# Neural Nest

Final Report

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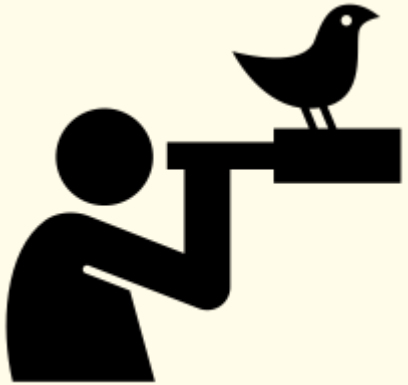
# Goals

- Develop an accurate bird identification system using computer vision and machine learning techniques.
- Design a user-friendly interface to display species information and observational data.
- Implement efficient data storage and retrieval to track bird activity over time.
- Ensure the system is low-cost, sustainable, and easy to deploy, promoting accessibility for a wide audience.



# Intellectual Merits

**Modular Architecture**

- Plugin-Ready Design: Easily installed to existing housing makes the device accessible to all users

**User-Centered Accessibility**

- Intuitive UI/UX Design: A simple layout so that non-technical bird-watchers can navigate the app

**Personal Merits**

- **Ethan -** Got a much deeper understanding of using QML with python and an intro to SQL databases
- **Rayhan -** Got an intro to QML overall and many computer vision concepts

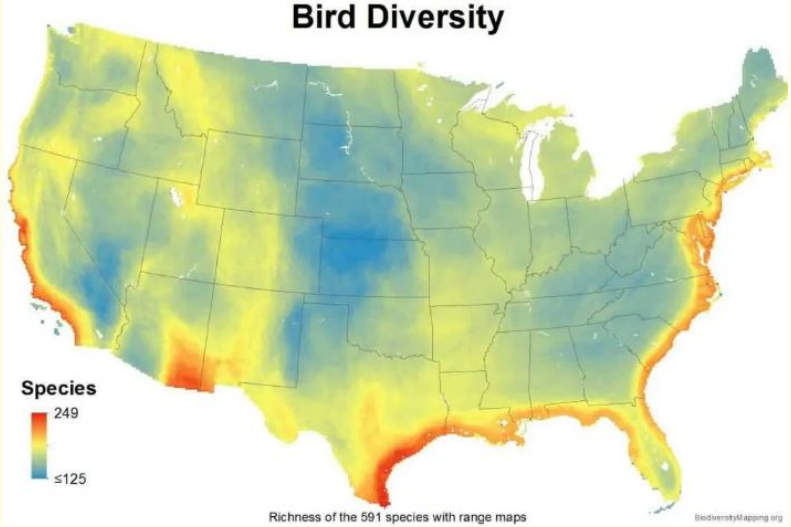
# Broader Impacts

**Citizen Science & Hobbists:**

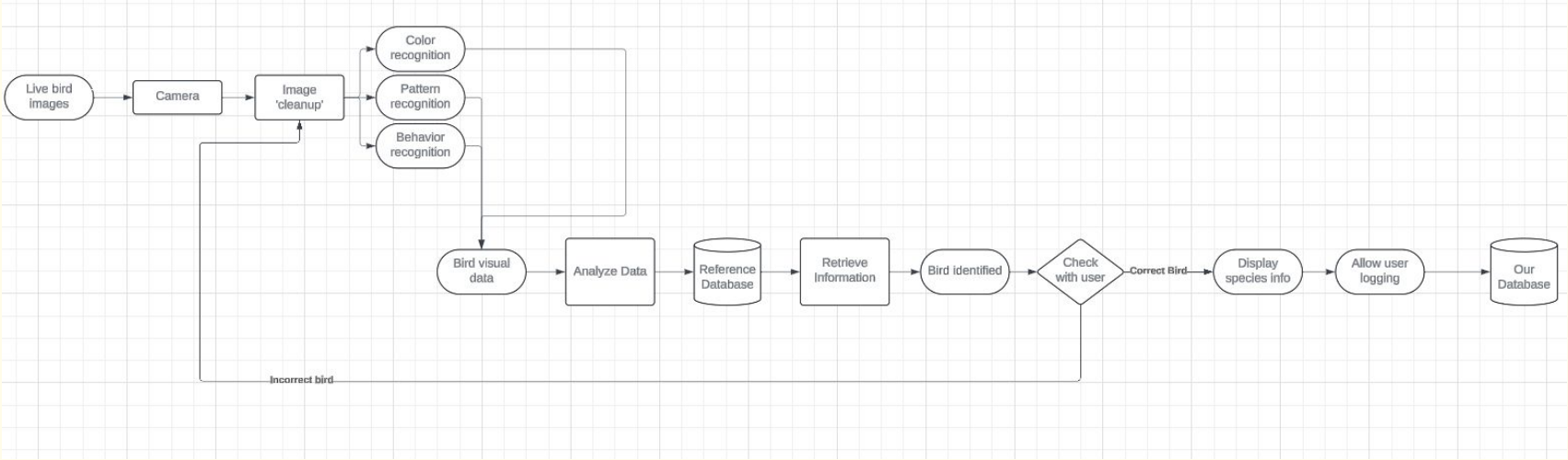
- Lets hobbyists and researchers crowd-source large-scale bird counts.
- Data feeds (location, species, etc) can automatically fill out state/federal wildlife databases.

