Intelligent Vehicle Damage Assessment and Cost Estimator for Insurance Companies

Ideation Phase - Literature survey

Paper 1: Research on Intelligent Vehicle Damage Assessment System Based on Computer Vision

- ☐ Publication year: 2020
- ☐ Author: Zhu Qianqian, Guo Weiming, Shen Ying, and Zhao Zihao
- ☐ Journal name: Journal of Physics: Conference Series
- ☐ Summary: The core advantages of the intelligent damage determination system based on computer vision are as follows: Intelligent image algorithm has high precision; the accuracy rate is 87.3%. It can assist all or part of the damage fixing personnel to complete the damage fixing work. The speed of survey and damage determination is fast, the time of survey and damage determination can be raised from 9.94 days to minute level. Intelligent wind control is rigorous, covering the whole process of fixed loss. Intelligent damage determination system can effectively enhance the experience of automobile insurance companies, car owners and road traffic. It can effectively control the cost expenditure of automobile insurance company, reduce the cost of automobile insurance company investigation, realize the first spot investigation, accurately fix the loss and effectively control the cost of compensation. It can also improve the owners' claim experience and shorten the time for the owners to settle claims. At the same time, it can effectively alleviate road traffic pressure, avoid traffic congestion and secondary accidents, and improve the situation of insufficient police force at the grassroots level.

Paper 2: Automatic assessment of damage and repair costs in vehicles.

- ☐ Publication year: October 12, 2017

☐ Author: Vikas Taliwal, Boston, MA (US); Siddhartha Dalal, Bridgewater, NJ (US); Kaigang Li, Brooklyn, NY (US); Gaurav Sharma, Webster, NY (US)

☐ Journal name: American International Group, Inc., New York, NY (US)

☐ Summary: A method for automatically estimating a repair cost for a vehicle, comprising: receiving, at a server computing device over an electronic network, one or more images of a damaged vehicle from a client computing device; performing image processing operations on each of the one or more images to detect external damage to a first set of parts of the vehicle ; inferring internal damage to a second set of parts of the vehicle based on the detected external damage; and, calculating an estimated repair cost for the vehicle based on the detected external damage and inferred internal damage based on accessing a parts database that includes repair and labour costs for each part in the first and second sets of parts . Additionally in some embodiments, the server computing device may classify the loss as a total, medium or small loss.

Paper 3: Automatic Car Insurance using Image Analysis.

☐ Publication year: April 2020

☐ Authors: Aniket Gupta, Jitesh Chogale, Shashank Shrivastav, Prof. Rupali Nikhare

☐ Journal name: International Research Journal of Engineering and Technology (IRJET).

☐ Summary: Image analysis methods extract information from an image by using semi-automatic or automatic techniques termed: image understanding, image description, scene analysis, pattern recognition, computer/machine vision etc). Image analysis is different from the various other types of image processing methods, such as the restoration or enhancement in that the end result of image analysis procedures is a numerical output rather than an image or some pictorial output. By analyzing different techniques in literature review we conclude different technologies used to provide solutions for insurance companies, such as Srimal Jayawardena uses 3D model of car and other latest papers uses CNN model and categories different types of damages which provide efficient machine learning concepts to predict cost evaluation for damage.

Paper 4: Car Damage Detection using Machine Learning

- ☐ Publication year: 2021
- ☐ Author: Girish N, Mohammed Aqeel Arshad
- ☐ Journal name: International Journal of Advanced Research in Science, Communication and Technology(IJARSCT)
- ☐ Summary:

One of the key research topics in computer vision is object detection. On the instance level, it determines the category and position information of the object of interest in the image. RCNN, Fast RCNN, Faster RCNN, and SSD are some of the most popular target detection algorithms. These frameworks, on the other hand, necessitate a large quantity of training data and thus end-to-end detection is not possible. The detection frame's positioning ability is limited, and the gradient disappearance or gradient explosion is common when a feature is extracted as the number of convolution layers grows. For these drawbacks, Author proposed a residual network (ResNet) that uses the residual module to help the model converge, accelerates neural network training, and integrates it with the Mask RCNN target detection model to achieve object detection and segmentation, significantly enhancing model detection accuracy. Mask RCNN is the first deep learning model that incorporate target identification and segmentation in a single network

