -
val_loss: 1.4555 - val_accuracy: 0.4483
Epoch 56/100
50/50 [==============================] - 1s 28ms/step - loss: 1.3444 - accuracy: 0.4600 -
val_loss: 1.3545 - val_accuracy: 0.5172
Epoch 57/100
50/50 [==============================] - 2s 45ms/step - loss: 1.3358 - accuracy: 0.4867 -
val_loss: 1.3270 - val_accuracy: 0.5000
Epoch 58/100
50/50 [==============================] - 3s 60ms/step - loss: 1.0882 - accuracy: 0.5667 -
val_loss: 1.4939 - val_accuracy: 0.3793
Epoch 59/100
50/50 [==============================] - 1s 30ms/step - loss: 1.1450 - accuracy: 0.4867 -
val_loss: 1.9373 - val_accuracy: 0.1897
Epoch 60/100
50/50 [==============================] - 2s 31ms/step - loss: 1.3480 - accuracy: 0.5200 -
val_loss: 1.4473 - val_accuracy: 0.3966
Epoch 61/100
50/50 [==============================] - 0s 8ms/step - loss: 1.3313 - accuracy: 0.4800 -
val_loss: 1.4654 - val_accuracy: 0.3966
Epoch 62/100
50/50 [==============================] - 2s 34ms/step - loss: 1.1875 - accuracy: 0.5067 -
val_loss: 1.7702 - val_accuracy: 0.1724
Epoch 63/100
50/50 [==============================] - 2s 49ms/step - loss: 1.2827 - accuracy: 0.4600 -
val_loss: 1.4625 - val_accuracy: 0.3966
Epoch 64/100
50/50 [==============================] - 2s 31ms/step - loss: 1.2039 - accuracy: 0.5800 -
val_loss: 1.9994 - val_accuracy: 0.1897
Epoch 65/100
50/50 [==============================] - 1s 30ms/step - loss: 1.2852 - accuracy: 0.4733 -
val_loss: 1.4833 - val_accuracy: 0.3448
Epoch 66/100
50/50 [==============================] - 1s 19ms/step - loss: 1.1616 - accuracy: 0.6133 -
val_loss: 1.8510 - val_accuracy: 0.1897
Epoch 67/100
50/50 [==============================] - 2s 37ms/step - loss: 1.0652 - accuracy: 0.5867 -
val_loss: 1.8843 - val_accuracy: 0.1552
Epoch 68/100
50/50 [==============================] - 2s 39ms/step - loss: 1.2094 - accuracy: 0.5467 -
val_loss: 1.8354 - val_accuracy: 0.1552
Epoch 69/100
50/50 [==============================] - 2s 45ms/step - loss: 1.0630 - accuracy: 0.5933 -
val_loss: 1.8359 - val_accuracy: 0.2414
Epoch 70/100
50/50 [==============================] - 2s 46ms/step - loss: 1.1684 - accuracy: 0.5800 -
val_loss: 1.5089 - val_accuracy: 0.4138
Epoch 71/100
50/50 [==============================] - 1s 26ms/step - loss: 1.2464 - accuracy: 0.5067 -
val_loss: 1.4522 - val_accuracy: 0.4138
Epoch 72/100
50/50 [==============================] - 2s 42ms/step - loss: 1.1450 - accuracy: 0.5600 -
val_loss: 1.2666 - val_accuracy: 0.5690
Epoch 73/100
50/50 [==============================] - 2s 38ms/step - loss: 1.2156 - accuracy: 0.4867 -
val_loss: 1.8619 - val_accuracy: 0.2931
Epoch 74/100
50/50 [==============================] - 2s 35ms/step - loss: 1.1629 - accuracy: 0.5467 -
val_loss: 1.7583 - val_accuracy: 0.3793
Epoch 75/100
50/50 [==============================] - 2s 33ms/step - loss: 1.1237 - accuracy: 0.6133 -
val_loss: 2.1321 - val_accuracy: 0.1897
Epoch 76/100
50/50 [==============================] - 2s 40ms/step - loss: 1.0010 - accuracy: 0.6733 -
val_loss: 1.6017 - val_accuracy: 0.4483
Epoch 77/100
50/50 [==============================] - 2s 47ms/step - loss: 1.1755 - accuracy: 0.5600 -
val_loss: 1.7248 - val_accuracy: 0.3276
Epoch 78/100
50/50 [==============================] - 2s 34ms/step - loss: 1.2896 - accuracy: 0.5000 -
val_loss: 1.5425 - val_accuracy: 0.3276
Epoch 79/100
```

