Wildlife Image Processing & Semantic Search System

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Agenda

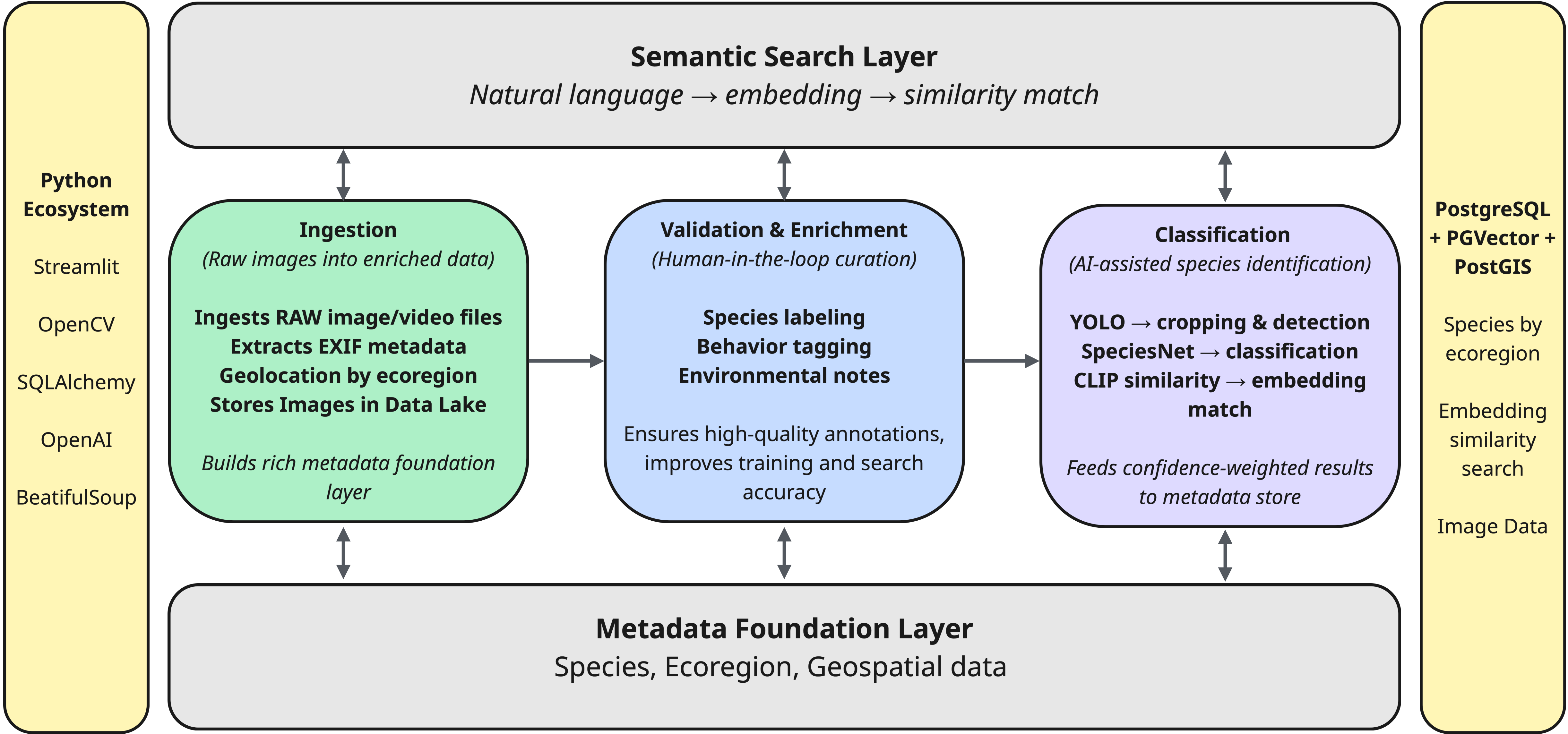* Why This Project

* The Hummingbird

* Architecture

* Demo

* Q&A

Wildlife Image Processing & Semantic Search System Architecture

From Field Capture to Searchable Insight

Semantic Search Layer

Natural language → embedding → similarity match

Python Ecosystem

Streamlit

OpenCV

SQLAlchemy

OpenAI

BeatifulSoup

Ingestion
(Raw images into enriched data)

**Ingests RAW image/video files
Extracts EXIF metadata
Geolocation by ecoregion
Stores Images in Data Lake**

Builds rich metadata foundation layer

Validation & Enrichment
(Human-in-the-loop curation)

**Species labeling
Behavior tagging
Environmental notes**

Ensures high-quality annotations, improves training and search accuracy

Classification
(AI-assisted species identification)

**YOLO → cropping & detection
SpeciesNet → classification
CLIP similarity → embedding match**

Feeds confidence-weighted results to metadata store

PostgreSQL + PGVector + PostGIS

Species by ecoregion

Embedding similarity search

Image Data

Metadata Foundation Layer

Species, Ecoregion, Geospatial data

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Wildlife Image Processing & Semantic Search System

This project presents the development of a modular, AI-enhanced system for processing, classifying, and retrieving wildlife images and videos. It integrates traditional computer vision techniques with advanced semantic understanding powered by Large Language Models. The platform supports manual and AI-assisted annotation, stores visual metadata and embeddings, and enables intuitive natural language queries to discover relevant visual content. By enabling contextual insights and advanced search capabilities, the system transforms how wildlife media can be explored and utilized.

Brown Bear

Confidence: 0.738

mammalia, carnivora, ursidae, ursus, arctos, brown bear

American Bison

Confidence: 0.9952

mammalia, cetartiodactyla, bovidae, bison, bison, None, american bison

Owl

Confidence: 0.322

aves, strigiformes, owl

Summary

Every image is a question. This system helps find the answer

✳ Built a complete wildlife image processing system to turn photos into insights

✳ Combined AI, spatial data, and semantic search to make observations smarter

✳ Grounded species predictions in real-world ecology—location, behavior, habitat

✳ Enables faster discovery of patterns in migration, seasonal changes, and biodiversity

✳ Modular and extensible: adapts to new species, regions, and conservation needs

✳ Designed for anyone documenting nature—photographers, researchers, citizen scientists

Q & A