IguanaGuard

A Proposal submitted by Group #6

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Sponsors: Detect, Defer, and Destroy Iguanas

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Project Summary (Tristan Baldeo)

Iguanas have become an invasive species in Florida, causing a lot of damage to the foundational structure of buildings, vegetation and gardens, as well as ecosystems. Fast population growth and adaptability has made them an issue difficult to handle. With current solutions, such as trapping, fencing, and chemical sprays are ineffective as well as expensive. IguanaGuard is a device that aims to develop a better solution through an automated detection and deterrence system that uses computer vision, detection through an AI model, and an escalating deterrence system to efficiently manage affected areas.

IguanaGuard uses a Raspberry Pi and AI HAT for processing power with an integrated AI model trained to recognize iguanas in real time. Upon detection through our camera, the system will deploy deterrent methods in an escalating sequence one by one. The device starts with a laser pointer to disrupt movement, then an ultrasonic sound emitter that humans cannot hear but the iguanas can in order to startle them, and lastly a garlic-based misting spray system as a final measure to repel them. The system will be in a weatherproof housing that will in total be low maintenance, automatic, and cost effective making it practical for homeowners, businesses, and local governments looking to get rid of these invasive reptiles in a safe manner.

The overall design focuses on a safe, ecofriendly deterrence approach that complies with Florida wildlife regulations while also offering a sustainable, automated solution that is easy to install. Through computer vision, real time data processing and an easy-to-use remote interface, IguanaGuard provides a new solution to fight Florida's iguana crisis.

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I. INTRODUCTION (Tristan Baldeo)

A. Background

The iguana population in Florida has become a big problem throughout the years, this is due to their constant rapid rise in population and negative impact on things such as vegetation, ecosystems, and groundwork for a lot of buildings and architecture in the state. These reptiles thrive in the warm climate that Florida offers, they also burrow into sidewalks and building foundations often as well, causing major structural damage. The damage continues through consuming a lot of native plants, disrupting gardens, and spreading diseases through things such as droppings, this is the start of the many problems that they bring to the sunshine state.

Methods to control iguanas consist of activities such as trapping them, hunting them, and using chemical repellents that are unsafe for the surrounding environment as well as possibly causing harm to the iguanas too. These approaches typically cost a lot more than what the regular person is willing to spend to get rid of the species, can be labor intensive at times, and overall ineffective in actually working as well. Trapping these iguanas requires constant involvement and intervention and hunting them is sometimes viewed as too cruel and requires certain laws to be followed. Taking further measures, such as building proper fencing, can also be too extensive and impractical at times. A modern approach is very much needed that can also be automated for as little involvement as possible, something that is effective and sustainable long term.

B. Statement of the Problem

The overwhelming increase in iguana population is a major challenge that needs to be addressed by many members in society including homeowners, various businesses, and local government officials even. Repair costs in some areas for the damage that iguanas cause has reached millions of dollars. The impact they have on both urban and residential areas also provides safety concerns and they weaken the foundations that these buildings have been built on, leading to further damage and even possibly structural collapses.

Current deterrence solutions that exist on the market fail to provide both a long-term solution, as well as something easily automated that doesn't require constant attention every day. Manual removal solutions through the likes of traps require constant labor and are very limited in scope. Chemical deterrence's such as sprays often provide more harm than good, and physical ones such as fences are only temporary solutions that are worked around easily. Overall, these deterrence methods are one dimensional and lack adaptability, both of which are needed.

IguanaGuard addresses the issues that these current solutions don't provide by implementing an automated deterrence system that uses multiple different stages, AI detection, targeting mechanisms and real time monitoring. Automating the processes of detection and response through a cycle of deterrents reduces the need for human involvement and labor while also being efficient and humane. The system is scalable based on the area being worked with while remaining just as cost effective as it can adapt to changing conditions, providing long term iguana handling and management for all homeowners and businesses.

II. SCOPE OF WORK (Chwoeger Charleston)

A. Overview

IguanaGuard is a humane, automated deterrence system designed to detect and repel iguanas from a designated area using computer vision and a multi-stage escalation system. The development of this system has been broken down into four key stages:

1. **Research Stage** – In this phase, we identified the behaviors and biological sensitivities of iguanas—such as their aversion to strong odors and certain sounds or light stimuli. We also evaluated different hardware and software platforms to determine the most efficient and compact combination for our needs. Considerations included computational power, power consumption, and physical size constraints for field deployment.
2. **Design Stage –** Using insights gathered during the research phase, we designed the overall system architecture. This included dividing the system into modular subsystems—detection, control, and deterrence—and defining how each component interacts. We also mapped out the software structure, including the AI detection model, servo controls, and decision-making flow for triggering deterrents.
3. **Construction Stage** – In this phase, we built the initial prototype. Subsystems were individually implemented, tested, and integrated into a working system. Both hardware (e.g., servos, pumps, sensors, and mounting systems) and software (e.g., detection algorithms, control logic) were iteratively improved based on performance tests. Once we confirmed the core functionality, we moved toward refining the final build, including creating the housing and securing all components for reliable outdoor use.
4. **Final Testing Stage** – The completed system is tested in real-world environments where iguana presence is common. This phase involves performance validation—ensuring the system can accurately detect iguanas and trigger deterrents in sequence. Based on testing outcomes, we make final adjustments to improve response time, coverage, and system stability.

B. Literature Review

Patents

A key patent that closely aligns with our system is US11793190B1, titled “Automatic Animal Detection and Deterrent System” by Charles Hartman King. This design utilizes a video camera and convolutional neural networks (CNNs) to identify target animals and trigger a deterrent within two seconds. Though we developed our concept before discovering this patent, it confirmed our system architecture—particularly the use of real-time image processing and multi-stage deterrents. Additionally, it inspired us to consider recording detection instances for retraining the model and refining the deterrence logic.

Another relevant patent is WO2013122468A1, “Automated Monitoring and Controlling of Undesired Livestock Behavior”, which incorporates cameras, motion, and heat sensors to monitor behavior and prevent aggression in livestock using sound or light stimuli. While it addresses a different class of animals, it shares the same principle of using non-invasive deterrence methods and AI detection, which informed our approach to humane, multi-modal deterrence.

