Applying TensorFlow Machine Learning and Crowd Sourced Data to Better Understand Campus Environments: Pinpointr

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December 5, 2018

Introduction

With an ever-expanding campus it is difficult for custodial staff to know where every sanitary issue on campus is. Pinpointr is a solution that provides anyone with the ability to send photos and have machine-learning identify and locate the issue on campus.

Pinpointr

What is Pinpointr?

- Integrated solution for managing waste on campus
- Tools for anyone on campus to report environmental hazards by sending a photo
- Map of hazard locations and alerts sent to appropriate staff to deal with the hazards

Software Goals

- Classify type of hazard, and get a location from a received image
- Plot image location on map if it is within campus bounds
- Alert faculty of issue

Overall Goals

- Decrease response time for dealing with environmental hazards
- Provided a better work metric for janitorial staff
- Identify problem areas around campus, so steps can be taken to add more waste disposal options
- Identify common sources of waste that originate on campus, so steps can be taken to reduce unnecessary packaging or transition to more environmentally friendly options
- Reduce the amount of waste on campus by promoting awareness amongst the user base

Flowchart

User Adoption

Phase 1

- Beta version of an app for uploading and classifying photos, locating them on a map
- Small team of testers to determine the ease of use of the app, identify bugs on the users side

Phase 2

- Release revised Pinpointr app
- A small team of janitorial staff testing the software to see if it makes their work easier or more efficient, and identifying any existing bugs or improvements that can be made on the staff side

Phase 3

- Multiple platforms for sending pictures (Text, Twitter, App)
- Greater adoption by janitorial staff

Phase 4

- Promotion and incentives for downloading the app and reporting environmental hazards, increasing the user base
- Use derived metrics from the app to inform and improve purchasing decisions for other staff on campus

Object Recognition with TensorFlow

Tensor Flow

- Built by Google Brain, Tensorflow is an open-source combines several machine learning and deep learning models and algorithms.
- C++ back end, Python front end.

MobileNets

- TFLite ("Tensorflow Lite") models such as MobileNets provide low-latency, on-device machine learning inference requiring minimal storage space, optimal for mobile devices.
- MobileNets model provides a lightweight, yet powerful model with training methodology based on convolutional neural network architecture.

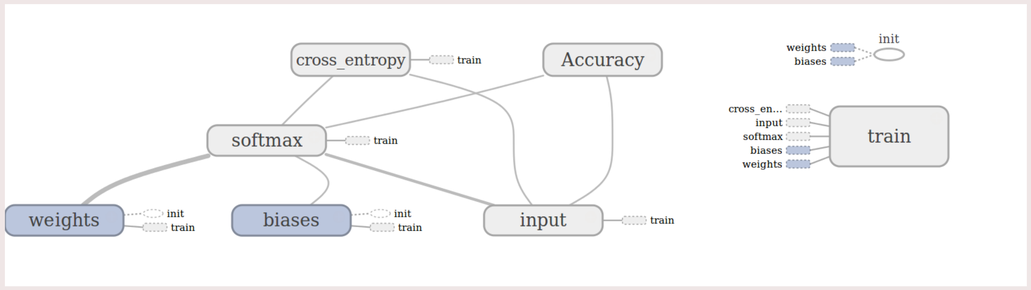


Figure 1: "softmax" represents the final output layer, providing the final object categorization and probability. The bottleneck nodes to the right represent a series of layers created during the training process.

TensorBoard

- Data visualization tool for model training. Provides a platform for continuous monitoring of model accuracy.

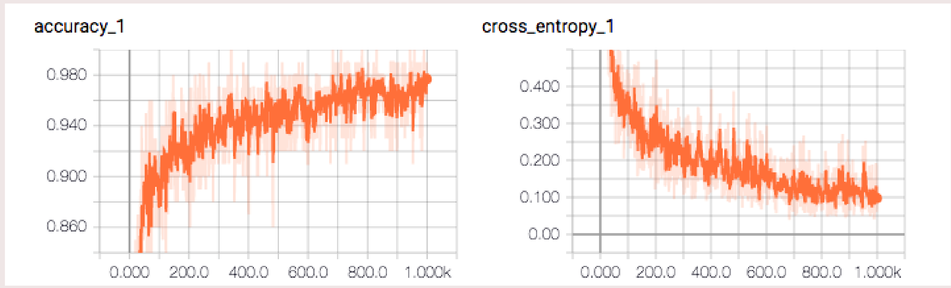
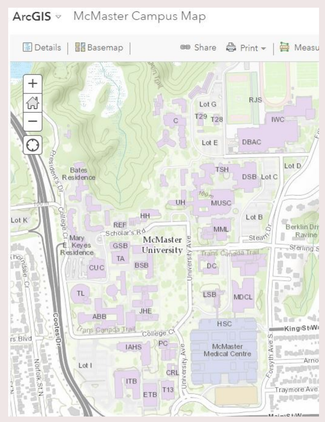


Figure 2: Tensorboard Interface: As the training dataset grows and the number of training sessions increases, the accuracy of the model approaches 1, while cross entropy approaches 0.

Conclusions & Future Work

- Created a working AI prototype that can classify differences between glass and plastics based on only a small data set.
- Display points on map, categorize points in sections of campus or by buildings
- Display graduated colour charts to find hot spots around campus
- Dynamic heatmaps based on submitted data
- Uses ESRI and ArcGIS services and maps
- Leaflet.js mapping API based interface



References

[1] N. Cerpa, P. Chandler, and J. Sweller, "Some conditions under which integrated computer-based training software can facilitate learning," *Journal of Educational Computing Research*, vol. 15, no. 4, pp. 345–367, 1996.

Google Brain TensorFlow esri