Paper 5: Vehicle Damaged Detection Using Deep Learning

- ☐ Publication year: 2022
- ☐ Author: Mohammed Yusuf Jamal Aziz Azmi, Israr Ahmad, Mohammed ZainulArefeen, Daaniyal Ahmed, Hussam Bin Mehare
- ☐ Journal name: International Research Journal of Modernization in Engineering Technology and Science
- ☐ Summary: One of the key research topics in computer vision is object detection. On the instance level, it determines the category and location information of the object of interest in the image. Car insurance companies spend millions of dollars each year owing to claims leakage in today's society, when the rate of car accidents is on the rise. In the insurance industry, AI technology based on machine learning and deep learning can help with issues

such as data analysis and processing, fraud detection, risk reduction, and claim automation. However, developing current applications to address such issues remains difficult, particularly when using deep learning to assess automotive damage. Deep learning is an effective method for tackling complicated problems, but it necessitates more resources for model building, i.e., deep learning demands a large dataset and takes longer to compute. This study focuses on two difficulties for developing an efficient deep learning system for automotive damage assessment: car damaged datasets for training and computation time reduction. Deep Learning is a subbranch of machine learning that has been successfully shown on a variety of platforms for dealing with lots of data. Through stacked blocks of layers that make up the Deep Learning skeleton, Deep Learning models may capture and understand information that is hidden in data to anticipate distinct patterns. Deep Learning-based models have been effectively applied in various applications in a wide range of research areas, including computer vision, speech and audio identification, and damage detection, mainly due to breakthroughs in parallel computation and the development of Deep Learning. In this study, we propose an automated approach for classifying damaged vehicles and predicting how they were damaged.

Paper 6: Car Damage Assessment for Insurance Companies

- ☐ Publication year:2022
- ☐ Authors: Mandara G S and Prashant Ankalkoti
- ☐ Journal name: International Journal of Advanced Research in Computer and Communication Engineering
- ☐ Summary: In this literature survey several methods have been proposed for detection of car damage. Srimal proposed a solution which uses 3D Computer Aided Design for the discernment of car damage from the picture, the system only detect damage at edge portion only. Detection of the car damage through CAD software requires some knowledge about the software. Gontscharov, the proposed system designed by using YOLO (you only look once) algorithm to detect the car damage, Here the multi sensor data fusion technique is allows to locate the portion of damage more accurately and performs detection faster compared to other algorithms which is fully

automatic and doesn't require much human intervention. Phyu Mar Kyu, the proposed system uses deep learning-based algorithm are VGG16 and VGG19 damaged car detection in the real world. This algorithm notices the severity of the damaged car based on the location. Finally, the author concludes that L2 regularization work greater. Girish N, proposed system uses vehicle damage detection technique depends on transfer learning and mask RCNN, the mask regional convolution neural network determines a damaged car by its position and estimate the depth of the damage. A Neela Madheswari, the proposed system uses convolution neural network is used to accept that image contains a car damage or not. It takes as great opportunities to attempt by classifying the car damage into different classes.

Paper 7: Damage Assessment of a vehicle and Insurance Reclaim.

- ☐ Publication year: 2020
- ☐ Author: Vaibhav Agarwal, Utsav Khandelwal, Shivam Kumar, Raja Kumar, Shilpa M
- ☐ Journal name: International Journal of Creative Research Thoughts
- ☐ Summary: Li Ying & Dora Chitra, presented the CNN Model for the auto insurance claims process, improvements in the First Notice of Loss and rapidity in the investigation and evaluation of claims could drive significant values by reducing loss adjustment expense. This paper proposed a novel application where advanced technologies in image analysis and pattern recognition are applied to automatically identify and characterize automobile damage. Success in this will allow some cases to proceed without human adjusters, while others to proceed more efficiently, thus ultimately shortening the time between the first Notice of Loss and the final pay-out. To investigate its feasibility, they built a prototype system which automatically identifies the damaged areas based on the comparison of ages. Performance of the before- and after-accident automobile in of the prototype system has been evaluated on images taken from forty scaled model cars under reasonably controlled environments, and encouraging results were obtained. It is a belief that, with the advancement of image analysis and pattern recognition technologies, their proposed idea could evolve into a very promising application area where the auto insurance industry could significantly benefit. The main drawback in this

