From Waste Chaos to Compliance: A Robotic AI System Achieving Real-World Remediation End States

About Us

- Research & Development
- Founded in 2008
- Privately Owned
- Headquarters in the United Kingdom
- Offices in Japan, United States and South Korea

Sort & Segregation of Nuclear Waste

Automation of Nuclear Waste Sorting

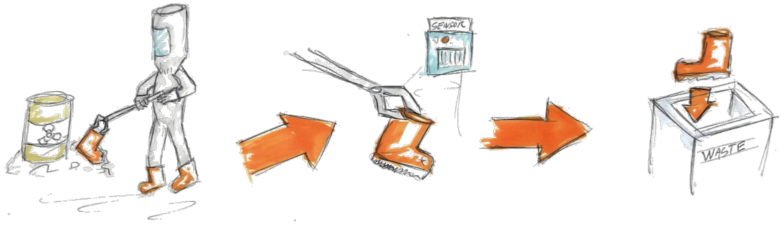
Utilises advanced computer vision, ML and robotic technology

Identifies Waste

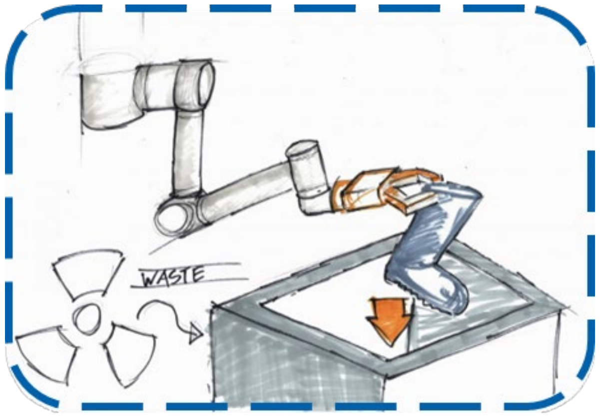
Identifies and sorts debris based on size, material and shape

Agnostic Platform

Utilised by any robotic platform



Humans assess and sort contaminated into the appropriate stream for disposal.



A robot can mimic human activity via machine learning and allocate the waste to the appropriate stream.

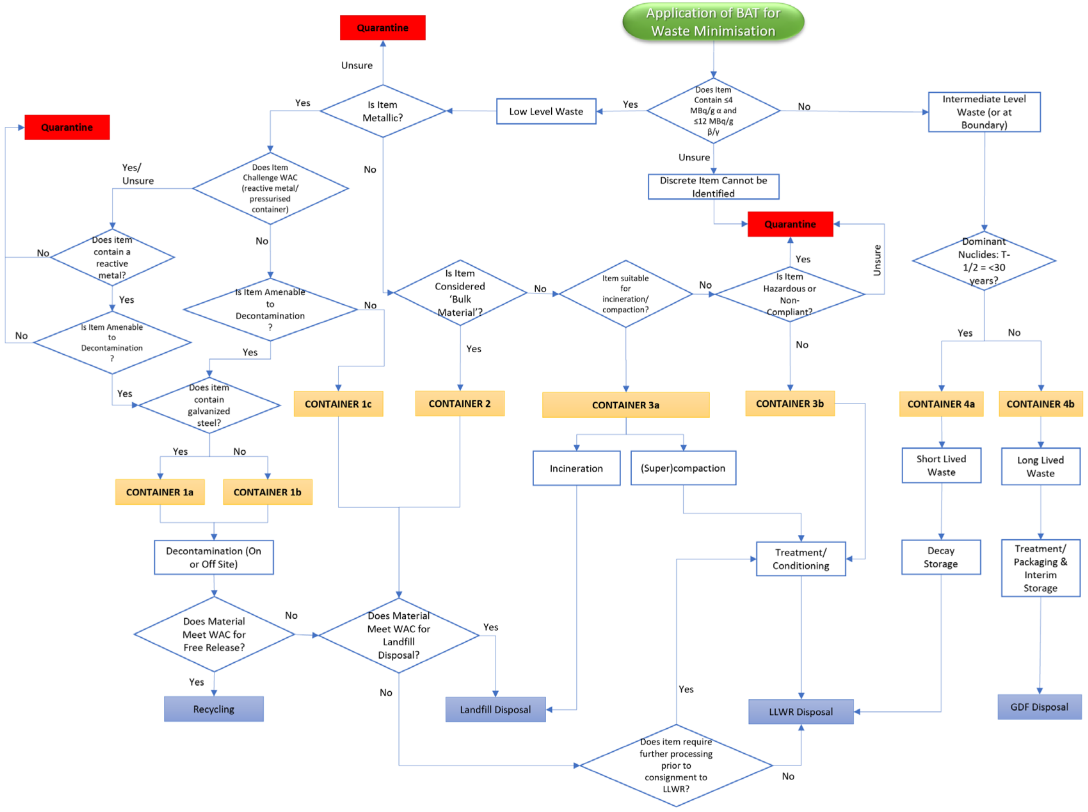
Waste Stream Compliance

BAT – Best Available Technique

- Utilise the best practical methods currently available.
- That are technically and economically feasible.
- And that minimised the generation of waste or its hazardous properties.

Relevance to UK and EU Nuclear Regulation.

- Operators are required to demonstrate the application of BAT when managing radioactive or hazardous waste.

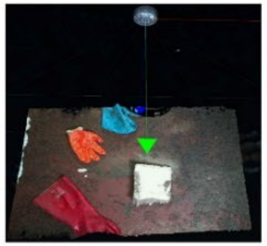


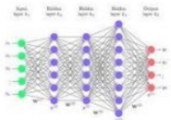
Material Identification

- Initial identification via Machine Learning (deep-learning computer vision).
- Orthogonal datasets for mass and paramagnetic materials.
- Laser ablation techniques
- Hyperspectral imaging techniques

Material identification

Initial Recognition

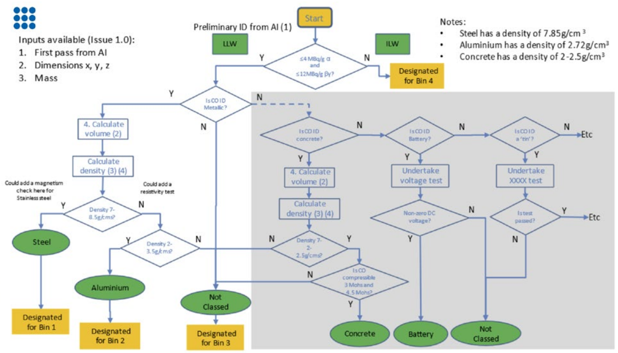




Deep learning recognition

Orthogonal Data

✓ now ✓ future



- ✓ density
- ✓ ferro-magnatism
- ✓ voltage test
- ✓ compressable
- ✓ laser-induced breakdown spectroscopy (LIBS)

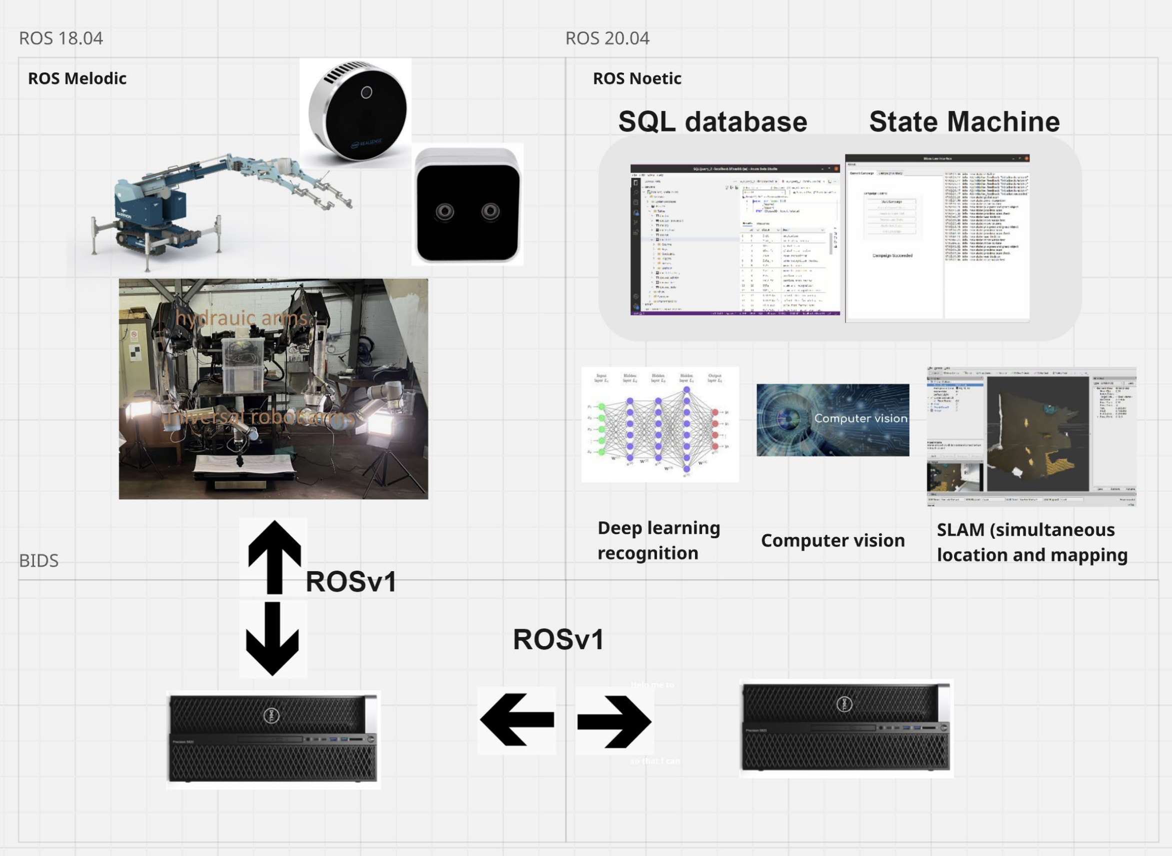
System Architecture

Device side (ROS Melodic):

- Interfaces to hydraulic arms/universal robots, RGB-D cameras, and other sensors provide real-time motion control.

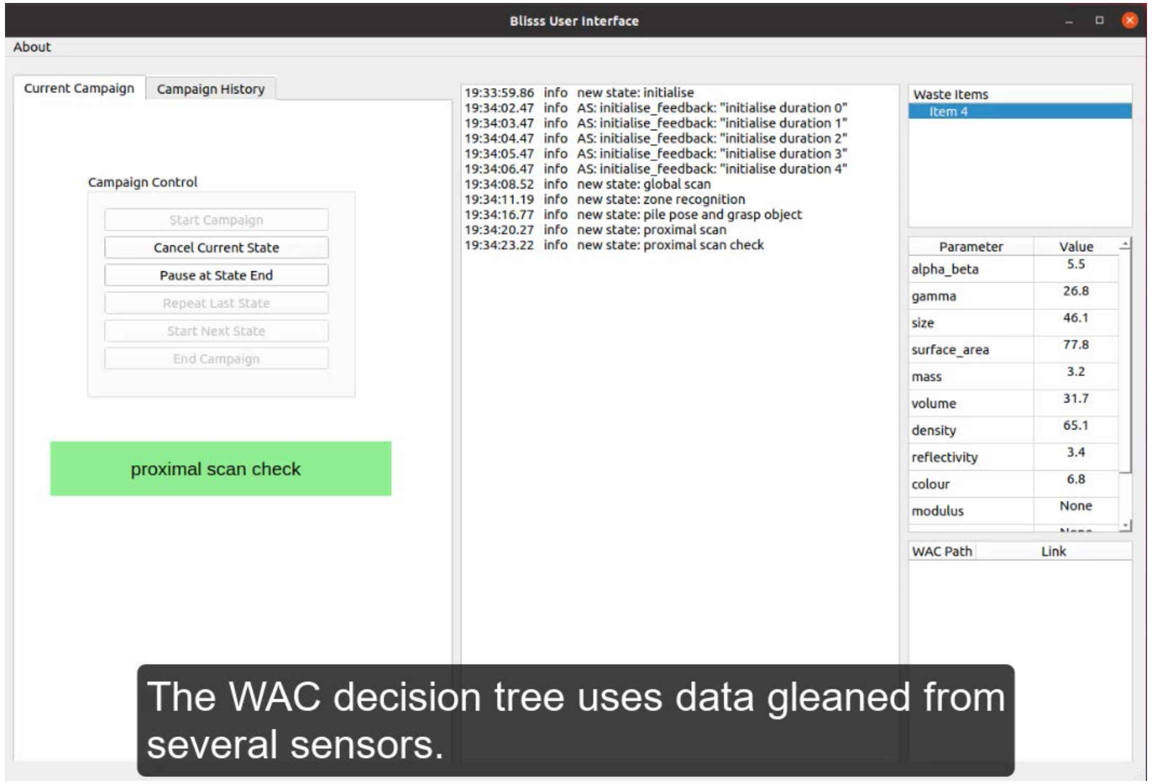
Perception (ROS Noetic):

- Deep-learning recognition for object/material ID.
- Computer vision for pose detection.
- SLAM for workspace mapping and localisation.
- State machine coordinates tasks, exceptions, and recovery sequences.
- SQL database logs images, features, decisions, and traceability metadata.



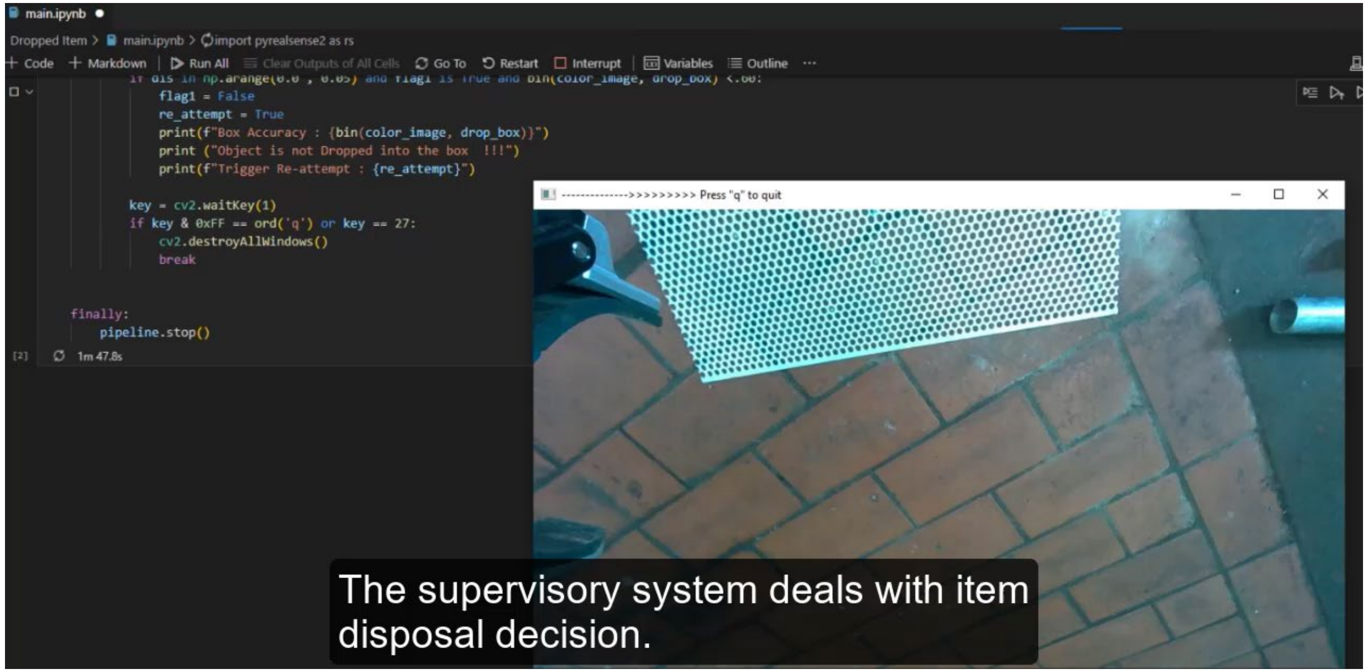
Waste Item Process

- Example of waste classification
- Each stage of the identification
- Laser ablation tec
- Hyperspectral imaging techniques



Waste Allocation

- Follows the WAC Decision Tree
- Classifies: material, radiological Identification (iso ID) & object ID (shoe/tool/parts, etc)
- Routes to correct assignment
- Packing
- An image of the item placed in the correct bin is in the SQL database.



Auto Allocation of Nuclear Waste: Summary

- **Problem:** Manual waste sorting is variable, slow, and dose-intensive with limited traceability.
- **Principle:** Decisions are grounded in BAT—best practical, technically & economically feasible methods that minimise waste and hazard.
- **Solution:** Automated sort & segregation using computer vision + ML + robotics, aligned to site WAC/BAT rules with quarantine for uncertainty.
- **Material ID:** Fast DL recognition, then orthogonal tests (density, magnetism, voltage, compressibility; roadmap: LIBS, hyperspectral) to raise confidence and auditability.
- **Value:** Lower dose (ALARP), higher throughput, fewer mis-sorts, increased recycling/decontamination, strong compliance evidence.