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Adaptive Hybrid Optimizer based Framework for Lumpy Skin Disease Identification

LUMPNet: YOLOv11 + EfficientNet + AWDR optimizer

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Why early LSD detection matters

Contagious viral disease

Spread by blood-feeding insects. It harms livestock health and threatens the economy and food security.

Early signs are subtle

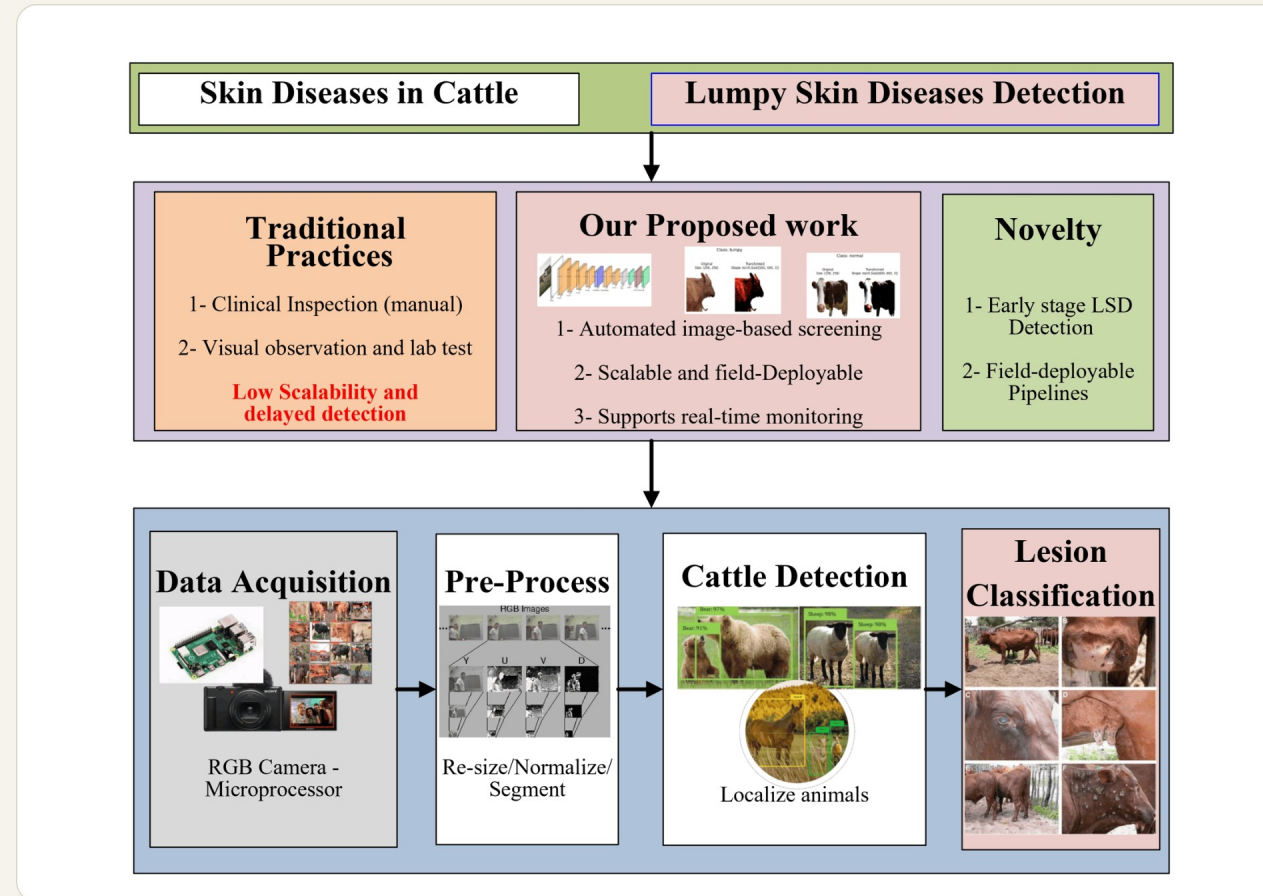
Fever, swelling and reduced milk yield come first. Skin nodules are less pronounced in early stages.

Gaps in prior work

Weak generalization across environments, scarce data, and slow convergence limit real-world use.

Goal: detect and classify skin nodules from images, as early as possible.

Proposed framework at a glance



LUMPNet pipeline

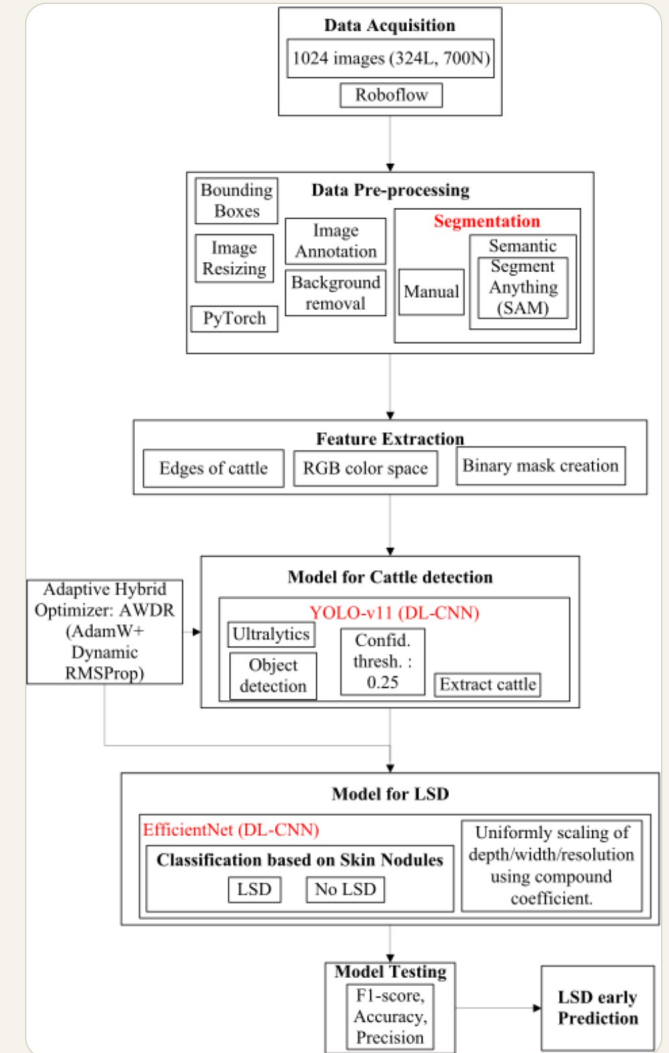
1 · **SAM**: segments the cattle and masks the background.

2 · **YOLOv11**: detects cattle and nodules (confidence threshold 0.25).

3 · **EfficientNet**: classifies LSD versus healthy.

Both networks are trained separately with AWDR.

Detection output feeds the classifier only at inference time.



AWDR: adaptive hybrid optimizer

Dynamic RMSProp

Adaptive variance smoothing: stable gradient updates early in training.

$\beta(t)$
dynamic blend

Decoupled weight decay

AdamW-style regularization for better generalization in later epochs.

Stable gradients

Faster convergence

Less overfitting on small data

Dataset and setup

1,024

public cattle images (Kaggle),
mild to extreme nodules

324 / 700

LSD-affected / healthy images

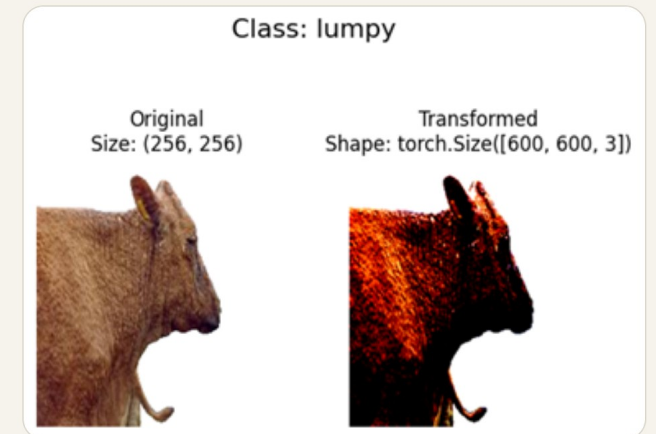
724 / 300

train / held-out test images

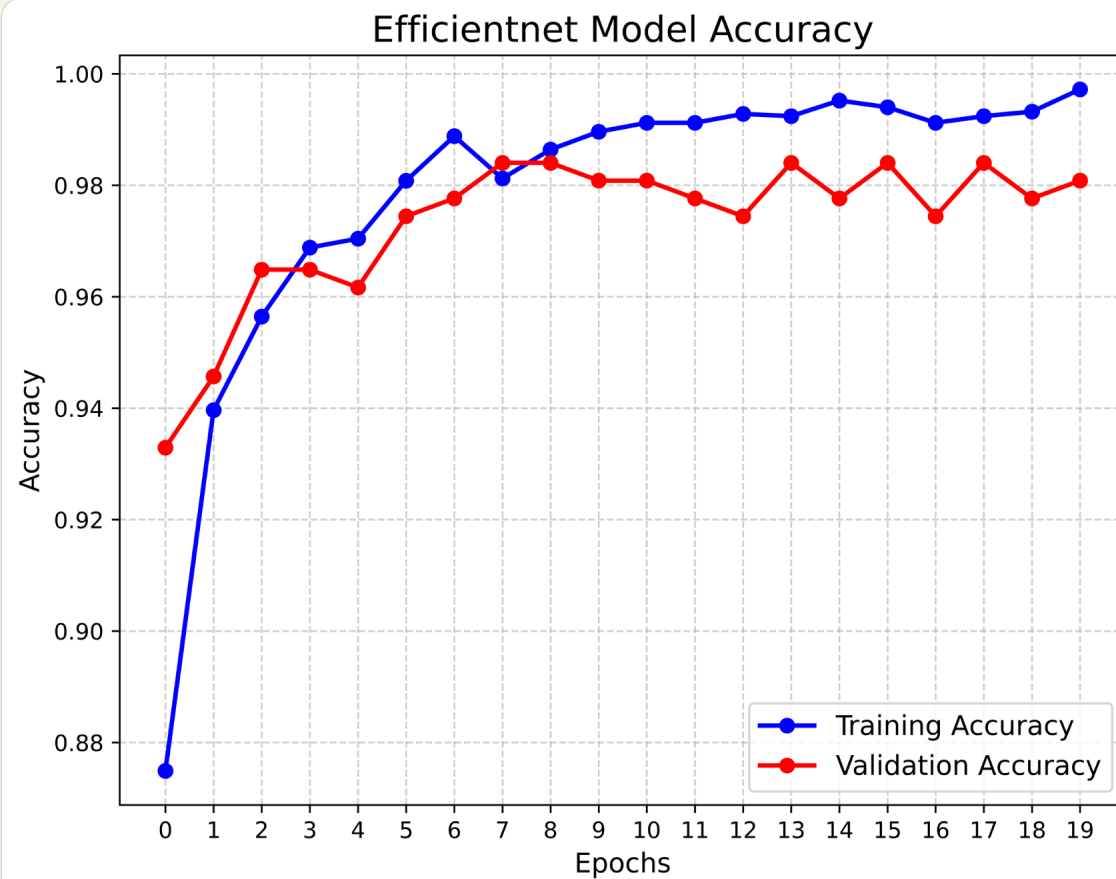
Split: train 500 healthy + 224 LSD; test 200 healthy + 100 LSD.

Hardware: NVIDIA RTX 4090, 64 GB RAM, 13th-gen Core i9; CUDA, plus Google Colab.

Right: sample image, original (256×256) versus transformed (600×600×3).



Training behavior: EfficientNet



≈ 0.997

training accuracy by epoch 19

≈ 0.98

validation accuracy, plateauing after epoch 7

Results

98%

classification accuracy

0.99

precision, recall and F1-score

Reported accuracy, image-based LSD detection

SVM on CNN features (Girma 2021)	95.7%	1,740 images
MobileNetV2 + RMSprop (Saqib 2024)	95%	793 images
MobileNetV2 (Senthilkumar 2024)	96.39%	public data
Vision Transformer (Ullah 2025)	98%	8,000 images
LUMPNet (this work)	98%	1,024 images

Datasets differ across studies; not a like-for-like benchmark.

Comparison with similar studies

Table 3. Comparison with similar studies

Model	Accuracy
Extreme Learning Machine (ELM)	92%
DenseNet121	90%
CNN Model	89%
MobileNetV2	84%
RMSProp + MobileNetV2	95%
Proposed LUMPNet	99%

Conclusions

Two-stage pipeline

YOLOv11 localizes nodules;
EfficientNet classifies LSD versus
healthy cattle.

AWDR optimizer

Blends variance smoothing
with decoupled weight
decay for stable, fast, well-
generalizing training.

Strong accuracy

98% accuracy and 0.99
precision, recall and F1 on a held-
out set.

Next: generalization to real field conditions and early-stage lesion variability.

Thank you. Questions?