BUSINESS CASE

Copy-Waste

Proposed Project	Copy-Waste
Date Produced	Sept 16, 2021
Background	A report commissioned by Environment and Climate Change Canada, which has a goal of eliminating plastic waste in Canada, established that only 9% of plastic waste is collected and recycled (Deloitte Canada, 2019). The report recommended, among other changes, that there would need to be a significant increase in the number of recycling facilities and investments in this industry. Our Industry Partner is an Artificial Intelligence company offering solutions for waste management object classification. Machine Learning is used to identify and classify contaminants found in waste bins. They have partnered with multiple Western Canadian municipalities and waste management companies to reduce recycling contaminants in residential collection programs. Rare and Severe Contaminants in the recycling collection stream pose significant risk to operators and result in substantial financial costs. Incidents such as propane tanks or batteries inadvertently placed in waste bins can cause fires or explosions in either the collection vehicle or at material recovery facilities (MRF). A report on fires at MRFs in Canada and the US estimated there were more than 1800 fires at facilities in 2020. These fires cost the industry 1.8 Billion annually and in 2020, resulted in 23 injuries and 3 fatalities (Fogelman, 2020).
Business Need/ Opportunity	Events such as propane tanks or batteries in waste bins are rare, however they are important to detect as they can pose immediate risks to employees and the public. Not only are these incidents extremely costly, they can be deadly. By developing a method of detecting rare and severe contaminants, the waste management industry can take preventative action to remove contaminants safely. This can reduce costs, prevent injuries and save lives.
Options	1. Augment rare contaminants within current dataset to train a detection model 2. Train a detection model based on current set of real-world instances of rare contaminants within the current image dataset

Cost-Benefit Analysis

Option 1 - Augment Rare Contaminants into the current waste image dataset

- **Cost**
  - Development time to simulate an authentic augmentation of data. For example, simulating positioning, lighting, and layering of objects being detected
  - Managing and maintaining an augmentation pipeline
  - The performance is expected to be worse than working with a dataset of real-world occurrences
- **Benefit**
  - Ability to detect rare contaminants immediately after the pipeline is developed
  - Ability to re-train the model with real-world instances of the rare contaminant when detected
  - Save time creating individual segmentation masks for each image. Through augmentation, this is done rapidly across thousands of images without manual work.

Option 2 - Train a detection model based on current set of real-world instances of rare contaminants within the current image dataset

- **Cost**
  - Extremely long period of time to collect authentic occurrences of these rare contaminants in household recycling
  - Some contaminants are hazardous (ex: propane tanks) and it is not feasible to wait as it can cause fatalities and destruction
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- **Benefit**
  - Detect rare and severe contaminants with higher accuracy and precision
  - Less development and management time

Recommendation

In this case, option 1 is recommended as it is the community's best interest to detect and eliminate rare and severe contaminants as they can be hazardous. Option 2 is generally a good solution when detecting common contaminants. However, as recycling rates increase contamination including these rare contaminants becomes an immediate concern. Therefore, although additional time and resources will be required to implement option 1, it will provide significant benefits when incorporated.

References

Fogelman, R. (2020, March 6). *2019 report: Annual reported Waste & Recycling Facility fires US/can*. LinkedIn. Retrieved from https://www.linkedin.com/pulse/2019-report-annual-reported-waste-recycling-facility-fires-fogelman/

Deloitte Canada. (2019) Economic Study of the Canadian Plastics Industry, Market and Waste. https://publications.gc.ca/site/eng/9.871296/publication.html.