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Car Damage Classification Based on Deep Learning

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Abstract-
Nowadays, the rise of automobile industries is directly related to the increasing number of car accidents. So, organizations like insurance companies and others are facing a lot of claims leakage and problems of delay in processing it. To reduce the load, artificial intelligence based on machine learning and deep learning algorithms can help to solve these kinds of problems. In this project, we are going to apply deep learning-based algorithms like VGG16 and VGG19 to classify damage and also used dataset which is manually augmented. The algorithms used helps in detecting damaged parts of a car and assess its location and severity. Initially, we discover the effect of domain-specific pre-trained CNN models, which are trained on the ImageNet dataset and followed by fine-tuning along with CAM (Class Active Mapping). Then we apply transfer learning in trained VGG models and used some techniques to increase the accuracy of our system. Based on the performance of VGG models, we will come to know which VGG model is better for our system. After analyzing and implementing our models, we came to know that the results of using which technique can work better and will give better accuracy. This project will reduce the human efforts and give prompt results.

Keywords — *Damage detection and assessment, Deep learning, CNN model, Transfer learning, VGG model, CAM (Class Activation Mapping)*

I. INTRODUCTION

Car insurance firms waste millions of rupees per year due to claims leakage in today's world, as the incidence of car and vehicle accidents rises. The insurance claim process is not only complicated, frantic, and wasteful of resources, but it also takes time. AI technologies focused on machine learning and deep learning will assist with issues such as data analysis and processing, fraud detection, and more reduces losses and medical claim process. However, developing modern applications to address such issues remains difficult, especially when using deep learning to assess car damage. Deep learning is a time-saving technique. It is a method for solving complex problems, but it requires more resources.

Deep learning is used for model creation, or training a model. It necessitates a large dataset and takes longer to compute. To realize a deep learning approach for assessing car impact, the paper focuses on two issues that must be addressed in order to create an effective model: (i) car damaged dataset for training, and (ii) a decrease in computation time. since car damage assessment is a specific area, so we have lack of publicly available datasets for car damaged images with labelling. The most difficult part of training a model is doing so with a limited dataset. Made considerable progress in this case on how to solve classification problems when a small dataset is insufficient to train a CNN model. This problem can be solved by using data augmentation, which entails manually collecting and labelling data on the web. The most difficult challenge is reducing model training time.

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Performing image classification tasks with a conventional CNN model and identifying the correct weights for the network through several forward and backward iterations will take a long time. Using GPUs, this process may take days or even weeks to complete. Fortunately, using pre-trained CNN models that have been previously trained on broad benchmark datasets like the Image Net dataset, the model training time can be reduced. Via transfer learning, we can freely download their weights and use their architectures for other unique tasks. In this paper, Alexnet CNN model is used for classification.

II. LITERATURE SURVEY

Literature survey is all about study of existing system and also the collection of the information needs to implement in our task. It helps in knowing the recent work and researches done on that topic and provides a platform to implement our ideas and concept. There are many research papers and journals has been published on Home Air Quality Monitoring system. Some of them are mentioned below

Survey 1: 01] Mahavir Dwivedi, Malik Hashmat Shadab, SN Omkar, Edgar Bosco Monis, Bharat Khanna, and Satya Ranjan. [n.d.].” Deep Learning-Based Car Damage Classification and Detection”. They made an insurance claim app for the damage detection of the car, the customer will upload an image from his/her mobile app to the server.

Survey 2: 02] Phyu Mar Kyu, Kuntpong Woraratpanya.1-5 June2020 IAIT Thailand. “Car Damage Detection and Classification”. They considered common damage types such as bumper dent, door dent, glass shatter, headlamp broke, a tail lamp is broken, scratch and smash.

Survey 3: 03] Kalpesh Patil, Mandar Kulkarni, Anand Sriraman and Shirish Karande.” Deep Learning Based Car Damage Classification”.2017 16th IEEE International Conference on Machine Learning and Application. Here it is presented as a novel framework to detect, locate, and identify damage severity on vehicles using CNN, transfer learning, and Mask R-CNN techniques.