model was that the automobile damaged can be analyzed only having white background otherwise it will be not able to give the desired results and the study also indicates that there may be an error in the result, it may not give that accurate result like 85-90% affective.

Paper 8: Image Based Automatic Vehicle Damage Detection

- [ ] Publication year: 2021
- [ ] Author: Srimal Jayawardena
- [ ] Journal name: A thesis submitted for the degree of Doctor of Philosophy at The Australian National University
- [ ] Summary: This thesis proposes a solution which uses 3D Computer Aided Design for the discernment of car damage from the picture, the system only detects damage at the edge portion only. Detection of car damage through CAD software requires some knowledge about the software. The proposed models are Monocular 2D/3D pose estimation, 3D model-assisted segmentation, Reflection detection Obtain reliable point correspondences across photographs with largely reflective and homogeneous regions. The project explores the problem of automatically detecting mild damage in vehicles using photographs taken at the scene of the accident. Detecting damages to vehicle panels such as dents, deformations in panels and estimating the degree of damage in terms of repair costs. Making use of the reflections and specular highlights in the process of recovering the 3D pose.

Paper 9: Preventing Car Damage using CNN and Computer Vision

- [ ] Publication year: November 2019
- [ ] Authors: Avinash Sharma, Aaditi Verma, Dhananjay Gupta
- [ ] Journal name: International Journal of Innovative Technology and Exploring Engineering

Summary: In today's world, insurance is a vast diligence. With vast number of cars evident on the paths of most modern firms, it is no astonishment that vehicle insurance is a booming industry. The countrywide average auto insurance outlay rose 5.3% to $935.80 in 2016 from $889.09 in 2015, rendering to the National

Association of Insurance Commissioners. In 2016, the average outflow was highest in New Jersey ($1,309.29), and New York ($1,301.64). With the number of road accidents rising everyday there is an enormous load on the insurance companies to course loan and due to manual intrusion, the accuracy of the process is hampered. This programme design grants an insurance industry use case: car damage analyser. When a car becomes impaired in accident, the guarantor pays the required cost. However, the shop may overprice the expensive. Likewise, the approximation procedure is blue-collar and involves mortal experts and time to estimate damage. Image cataloguing is emergent prerequisite for each types of bodies, and insurance companies. Occupying machine learning, it simpler to train a model which will distinguish the damaged cars, make estimates about what type of repair is looked-for, and estimate how much it may cost.

Paper 10: Vehicle Part Damage Analysis Platform for Auto insurance Application

- ☐ Publication year: 2021
- ☐ Author: Kundjanasith Thonglek, Norawit Urailertprasert, Patchara Pattiyathanee, and Chantana Chantrapornchai.
- ☐ Journal name: ECTI Transactions on CIT
- ☐ Summary: This paper deals with present a damage vehicle part detection platform, called Intelligent Vehicle Accident Analysis (IVAA), which provides an artificial intelligence as a service (AIaaS). It helps automatically assess vehicle parts' damage and severity level. There are four main elements in the service system which support four stakeholders: insurance experts, data scientists, operators, and field employees. The Intelligent Vehicle Accident Analysis System (IVAA) is an artificial intelligence platform as a service. It provides an end-to-end solution for an auto-insurance company. It consists of four modules, the first module, is a data labelling (for insurance experts), an insurance expert uploads the damaged vehicle image to the IVAA system. They can select the part and label the photo of a damaged vehicle. The tool makes the labelling process easier than manual labelling. They also provide a tool to download the labelled and unlabelled photo data from the system to the local machine, saving it for future use. The second module is deep learning API for data scientists, Deep learning APIs in our system are an important extension because the user can employ system by connecting to the

APIs. The network is used to recognize many photos obtained from many perspectives. This allows adding a specific training dataset and retraining the deep learning model effectively model effectively. The third module is the web monitoring application for the operators, application shows the visualization where the user can interact with the data from the system database, and the fourth module is LINE official integration for field employees where the image and text data can be redirected from the Line server to our database. The current deep learning model used is CapsNet, which can predict correctly up to 98.47 % when testing on the proposed Toyota Camry data set. The average image inference time is 13.12 seconds.

