



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 5, May 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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Automated Identification of Vehicle Using Deep Learning Neural Network

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ABSTRACT: In recent years, the number of vehicles on the road is rapidly increasing and it causes different major concerns. One of the major effects of this increasing volume of vehicles is the traffic congestion it caused on our roads especially in the urban areas. This traffic congestion became one of the major problems in many cities in the world including Metro Manila, Philippines. Many options are discussed and implemented by the traffic management but it seems that it is still unsolved. In recent years, traffic congestions became unpredictable, there are parts of the cities that don't experience traffic congestion then suddenly traffic builds up to that area. Also, traffic congestion might happen every hour of the day.

With this concern, the study proposed a system for vehicle headlight recognition for on-road vehicle detection and counting. This study focused on the detection of the headlight of every vehicle that will be seen on the perimeter of the installed camera. The system can detect headlight vehicles during daytime and nighttime as we trained the AI to recognize the headlights in these scenarios. Possible applications of this system can be in monitoring the volume of vehicles within the area and it can be used by traffic management authority in monitoring the build-up of traffic or traffic situation in an area so that they can provide an immediate solution, such as re-routing, one-way street conversion.

I. INTRODUCTION

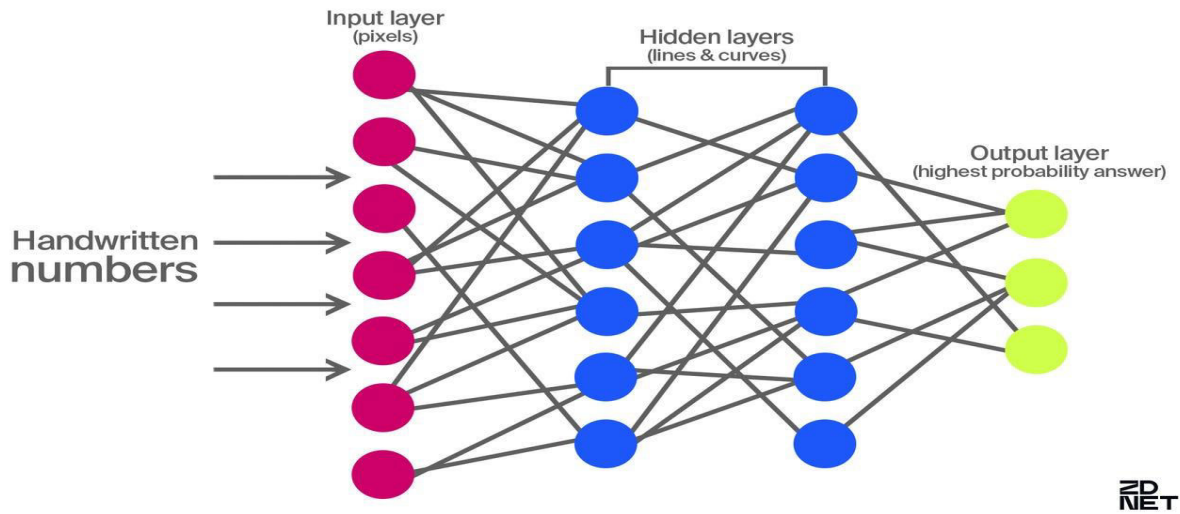
One of the most important reasons why cars have already become more important and prevalent is because it's a very easy way of transporting from one point to another. Getting from location A to B has actually never been easier and more convenient than ever before. As a matter of fact, if you have a car of your own, you do not need to rely on other public means of transportation anymore for your commutes every day, and you can also be able to enjoy the independence, liberty, and comfort that comes with your own car.

Though they offer the benefit of convenience, they also have certain negative effects as they add to air pollution and global warming, as well risks when they are not handled properly. In recent years, with the growing number of cars on our roads, one of its main consequences is the occurrence of severe traffic congestion. And traffic congestion nowadays become unpredictable, traffic can build up anytime and anywhere.

