CNNMINEEAMONG

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[1]:
```
import os
import matplotlib.pyplot as plt
import tensorflow as tf
```

[2]:
```
dataset_dir = os.path.join(os.getcwd(), 'Downloads')

dataset_train_dir = os.path.join(dataset_dir, 'Train')
dataset_train_minecraft_len= len(os.listdir(os.path.join(dataset_train_dir,␣
 ↪'Mine')))
dataset_train_Among_len= len(os.listdir(os.path.join(dataset_train_dir,␣
 ↪'Among')))


dataset_validation_dir = os.path.join(dataset_dir, 'Validation')
dataset_validation_minecraft_len= len(os.listdir(os.path.
 ↪join(dataset_validation_dir, 'Mine2')))
dataset_validation_Among_len= len(os.listdir(os.path.
 ↪join(dataset_validation_dir, 'Among2')))


print('Train Mine: %s' % dataset_train_minecraft_len)
print('Validation Mine: %s' % dataset_validation_minecraft_len)

print('Train Among Us: %s' % dataset_train_Among_len)
print('Validation Among Us: %s' % dataset_validation_Among_len)
```

```
Train Mine: 473
Validation Mine: 456
Train Among Us: 505
Validation Among Us: 495
```

[3]:
```
image_width = 160
image_height = 160
image_color_channel = 3
image_color_channel_size = 255
image_size = (image_width, image_height)
image_shape = image_size + (image_color_channel,)
```

```
batch_size = 100
epochs = 100
learning_rate = 0.0001

class_names = ['among', 'mine']
```

[4]:
```
dataset_train = tf.keras.preprocessing.image_dataset_from_directory(
dataset_train_dir,
image_size = image_size,
batch_size = batch_size,
shuffle = True
)
```

```
Found 978 files belonging to 2 classes.
```

[5]:
```
dataset_validation = tf.keras.preprocessing.image_dataset_from_directory(
    dataset_validation_dir,
    image_size = image_size,
    batch_size = batch_size,
    shuffle = True
)
```

```
Found 951 files belonging to 2 classes.
```

[6]:
```
dataset_validation_cardinality = tf.data.experimental.
 ↪cardinality(dataset_validation)
dataset_validation_batches = dataset_validation_cardinality // 5

dataset_test = dataset_validation.take(dataset_validation_batches)
dataset_validation = dataset_validation.skip(dataset_validation_batches)

print('Validation Dataset Cardinality: %d' % tf.data.experimental.
 ↪cardinality(dataset_validation))
print('Test Dataset Cardinality: %d' % tf.data.experimental.
 ↪cardinality(dataset_test))
```

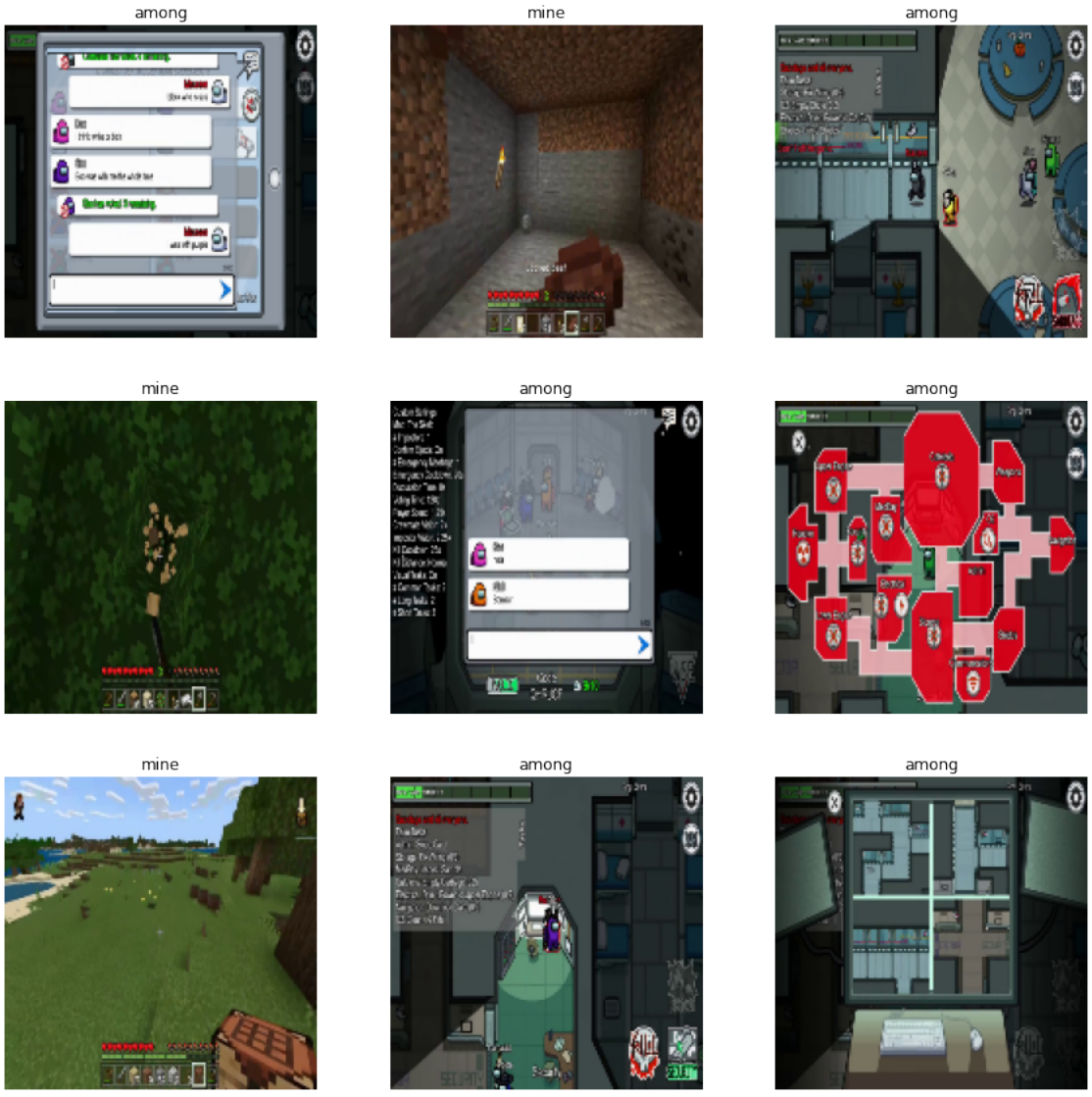
```
Validation Dataset Cardinality: 8
Test Dataset Cardinality: 2
```

[7]:
```
def plot_dataset(dataset):

    plt.gcf().clear()
    plt.figure(figsize = (15, 15))

    for features, labels in dataset.take(1):
```

```
        for i in range(9):

            plt.subplot(3, 3, i + 1)
            plt.axis('off')

            plt.imshow(features[i].numpy().astype('uint8'))
            plt.title(class_names[labels[i]])
```

