PestPi: Automated Non-native Species Detection

Computer Science and Engineering
University of Puerto Rico Mayagüez Campus

María Cotto Nieves, Javier Cuebas Quintana,
Javier Maldonado Rivera, Gerónimo Outerbridge DeCastro
Advisor: Wilson Rivera Gallego, PhD
Department of Computer Science and Engineering

1 Problem Statement

Non-native species identification and monitoring on agricultural lands is a vital tool in pest control and population management efforts in Puerto Rico. Automated identification methods that use technologies like image recognition and machine learning offer better prospects for identifying boas, iguanas and boas quickly and accurately.

2 Problem Background

Invasive species represent a significant threat to Puerto Rican native flora and fauna, disrupting local food and agricultural production [1]. Consequently, it disrupts economic activity resulting in millions of dollars in losses for a beleaguered sector on the island.
Managing species that threaten a farmer's livelihood can be difficult without tools that provide timely identification and behavioral data, especially in large or inaccessible extensions of land. Preventing establishment of invasive individuals is a time-critical endeavor that could benefit from accurate, constant automated monitoring.

3 Objectives

-Identify iguanas, boas, and rodents through image processing models with at least 60% accuracy.

-Develop a backend system that collects, analyzes and produces relevant data with a target response time of less than 500ms.

-Design a user-friendly dashboard for alerts with informative statistics, adhering to visual perception and accessibility standards, with a color contrast ratio of at least 5.0 between background and text color. [2]

4 Technical Approach

-Used an AI-Image detection model utilizing YOLOv8, trained on a custom dataset, connected to a specially programmed Raspberry Pi streaming live footage and detecting movement with MotionEyeOS. [3]
-Built a backend system hosted with Heroku, managing detection data through a REST API in Python.
-Prepared data visualization and report design through a dashboard connected to the Heroku application.

Figure 1. Raspberry Pi 4 Model B 2018.

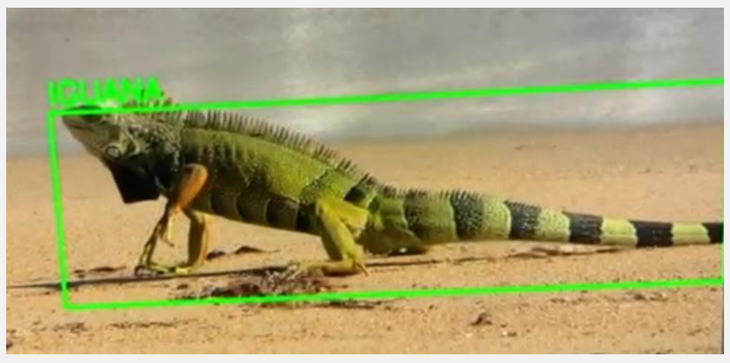


Figure 2. YOLO v8 detection model correctly identifies an iguana, one of the target species, using a custom dataset for training.

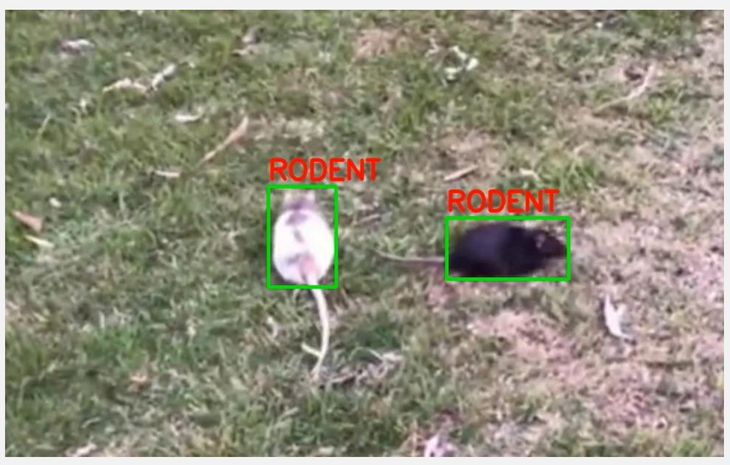
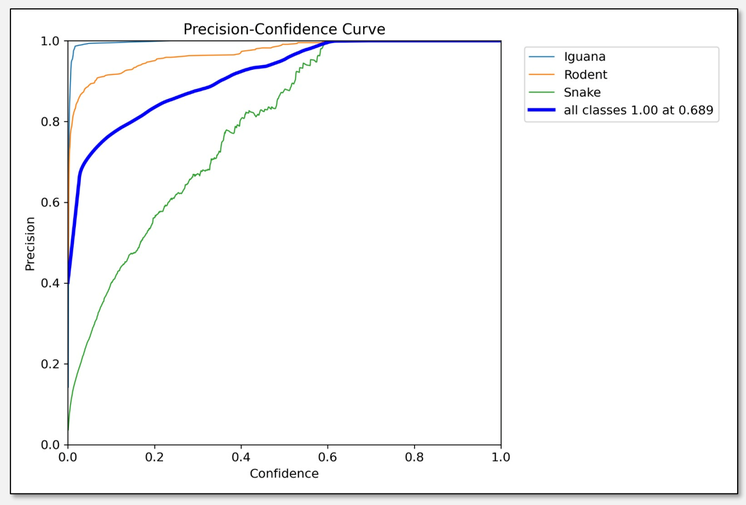


Figure 3. YOLO v8 detection model identifies rodents accurately from a low resolution video during tests.

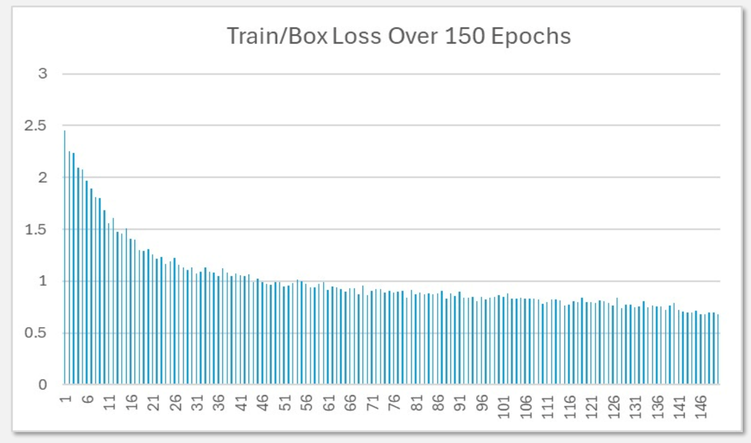
5 Results

The model shows lower loss values indicating improved performance in species detection.

Graph 1. Precision to confidence ratio curve for pest detection and identification model.



Graph 2. Train/Box Loss over 150 epochs demonstrates a successful learning trend for the model.



Graph 3. Background and text color contrast ratio.

Dashboard visual elements display data in an accessible and readable way with a proper contrast ratio, surpassing the goal of at least 5.0.

6 Conclusion

Pest control efforts can benefit from automated detection of target species. A responsive system that displays pertinent data in a clear and accessible way is a valuable tool for the agricultural sector in Puerto Rico.

R References

1. W. Almodóvar, "2005 International Institute of Tropical Forestry USDA Forest Service: Survey of Forest Pests and Early Detection of Exotic Pests in Puerto Rico," 2007.
2. Ahamed. M Mithun, Z. A. Bakar, and Wael. M. S. Yafooz, "The Impact of Web Contents Color Contrast on Human Psychology in the Lens of HCI," International Journal of Information Technology and Computer Science, vol. 11, no. 10, pp. 27–33, Oct. 2019.
3. J. W. Jolles, "Broad-scale applications of the Raspberry Pi: A review and guide for biologists," Methods in Ecology and Evolution, vol. 12, no. 9, pp. 1562–1579, Jun. 2021.