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Image Classification Of Automobiles Using Deep Learning In Tensorflow

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Abstract- The number of automobiles recently increased. The traffic level has also increased, leading to congestion and traffic accidents. A traffic accident has been a major challenge. Numerous machine-learning models have been developed to solve this challenge, and the existing system involves the use of hardware [11]. This model identifies the make of the car in the case of an auto-crash situation. Some auto-crashes are hit-and-run, involving parked vehicles, and some would be a vehicle hitting pedestrians, cyclists, and motorcyclists. Convolutional neural networks (CNNs) are used in this model to predict cars. **The convolutional neural networks (CNN) will aid in** ***identifying and recognizing the make of the automobile.***

Keywords—Automobiles, TensorFlow, Deep Learning, Convolutional Neural Network, Precision, Image Classification, Recall, Image Preprocessing, Accuracy, Data augmentation, Validation, Pandas, Confusion Matrix, Seaborn, NumPy, Matplotlib.

1. INTRODUCTION

Image Classification is the process of using a specific algorithm through the input image to provide a model, which outputs the class or the probability of the class to which the image belongs. Deep learning can be classified as the subfield of machine learning. For large amounts of data, the software consists of algorithms that allow it to perform image recognition by training itself to display multi-layered neural networks [1]. This classification of vehicles will enable us to calculate the percentage of vehicles that must be counted manually by humans and then automatically updated [13]. This project involves extensive usage of CNN as our primary architecture of classifiers. Deep learning allows the computer to recognize objects, shapes, speech, etc., independently. In deep learning, neural networks identify the features of an image that are built [2]. While image-preprocessing

techniques have improved over the years, they remain susceptible to changes caused by the external environment, and when unexpected changes occur, they usually lose accuracy.

When one function modifies (or convolves) the shape of another, it is called convolution. Image convolutions are typically used for a variety of purposes, including sharpening, smoothing, and intensifying. Images are analyzed using convolutions to extract prominent features.

1.1 THEORETICAL FRAMEWORK

The TensorFlow approach was used in this project to design the model. TensorFlow has one of the most significant advantages of deep learning, it is easy to work with because it provides C++ and Python APIs, and the compilation is faster than other deep learning libraries like Keras and Torch. TensorFlow has built-in libraries like Matplotlib to display the result of the model. The Scikit-learn machine-learning library is an open-source Python library.

Steps of TensorFlow Algorithm:

a) Data is imported/generated
b) Data normalization or transformation
c) Set and initialize the variables and placeholders
d) Create a model structure
e) Define the loss function
f) Train model
g) Evaluate the performance
h) Predict the outcome

Convolutional neural networks are used for a variety of tasks in computer vision. The TensorFlow framework permits highly flexible convolutional neural network architectures for creating computer vision tasks.

Train Convolutional Neural Network with TensorFlow, steps are:

a) Upload Dataset
b) Input layer
c) Convolutional layer
d) Pooling layers
e) Second convolutional layer and pooling layer
f) Dense layer
g) Logit layer

An attempt is made to replicate the human brain in deep learning. This is done by using something called artificial neural networks (ANN). Convolutional neural networks (CNNs), which are primarily used for image recognition, are extensions of artificial neural networks

(ANNs). There are several layers in Convolutional Neural Networks (CNNs), which allow them to learn complicated objects and patterns. A multitude of hidden layers follow the input layer and output layer. To generate the output layer, an activation function is applied after the input has been sub-sampled by means of convolution and pooling. The hidden layers are partially connected at the start but become fully connected at the end.

2. LITERATURE REVIEW

Auto-crash has been the most common traffic accident in recent years. Yearly, auto-crash Statistics show about 1.35 million death rates. Automobile crashes [11] have been ranked as one (ninth) of the leading causes of death. Whereas damages caused by car crashes cost virtually all the countries 3% of their GDP on average, statistics also show six million car accidents yearly [12]. Owning an automobile has become rapid in the 21st century. Numerous researchers in recent years have proffered approaches for determining vehicles and classifying them. According to [13], standard Principal Component Analysis (PCA) uses feature extraction. In [14], Scale Invariant Feature Transform became used to come across the rear images of vehicles [15][16], and the neural network enables the recognition of the make and model of the automobiles. The detection and tracking of vehicles entering can be accomplished by developing a vehicle detection and tracking system. Based on the classification of headlights, bonnets, front windows, and roof locations, this system measured optical glides and tracked vehicles [17]. A convolutional neural network may carry numerous distinctive obligations, including image recognition, object localization, and change detection [3] [18]. In image classification, an object is classified as a car, bicycle, rail, or other type of object [3]. In addition, it also refers to image localization, which identifies the specific location of these objects using restrictive fields. An image classification system relies on recognizing a variety of objects, such as cars, motorcycles, and buses, in order to classify them. It is possible to calculate the percentages of vehicles based on the automobile classification that might be manually counted by operators and often need to be updated because automated updating systems are not readily available. An automated vehicle classification system can help determine the thickness of road pavement in a cost-efficient manner. In addition, it can provide information about the types of vehicles that use a particular street [13]. [21] Recognizing the makes and models of cars is one such task. This is primarily a straightforward task for humans, particularly for automobile enthusiasts. The human eye can typically identify vehicles due to specific key components, logos, hood ornaments, or lettering. However, due to the visual complexity of cars, this has traditionally been an arduous task for computers [20].

