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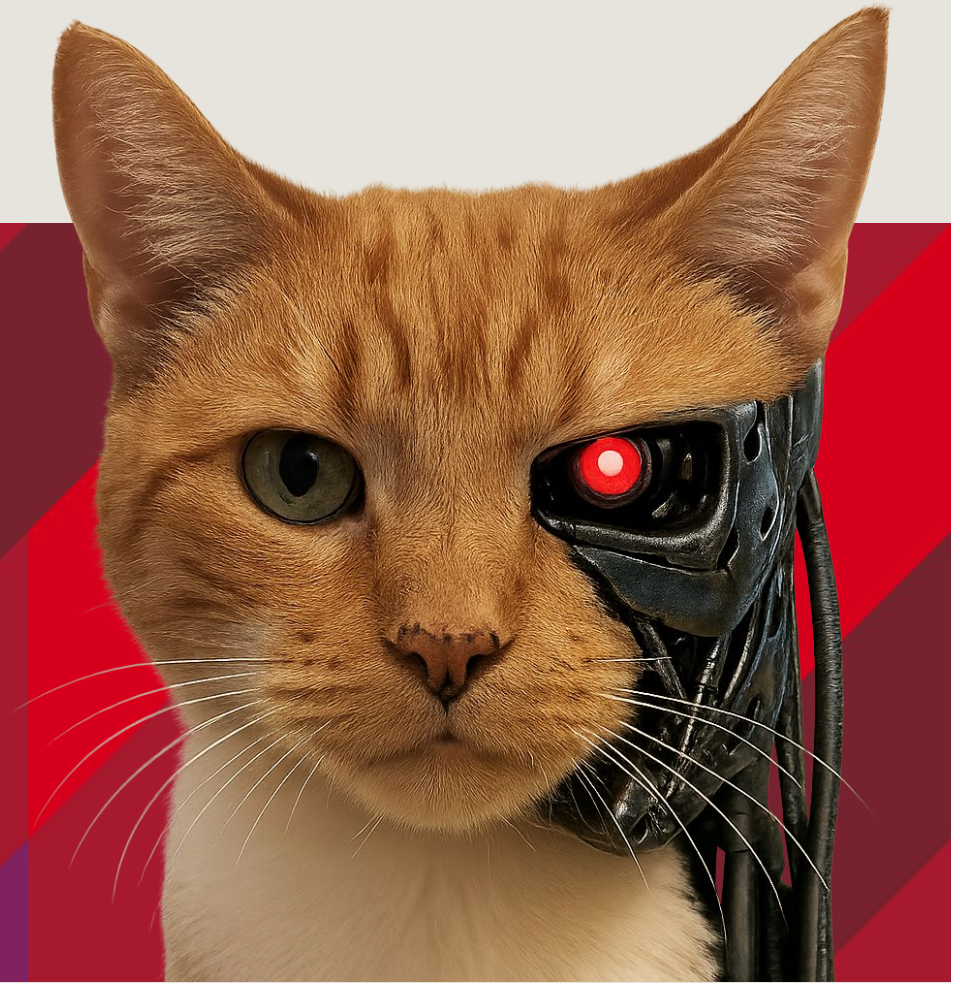
Cat Image Classifier with Robot Integration:

“THE CATINATOR”



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COMP8430 Major Project Phase 4, S1, 2025

Introduction

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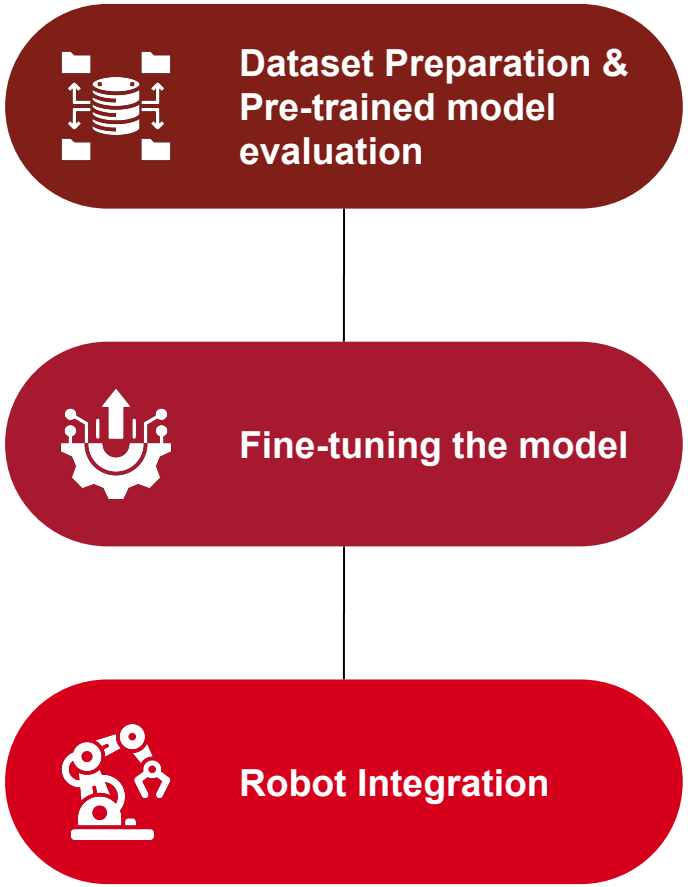
Project Overview:

Phase 1: Collect & Test – Creating and validating datasets with advanced models.

Phase 2: Optimize & Refine – Enhancing model accuracy through fine-tuning.

Phase 3: Integrate & Deploy – Implementing the model in a live robotic environment.



Objective:

- Develop a computer vision model capable of identifying cat breeds from images and integrate this model into a robotic platform.

Significance:

- Effective & Efficient breed classification

Reference Scenario: Robotic system used in animal shelters for efficient breed identification of incoming cats.

Approaches

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Brief description on techniques applied throughout this project

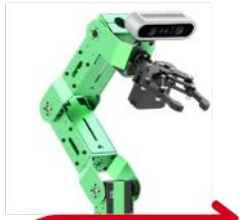
Model Evaluation

1.
Each team member trained models individually using diverse cat breed images, varying in size and of classes

2.
Evaluate all the models

3.
Determine the best performing model

ResNet 50



4.
Test the Model on image captured on the JetRover Integrated Camera

5.
Finetuning the Model on robot captured images

6.
Incorporate Real-Time Classification and Execute Appropriate Actions on the Robot

Robot Implementations

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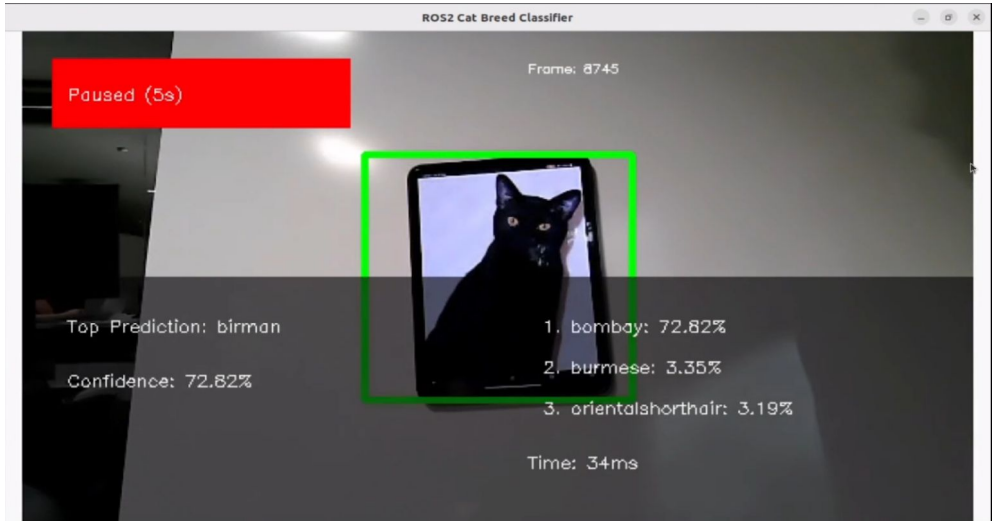
Brief description on techniques applied throughout this project

