PROJECT ABSTRACT

Bird Feeder Species Logger on Raspberry Pi

Raspberry Pi camera trap that detects birds at a feeder and classifies species on-device with a fine-tuned MobileNetV2, with a detection dashboard and training notebook — built-to-order with report, PPT and viva kit.

01. Title

Bird Feeder Species Logger on Raspberry Pi

02. Introduction / Background

Backyard birdwatching generates data nobody records: which species visit, when, and how often. Commercial smart feeders are closed and expensive. This project does it the open way: a wooden feeder fitted with a Raspberry Pi 4 and Pi Camera watches the seed tray; a PIR sensor plus frame-differencing triggers captures only on motion, and a MobileNetV2 network fine-tuned on a 20-species labeled bird dataset classifies each visitor on-device in about 1.4 seconds. Detections — species, confidence, timestamp, photo — are logged to a dashboard with a detection feed, hourly activity chart and species breakdown, while low-confidence frames go to a manual review queue.

03. Problem Statement

Wildlife visitors are observed anecdotally and never quantified, and existing smart feeders cannot be opened, retrained or studied. The project addresses this with an open camera trap: motion-triggered capture, on-device species classification with honest confidence handling, and a dashboard that turns visits into analyzable data — with accuracy measured on a held-out validation split rather than pre-claimed.

04. Objectives

- Trigger 1080p captures from the Pi Camera on PIR + frame-difference motion at the feeder tray.
- Classify visitors on-device with MobileNetV2 fine-tuned on a 20-species labeled bird dataset (TensorFlow Lite).
- Log species, confidence, timestamp and photo to SQLite and render the detection feed, hourly chart and species breakdown on a dashboard.
- Route low-confidence frames to a manual review queue and deliver the training notebook, retraining guide, report, PPT and viva Q&A.

05. Proposed Methodology

The pipeline is trigger-gated to save compute and storage. The PIR sensor and frame-differencing detect motion; the Pi Camera captures a 1080p frame, which is cropped around the motion region and resized to 224x224. The fine-tuned MobileNetV2 (TFLite) returns the top species and confidence. Above-threshold predictions are logged with photo and timestamp; below-threshold frames enter the review queue. The dashboard reads the SQLite log for the feed, charts and export. The training notebook documents dataset prep, fine-tuning and the validation evaluation the buyer runs.

06. System Architecture / Working

The system has four blocks. (1) Trigger: PIR + frame differencing wakes capture. (2) Vision: Pi Camera v2, crop/resize preprocessing, TFLite MobileNetV2 inference on the Pi 4. (3) Logging: SQLite store with photos; confidence-gated review queue; weekly CSV export in eBird-compatible format. (4) Presentation: single-file dashboard with detection feed, visits-per-hour chart, species breakdown and review queue UI.

07. Hardware / Software Requirements

- Raspberry Pi 4 (4 GB) + Pi Camera Module v2 with feeder bracket
- PIR motion sensor; wooden bird feeder; weather protection for the Pi
- Python 3, TensorFlow Lite runtime, OpenCV (frame differencing), SQLite
- Labeled 20-species bird image subset for fine-tuning (documented in notebook)
- Single-file HTML/CSS/JS dashboard

08. Expected Outcomes

The student receives a working camera trap: motion at the tray triggers a capture, the classifier labels the species with confidence, and the dashboard shows the detection feed, today's visits and the species breakdown. The design target is ~85% top-1 accuracy on the validation split — measured by the buyer's own evaluation run and reported with confusion patterns, never pre-claimed. Out-of-distribution birds land in the review queue by design.

09. Applications

- Backyard biodiversity logging and citizen science (eBird-compatible export)
- Teaching platform for embedded vision, transfer learning and TFLite
- School nature-club monitoring projects
- Base build for multi-feeder networks or NoIR night vision

10. Future Scope

- NoIR camera + IR illumination for night detections
- Retraining on local species via the documented notebook pipeline
- Individual re-identification across visits

- Solar + battery power for fully off-grid feeder placement