

↯ Import and unzip the dataset

```
from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

```
#unzip the downloaded dataset
!unzip '/content/drive/MyDrive/damage vehicle.zip'
```

```
Archive: /content/drive/MyDrive/damage vehicle.zip creating:
damage vehicle/ creating: damage vehicle/body/ creating:
damage vehicle/body/training/ creating: damage
vehicle/body/training/00-front/ inflating: damage
vehicle/body/training/00-front/0001.jpeg inflating: damage
vehicle/body/training/00-front/0002.JPEG inflating: damage
vehicle/body/training/00-front/0003.JPEG inflating: damage
vehicle/body/training/00-front/0004.JPEG inflating: damage
vehicle/body/training/00-front/0005.JPEG inflating: damage
vehicle/body/training/00-front/0006.JPEG inflating: damage
vehicle/body/training/00-front/0007.JPEG inflating: damage
vehicle/body/training/00-front/0008.jpeg inflating: damage
vehicle/body/training/00-front/0009.JPEG inflating: damage
vehicle/body/training/00-front/0010.JPEG inflating: damage
vehicle/body/training/00-front/0011.JPEG inflating: damage
vehicle/body/training/00-front/0012.jpeg inflating: damage
vehicle/body/training/00-front/0013.JPEG inflating: damage
vehicle/body/training/00-front/0014.JPEG inflating: damage
vehicle/body/training/00-front/0015.JPEG inflating: damage
vehicle/body/training/00-front/0016.JPEG inflating: damage
vehicle/body/training/00-front/0017.JPEG inflating: damage
vehicle/body/training/00-front/0018.JPEG inflating: damage
vehicle/body/training/00-front/0019.JPEG inflating: damage
vehicle/body/training/00-front/0020.jpeg inflating: damage
vehicle/body/training/00-front/0021.JPEG inflating: damage
vehicle/body/training/00-front/0022.JPEG inflating: damage
vehicle/body/training/00-front/0023.JPEG inflating: damage
vehicle/body/training/00-front/0024.JPEG inflating: damage
vehicle/body/training/00-front/0025.jpeg inflating: damage
vehicle/body/training/00-front/0026.JPEG inflating: damage
vehicle/body/training/00-front/0027.JPEG inflating: damage
vehicle/body/training/00-front/0028.JPEG inflating: damage
vehicle/body/training/00-front/0029.JPEG inflating: damage
vehicle/body/training/00-front/0030.JPEG inflating: damage
vehicle/body/training/00-front/0031.JPEG inflating: damage
vehicle/body/training/00-front/0032.JPEG inflating: damage
vehicle/body/training/00-front/0033.JPEG inflating: damage
vehicle/body/training/00-front/0034.JPEG inflating: damage
vehicle/body/training/00-front/0035.jpeg inflating: damage
vehicle/body/training/00-front/0036.JPEG inflating: damage
vehicle/body/training/00-front/0037.JPEG inflating: damage
vehicle/body/training/00-front/0038.JPEG inflating: damage
vehicle/body/training/00-front/0039.JPEG inflating: damage
vehicle/body/training/00-front/0040.JPEG inflating: damage
vehicle/body/training/00-front/0041.JPEG inflating: damage
vehicle/body/training/00-front/0042.JPEG inflating: damage
vehicle/body/training/00-front/0043.JPEG inflating: damage
vehicle/body/training/00-front/0044.JPEG inflating: damage
vehicle/body/training/00-front/0045.JPEG inflating: damage
vehicle/body/training/00-front/0046.jpeg inflating: damage
vehicle/body/training/00-front/0047.JPEG inflating: damage
vehicle/body/training/00-front/0048.JPEG inflating: damage
vehicle/body/training/00-front/0049.JPEG inflating: damage
vehicle/body/training/00-front/0050.JPEG inflating: damage
vehicle/body/training/00-front/0051.JPEG inflating: damage
vehicle/body/training/00-front/0052.JPEG inflating: damage
vehicle/body/training/00-front/0053.JPEG
```

↯ Image Preprocessing

1. Import The ImageDataGenerator Library