**Conservation Support:**

- Tracking data can reveal migratory pattern shifts due to climate change.
- Early warnings for threatened species through anomaly detection.



# Design Specifications - Diagram




Explanation: This is an even more detailed overview of the overall project workflow. It starts with the camera taking a picture of the bird. The image is then taken through a cleanup process where blur and other artifacts are filtered out to make the processing easier. Once the image is ready, it is fed into a code script where it will be broken down into its color, pattern, and behavior. After the data is ready, it gets analyzed and compared to a reference database that contains exact information on existing bird species. This data is compared to each entry in the database and when it finds a match, the code will retrieve the information of that bird species to output to the user. The user will then verify if that is the correct bird species. If not, the process will loop back to the image cleanup and reanalyze. This loop will continue until the user verifies that it is the correct bird. Once the bird is verified to be correct, the information of the bird that visited will be saved and stored into a database.

# Technologies

**Software used:**

| QML/Python | OpenCV | Roboflow BirdV2 Model | SQL Database |
|---|---|---|---|
| Used to create the app's UI and connect all of the backend functionality | A Python Library used for image pre-processing (Clean up) | A trained deep-learning model that identifies the birds | Where all of the gathered data is stored, allows tracking over time and other analysis |
|  |  |  |  |

# Milestones

## Overall Idea requirements - Fall Semester

- Settining on the final idea for the project and nailing down specific planning info

## Software selection and setup - Fall Semester

- After deciding on the project we had to figure out what research and software we would need to make our idea happen
- QML was chosen because of its ability to make a good UI but also have easy connections to python.
- Getting all of our software to work successfully with each other was a major checkpoint that allowed the final project to start taking shape

## Final version finished- Spring Semester

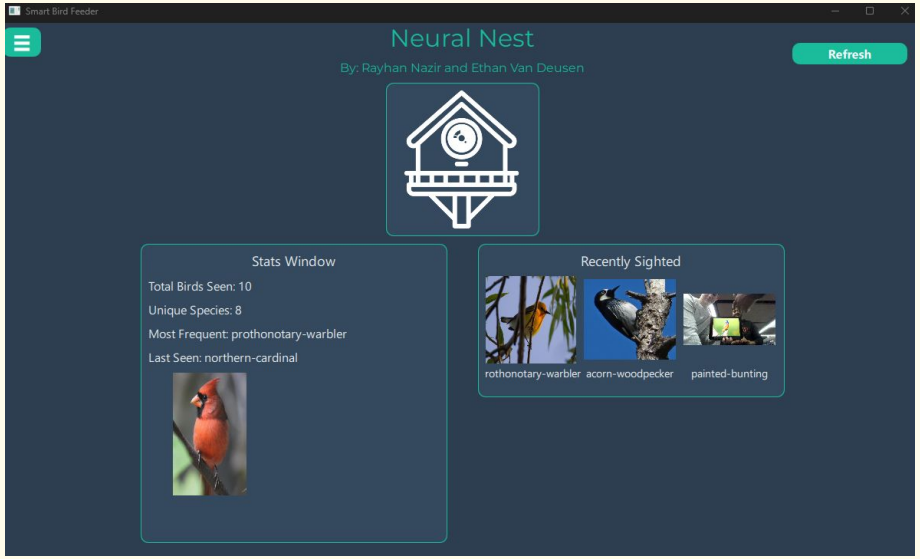
- The application, and database had been both fully designed and connection, we also had connected the CV vision model and were getting accurate results

## Expo Prep and Project Finalization- Fall Semester

- We transitioned our most recent version into a demo-able version to showcase at the expo
- We also finalized all of our project paperwork and updated our repository

# Results and Future

We developed a working version of our planned application, this app would allow users to connect to an existing camera and mount the camera on a window or bird feeder. The user can then track birds automatically as the visit that location




## Future Plans:

- Design a physical feeder, integrate program into hardware. Most likely with a Raspberry Pi
- Train our own model using a custom dataset
- Setup and test multiple devices in separate locations, build a local bird tracking network.

# Challenges

**Challenges**

- No entirely familiar with the software we chose. Both of us were new or unfamiliar with at least one of the languages we used.

- Integrating several types of tools into one program, we struggled with conflicting dependencies and version compatibility.

- Managing the project during senior year, it was hard to stick to all of our project meetings because of other class obligations.