UNIVERSITY OF INFORMATION TECHNOLOGY AND SCIENCES

Project Name : Train a model that can classify vehicles from their images

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Introduction

The objective of this project is to develop a system for classifying vehicle types from images using machine learning techniques. Two approaches were explored: a conventional method using Histogram of Oriented Gradients (HOG) features with Support Vector Machine (SVM), and a modern deep learning approach utilizing a Convolutional Neural Network (CNN). By comparing these techniques, the project aims to identify the strengths and limitations of each method in handling image-based classification tasks.

Dataset Description

The dataset used for this project is the "Vehicle Type Recognition" dataset, downloaded from Kaggle. It contains images of different vehicle categories organized into separate folders for each class. Key characteristics of the dataset:

Classes: Multiple vehicle types such as cars, buses, motorcycles, and trucks.

Image Size: Images were resized to 64x64 pixels for uniformity.

Normalization: Pixel values were scaled to the range [0, 1] for deep learning models.

Train/Test Split: 80% of the dataset was used for training, and 20% for testing.

Methodology

Conventional Approach: HOG + SVM

1. **Feature Extraction**:

   HOG was used to extract robust features capturing the shape and edge information of vehicles. Images were converted to grayscale for HOG feature computation.

2. **Classifier**:

   SVM with a linear kernel was trained on the extracted features.

Deep Learning Approach: CNN

1. **Model Design**:
   - A CNN architecture with convolutional layers, max-pooling layers, and a dense layer was implemented.
   - Dropout was applied to prevent overfitting.
2. **Training**:
   - The model was compiled with the Adam optimizer and categorical cross-entropy loss.
   - It was trained for 10 epochs with a batch size of 32.

3.Evaluation:

- Metrics such as accuracy and loss were computed for training and testing datasets.
- The model's performance was visualized using plots of accuracy and loss over epochs.

Results and Discussion

The SVM classifier achieved moderate accuracy but struggled with complex vehicle classes where inter-class variations were subtle. Computationally less expensive, interpretable feature extraction. Manual feature engineering required; less effective for high-dimensional data. The CNN model outperformed SVM, achieving higher accuracy and better generalization. Automatically learns features directly from image data; highly effective for complex patterns. Requires more computational resources and larger datasets for optimal performance.

Conclusion

The project demonstrates the advantages of modern deep learning methods over conventional machine learning techniques in image classification tasks. While the HOG + SVM approach offers simplicity and interpretability, the CNN approach excels in handling the complexities of image data, delivering superior accuracy.