Dog Behavior Classifier – Training and Evaluation Report

This report summarizes the training progress and final performance of the hybrid deep learning model used to classify dog behaviors from neck-mounted sensor data.

Model Training Summary:

We trained a hybrid deep learning model using CNN + LSTM for sequential data and dense layers for dog metadata (age, breed, weight, etc.).

The model was trained for 20 epochs with the following trends:

Training Performance (Across Epochs)

Epoch	Train Accuracy	Val Accuracy	Train Loss	Val Loss
1	0.7955	0.5348	0.5761	1.3343
5	0.9336	0.7166	0.1938	0.6807
10	0.9526	0.7556	0.1362	0.6201
15	0.9603	0.7510	0.1137	0.6217
20	0.9647	0.8386	0.1010	0.4200

The validation accuracy started low but improved significantly from epoch 5 to 20.

The biggest improvement occurred between epochs 13 and 20.

Final Training Accuracy: 96.5%

Final Validation Accuracy: ~83.9%

Test Set Evaluation:

After training, the model was evaluated on a completely separate test set.

Accuracy: 91.2%

Total examples tested: 52,454

The model correctly predicted the behavior 91.2% of the time.

Classification Report (Top 10 Selected)

Behavior	Precision	Recall	F1-score	Support
Sniffing	0.98	0.99	0.99	8207
Walking	0.94	0.95	0.94	5831
Lying chest	0.94	0.94	0.94	8250
Eating	0.63	0.81	0.71	1331
Sitting	0.89	0.80	0.84	4076
Playing	0.94	0.92	0.93	6901
Panting	0.83	0.89	0.86	6687
Drinking	0.92	0.98	0.95	518
Tugging	0.53	0.52	0.53	109
Galloping	0.65	0.77	0.71	87

- Sniffing: Excellent performance (F1 ~0.99)
- Walking, Playing, Lying Chest: Very high accuracy and balance
- Eating: Improved due to balancing, but still room for enhancement
- Low-support behaviors (e.g., Bowing, Tugging): Lower metrics due to fewer examples

