**Paper 1:Car make and model classification from image**

[**(PDF) Car make and model classification from image (researchgate.net)**](https://www.researchgate.net/publication/372159544_Car_make_and_model_classification_from_image)

**Main purpose**

The main aim of the project is to develop a convolutional neural network (CNN) that can classify images of cars. and integrate this model into web applications. The application allows users to upload photos of their cars and receive predictions about the vehicle's make, model, and production year.

**Data set**

The dataset used to train the model is the Stanford Cars dataset. This dataset contains a total of 16,185 images spread across 196 car model classes.

**Methodology**

1. **Experimental method:**

* Several models have been evaluated through testing, such as GoogLeNet, ResNet-34, and ResNet-50.
* Pre-training was performed on the ImageNet dataset, then fine-tuning was performed using the Stanford car dataset.
* The final model selection depends on the prediction accuracy and time parameters.

1. **Web application development:**

* Web applications are developed using a development process model that allows flexible development along with the model.
* The application consists of a backend with API endpoints for model prediction. and a front end with a user-friendly interface.

**Conclusion**

* The ResNet-34 model was selected as the final model. It has a top-1 accuracy of 90.6% with a prediction time of 9 milliseconds per image. It performs better in terms of accuracy and prediction time compared to other models.
* The web application provides users with an interface for uploading images and receiving forecasts. With the ability to control the screen size of various devices. and touch screen input...
* The system has limitations. Including performance issues with non-car images And only JPG format images are supported.
* Future recommendations include expanding the dataset. Improving model scalability by deploying to cloud services.

**Paper 2:** An Empirical Analysis of Deep Learning Architectures for Vehicle Make and Model Recognition

**https://ieeexplore.ieee.org/document/9460843**

* **Main Objective**

The study will compare and improve the recognition of vehicle make and model using state-of-the-art deep learning techniques. This is aimed at classifying every different kind of vehicle based on its make, model, and year through the use of recent deep neural network architectures and performance optimization by various means.

* **Dataset**

Used within this study are two sources:

**Stanford Cars Dataset:** It consists of images of cars from 196 classes. For training, the dataset contains approximately 8,144 images, and for testing, it has about 8,041 images.

**VMMRdb-51 Dataset:** This is a subset of the VMMRdb dataset, which contains 51 classes common to the Stanford Cars dataset. It was used for exclusively testing the generalization performance of the models.

* **Methodology**

1. **Data Augmentation:** Several augmentation techniques were applied to the training dataset in order to increase the number of images and provide robustness for the model. It includes random erasing, horizontal flipping, random cropping, resizing, rotation, and sharpening.
2. **Transfer Learning:** Pre-trained models of ImageNet were used to reduce the time taken for training by enhancing its performance. Additional dropout layers were added so that issues regarding the fitting of data could be avoided, which would also improve generalization.
3. **Mix-up and cyclical learning rate:** policies were further employed for optimization in model training in order to avoid overfitting. The cyclical policy, on the other hand, provided a more suitable range of the learning rate for convergence with much higher efficiency.
4. **Some deep learning models here included:**
5. MobileNetV2
6. ResNet152
7. DenseNet121
8. Xception
9. Inception ResNetV2
10. DenseNet201

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1. **Ensemble Learning:** An ensemble of five homogeneous models was developed using k-fold cross-validation. In this approach, different models are combined in their predictions to increase general accuracy and robustness.

* **Conclusion**

This work also demonstrated that ensemble learning combined with state-of-the-art deep learning architectures and techniques for optimization of training has a significant positive impact on vehicle make and model recognition. The final results obtained using ensemble learning with DenseNet201 showed significant improvement over previous approaches; this evidences that the proposed approach effectively realizes high accuracy in vehicle classification tasks.