```
# Import required lib
```

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

2. Configure ImageDataGenerator Class

```
#Creating augmentation on training variable train_datagen =
ImageDataGenerator(rescale=1./255, shear_range = 0.1,
zoom_range=0.1, horizontal_flip=True)
```

```
# Creating augmentation on testing variable
```

```
test_datagen = ImageDataGenerator(rescale=1./255)
```

3. Apply ImageDataGenerator Functionality To Trainset And Testset

```
# Passing training data to train variable for body
```

```
xtrain = train_datagen.flow_from_directory('/content/damage vehicle/body/training',
                                          target_size=(224,224),
                                          class_mode='categorical', batch_size=10)
```

```
Found 979 images belonging to 3 classes.
```

```
# Passing testing data to test variable for body
```

```
xtest = test_datagen.flow_from_directory('/content/damage vehicle/body/validation',
                                         target_size=(224,224),
                                         class_mode='categorical', batch_size=10)
```

```
Found 171 images belonging to 3 classes.
```

```
# Passing training data to train variable for level
```

```
x_train = train_datagen.flow_from_directory('/content/damage vehicle/level/training',
                                             target_size=(224,224),
                                             class_mode='categorical', batch_size=10)
```

```
Found 979 images belonging to 3 classes.
```

```
# Passing testing data to test variable for level
```

```
x_test = test_datagen.flow_from_directory('/content/damage vehicle/level/validation',
                                           target_size=(224,224),
                                           class_mode='categorical', batch_size=10)
```

```
Found 171 images belonging to 3 classes.
```

Model Building

▼ For Body

1. Importing The Model Building Libraries

```
#Import the library from tensorflow.keras.layers import Dense, Flatten, Input from tensorflow.keras.models import Model from
tensorflow.keras.preprocessing import image from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img from
tensorflow.keras.applications.vgg16 import VGG16, preprocess_input from glob import glob
```

```
import numpy as np
```

```
import matplotlib.pyplot as plt
import tensorflow as tf from tensorflow.keras.layers import Input, Lambda, Dense, Flatten from tensorflow.keras.models import Model
from tensorflow.keras.applications.vgg16 import VGG16 from tensorflow.keras.applications.vgg19 import VGG19 from
tensorflow.keras.preprocessing import image from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img from
tensorflow.keras.models import Sequential import numpy as np from glob import glob
```

2. Loading The Model

```
IMAGE_SIZE = [224, 224]
```

```
train_path = '/content/damage vehicle/body/training' valid_path = '/content/damage vehicle/body/validation'
```

```
vgg16 = VGG16(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels58889256/58889256 [=====] - 3s 0us/step



3. Adding Flatten Layer

```
for layer in vgg16.layers:  
    layer.trainable = False
```

```
folders = glob('/content/damage vehicle/body/training/*')
```

```
folders
```

```
['/content/damage vehicle/body/training/00-front',  
 '/content/damage vehicle/body/training/01-rear',  
 '/content/damage vehicle/body/training/02-side']
```

```
x = Flatten()(vgg16.output)
```

```
len(folders)
```

```
3
```

4. Adding Output Layer

```
prediction = Dense(len(folders), activation='softmax')(x)
```

5. Creating A Model Object

```
model = Model(inputs=vgg16.input, outputs=prediction)
```

```
model.summary()
```

```
Model: "model"
```

Layer (type)	Output Shape	Param #
=====		
input_1 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808

block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
		2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 3)	75267

===== Total
 params: 14,789,955
 Trainable params: 75,267
 Non-trainable params: 14,714,688

6. Configure The Learning Process

```
model.compile( loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy']
)
```

7. Train The Model

```
r = model.fit_generator( xtrain, validation_data=xtest, epochs=25,
  steps_per_epoch=len(xtrain), validation_steps=len(xtest)
)
```

