BirdBox

Technology at the service of nature

Project Name	Connected nest box
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Project Location	ICAM Strasbourg-Europe
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Client: Timothé TURKO	Contractor: ICAM Strasbourg-Europe

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A. INTRODUCTION

A.1 Background and problem definition

As part of our ECAM 4 technical project, our group composed of (Joséphine COTTIN, Andréas ADAIN, Deniz YALCIN & Axel MARSACQ) decided to work on the subject of the connected nest box. In collaboration with the Ligue de Protection des Oiseaux d'Alsace (LPO), this nest box aims to collect data from 2 particular bird species: the great tit and the black redstart. This shelter will be installed on the ICAM Strasbourg site, for the beginning of 2025.

To correctly state the need of the project, a "Horned Beast" was integrated into the specifications:

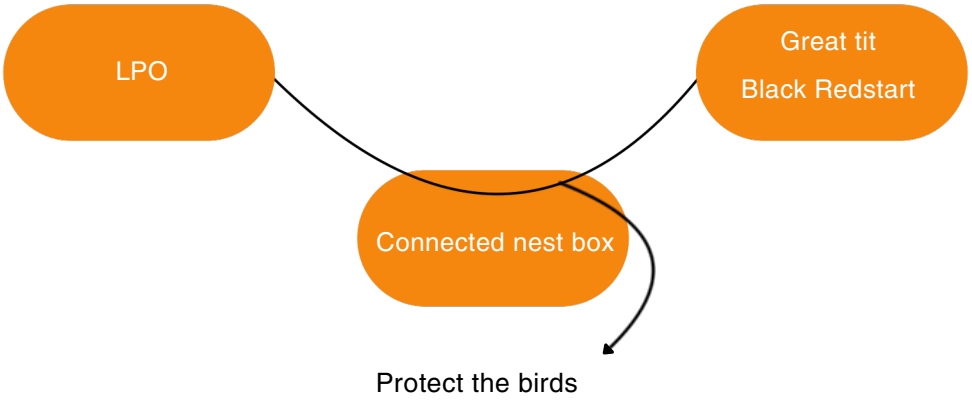

Figure 1: Horned Beast-Connected Nest Box

In order to correctly identify the project problem (fish head), here is the Ishikawa diagram:

