# Smart Bird Feeder

Project Purposes: The purpose of this project is to create a smart bird feeder that use computer vision to identify and track bird species in real-time. This system provides users with accessible info on local bird populations, supporting wildlife observation, education, and conservation efforts

Goals Statements:

- 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.

# Names

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# Abstract

This project aims to design a **smart bird feeder** that utilizes **computer vision** and **machine learning** to automatically identify **bird species**, offering users valuable insights into local bird populations. By capturing and analyzing visual data, the system will provide species identification and track activity patterns, stored in a **database** for easy access and historical reference. Key features include a **user-friendly interface** for viewing bird information, a low-cost, sustainable **hardware setup** using a Raspberry Pi, and efficient data storage and retrieval. This project promotes **wildlife observation**, **education**, and **conservation awareness** through accessible technology and data.

# User Stories

- As a birdwatcher, I want to receive notifications about the bird species visiting my feeder, so that I can learn more about local wildlife and enhance my bird watching experience.
- As a birdwatcher, I want to receive alerts when the feeder needs to be refilled or maintained, so that I can ensure a constant supply of food for the birds.
- As a data enthusiast, I want to analyze trends in bird visits over time, so that I can understand seasonal patterns and behaviors of different bird species.
- As an avid gardener, I want to understand the feeding habits of local birds, so that I can plant flowers that attract them and enhance my garden.
- As a researcher, I want to access detailed reports on bird species and their visit patterns, so that I can contribute to studies on local wildlife.

**Design D0: High-Level View**

**Title:** Smart Bird Feeder

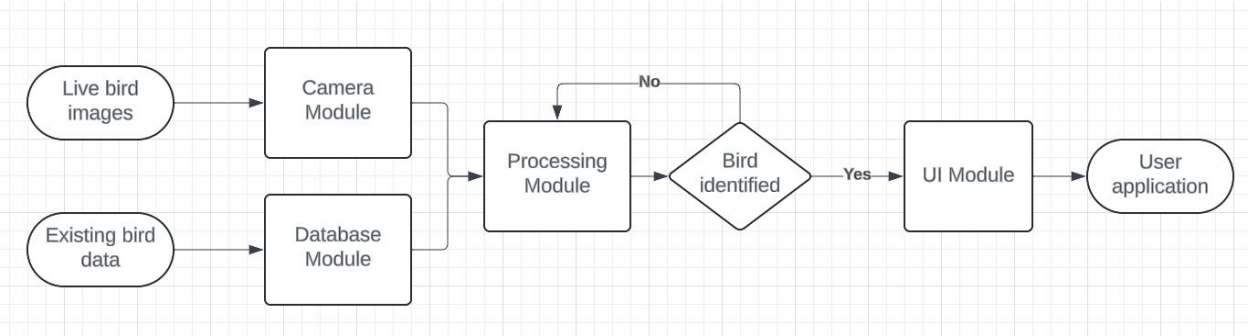
**Goal Statement:** To create a smart bird feeder that utilizes computer vision to capture and analyze bird data in real-time


**Explanation:** This diagram shows a very high level overview of the process, the device takes in data and outputs the correct bird.

**Design D1: Module Breakdown**

**Title:** Smart Bird Feeder

**Goal Statement:** To create a smart bird feeder that utilizes computer vision to capture and analyze bird data in real-time.

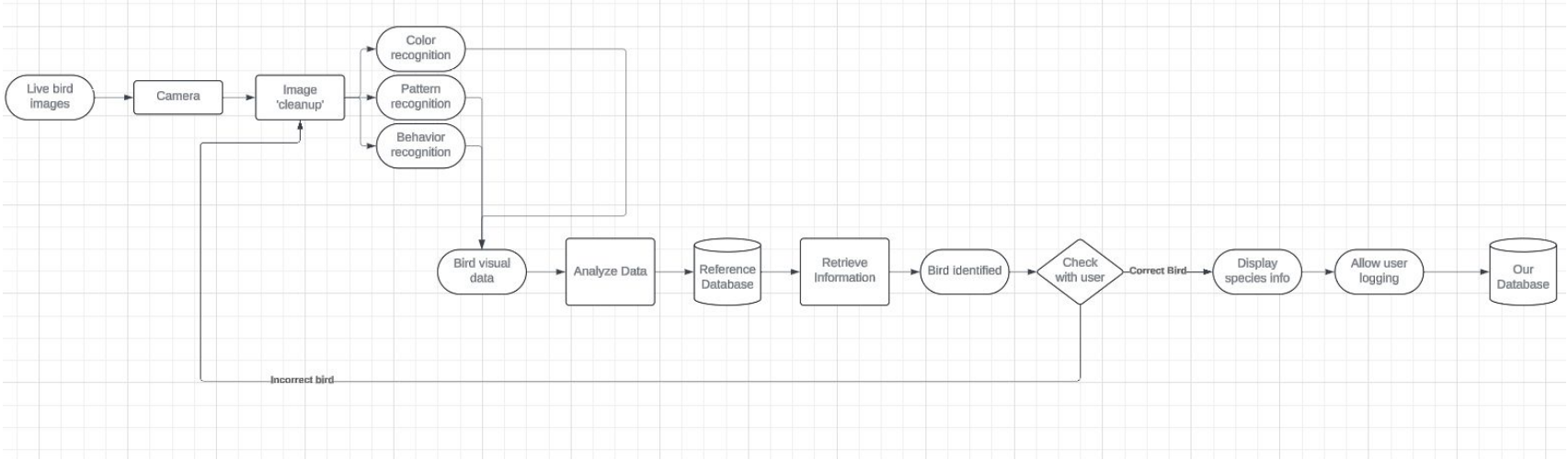



**Explanation:** This diagram shows a deeper view on how the birds are identified. The camera will capture images and then the device will process them. The processed data is then compared to existing bird data stored in a database. If the bird is correct the user moves on to the application where info is displayed. If it is wrong, the program will check again and try to re identify the bird

**Design D2: Detailed System Overview**

**Title:** Smart Bird Feeder

**Goal Statement:** To create a smart bird feeder that utilizes computer vision to capture and analyze bird data in real-time.




**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.

# Major Project Constraints

Economically, we are on a low budget; the solution should be restricted to reasonably cheap hardware such as Raspberry Pi and free-of-cost software tools like OpenCV. This would mean we will need to choose cost-effective solutions that meet our needs for performance. While this is a limitation, working on simpler and cheaper hardware will present a challenge that will be beneficial to be able to solve in terms of our personal learning.

Most importantly we have to keep the ethical considerations in mind when it comes to the requirement for the system to act responsibly, with regard to both interaction with wildlife and the data acquisition process. We have to consider the environmental impact of our hardware in terms of power consumption and other factors by making responsible design choices to minimize negative impacts.

Our project does present some security and legal concerns as well. As we will be using the users location, there may be concerns of using the users location. We will definitely need to make sure we are only using the location for the specific needs of our project and ensure that the location will be used legally and not used against the users in any way. Another concern that relates to security and legal is the use of the camera. The app will require permission to use the camera on whatever device is hosting the app. For the same reasons as location, we must make sure that the camera is only providing data that we strictly need for the app and we are not using anything else.

# Review of Project Progress

- Project goal established

- Team roles defined

- Project structure and time organization

# Expected Accomplishments

By then end of this term, we would like to have the project fully planned out and start the development process. Here are our goals:

- Project Organization is complete
- Research is complete
- Hardware that is necessary to start developing has been setup

# Division of Work

**Tasks Assigned to Ethan (Computer Vision Focus):**

1. **Research** computer vision libraries (e.g., OpenCV) to identify the best tools for bird species identification.
2. **Design** the algorithm for processing live bird images captured by the feeder's camera.
3. **Develop** a bird species recognition system using machine learning or predefined image datasets.
4. **Test** the accuracy of the bird identification system with sample data to validate performance.
5. **Integrate** the computer vision system with the feeder's camera module, ensuring real-time data capture.
6. **Refine** the species identification algorithm to improve accuracy based on user feedback and data analysis.
7. **Document** the computer vision pipeline, including any pre-processing steps and algorithms used.
8. **Create** a prototype of the system to test real-time bird identification in a live environment.

**Tasks Assigned to Rayhan(Database and Data Management Focus):**

1. **Research** about SQL databases and how to incorporate them into our bird identification system
2. **Investigate** existing databases that contain information about different bird species to use as our reference for our data comparison model
3. **Develop** algorithm that will analyze the data collected on the bird through our bird identification program and compare to the reference database
4. **Design** our own database that will organize and store the data that we collect for each bird
5. **Refine** database model to increase accuracy and efficiency based on results collected by the bird identification program
6. **Document** database structure that outlines where specific data is stored and relationships between tables.

**Joint Tasks (Collaboration):**

1. **Specify** the requirements for the smart bird feeder hardware, including the camera, sensors, and Mirco.
2. **Investigate** various hardware components and choose the best options for the camera and sensors based on budget and performance.
3. **Develop** the overall user interface, allowing users to access bird data and set preferences.
4. **Test** the complete system (camera, computer vision, database) to ensure all components work together effectively.

# Expected Demo

We plan to have a working prototype app for a user to interact with. The app will showcase the camera vision feature that will recognize images of birds and the app will be able to present the user with information on the specific bird provided.