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:6: UserWarning: `Model.fit_generator` is deprecated and will be

```
Epoch 1/25
98/98 [=====] - 23s 146ms/step - loss: 1.2077 - accuracy: 0.5465 - val_loss: 1.2900 - val_accuracy:
Epoch 2/25
98/98 [=====] - 13s 128ms/step - loss: 0.8364 - accuracy: 0.7028 - val_loss: 0.8665 - val_accuracy:
Epoch 3/25
98/98 [=====] - 13s 128ms/step - loss: 0.5293 - accuracy: 0.7998 - val_loss: 1.3260 - val_accuracy:
Epoch 4/25
98/98 [=====] - 12s 127ms/step - loss: 0.3978 - accuracy: 0.8611 - val_loss: 0.9842 - val_accuracy:
Epoch 5/25
98/98 [=====] - 12s 127ms/step - loss: 0.2783 - accuracy: 0.9030 - val_loss: 0.9397 - val_accuracy:
Epoch 6/25
98/98 [=====] - 13s 128ms/step - loss: 0.2690 - accuracy: 0.9070 - val_loss: 0.9892 - val_accuracy:
Epoch 7/25
98/98 [=====] - 12s 127ms/step - loss: 0.1788 - accuracy: 0.9448 - val_loss: 1.0052 - val_accuracy:
Epoch 8/25
98/98 [=====] - 13s 129ms/step - loss: 0.1671 - accuracy: 0.9469 - val_loss: 1.1693 - val_accuracy:
Epoch 9/25
98/98 [=====] - 13s 129ms/step - loss: 0.1277 - accuracy: 0.9561 - val_loss: 1.0058 - val_accuracy:
Epoch 10/25
98/98 [=====] - 13s 128ms/step - loss: 0.1184 - accuracy: 0.9591 - val_loss: 1.0620 - val_accuracy:
Epoch 11/25
98/98 [=====] - 13s 130ms/step - loss: 0.0963 - accuracy: 0.9745 - val_loss: 1.1219 - val_accuracy:

Epoch 12/25

98/98 [=====] - 13s 129ms/step - loss: 0.0857 - accuracy: 0.9765 - val_loss: 1.0284 - val_accuracy:
Epoch 13/25
98/98 [=====] - 13s 129ms/step - loss: 0.0582 - accuracy: 0.9837 - val_loss: 1.1153 - val_accuracy:
Epoch 14/25
98/98 [=====] - 13s 129ms/step - loss: 0.0688 - accuracy: 0.9877 - val_loss: 1.1033 - val_accuracy:
Epoch 15/25
98/98 [=====] - 13s 131ms/step - loss: 0.0709 - accuracy: 0.9867 - val_loss: 1.0730 - val_accuracy:
Epoch 16/25
98/98 [=====] - 13s 128ms/step - loss: 0.0895 - accuracy: 0.9775 - val_loss: 1.1225 - val_accuracy:
Epoch 17/25
98/98 [=====] - 13s 129ms/step - loss: 0.0609 - accuracy: 0.9918 - val_loss: 1.2937 - val_accuracy:
Epoch 18/25
98/98 [=====] - 13s 128ms/step - loss: 0.0998 - accuracy: 0.9714 - val_loss: 1.1754 - val_accuracy:
Epoch 19/25
98/98 [=====] - 13s 128ms/step - loss: 0.0728 - accuracy: 0.9847 - val_loss: 1.5074 - val_accuracy:
Epoch 20/25
98/98 [=====] - 13s 129ms/step - loss: 0.0972 - accuracy: 0.9714 - val_loss: 1.4684 - val_accuracy:
Epoch 21/25
98/98 [=====] - 13s 131ms/step - loss: 0.0404 - accuracy: 0.9908 - val_loss: 1.4215 - val_accuracy:
Epoch 22/25
98/98 [=====] - 13s 131ms/step - loss: 0.0854 - accuracy: 0.9867 - val_loss: 1.4772 - val_accuracy:
Epoch 23/25
98/98 [=====] - 13s 128ms/step - loss: 0.0399 - accuracy: 0.9918 - val_loss: 1.4306 - val_accuracy:
Epoch 24/25
```

```
98/98 [=====] - 13s 129ms/step - loss: 0.0400 - accuracy: 0.9908 - val_loss: 1.4562 - val_accuracy:
Epoch 25/25
98/98 [=====] - 13s 129ms/step - loss: 0.1692 - accuracy: 0.9387 - val_loss: 1.6805 - val_accuracy:
```