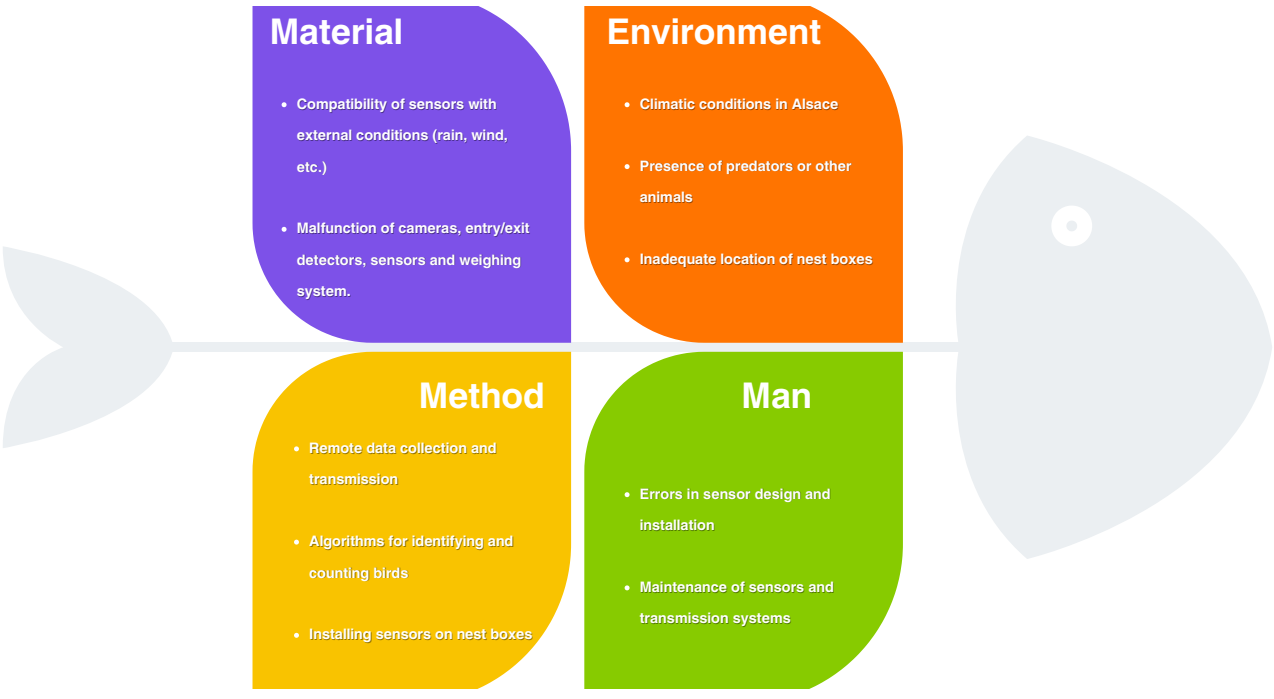

Figure 2: Interest Diagram

A.1) State of the art

Existing technology for a connected nest box:

There are many types of connected nest boxes currently on the market. There are nest boxes equipped with these different elements:

Conception

- **Natural design:** organic shapes, ecological materials, integration of structures into the environment while providing a secure refuge for birds.
- **Integrated drainage system:** Ensures a dry interior, even after bad weather.

Recognition and notifications

- **Species Identification:** Able to instantly recognize thousands of bird species, with real-time notifications delivered using an image classification model
- **Intelligent Motion Detection:** Captures every movement including landings and wing beats with the camera
- **Live App & Video Capture:** Automatically records videos whenever motion is detected, with configurable capture duration.

Camera and video

- **1080p Full HD Camera:** 24/7 live streaming via a mobile app connected to your phone or tablet.
- **Night Vision:** Infrared mode with invisible LEDs for discreet surveillance at night.
- **Multi-cameras:** Allows you to connect and manage multiple cameras simultaneously via the app.

Additional features

- **Time-lapse function:** Captures time-lapse videos to observe the evolution and behavior of birds over an extended period.
- **High capacity battery:** 7800 mAh battery, rechargeable via an integrated solar panel for extended autonomy.
- **Flexible Mounting:** Wall, tree or floor mounting options to suit various environments.

Connectivity and range

- **Long Range Wireless Birdhouse:** Reliable wireless connection thanks to different types of waves, even over long distances
- **Long Range Receiver:** Ensures stable and fast data transmission to the mobile app or connected platform.

Sources : Vivaria / Nestera / Green-Backward

Among all these already existing elements it is necessary to add this to carry out our project

- Integrated balance sensor → Dynamometer
- Thermal sensor → Arduino temperature sensor
- Hygrometer sensor → Arduino hygrometer sensor
- Microphone → Microphone Arduino
- Passage counter → Infrared ultrasonic sensor
- Fun and expert interface → Mobile application

Sources : Gotronik-Kubii-Conrad

SWOT Matrix :

Figure 3: SWOT Matrix

B. Functional analysis

Main functions:

Category	Function	Description	Flexibility	Level
FP	Help protect birds	Protecting and collecting data on birds	Weak	Imperative

Table 1: Main functions

Secondary functions:

Category	Function	Description	Flexibility	Level
FC1	Temperature control	Measure the interior temperature of the nest box.	Weak	Imperative
FC2	Hygrometric control	Measure the humidity inside the n est box.	Weak	Imperative
FC3	Identify types of birds	Recognize the species of birds present.	Moderate	Imperative
FC4	Count the number of individuals	Count the birds present in the nest box.	Moderate	Not very negotiable
FC5	Measure the weight of the nest box	Monitor changes in nest box weight.	Weak	Imperative

Table 2: Secondary functions

Constrained functions:

Category	Function	Description	Flexibility	Level
FC	Weather resistance	Ensure the birdhouse is waterproof and weatherproof.	None	Imperative
FC	Sustainability of materials	Use durable materials to ensure a long life for the nest box.	Weak	Imperative
FC	Data Security	Protect collected data from unauthorized access.	None	Not negotiable
FC	Minimize disturbance to birds	Install and operate the nest box without disturbing the birds.	None	Imperative
FC	Ease of installation	Allow for quick and easy installation of the nest box.	Average	Negotiable
FC	Energy autonomy	Ensure long-term operation without frequent maintenance.	Weak	Not very negotiable
FS	Adapting to trees	Install the nest box on different trees.	Strong	Negotiable

Table 3: Constrained functions

C. Environmental approach

The project aims not only to protect birds, but also to minimise their ecological impact:

Eco-responsible design

- **Sustainable materials:** Use of wooden boards from French forests for a more local birdhouse manufacturing. This reduces the carbon footprint linked to the transport of materials.
- **Reuse of components: T**he project foresees the reuse of electronic components from previous works if possible. This aims to reduce the production of electronic waste and to maximize the use of available resources within the school.

Manufacturing and assembly

- **Waste Reduction:** Manufacturing processes are optimized to minimize waste. Wood scraps, for example, can be reused for other projects or recycled.
- **Use of renewable energy:** The electronic system of the nest boxes will be powered by solar panels connected to a battery, thus reducing the consumption of electrical energy from non-renewable sources.

Product life

- **Low-power data storage:** Data collected by the sensors will be stored on a low-power server or cloud, thus limiting the energy footprint of the storage.
- **Optimizing lifespan:** Ensure a solid and waterproof design to guarantee a long lifespan for the nest box.

End of life

- **Recyclable Materials:** At the end of their life cycle, the materials used for birdhouses, mainly wood and some electronic components, are recyclable. The wood can be composted or reused, and the electronic components can be salvaged for other projects.
- **Disassembly:** The nest boxes are designed to be easily disassembled to allow better waste management at the end of their life. The different parts can be sorted and directed to suitable recycling channels. We will not use glue for an ingenious design.

Societal impact

- **Awareness and education:** This project contributes to raising public awareness about the importance of preserving birds and natural ecosystems. The data collected will be used for local educational initiatives, thus reinforcing the positive societal impact.

D. Users Stories et backlog

User Story	Validation criteria	Priority	Sprint	Stain
As an ornithologist, I want to be able to track the temperature and humidity inside the nest boxes in order to monitor nesting conditions.	Temperature and humidity sensors are installed and the data is available on an interface.	High	1	Selection and installation of sensors. Development of the data visualization interface.
As an ornithologist, I want to be able to identify and count the number of birds present in the nest boxes in order to monitor the evolution of bird populations.	The system is able to detect the presence of birds and count them in real time.	High		Implementation of motion detection sensors. Real-time counting algorithm.
As a user, I want to view an event log (bird entries/exits) to visualize key moments of bird activity.	The interface allows you to display a time-stamped event log, including bird entries and exits.	Average		Development of the logging module. Display test on the interface.
As the engineer responsible for the project, I want to power the system with solar panels in order to reduce energy consumption and respect the ecological principles of the project.	Solar panels provide continuous and reliable power for the entire electronic system.	High		Selection and installation of solar panels. Testing the power supply of electronic components
As a user, I want the nest box to be dismountable and recyclable to promote sustainable resource management and minimize waste.	The nest box is designed without glue, its components are easily disassembled and can be sorted for recycling.	Average		Design and manufacture of the removable nest box. Selection of recyclable materials. Prototyping and disassembly validation

Table 4 : User story et Backlog

Budget Envelope

1. Materials and Supplies

- **Sensors (Temperature, Humidity, Motion):** These elements are essential for the basic functionality of the connected nest box.
- **Electronic Components (Boards, cables, etc.):** Required for the assembly and connection of the various sensors and modules.
- **Construction Materials (Wood, screws, etc.):** For the physical construction of the nest box.
- **Battery or Solar Panel:** For the autonomous energy supply of the system.

2. Development and Services

- **Software development:** Creation of the user interface and data processing algorithms.
- **Installation and Testing:** Field work for installation of nest boxes and initial testing.

3. Miscellaneous costs

- **Transportation and Logistics:** Costs associated with transporting materials and deploying them to site.
- **Contingencies:** A small reserve to cover unforeseen events or cost overruns.

