

# Nuclear Waste Identification and Classification Using Deep Learning

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## Background

- Project developed for the U.S. Department of Energy (DOE) to automate waste segregation in hazardous sites.
- Uses a robotic arm with a 3D camera and deep learning algorithms for autonomous waste identification, classification, and sorting.
- Interchangeable end-effectors allow safe handling of diverse waste types.
- Aims to reduce health risks to workers in radioactive environments and improve efficiency in DOE's waste management.

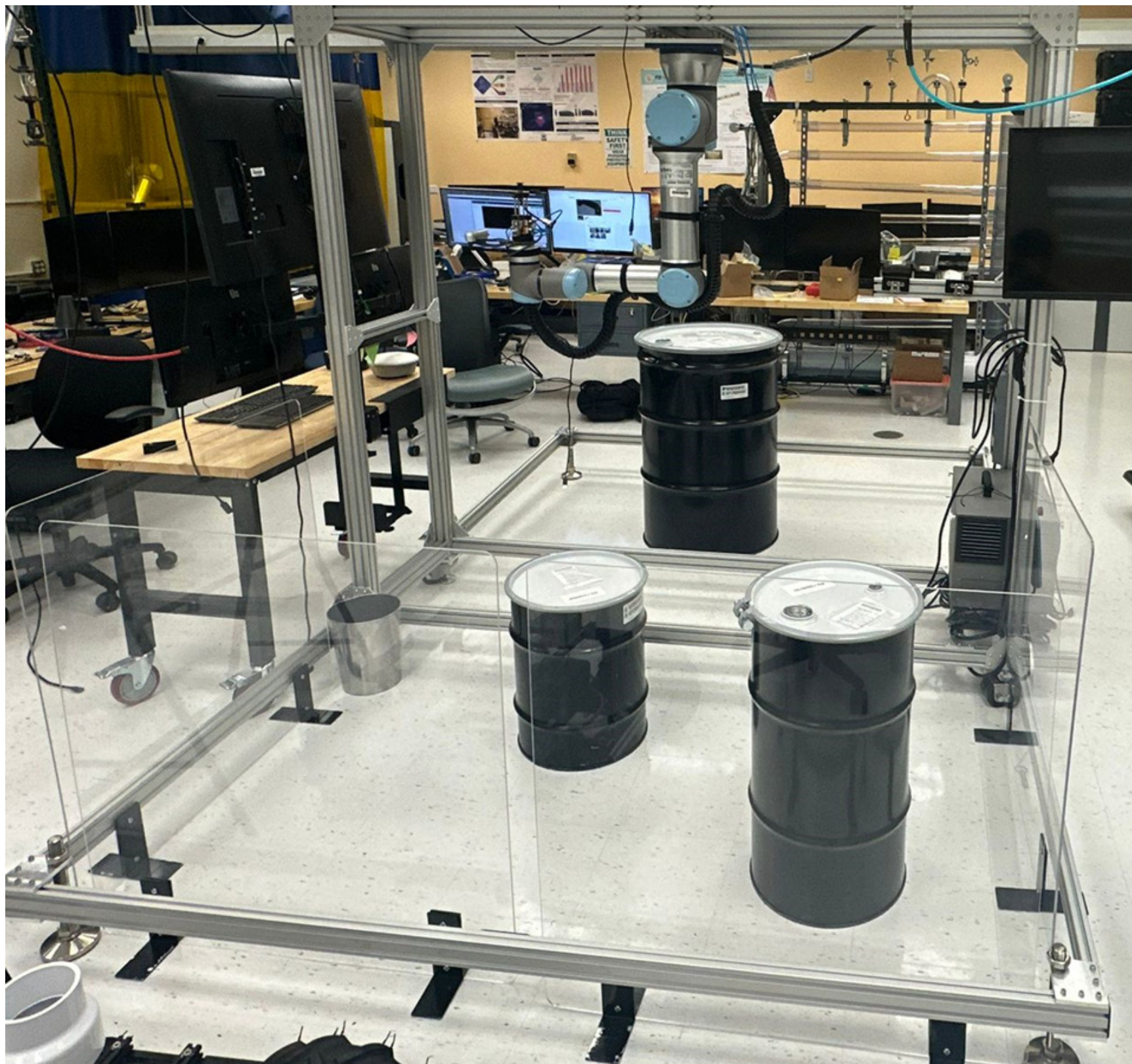


Figure 1. UR16e robotic arm with mock environment used for research

## Objectives

The objectives of this research is to:

- Classify, and successfully separate items found in the mock environment.
- A full integration of the UR16e, camera, and end effectors.

## Object Detection

Using ROS2, the object detection can be integrated to the arm. The following images are from RViz, a visualization software that demonstrates what the robot sees through the camera. The detection is set to filter green balls found in the environment.



Figure 2. Object detection of soda cans using YOLO v8 with confidence level displayed

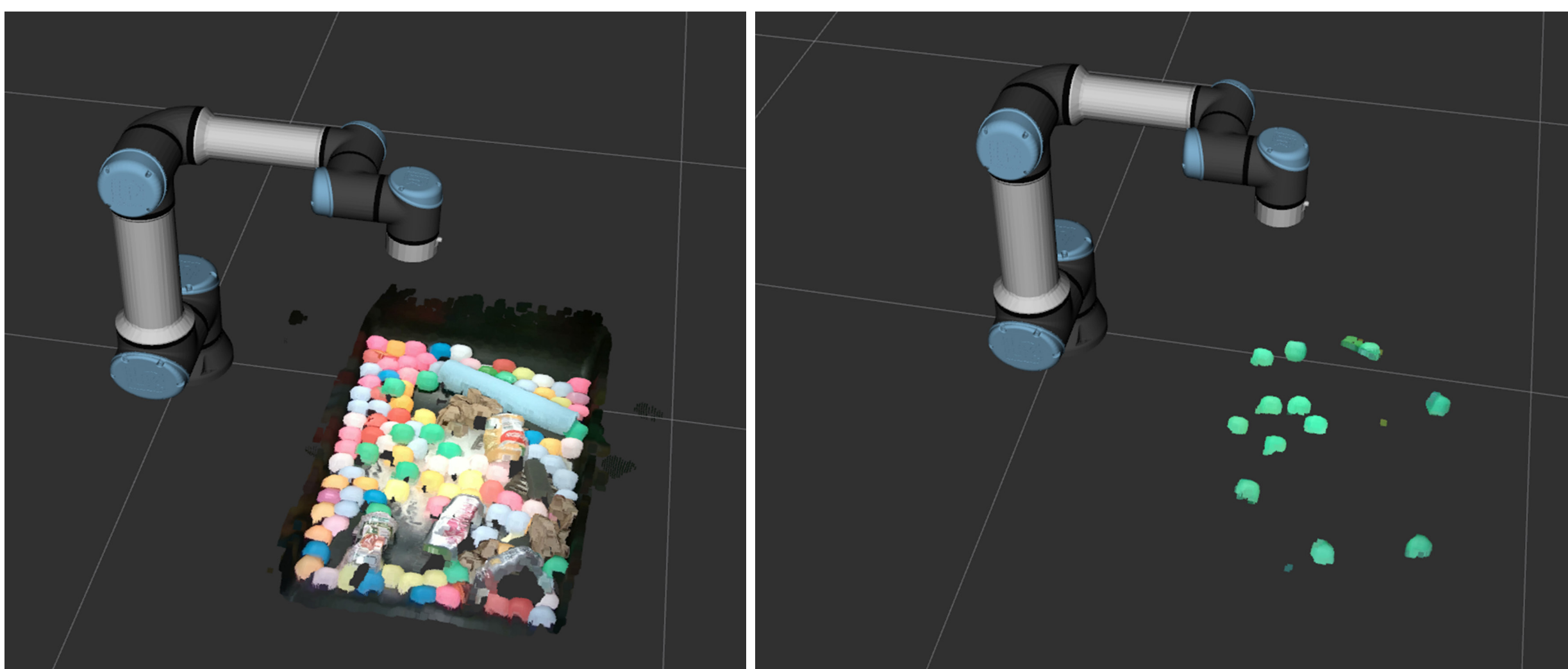


Figure 3. Green ball filtering

## Tools

Different tools are used as well to handle different items found in the mock environment.

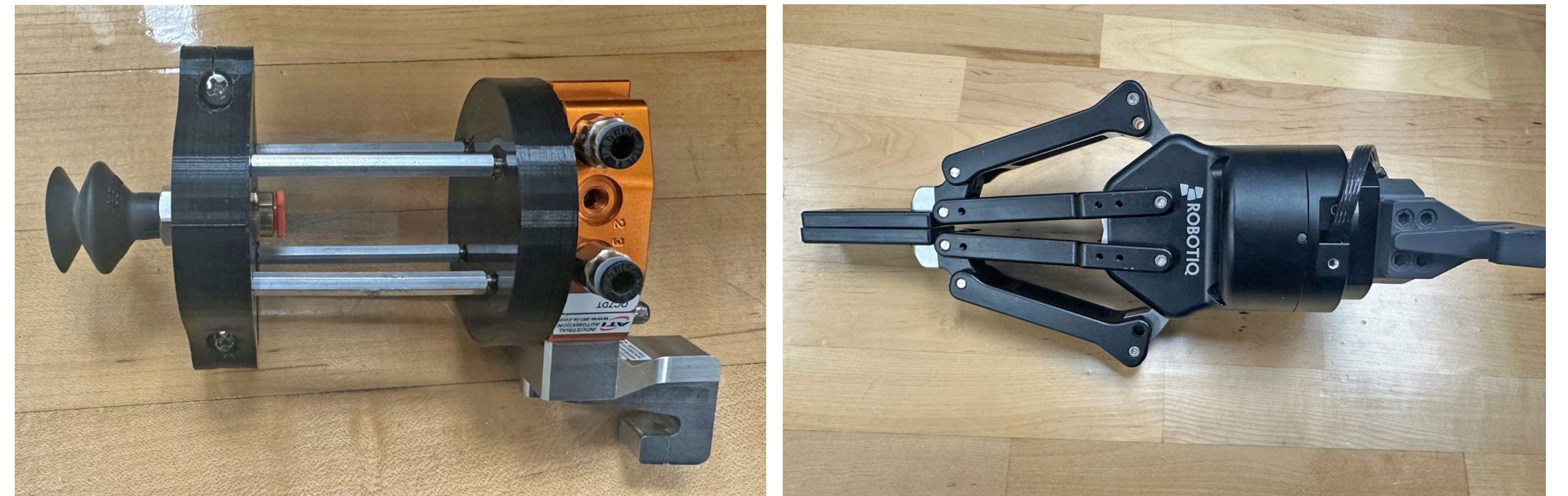


Figure 4. Suction device and gripper

## Pick-up Operation

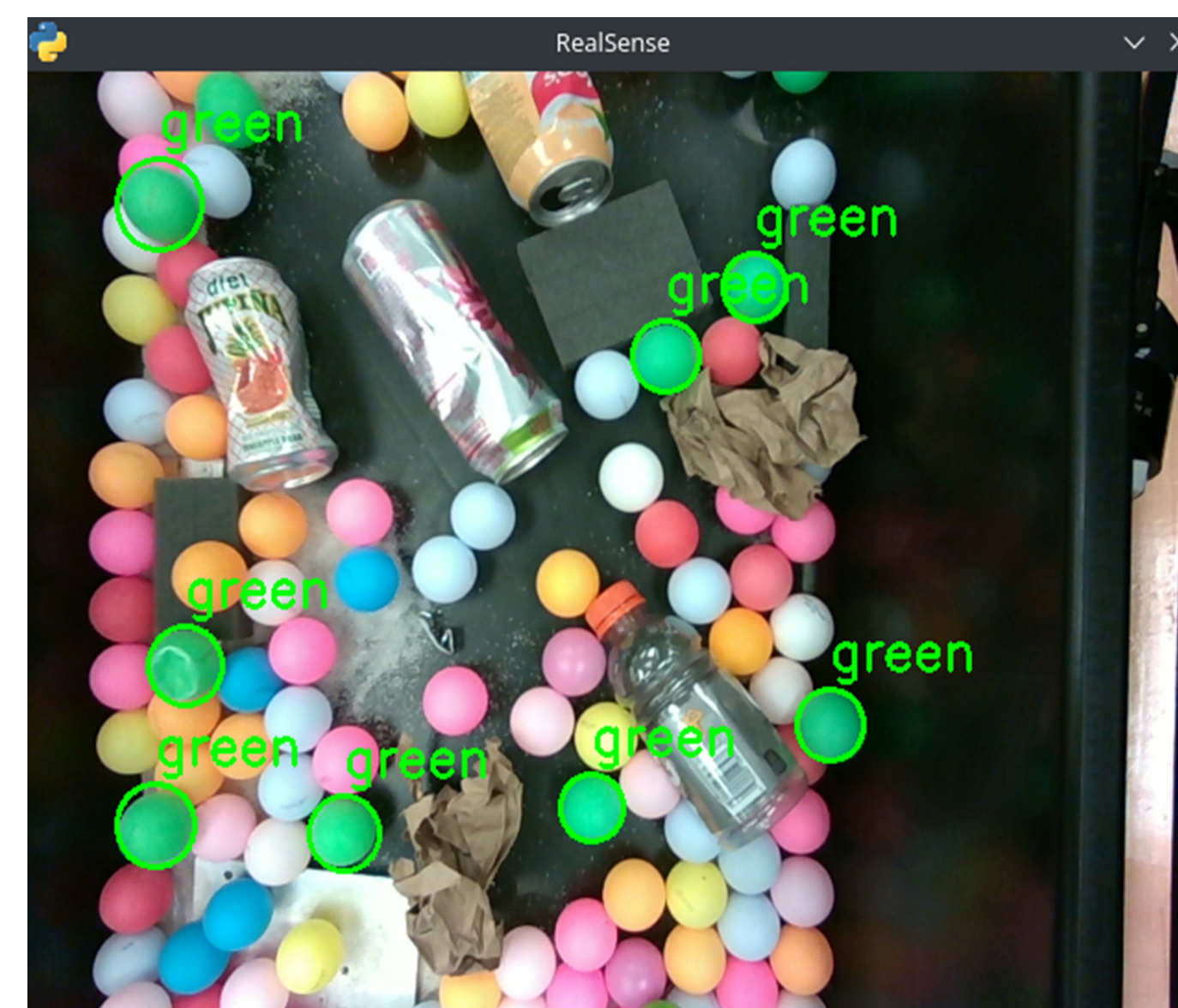


Figure 5. Clear Image of the environment and targets, ready to begin pick up operation



Figure 6. Arm picking up green ball

## Future Plans

Moving forward, the project will focus on:

- Integrating an unsupervised machine learning model.
- Cold testing the UR16e on the waste drums.
- Train the model on new objects such as tools, clothing, etc.

## Acknowledgements

DOE-FIU Science & Technology Workforce Development Program Under DOE-FIU Cooperative Agreement No. DE-EM0005213