A Computer Vision application has also been developed to identify each image's vehicle model. It was quite challenging to accomplish this type of task until recently, there is a lot of similarity between automobile models, and a vehicle may look differently depending on its surroundings and the angle from which it is viewed. Large datasets and domain-specific features are needed for the data to tackle automobile detection and identify traffic control and management. According to [6][19], From 2012 (the development of AlexNet) [4] until now, Convolutional Neural Networks (CNNs) have been applied to extract information from video streams and images. Aerial photographs differ significantly from the classical variants of images (ground-level images) in many ways, classification, semantic segmentation, and detection are most effectively performed by CNNs. When it comes to improving classification accuracy, effectiveness, and efficiency, neural networks are ideal [20][21][22]. The valuable factor for the success of deep convolutional neural networks [22] is access to large-scale labeled training data [3] [11]. The deeper the neural network, the more accurate it will be at classifying vehicle images [6].

3. DATA

The dataset was obtained from Kaggle, consisting of 9737 built-up images of 13 different brands of automobiles. The dataset was split into three broad categories: training, testing, and validation. The training dataset was used to train the prediction model, the test dataset was used to test the model's accuracy, and the validation dataset to evaluate the prediction model. Training dataset images are composed of 607 images of Mazda-2000, 589 images of Nissan-Zamiad, 787 images of Peugeot-206, 737 images of Peugeot-207i, 585 images of Peugeot-405, 738 images of Peugeot-Pars, 761 images of Peykan, 858 images of Pride-111, 749 images of Pride-131, 1005 images of Quik, 646 images of Renault-L90, 843 Images of Samand, 832 Images of Tiba2, in the split folder, I have used the split folders lib to split the data in 70:15:15 ratio to make it easier to use. The following are some images of the 13 different types of automobiles:

a. Tiba

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b. Quik

c. Peugeot-206

d. Pride-111

e. Peugeot-207i

Figure 1: Automobile dataset

Image classification with deep learning works with convolutional neural networks. Deep learning allows the machines to recognize and extract features from images. For image classification, convolutional neural networks (CNNs) are preferred. The compilation step configures the model for the fitting or training process. We created a configuration file and used TensorFlow DataLoader from the dataset directory. This procedure was followed by various data augmentation steps, such as randomly resizing and cropping the images to a particular dimension.

The image preprocessing and preparation are categorized into,

(a) Image resizing: The image is reduced in size, and unneeded pixel information is discarded.

(b) Data splitting: Divided the data into two or more subsets, one part for data testing and the other part for model training.

(c) Data normalization: The cohesion of the types of entities within the data model improve with the data attributes.

(d) Modeling: In order to communicate the connections between data points and structures within a whole information system, a visual representation of the whole is processed and created or parts of it are created and processed.

4. METHODS

As a deep learning approach works best with a large amount of training data, image classification is often performed using deep learning. An image category classifier is continually trained by the use of a pre-trained convolutional neural network ("CNN" or "ConvNet") that is trained to identify features in images. Image is taken as input and categorized into a prescribed class using image classification.

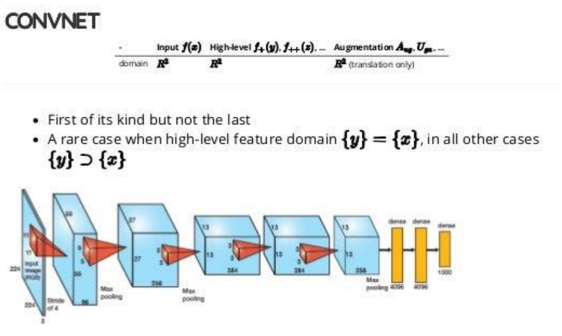

Figure 2: Keras (CONVNET) Architecture

Some Python libraries are used for the model development; examples are TensorFlow, Pandas, NumPy, Matplotlib, etc.

TensorFlow- This is an open-source machine learning library; TensorFlow assists in loading the data for model training and deploying it. Several

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programming languages are compatible with TensorFlow, including Python, JavaScript, C++, and Java.

Pandas- This library is used for data manipulation and analysis. It is used for importing and managing datasets. Pandas is also an open-source machine-learning library in Python.

NumPy- This library is used for calculations in Python and mathematical operations in code. It is also an open-source machine-learning package in Python.

Matplotlib- This is a data graphical plotting package and a data visualization library in Python. It is an open-source machine-learning library and can be used freely. Matplotlib is used for 2D graphics.

Seaborn- This Python library provides more attractive data visualizations based on Matplotlib. A high-level graph is provided to help the user understand data at a higher level.