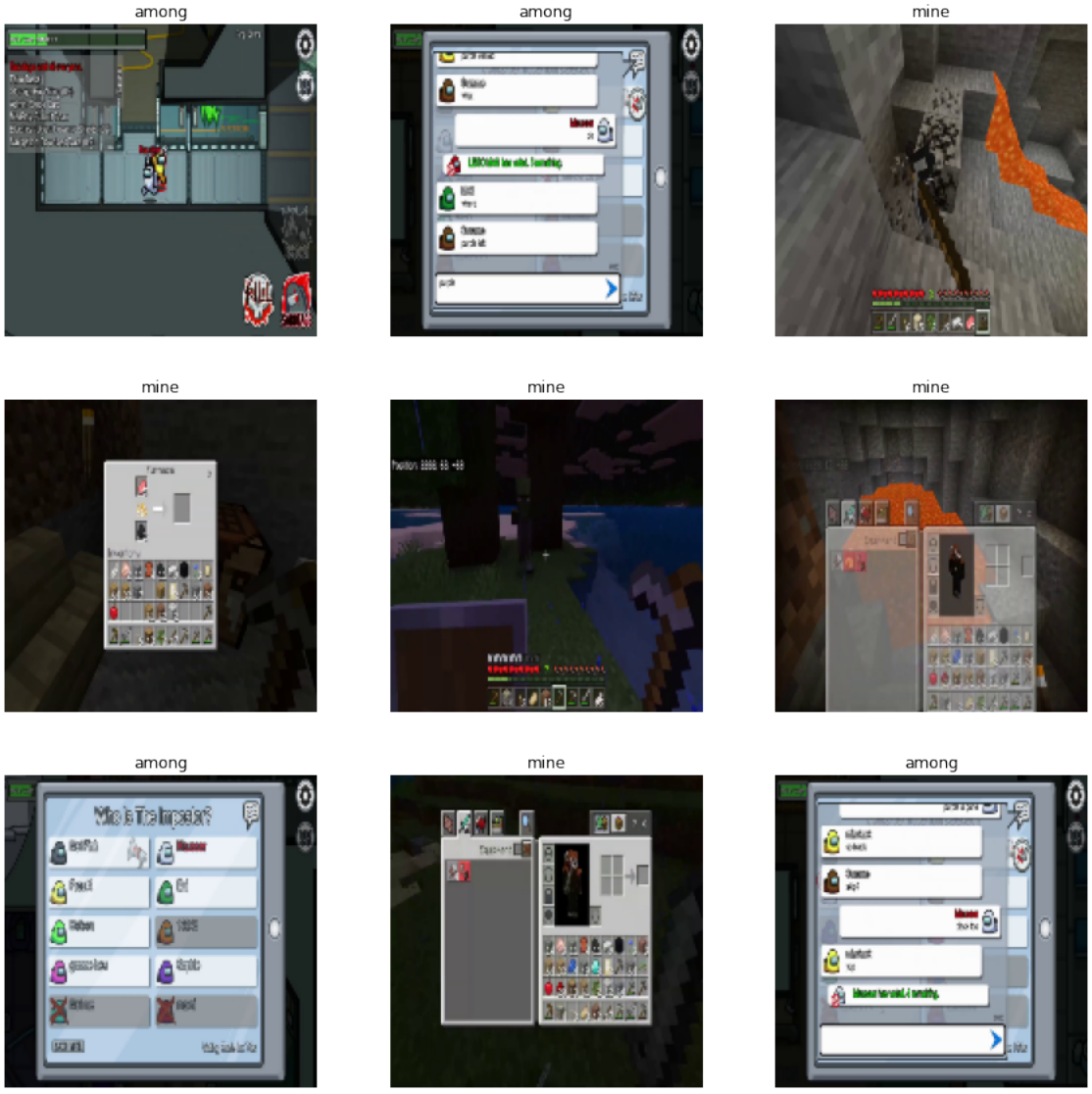
[8]:
```
plot_dataset(dataset_train)
```

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



[9]:
```
plot_dataset(dataset_validation)
```

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



[10]:
```
plot_dataset(dataset_test)
```

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

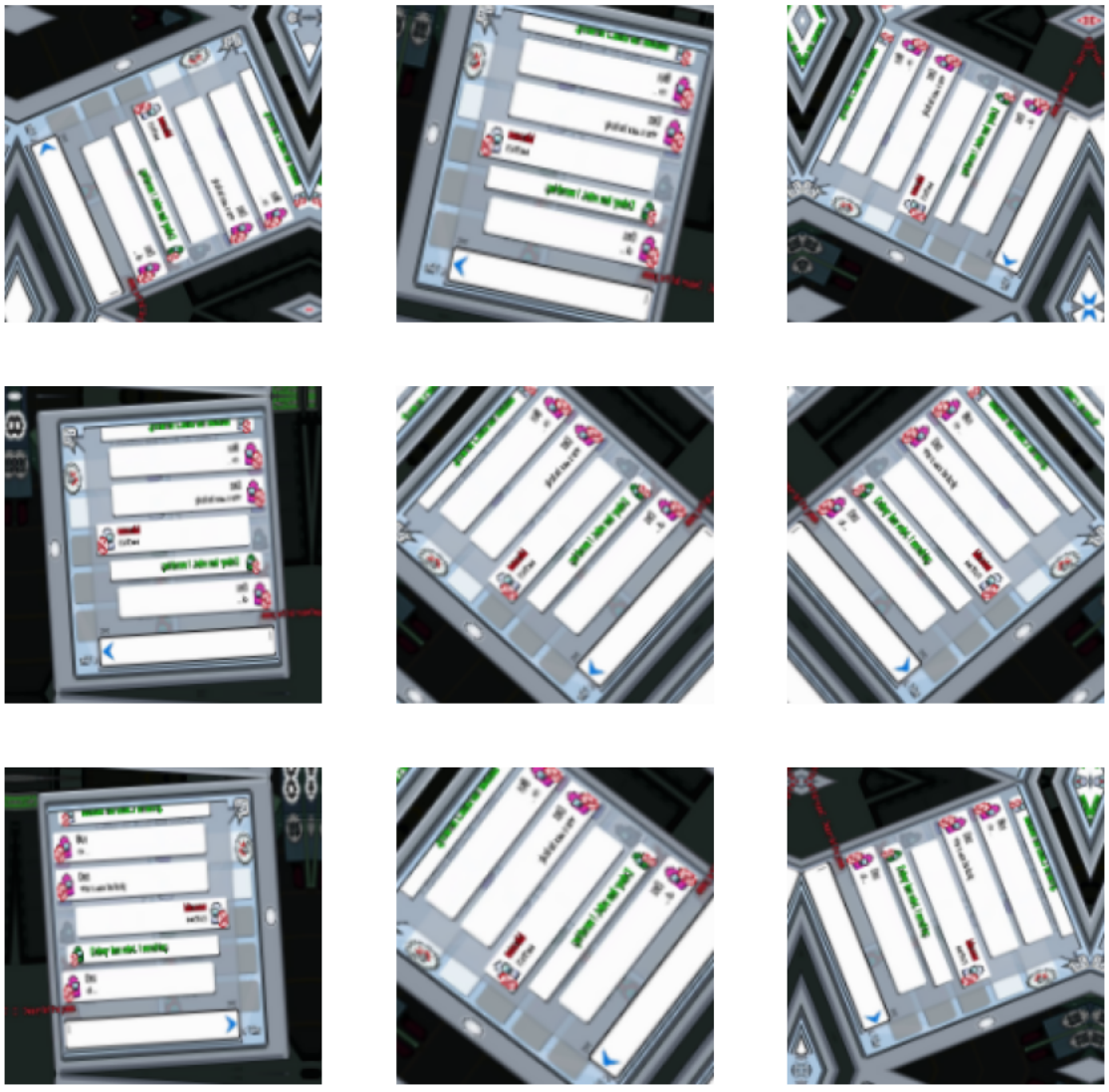
[11]:
```
data_augmentation = tf.keras.models.Sequential([
    tf.keras.layers.experimental.preprocessing.RandomFlip('horizontal'),
    tf.keras.layers.experimental.preprocessing.RandomRotation(0.2),
    tf.keras.layers.experimental.preprocessing.RandomZoom(0.2)
])
```

[12]:
```
def plot_dataset_data_augmentation(dataset):

    plt.gcf().clear()
    plt.figure(figsize = (15, 15))

    for features, _ in dataset.take(1):
```

```
        feature = features[0]

        for i in range(9):

            feature_data_augmentation = data_augmentation(tf.
↪expand_dims(feature, 0))

            plt.subplot(3, 3, i + 1)
            plt.axis('off')

            plt.imshow(feature_data_augmentation[0] / image_color_channel_size)
```