```
50/50 [==============================] - 1s 14ms/step - loss: 1.2725 - accuracy: 0.5067 -
val_loss: 1.4101 - val_accuracy: 0.4138
Epoch 80/100
50/50 [==============================] - 1s 10ms/step - loss: 1.0221 - accuracy: 0.5933 -
val_loss: 2.1509 - val_accuracy: 0.1897
Epoch 81/100
50/50 [==============================] - 1s 29ms/step - loss: 1.0947 - accuracy: 0.5667 -
val_loss: 1.3856 - val_accuracy: 0.4483
Epoch 82/100
50/50 [==============================] - 2s 34ms/step - loss: 1.1632 - accuracy: 0.5467 -
val_loss: 1.6539 - val_accuracy: 0.2931
Epoch 83/100
50/50 [==============================] - 3s 65ms/step - loss: 1.1087 - accuracy: 0.5867 -
val_loss: 1.7232 - val_accuracy: 0.2414
Epoch 84/100
50/50 [==============================] - 1s 14ms/step - loss: 0.9719 - accuracy: 0.6467 -
val_loss: 1.7175 - val_accuracy: 0.2586
Epoch 85/100
50/50 [==============================] - 0s 9ms/step - loss: 1.0825 - accuracy: 0.5800 -
val_loss: 1.6805 - val_accuracy: 0.2586
Epoch 86/100
50/50 [==============================] - 1s 30ms/step - loss: 1.1908 - accuracy: 0.5867 -
val_loss: 1.4243 - val_accuracy: 0.4655
Epoch 87/100
50/50 [==============================] - 1s 20ms/step - loss: 0.9941 - accuracy: 0.5800 -
val_loss: 1.5494 - val_accuracy: 0.3448
Epoch 88/100
50/50 [==============================] - 4s 72ms/step - loss: 0.9438 - accuracy: 0.6800 -
val_loss: 1.6603 - val_accuracy: 0.3966
Epoch 89/100
50/50 [==============================] - 3s 55ms/step - loss: 0.9861 - accuracy: 0.5933 -
val_loss: 1.5413 - val_accuracy: 0.4483
Epoch 90/100
50/50 [==============================] - 1s 10ms/step - loss: 1.0598 - accuracy: 0.6133 -
val_loss: 1.4950 - val_accuracy: 0.4655
Epoch 91/100
50/50 [==============================] - 1s 16ms/step - loss: 0.9599 - accuracy: 0.6867 -
val_loss: 1.6449 - val_accuracy: 0.3621
Epoch 92/100
50/50 [==============================] - 3s 52ms/step - loss: 1.0137 - accuracy: 0.6200 -
val_loss: 1.7189 - val_accuracy: 0.3276
Epoch 93/100
50/50 [==============================] - 2s 46ms/step - loss: 1.0523 - accuracy: 0.6600 -
val_loss: 2.1982 - val_accuracy: 0.1897
Epoch 94/100
50/50 [==============================] - 2s 35ms/step - loss: 1.0807 - accuracy: 0.5933 -
val_loss: 1.5905 - val_accuracy: 0.3793
Epoch 95/100
50/50 [==============================] - 1s 12ms/step - loss: 1.1214 - accuracy: 0.6133 -
val_loss: 1.6064 - val_accuracy: 0.4138
Epoch 96/100
50/50 [==============================] - 2s 42ms/step - loss: 0.8614 - accuracy: 0.6800 -
val_loss: 1.7350 - val_accuracy: 0.4310
Epoch 97/100
50/50 [==============================] - 5s 91ms/step - loss: 1.0111 - accuracy: 0.6067 -
val_loss: 1.6299 - val_accuracy: 0.3621
Epoch 98/100
50/50 [==============================] - 1s 22ms/step - loss: 1.0809 - accuracy: 0.5800 -
val_loss: 1.7067 - val_accuracy: 0.3103
Epoch 99/100
50/50 [==============================] - 2s 36ms/step - loss: 0.9948 - accuracy: 0.6067 -
val_loss: 1.2862 - val_accuracy: 0.5172
Epoch 100/100
50/50 [==============================] - 0s 7ms/step - loss: 1.0113 - accuracy: 0.6467 -
val_loss: 1.4589 - val_accuracy: 0.4655
```

In [31]:

```
cnn.summary()
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_9 (Conv2D)            (None, 30, 30, 32)        896
_________________________________________________________________
max_pooling2d_9 (MaxPooling2 (None, 15, 15, 32)        0
_________________________________________________________________
conv2d_10 (Conv2D)           (None, 13, 13, 32)        9248
_________________________________________________________________
max_pooling2d_10 (MaxPooling (None, 6, 6, 32)          0
_________________________________________________________________
conv2d_11 (Conv2D)           (None, 4, 4, 64)          18496
_________________________________________________________________
max_pooling2d_11 (MaxPooling (None, 2, 2, 64)          0
_________________________________________________________________
flatten_3 (Flatten)          (None, 256)               0
_________________________________________________________________
dense_6 (Dense)              (None, 64)                16448
_________________________________________________________________
dense_7 (Dense)              (None, 6)                 390
=================================================================
Total params: 45,478
Trainable params: 45,478
Non-trainable params: 0
_________________________________________________________________
```

In [32]:

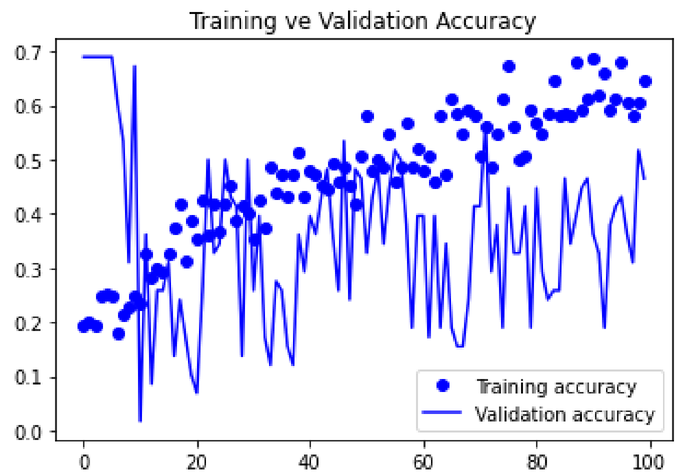
```python
import matplotlib.pyplot as plt
%matplotlib inline

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[32]:

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




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

In [ ]: