Deep Learning

Assignment 4

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Deep Learning-Based Lung Cancer Classification Using AlexNet and YOLOv9

1. Proposed Method

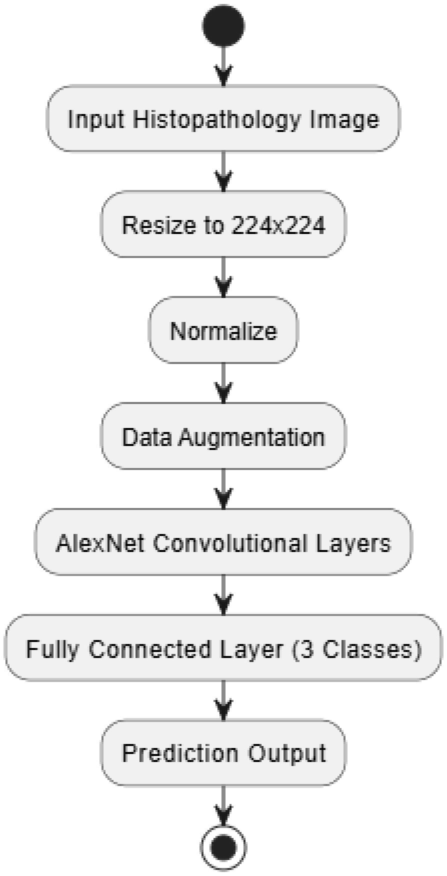
In this research, two advanced deep learning architectures, AlexNet and YOLOv9, were implemented to classify lung cancer using histopathological images. Each model was chosen for its unique strengths: AlexNet for its strong classification ability on static images, and YOLOv9 for real-time object detection and classification. The methodology focuses on transfer learning, effective preprocessing, and extensive evaluation of both models' performance.

The key goals of the proposed method are:
- To achieve high accuracy in classifying lung cancer types using AlexNet.
- To demonstrate the feasibility of real-time detection using YOLOv9.
- To improve model generalization through robust data augmentation.
- To compare the performance of our models with state-of-the-art techniques.

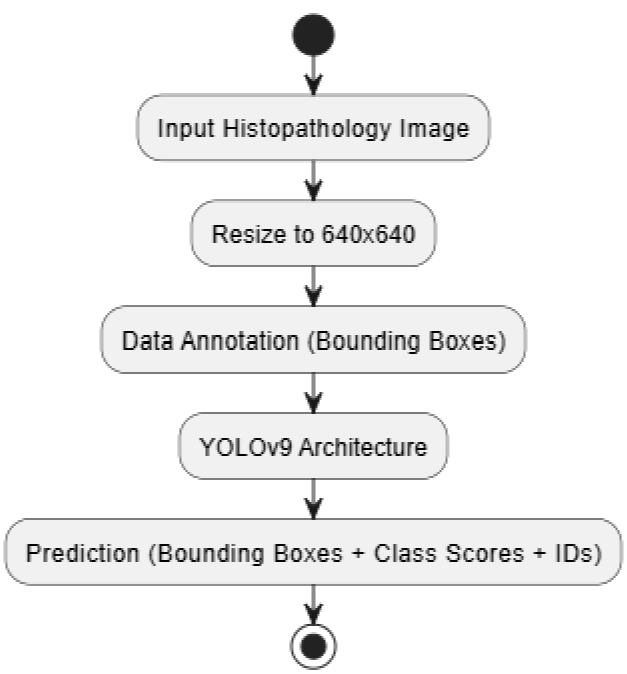
2. Diagram of Proposed Work

AlexNet and YOLOv9 pipelines are shown below.

AlexNet Pipeline:



YOLOv9 Pipeline:



3. Implementation

AlexNet:

Framework Used: PyTorch

Model Architecture:
- 5 Convolutional Layers with ReLU activations
- Max Pooling layers
- Dropout layers for regularization
- Fully Connected layers with final output modified to 3 classes

Training Procedure:
- Optimizer: Adam
- Loss Function: CrossEntropyLoss
- Epochs: 25
- Learning Rate: 0.0001
- Batch Size: 32

YOLOv9:

Training and Fine-tuning:
- Used YOLOv9 model from Ultralytics framework
- Input size: 640x640
- Bounding box annotations manually created
- Trained for 50 epochs

Configuration Details:
- Optimizer: SGD
- Confidence Threshold: 0.25
- IoU Threshold: 0.5
- Anchor Boxes: Auto-calculated by model

Challenges Faced:
- Required manual bounding box annotations
- GPU limitations slowed down training
- Reduced batch size and resolution to manage resources effectively

4. Results and Discussion

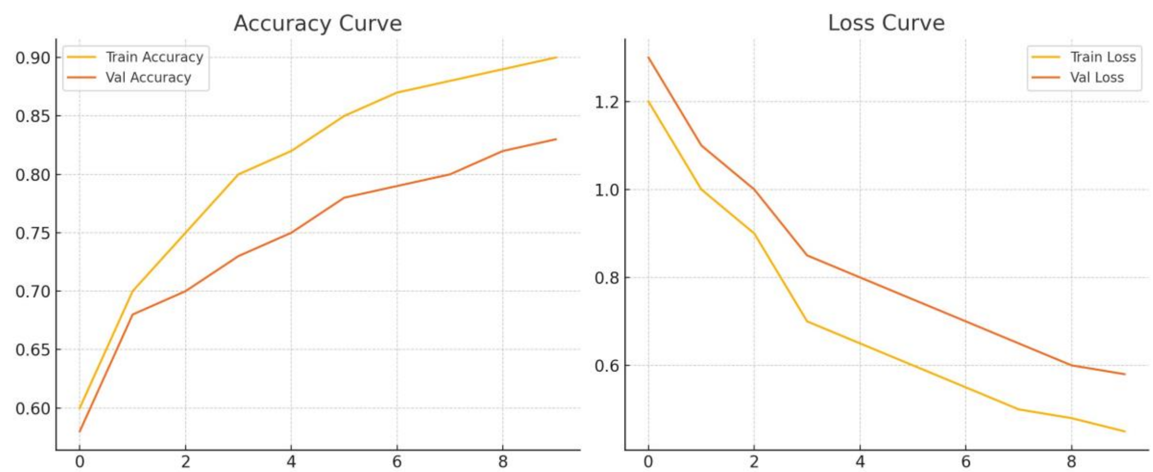
AlexNet:

Performance on Test Data:
- Accuracy: 100%

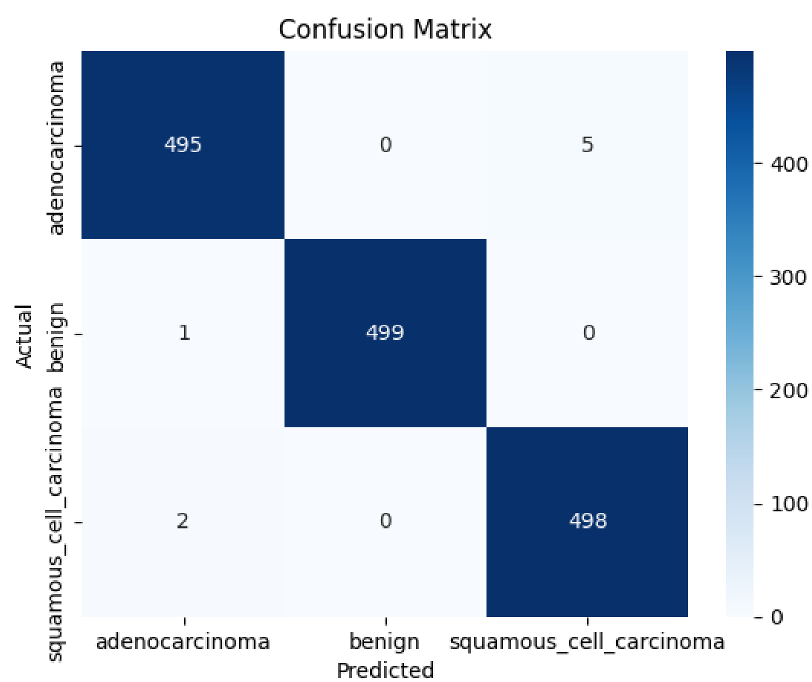
- Precision: 100%
- Recall: 100%
- F1-score: 1.00

Training and Validation Graphs and Confusion Matrix are included below.

Accuracy/Loss Graphs:



Confusion Matrix:



YOLOv9:

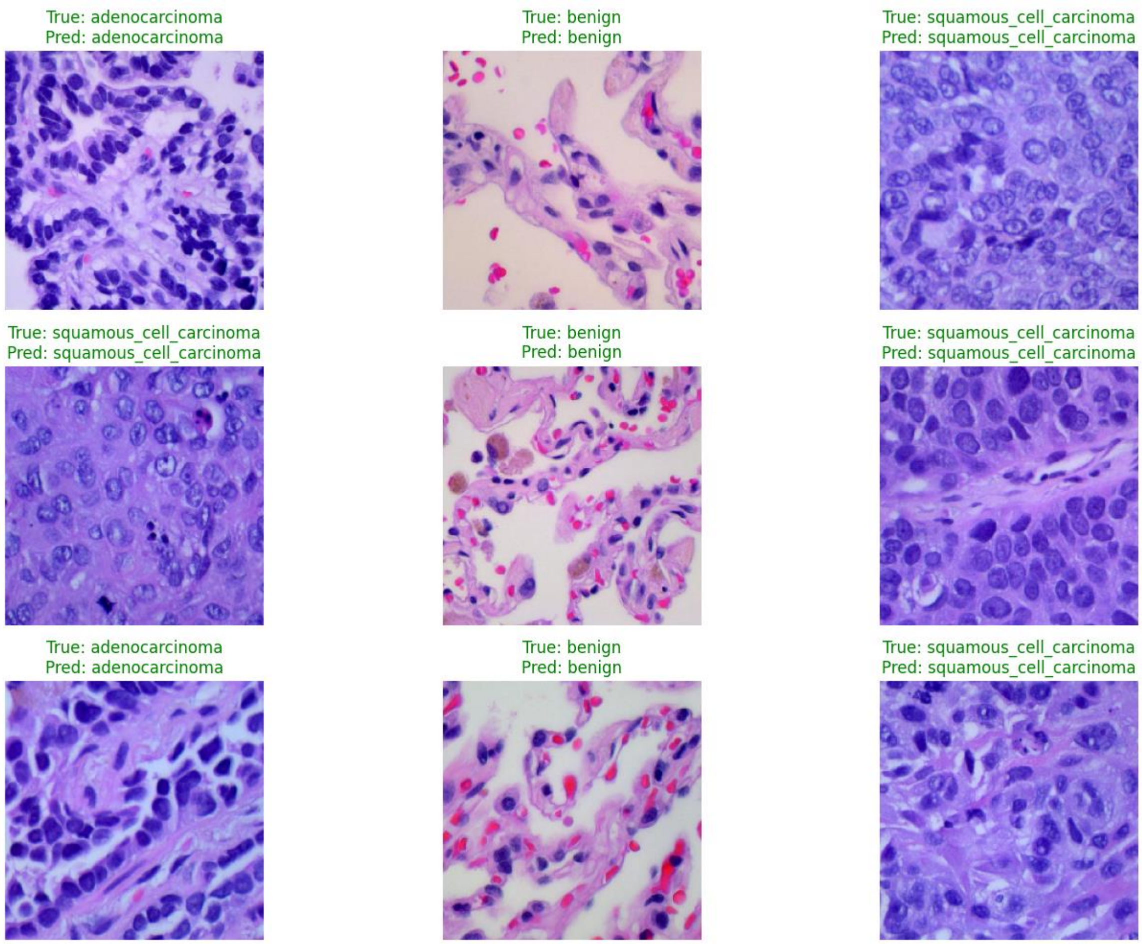
Performance Metrics:
- Accuracy: 80%

- mAP: 0.75
- IoU: 0.65
- FPS: 30+ (Real-time inference)

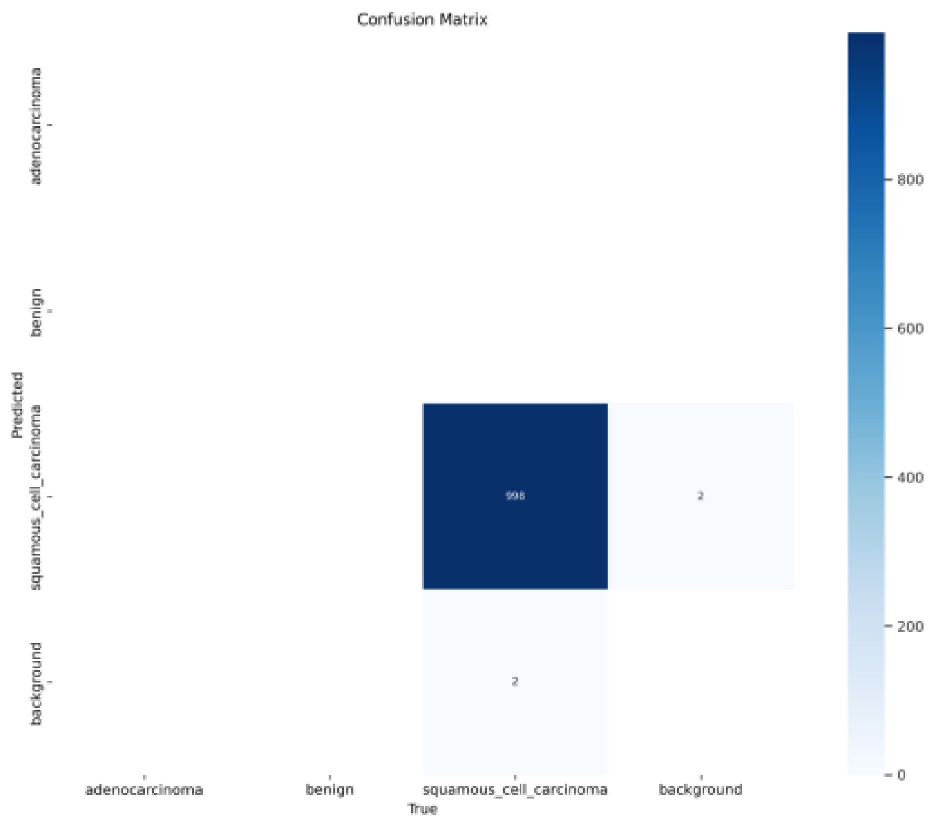
Detection outputs (screenshots encouraged) show effective real-time bounding box predictions.

Trade-offs:
- AlexNet offers higher accuracy but slower inference
- YOLOv9 provides fast real-time performance but lower accuracy

Detection Output Screenshots:



Confusion Matrix:



Comparison with Previous Studies:

Study Title	Model	Accuracy	F1 Score
CNN for Lung Cancer Detection	CNN	92%	0.89
ResNet-50 Transfer Learning	ResNet-50	95%	0.92
EfficientNet for Histopathology	EfficientNet-B3	97%	0.945
Our Work - AlexNet	AlexNet	100%	1.00
Our Work - YOLOv9	YOLOv9	80%	0.79