Survey 4: 4] Najmeddine Dhieb, Hakim Ghazali, Hichem Besbes, and Yehia Massoud. 2019.” A very deep transfer learning model for vehicle damage detection and localization”. In 2019 31st International Conference on Microelectronics (ICM). IEEE,158–161’. Here it is presented as a framework for Car damage detection and classification. CAR DAMAGE DETECTION AND CLASSIFICATION 13

Survey 5: 5] Advances in Artificial Intelligence and Data Engineering Select Proceedings of AIDE 2019. Here we learn concepts of CNN, Deep Learning.

Survey 6: 6] Srikanth Tammina. [n.d.]. Transfer learning using VGG-16 with Deep Convolutional Neural Network for Classifying Images. ([n.d]) They considered common damage types such asbumper dent, door dent, glass Shatter, headlamp broke, a tail lamp is broken, scratch and smash.

III. CAR TRANING DATASET

For Car damage classification**,** training is to be done for our system to understand that whether given image is of car or not damaged or not. There is image of dataset attached below which shows car. There are around 920 images each for testing and training and of three categories which is car in good condition, car in damaged condition and car based on severity and location. So, total there is around 4000 images.

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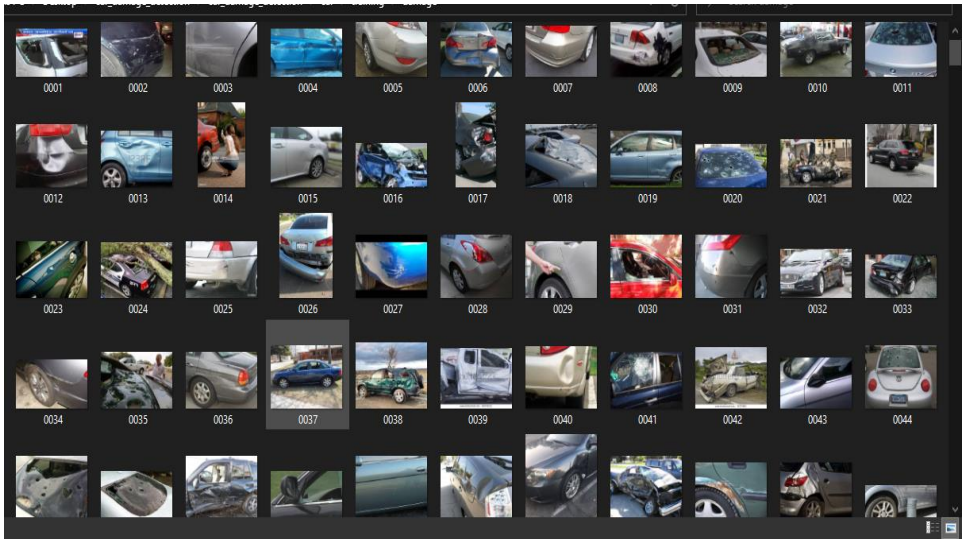

Fig name?

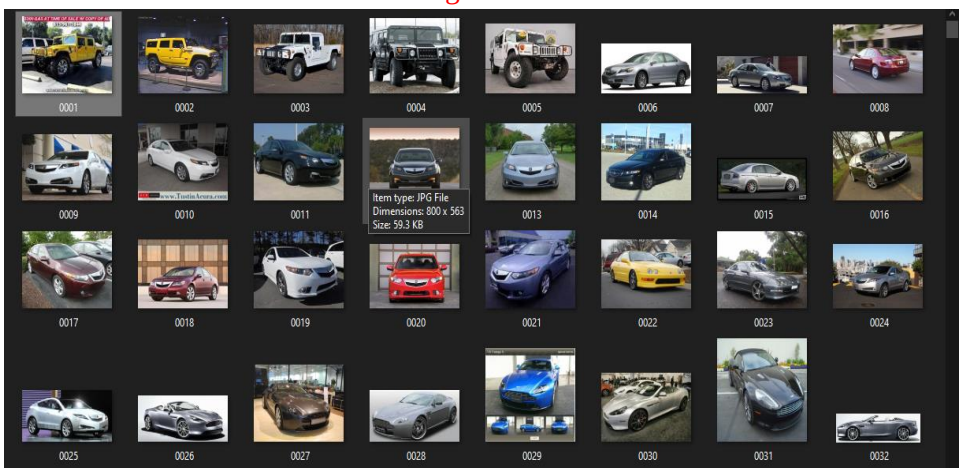

Fig 1. Dataset images

IV. PRAPOSED METHODOLOGY

Car damage detection and classification is based on several methods. It consists of some stages which is shown below in from of block diagram:

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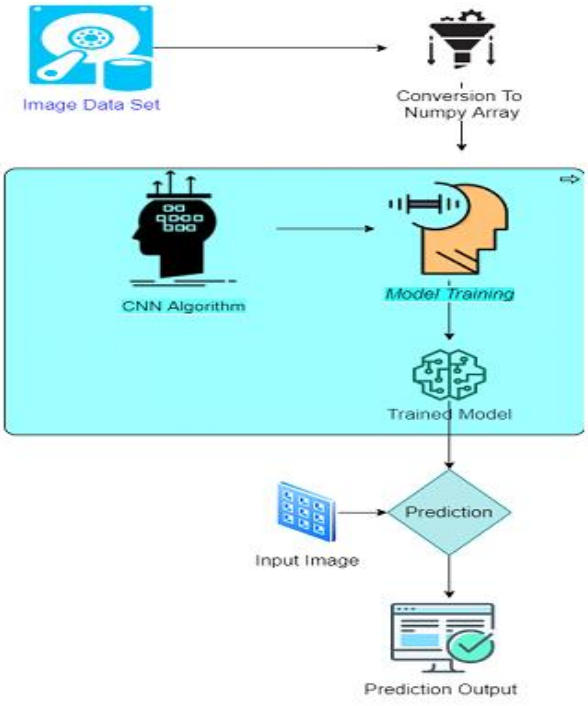

Fig. 2 Block Diagram

The diagram shows the overall function one need to perform during classification of car damage. It mainly consists of 4 statges-
Dataset collection, pre-processing of images, CNN prediction and final output.

The block diagram above depicts a car damage assessment. Here, we will perform various tasks such as determining if the given picture is of a car or not, whether it is damaged or not, and what the location and magnitude of the damage are. The overall method of car damage assessment is depicted in Figure 1. There are four phases in total, each with three models based on three datasets. Task 2 is completed by two classes in dataset 1; task 3 is completed by three classes in dataset 2; and task 4 is completed by three classes in dataset 3. We get input data from our datasets in the first process, and then we select one of the CNN models trained on an ImageNet dataset to recognise as a car or not a car in the second phase. We move on to the second step after selecting and checking the model. We build model 1 and train it with dataset 1 in this process to decide if the input data is a damaged or undamaged vehicle. We also train a model 2 with dataset 2 to detect the position of the damaged part of a car when we enter the third level. After training, input is given as input to the system and then image is pre-processed. Here the system understands the features of image and then using CNN model given condition is predicted. After all this we get final output at the end user.

A. Input

Input given to system should be trained image i.e., having same pixels value, so that it could be easily pre-processed. Some of the images are shown below-

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Fig 3: Input Images

B. Convolutional neural network (CNN)

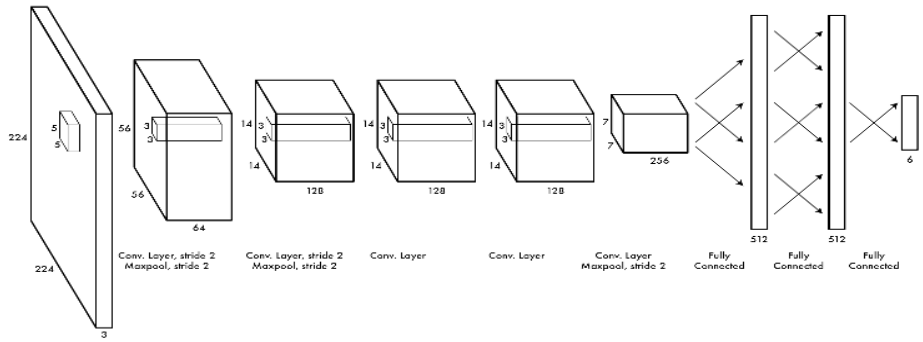

Fig 4. CNN model

Step 1: Convolution Operation

The convolution operation is the first step in our attack strategy. We'll talk about feature detectors in this step, which are

essentially the neural network's filters. We'll also talk about function charts, including how to learn the parameters of

such maps, how to detect patterns, the layers of detection, and how to map out the results.

