Car Model Classification

Computer Vision Slide – Group 15

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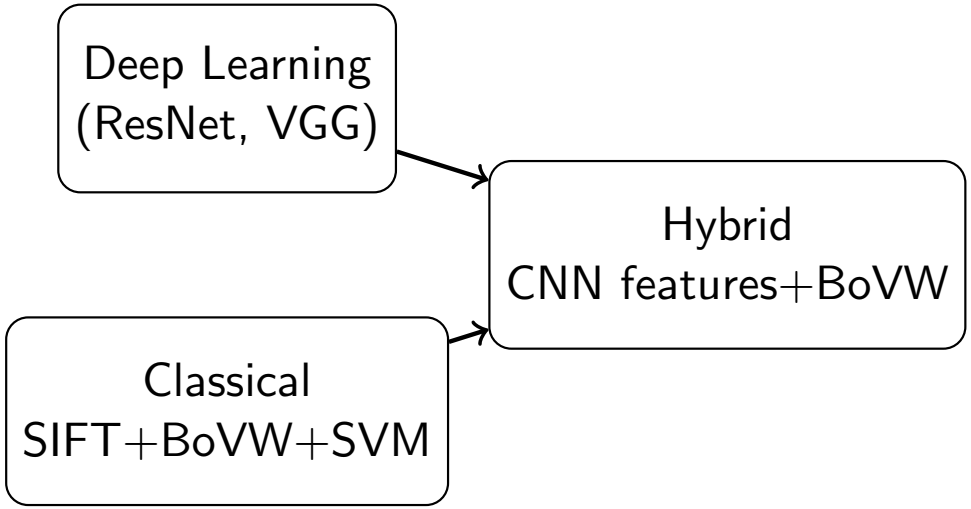
Problem Definition

- **Input**: An image of the car
- **Output**: Car make & model (8 classes)

Global & Existing Approaches

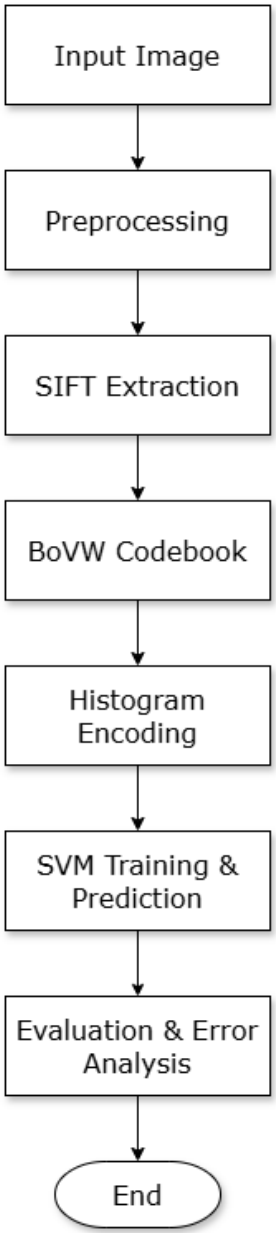


Common solutions:

- **Deep Learning**: fine-tuned CNNs (ResNet, VGG) — high accuracy, heavy compute
- **Classical**: SIFT + BoVW + SVM — interpretable, low resources
- **Hybrid**: CNN features + BoVW + SVM — balanced performance