- **Model Evaluation:** ResNet50 was chosen from multiple CNNs for its accuracy and stability on 21 cat breeds.
- **Challenge Faced:** Real-time tests showed overfitting due to differences in image domains.
- **Solution:** Fine-tuned using robot-captured images; tested on 6 unseen images with 100% correct predictions.
- **Integration:** Deployed using a ROS node at ~20fps with OpenCV.
- **Action Mechanism:** Robot arm triggered when confidence > 0.6; top-3 predictions also shown.
- **Interface:** Built a simple GUI for visualizing predictions and interacting with results.



Results

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- Fine-tuned a pretrained ResNet-50 model on 21 cat breeds
- Extracted a 3-way classifier head for **Norwegian Forest**, **Sphynx**, and **Toyger**
- Achieved high zero-shot accuracy: **95.6%** overall
- All three classes showed strong performance; **Sphynx** had slightly lower accuracy
- Indicates good generalization of the fine-tuned model to unseen test categories

```
Test folders: ['norwegianforest', 'sphynx', 'toyger']
Mapped to original indices: [11, 19, 20]

Zero-shot loss: 0.1560,  accuracy: 95.5882%
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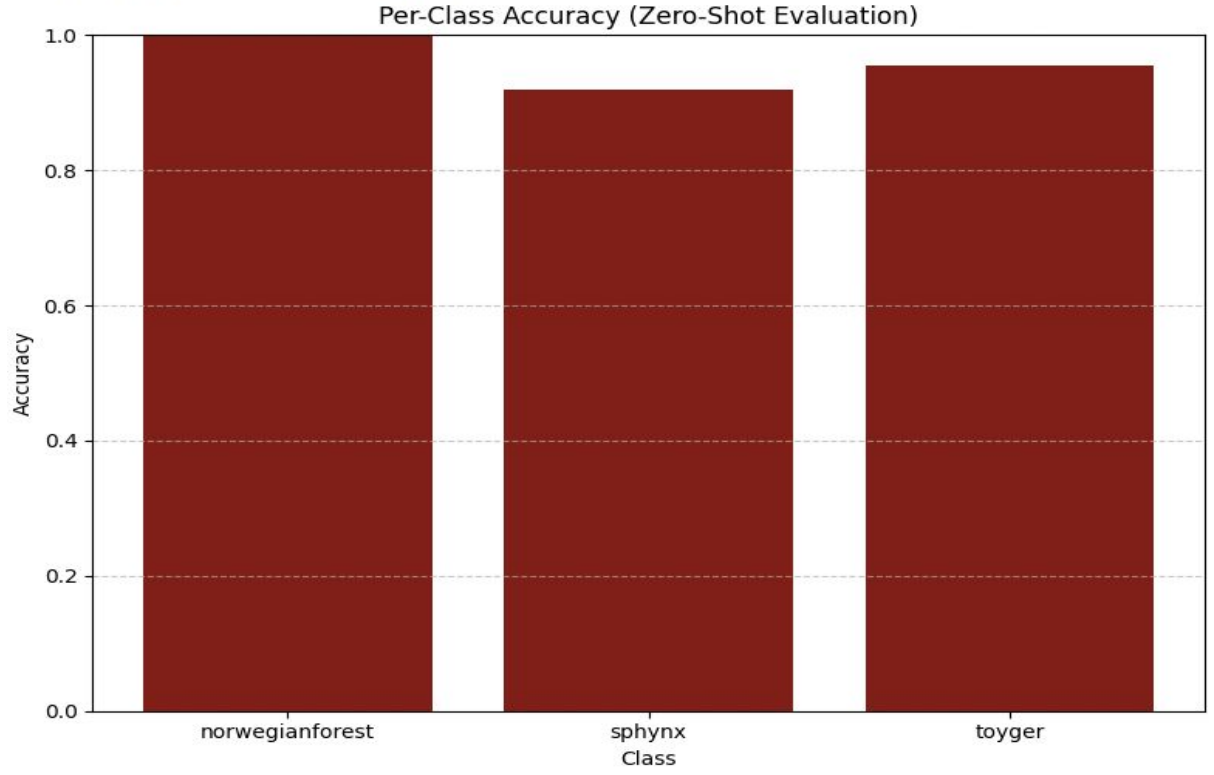

Discussion & Analysis

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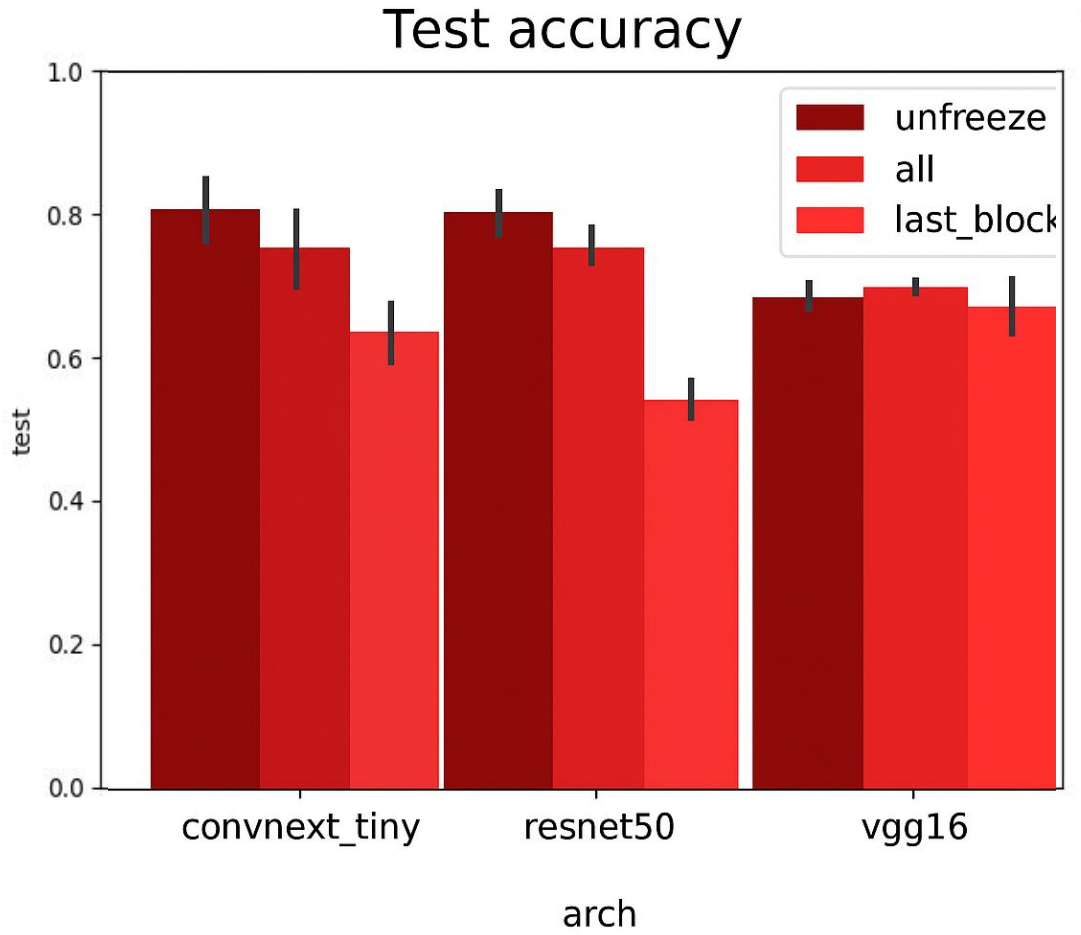
- Compared **ResNet50**, **ConvNeXt-Tiny**, and **VGG16** across unfreezing strategies
- Strategies tested: `last_fc`, `last_block`, and `all` layers
- **Full unfreezing (`all`) consistently achieved the highest test accuracy**
- **ConvNeXt-Tiny with full unfreezing + cosine LR** was the best overall configuration
- Empirically confirmed that **fine-tuning deeper layers improves performance**, especially with advanced schedulers



Future Improvements

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Contributions

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Thank you!
Questions?