8. Save The Model

```
from tensorflow.keras.models import load_model

model.save('/content/damage_vehicle/Model/body.h5')
```

9. Test The Model

```
from tensorflow.keras.models import load_model
import cv2 from skimage.transform import resize

model = load_model('/content/damage_vehicle/Model/body.h5')

def detect(frame):
    img = cv2.resize(frame,(224,224))
    img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)

    if(np.max(img)>1): img
        = img/255.0
    img = np.array([img]) prediction =
    model.predict(img) label =
    ["front","rear","side"] preds =
    label[np.argmax(prediction)] return
    preds
import numpy as np

data = "/content/damage_vehicle/body/training/00-front/0002.JPEG"
image = cv2.imread(data) print(detect(image))

1/1 [=====] - 0s 148ms/step front
```

Model Building

For Level

```
import tensorflow as tf from tensorflow.keras.layers import Input, Lambda, Dense, Flatten from
tensorflow.keras.models import Model from tensorflow.keras.applications.vgg16 import VGG16 from
tensorflow.keras.applications.vgg19 import VGG19 from tensorflow.keras.preprocessing import image from
tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img from tensorflow.keras.models import
Sequential import numpy as np from glob import glob
```

2. Loading The Model

```
IMAGE_SIZE = [224, 224]

train_path = '/content/damage_vehicle/level/training' valid_path = '/content/damage_vehicle/level/validation'

vgg16 = VGG16(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

3. Adding Flatten Layer

```
for layer in vgg16.layers:
    layer.trainable = False

folders = glob('/content/damage_vehicle/level/training/*')
```

folders

```
['/content/damage_vehicle/level/training/03-severe',
 '/content/damage_vehicle/level/training/02-moderate', '/content/damage_vehicle/level/training/01-minor']
```

x = Flatten()(vgg16.output)

len(folders)

3

4. Adding Output Layer

prediction = Dense(len(folders), activation='softmax')(x)

5. Creating A Model Object

model = Model(inputs=vgg16.input, outputs=prediction)

model.summary()

Model: "model_1"

Layer (type)	Output Shape	Param #
=====		
input_2 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten_1 (Flatten)	(None, 25088)	0
dense_1 (Dense)	(None, 3)	75267
=====		
Total params: 14,789,955		
Trainable params: 75,267		
Non-trainable params: 14,714,688		

6. Configure The Learning Process

```
model.compile( loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy']
)
```

7. Train The Model

```
r = model.fit_generator( x_train, validation_data=x_test, epochs=25,
                        steps_per_epoch=len(x_train), validation_steps=len(x_test)
)
```

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:6: UserWarning: `Model.fit_generator` is deprecated and will be

```
Epoch 1/25
98/98 [=====] - 14s 133ms/step - loss: 1.1629 - accuracy: 0.5495 - val_loss: 1.1559 - val_accuracy:
Epoch 2/25
98/98 [=====] - 13s 130ms/step - loss: 0.7157 - accuracy: 0.7089 - val_loss: 0.9643 - val_accuracy:
Epoch 3/25
98/98 [=====] - 13s 130ms/step - loss: 0.4978 - accuracy: 0.8161 - val_loss: 1.5663 - val_accuracy:
Epoch 4/25
98/98 [=====] - 13s 128ms/step - loss: 0.5277 - accuracy: 0.7865 - val_loss: 1.6003 - val_accuracy:
Epoch 5/25
98/98 [=====] - 13s 128ms/step - loss: 0.3763 - accuracy: 0.8468 - val_loss: 1.1925 - val_accuracy:
Epoch 6/25
98/98 [=====] - 13s 128ms/step - loss: 0.2445 - accuracy: 0.9203 - val_loss: 1.0354 - val_accuracy:
Epoch 7/25
98/98 [=====] - 13s 128ms/step - loss: 0.1902 - accuracy: 0.9346 - val_loss: 1.2155 - val_accuracy:
Epoch 8/25
98/98 [=====] - 13s 128ms/step - loss: 0.1327 - accuracy: 0.9571 - val_loss: 1.0902 - val_accuracy:
Epoch 9/25
98/98 [=====] - 13s 127ms/step - loss: 0.1206 - accuracy: 0.9540 - val_loss: 1.1282 - val_accuracy:
Epoch 10/25
98/98 [=====] - 13s 128ms/step - loss: 0.1181 - accuracy: 0.9591 - val_loss: 1.1311 - val_accuracy:
Epoch 11/25
98/98 [=====] - 13s 128ms/step - loss: 0.0910 - accuracy: 0.9765 - val_loss: 1.1538 - val_accuracy:
Epoch 12/25
98/98 [=====] - 12s 127ms/step - loss: 0.0813 - accuracy: 0.9806 - val_loss: 1.2209 - val_accuracy:
Epoch 13/25
98/98 [=====] - 13s 128ms/step - loss: 0.0603 - accuracy: 0.9857 - val_loss: 1.2545 - val_accuracy:

Epoch 14/25

98/98 [=====] - 12s 127ms/step - loss: 0.0474 - accuracy: 0.9949 - val_loss: 1.1609 - val_accuracy:
Epoch 15/25
98/98 [=====] - 13s 129ms/step - loss: 0.0366 - accuracy: 0.9959 - val_loss: 1.1688 - val_accuracy:
Epoch 16/25
98/98 [=====] - 13s 128ms/step - loss: 0.0493 - accuracy: 0.9888 - val_loss: 1.1850 - val_accuracy:
Epoch 17/25
98/98 [=====] - 13s 128ms/step - loss: 0.0320 - accuracy: 0.9939 - val_loss: 1.1884 - val_accuracy:
Epoch 18/25
98/98 [=====] - 13s 129ms/step - loss: 0.0363 - accuracy: 0.9939 - val_loss: 1.2897 - val_accuracy:
Epoch 19/25
98/98 [=====] - 13s 128ms/step - loss: 0.0298 - accuracy: 0.9949 - val_loss: 1.2499 - val_accuracy:
Epoch 20/25
98/98 [=====] - 13s 130ms/step - loss: 0.0250 - accuracy: 0.9980 - val_loss: 1.2801 - val_accuracy:
Epoch 21/25
98/98 [=====] - 13s 129ms/step - loss: 0.0329 - accuracy: 0.9959 - val_loss: 1.2366 - val_accuracy:
Epoch 22/25
98/98 [=====] - 13s 128ms/step - loss: 0.0170 - accuracy: 1.0000 - val_loss: 1.2901 - val_accuracy:
Epoch 23/25
98/98 [=====] - 13s 130ms/step - loss: 0.0216 - accuracy: 1.0000 - val_loss: 1.2697 - val_accuracy:
Epoch 24/25
98/98 [=====] - 13s 128ms/step - loss: 0.0365 - accuracy: 0.9908 - val_loss: 1.4214 - val_accuracy:
Epoch 25/25
98/98 [=====] - 13s 129ms/step - loss: 0.0380 - accuracy: 0.9939 - val_loss: 1.4219 - val_accuracy:
```

<

>

8. Save The Model

```
from tensorflow.keras.models import load_model

model.save('/content/damage_vehicle/Model/level.h5')
```

9. Test The Model

```
from tensorflow.keras.models import load_model
import cv2 from skimage.transform import resize
```

```
model = load_model('/content/damage_vehicle/Model/level.h5')
```

```
def detect(frame):
    img = cv2.resize(frame,(224,224))
    img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)

    if(np.max(img)>1):
        img = img/255.0
    img = np.array([img]) prediction =
    model.predict(img) label =
    ["minor","moderate","severe"] preds =
    label[np.argmax(prediction)] return
    preds
```

```
import numpy as np
```

```
data = "/content/damage_vehicle/level/validation/01-minor/0005.JPEG"
image = cv2.imread(data) print(detect(image))
```

```
1/1 [=====] - 0s 142ms/step minor
```

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