Patent US10085133B2, titled “Pest Control Device”, introduces a system using light and sound to deter pests like rodents. The device attracts pests via light and uses sound to repel them upon detection. Though this patent is not aimed at reptiles, it showed us the potential of integrating stimuli like sound and laser into our escalation system, and sparked ideas about using light signals as possible behavioral cues.

Other patents, such as CN110719733B, employ ultrasonic deterrence, which reinforced the idea of sound as an effective early-stage repellent. These patents mostly implement passive systems, while our system is reactive and intelligently escalates based on real-time detection.

Articles and Technical Research

Our research into animal repellent studies revealed that garlic spray is a safe and effective natural deterrent for iguanas. Its use in other eco-friendly pest control contexts validated its role as the final escalation in our system. Unlike existing products that rely on manual spraying or timed dispensers, IguanaGuard automates this process through AI-driven detection and targeted deployment.

Studies of AI-based animal control systems also supported our multi-sensor approach. For example, bird deterrent systems that use image recognition and lasers have demonstrated the accuracy and efficacy of species-specific deterrents. This informed our decision to train a custom AI model to detect iguanas while minimizing impact on other wildlife.

Existing Products

Commercial products like Iguana Rid Ready-to-Use Spray and Iguana Tree Wrap attempt to repel iguanas using scent-based deterrents or physical barriers. However, these solutions are static and preventative—they do not address active intrusions or movement across open spaces. In contrast, IguanaGuard detects and responds to iguanas in real-time, enforcing a dynamic boundary through escalating deterrent levels.

Additionally, guides such as The Ultimate Guide to Iguana Control and consumer-grade systems like the Smart Animal Repelling Device informed the practical and ethical considerations in our design, helping us emphasize humane, non-lethal, and environmentally conscious solutions.

C. Alternative Solutions

CV Sprinkler System

- **Description**: This approach used a sprinkler system and a camera. The camera would detect any iguanas via computer vision, then it would activate a sprinkler system that contains either water or iguana repellant.
- **Strengths**: Covers a wide area and non-lethal.
- **Weaknesses**: Disruptive, non-portable, high maintenance

CV Deterrent Escalation System

- **Description:** This approach will use a variety of deterrents, and a camera. The camera would detect any iguanas via computer vision. Then if one is detected it would start the escalation model. Starting with the least disruptive too then if the iguana is still detected, it goes up a deterrent that is more disruptive.
- **Strength:** Lower maintenance (liquid not always used), portable, scalable
- **Weaknesses:** Effective areas limited to the camera, environmental factors can affect detection, higher cost

D. Evaluation

Detection Performance – Our detection model has been trained using a dataset composed of both self-collected and online images of iguanas. We have successfully tested the model on images, demonstrating its ability to recognize iguanas. Moving forward, we will enhance evaluation by testing the model using a live video feed in various environments to ensure consistent accuracy in real-world conditions.

Deterrence Effectiveness – We developed our deterrence methods based on extensive research into iguana behavior and commonly used deterrents. This informed us of the most effective techniques for repelling iguanas. To further validate our approach, we plan to conduct real-world testing to measure the actual effectiveness of each deterrence method.

System Responsiveness – We successfully implemented a servo motor with a laser attachment that activates immediately upon detecting an iguana (simulated with a toy iguana). The system demonstrated fast and reliable response times, which suggests that the full deterrence system will perform effectively once fully developed. Additional testing will be conducted as we integrate other deterrence methods.

Environmental Adaptability – While we have not yet tested adaptability in different environmental conditions, the system is designed with real-world deployment in mind. Future tests will focus on assessing its performance under varying lighting conditions, different backgrounds, and outdoor settings to ensure robustness and reliability.

E. Decision

Based on our evaluation, we determined that the Computer Vision Deterrent Escalation System is the most effective solution. It balances cost, effectiveness, and automation while minimizing maintenance. The key factors influencing this decision include:

Higher Success Rate – The escalation model ensures multiple layers of deterrence, making it more effective than single-method solutions like sprinklers.

Lower Maintenance – Unlike a sprinkler system that requires regular refilling and monitoring, IguanaGuard's deterrents require minimal upkeep, increasing its long-term usability.

Scalability – The modular design allows for expansion, meaning additional deterrents or detection improvements can be integrated easily.

Cost Efficiency – While the initial setup cost is slightly higher than some alternatives, the reduced need for manual intervention and consumable materials makes it more economical in the long run.

Thus, IguanaGuard provides an optimal balance of automation, effectiveness, and sustainability, making it a viable solution for controlling the iguana population.

III. IMPLEMENTATION DETAILS

A. System Specifications and Functionalities (Gabriel Suoth)

A.1. Hardware Specifications

Raspberry Pi 5

The Raspberry Pi 5 will act as the central control center of the system, integrating the hardware and software components. It is responsible for hosting the software, including the aiming algorithm, detection model, recording video, data processing from the camera, and escalation logic. The deterrence methods will be controlled by the Pi as well, via the GPIO pins.

Raspberry Pi AI HAT+ (Hailo-8L)

The Raspberry Pi AI HAT+ will connect to the Raspberry Pi and provide additional computational power for the detection model. This will ensure that we have more than enough power to run multiple software and ensure the accuracy and speed of the detection system will not be affected.

VLM-650-01 LPT (Laser Diode)

The VLM-650-01 LPT is a 1mW red laser diode. This should be a safe deterrent option, due to its low power, wavelength, range, and on top of that being refracted by the lens. This shouldn't do any permanent damage to any eyes and flesh.

1080p Webcam

Using a simple webcam is enough for this case. We were originally going to use a night vision Raspberry Pi camera, but that was shown not to be ideal. The colors had a purple hue due to its IR filter, and the model accounts for color, also the resolution of the camera wasn't ideal. So, we went with a webcam we already had, and that was simple to implement and connected to the model easily.

SG90 Servo Motor

The SG90 is a servo motor. This servo is lightweight, compact, and its power is sufficient for our use case. It is precise enough and it can handle the weight of the components attached to it. Convenient as well needing 5V, which is the voltage our power bank outputs.

HC-SR04 (Ultrasonic Sensor)

The HC-SR04 is an ultrasonic sensor. While the component is originally meant to be used to measure distance, we only use the ultrasonic emitter part of it. Iguanas are shown to be sensitive to high frequency noise, but ultrasonic frequencies are inaudible to humans and most animals. The device's range is also ideal going up to 4m, which is enough for our case.

Sanpaint Brass Hose Nozzle

The Sanpaint Brass Hose Nozzle is what we used to disperse the water for liquid deterrence. The adjustable nozzles allowed us to control the pressure and range. Giving us flexibility depending on the environment. Its brass construction will prevent corrosion, which is ideal for this case, since the device will be outside most of the time.

SEAFLO 21 Series 12V Mini Water Pump

The SEAFLO Mini Water Pump is our choice for the spray mechanism of the system due to its compact size and reliability. The pump can deliver a consistent flow rate of one to two liters per minute at a pressure of 35 PSI, making it good for precise dispersion of liquid. This pump will power the liquid deterrent and effectively direct the solution toward the detected iguanas.

Nalgene HDPE Wide Mouth (Liquid Reservoir)

A plastic water bottle such as the Nalgene HDPE Wide Mouth serves as a simple and cost-effective liquid reservoir for the deterrence liquid. Its lightweight design and wide availability anywhere making it an ideal choice. The bottle can be quickly replaced and refilled and provides sufficient volume.

EZ-FLO 1/4 Inch ID (3/8 Inch OD) PVC Clear Vinyl Tubing

The EZ-FLO Vinyl Tubing is what we used to connect the liquid deterrence components. The vinyl tubing provided both flexibility and durability, making it ideal for our use case. We chose this diameter to match the pump, and it can handle the pump's PSI as well.

Talentcell Rechargeable 12V 6000mAh/5V 12000mAh DC Output Lithium-ion Battery Pack

The Talentcell Battery Pack is a good choice for powering the system as it provides dual voltage outputs of both 12V and 5V, the two necessary to run the system. The 12V output can power components such as the pump, while the 5V can power components such as the servo motors. While it can't power the Pi due to the lack of current, it can provide power to components which need clean current, that the Pi cannot reliably provide. The 6000mAh capacity also provides for long time use without needing to recharge.

AEDIKO DC 5V Relay Board

The Relay Board allows the Raspberry Pi to use and control 12V components. The board is compact and allows us to control the pump via the Raspberry Pi. We chose 5V because that's the common voltage that the Raspberry Pi 5 operates at.

A.2. Software Specifications

Python

For the main programming language, we chose to use Python. We mainly chose Python because of its support for computer vision like OpenCV, the library for the AI Chip, and its easy connection to the Raspberry Pi with things such as RPI.GPIO.

YoloV11n & Ultralytics

For the training of our detection model, we chose to use Ultralytics due to its simple process of training the YOLO model. We chose YOLO because it has one of the faster detection speeds out of all the detection models. We specifically chose to use YOLOv11n because it was the latest stable version of YOLO at the time. We used the nano version, because based on Hailo's benchmarks that was the size we needed to maintain real time detection with our hardware. As well as the time needed to train and compile the model.

Hailo Model Zoo

We used Hailo Model Zoo to compile our detection model to the HEF format which is needed for the Hailo AI kit. By using the detection model on a dedicated chip, we can significantly speed up inference and improve performance, all while offloading the workload to ensure the performance of the main program.

Flask

We used Flask to create a live feed for our detection system, and to display important information like system stats, and current state of the device. As well as handling control of the device such as the confidence threshold of the model.

OpenCV

We used OpenCV to handle the webcam feed, which is then sent to the detection model. Additionally, OpenCV is used to stream and display the feed into the Flask server for monitoring. OpenCV was also used to calibrate the camera, removing the fisheye distortion from images for more accurate detection and tracking.

RPI.GPIO

We used RPI.GPIO as the main way to control the GPIO pins. PIGPIO is not available yet on the Raspberry Pi 5, so we chose RPI.GPIO as a good alternative. It also has functionality for PWM, which is necessary to control the servos.

A.3. Functionalities

Real-time Detection

The system utilizes a YoloV11n model trained off iguana images, running off a Hailo-8L AI Kit. By using a lightweight model and a dedicated AI chip, the model is optimized to near real-time detection, that is needed for an effective deterrence device.

Progressive Escalation Deterrence Model

The system utilizes a progressive escalation model. Starting with shining a laser at the iguana. Then if the iguana remains, it moves to more extreme measures by emitting ultrasonic sounds at the iguana. Then finally the most extreme, it would then spray a liquid at the iguana. Using a progressive model, it lowers the need of maintenance of the device.

Servo-Controlled Aim System

The deterrence methods are connected to a set of servos. These servos are connected to an algorithm that takes in the coordinates of the detected iguana then converts that into angles that the servo can use. This ensures that the deterrence methods are always being pointed in the direction of the detected iguana, and not anywhere else.

Remote Feed for Monitoring and Control

Using Flask, the system shows a live feed of the device’s camera, allowing the user to monitor the detection process. It also displays important information such as system stats. As well the user can control the detection model by changing the confidence threshold, allowing fine tuning to different environments.

B. Overall System Design with Block Diagram(s) (Gabriel Suoth)

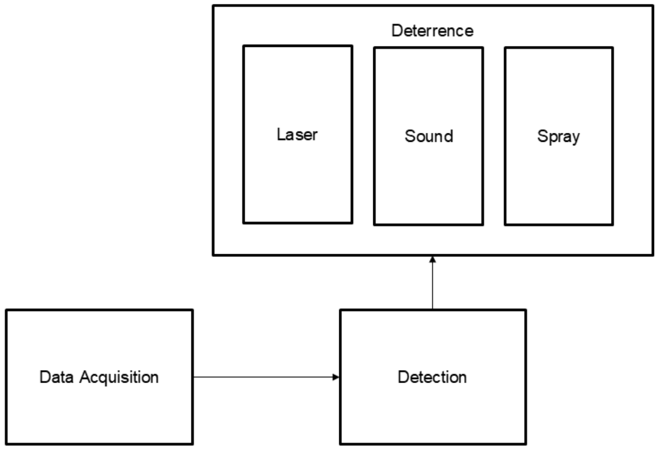


Figure B.1: Subsystem Block Diagram

The current system is comprised of three subsystems: Data Acquisition, Detection, and Deterrence.

The data acquisition subsystem collects images from the camera feed and sends it through a calibration algorithm using OpenCV, which removes the fisheye distortion from the images. This step is necessary for the aiming algorithm, to ensure that the coordinates and angles relationship are consistent with each other.

The detection subsystem is the way the system handles the detection of the presence of iguanas. This ensures the system only enables in the presence of iguanas and no other animals. The identification is handled via a YoloV11n model that was trained off images of iguanas. Then when an iguana is detected, it activates the deterrence subsystem, and sends the necessary information needed.

The deterrence subsystem handles the deterrence of the iguana from the area. It consists of three systems: laser, sound and spray. The laser system consists of a laser diode, attached to a lens. The lens refracts the laser into a wider area with a distinct pattern, which would then disturb the iguana. The sound system consists of an ultrasonic sensor. This device would emit an ultrasonic sound towards the iguana. This would be inaudible to humans and most other animals, but not to iguanas. The last system is the most extreme, the spray system would spray a solution that can either be water or a specialized iguana deterrent. These systems would be attached to a servo system, controlled by an aiming algorithm.

Also, the deterrence subsystem would work on a progressive escalation model, starting with the least aggressive method of lasers, to sound, then finally spray. This ensures that we disturb the environment as minimal as we can and minimizes the amount of maintenance needed.

C. Circuit diagrams, Flowcharts and/or Use Case Diagrams (Gabriel Suoth)

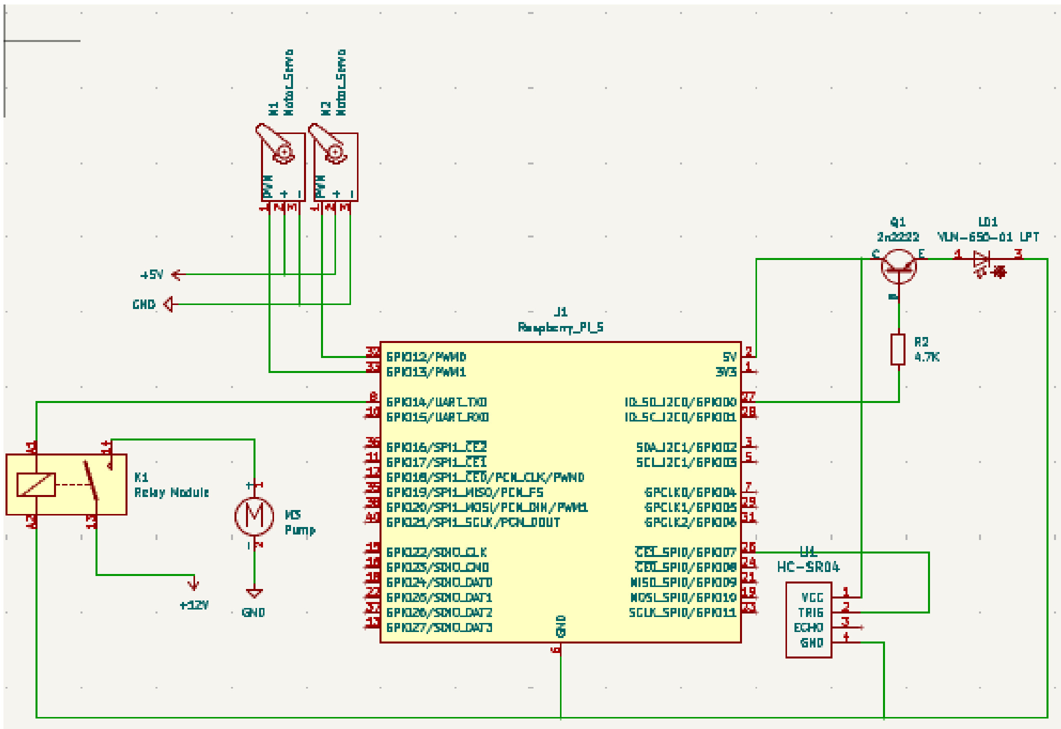
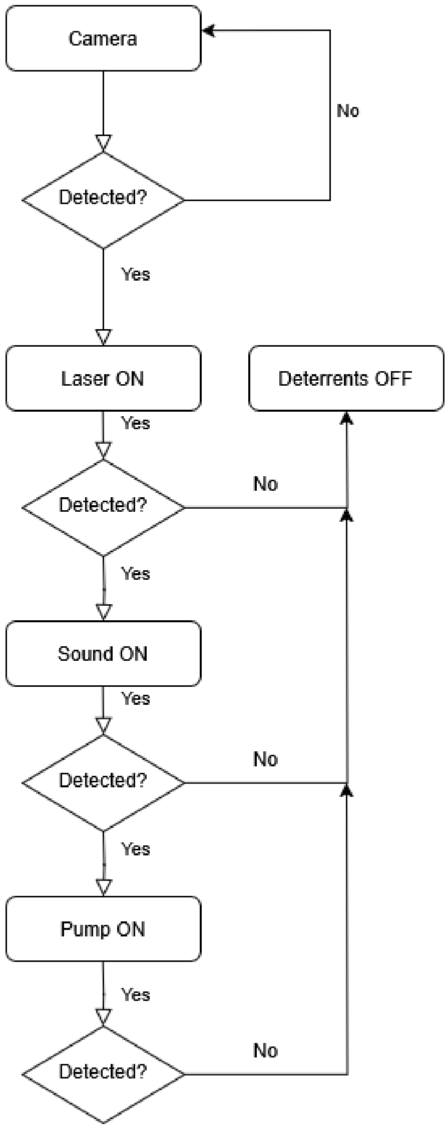


Figure C.1: System Circuit Diagram

For the laser deterrence, we used a laser diode connected to an NPN transistor acting as a switch. The transistor's base is connected to a GPIO pin on the Pi, and the collector is connected to the Pi's 5v and goes to the laser diode than to ground. For the ultrasonic deterrence, we used an ultrasonic sensor. The VCC power is connected to the Pi 5v, and GND goes to the Pi's GND. The trigger pin is controlled by a GPIO pin. The ECHO isn't connected since we are not using it as a sensor and are using the emitter only.

For the liquid deterrence, we used a pump. Since the pump runs on 12V, we had to use a relay module to control it from the Pi. The relay module is connected to the Pi's GPIO pin. The current of the relay is connected to the 12V Power bank, then that other side of the path is connected to the pump.

For the aiming system, we used a set of servos. The servos are connected to a separate power supply, to ensure clean current to prevent jittering and malfunctions. The Pi itself can't output this clean current, so had to use the power bank. The PWM pins are connected to the Pi's GPIO pin.



This is the flowchart of the system. It starts with a camera feed going to the model, and that checks if any iguanas are detected. If there are no iguanas, this will loop indefinitely. When an iguana is detected, the system starts the deterrence methods. By first turning on the laser. After a set time, if the iguana is still detected, it will turn on the ultrasonic sound. If the iguana is still detected, then turn on the pump. During any point of the deterrence states, if the iguana is not detected the system will shut off all deterrence methods.

Figure C.2: System State Flowchart

D. Technology and Technical Standards used (Chwoeger Charleston)

Python

a. Python Software Foundation
b. Python has multiple standards in the form of PEPs (Python Enhancement Proposals). These PEPs are meant to provide information, or describe a new feature in Python. Like the **PEP8** is a styling guide on how to write Python. Making sure that code written is consistent and readable, with things like indentations, maximum line length, and how to handle imports. **PEP20** is the “Zen on Python”, which deals with the design principles of Python like “Beautiful is better than ugly” and “Flat is better than nested”.
c. PEP8

AI

a. ISO & IEC
b. There are multiple standards that deal with AI. **The ISO/IEC 42001** deals with management systems. This includes things such as ethics, transparency, cost savings, and risk management. Another standard is ISO/IEC 22989, which deals with establishing what AI is, and the concepts. **ISO/IEC 38507** deals with guiding the governing body of an organization on how to use and govern AI.
c. ISO/IEC 42001:2023

Lasers

a. IEC
b. **The IEC 60825-1** deals with safety, classification, and requirements of lasers. This standard defines the different classes of lasers, and how dangerous each of them are. Also they deal with safety measures needed to handle lasers, like properly labeling things and wearing proper equipment.
c. IEC 60825-1:2014

Raspberry Pi

a. IEEE & ISO/IEC JTC 1
b. **IEEE 1620-2004 (Standard for Embedded Microcontroller Systems)** which defines the framework for embedded computing as well as **ISO/IEC 24790 (General Purpose I/O for Embedded Systems)** which regulates GPIO communication for microcontrollers like the Raspberry Pi
c. The official names are **IEEE 1620-2004: Standard for Embedded Microcontroller Systems** and **ISO/IEC 24790: General Purpose I/O for Embedded Systems**

Liquid Deterrent

a. ISO & ASTM
b. The standard numbers are **ISO 16165:2020 (Water Spray Application for Environmental Protection)** and **ASTM F1979-04 (Standard Test Method for Determining Spray Characteristics)** which define spray effectiveness, fluid distribution, and environmental safety
c. The official names are **ISO 16165:2020 - Water Spray Application for Environmental Protection** and **ASTM F1979-04 - Standard Test Method for Determining Spray Characteristics**

Ultrasonic Deterrent

a. IEC & ANSI
b. The standard numbers are **IEC 61672-1:2013 (Electroacoustics – Sound Emission and Measurement)** and **ANSI S1.1-2013 (Acoustical Terminology & Ultrasonic Sound Devices)** which define frequency ranges, intensity levels, and testing procedures
c. The official names are **IEC 61672-1:2013 - Electroacoustics – Sound Emission and Measurement** and **ANSI S1.1-2013 - Acoustical Terminology & Ultrasonic Sound Devices**

Battery

a. IEC & ANSI
b. Battery standards ensure safety, performance, and interchangeability. **IEC 60086** covers primary (non-rechargeable) batteries, while ANSI C18 defines battery chemistries and sizes.
c. **IEC 60086** & **ANSI C18**

Tinkercad

a. Autodesk
b. Tinkercad primarily uses STL (Stereolithography) and OBJ file formats for 3D modeling and printing, which are industry standards.
c. STL Format Standard**: ISO 10303-21** (Part of the STEP standard for CAD data exchange).
d. **ISO 10303-21** & STL File Formats

3D Printing

a. ISO & ASTM
b. 3D printing follows standards set by ISO and ASTM, ensuring consistency in materials, processes, and file formats.
    a. **ISO/ASTM 52900** defines key terminology, while **ISO/ASTM 52910** provides design guidelines for additive manufacturing.
c. ISO/ASTM 52900 & ISO/ASTM 52910

E. Testing and Performance Evaluation (Tristan Baldeo)

Our system underwent thorough component and integration testing to ensure that all systems function correctly and as a whole unit. As well as to be able to make sure we are maximizing performance, the more we progress. Some areas focused on include:

1) AI Detection Accuracy
    a) Trained AI model on thousands of images both taken on campus and from online to ensure accuracy would be the highest it can be
    b) While the model detects a majority of the time and the test cases trigger all deterrents, future training will continue to be done to the model to ensure an even higher accuracy

2) Responsiveness Real Time
    a) Combining the YOLOv11n model with our AI HAT+ provided fast response times when constrained under the load that the live video applies
    b) This led to minimal latency as rapid response time when using our deterrents and detecting the presence of iguanas in the camera

3) Deterrence Effectiveness
    a) The laser and ultrasonic sound deterrents were tested with a toy iguana placed at different angles and lightings. Both systems were triggered when detection occurred successfully with no errors
    b) The spray system was then also tested in which properly gets triggered on and off and provides a strong stream that will certainly serve well against iguanas in the environment

4) System Integration
    a) System integration to ensure smooth operation is to be done with our escalation model that will progress through all deterrents until the iguana is no longer spotted, in which it will reset from there
    b) The Flask server being used also applies to our system integration by allowing real time video and parameters to be adjusted such as confidence level

F. Discussions on Lesson Learned (Gabriel Suoth)

Throughout this project, we have learned lessons along the way. One of these lessons is power management. When we were implementing the servos, while testing the servo individually it worked fine. But when integrating with the rest of the system, it became jittery, and the angles values were not precise and consistent. We were originally powering the servo straight from the Pi's 5V pin, and this seems to not have been a clean enough power source, so we switched to a separate power bank.

Another issue we had with power was finding out the power bank could not power the Raspberry Pi. We originally planned on powering the Pi using the 5V port, and the pump with the 12V. But the current was not enough for the Pi, so we had to scrap that idea and were planning on buying a UPS. But we had issues with ordering the parts, since they did not give us the exact model, we asked for on the ordering sheet. So, we scrapped the idea of being portable and chose to use an extension cord for the expo.

We learned another lesson regarding Python. Python turned out to not truly support multithreading. Using the threading library, we had some issues with the servo integration. Every time the servo moved; it caused some lag to the video feed. We now know of the multicore library which could potentially work, or we could use a faster programming language as well. Something like C++, but that could also make things more complex.

We also had another component originally part of the liquid deterrent section, being a solenoid. But we couldn't figure out how to connect it, and we also decided that the pump itself was enough. Doing this was the right choice, minimizing the complexity of the device.

IV. Conclusion (Gabriel Suoth)

In the end, IguanaGuard reached its goal of being an automatic iguana deterrence. We accomplished our goal of having an automatic detection system with an escalation deterrence model and implemented all the deterrence methods we planned.

Although there are some things that we didn't implement or could improve upon. Such as portability, a more accurate detection model, and having an aiming system for liquid deterrence. If we are to revisit this project, for portability we would use a UPS for power, a data plan for connection, and a startup script for the server. To improve the detection model, we would train the models on more powerful computers and make the dataset larger. For the spray aiming system, we would need to use much more powerful servos, compared to our current 5V servos.

Overall, this project was an important learning experience. As all three of us are computer science students, we had no experience with things such as 3D printing, and hardware. But we gained valuable experience through this, pushing us out of our comfort zone and learning valuable skills.

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VII. Organization Chart

Name	**Tasks**
Gabriel Suoth	Data Acquisition & Detection - Camera and calibration - Dataset labeling - Model training - Model conversion & compilation Aiming Algorithm
Chwoeger Charleston	Progressive Escalation Model (Deterrence) Servo Pan Tilt Design Component Holder Design
Tristan Baldeo	3D Printing Housing Design Lens Holder Design UI Design Video Editing

Appendix

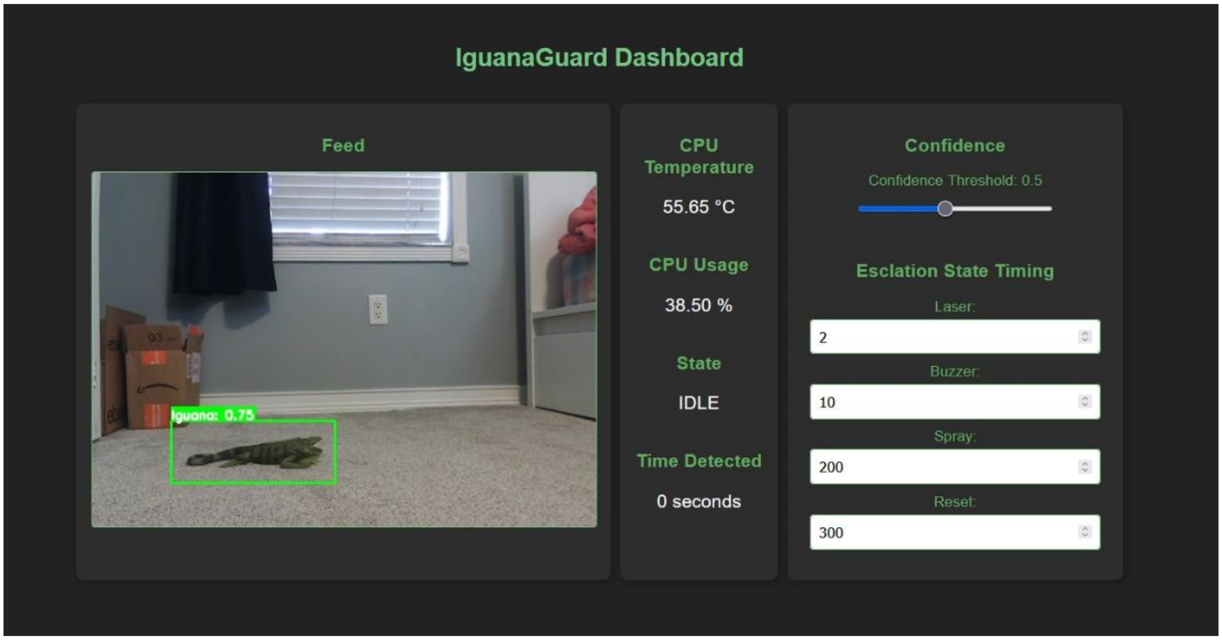

Image 1. Remote UI

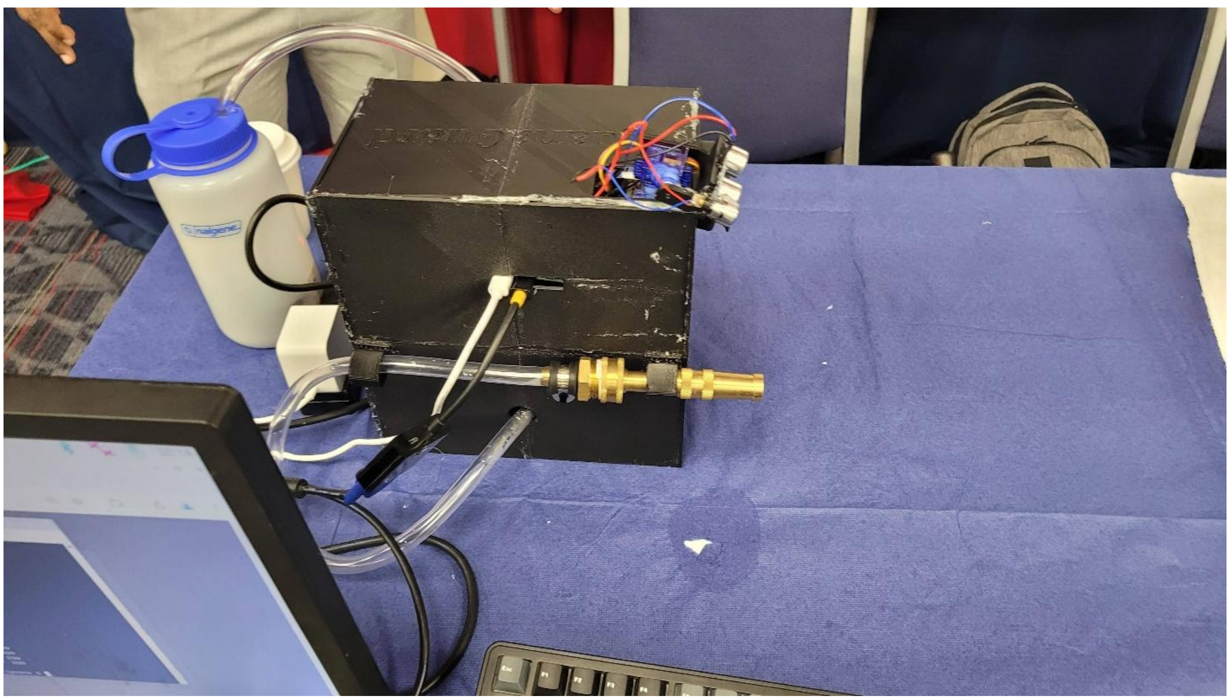

Image 2. Device Exterior

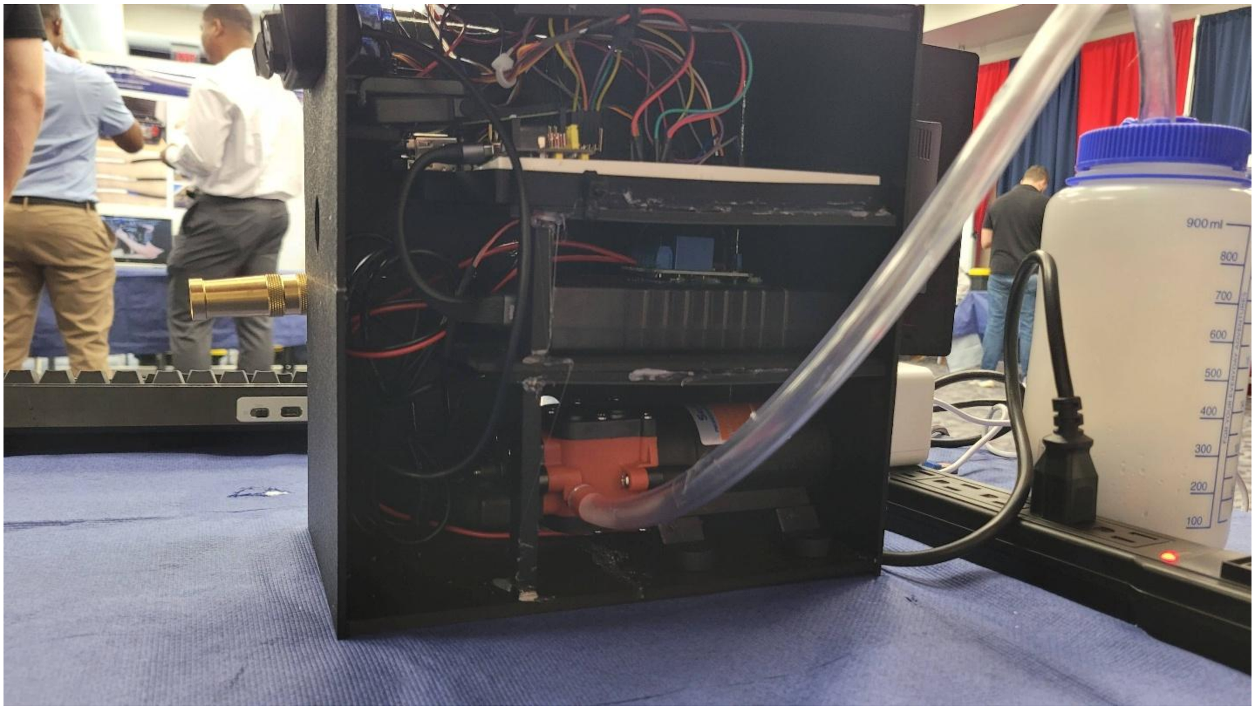

Image 3. Device Interior

Image 4. Active Laser Deterrent

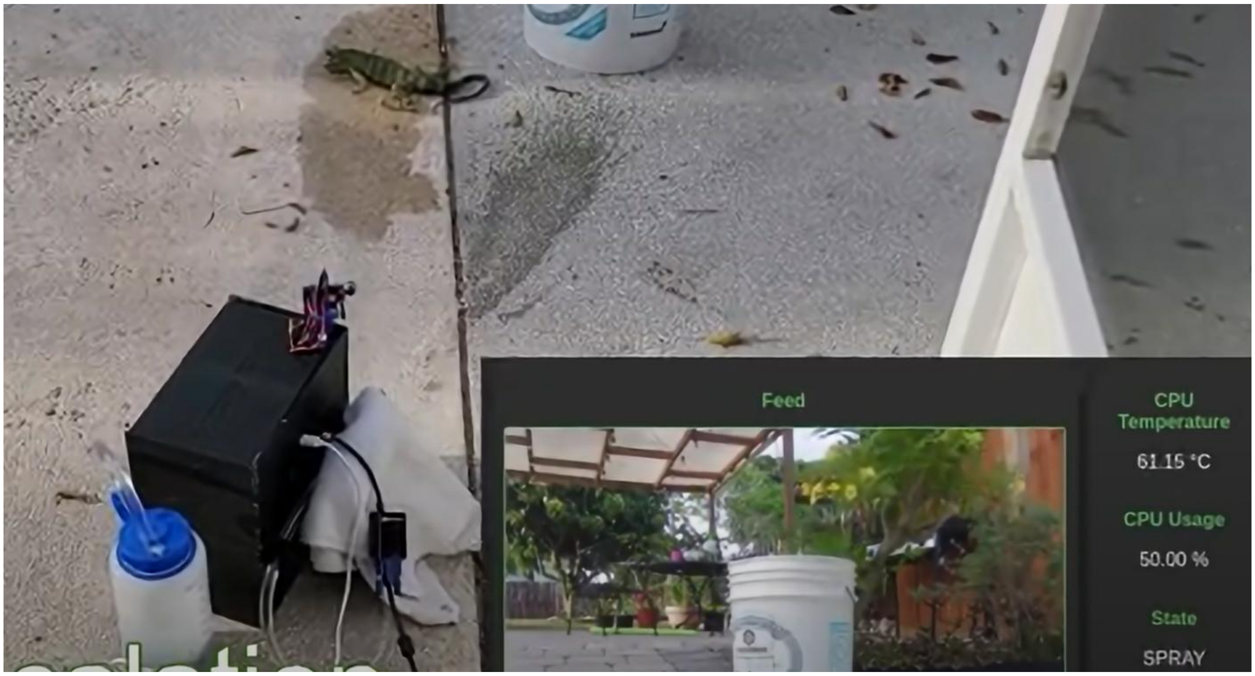

Image 5. Active Spray Deterrent

Image 6. Housing Design Interior

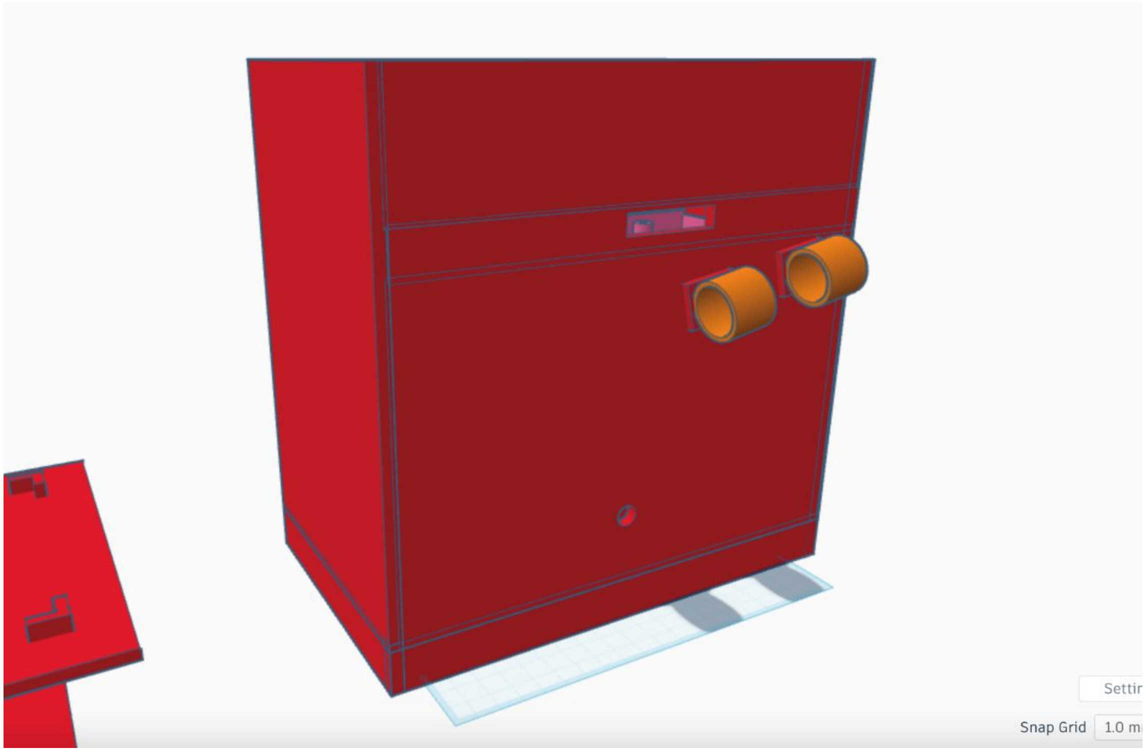

Image 7. Housing Design Exterior

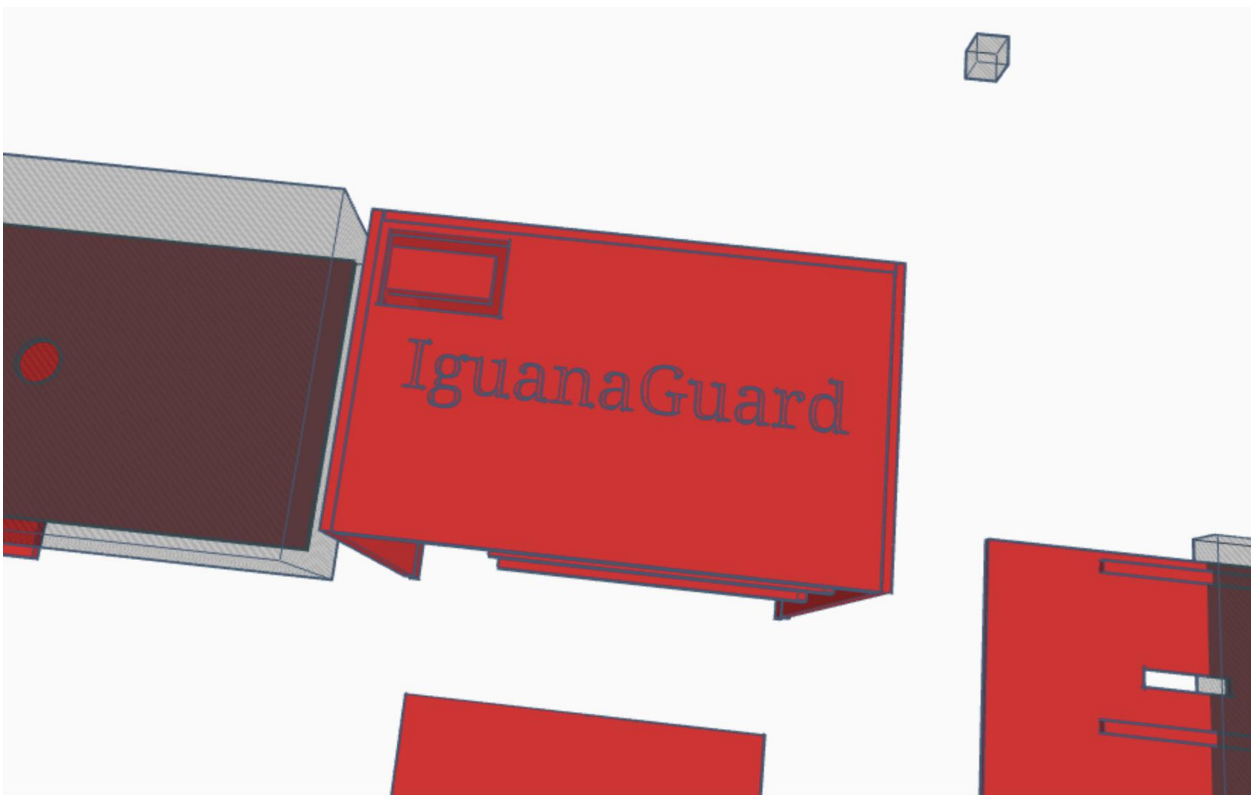

Image 8. Housing Design Above