A white, dome-shaped camera is centered in the background. Three large, semi-transparent cones of light—pink, yellow, and blue—emanate from the camera, filling the background. The title text is overlaid on the camera and the background.

WAICY Submission — AloT Intelligent Pest & Rodent Automated Detection and Notification System

This AloT system integrates deep-learning visual detection, IoT-based automated pest deterrence, and real-time cloud reporting into a unified 24/7 autonomous pest-control platform.

Problem It Solves

1

High sanitation risks in urban environments

Rats, cockroaches, and mosquitoes spread over 200+ diseases (WHO), including Hantavirus, Salmonella, Leptospirosis, and dengue.

2

Traditional pest control is reactive and ineffective

- Manual inspection is slow and inconsistent
- No real-time monitoring
- Heavy reliance on chemical pesticides → pollution + health hazards

3

Rising operational cost

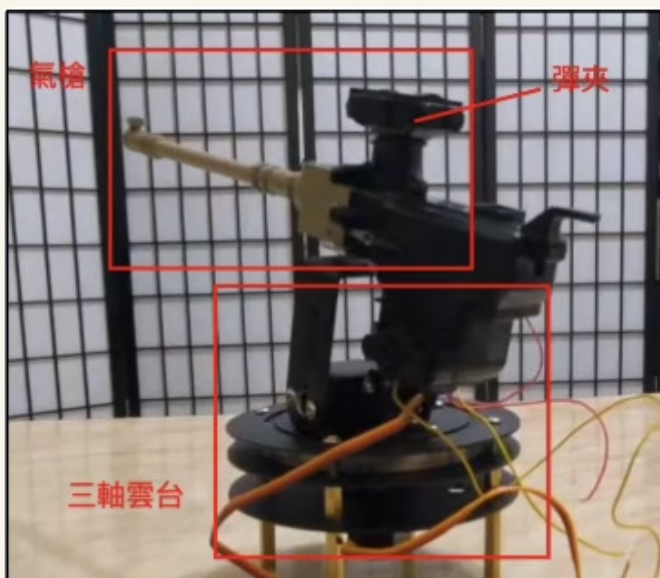
Labor-intensive inspections and routine spraying increase costs for restaurants, hospitals, and factories.

4

Lack of early detection

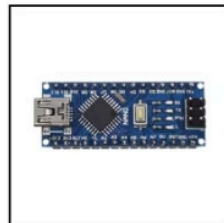
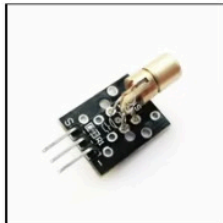
Many establishments discover pests *after* contamination or viral incidents occur (e.g., rat sightings in restaurants and department stores).

The system provides an **automated, eco-friendly, and highly scalable solution** suitable for homes, public spaces, farms, and industrial facilities.

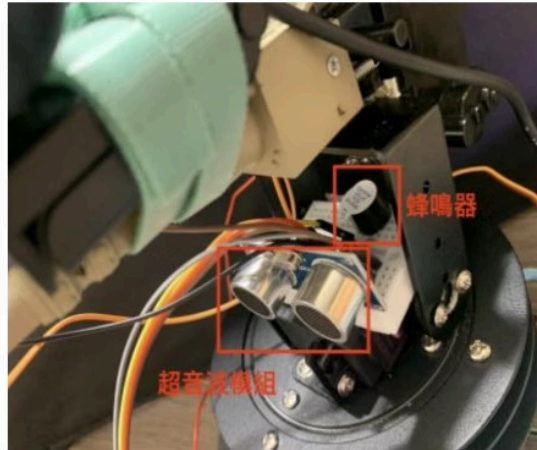
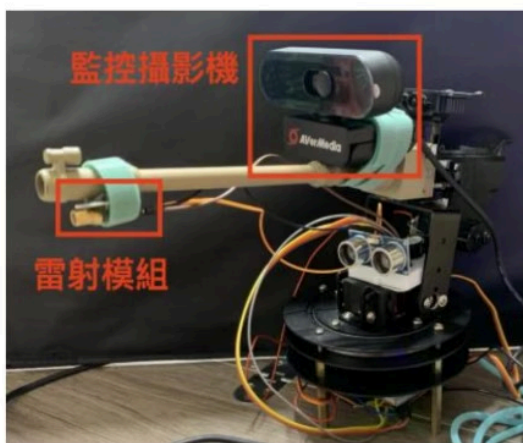


User Value

- ☐ 24/7 autonomous AI monitoring
- ☐ Chemical-free deterrence
(ultrasound, bright-light laser, buzzer, air cannon)
- ☐ Real-time alerts via cloud platform
- ☐ Precise YOLO-based detection for high accuracy
- ☐ Data analytics for preventive planning
- ☐ Supports SDGs
(Good Health, Sustainable Cities, Responsible Consumption)



超音波模組、無源蜂鳴器、雷射模組、Arduino Nano



Motivation

Urbanization, climate change, and rising temperatures have significantly increased pest populations worldwide. Cities, restaurants, schools, hospitals, and food-processing factories face growing sanitary hazards, yet traditional pest control remains outdated, labor-dependent, and chemical-heavy.



Chat History

Sample 12-Turn Chat Log

User: Hi, what is the current pest status?

System: No pests detected in the last 3 minutes. Monitoring continues.

User: Alert me if anything appears.

System: Understood. Real-time notifications enabled.

User: What pests can you detect?

System: Rats, cockroaches, mosquitoes, flies, and ants using YOLO11 with custom training.

User: Something moved near the storage room.

System: Checking... Detected: **Rat (92% confidence)** at Camera 2.

User: Activate deterrence.

System: Laser turret + buzzer activated. Rat repelled.

User: Log this event.

System: Event logged with timestamp and species classification.

User: How many detections today?

System: 4 total — 3 cockroaches, 1 rat.

User: Show me the activity chart.

System: Uploading... A spike occurred at 1 AM around food storage.

User: Why did that happen?

System: Likely attracted by leftover food traces. Recommend inspection.

User: Give me prevention tips.

System: Seal gaps near the storage rack and clean floor drains weekly.

User: Good. Keep monitoring.

System: Always on standby.

User: Thanks.

System: You're welcome! Ready for the next detection.

Chatbot Link (Interactive Version)

Chatbot URL: https://api.openai.com/v1/chat/completions?api_key=sk-guide-APIKEY-246810



Web-based live camera demo



Real-time YOLO detection preview



Hardware activation simulation



Cloud dashboard for detection logs



Mobile alert interface

Iterative Prompt Development Process Idea

Create a fully automated pest-control AIoT system combining:

- YOLO-based detection
- Raspberry Pi real-time edge computing
- Arduino hardware modules for deterrence
- Cloud reporting + analytics dashboard

Initial Prompt

-
- "Analyze the camera frame using YOLO. Identify pests (rats, cockroaches, mosquitoes). If detected, trigger the corresponding deterrence module and send event data to the cloud with timestamp and species label."

Experimental Result

- YOLO11 achieved high accuracy after fine-tuning with a diverse pest dataset
- Raspberry Pi processed frames in real time with optimized OpenCV pipelines
- Arduino modules responded reliably to serial commands
- AppSheet mobile dashboard pushed alerts instantly
- Multiple deterrence modes improved repelling success

Error Analysis

Issue	Observation	Cause	Fix
Misclassification of small pests	Tiny cockroaches detected poorly	Dataset lacked micro-scale images	Expanded dataset + augmented samples
Delay in hardware activation	0.3–0.5s lag	Serial bottleneck	Implemented command queue + USB optimization
False positives	Triggered by shadows or debris	High sensitivity	Added confidence threshold + ROI filtering
Ineffective ultrasonic deterrence	Some pests ignored it	Ultrasound variability	Combined ultrasound + laser for hybrid deterrence
Notification delay	Push slow under load	Cloud sync interval	Introduced priority alerts & compressed payloads

Limitations & Future Development

Limitations

Accuracy decreases in low-light or visually cluttered scenes

Certain pests adapt to single-mode deterrence

Air cannon requires periodic cleaning

Internet needed for cloud notifications

Multi-camera setups require additional calibration

Future Development



Integration with smart-building management systems



Multi-camera, multi-room tracking



Thermal or infrared detection for dark environments



Solar-powered outdoor modules for agriculture



Reinforcement Learning to optimize deterrence strategy over time



Enterprise-level dashboard for chain restaurants, hospitals, and logistics centers

Conclusion

The AIoT Intelligent Pest & Rodent Detection System delivers a **fully automated, eco-friendly, and scalable** solution to modern pest-control challenges. By combining YOLO-based vision, Raspberry Pi processing, Arduino-driven deterrence, and cloud reporting, the system achieves:

Real-time detection

Autonomous and chemical-free deterrence

Reduced labor cost and higher hygiene standards

Data-driven prevention strategies

Increased safety for homes, restaurants, hospitals, and farms

It represents a **major step toward intelligent sanitation management** and supports global sustainable-development goals.

References

- Ultralytics YOLO11 Documentation
- Raspberry Pi 4 Documentation
- Arduino Nano Hardware Guide
- WHO Vector-Borne Disease Reports
- Environmental Health & Pest Control Journals