**Team Copy-Waste - Vlog 2 Script**

**Team Member (Re)introductions**

- Nolan - Machine Learning
- Will - Back-End Services
- Rishabh - Front-End Services

**Vision:**

Our project has two objectives; reduce risks to the public, waste management employees and facilities and reduce the cost to municipalities and waste management companies caused by these contaminants.

**Mission**

We strive to achieve this mission by automating the detection of severe and rare contaminants in the recycling stream

**Business Need**

Our business need, to reiterate, is to reduce risk and cost to municipalities and waste management employees. As recycling rates increase, contamination and risk becomes a growing concern.

Fires are a major concern at waste facilities: Here in Regina there have been two serious incidents in the past 6 months:

- On April 8th, 2021 there was a fire at crown shred and recycling. Firefighters were able to prevent the fire from entering the main building.
- Wednesday of last week, Oct 7th, there was a fire at the Emterra facility that took Firefighters more than 3 hours to extinguish.

A report by Ryan Fogelman at Fire Rover found an average of 318 fires annually between 2016-2020 at facilities monitored by Fire Rover. He estimates that there are more than 1800 fires annually at facilities in Canada and the United States. These incidents cost municipalities and waste management companies 1.2 Billion dollars each year.

A report from the EPA analysed fires confirmed to be caused by Lithium Ion batteries found 217 fires at 64 facilities between 2013 and 2020.

**Risks to workers within Business Need**

- Regina fire
- Careless recycling can kill
- Recycling workers are more than twice as likely as other workers to be injured on the job

1. Contamination leads to risks such as fires and explosions.
2. Recycling workers are more than twice as likely as other workers to be injured on the job
3. Careless recycling can kill. In 2020, there were 23 injuries and 3 deaths attributed to fires at recycling facilities.

In addition to the immediate threats posed by fires, there are long term health impacts resulting from smoke and hazardous fumes. If recycling material is ignited in transit, these risks are presented to the surrounding communities and general public.

**Opportunity and Innovation**

Traditional Machine learning requires thousands or millions of annotated images to train detection models. There are some public datasets, such as TrashNet that contain images of common recycling contamination and waste.

We are attempting to detect rare items which are not found in these datasets. Some of these objects include hazardous material such as a propane tank, needles, and batteries. These contaminants do not occur commonly, however, they are critical to detect because they pose an immediate risk. To our knowledge, there are no known image datasets for these objects in waste, publicly or privately. Our goal is to create a process using the copy paste algorithm to take a small sample set of annotated objects and return a large dataset of annotated images. Not only will this project allow us to train models for objects which were previously undetectable, this process will also drastically reduce the amount of time and resources required to create image masks for new contaminants.

**Partnership**

We have established a partnership with Prairie Robotics to use their platform to build our product. As our project sponsor, Prairie Robotics will be providing mentorship, knowledge and resources to help us achieve our goal.

**Customers**

Our primary customers are waste management companies and municipalities in western Canada which require detection of rare and severe contamination to reduce risk of dangers and address high costs.

**Project Activity Dates**

Sept. 10, 2021 - October 15, 2021

**Project Activity:**

- Meetings with Sam, Matt, Avery from Prairie Robotics
- Meetings with Dr. El-Darieby and his PhD student George

- Access to Prairie Robotics' Technology
- State of Prairie Robotics Meetings
- Exhaustive research on industry needs and technologies to accomplish them
- General Project Management setup
    - Github Organization for code bases and knowledge management
    - Trello for work management
    - Discord for communication
- Mitacs Proposal

**Individual Contributions:**

**Will**

- Yolo research
- Setting up repositories for image scrubbing
- Collecting true negative datasets
- Activity-based schedule
- Milestone-based schedule
- Yolo tutorial

**Nolan**

- Gave presentation on State of GIS for Prairie Robotics
- Gave presentation to AAFC on how GIS is being used at Prairie Robotics
- Project Charter, Project Proposal, Project Business Case,
- Research into Yolo and variants
- collecting true negative image datasets,
- External meetings with Adam Tilson and Dr. Yow regarding our project concept

**Rishabh**

- Stakeholder analysis, stakeholder management plan, project requirements
- Green Screen
    - Community Orientation Research
    - Business Case Analysis
    - Technology Inventory
    - Researching Valuable Front-end Metrics and Information to be display
- Understanding Prairie Robotics Architecture to Integrate with their Technology
- React Architecture Startup

**Status description**
GREEN

**Project issues**

The submission of our Mitacs document is currently blocked as we are awaiting revisions from others.

**Project changes**

No changes have been made since our previous Vlog

**Documentation overview and/or project/technology demo**

In order to remain coordinated and on schedule we have been conducting weekly sprint planning and retrospectives. During these meetings we discuss our Trello board which contains actionable items under different columns (backlog, doing, done, etc). We take meeting minute notes and upload the documents to github after each meeting.

For the past two weeks we have been in the process of creating a dataset for false positive images and images of underrepresented classes (blue billboards, blue vehicles, portable restroom, blue bin far, black bin far, etc). We have used data and tools from Prairie Robotics during this process to help us look through images from waste trucks and pick out the images we need.

The work being done for Green Screen which is our front-end dashboard has been largely research related. In order to build an effective user interface, it is important to understand the community that will be utilizing it. The data represented on Green Screen will allow users to understand the state of recycling on a collection basis and be notified about rare and severe contaminants as they are detected.

**Next up**

**Team**

- Meetings planned with our Advisors and with Prairie Robotics
- Submitting Mitacs Proposal
- Completing remaining project startup documentation

**Rishabh**

- Designing and Structuring MVPs for Green Screen Dashboard
    - Prototyping and diagramming user interfaces
    - Design and understand user experiences
- Completing Architecture Development for the front-end
- Integrate our dashboard successfully with Prairie Robotics technology
- Various Research and Documentation as needed for technology development processes
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**Nolan**

- Finish collecting FAL images
- Annotate/classify true negative images
- Documentation
    - Risk Assessment/Analysis

- Train bin detector in yolov5 and yolact++
- Test bin detector using training dataset
- Test bin detector by deploying model to PR test truck
- Measure bin detector real-time performance on edge computer
- Measure bin detector performance against existing model
- Test bin detector on TPU unit

**Will**

- Finish collecting true negative images
- Annotate/classify true negative images
- Documentation
    - Empathy Mapping
- Train bin detection models
- Deploy model
- Test performance of our model on edge computers
- Compare with existing models

**Team Reflection**

- **Does the team feel "on track"? (reiterate the above colour status)**
    - We believe we are still on track, time management has been a challenge. The next two week have quite a few tasks outside of the capstone.
- **What progress does the team particularly feel good (great) about?**
    - Our Conversations with Stakeholders have helped us develop a stronger understanding of the business needs and impact.
    - Conversations within our project group have led to a clear set of objectives and focus on specific technology platforms.
    - Our research has clarified a number of questions/concerns about the technologies we will be using. We researched a number of different methods of detection and classification, we found that the YOLO algorithm has the fastest performance when doing real time detection and image segmentation.
        - Yolov5, yolact++ vs Mask R CNN
    - Conversation about Dashboards regarding:
        - How it will be used and its value to municipality
        - How does our Dashboard stand out compared to existing ones
    - We have a stronger understanding of the business need through finding Information about how pervasive this issue is. For example, the fires at Emterra/Crown Shred

- **What barriers (if any) does the team feel is a current impediment to success?**
    - The Mitacs Proposal is still being reviewed and completed by Prairie Robotics. We are still awaiting feedback before it can be submitted.
- **What help (if any) does the team require to move positively forward?**
    - We will need to review Project Initialization documents with stakeholders to ensure our visions are aligned
- **What questions or concerns does the team have (if any)?**
    - Concerned about the processing power of the edge computer. More specifically, how many frames it can process when performing image segmentation