[13]:
```
plot_dataset_data_augmentation(dataset_train)
```

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



[14]:
```
model_transfer_learning = tf.keras.applications.MobileNetV2(
    input_shape = image_shape,
    include_top = False,
    weights = 'imagenet'
)

model_transfer_learning.trainable = False

model_transfer_learning.summary()
```

```
Model: "mobilenetv2_1.00_160"
__________________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==================================================================================================
 input_1 (InputLayer)           [(None, 160, 160, 3  0           []
                                )]

 Conv1 (Conv2D)                 (None, 80, 80, 32)   864
['input_1[0][0]']

 bn_Conv1 (BatchNormalization)  (None, 80, 80, 32)   128         ['Conv1[0][0]']

 Conv1_relu (ReLU)              (None, 80, 80, 32)   0
['bn_Conv1[0][0]']

 expanded_conv_depthwise (Depth  (None, 80, 80, 32)  288
['Conv1_relu[0][0]']
 wiseConv2D)

 expanded_conv_depthwise_BN (Ba  (None, 80, 80, 32)  128
['expanded_conv_depthwise[0][0]']
 tchNormalization)

 expanded_conv_depthwise_relu (  (None, 80, 80, 32)  0
['expanded_conv_depthwise_BN[0][0
 ReLU)                                                          ]']

 expanded_conv_project (Conv2D)  (None, 80, 80, 16)  512
['expanded_conv_depthwise_relu[0]
                                                                [0]']

 expanded_conv_project_BN (Batc  (None, 80, 80, 16)  64
['expanded_conv_project[0][0]']
```

```
 hNormalization)

 block_1_expand (Conv2D)        (None, 80, 80, 96)   1536
['expanded_conv_project_BN[0][0]'
                                                                  ]

 block_1_expand_BN (BatchNormal  (None, 80, 80, 96)  384
['block_1_expand[0][0]']
 ization)

 block_1_expand_relu (ReLU)     (None, 80, 80, 96)   0
['block_1_expand_BN[0][0]']

 block_1_pad (ZeroPadding2D)    (None, 81, 81, 96)   0
['block_1_expand_relu[0][0]']

 block_1_depthwise (DepthwiseCo  (None, 40, 40, 96)  864
['block_1_pad[0][0]']
 nv2D)

 block_1_depthwise_BN (BatchNor  (None, 40, 40, 96)  384
['block_1_depthwise[0][0]']
 malization)

 block_1_depthwise_relu (ReLU)  (None, 40, 40, 96)   0
['block_1_depthwise_BN[0][0]']

 block_1_project (Conv2D)       (None, 40, 40, 24)   2304
['block_1_depthwise_relu[0][0]']

 block_1_project_BN (BatchNorma  (None, 40, 40, 24)  96
['block_1_project[0][0]']
 lization)

 block_2_expand (Conv2D)        (None, 40, 40, 144)  3456
['block_1_project_BN[0][0]']

 block_2_expand_BN (BatchNormal  (None, 40, 40, 144)  576
['block_2_expand[0][0]']
 ization)

 block_2_expand_relu (ReLU)     (None, 40, 40, 144)  0
['block_2_expand_BN[0][0]']

 block_2_depthwise (DepthwiseCo  (None, 40, 40, 144)  1296
['block_2_expand_relu[0][0]']
 nv2D)
```

```
 block_2_depthwise_BN (BatchNor  (None, 40, 40, 144)  576
['block_2_depthwise[0][0]']
 malization)

 block_2_depthwise_relu (ReLU)  (None, 40, 40, 144)  0
['block_2_depthwise_BN[0][0]']

 block_2_project (Conv2D)       (None, 40, 40, 24)   3456
['block_2_depthwise_relu[0][0]']

 block_2_project_BN (BatchNorma  (None, 40, 40, 24)  96
['block_2_project[0][0]']
 lization)

 block_2_add (Add)              (None, 40, 40, 24)   0
['block_1_project_BN[0][0]',
'block_2_project_BN[0][0]']

 block_3_expand (Conv2D)        (None, 40, 40, 144)  3456
['block_2_add[0][0]']

 block_3_expand_BN (BatchNormal  (None, 40, 40, 144)  576
['block_3_expand[0][0]']
 ization)

 block_3_expand_relu (ReLU)     (None, 40, 40, 144)  0
['block_3_expand_BN[0][0]']

 block_3_pad (ZeroPadding2D)    (None, 41, 41, 144)  0
['block_3_expand_relu[0][0]']

 block_3_depthwise (DepthwiseCo  (None, 20, 20, 144)  1296
['block_3_pad[0][0]']
 nv2D)

 block_3_depthwise_BN (BatchNor  (None, 20, 20, 144)  576
['block_3_depthwise[0][0]']
 malization)

 block_3_depthwise_relu (ReLU)  (None, 20, 20, 144)  0
['block_3_depthwise_BN[0][0]']

 block_3_project (Conv2D)       (None, 20, 20, 32)   4608
['block_3_depthwise_relu[0][0]']

 block_3_project_BN (BatchNorma  (None, 20, 20, 32)  128
['block_3_project[0][0]']
 lization)
```

```
 block_4_expand (Conv2D)        (None, 20, 20, 192)  6144
['block_3_project_BN[0][0]']

 block_4_expand_BN (BatchNormal  (None, 20, 20, 192)  768
['block_4_expand[0][0]']
 ization)

 block_4_expand_relu (ReLU)     (None, 20, 20, 192)  0
['block_4_expand_BN[0][0]']

 block_4_depthwise (DepthwiseCo  (None, 20, 20, 192)  1728
['block_4_expand_relu[0][0]']
 nv2D)

 block_4_depthwise_BN (BatchNor  (None, 20, 20, 192)  768
['block_4_depthwise[0][0]']
 malization)

 block_4_depthwise_relu (ReLU)  (None, 20, 20, 192)  0
['block_4_depthwise_BN[0][0]']

 block_4_project (Conv2D)       (None, 20, 20, 32)   6144
['block_4_depthwise_relu[0][0]']

 block_4_project_BN (BatchNorma  (None, 20, 20, 32)  128
['block_4_project[0][0]']
 lization)

 block_4_add (Add)              (None, 20, 20, 32)   0
['block_3_project_BN[0][0]',
'block_4_project_BN[0][0]']

 block_5_expand (Conv2D)        (None, 20, 20, 192)  6144
['block_4_add[0][0]']

 block_5_expand_BN (BatchNormal  (None, 20, 20, 192)  768
['block_5_expand[0][0]']
 ization)

 block_5_expand_relu (ReLU)     (None, 20, 20, 192)  0
['block_5_expand_BN[0][0]']

 block_5_depthwise (DepthwiseCo  (None, 20, 20, 192)  1728
['block_5_expand_relu[0][0]']
 nv2D)

 block_5_depthwise_BN (BatchNor  (None, 20, 20, 192)  768
```

```
['block_5_depthwise[0][0]']
 malization)

 block_5_depthwise_relu (ReLU)  (None, 20, 20, 192)  0
['block_5_depthwise_BN[0][0]']

 block_5_project (Conv2D)       (None, 20, 20, 32)   6144
['block_5_depthwise_relu[0][0]']

 block_5_project_BN (BatchNorma  (None, 20, 20, 32)  128
['block_5_project[0][0]']
 lization)

 block_5_add (Add)              (None, 20, 20, 32)   0
['block_4_add[0][0]',
'block_5_project_BN[0][0]']

 block_6_expand (Conv2D)        (None, 20, 20, 192)  6144
['block_5_add[0][0]']

 block_6_expand_BN (BatchNormal  (None, 20, 20, 192)  768
['block_6_expand[0][0]']
 ization)

 block_6_expand_relu (ReLU)     (None, 20, 20, 192)  0
['block_6_expand_BN[0][0]']

 block_6_pad (ZeroPadding2D)    (None, 21, 21, 192)  0
['block_6_expand_relu[0][0]']

 block_6_depthwise (DepthwiseCo  (None, 10, 10, 192)  1728
['block_6_pad[0][0]']
 nv2D)

 block_6_depthwise_BN (BatchNor  (None, 10, 10, 192)  768
['block_6_depthwise[0][0]']
 malization)

 block_6_depthwise_relu (ReLU)  (None, 10, 10, 192)  0
['block_6_depthwise_BN[0][0]']

 block_6_project (Conv2D)       (None, 10, 10, 64)   12288
['block_6_depthwise_relu[0][0]']

 block_6_project_BN (BatchNorma  (None, 10, 10, 64)  256
['block_6_project[0][0]']
 lization)
```

```
 block_7_expand (Conv2D)        (None, 10, 10, 384)  24576
['block_6_project_BN[0][0]']

 block_7_expand_BN (BatchNormal  (None, 10, 10, 384)  1536
['block_7_expand[0][0]']
 ization)

 block_7_expand_relu (ReLU)     (None, 10, 10, 384)  0
['block_7_expand_BN[0][0]']

 block_7_depthwise (DepthwiseCo  (None, 10, 10, 384)  3456
['block_7_expand_relu[0][0]']
 nv2D)

 block_7_depthwise_BN (BatchNor  (None, 10, 10, 384)  1536
['block_7_depthwise[0][0]']
 malization)

 block_7_depthwise_relu (ReLU)  (None, 10, 10, 384)  0
['block_7_depthwise_BN[0][0]']

 block_7_project (Conv2D)       (None, 10, 10, 64)   24576
['block_7_depthwise_relu[0][0]']

 block_7_project_BN (BatchNorma  (None, 10, 10, 64)  256
['block_7_project[0][0]']
 lization)

 block_7_add (Add)              (None, 10, 10, 64)   0
['block_6_project_BN[0][0]',
'block_7_project_BN[0][0]']

 block_8_expand (Conv2D)        (None, 10, 10, 384)  24576
['block_7_add[0][0]']

 block_8_expand_BN (BatchNormal  (None, 10, 10, 384)  1536
['block_8_expand[0][0]']
 ization)

 block_8_expand_relu (ReLU)     (None, 10, 10, 384)  0
['block_8_expand_BN[0][0]']