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II. DEEP LEARNING

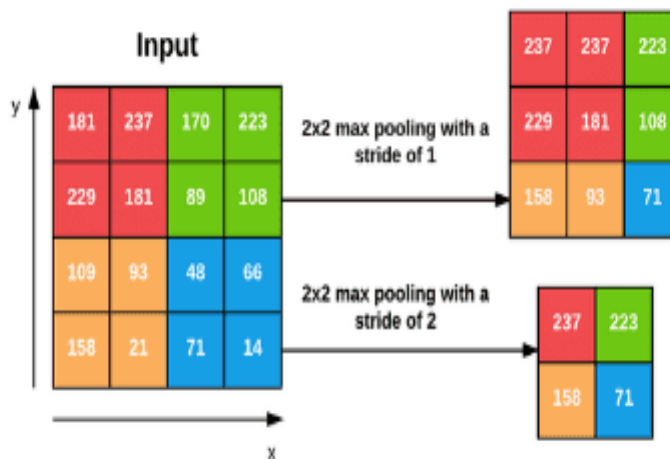
Deep learning (also known as deep structured learning) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised. Deep-learning architectures such as deep neural networks, deep belief networks, deep reinforcement learning, recurrent neural networks and convolutional neural networks have been applied to fields including computer vision, speech recognition, natural language processing, machine translation, bioinformatics, drug design, medical image analysis, climate science, material inspection and board game programs, where they have produced results comparable to and in some cases surpassing human expert performance.



III. CONVOLUTIONAL NEURAL NETWORK

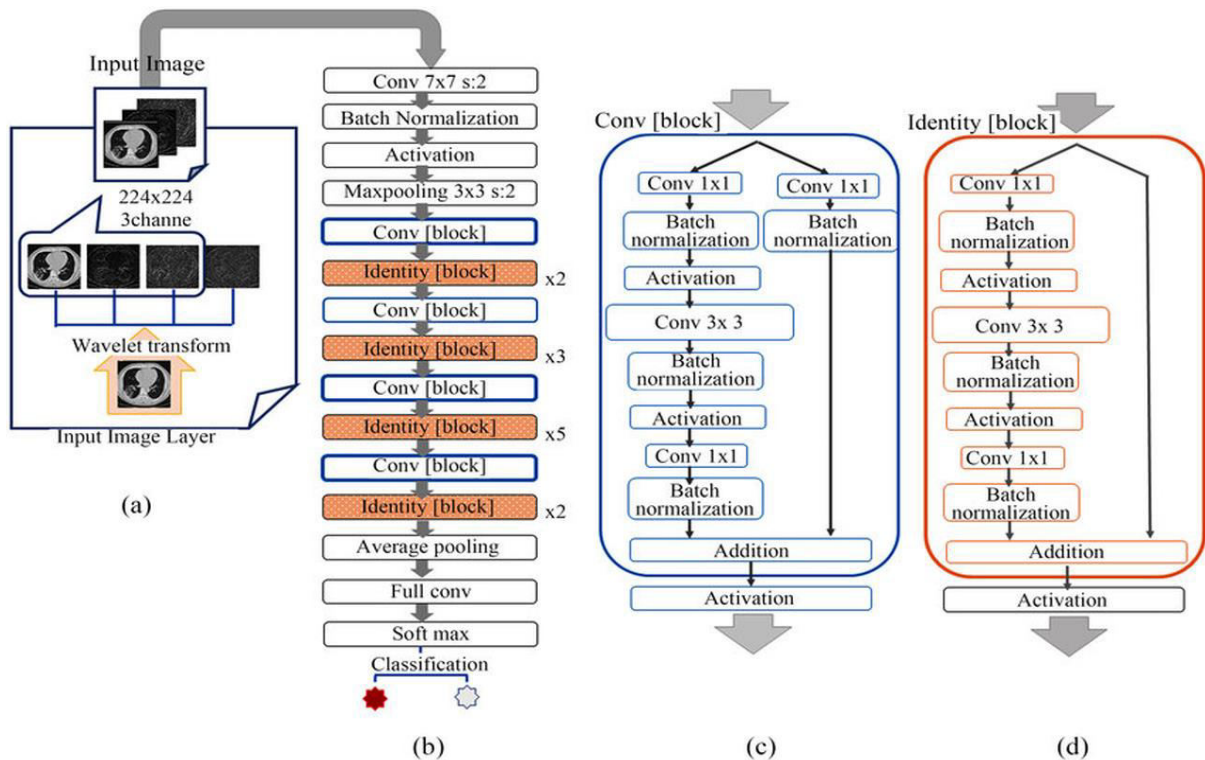
In deep learning, a convolutional neural network (CNN) is a class of Artificial Neural Network(ANN), most commonly applied to analyse visual imagery. CNNs are regularized versions of multilayer perceptrons. Multilayer perceptrons usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The "full connectivity" of these networks make them prone to overfitting data. Typical ways of regularization, or preventing overfitting, include: penalizing parameters during training (such as weight decay) or trimming connectivity (skipped connections, dropout, etc.) CNNs take a different approach towards regularization: they take advantage of the hierarchical pattern in data and assemble patterns of increasing complexity using smaller and simpler patterns embossed in their filters. Therefore, on a scale of connectivity and complexity, CNNs are on the lower extreme.

