# Team Copy Waste

## Project Vlog 4

Dec. 6, 2021 - Feb. 1, 2022

# THE TEAM

**Nolan Flegel**

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*

# Business Needs

→ Reduce Risk of Fires and Associated Health Concerns

→ Reduce Cost

→ Address Careless Recycling & Hazardous Contamination

# Business Needs





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

**STATUS**
GREEN

# Project Issues / Changes

- Experimental Methodology
- New Faculty Mentor
- Updates to Edge Computers
- Yard Waste as First Contaminant

# Addressing Comments

Dr. Gelowitz:
"Have you sorted out the IP?"

Adam:
"Anytime you are dealing with ML stuff, you need a large test buffer"

# Individual Contributions

→ Collected/annotated image datasets

→ Separated/categorized images using python scripts

→ Created, trained, and generated results for initial YOLO detection model

→ Annotated additional training images

→ Python scripts for imports

# Individual Contributions

→ Research implementations of Copy Paste data augmentation

→ Collecting annotated images of audited hopper images

→ Begin prototype version copy paste augmentation on a subset of images
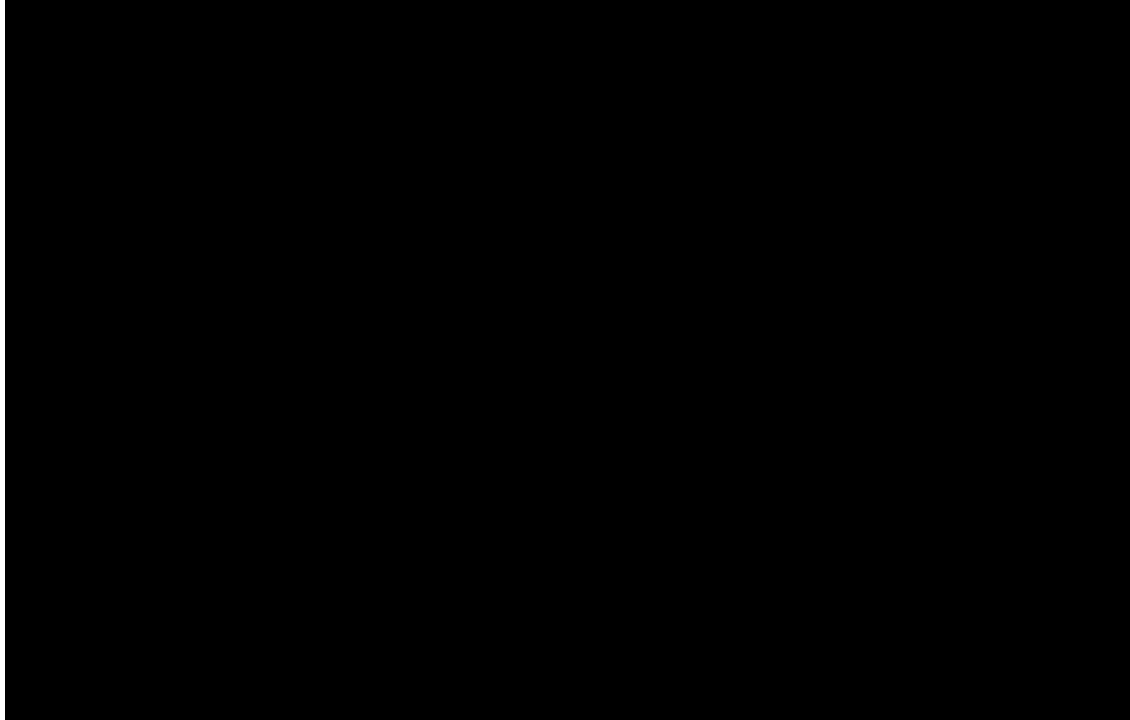
# Individual Contributions

→ Training Detection Models in Yolov5

→ Evaluate Model Performance

→ Re-Training Detection Model

→ Deploy Model to Recycling Truck Edge Computer

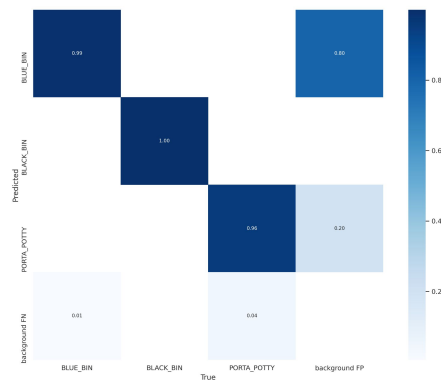# Product Demonstration

# Bin Tip Overview

# Bin Tip Overview

| Classes | Predicted | True Pos | False Pos | False Neg | Precision | Recall |
|---------|-----------|----------|-----------|-----------|-----------|--------|
| BLUE_BIN | 1236 | 1172 | 64 | 32 | 0.948 | 0.973 |
| BLACK_BIN | 316 | 315 | 1 | 0 | 0.997 | 1.0 |
| PORTA_POTTY | 140 | 140 | 0 | 0 | 1.0 | 1.0 |

**94.8%** Accuracy in detecting Blue Bins

**30/30** detections at 24fps

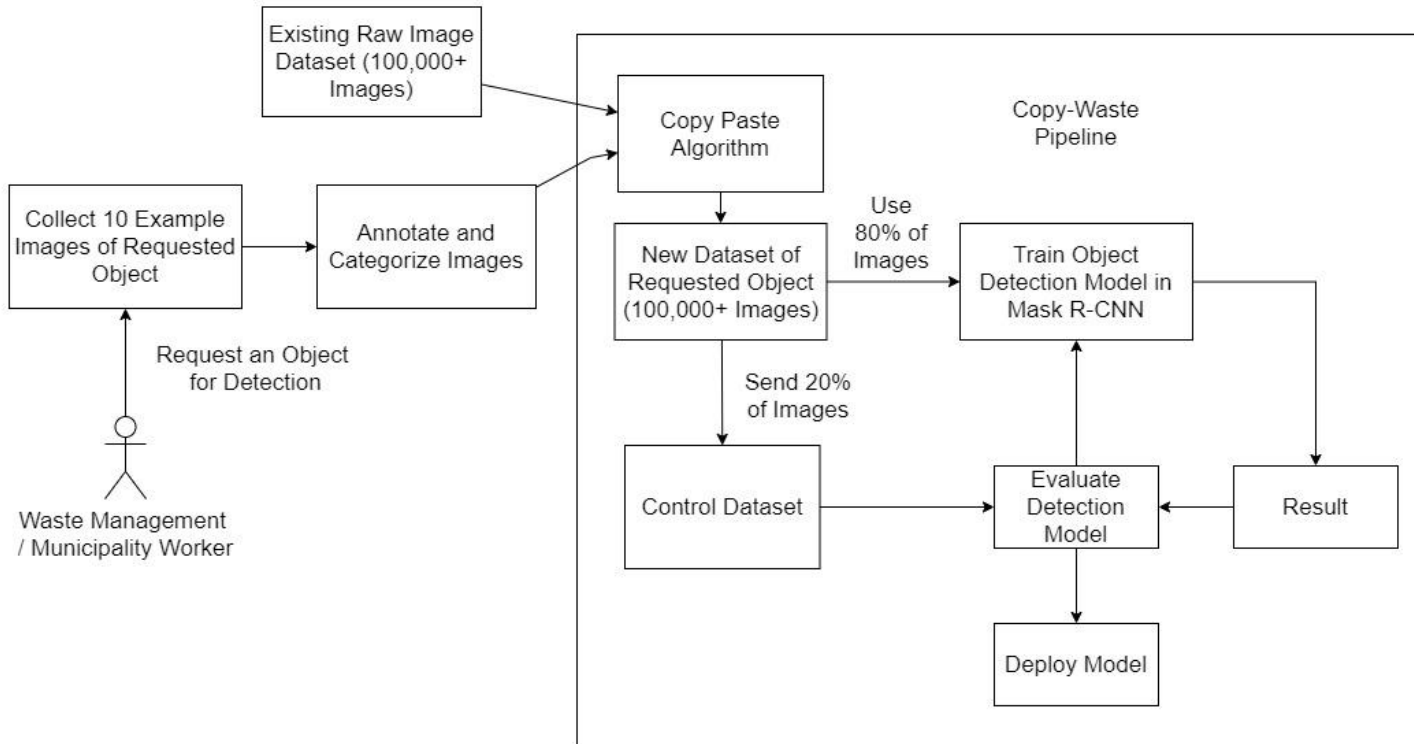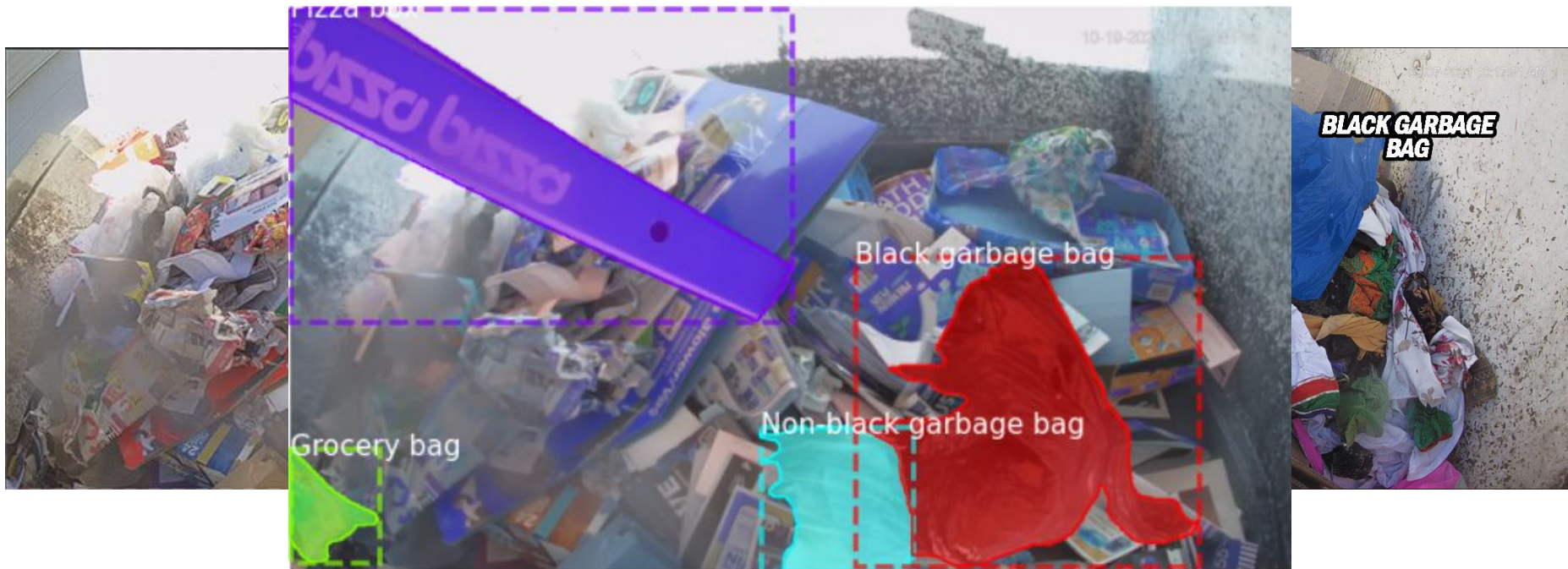**28/30** detections at 4fps

# Bin Tip Overview

→ Bin Detector Deployed

→ Bin detector inferences on the edge computer were **300ms**

# Simple Copy-Paste

# Simple Copy-Paste

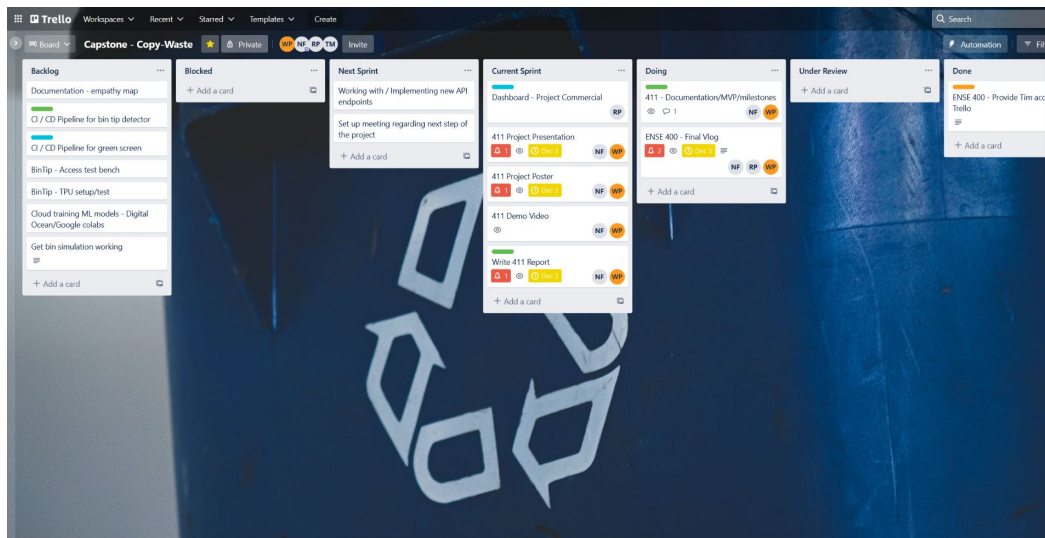# Dashboard Overview

## Green Screen Dashboard

Username *

DemoAdmin

Password *

••••••••••

SIGN IN

# Knowledge Management Overview

## Team Meeting

**Nov 16, 2021** / 2:00 PM / Zoom

### Attendees

Nolan Flegel, Rishabh Prasad, William Peers, Sam Dietrich

### Agenda

- Bin Tip Status
- Dashboard Status
- Roadmap for ENSE405/411 final project submissions