 block_8_depthwise (DepthwiseCo  (None, 10, 10, 384)  3456
['block_8_expand_relu[0][0]']
 nv2D)

 block_8_depthwise_BN (BatchNor  (None, 10, 10, 384)  1536
['block_8_depthwise[0][0]']
```

```
 malization)

 block_8_depthwise_relu (ReLU)  (None, 10, 10, 384)  0
['block_8_depthwise_BN[0][0]']

 block_8_project (Conv2D)       (None, 10, 10, 64)   24576
['block_8_depthwise_relu[0][0]']

 block_8_project_BN (BatchNorma  (None, 10, 10, 64)  256
['block_8_project[0][0]']
 lization)

 block_8_add (Add)              (None, 10, 10, 64)   0
['block_7_add[0][0]',
'block_8_project_BN[0][0]']

 block_9_expand (Conv2D)        (None, 10, 10, 384)  24576
['block_8_add[0][0]']

 block_9_expand_BN (BatchNormal  (None, 10, 10, 384)  1536
['block_9_expand[0][0]']
 ization)

 block_9_expand_relu (ReLU)     (None, 10, 10, 384)  0
['block_9_expand_BN[0][0]']

 block_9_depthwise (DepthwiseCo  (None, 10, 10, 384)  3456
['block_9_expand_relu[0][0]']
 nv2D)

 block_9_depthwise_BN (BatchNor  (None, 10, 10, 384)  1536
['block_9_depthwise[0][0]']
 malization)

 block_9_depthwise_relu (ReLU)  (None, 10, 10, 384)  0
['block_9_depthwise_BN[0][0]']

 block_9_project (Conv2D)       (None, 10, 10, 64)   24576
['block_9_depthwise_relu[0][0]']

 block_9_project_BN (BatchNorma  (None, 10, 10, 64)  256
['block_9_project[0][0]']
 lization)

 block_9_add (Add)              (None, 10, 10, 64)   0
['block_8_add[0][0]',
'block_9_project_BN[0][0]']
```

```
 block_10_expand (Conv2D)       (None, 10, 10, 384)  24576
['block_9_add[0][0]']

 block_10_expand_BN (BatchNorma  (None, 10, 10, 384)  1536
['block_10_expand[0][0]']
 lization)

 block_10_expand_relu (ReLU)    (None, 10, 10, 384)  0
['block_10_expand_BN[0][0]']

 block_10_depthwise (DepthwiseC  (None, 10, 10, 384)  3456
['block_10_expand_relu[0][0]']
 onv2D)

 block_10_depthwise_BN (BatchNo  (None, 10, 10, 384)  1536
['block_10_depthwise[0][0]']
 rmalization)

 block_10_depthwise_relu (ReLU)  (None, 10, 10, 384)  0
['block_10_depthwise_BN[0][0]']

 block_10_project (Conv2D)      (None, 10, 10, 96)   36864
['block_10_depthwise_relu[0][0]']

 block_10_project_BN (BatchNorm  (None, 10, 10, 96)  384
['block_10_project[0][0]']
 alization)

 block_11_expand (Conv2D)       (None, 10, 10, 576)  55296
['block_10_project_BN[0][0]']

 block_11_expand_BN (BatchNorma  (None, 10, 10, 576)  2304
['block_11_expand[0][0]']
 lization)

 block_11_expand_relu (ReLU)    (None, 10, 10, 576)  0
['block_11_expand_BN[0][0]']

 block_11_depthwise (DepthwiseC  (None, 10, 10, 576)  5184
['block_11_expand_relu[0][0]']
 onv2D)

 block_11_depthwise_BN (BatchNo  (None, 10, 10, 576)  2304
['block_11_depthwise[0][0]']
 rmalization)

 block_11_depthwise_relu (ReLU)  (None, 10, 10, 576)  0
['block_11_depthwise_BN[0][0]']
```

```
 block_11_project (Conv2D)      (None, 10, 10, 96)   55296
['block_11_depthwise_relu[0][0]']

 block_11_project_BN (BatchNorm  (None, 10, 10, 96)  384
['block_11_project[0][0]']
 alization)

 block_11_add (Add)             (None, 10, 10, 96)   0
['block_10_project_BN[0][0]',
'block_11_project_BN[0][0]']

 block_12_expand (Conv2D)       (None, 10, 10, 576)  55296
['block_11_add[0][0]']

 block_12_expand_BN (BatchNorma  (None, 10, 10, 576)  2304
['block_12_expand[0][0]']
 lization)

 block_12_expand_relu (ReLU)    (None, 10, 10, 576)  0
['block_12_expand_BN[0][0]']

 block_12_depthwise (DepthwiseC  (None, 10, 10, 576)  5184
['block_12_expand_relu[0][0]']
 onv2D)

 block_12_depthwise_BN (BatchNo  (None, 10, 10, 576)  2304
['block_12_depthwise[0][0]']
 rmalization)

 block_12_depthwise_relu (ReLU)  (None, 10, 10, 576)  0
['block_12_depthwise_BN[0][0]']

 block_12_project (Conv2D)      (None, 10, 10, 96)   55296
['block_12_depthwise_relu[0][0]']

 block_12_project_BN (BatchNorm  (None, 10, 10, 96)  384
['block_12_project[0][0]']
 alization)

 block_12_add (Add)             (None, 10, 10, 96)   0
['block_11_add[0][0]',
'block_12_project_BN[0][0]']

 block_13_expand (Conv2D)       (None, 10, 10, 576)  55296
['block_12_add[0][0]']

 block_13_expand_BN (BatchNorma  (None, 10, 10, 576)  2304
```

```
['block_13_expand[0][0]']
 lization)

 block_13_expand_relu (ReLU)    (None, 10, 10, 576)  0
['block_13_expand_BN[0][0]']

 block_13_pad (ZeroPadding2D)   (None, 11, 11, 576)  0
['block_13_expand_relu[0][0]']

 block_13_depthwise (DepthwiseC  (None, 5, 5, 576)   5184
['block_13_pad[0][0]']
 onv2D)

 block_13_depthwise_BN (BatchNo  (None, 5, 5, 576)   2304
['block_13_depthwise[0][0]']
 rmalization)

 block_13_depthwise_relu (ReLU)  (None, 5, 5, 576)   0
['block_13_depthwise_BN[0][0]']

 block_13_project (Conv2D)      (None, 5, 5, 160)    92160
['block_13_depthwise_relu[0][0]']

 block_13_project_BN (BatchNorm  (None, 5, 5, 160)   640
['block_13_project[0][0]']
 alization)

 block_14_expand (Conv2D)       (None, 5, 5, 960)    153600
['block_13_project_BN[0][0]']

 block_14_expand_BN (BatchNorma  (None, 5, 5, 960)   3840
['block_14_expand[0][0]']
 lization)

 block_14_expand_relu (ReLU)    (None, 5, 5, 960)    0
['block_14_expand_BN[0][0]']

 block_14_depthwise (DepthwiseC  (None, 5, 5, 960)   8640
['block_14_expand_relu[0][0]']
 onv2D)

 block_14_depthwise_BN (BatchNo  (None, 5, 5, 960)   3840
['block_14_depthwise[0][0]']
 rmalization)

 block_14_depthwise_relu (ReLU)  (None, 5, 5, 960)   0
['block_14_depthwise_BN[0][0]']
```

```
 block_14_project (Conv2D)      (None, 5, 5, 160)    153600
['block_14_depthwise_relu[0][0]']

 block_14_project_BN (BatchNorm  (None, 5, 5, 160)   640
['block_14_project[0][0]']
 alization)

 block_14_add (Add)             (None, 5, 5, 160)    0
['block_13_project_BN[0][0]',
'block_14_project_BN[0][0]']

 block_15_expand (Conv2D)       (None, 5, 5, 960)    153600
['block_14_add[0][0]']

 block_15_expand_BN (BatchNorma  (None, 5, 5, 960)   3840
['block_15_expand[0][0]']
 lization)

 block_15_expand_relu (ReLU)    (None, 5, 5, 960)    0
['block_15_expand_BN[0][0]']

 block_15_depthwise (DepthwiseC  (None, 5, 5, 960)   8640
['block_15_expand_relu[0][0]']
 onv2D)

 block_15_depthwise_BN (BatchNo  (None, 5, 5, 960)   3840
['block_15_depthwise[0][0]']
 rmalization)

 block_15_depthwise_relu (ReLU)  (None, 5, 5, 960)   0
['block_15_depthwise_BN[0][0]']

 block_15_project (Conv2D)      (None, 5, 5, 160)    153600
['block_15_depthwise_relu[0][0]']

 block_15_project_BN (BatchNorm  (None, 5, 5, 160)   640
['block_15_project[0][0]']
 alization)

 block_15_add (Add)             (None, 5, 5, 160)    0
['block_14_add[0][0]',
'block_15_project_BN[0][0]']

 block_16_expand (Conv2D)       (None, 5, 5, 960)    153600
['block_15_add[0][0]']

 block_16_expand_BN (BatchNorma  (None, 5, 5, 960)   3840
['block_16_expand[0][0]']
```

```
 lization)

 block_16_expand_relu (ReLU)    (None, 5, 5, 960)    0
['block_16_expand_BN[0][0]']

 block_16_depthwise (DepthwiseC  (None, 5, 5, 960)   8640
['block_16_expand_relu[0][0]']
 onv2D)

 block_16_depthwise_BN (BatchNo  (None, 5, 5, 960)   3840
['block_16_depthwise[0][0]']
 rmalization)

 block_16_depthwise_relu (ReLU)  (None, 5, 5, 960)   0
['block_16_depthwise_BN[0][0]']

 block_16_project (Conv2D)      (None, 5, 5, 320)    307200
['block_16_depthwise_relu[0][0]']

 block_16_project_BN (BatchNorm  (None, 5, 5, 320)   1280
['block_16_project[0][0]']
 alization)

 Conv_1 (Conv2D)                (None, 5, 5, 1280)   409600
['block_16_project_BN[0][0]']

 Conv_1_bn (BatchNormalization)  (None, 5, 5, 1280)  5120
['Conv_1[0][0]']

 out_relu (ReLU)                (None, 5, 5, 1280)   0
['Conv_1_bn[0][0]']

==================================================================================
==================
Total params: 2,257,984
Trainable params: 0
Non-trainable params: 2,257,984
----------------------------------------------------------------------------------
------------------
```

