Vehicle Detection in Various Weather Conditions

The development of a deep learning algorithm for detecting weather conditions from images involves several structured steps to ensure accuracy and robustness.

Methodology:

1. Dataset Preparation:

Data Collection: The images were grouped into four classes, namely rainy_day, rainy_night, sunny_day and sunny_night any class could not contain a few images.

Data Splitting: Splitfolders library was used to split the dataset into the training set at 70%, validation set at 20%, and the test set at 10%. The division is mainly done to make the tokens sets impartial and it also helps in making it capable of generalizing over the unseen data.

2. Data Loading:

In this, datasets were loaded using TensorFlow's image_dataset_from_directory function, from the directories created during the datasets splitting process. This function assists in keeping the images in the appropriate format and grouping them within a batch for training or testing.

3. Model Architecture:

A CNN was first created and developed using keras Sequential API. This model has batch normalization layer followed by multiple convolutional layers that learn spatial features, followed by pooling layers to downsample the feature map and dense layers that provide the final classification. The intention of the architecture is to properly record details and variations of the weather conditions.

4. Training:

The model was compiled using the Adam optimizer was chosen for efficiency on large datasets and sparse gradient. The loss function that was utilized was sparse categorical cross entropy which is ideal for use in multi class classification. Training was conducted with callback for saving the best model based on the validation accuracy meaning the generalization ability of the model was saved. Such a model yields the training accuracy of 99.30 %.

5. Evaluation:

Once the training was done the accuracies of the model on the validation as well as test data sets were evaluated. The features of the model include having got the test accuracy of 99.29 %. Moreover, it was decided that the Mean Average Precision with the abbreviation of mAP is equal to 1. 0 which depicted a very good performance in the identification of the various

types of weather.

Highlights

- **Balanced Data Splitting:** This means that use of the split-folders library ensured that all the data was split fairly with three parts as the training, the validation and the testing sets. Such thinking is useful in an effort to avoid the curse of model complexity hindering it from overfitting well to the training data and thereby yielding biased results.

- **Efficient Data Pipeline:** TensorFlow proved to be useful in loading and prefetching of data which made the training much more manageable. The data prefetching helps to coordinate the preprocessing of the data and performing the model which fastens the training process.

- **Comprehensive Model Architecture:** CNN must be designed in a way that multiple layers of convolution and pooling into the network which gives the spatial hierarchy of the images. This deep architecture is important when it comes to analyzing forms of the weather conditions displayed by those images.

- **Automated Best Model Selection:** Model checkpoint enabled the model to save the model that was performing best while training the model was ongoing. This procedure is useful to retain only the model which is having the high accuracy in the validation set which is very good and perfect.

- **Evaluation on mAP:** Moreover, apart from comparing precision, recall, and F1 score, the given was assessed with the help of Mean Average Precision (mAP). It is advantageous in deciding the models used in the processes of object detection and classification given that the detection performance is best illustrated.

Conclusion

It includes a proper preprocessing of the images, a proper design of the model structure, and proper metrics for the evaluation of the results for achieving proper detection of the weather condition from the images. The major ideas including the split of data and better performance measurements are clear indications of the efficiency of this detection algorithm. As for the training accuracy, the best achieved value was 99. 30% and test accuracy of 99. 29%, and a perfect mAP score of 1. Closing the accuracy rate at 0, the model proves great competency on how it performs the function of distinguishing between various weather types.

Github: https://github.com/Kavin56/ICDEC-2024-Challenge-Vehicle-Detection-in-Various-Weather-Conditions

Contact

NAME: KAVINKUMAR VS

PHONE : +91 9344039624

EMAIL : vskavinkumar2004@gmail.com