Presentation on

Car Damage Detection using CNN

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Problem Statement

- **There are many car rental services around the world which rents the car on the basis of count of hours or days.**
- **However after usage the car may have been damaged.**
- **Even though, there are many automatic car damage detection system, human intervention is also required and also the accuracy is very less when compared with recent development in the field of data science.**
- **So there is an urgent requirement to develop a system with improved accuracy which eliminates the human intervention.**

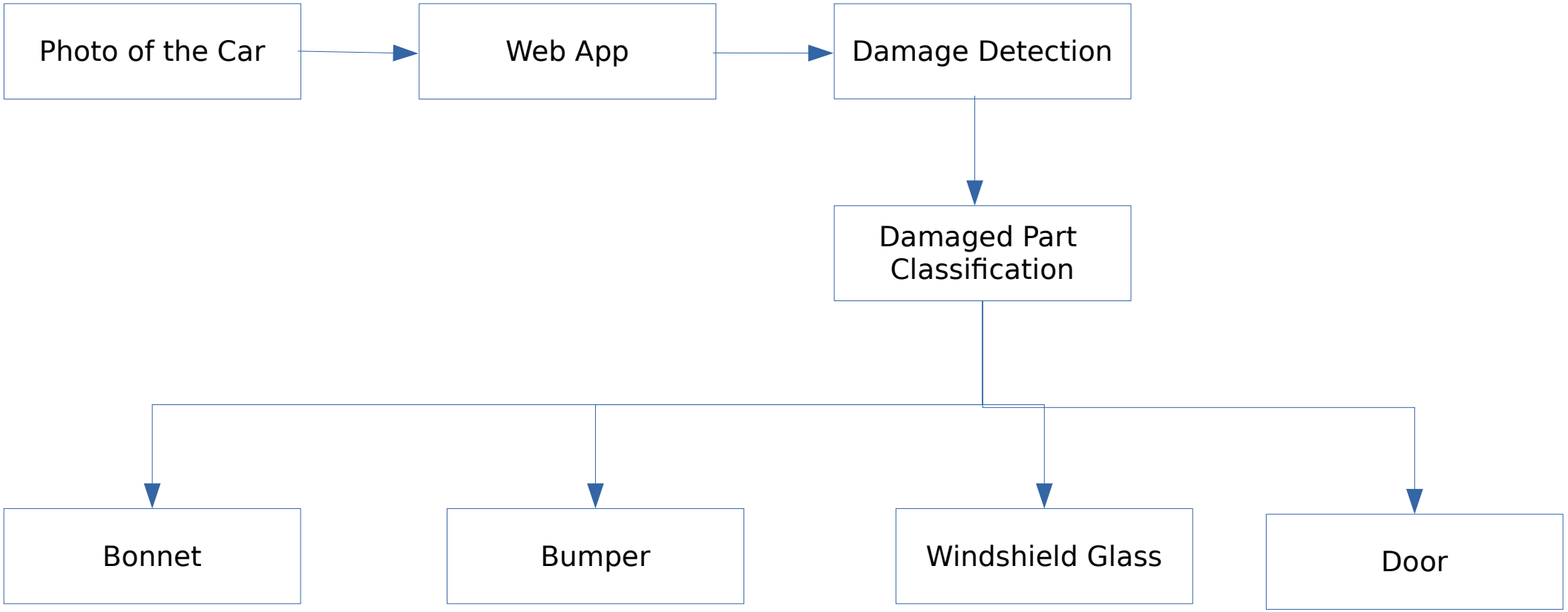
ABSTRACT

- **Research on damage detection has been conducted in various areas been actively conducted.**
- **In this study,improvements were made to the existing car damage detection systems.**
- **The models : Complete or Partial; Left or Right; Front or Rear**
- **The object detection is done using SSD along with MobileNetV2 .**

MOTIVATION OF THIS WORK

- **The main motivation is to detect the damages of the car along with parts on all the four sides(i.e.) Front, Rear, Left and Right with higher accuracy and no human involvement.**

System Architecture



Requirements

- **Keras**
- **Tensorflow**
- **LabelImg**
- **Flask**

ALGORITHMS USED

- **MOBILENET**
  - The default image input size for this model is 224*224.
  - It is a streamlined architecture that uses depth-wise separable convolutions to build light weight deep neural networks.
  - Usage in this application
    - This algorithm is used to check whether full or partial image of required side of the car is taken.
    - Along with this, 2 dense layers one with 1024 neurons and another with 512 neurons with l2 regularizers and ‘relu’ activation so that model can learn more complex functions and classify for better results.

ALGORITHMS USED

- **MOBILENETV2**
  - The default image input size for this model is 224*224.
  - This algorithm is similar to MobileNet but there is a significant decrease in number of operations and memory usage retaining the accuracy
  - Usage in this application
    - This algorithm is used for extracting features and detecting the damaged part of the car.

MOBILENET BODY ARCHITECTURE

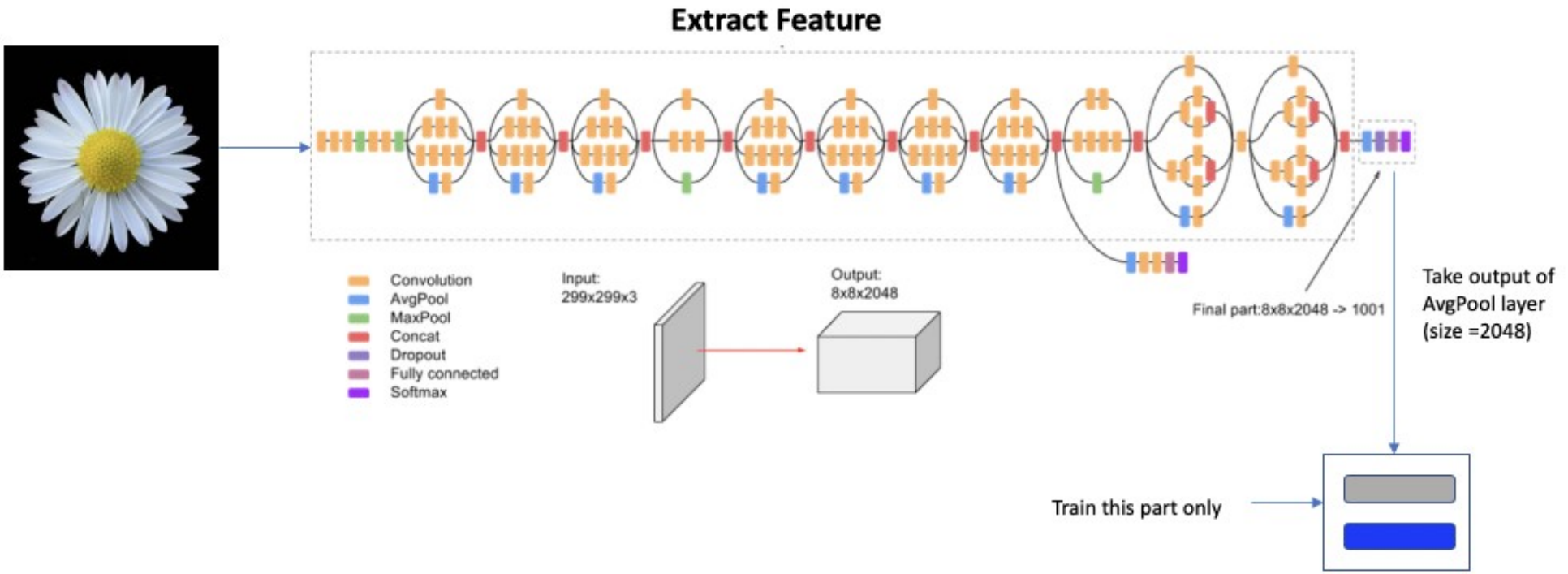
Table 1. MobileNet Body Architecture

Type / Stride	Filter Shape	Input Size
Conv / s2	$3 \times 3 \times 3 \times 32$	$224 \times 224 \times 3$
Conv dw / s1	$3 \times 3 \times 32$ dw	$112 \times 112 \times 32$
Conv / s1	$1 \times 1 \times 32 \times 64$	$112 \times 112 \times 32$
Conv dw / s2	$3 \times 3 \times 64$ dw	$112 \times 112 \times 64$
Conv / s1	$1 \times 1 \times 64 \times 128$	$56 \times 56 \times 64$
Conv dw / s1	$3 \times 3 \times 128$ dw	$56 \times 56 \times 128$
Conv / s1	$1 \times 1 \times 128 \times 128$	$56 \times 56 \times 128$
Conv dw / s2	$3 \times 3 \times 128$ dw	$56 \times 56 \times 128$
Conv / s1	$1 \times 1 \times 128 \times 256$	$28 \times 28 \times 128$
Conv dw / s1	$3 \times 3 \times 256$ dw	$28 \times 28 \times 256$
Conv / s1	$1 \times 1 \times 256 \times 256$	$28 \times 28 \times 256$
Conv dw / s2	$3 \times 3 \times 256$ dw	$28 \times 28 \times 256$
Conv / s1	$1 \times 1 \times 256 \times 512$	$14 \times 14 \times 256$
$5\times$ Conv dw / s1	$3 \times 3 \times 512$ dw	$14 \times 14 \times 512$
$5\times$ Conv / s1	$1 \times 1 \times 512 \times 512$	$14 \times 14 \times 512$
Conv dw / s2	$3 \times 3 \times 512$ dw	$14 \times 14 \times 512$
Conv / s1	$1 \times 1 \times 512 \times 1024$	$7 \times 7 \times 512$
Conv dw / s2	$3 \times 3 \times 1024$ dw	$7 \times 7 \times 1024$
Conv / s1	$1 \times 1 \times 1024 \times 1024$	$7 \times 7 \times 1024$
Avg Pool / s1	Pool 7×7	$7 \times 7 \times 1024$
FC / s1	1024×1000	$1 \times 1 \times 1024$
Softmax / s1	Classifier	$1 \times 1 \times 1000$

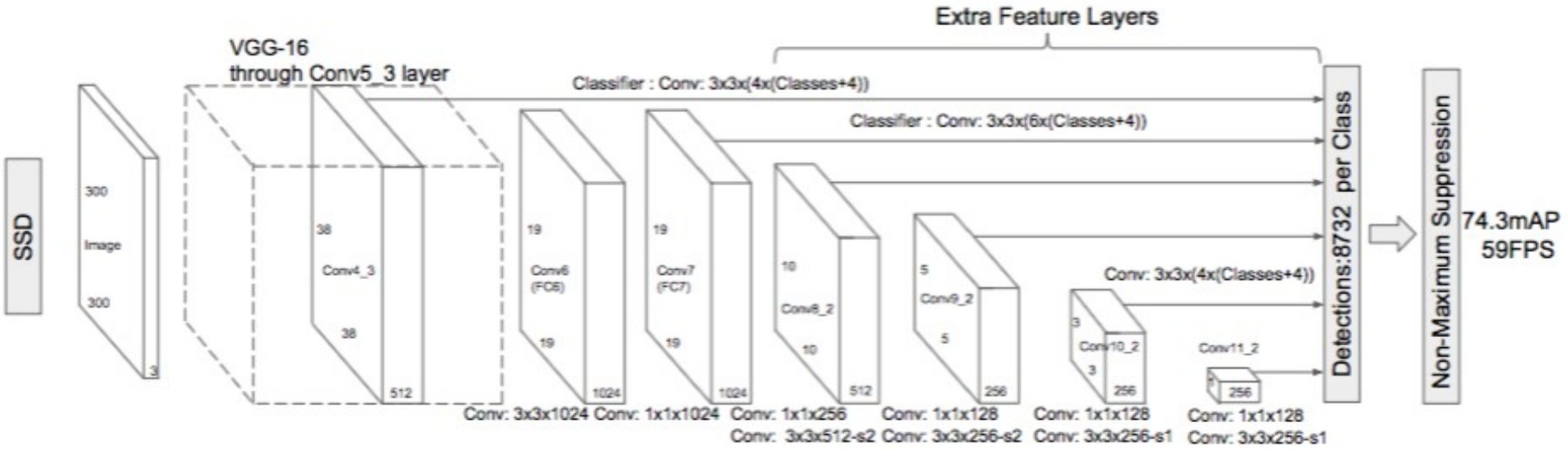
ALGORITHMS USED

- **INCEPTIONV3**
  - The default image input size for this model is 299*299.
  - This algorithm is a variant of InceptionV2 with BN-auxilary. BN-auxilary refers to the version in which all classifiers and convolutions are normalized
  - Usage in this application
    - This algorithm is to check whether the required side of the car is taken or not.

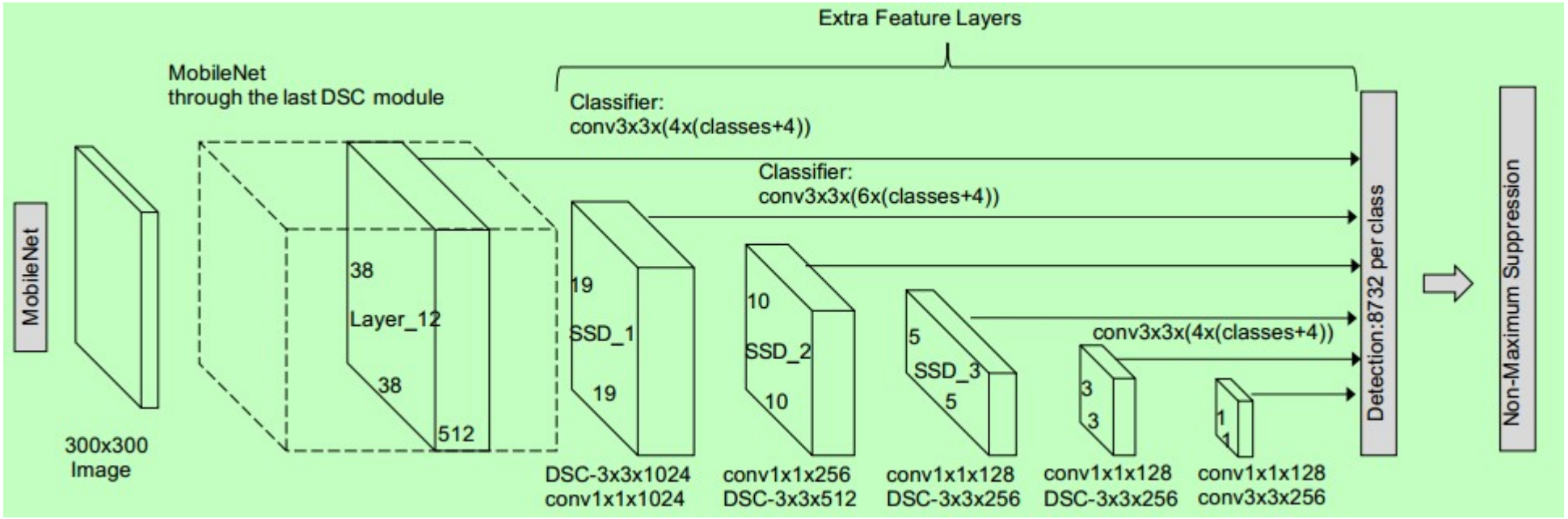
INCEPTION V3 ARCHITECTURE



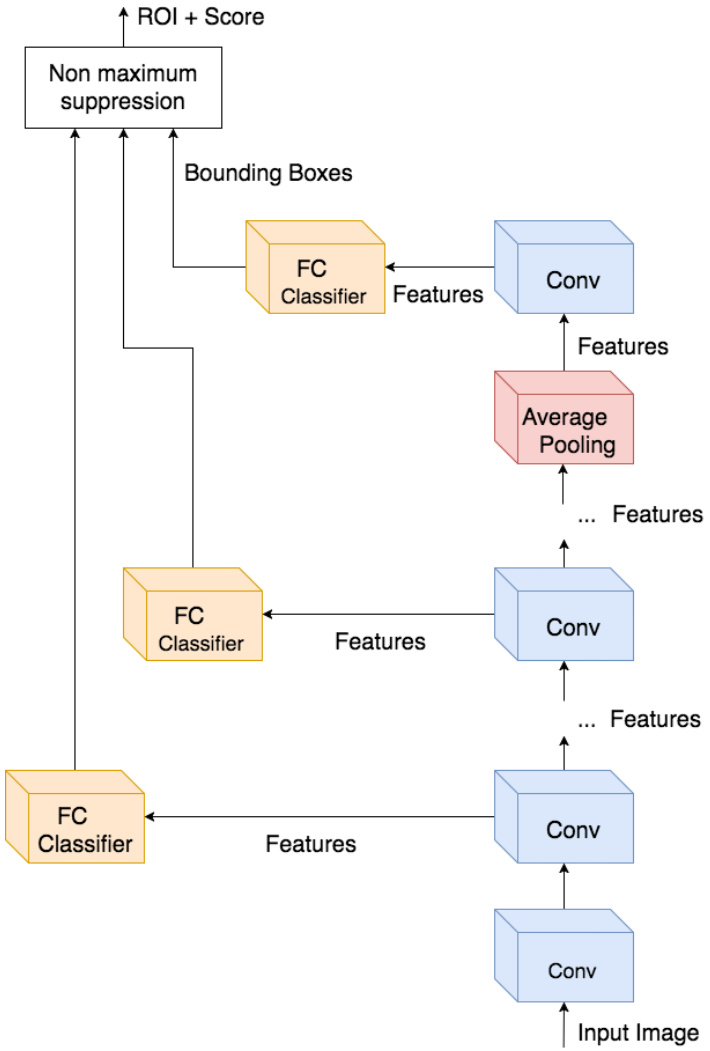
SSD Architecture



SSD Architecture with MobileNet Backbone



Damage Detection Flow



Tool Used

- **LabelImg**
  - A graphical image annotation tool. Annotations are saved as XML files in PASCAL VOC format which is then sent as an input along with training images.

Existing Vs Proposed

- **An Anti-fraud System for Car Insurance Claim Based on Visual Evidence**
  - In this paper, YOLO is used as object detector. Robust features are being extracted using the pre-trained VGG16 object recognition algorithm as feature extractor.
  - In my application, SSD is used for detection of damages. The feature extraction is done by MobileNet V2, which separating the layers depth wise instead of regular convolution layers which can be also be helpful to get real-time results

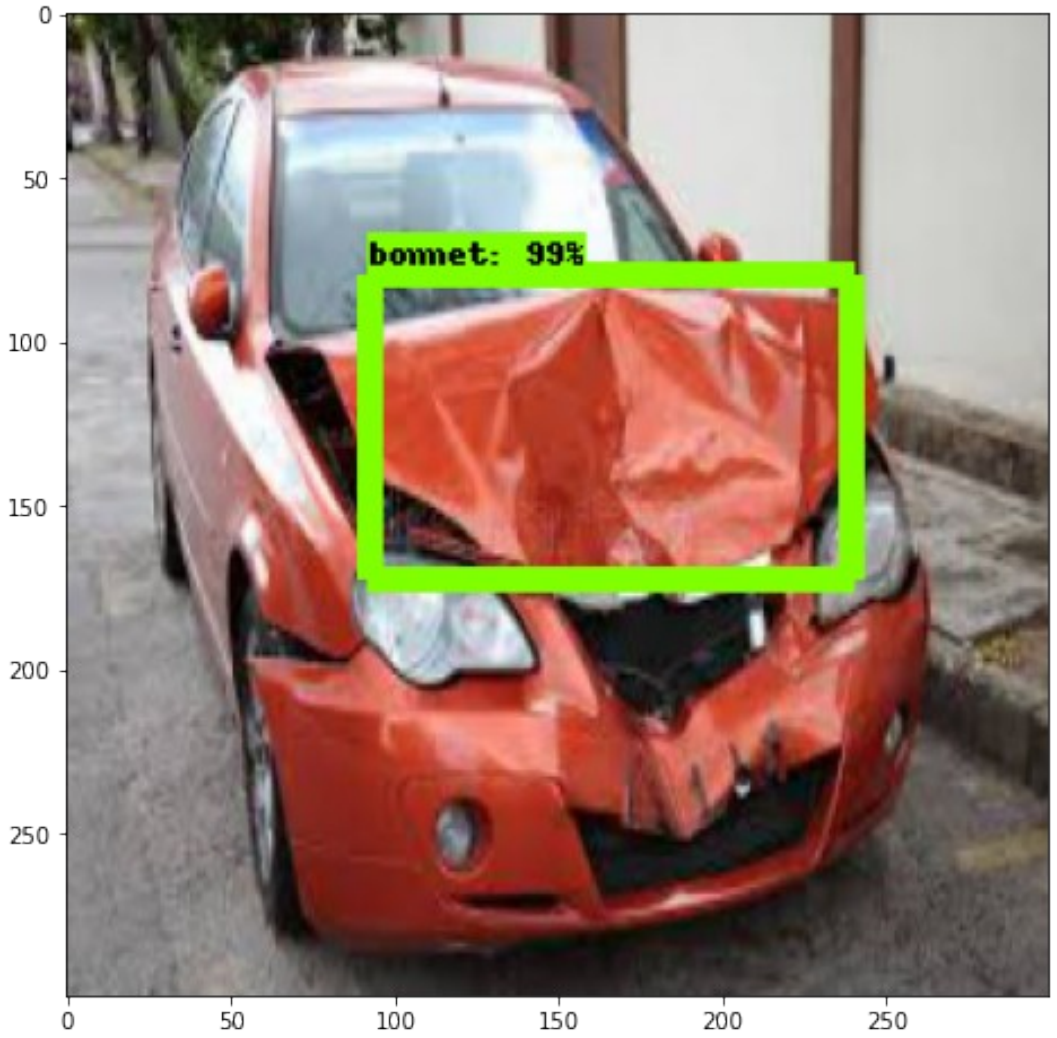
Dataset Description

- **The source of the images are from Kaggle and Google Images**
- **Training**
  - 3000 images combining Front, Left, Rear, Right
- **Testing**
  - 1000 images combining Front, Left, Rear, Right

Application Working with Result

- **After usage of the rented car, before completing, the user has to submit the image of the car of all the 4 sides (i.e.) Front, Left, Rear, Right.**
- **When the user submits the image, the damage is detected and the part that got damaged is show**

Output with Bounding Box



Sample Output

MIRACLE SOFTWARE SYSTEMS

Car Classification

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Home | Single Image | Folder of Images

Select a single image to upload

Selected image:

Choose file 0147.JPEG Upload

Result

The image is Completely Captured and the damages of the car are ['bumper']

Created by Miracle's Innovation Labs

REFERENCES

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- **An Anti-fraud System for Car Insurance Claim Based on Visual Evidence** by **Pei Li, BingYu Shen, Weishan Dong**. Published on **30.04.2018**.
- **Road Damage Detection Using Deep Neural Networks with Images Captured Through a Smartphone** by **Hiroya Maeda, Yoshihide Sekimoto, Toshikazu Seto**. Published on **02.02.2018**.
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- **Front-View Vehicle Damage Detection using Roadway Surveillance Camera Images** by **Burak Balci, Yusuf Artan, Bensu Alkan and Alperen Elihos**. Published on **30.08.2019**.