[15]:
```
model = tf.keras.models.Sequential([
    tf.keras.layers.experimental.preprocessing.Rescaling(
        1. / image_color_channel_size,
        input_shape = image_shape
    ),
    data_augmentation,
    model_transfer_learning,
```

```
    tf.keras.layers.GlobalAveragePooling2D(),
    tf.keras.layers.Dropout(0.2),
    tf.keras.layers.Dense(1, activation = 'sigmoid')
])

model.compile(
    optimizer=tf.keras.optimizers.Adam(learning_rate = learning_rate),
    loss = tf.keras.losses.BinaryCrossentropy(),
    metrics = ['accuracy']
)

model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 rescaling (Rescaling)       (None, 160, 160, 3)       0

 sequential (Sequential)     (None, 160, 160, 3)       0

 mobilenetv2_1.00_160 (Funct  (None, 5, 5, 1280)       2257984
 ional)

 global_average_pooling2d (G  (None, 1280)             0
 lobalAveragePooling2D)

 dropout (Dropout)           (None, 1280)              0

 dense (Dense)               (None, 1)                 1281

=================================================================
Total params: 2,259,265
Trainable params: 1,281
Non-trainable params: 2,257,984
_________________________________________________________________
```

[16]:
```
history = model.fit(
    dataset_train,
    validation_data = dataset_validation,
    epochs = epochs
)
```

```
Epoch 1/100
10/10 [==============================] - 55s 5s/step - loss: 0.9343 - accuracy:
0.5123 - val_loss: 0.6170 - val_accuracy: 0.6605
Epoch 2/100
10/10 [==============================] - 64s 6s/step - loss: 0.8202 - accuracy:
```

```
0.5266 - val_loss: 0.5592 - val_accuracy: 0.7017
Epoch 3/100
10/10 [==============================] - 60s 6s/step - loss: 0.7770 - accuracy:
0.5450 - val_loss: 0.5376 - val_accuracy: 0.7350
Epoch 4/100
10/10 [==============================] - 63s 6s/step - loss: 0.6910 - accuracy:
0.5736 - val_loss: 0.5091 - val_accuracy: 0.7896
Epoch 5/100
10/10 [==============================] - 56s 5s/step - loss: 0.6448 - accuracy:
0.6319 - val_loss: 0.4865 - val_accuracy: 0.7989
Epoch 6/100
10/10 [==============================] - 34s 3s/step - loss: 0.5842 - accuracy:
0.6881 - val_loss: 0.4753 - val_accuracy: 0.7976
Epoch 7/100
10/10 [==============================] - 34s 3s/step - loss: 0.5524 - accuracy:
0.7127 - val_loss: 0.4449 - val_accuracy: 0.8216
Epoch 8/100
10/10 [==============================] - 33s 3s/step - loss: 0.5530 - accuracy:
0.7117 - val_loss: 0.4171 - val_accuracy: 0.8469
Epoch 9/100
10/10 [==============================] - 34s 3s/step - loss: 0.5065 - accuracy:
0.7536 - val_loss: 0.3967 - val_accuracy: 0.8469
Epoch 10/100
10/10 [==============================] - 33s 3s/step - loss: 0.4883 - accuracy:
0.7669 - val_loss: 0.3808 - val_accuracy: 0.8482
Epoch 11/100
10/10 [==============================] - 33s 3s/step - loss: 0.4545 - accuracy:
0.8129 - val_loss: 0.3779 - val_accuracy: 0.8469
Epoch 12/100
10/10 [==============================] - 35s 3s/step - loss: 0.4375 - accuracy:
0.8272 - val_loss: 0.3470 - val_accuracy: 0.8682
Epoch 13/100
10/10 [==============================] - 34s 3s/step - loss: 0.3925 - accuracy:
0.8487 - val_loss: 0.3415 - val_accuracy: 0.8682
Epoch 14/100
10/10 [==============================] - 34s 3s/step - loss: 0.3811 - accuracy:
0.8630 - val_loss: 0.3264 - val_accuracy: 0.8762
Epoch 15/100
10/10 [==============================] - 33s 3s/step - loss: 0.3555 - accuracy:
0.8722 - val_loss: 0.3197 - val_accuracy: 0.8802
Epoch 16/100
10/10 [==============================] - 33s 3s/step - loss: 0.3638 - accuracy:
0.8681 - val_loss: 0.3175 - val_accuracy: 0.8722
Epoch 17/100
10/10 [==============================] - 34s 3s/step - loss: 0.3432 - accuracy:
0.8814 - val_loss: 0.2977 - val_accuracy: 0.8868
Epoch 18/100
10/10 [==============================] - 34s 3s/step - loss: 0.3165 - accuracy:
```

```
0.9080 - val_loss: 0.2865 - val_accuracy: 0.8881
Epoch 19/100
10/10 [==============================] - 34s 3s/step - loss: 0.3125 - accuracy:
0.8978 - val_loss: 0.2760 - val_accuracy: 0.8975
Epoch 20/100
10/10 [==============================] - 33s 3s/step - loss: 0.3068 - accuracy:
0.9070 - val_loss: 0.2793 - val_accuracy: 0.8975
Epoch 21/100
10/10 [==============================] - 33s 3s/step - loss: 0.2918 - accuracy:
0.9162 - val_loss: 0.2674 - val_accuracy: 0.8935
Epoch 22/100
10/10 [==============================] - 34s 3s/step - loss: 0.2674 - accuracy:
0.9346 - val_loss: 0.2617 - val_accuracy: 0.8948
Epoch 23/100
10/10 [==============================] - 33s 3s/step - loss: 0.2672 - accuracy:
0.9274 - val_loss: 0.2501 - val_accuracy: 0.9095
Epoch 24/100
10/10 [==============================] - 34s 3s/step - loss: 0.2515 - accuracy:
0.9335 - val_loss: 0.2446 - val_accuracy: 0.9068
Epoch 25/100
10/10 [==============================] - 34s 3s/step - loss: 0.2502 - accuracy:
0.9274 - val_loss: 0.2350 - val_accuracy: 0.9081
Epoch 26/100
10/10 [==============================] - 34s 3s/step - loss: 0.2429 - accuracy:
0.9366 - val_loss: 0.2422 - val_accuracy: 0.9041
Epoch 27/100
10/10 [==============================] - 34s 3s/step - loss: 0.2342 - accuracy:
0.9407 - val_loss: 0.2319 - val_accuracy: 0.9134
Epoch 28/100
10/10 [==============================] - 34s 3s/step - loss: 0.2321 - accuracy:
0.9479 - val_loss: 0.2313 - val_accuracy: 0.9134
Epoch 29/100
10/10 [==============================] - 34s 3s/step - loss: 0.2270 - accuracy:
0.9509 - val_loss: 0.2201 - val_accuracy: 0.9201
Epoch 30/100
10/10 [==============================] - 34s 3s/step - loss: 0.2151 - accuracy:
0.9468 - val_loss: 0.2260 - val_accuracy: 0.9134
Epoch 31/100
10/10 [==============================] - 34s 3s/step - loss: 0.2120 - accuracy:
0.9571 - val_loss: 0.2152 - val_accuracy: 0.9174
Epoch 32/100
10/10 [==============================] - 34s 3s/step - loss: 0.2086 - accuracy:
0.9530 - val_loss: 0.2162 - val_accuracy: 0.9161
Epoch 33/100
10/10 [==============================] - 34s 3s/step - loss: 0.1936 - accuracy:
0.9632 - val_loss: 0.2168 - val_accuracy: 0.9121
Epoch 34/100
10/10 [==============================] - 34s 3s/step - loss: 0.1938 - accuracy:
```

```
0.9611 - val_loss: 0.2073 - val_accuracy: 0.9174
Epoch 35/100
10/10 [==============================] - 33s 3s/step - loss: 0.1852 - accuracy:
0.9714 - val_loss: 0.1961 - val_accuracy: 0.9268
Epoch 36/100
10/10 [==============================] - 34s 3s/step - loss: 0.1813 - accuracy:
0.9611 - val_loss: 0.1997 - val_accuracy: 0.9241
Epoch 37/100