Data processing techniques used are.

i. Data cleansing: Data are not all accurate and correct, so cleaning of data is necessary.
ii. Handling of missing values
iii. Transformation of a variable to the required format needed.
iv. Scaling of numerical variables
v. Divide the data set into the train, test, and validation datasets.

5. IMPLEMENTATIONS AND EXPERIMENTS

The automobile images were resized to 180 X 180; the dataset was loaded using a batch size of 32. That is, the

tensor of the shape of the image batch is (32 batch size, 180 image width, 180 image heights, 3), whereby the last dimension means the color channels RGB. A total epoch of 60 was used while training. The data is loaded using a Keras utility that takes the data from the image's directory to the disk. The class names were obtained from the attribute of the dataset. Two essential methods were used to configure and ensure performance: The dataset cache, after images are loaded off disk. They are kept in memory as part of the dataset cache. During the first epoch, the dataset cache helps prevent the dataset from becoming a bottleneck while training the model. The second method involves prefetching datasets for overlaps during data preprocessing. The data were standardized using Keras layers rescaling (1. / 255).

With Keras, there are three convolution blocks with different max pooling layers (the layer is fully connected) and units of 128 ('relu') that are activated using a ReLU activation function. The model was compiled using the Adam optimizer and loss function, which was then passed into the metrics for each training epoch. You can view the accuracy of the training and validation. In this process, the uploaded image is converted into a tensor image by applying a series of defined preprocessing steps, such as resizing and normalization.

6. RESULTS

A few analyzed parameters are obtained from the results, including precision, recall, F1 score and Support. Based on our dataset, support refers to the number of occurrences of a particular class. The results also entail the classification report from the confusion matrix generated from the heatmap.

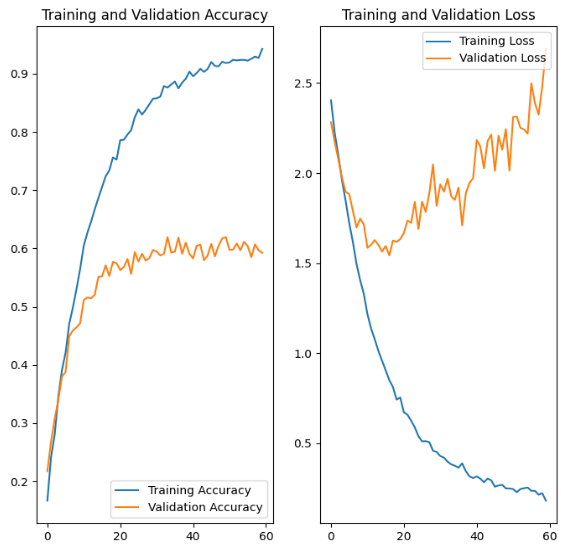

Figure 3: Training, validation accuracy, and loss

The average training accuracy obtained was 94.27%, and the average validation accuracy of 60% after training the model for 60 epochs.

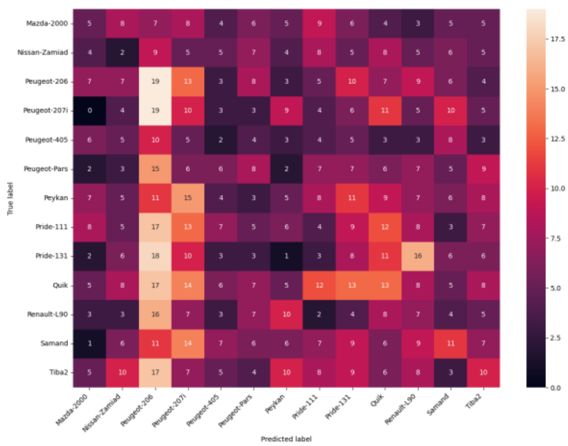

Figure 4: Confusion matrix

A classification report was obtained based on the confusion matrix, as shown in figure 4.

	Precision	Recall	F1-Score	Support
Mazda-2000	0.09	0.07	0.08	75
Nissan-Zamiad	0.03	0.03	0.03	73
Peugeot-206	0.10	0.19	0.13	101
Peugeot-207i	0.08	0.11	0.09	89
Peugeot-405	0.03	0.03	0.03	61
Peugeot-Pars	0.11	0.10	0.10	83
Peykan	0.07	0.05	0.06	99
Pride-111	0.05	0.04	0.04	104
Pride-131	0.08	0.09	0.08	93
Quik	0.12	0.11	0.12	121
Renault-190	0.07	0.09	0.08	79
Samand	0.14	0.11	0.12	100
Tiba2	0.12	0.10	0.11	102

Table 1: Classification Report

7. DISCUSSION AND CONCLUSION

This project is to provide knowledge about various vehicles, making it easier to identify vehicles involved in an auto crash using a deep learning approach in TensorFlow. By using preprocessing techniques for resizing and normalization, the model is optimized.

Moreover, the deep learning approach is also helpful in developing tools that can aid the classification of automobile make, particularly in the issue of auto-crash and traffic collisions.

The delimitation of this work is the use of old-version vehicles; having a newer version of vehicles will make our model immediately applicable to recent happenings.

A further research work would involve the use of another neural network in training the model.

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