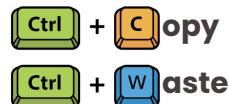


# Rare Contamination Detection in Residential Recycling

By Team Copy-Waste



# THE TEAM



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Machine Learning



**Rishabh Prasad**

Front-End Services



**William Peers**

Back-End Services

# PROJECT VISION

REDUCE RISK FOR  
WASTE MANAGEMENT  
WORKERS & COST FOR  
MUNICIPALITIES



# PROJECT MISSION

TO AUTOMATE THE  
DETECTION OF  
**SEVERE & RARE**  
CONTAMINANTS IN  
RECYCLING



# Our Customer

Waste Management  
companies & Municipalities  
who are attempting to identify  
hazardous waste



# Why is this important?



Saskatchewan

**Firefighters knock down recycle depot fire in Regina's west end**



<https://www.cbc.ca/news/canada/saskatchewan/crews-fighting-fire-at-crown-shred-and-recycling-1.5980051>

<https://www.cbc.ca/news/canada/saskatchewan/emterra-recycle-depot-fire-1.6202918>

# Why is this important?



Figure 10: Photo of the aftermath of an LIB fire in a garbage truck. An LIB fire in a garbage truck forced the driver to empty garbage onto the street to be extinguished, disrupting service for customers and creating a traffic hazard for community members and first responders. Photo courtesy of Bellevue Police Department.

# Why is this important?

Example pictures for damage classes of portable batteries:

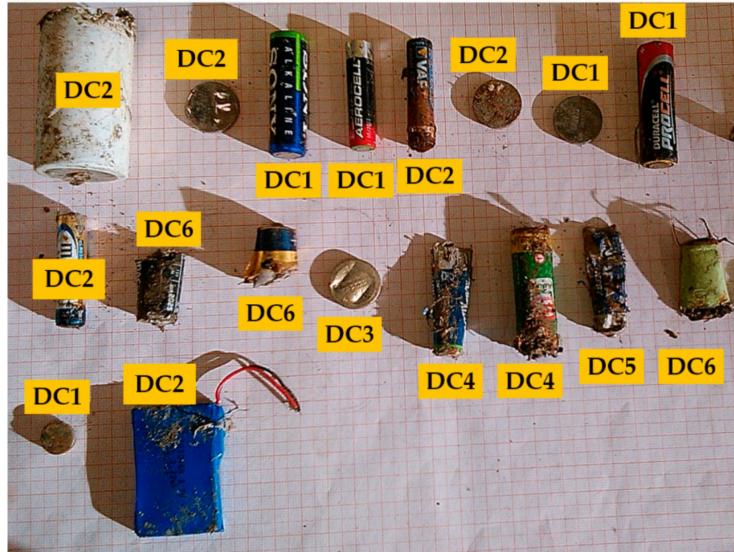


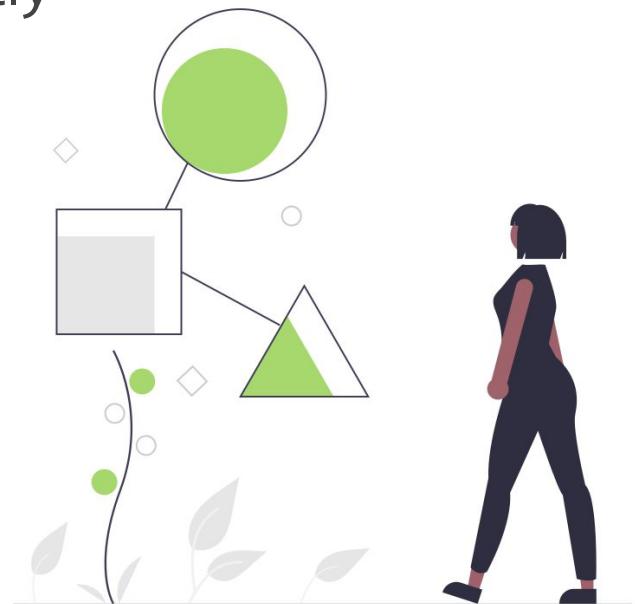
Figure S1. Damage classes of end-of-life portable batteries (after sampling campaign).



Figure 11: Photo of firefighters battling the Larimer County LIB fire. Firefighters hosing down the Larimer County LIB fire after the combusted pile of recyclables was moved outside by a MRF operator. Photo courtesy of Larimer County Solid Waste Department.

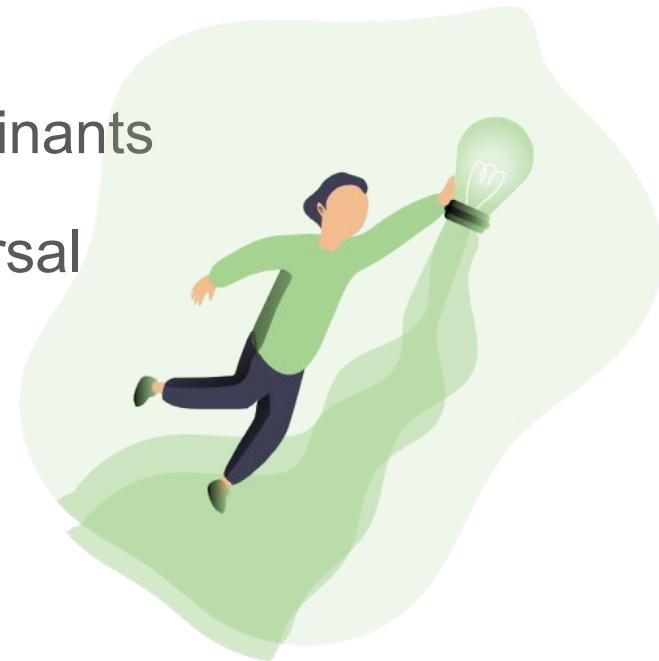
# Why is this important?

- Rare contaminants are currently undetectable
- Address careless recycling & hazardous contamination
- Serious and immediate risks



# Opportunity and Innovation

1. Automate detection of rare contaminants
2. Implement a highly scalable Universal Bin Detector
3. Build an Interactive dashboard to improve user experience



# Product Demonstration



## GREEN SCREEN

### Green Screen Login

Username

Password

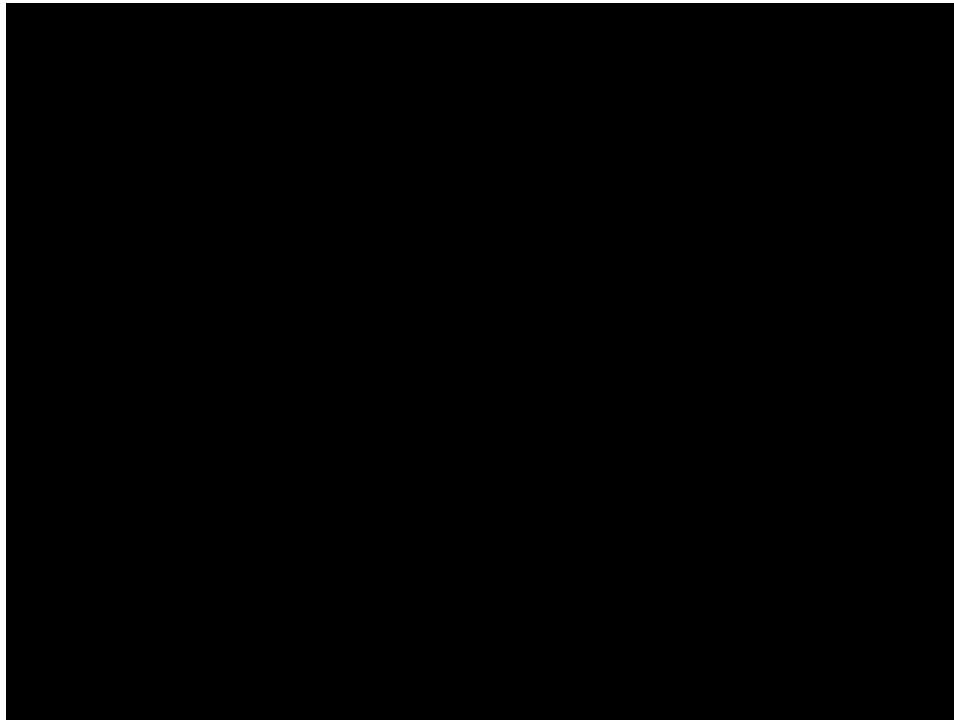
**SIGN IN**

# Universal Bin Detector

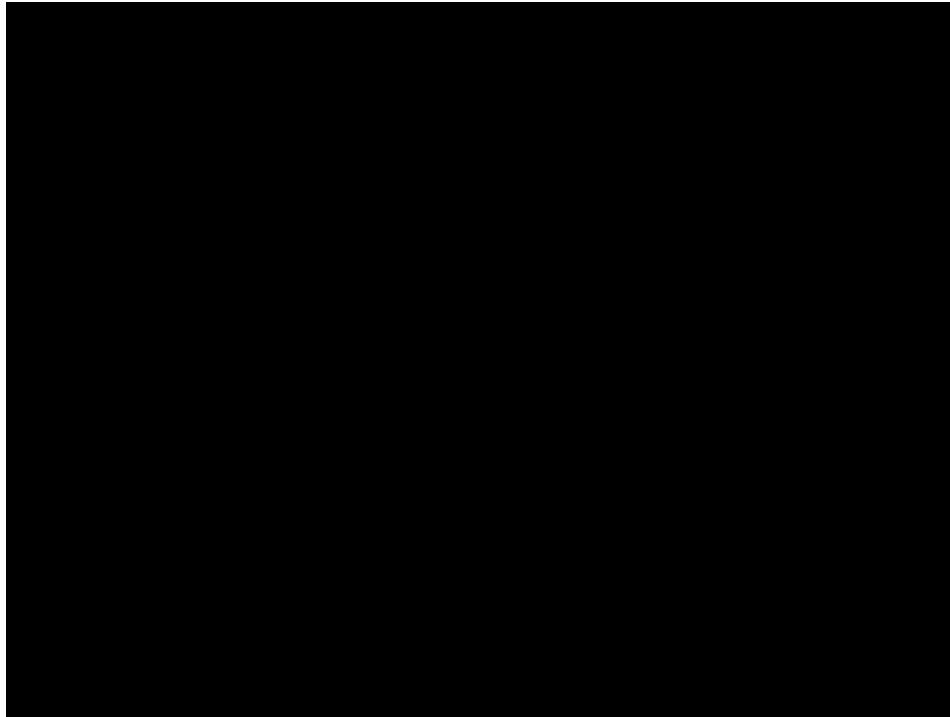
- Used in any municipality
- Detect different styles of bins



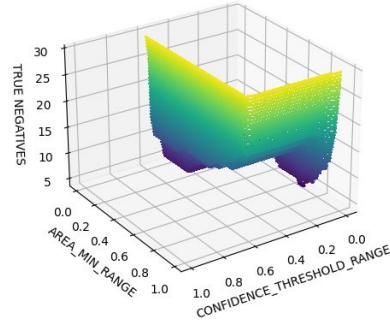
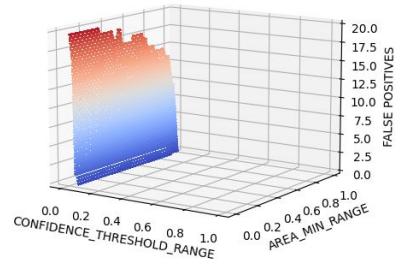
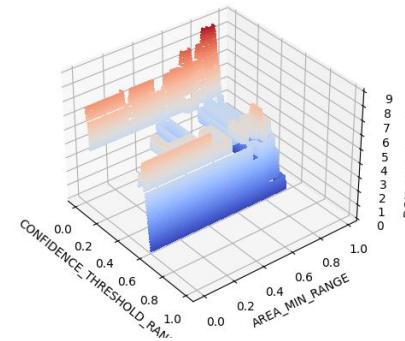
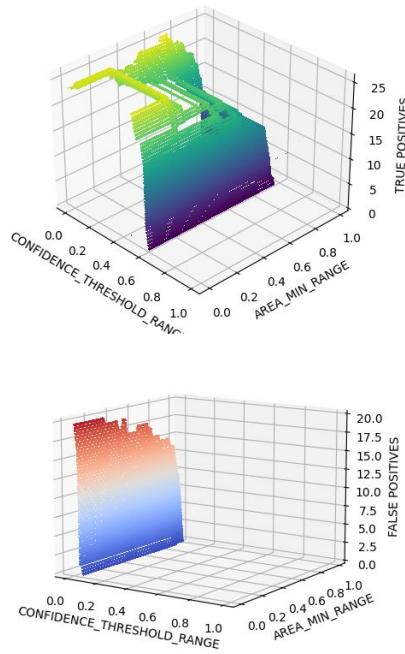
# Universal Bin Detector



# Universal Bin Detector



# Universal Bin Detector



# Bin Detector Overview

- Bin Detector in Operation
- Multiple Municipalities



# Rare Contaminant Detection Pipeline

- Goal is to detect currently undetectable contaminants
- Simple Copy Paste Method to Build an artificial dataset to train a machine learning model
- Using leaves as a proof of concept

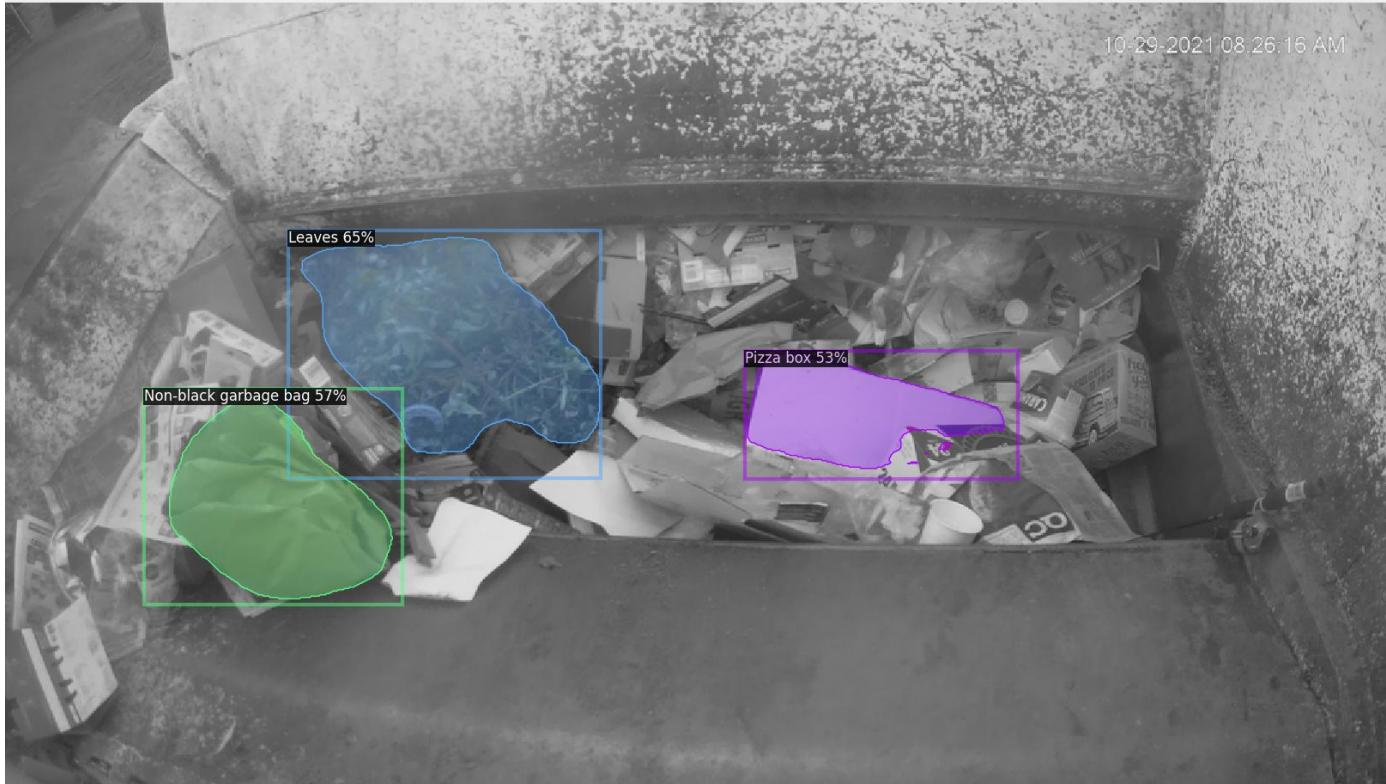
# Rare Contaminant Pipeline



# Rare Contaminant Pipeline



# Rare Contaminant Pipeline



# Rare Contaminant Detection Metrics

- Detected **3188** instances of Leaves which were previously undetected
- Comparing Average Precision
  - Model 1 - 76.76%
  - Model 2 - 79.68%

# Rare Contaminant Future Work

- Include additional rare contaminants
- Add weather occlusions when augmenting images
- Automate training process using detected contaminants

# Dashboard Future Work

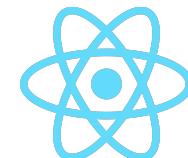
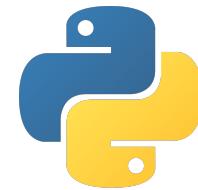
- Email Notifications for rare contaminants
- Develop communication threads so users can collaborate within the dashboard.

# Bin Detector Future Work

- Add more styles of waste bins
- Automated retraining process
- Improve hardware performance

# Technologies Used

- Python
- PyTest
- COCO
- React
- Mask R-CNN
- TypeScript
- YOLO
- MapboxGL
- SuperAnnotate
- Jest
- Detectron2
- AWS S3
- Tensorflow
- AWS Sagemaker
- Pytorch



# Acknowledgements

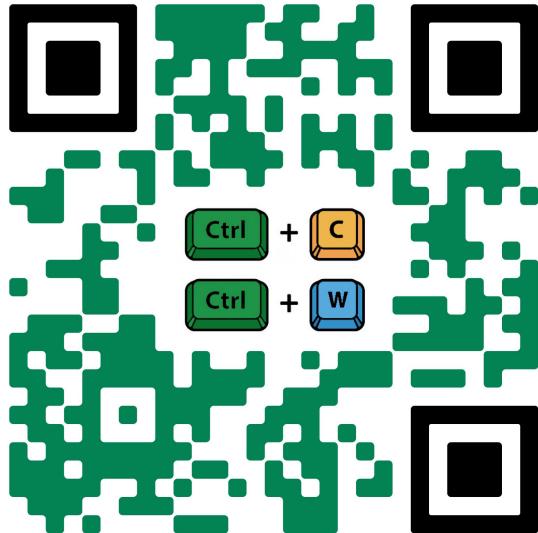
- Prairie Robotics
- University of Regina
- Dr. Mohamed El-Darieby
- Dr. Timothy Maciag
- Trevor Douglas
- George Daoud



University  
of Regina



# Find us on Github



**[github.com/Copy-Waste  
/cw-core](https://github.com/Copy-Waste/cw-core)**

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**Thanks for Watching!**

# Questions?