ReLU Layer (Step 1(b))

The Rectified Linear Unit, or ReLU, will be used in the second part of this stage. We'll talk about ReLU layers and how linearity operates in the sense of Convolutional Neural Networks. It's not mandatory to understand CNN's, but it's never a bad idea to brush up on your skills.

Step 2: Pooling

We'll go over pooling in this section and see how it operates in general. However, our nexus would be a specific form of pooling: maximum pooling. However, we'll go through a variety of methods, including mean (or sum) pooling. This section will conclude with a presentation using a visual interactive method that will undoubtedly clarify the entire definition.

Step 3: Flattening

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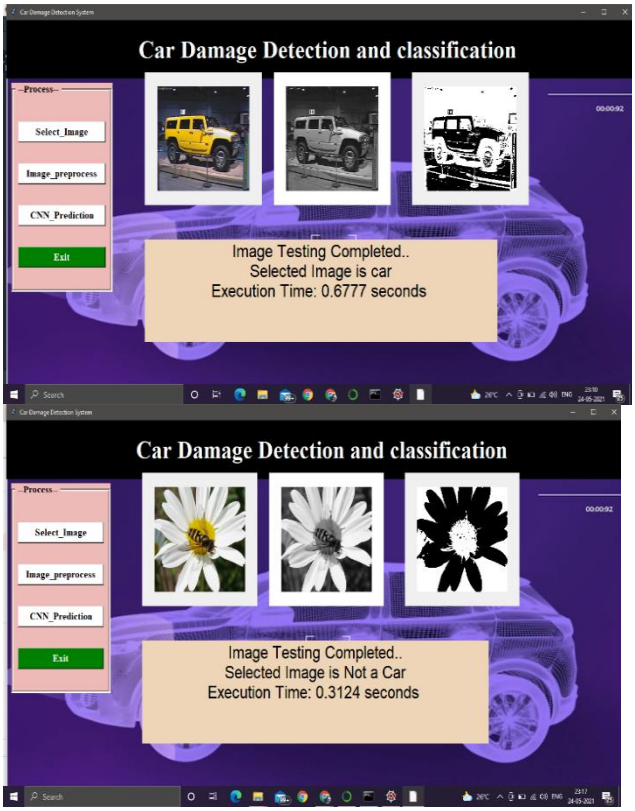
When dealing with Convolutional Neural Networks, this will be a brief breakdown of the flattening mechanism and how we switch from pooled to flattened layers

Step 4: Full Connection

All we've discussed so far in this section will be combined in this section. You'll gain a better understanding of how Convolutional Neural Networks function and how the "neurons" that are eventually generated learn to classify images by learning this.

C. Output

Images used for predicting output is taken from dataset. Using CNN model is it trained and classified then final output is predicted on given conditions. Some of the outputs are shown below-



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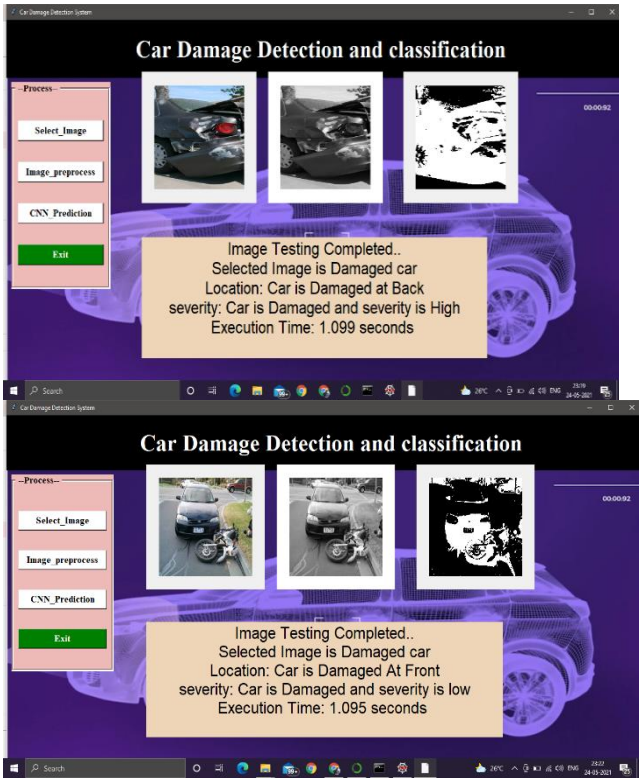