10/10 [==============================] - 34s 3s/step - loss: 0.1751 - accuracy:
0.9632 - val_loss: 0.1958 - val_accuracy: 0.9228
Epoch 38/100
10/10 [==============================] - 33s 3s/step - loss: 0.1828 - accuracy:
0.9611 - val_loss: 0.1841 - val_accuracy: 0.9294
Epoch 39/100
10/10 [==============================] - 34s 3s/step - loss: 0.1603 - accuracy:
0.9755 - val_loss: 0.1814 - val_accuracy: 0.9348
Epoch 40/100
10/10 [==============================] - 33s 3s/step - loss: 0.1726 - accuracy:
0.9622 - val_loss: 0.1862 - val_accuracy: 0.9268
Epoch 41/100
10/10 [==============================] - 34s 3s/step - loss: 0.1561 - accuracy:
0.9693 - val_loss: 0.1857 - val_accuracy: 0.9321
Epoch 42/100
10/10 [==============================] - 33s 3s/step - loss: 0.1572 - accuracy:
0.9734 - val_loss: 0.1811 - val_accuracy: 0.9334
Epoch 43/100
10/10 [==============================] - 34s 3s/step - loss: 0.1586 - accuracy:
0.9663 - val_loss: 0.1791 - val_accuracy: 0.9321
Epoch 44/100
10/10 [==============================] - 34s 3s/step - loss: 0.1498 - accuracy:
0.9724 - val_loss: 0.1744 - val_accuracy: 0.9348
Epoch 45/100
10/10 [==============================] - 33s 3s/step - loss: 0.1444 - accuracy:
0.9755 - val_loss: 0.1727 - val_accuracy: 0.9334
Epoch 46/100
10/10 [==============================] - 34s 3s/step - loss: 0.1489 - accuracy:
0.9683 - val_loss: 0.1690 - val_accuracy: 0.9321
Epoch 47/100
10/10 [==============================] - 34s 3s/step - loss: 0.1427 - accuracy:
0.9755 - val_loss: 0.1672 - val_accuracy: 0.9334
Epoch 48/100
10/10 [==============================] - 33s 3s/step - loss: 0.1367 - accuracy:
0.9816 - val_loss: 0.1677 - val_accuracy: 0.9361
Epoch 49/100
10/10 [==============================] - 33s 3s/step - loss: 0.1424 - accuracy:
0.9673 - val_loss: 0.1633 - val_accuracy: 0.9374
Epoch 50/100
10/10 [==============================] - 33s 3s/step - loss: 0.1304 - accuracy:
```

```
0.9806 - val_loss: 0.1621 - val_accuracy: 0.9361
Epoch 51/100
10/10 [==============================] - 34s 3s/step - loss: 0.1333 - accuracy:
0.9816 - val_loss: 0.1574 - val_accuracy: 0.9401
Epoch 52/100
10/10 [==============================] - 34s 3s/step - loss: 0.1242 - accuracy:
0.9816 - val_loss: 0.1544 - val_accuracy: 0.9454
Epoch 53/100
10/10 [==============================] - 33s 3s/step - loss: 0.1262 - accuracy:
0.9826 - val_loss: 0.1598 - val_accuracy: 0.9334
Epoch 54/100
10/10 [==============================] - 33s 3s/step - loss: 0.1215 - accuracy:
0.9877 - val_loss: 0.1573 - val_accuracy: 0.9374
Epoch 55/100
10/10 [==============================] - 34s 3s/step - loss: 0.1183 - accuracy:
0.9857 - val_loss: 0.1460 - val_accuracy: 0.9427
Epoch 56/100
10/10 [==============================] - 33s 3s/step - loss: 0.1233 - accuracy:
0.9847 - val_loss: 0.1512 - val_accuracy: 0.9427
Epoch 57/100
10/10 [==============================] - 34s 3s/step - loss: 0.1191 - accuracy:
0.9785 - val_loss: 0.1538 - val_accuracy: 0.9387
Epoch 58/100
10/10 [==============================] - 33s 3s/step - loss: 0.1099 - accuracy:
0.9908 - val_loss: 0.1486 - val_accuracy: 0.9427
Epoch 59/100
10/10 [==============================] - 33s 3s/step - loss: 0.1167 - accuracy:
0.9836 - val_loss: 0.1499 - val_accuracy: 0.9427
Epoch 60/100
10/10 [==============================] - 33s 3s/step - loss: 0.1087 - accuracy:
0.9847 - val_loss: 0.1442 - val_accuracy: 0.9427
Epoch 61/100
10/10 [==============================] - 33s 3s/step - loss: 0.1001 - accuracy:
0.9908 - val_loss: 0.1473 - val_accuracy: 0.9441
Epoch 62/100
10/10 [==============================] - 35s 3s/step - loss: 0.1064 - accuracy:
0.9847 - val_loss: 0.1444 - val_accuracy: 0.9441
Epoch 63/100
10/10 [==============================] - 34s 3s/step - loss: 0.1065 - accuracy:
0.9796 - val_loss: 0.1407 - val_accuracy: 0.9454
Epoch 64/100
10/10 [==============================] - 33s 3s/step - loss: 0.1076 - accuracy:
0.9847 - val_loss: 0.1461 - val_accuracy: 0.9441
Epoch 65/100
10/10 [==============================] - 35s 3s/step - loss: 0.1019 - accuracy:
0.9857 - val_loss: 0.1365 - val_accuracy: 0.9547
Epoch 66/100
10/10 [==============================] - 34s 3s/step - loss: 0.0975 - accuracy:
```

```
0.9847 - val_loss: 0.1418 - val_accuracy: 0.9521
Epoch 67/100
10/10 [==============================] - 34s 3s/step - loss: 0.1028 - accuracy:
0.9908 - val_loss: 0.1347 - val_accuracy: 0.9494
Epoch 68/100
10/10 [==============================] - 33s 3s/step - loss: 0.0938 - accuracy:
0.9857 - val_loss: 0.1338 - val_accuracy: 0.9534
Epoch 69/100
10/10 [==============================] - 33s 3s/step - loss: 0.0996 - accuracy:
0.9826 - val_loss: 0.1401 - val_accuracy: 0.9494
Epoch 70/100
10/10 [==============================] - 34s 3s/step - loss: 0.0892 - accuracy:
0.9918 - val_loss: 0.1344 - val_accuracy: 0.9494
Epoch 71/100
10/10 [==============================] - 34s 3s/step - loss: 0.0910 - accuracy:
0.9918 - val_loss: 0.1277 - val_accuracy: 0.9587
Epoch 72/100
10/10 [==============================] - 33s 3s/step - loss: 0.0931 - accuracy:
0.9867 - val_loss: 0.1350 - val_accuracy: 0.9534
Epoch 73/100
10/10 [==============================] - 33s 3s/step - loss: 0.0847 - accuracy:
0.9898 - val_loss: 0.1270 - val_accuracy: 0.9561
Epoch 74/100
10/10 [==============================] - 34s 3s/step - loss: 0.0908 - accuracy:
0.9877 - val_loss: 0.1284 - val_accuracy: 0.9574
Epoch 75/100
10/10 [==============================] - 36s 3s/step - loss: 0.0807 - accuracy:
0.9959 - val_loss: 0.1289 - val_accuracy: 0.9561
Epoch 76/100
10/10 [==============================] - 34s 3s/step - loss: 0.0861 - accuracy:
0.9898 - val_loss: 0.1261 - val_accuracy: 0.9547
Epoch 77/100
10/10 [==============================] - 34s 3s/step - loss: 0.0840 - accuracy:
0.9918 - val_loss: 0.1269 - val_accuracy: 0.9561
Epoch 78/100
10/10 [==============================] - 34s 3s/step - loss: 0.0867 - accuracy:
0.9867 - val_loss: 0.1298 - val_accuracy: 0.9547
Epoch 79/100
10/10 [==============================] - 33s 3s/step - loss: 0.0878 - accuracy:
0.9826 - val_loss: 0.1319 - val_accuracy: 0.9521
Epoch 80/100
10/10 [==============================] - 33s 3s/step - loss: 0.0810 - accuracy:
0.9847 - val_loss: 0.1209 - val_accuracy: 0.9614
Epoch 81/100
10/10 [==============================] - 33s 3s/step - loss: 0.0844 - accuracy:
0.9939 - val_loss: 0.1184 - val_accuracy: 0.9627
Epoch 82/100
10/10 [==============================] - 34s 3s/step - loss: 0.0849 - accuracy:
```