Estimated Budget Breakdown

Category	Planned allocation (€)	Percentage of Total Budget
Equipment and Supplies	150	50%
Development and Services	120	40%
Miscellaneous costs	30	10%
Total	**300**	**100%**

Figure 5: Budget distribution

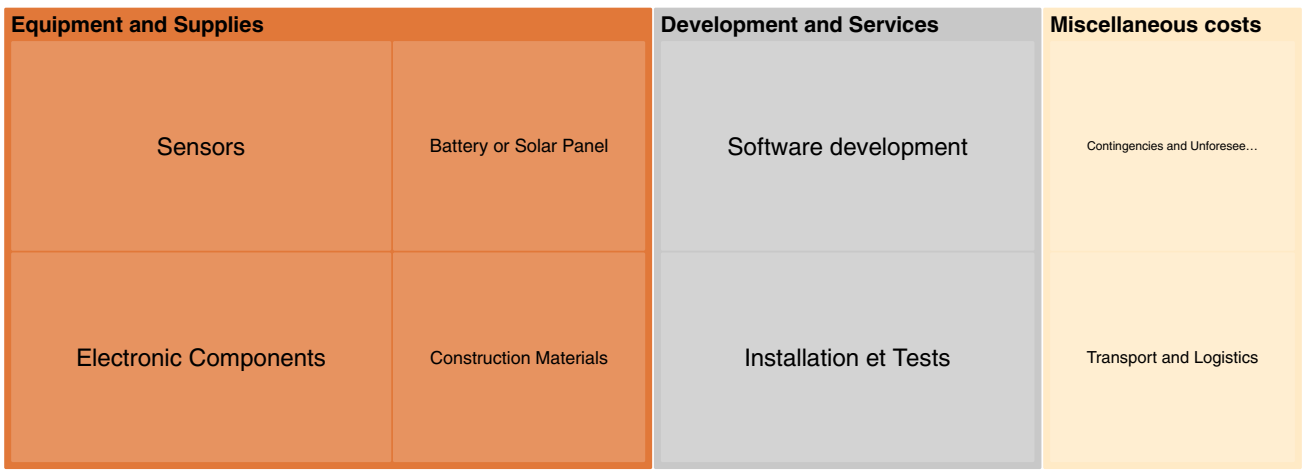

Figure 5: Budget distribution

Notes and Justifications of the budget distribution

- **Priority is given to sensors and construction materials, as these are the essential elements to ensure the functionality of the nest box.**
- **Software development has a significant share of the budget because the platform must be reliable and well designed for the project to be successful.**
- **A small contingency reserve is included to manage project risks.**

Conclusion

This forecast budget should be revised regularly as the project progresses. This will allow expenditures to be adjusted based on achievements and discoveries made during the project.

F. Planning

In our project to develop a connected birdhouse, we use Notion as our central project management tool. It allows us to centralize all information and activities related to the project, providing a convenient side for documentation, task planning, and progress tracking.

Project Management with Notion

1. Documentation of Objectives and Missions: The missions of our project are clearly defined, such as the protection of bird species and public awareness.

2. Technical Features and Product Backlog: The technical features of our connected birdhouse are detailed directly in Notion. Each feature, such as temperature control and bird identification, is associated with specific user stories that are integrated into our product backlog. This organization allows us to precisely track development and prioritize tasks efficiently.

3. Visual Planning and Task Tracking: Notion's timeline views, similar to Gantt charts, help us plan and track our milestones. Each task is assigned to a specific sprint, making it easy to visualize our progress and manage deadlines.

4. Team Collaboration: Notion also serves as a collaboration platform for our team. Technical documents, project updates, and communications are all centralized. Every team member can access and contribute to this information in real-time, making our teamwork more cohesive and efficient.

5. Resource Management: All technical documents, including specifications, work orders, and educational resources, are stored and organized in Notion. This ensures that information is accessible at all times to all team members, facilitating quick references and necessary revisions.

Conclusion

Using Notion helps us maintain an organized structure, manage our project efficiently, and ensure that all stakeholders are constantly informed and involved. This allows us to remain agile and respond effectively to challenges as we move forward with our connected birdhouse project.

G. Conclusion

This project is an innovative solution for protecting and observing birds, while raising public awareness of biodiversity conservation.

The connected nesting box project undertaken as part of Ecam 4's Technical Project stems from a request from the Ligue de le Protection des Oiseaux d'Alsace. After much research, such a nesting box does not yet exist. Different technologies will be brought together to create a shelter and collect data on two specific species. The budget allocated by Ecam will be used entirely for components, transport costs and testing. Planning will be carried out on Notion so that all information is properly centralized and continually updated for the whole group.

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