Paper 11: Assessing Car Damage with Convolutional Neural Networks

- ☐ Publication year: 2021
- ☐ Author: HaritBandi, Suyash Joshi, Siddhant Bhagat, Amol Deshpande
- ☐ Journal name: Institute of Electrical and Electronics Engineers
- ☐ Summary: This paper deals with estimating car damage, primarily with auto insurers as our key potential customers. For this purpose, three distinct Transfer Learning approaches are used which detect the presence of damage, location, and severity of the damage. The basis for algorithms used lies in Convolutional Neural Networks, customized to optimize accuracy. Convolutional Neural Networks are accurate at evaluating car damage extent, even when trained on only 300 images per class. Many techniques such as directly training a CNN and pre-training a CNN using transfer learning from large CNNs trained on ImageNet on top of the set of pre-trained classifiers were tested. Firstly, detection of the presence of car damaged takes place (logistic or logit classification). Secondly, the extraction of the features of the car damages, use the VGG16 model with ImageNet weights. The VGG16 architecture was selected because it has a relatively simple architecture and Kera's ships with a model that has been pre-trained on ImageNet. It is just several Conv2D and MaxPooling2D layers with a dense network on top with a final SoftMax activation function. Finally, image classification has been applied on the feature vectors to determine the severity of the damage to the car. The image data and corresponding class index are appended to training data. The training data is randomly shuffled to ensure that each data point

creates an independent change on the model, without being biased by the same points before them. With a higher quality dataset which includes pivotal parameters like location information and repair costs, the research could go a step further in predicting the cost of damage repair based on the image

Paper 12: Car Damage Assessment Based on VGG Models

- ☐ Publication year: 2021
- ☐ Authors: Phyu Mar Kyu, Kuntpong Woraratpanya
- ☐ Journal name: Institute of Electrical and Electronics Engineers
- ☐ Summary: In this paper, there apply deep learning-based algorithms, VGG16 and VGG19, for car damage detection and assessment in real world datasets. The algorithms detect the damaged part of a car, assess its location and severity. Initially, we discover the effect of domain-specific pre-trained CNN models, which are trained on ImageNet dataset, and followed by fine-tuning, because some of the categories can be fine-granular to get our specific tasks. They have chosen to apply it with the pre-trained VGG models to defeat the over-fitting problems on small dataset and solve for classification, regression, and clustering problems. The input of VGG16 is a fixed 224×224 RGB image, which passes through a stack of convolutional layers, where they use filters with a very small 3×3 receptive field, and utilizes the max-pooling, which is performed over a 2×2 window with stride 2. The stride and padding of all convolutional layers are fixed to one pixel. Then they apply transfer learning in pre-trained VGG models and use some techniques to improve the accuracy of our system., the performance of VGG19 is as near as VGG16 even they do not have enough time to train that model like VGG16. They have achieved the precision of 94%, 71% and 61% in damage detection, damage location and damage severity in VGG16 respectively. They accept the accuracy of 94.56% and 94.35% in the damaged detection, the accuracy of 74.39% and 76.48% in damage localization, the accuracy of 54.8% and 58.48% in damage severity respectively. By using both of transfer learning and regularization in VGG16 and VGG19 models. We use L2 regularization with its value 0.02 with 60 epochs in our models. They pretrained models not only detect damaged part but also assess its location and severity. Regarding to proposed models, still face the overfitting problem inmodels. Thus, in

future work, they said it is needed to utilize other types of regularization techniques with a large dataset.