

## ▼ 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 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\\_kernels/58889256/58889256](https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels/58889256/58889256) [=====] - 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
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
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



### 1. Importing The Model Building Libraries

8

```
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

```



