

# Automated Vehicle Fitness Test using CNN

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**Abstract** - As per Motor Vehicle act, all the commercial vehicles are mandatory to undergo fitness test periodically, depending on vehicle age. The vehicles are to be brought to fitness centers for inspection and certification. Also, there are limited number of center available per district so there are normally long queues and the process is hassle some. An innovative solution is required to reduce the human effort so that work can be done in an efficient way. An effective solution is required to ease this process for all. As this is the online-era, where everything is online, we required to develop a system in online which will be useful to maintain this process with ease and will reduce the human efforts. By using this technology, we can provide vehicle owner best possible way to complete the vehicle fitness test as compare to the existing system. The existing system carries more time to do a piece of work for this reason the online system is implemented where the whole fitness testing will be automated.

**Key Words:** CNN, Vehicle inspection, Deep Learning, Damage Detection, Mask R-CNN

## 1. INTRODUCTION

Most of the commercial sectors are now rely on the use of technology because it makes the task efficient and reduces the human efforts. Automobile is also one of the sectors where companies are trying to reduce the efforts and provide better solution to the vehicle owners Furthermore, the integrated technologies participate in solving the problems, improving current solutions, achieving particular business goals, and performing dedicated functions. Some of these tools and technologies is the camera, which is used in many fields such as the security field to protect companies or countries from unauthorized access. Cars are one of the essential and popular transportation vehicles, which performs transition from one place to another in a short time. With the increasing demand on relying on cars, periodic checkups must be executed to ensure the safety of their passengers. Also, the car may be exposed to accidents and this requires performing maintenance on it for which periodic vehicle test is done. Nowadays, car maintenance companies or inspection centers consume a long time in inspecting the car's body as part of its admission to the maintenance.

The main objective of this project is to make basic inspection possible without human intervention and reducing the time required to Perform this vehicle fitness test by using CNN technique to detect body damages on the vehicle from the captured images.

The scope of the project is for maintenance of the vehicle which will help in preventing accidents to a very large extent also using image CNN technique for reducing time required for each vehicle inspection.

## 2. PROBLEM STATEMENT

The car inspection starts when the car is brought to the inspection place, the employee walks around the car to check if there are any scratches and dents in the car's body. Then employee records the scratches and dents places on the manual inspection form that contains the general body of a car, while the customer can take a copy of this form. This requires more time and effort in performing the inspection and it negatively affects the accuracy of the process so that it is difficult to detect the damages on the car accurately by the human eyes. Some incidents happen when the customers deny the claim that this scratch has occurred because of them, since there is a lack in determining scratches and dents before and after inspecting the car. These problems may increase during the holiday seasons where car usage is usually increased. In addition to these problems, after a period of time when the vehicle owner comes again to inspect his car it will be difficult to notice the changes happened to the scratch that was marked previously.

## 3. EXISTING SYSTEM

The current inspection system consists of less number Testing Centers available per district causing rush at main Fitness Test center which lead to stand in queue for the vehicle owners for hours. As per Times of India article daily 25 appointments are being given per day out of which only 10-15 appointments are getting approved because of time limitation and not well- maintained process tracking of each vehicle. Where we think the number of tests per day should be increased also the residents of the village expressed concerns over crowding. With the increasing demand on relying on cars, periodic checkup must be executed to ensure the safety of their passengers. Nowadays, in car rental, maintenance, and insurance companies consume a long time

in inspecting the car's body as part of the car maintenance admission process or returning the car back to the car rental company. In current system, vehicle inspection is done manually, where it needs more time and effort in its performance. Also, it affecting the accuracy of the process and the there is no particular system to track the process.

#### 4. PROPOSED SYSTEM

The aim of the system is to create such system which shall provide exceptional quality and services to distinguish itself from other Systems. Here the authentication for every Owner will be based on his own vehicle Registration number. Then system will fetch vehicle details along with owner information and instructions related to vehicle fitness test. According to details If vehicle haven't done any test yet then user will be allowed to proceed with the damage inspection test. Vehicle owner allowed to upload captured photos of vehicle then by using CNN technique, system would begin the body inspection without human intervention. Here camera is used to detect dent or scratches on the vehicle. Which will reduce the time and efforts required so the number of tests will be increase. On passing the body inspection, token will be provided to the vehicle owner for rest manual inspection. Which will reduce time of the owner so he will not have to stay in queue.

Proposed System allows all the vehicle owners to have their Vehicle damage inspection without going to the inspection center they just have to visit the website where just to upload the images and fill the form for manual inspection claim if he passes the test he will be allowed for the further manual tests at inspection center else owner will have to reupload the images the check for the result.

#### 4.1 CNN (Convolutional Neural Network)

It is a neural network architecture which has number of convolutional layers and is used mainly for image processing, classification, segmentation and also for auto correlated data. A convolution is essentially sliding a filter over the input Convolutional Neural Network has had ground breaking results over the past decade in a variety of fields related to pattern recognition; from image processing to voice recognition. The most beneficial part of CNNs is reducing the number of parameters in ANN. In AI applications, CNNs perform well for PC vision tasks, for instance, visual thing affirmation and acknowledgment [5] [6].

This achievement has challenged both researchers and developers to approach larger models in order to solve complex tasks for particular problem, which was not possible with classic ANNs; The most important assumption about problems that are solved by CNN should not have features which are spatially dependent. In other words, for example, in a face detection application, we do not need to have attention to what is the location of faces available in the images. The only concern is to detect them without taking care of their position in the given images. Another important aspect of CNN, is to get features extraction when input

propagates toward the deeper layers. For example, in image classification, the edge can be detected in the first layers, and then the simpler shapes in the second layers, and then the higher-level features

#### 4.2 Damage detection using Mask R-CNN

It adopts image based deep learning to detect crack damages, the methodology used is acquiring images with the help of camera, then the pre-processing stage where the acquired images undergo scaling and segmentation, and finally to get the shape of damage or crack on image, feature extraction is done. CNN consists of different layers. They are input layer and output layer. Also, between these layers there are some number of hidden layers. There could be n number of hidden layers present in the network. Input layer takes the input and train accordingly and gives output from the output layer. With the help of CNN, we can use the large amount of data with more effectively and accurately. There are various CNN models available on ImageNet that are available openly, for instance, Alexnet [6], VGG-16 [7], VGG-19 [7], Inception [8], Cars [9], Resnet [4] are some of the models in CNN. Mask RCNN allows object segmentation with extension of faster RCNN and it is divided into two levels where first level scans the image and generates the proposal and the other classifies the proposal and generates the box and mask on the image. The algorithm consists of the following. (A) Input the image to be processed into a pre-trained ResNet50 and FPN network model to extract features and obtain corresponding feature maps. (B) feature map obtains a large number of region of interests through RPN, and then uses the SoftMax classifier to have binary classification of foreground and background, using frame regression to have more accurate candidate-frame position information and filtering out part of the Region of interest by non-maximum suppression. (C) Feature map and the all-remaining ROI are passed to the RoIAlign layer, so that each ROI generates a fixed-size feature map. (D) At last, the algorithm flow goes through two branches, one branch enters the fully connected layer for object classification and frame regression, and the other enters the full convolution network (FCN) for pixel segmentation using only a single Python file.

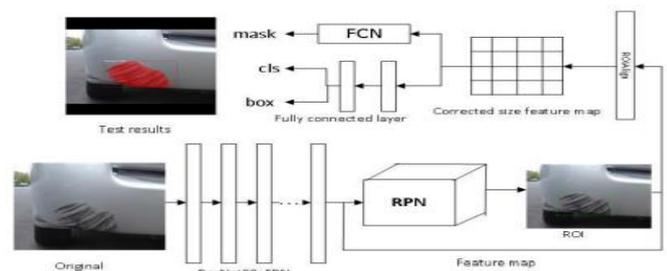


Fig 4.1 The network structure block diagram of the Mask RCNN algorithm

## 5. IMPLEMENTATION

### 5.1 User Flow

A use case diagram represents user interaction with the system also any non-technical person can get the idea about how is the workflow for a system.

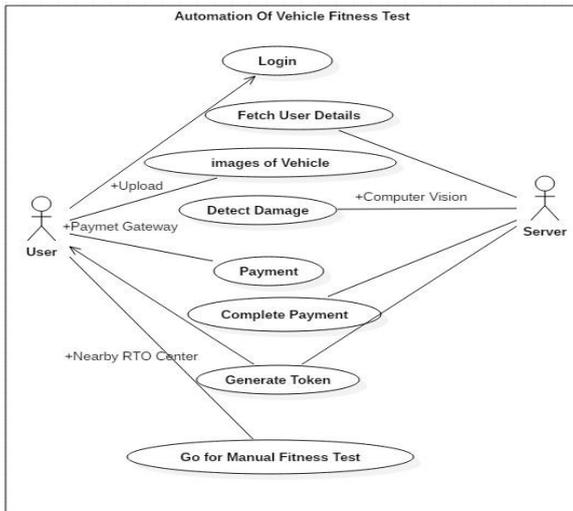


Fig5.1 Use Case Diagram

### 5.2 DATA ANNOTATION

Training Dataset in Mask R-CNN is need to be annotated, which is to have the region of damage in an image identified and the boundary of the damaged area marked. For example, of annotation tool is the VGG Image Annotator. It creates rectangular shape around the region. Then annotations is then saved as a json format file in the dataset directory for further classifications.

### 5.3 IMPORT DATASET AND VISUALIZATION

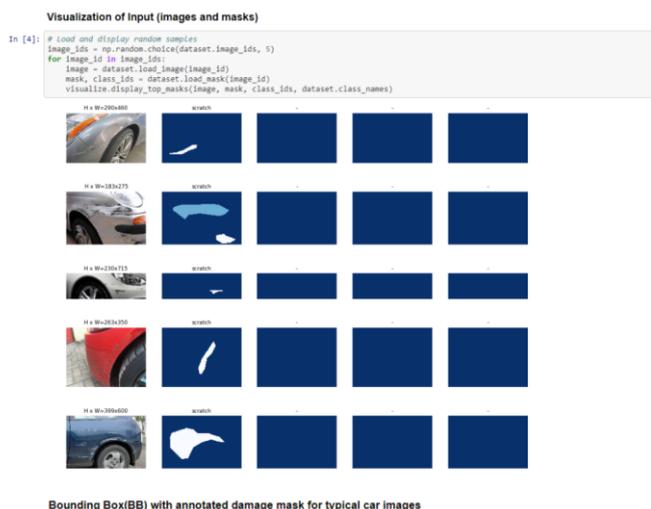


Fig 5.2 Visualization

### 5.4 TRAINING AND VALIDATION ON MODEL

Training is to be performed on the dataset to generate a model for the given algorithm.

### 5.5 PREDICTION ON MODEL

Inspecting model by performing prediction on test and validation to test the accuracy.



Fig 5.3 Prediction in inference mode

### 5.6 Flask for Model Integration

Flask is light weight framework allows to integrate a model in such a way that it can help to interact in real time problems. It gives developers flexibility as it is a more accessible framework for new developers since you can build a web application quickly. At last time for the model integration so flask provides jinja2 template engine to create webpages.

As per proposed system Vehicle owner will register on a webapp then upload a picture our model will determine the accuracy of the damage and will show the result accordingly.

## 6. Result

Our main aim was to detect damage on vehicle and system would respond according to the parameters if Damage detected then system will show message accordingly and if it does not detect damage, he is allowed for further Inspection at Inspection Center. As a result, we are successfully created a system which truly fulfill the requirements where vehicle fitness test can be done in an efficient way. All the needful for the vehicle damage inspection would be automated.

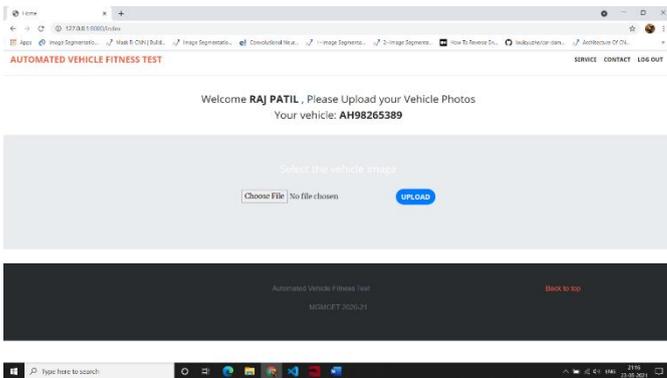


Fig 6.1 Uploading the car image

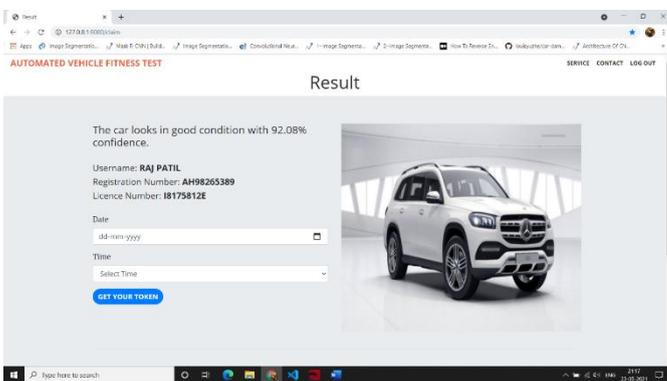


Fig 6.2 Booking slot for the inspection

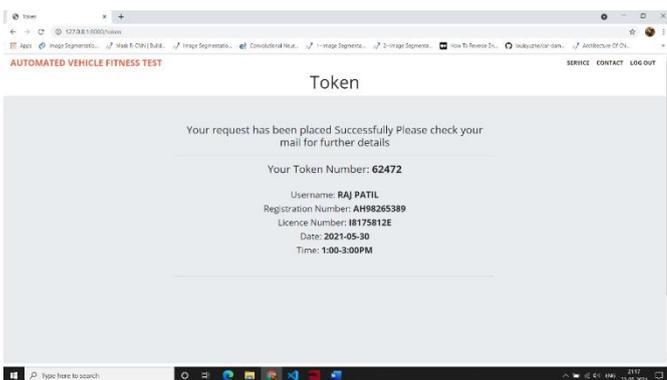


Fig 6.3 Token For further inspection

## 7. Conclusion

In this paper, we proposed deep learning based solution for Vehicle Inspection center where according to regulation it is compulsory to undergo your vehicle fitness test done but having one center per district was causing so much rush at the center and all vehicle owners had to go through this hectic process so coming to the conclusion it was necessary to develop such model which will automate this damage inspection process and compatibility of model allows to integrate this model with any of the existing application like insurance claim.

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