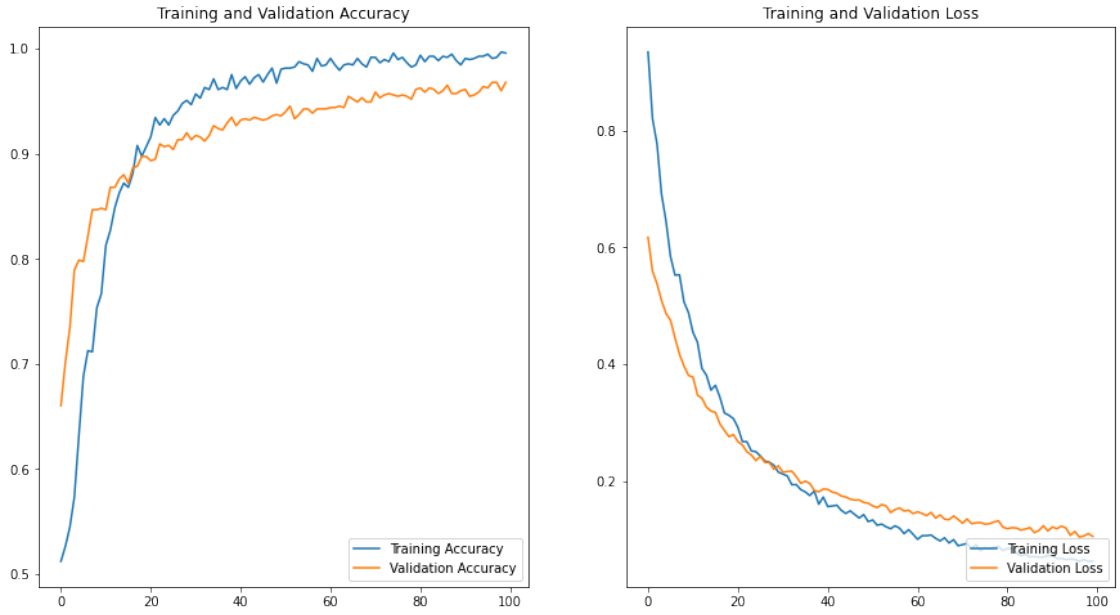
```
0.9877 - val_loss: 0.1201 - val_accuracy: 0.9587
Epoch 83/100
10/10 [==============================] - 34s 3s/step - loss: 0.0767 - accuracy:
0.9928 - val_loss: 0.1196 - val_accuracy: 0.9627
Epoch 84/100
10/10 [==============================] - 33s 3s/step - loss: 0.0718 - accuracy:
0.9928 - val_loss: 0.1159 - val_accuracy: 0.9614
Epoch 85/100
10/10 [==============================] - 34s 3s/step - loss: 0.0749 - accuracy:
0.9888 - val_loss: 0.1178 - val_accuracy: 0.9574
Epoch 86/100
10/10 [==============================] - 33s 3s/step - loss: 0.0701 - accuracy:
0.9928 - val_loss: 0.1202 - val_accuracy: 0.9601
Epoch 87/100
10/10 [==============================] - 33s 3s/step - loss: 0.0706 - accuracy:
0.9918 - val_loss: 0.1116 - val_accuracy: 0.9654
Epoch 88/100
10/10 [==============================] - 33s 3s/step - loss: 0.0697 - accuracy:
0.9949 - val_loss: 0.1153 - val_accuracy: 0.9574
Epoch 89/100
10/10 [==============================] - 34s 3s/step - loss: 0.0699 - accuracy:
0.9888 - val_loss: 0.1234 - val_accuracy: 0.9574
Epoch 90/100
10/10 [==============================] - 34s 3s/step - loss: 0.0721 - accuracy:
0.9847 - val_loss: 0.1145 - val_accuracy: 0.9601
Epoch 91/100
10/10 [==============================] - 33s 3s/step - loss: 0.0719 - accuracy:
0.9908 - val_loss: 0.1213 - val_accuracy: 0.9614
Epoch 92/100
10/10 [==============================] - 34s 3s/step - loss: 0.0675 - accuracy:
0.9898 - val_loss: 0.1185 - val_accuracy: 0.9547
Epoch 93/100
10/10 [==============================] - 34s 3s/step - loss: 0.0674 - accuracy:
0.9908 - val_loss: 0.1227 - val_accuracy: 0.9561
Epoch 94/100
10/10 [==============================] - 33s 3s/step - loss: 0.0655 - accuracy:
0.9928 - val_loss: 0.1197 - val_accuracy: 0.9587
Epoch 95/100
10/10 [==============================] - 36s 4s/step - loss: 0.0661 - accuracy:
0.9928 - val_loss: 0.1070 - val_accuracy: 0.9640
Epoch 96/100
10/10 [==============================] - 36s 4s/step - loss: 0.0656 - accuracy:
0.9949 - val_loss: 0.1137 - val_accuracy: 0.9627
Epoch 97/100
10/10 [==============================] - 33s 3s/step - loss: 0.0627 - accuracy:
0.9908 - val_loss: 0.1040 - val_accuracy: 0.9680
Epoch 98/100
10/10 [==============================] - 34s 3s/step - loss: 0.0654 - accuracy:
```

```
0.9918 - val_loss: 0.1060 - val_accuracy: 0.9680
Epoch 99/100
10/10 [==============================] - 33s 3s/step - loss: 0.0624 - accuracy:
0.9969 - val_loss: 0.1098 - val_accuracy: 0.9601
Epoch 100/100
10/10 [==============================] - 33s 3s/step - loss: 0.0627 - accuracy:
0.9959 - val_loss: 0.1053 - val_accuracy: 0.9680
```

