Real-time Wildlife Detection on Embedded Systems

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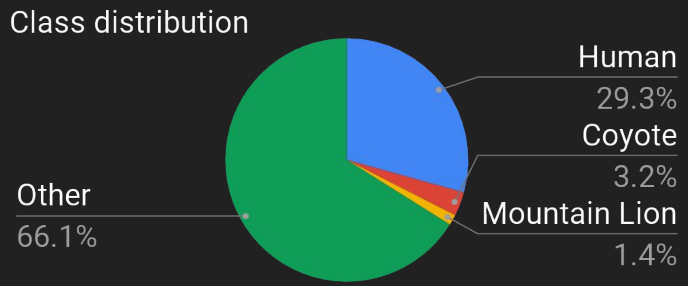
Final Presentation

Project Description

- Dataset: 200,000 photos taken by 18 fixed camera traps over 10 years
  - Focus on 3 classes that are most important to Jasper Ridge
- Train CNNs on GCP to get best possible performance on task
- Try to deploy on Raspberry PI and get inferences in real-time
- Reduce memory and power footprint by pruning and other sparsity techniques

Experimental Setup

- Filter out dataset to only include classes relevant to this task
- Split up into train/validation/test with equal class balance
- ~50,000 samples in Train, ~8,000 in Valid, ~6,000 in Test

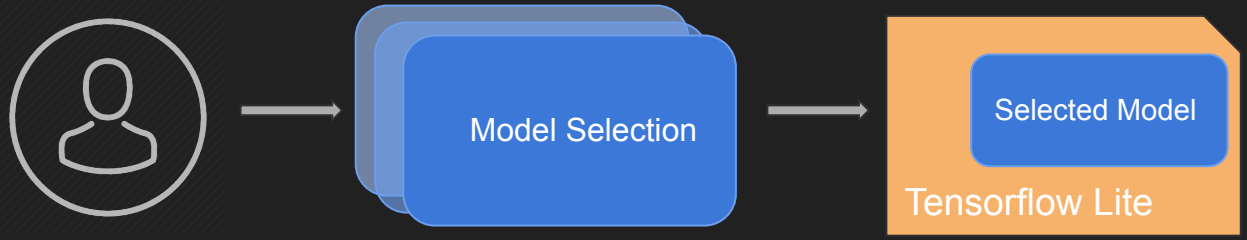


Deliverable

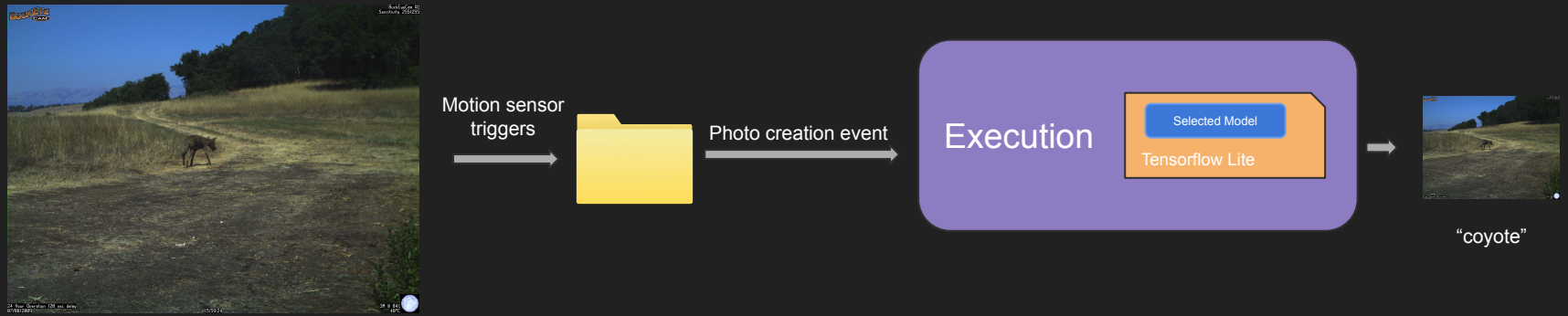
- Pretrained model selection
- Efficient execution framework
- Real-time, on-device, low power inference system

Delivered System

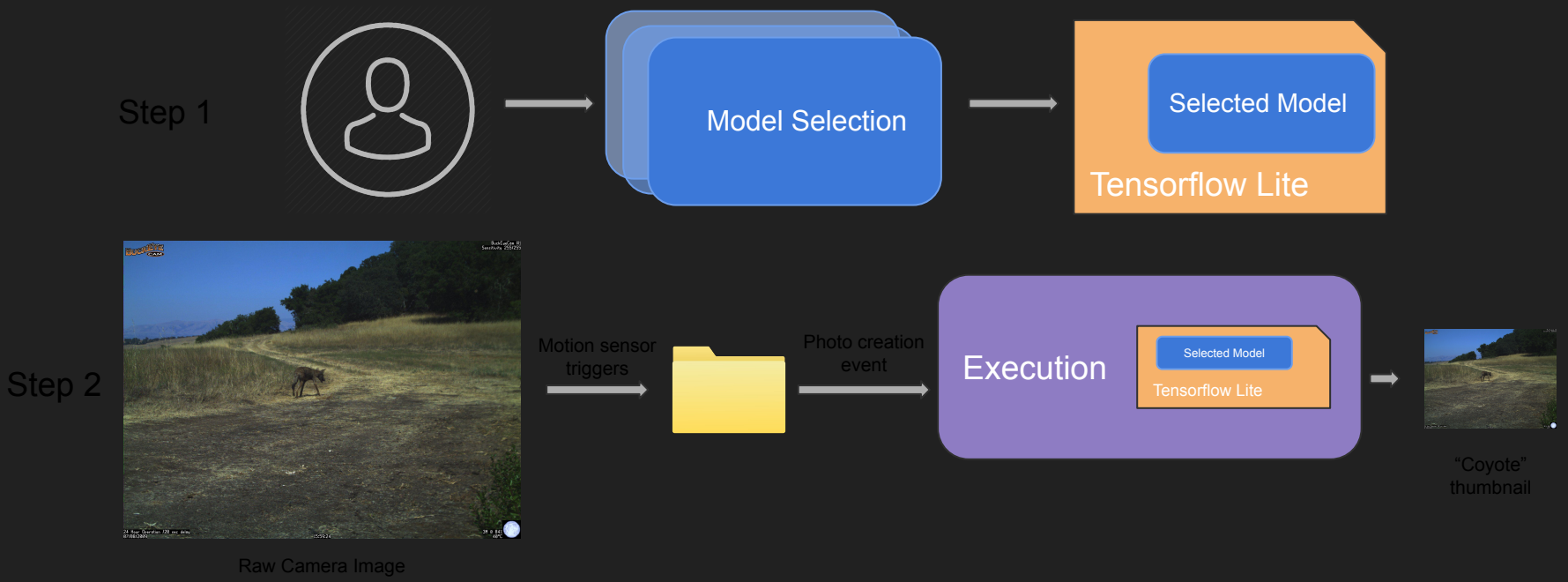
Step 1: Users use model selector, which chooses which model to use, given power/accuracy constraint



Step 2: Launch our script - it efficiently handles power consumption, preprocesses new images, and outputs predictions with thumbnails



Delivered System



Optimizations

- Configurable input tensor size
- < 2% CPU utilization during standard operation via low power sleep state
- < 25% CPU utilization during inference
- ~50x reduction in packaged model size through operator pruning and fusion
- Optional model quantization

Model Analysis

Accuracies are reported on test set

Model (image size)	Human Accuracy	Coyote Accuracy	Lion Accuracy	Mean per-class Accuracy	Execution Time (s)
Resnet18 (64x64)	97.9	57.6	62.7	72.7	0.39
Resnet18 (224x224)	99.3	71.5	81.7	84.2	4.03
Resnet50 (64x64)	98.2	58.0	62.0	72.7	0.92
Resnet50 (224x224)	99.2	80.1	83.7	87.6	10.58

Conclusion

Contributions

- Delivered a highly accurate ResNet model for wildlife detection
- Analysis of power vs. accuracy characteristics across model complexities and input resolutions
- Easy to use, optimized system for wildlife detection on the Raspberry Pi

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