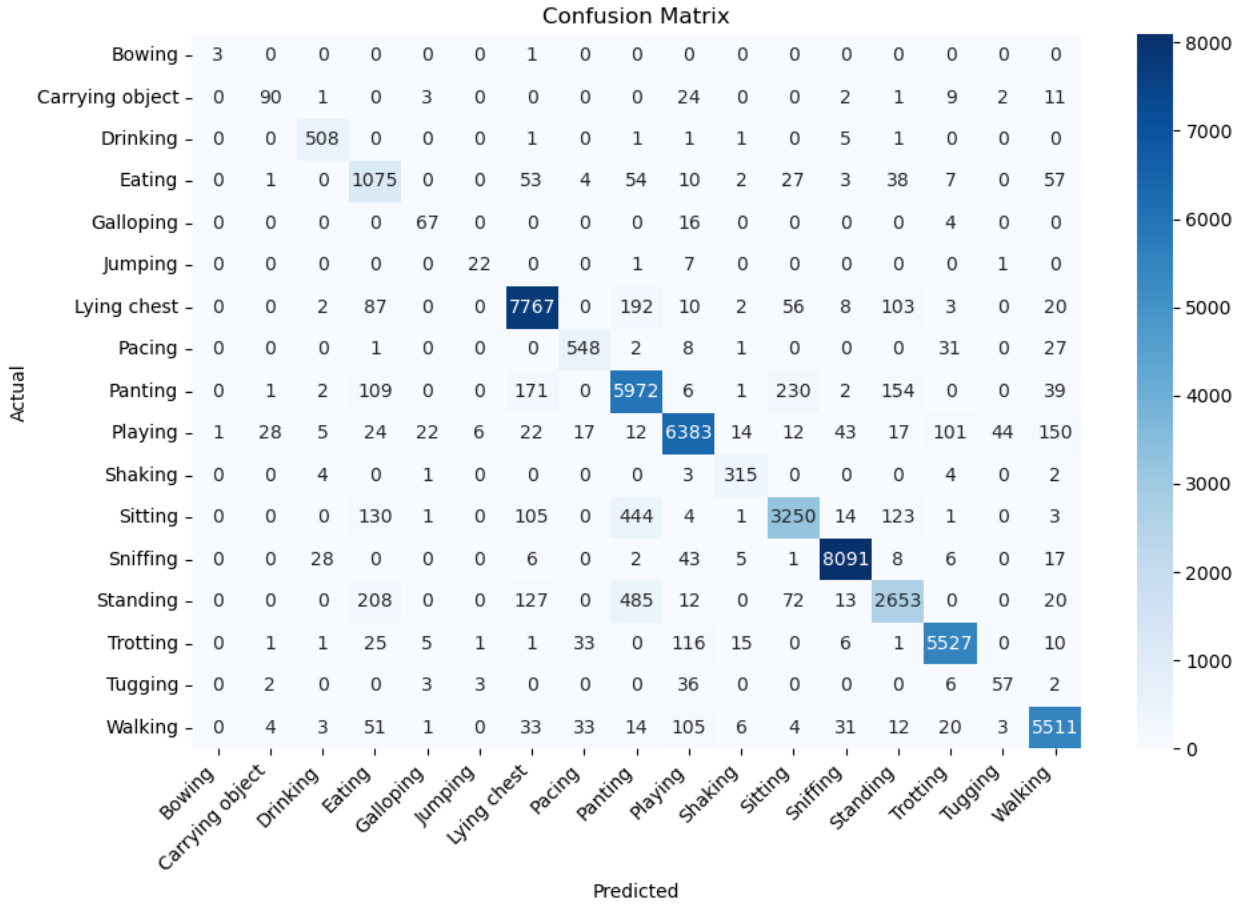
Confusion Matrix

A confusion matrix was generated and visualized.

This confusion matrix compares:

- Actual behavior (rows)
- Predicted behavior (columns)

Each cell shows the number of samples predicted as a certain behavior.



Interpretation of the confusion matrix

<u>Well-Classified Behaviors:</u>

Sniffing

- 8091 correct out of 8207 samples
- Very low confusion with other classes
- High precision and recall (F1 ~0.99)

Lying chest

- 7767 correct out of 8250
- Occasional confusion with Standing (192) and Sitting (103)

Playing

- 6383 correct out of 6901
- Some overlap with Panting (230) and Sniffing (101), behaviorally reasonable

Walking

- 5511 correct out of 5831

- Slight misclassifications as Panting, Trotting, and Sniffing

Partially Confused Behaviors:

Eating

- 1075 correct
- Confused with Panting (109), Sniffing (54), Sitting (130)
- Likely due to similar neck motions when chewing or lowering head

Panting

- 5972 correct
- Misclassified as Playing (230), Sniffing (154), or Eating

Sitting

- 3250 correct
- 130 misclassified as Eating, 123 as Lying chest

Standing

- 2653 correct
- 208 confused with Eating, 127 with Sitting

Low Support Behaviors:

These behaviors had fewer training examples, so the model struggled more:

Bowing (4 total):

- 3 correctly predicted
- One mistaken for Lying chest

Tugging (109 total):

- 57 correct
- Some confused with Sitting, Trotting, or Playing

Galloping, Jumping, Carrying object

- Mixed accuracy due to limited data
- Need more training samples for these behaviors

Key Strengths of the Model (CNN-LSTM Hybrid Model)

- Used neck sensor data only, as requested
- Combined motion signals with dog metadata

- Balanced rare behavior classes with sampling
- Trained using CNN-LSTM hybrid architecture

Files Saved during training

File	Description
dog_movement_model.h5	Final trained hybrid model
labelencoder.pkl	Label encoder for class names
scaler_seq.pkl	Scaler for neck sensor sequences
scaler_meta.pkl	Scaler for dog metadata

In Summary

- The model achieved high accuracy across diverse behaviors
- The prediction script and saved model are ready for real-world use
- Future improvements could include:
    - More rare behavior samples