CONVOLUTIONAL NEURAL NETWORKS (CNNs) AND LAYER TYPES



IV. RESNET ARCHITECTURE

Over the last few years, there have been a series of breakthroughs in the field of Computer Vision. Especially with the introduction of deep Convolutional neural networks, we are getting state of the art results on problems such as image classification and image recognition. So, over the years, researchers tend to make deeper neural networks (adding more layers) to solve such complex tasks and to also improve the classification/recognition accuracy. But, it has been seen that as we go adding on more layers to the neural network, it becomes difficult to train them and the accuracy starts saturating and then degrades also. Here Resnet comes into rescue and helps solve this problem. In this article, we shall know more about Resnet and its architecture.



V. PROPOSED METHODOLOGY

To write a software pipeline to identify vehicles model using data set. In my implementation, I used a Deep Learning approach to image recognition. Specifically, I leveraged the extraordinary power of Convolutional Neural Network (CNNs) to recognize images. Having trained this type of a model, the input's width and height dimensions can be expanded arbitrarily, transforming the output layer's dimensions from 1x1 to a map with an aspect ratio approximately matching that of a new large input. Here this model classifies and detects whether a vehicle is a car, bus or a bike.

This paper creates a convolution neural network from scratch to classify and detect these vehicles using a modern convolution neural network based on fast regions. Mostly in order to solve a complex problem, we stack some additional layers in the Deep Neural Networks which results in improved accuracy and performance. The intuition behind adding more layers is that these layers progressively learn more complex features.

The skip connections in ResNet-34 solve the problem of vanishing gradient in deep neural networks by allowing this alternate shortcut path for the gradient to flow through. The other way that these connections help is by allowing the model to learn the identity functions which ensures that the higher layer will perform at least as good as the lower layer, and not worse. Let me explain this further. So we here use ResNet-34 architecture to get more accuracy. Here we are using 10 epochs for testing. To get more accuracy we can use 20, then can get 5-6 %percent more accuracy.

VI. DATA SET

We have collected the car data set from Kaggle. The Cars dataset contains 16,185 images of 196 classes of cars. The data is split into 8,144 training images and 8,041 testing images
Image Source: Towards Data Science

DATA set used : “CAR DATA”

Features : Model

Data set format : “.jpg”

No of images trained : 16,185 images

No of models of car : 196

Each model : 30-40 images

Size of each image : 50-200 kb

Our dataset consists of 16,185 total images (train set + test set) labeled with 196 classes based on the car’s Make/Model/Year. Here these images come in various sizes and resolutions. For this analysis, the 196 image labels in the dataset were consolidated to five vehicle types as shown in the figure below. Although these represent somewhat ‘crude’ consolidation of vehicle types, they proved to be more manageable, and adequate for the image classification task. Features for each of the car images were extracted from Deep Learning Convolutional Neural Networks (CNN) with weights pre-trained on ImageNet dataset. The creators of these CNNs provide these weights freely, and modeling platform Keras provided a one stop access to these network architectures and weights

VII. RESULT AND DISCUSSION

Here we have trained our model with resnet34 architecture by training 16,185 images of different models of cars. We have trained this model with GPU (graphical processing unit), it will take one day to train this many images. After that we have done normalizing and reshaping to required size to all images of train, test and validation images. After we set epochs to ten so that it will get trained by back tracing like a loop. After the model get trained, we have tried with different inputs from testing images to test the model. We got 82 percent accuracy to this model. And the accuracy may get increased by 5-10 percent, if epochs is set to 20.

Training Classes

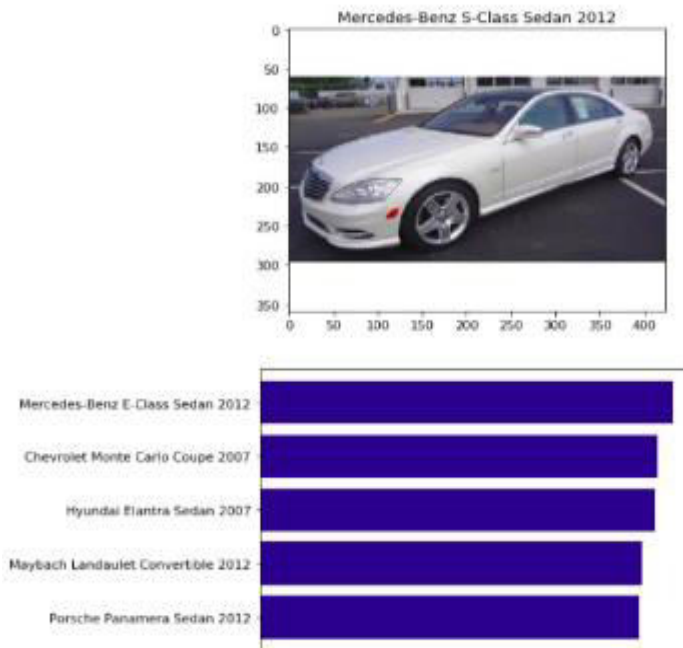
(196 classes of different cars, 17000 images in total)