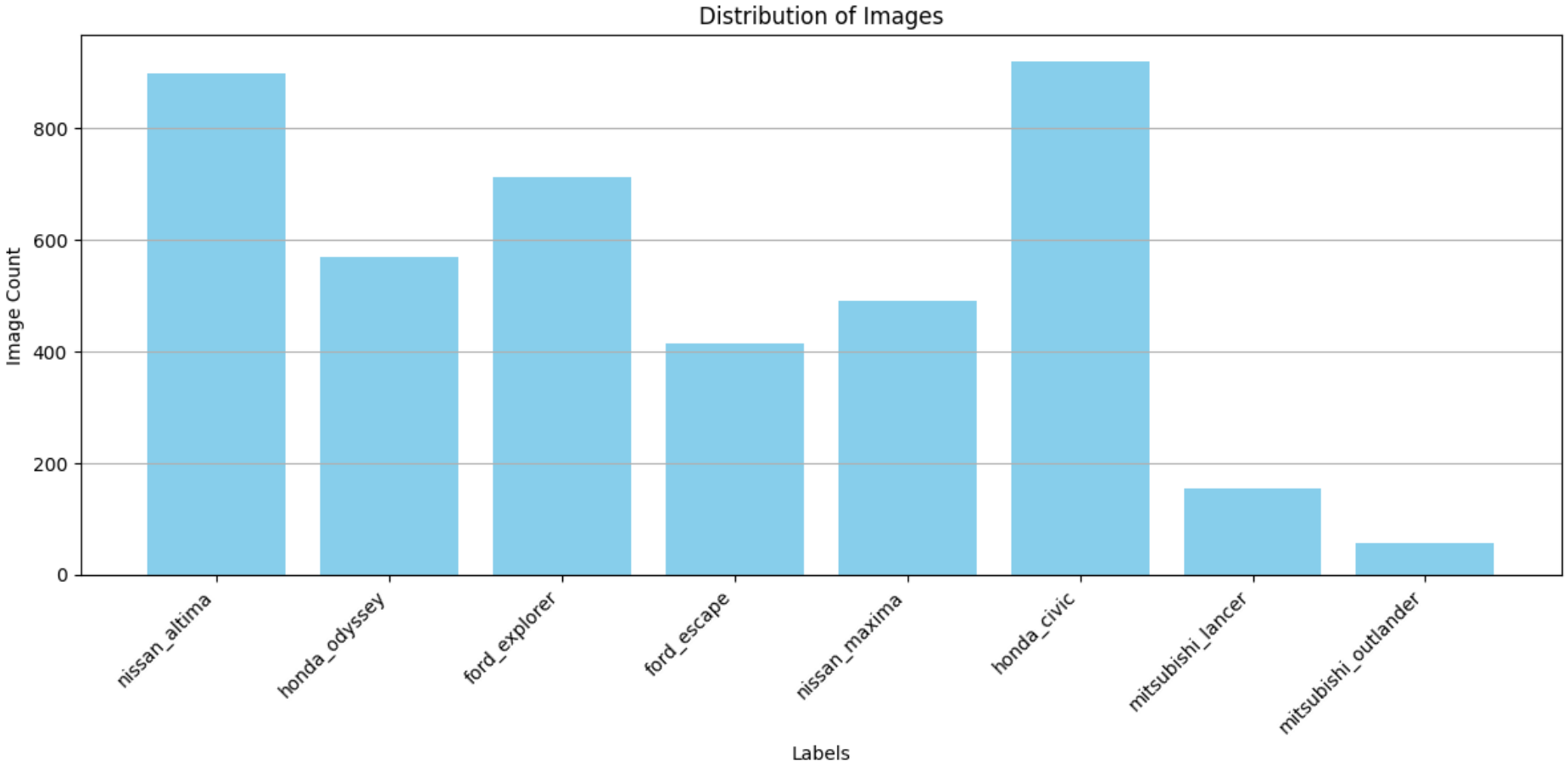
Summary from report Introduction and Related Work

