

# Copy-Waste: Rare Contaminant Detection in Residential Recycling

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## Introduction

Our objective is to reduce the risk and cost within residential recycling streams through three deliverables:

1. A universal bin detector which can detect a variety of waste bins to identify when a recycling bin is collected.
2. An interactive dashboard which displays residential recycling collection analytics and insights.
3. An automated system which can generate artificial image datasets to aid in detecting previously undetectable contaminants.

## Why is this important?

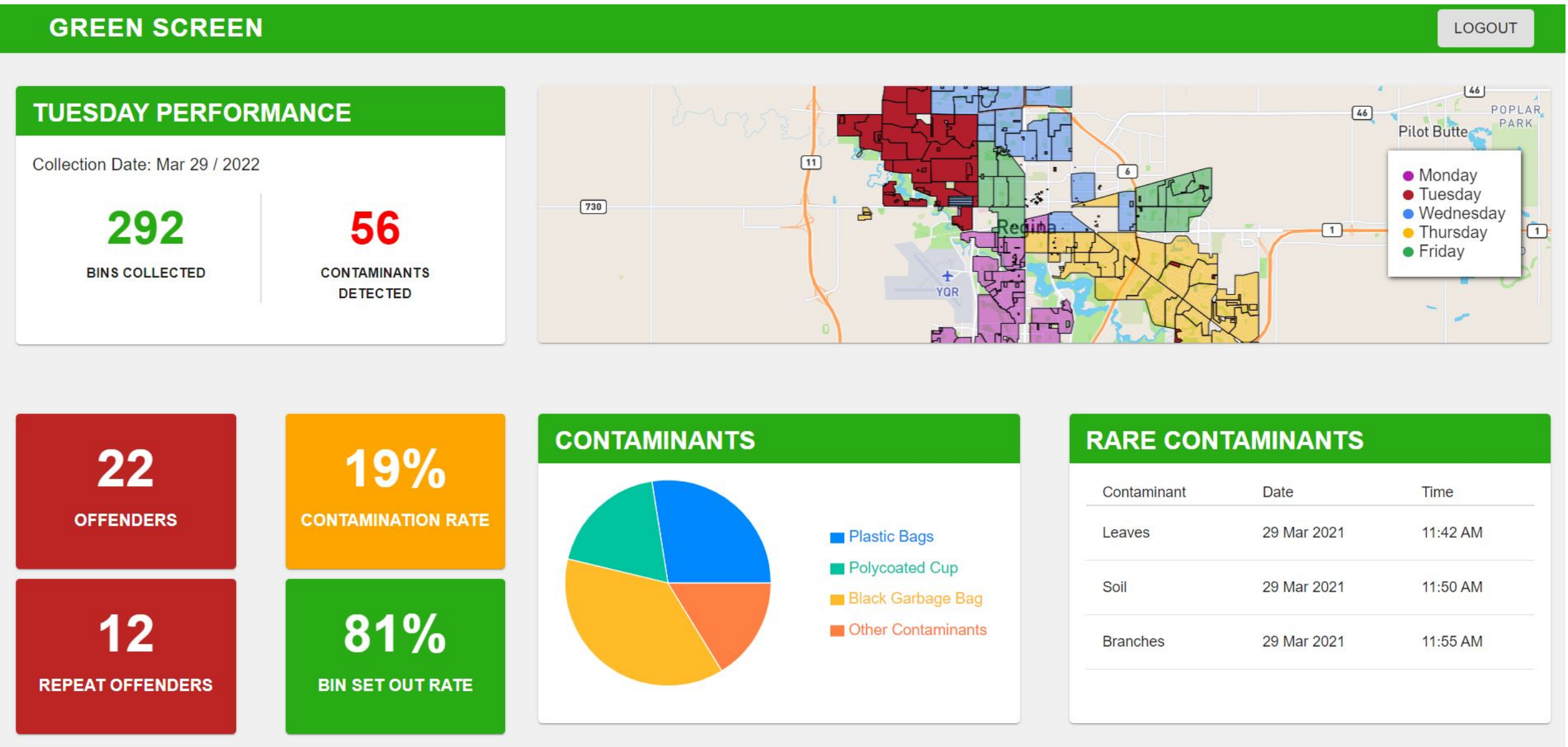
Mismanagement of recyclable waste is an environmental disaster and a burden on society. Recycling is an inefficient, costly and risky process as rare and severe contaminants can pose an immediate risk.

Fires caused by contaminants are a growing concern. A 2021 report by the Environmental Protection Agency found 343 fires at 64 facilities in Canada and the United States between 2013-2020 resulting in 2 fatalities and 49 injuries.



## Green Screen Dashboard

The dashboard is an interactive platform which provides recycling analytics to municipalities. This platform allows decision makers and stakeholders to view recycling insights to help reduce costs, risks, and inefficiencies.



Collection Day Insights on the Green Screen Dashboard

## Universal Bin Detector

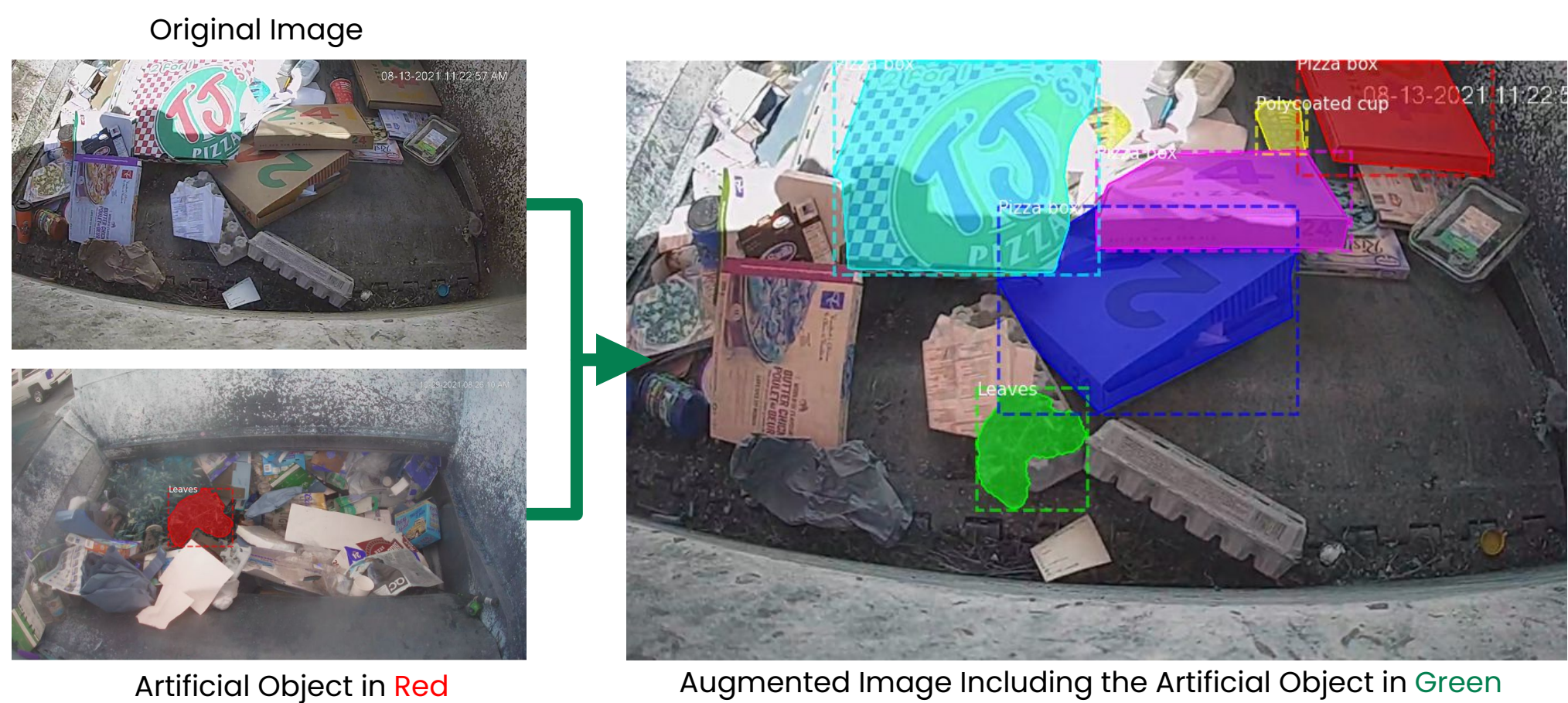
The universal bin detector allows for rapid scalability of smart recycling collection. It is used as part of the contaminant detection system and can be deployed onto collection vehicles in any municipality. Using computer vision, the waste bin detection process is automated. This model is already in operation in multiple municipalities across Canada.



Recycling Bin Detection in Real-Time

## Rare Contaminant Augmentation

Our data pipeline focuses on detecting rare and severe contaminants. This data augmentation pipeline solves this issue by generating large artificial image datasets of rare contaminants from a small sample of real images.



The sample objects are inserted into real images of recycling collection with random effects and transformations to mimic real world conditions. As seen in the sequence above, leaves from the artificial image are placed into the original to complete an augmentation.

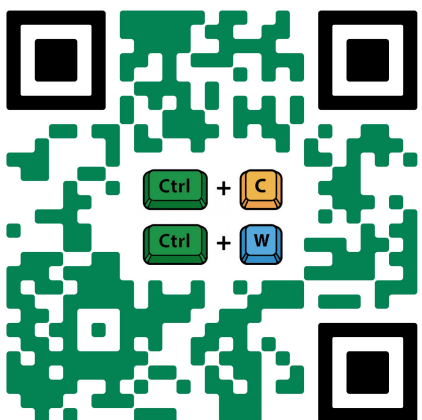
Using this process we generated a 40,000 image dataset to train a machine learning model which can detect previously undetected objects.

## Future Work

- Continue to add additional rare and severe contaminants within the image dataset for detection.
- Experiment with object transformations to improve the detection performance.
- Implement ability for users to communicate and share points of concern within the dashboard.

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**Scan** to view our citations and project in more detail on GitHub