Fig 5 Car Damage Detection

V. RESULTS AND DISCUSSION

In this paper, system presented a convolutional neural network as framework for car damage detection and classification. To proceed with this project first we evaluated the dataset from github and imageNet and manually we augmented the data from dataset. For model development we used tensorflow libraries, keras libraries, numPy libraries and for development we have decided to use PyCharm,spyder notebooks and anaconda virtual environment.The libraries which we are using is numpy, pandas, matplotlib,ipython etc. Below are some results of this paper-

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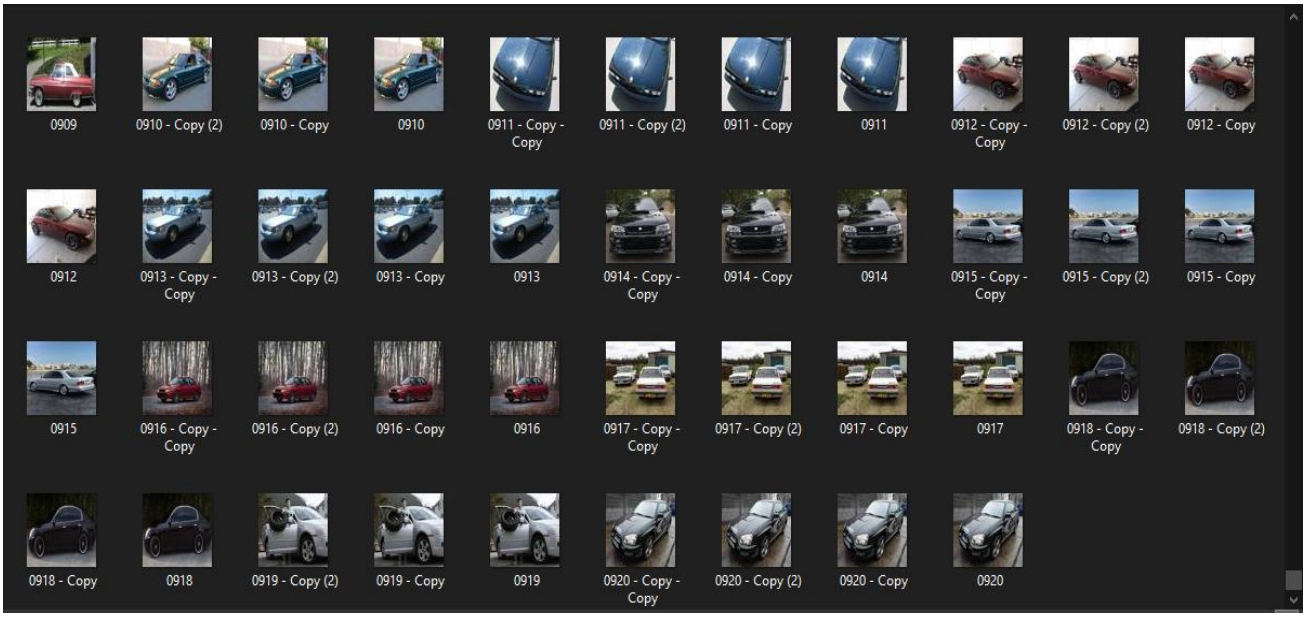