[17]:
```python
def plot_model():

    accuracy = history.history['accuracy']
    val_accuracy = history.history['val_accuracy']

    loss = history.history['loss']
    val_loss = history.history['val_loss']

    epochs_range = range(epochs)

    plt.gcf().clear()
    plt.figure(figsize = (15, 8))

    plt.subplot(1, 2, 1)
    plt.title('Training and Validation Accuracy')
    plt.plot(epochs_range, accuracy, label = 'Training Accuracy')
    plt.plot(epochs_range, val_accuracy, label = 'Validation Accuracy')
    plt.legend(loc = 'lower right')

    plt.subplot(1, 2, 2)
    plt.title('Training and Validation Loss')
    plt.plot(epochs_range, loss, label = 'Training Loss')
    plt.plot(epochs_range, val_loss, label = 'Validation Loss')
    plt.legend(loc = 'lower right')

    plt.show()
```

[18]:
```python
plot_model()
```

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

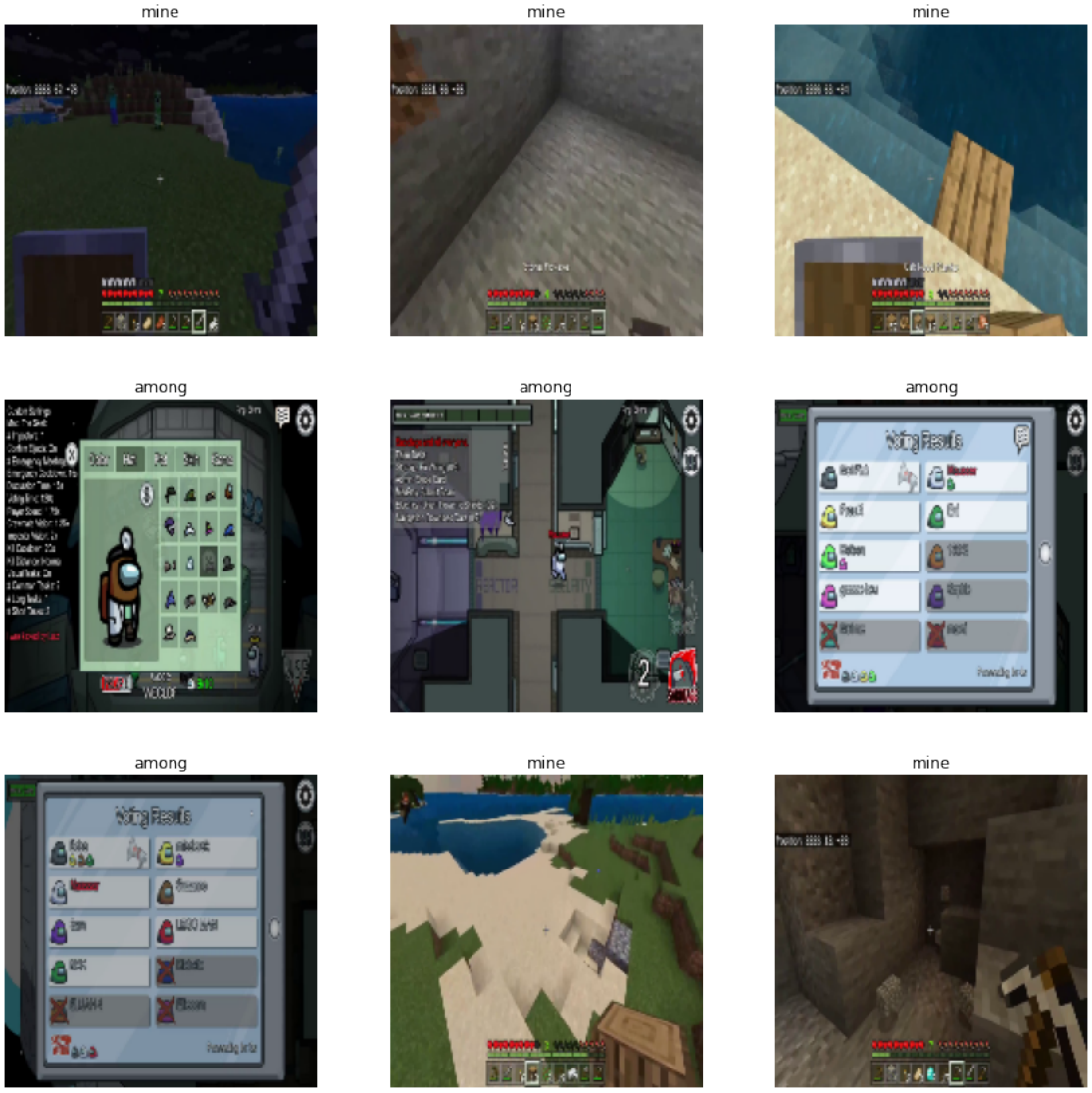


[19]:
```
def plot_dataset_predictions(dataset):

    features, labels = dataset.as_numpy_iterator().next()

    predictions = model.predict_on_batch(features).flatten()
    predictions = tf.where(predictions < 0.5, 0, 1)

    print('Labels:    %s' % labels)
    print('Predictions: %s' %predictions.numpy())

    plt.gcf().clear()
    plt.figure(figsize = (15, 15))

    for i in range(9):

        plt.subplot(3, 3, i + 1)
        plt.axis('off')

        plt.imshow(features[i].astype('uint8'))
        plt.title(class_names[predictions[i]])
```

[20]:
```
plot_dataset_predictions(dataset_test)
```

```
Labels:    [1 1 1 0 0 0 0 1 1 0 1 0 0 1 0 0 0 1 0 1 0 1 0 0 1 1 1 0 1 1 1 1 0 1
0 1 1
 1 0 0 0 0 0 0 1 1 0 1 0 1 1 1 0 0 0 1 1 1 1 0 0 1 1 1 0 1 0 0 1 0 0 0 0 0 1
 1 1 0 0 1 0 0 1 1 1 0 0 1 0 1 0 1 0 1 1 1 0 0 1 0 1]
```

```
Predictions: [1 1 1 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 0 1 0 0 1 1 1 0 1 1 1 1 0
1 0 1 1
 1 0 0 0 0 0 0 1 1 0 1 0 1 1 1 0 0 0 1 0 1 1 0 0 1 1 1 0 1 0 0 1 0 0 0 0 0 1
 1 1 0 0 1 0 0 1 1 1 0 0 1 0 1 0 1 0 1 1 1 0 0 1 0 1]

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



[21]:
```
model.save('path/to/model')
```

```
WARNING:absl:Found untraced functions such as _jit_compiled_convolution_op,
_jit_compiled_convolution_op, _jit_compiled_convolution_op,
_jit_compiled_convolution_op, _jit_compiled_convolution_op while saving (showing
5 of 52). These functions will not be directly callable after loading.

INFO:tensorflow:Assets written to: path/to/model\assets
```

```
INFO:tensorflow:Assets written to: path/to/model\assets
```

[ ]: