

The logo for GadgEon, with 'Gadg' in blue and 'Eon' in orange.

Engineering
Smartness

DEEP LEARNING MODEL TO CLASSIFY HAIL DAMAGE CLAIMS

22 June 2020

Version 03

Problem Statement

Automobile insurance companies are seeing huge increase in claims from hail-storm damages for more than 10 years now. As the hail damage claims rise, the National Insurance Crime Bureau warns of fraud. So there is an urgent need from insurance companies to deploy a solution which can detect fraud and optimize insurance claims during the hail-storm season.

To meet the above requirement, develop and deploy an advanced NN model to classify dents caused by hail-storm along with body panel for different automobile makes and models. Some of the challenges are given below :

- Detect dents accurately while reducing false positives like an actual gap between the doors or curves of panel design
- Detect small hailstorm dents which could be only a few pixels in the image, while noise should not be classified as false positives



Data Description

- Data Sources
 - Data was obtained from previously available hailstorm dent images and a custom labeling tool was used to increase speed of labeling using many automation techniques with manual correction facilities
- Data Capture Method
 - A drive-in tunnel with Cameras placed to front, back, sides and top view separately was
 - Custom lighting conditions reduced ambient lighting problems



NN Model Selection Considerations

- Faster-RCNN type of networks are not suitable for this problem, as it depends on semantic detection.
 - The semantic properties of pixel in dents can change due to lighting conditions which the training data may not capture properly. Also the training data mostly consists of only low-resolution images
- YOLOv3 with improved FPN was selected because
 - Its feature extraction capability does not let small features vanish as we go to deeper layers and
 - At the same time it can improve speed and accuracy for small dent detection on low resolution images
- Various Other techniques were used to improve small feature detection like
 - Change the anchor size – By explicitly providing the network with information about the size of objects by using relevant anchor size helps in improving small object detection
 - Splitting image into tiles – As we reduce the size of image to fit the network say 448*448 of Yolo many small features will be lost . To avoid this, we split the images to preserve small objects.
 - Tap the network early – by detecting till where small objects were going, earlier tap points were added by reducing the layers
- With Such techniques and customization of FPN etc the accuracy of detection was improved compared to using normal networks. Apart from this many pre/post processing techniques were applied to the data to suit the problem.



Data Pre-processing

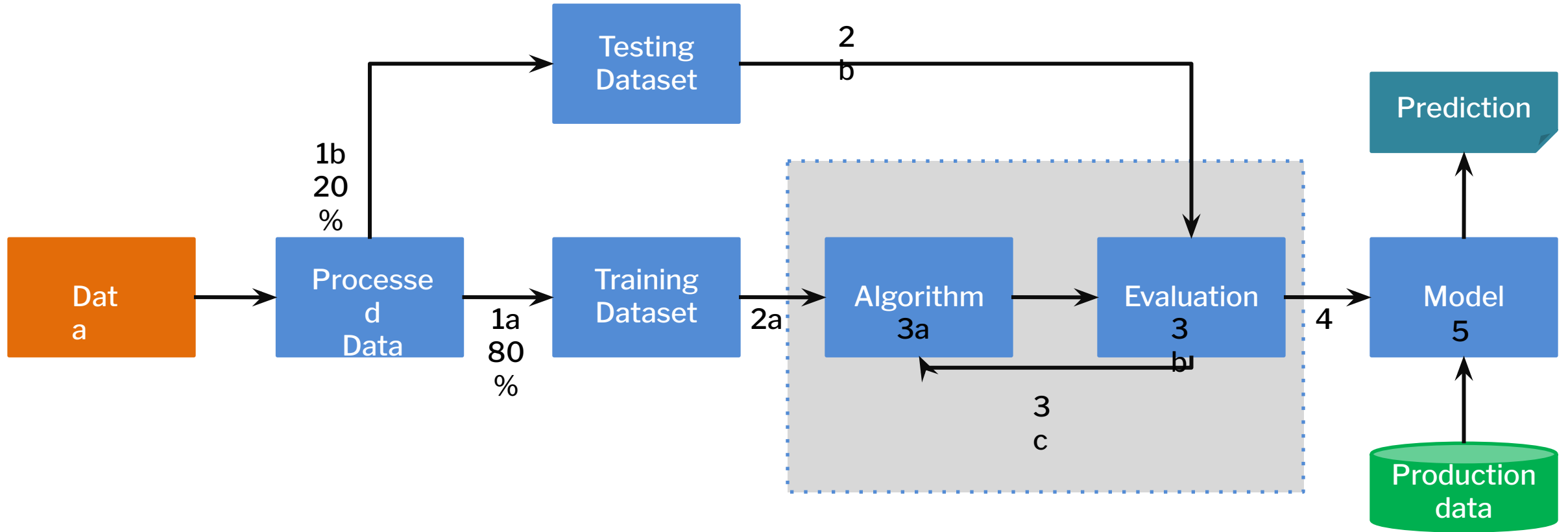
- Data pre-processing was kept to minimum so that the features of dent was kept as natural as possible and enhanced where possible
- De-noising - Noise is generally considered to be a random variable with zero mean. Consider a noisy pixel, $p = p_0 + n$ where p_0 is the true value of pixel and n is the noise in that pixel. You can take a large number of the same pixels (say N) from different images and compute their average. Ideally, you should get $p = p_0$ since mean of noise is zero. This property was used to remove the noise from the image.
- Intensity Correction - Intensity of the image had to be corrected based on the lightning conditions. This was done using Point operators (pixel transforms) and Neighborhood (area-based) operators



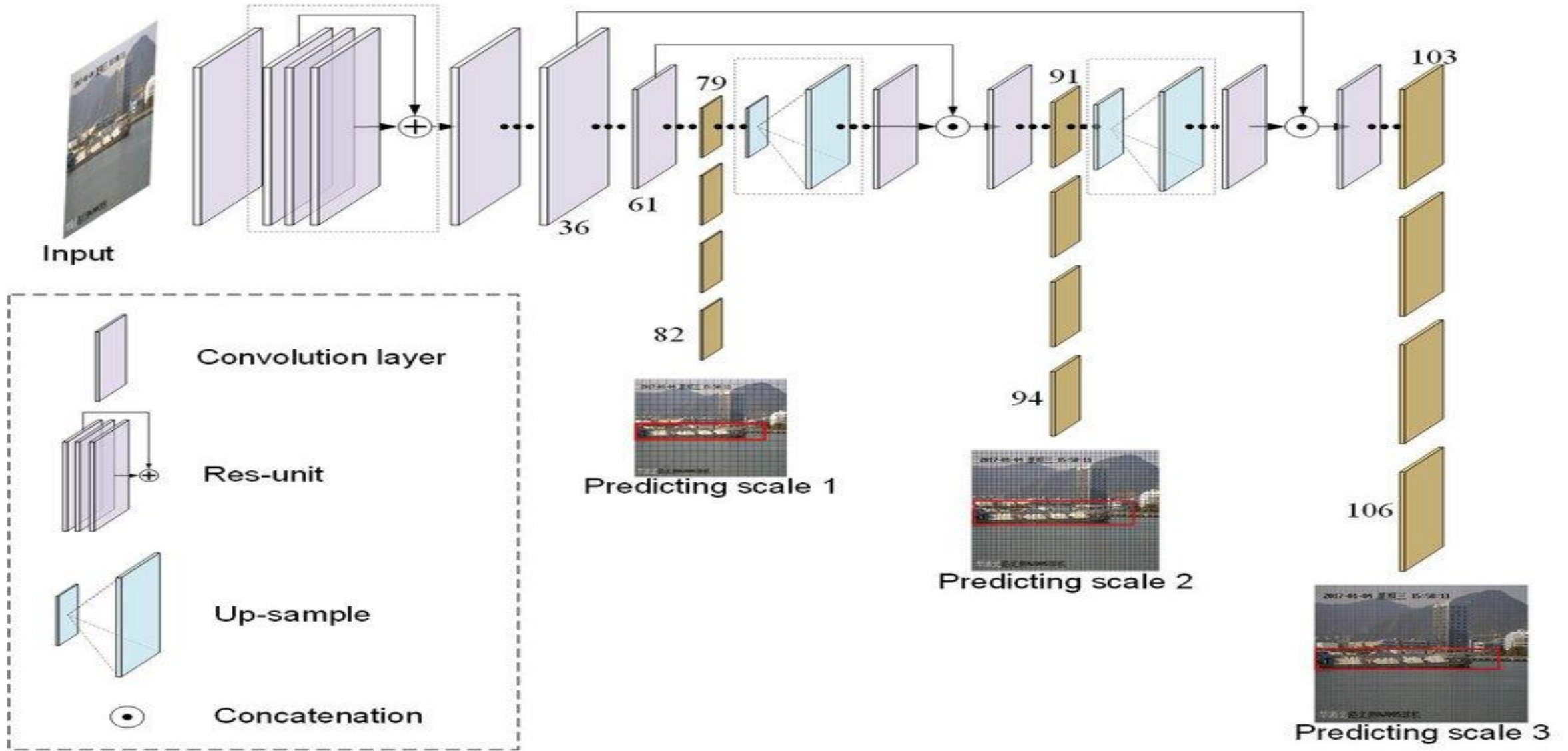
Data Augmentation

- Random Crop - Random cropping prevents a CNN from over fitting to specific features by changing the apparent features in an image. Random crop helps to increase the variety of training dent images and it helps the system to learn more variety dent features
- Horizontal flipping - Horizontal flipping doubles the variation in an image with specific orientations. It helps in detecting dents in both orientations.
- Rotation (Random or Fixed) - Rotation helps us to get the view of the object from different dimensions using rotation matrix. Some car images in real world will differ in orientation due to the parking faults or camera calibration issues. This problem reduces as we apply random rotation in the training set.
- Random Scaling - Random scaling produces the object images across all scales and this augmentation helps us to detect the dents across various scales.
- Perspective projection - Perspective projection helps us to retrieve bird eye view of the image. This will help us to get a more accurate view from the top of the dents.
- Shearing - Shearing, is another bounding box transformation, done with the help of the transformation matrix. Some Dents may not be properly visible due to the position of the car or camera. This will produce lot of negatives and this can be solved using shearing

Machine Learning Workflow



Model - Architecture (3a)





Evaluation & Fine Tuning of Model

- Trained with 150,000 dent images
- Tested with 30,000
- Accuracy of model – 95.04%

Sensitivity	0.7829
Specificity	0.9938
Precision	0.9701
Accuracy	0.9505
F1-Score	0.8665

Confusion Matrix

	Predicted Dent area	Predicted Non Dent area
Actual Dent area	0.16	0.004929577
Actual Non Dent area	0.044366197	0.787323944

THANK YOU



For More Details, Let's Connect



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