Fig 6. Collection of Dataset

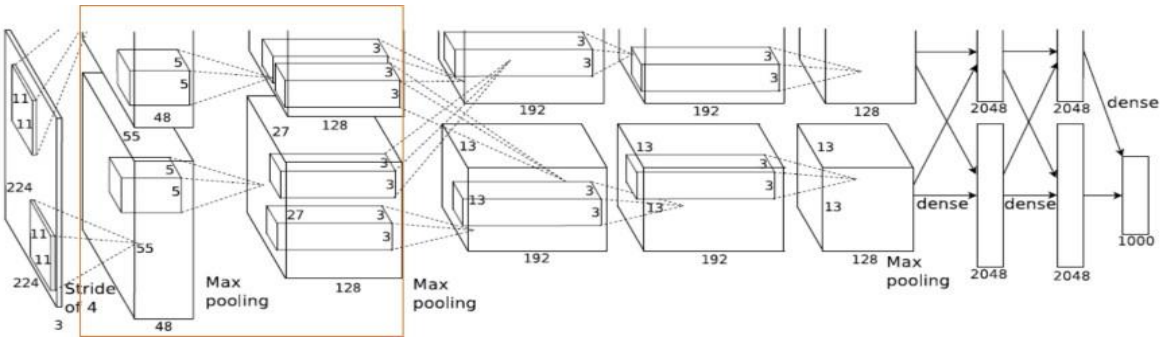

Fig 7. Alexnet architecture

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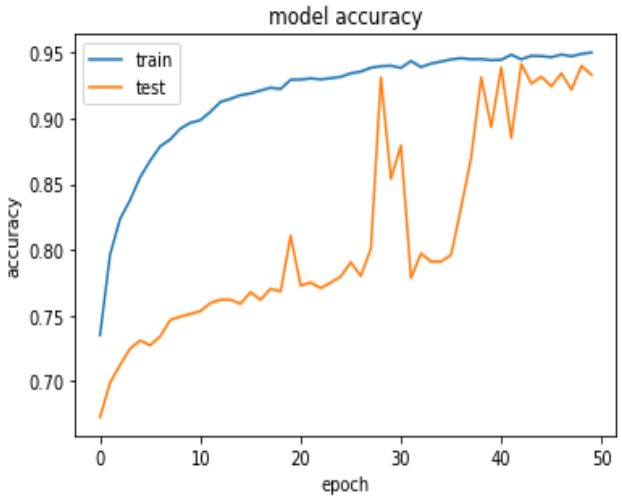

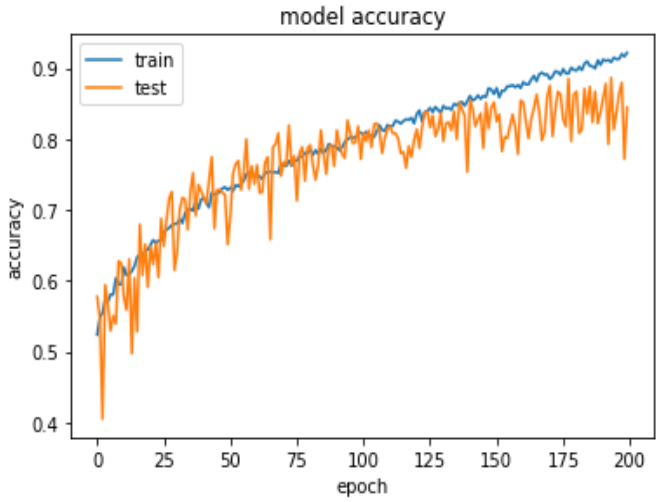

I. II.

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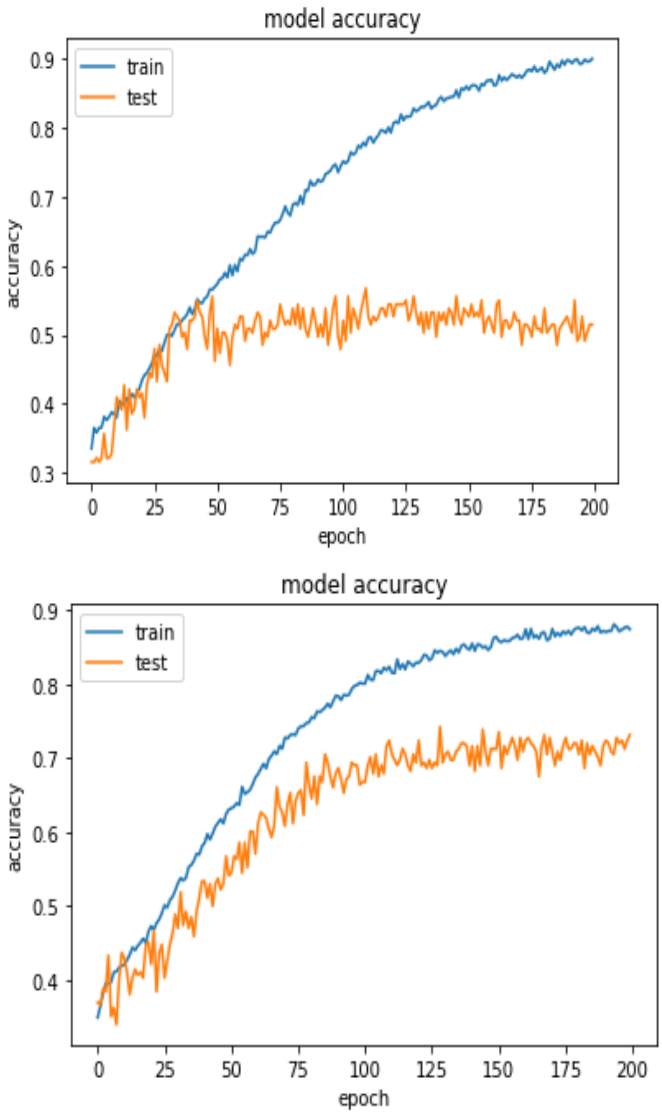