### Notes

- Mitacs - Review with Dr. El-Darieby, updated our CVs
- Dashboard updated, working with real data, working with Avery to fix issue
- BinTip - annotations completed, working on converting superannotate to Yolo format
- BinTip - Simulation -> work with Sam later this week if models are trained
- FrontEnd - Basic calculations and data display
- Busy next 2 weeks with other classes, focused on finishing all projects

### Action Items

1. Follow up with Dr. El-Darieby about Mitacs
2. Finish SA to Yolo Script
3. FrontEnd - get map legend working
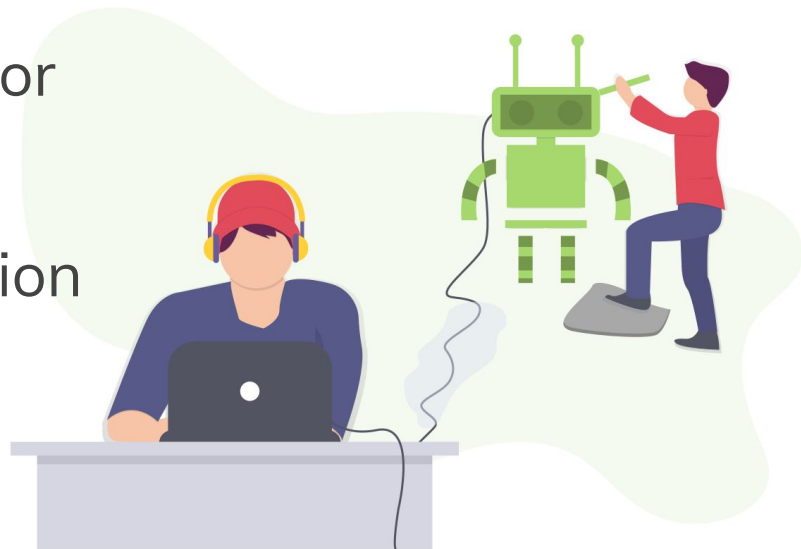4. Scrum with Tim on Friday

### Next Meeting Agenda (Nov 23, 2:00pm)

1. Address issues with API
2. Look into Edge compute simulation
3. Mitac Status

# Knowledge Management

| TASK | WEEK # | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | 21-22 | 23-24 | 25-26 |
|------|--------|-----|-----|-----|-----|------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | | | | | | | | | | | | | |
| **Phase 1: Bin-tip** | | | | | | | | | | | | | | |
| Consolidating data | | | | | | | | | | | | | | |
| Annotate and train segmentation model | | | | | | | | | | | | | | |
| Test and benchmark model | | | | | | | | | | | | | | |
| Deploy model to edge machines | | | | | | | | | | | | | | |
| Evaluate model performance | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| **Phase 2: Copy-Paste Augmentation** | | | | | | | | | | | | | | |
| Collect sample images of rare contaminants | | | | | | | | | | | | | | |
| Develop Copy-Paste Augmentation pipeline | | | | | | | | | | | | | | |
| Create sythetic datasets | | | | | | | | | | | | | | |
| Train Mask R-CNN model | | | | | | | | | | | | | | |
| Analyse model results | | | | | | | | | | | | | | |
| Deploy and benchmark model performance | | | | | | | | | | | | | | |

# Next Up

→ Meetings with New Mentor

→ Monitoring Bin Detector

→ Copy-Paste Implementation

# Reflection

→ Does the team feel "on track"?
   - We believe we are still on track

→ What progress does the team particularly feel good (great) about?
   - Universal Bin Detector
   - Initial progress on Copy Paste Implementation

# Reflection

→ What barriers (if any) does the team feel are a current impediment to success?
Limited copy-paste documentation

→ What help (if any) does the team require to move positively forward?
Regular meetings with our Industry Partner for guidance and code reviews.

# Reflection

→ What questions or concerns does the team have (if any)?
No concerns at this time

# References

→ https://leaderpost.com/news/local-news/smouldering-load-and-spray-cans-led-to-fire-at-crown-shred-says-regina-fire-department

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

→ https://www.epa.gov/system/files/documents/2021-08/lithium-ion-battery-report-update-7.01_508.pdf

→ https://www.waste360.com/business/li-ion-battery-fires-unfairly-cost-waste-recycling-and-scrap-operators-over-12-billion

# References

→ https://www.linkedin.com/pulse/2019-report-annual-reported-waste-recycling-facility-fires-fogelman/

→ https://publications.gc.ca/site/eng/9.871296/publication.html

→ https://arxiv.org/abs/2012.07177

→ https://arxiv.org/pdf/1506.02640.pdf

# Thanks for Watching!