This is the output of the model after training the 196 model classes, and the total trained images are 16,185 images. Here we are using GPU (graphical processing unit) interface rather than CPU (central processing unit) since CPU will take seven days to train our model as GPU take one day to train. Each having a 30-40 images and size of 50-200kb Here we taking data set as “.jpg” format.

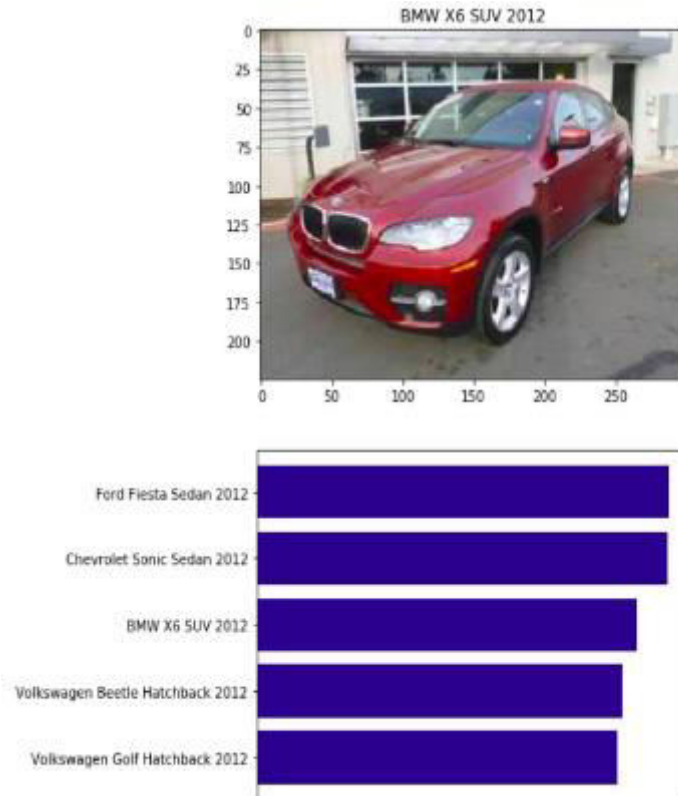




PREDECTION OUTPUT



CONFIDENCE OUTPUT



A trained deep learning neural network model can predict only at certain accuracy. We take the ground truth and estimate what is predicted rightly and what is not. And this is called correct prediction and miss-prediction.

VIII. CONCLUSION AND FUTURE SCOPE

Automatic detection of small objects such as vehicles is a very challenging task, due to the complexity of the background, vehicles colors, the large size of ground sample distance. Many methods were proposed for this task by using handcrafted features along with support vector machine classifier, however, Convolutional Neural Networks (CNN) have proved to be potentially more effective. Training this model with car dataset contains 16,185 images of 196 classes of cars. After we trained this model with 8,144 images 8,041 images for testing. We used GPU interface to train our model rather CPU interface since it takes seven days to train all the images as training with GPU will take one day. After that we are reshaping and normalizing the input images for training, testing and for validation by loading the data set from the directory. Here we write a software pipeline to identify vehicles model using data set. In this implementation, we used a Deep Learning approach to image recognition. Specifically, in this we leveraged the extraordinary power of Convolutional Neural Network (CNNs) to recognize images. Have trained this type of a model, the input's width and height dimensions can be expanded arbitrarily, transforming the output layer's dimensions from 1x1 to a map with an aspect ratio approximately matching that of a new large input. Here this model classifies and detects whether a vehicle is a car, bus or a bike. This paper creates a convolution neural network from scratch to classify and detect these vehicles using a modern convolution neural network based on fast regions. Finally, car model name and year of manufacture will be displayed on with the image of car. This model can be used as real time detection on embedded device with high accuracy, and can detection car at time and we can detect color of the car as extension to this project.

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