III IV.

Fig 8. Accuracy graph of images under different conditions

In figure no. 6 there is four different figures in which Fig I. shows the accuracy of CNN model, Fig II. Shows the accuracy of image of car, Fig III. Shows the accuracy of damage severity and Fig IV. Shows the accuracy of location of damage.

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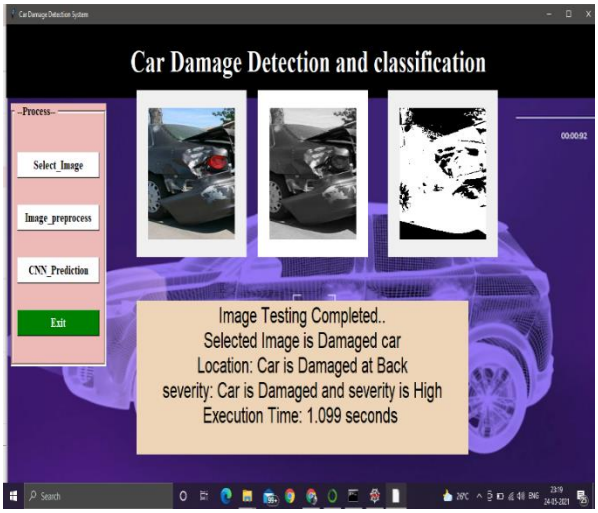

Fig I.

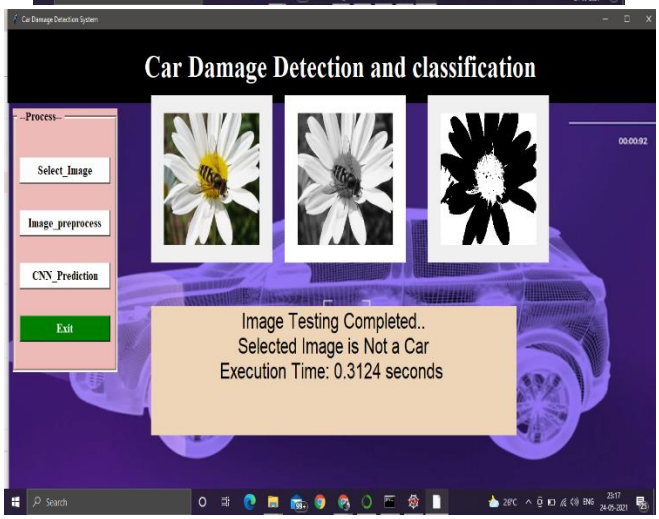

Fig II.

Fig 9. GUI result

In above figure, Fig 7, final result is shown which we get after creating GUI. In Fig I. all the required condition is predicted for car damage classification. Also, In Fig II. It is shown that selected image is not car is predicted by CNN model.

VI. CONCLUSION

This paper depicts the damage on car and classify its severity and location using deep learning method. The classification is done using alexnet which is a CNN algorithm. It gives accuracy of upto 90% - 95%. So, we can conclude that CNN is so efficient and reliable for classification of car damage that it can be further implemented by insurance companies.

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