Our Approach Overview



Data & Splitting

- Dataset: 4,216 images, 8 classes
- Method: 80% train/10% val/10% test

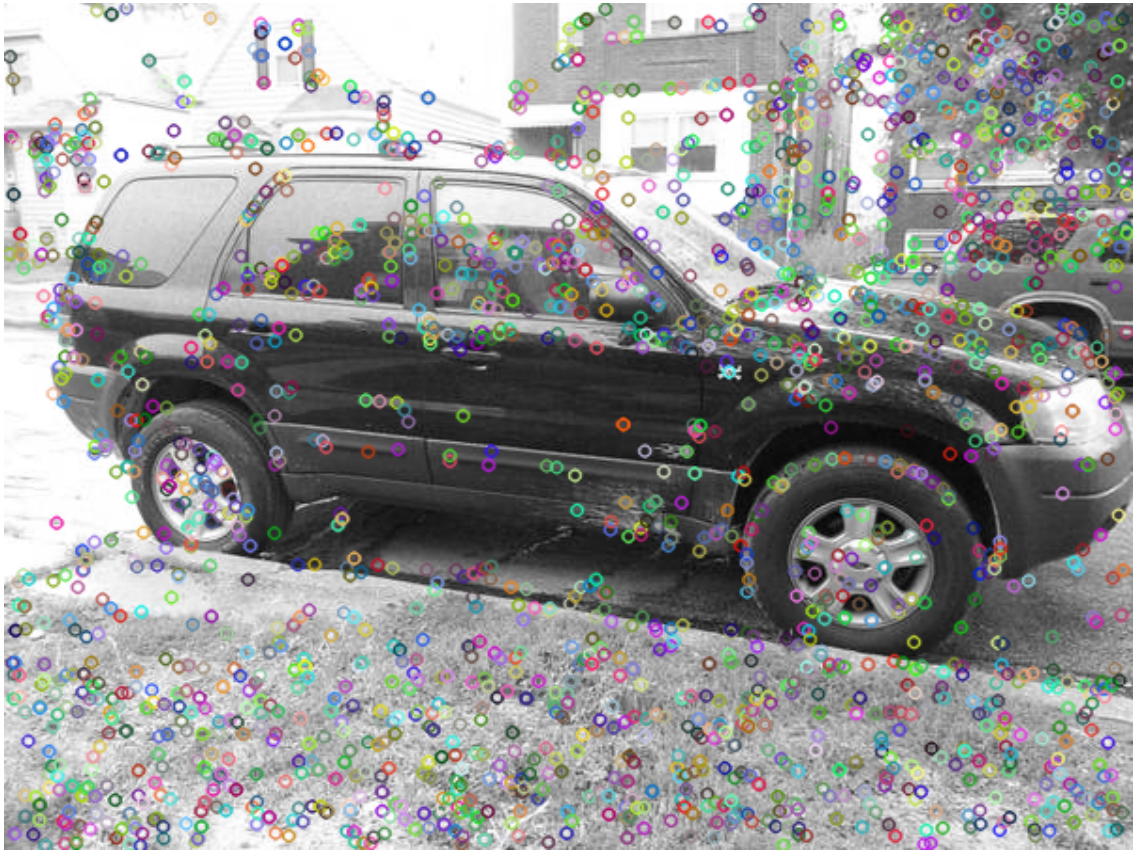


Preprocessing

- Resize to 256×256
- Convert to grayscale
- Label encoding

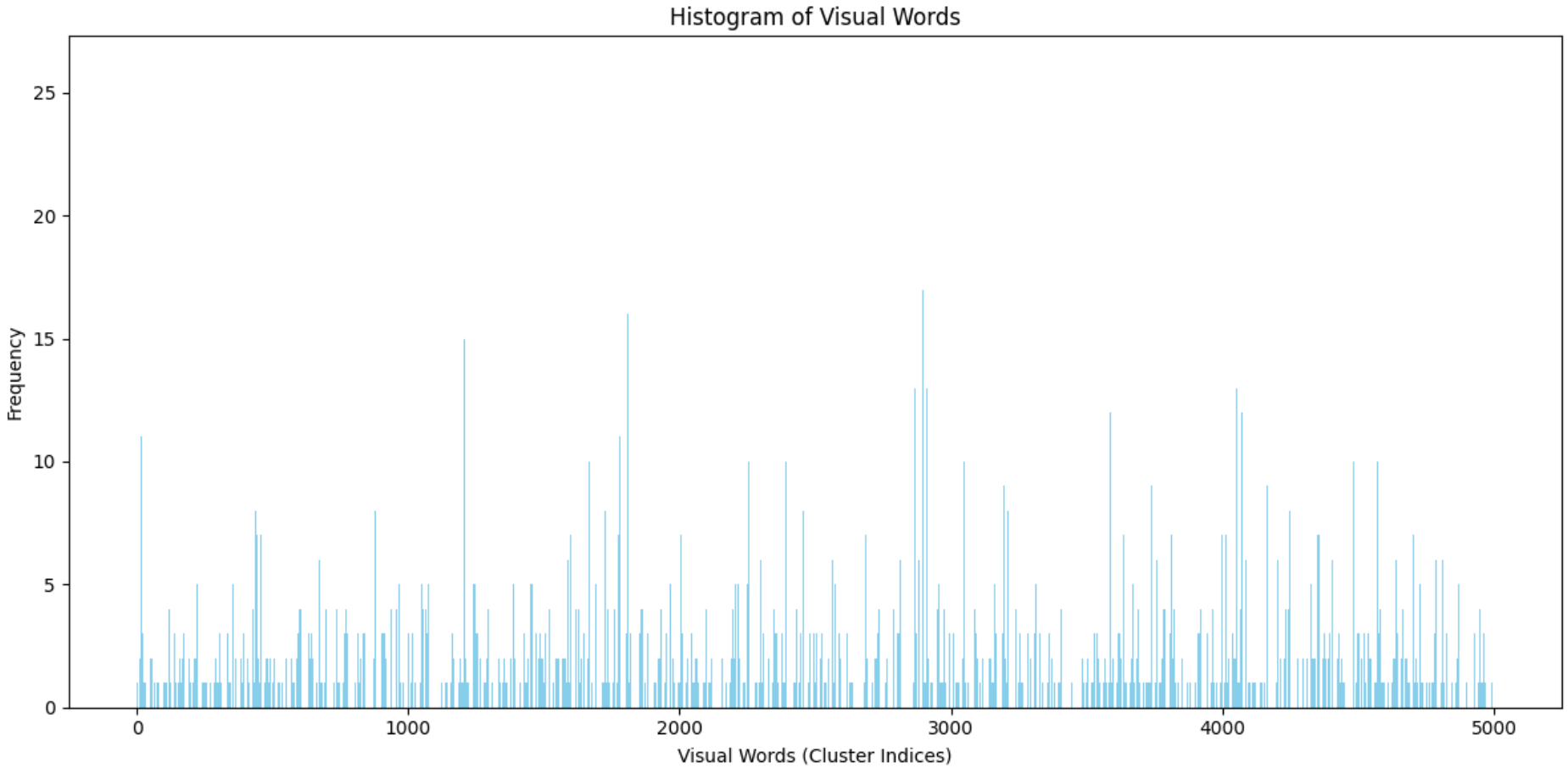
Feature Extraction (SIFT)

- Detect keypoints
- Compute 128-D descriptors



Codebook (BoVW)

- k-means clustering (k=5000 visual words)
- Map descriptors to histogram



Classification (SVM)

- Kernels: Linear, RBF, Sigmoid
- Training: 3 370 images
- Validation: 418 images
- Test: 428 images

Evaluation & Comparison

We evaluated our models on four key metrics and highlight the best results:

- **Metrics**: Accuracy, Precision, Recall, F1
- **Sigmoid SVM**: Accuracy 60%, F1 0.58
- **ResNet-18 fine-tune**: Accuracy 75%, F1 0.72

Error Analysis

Class	Precision	Recall
BMW	0.62	0.55
Audi	0.58	0.50
Toyota	0.65	0.60
Ford	0.60	0.57

Table: Per-class precision and recall from test results

Overlap between BMW and Audi features leads to misclassifications.

Conclusion & Future Work

- Classic pipeline plateau at 60% accuracy
- Kernel switching alone is not enough
- Current model can't be deployed for real-life applications
- Next steps:
  - Collect more data on imbalanced classes
  - Data augmentation & hyperparameter tuning
  - Ensemble methods

Questions?

The End