ARTIFICIAL INTELLIGENCE TRASH AMENDMENT SURVEYING

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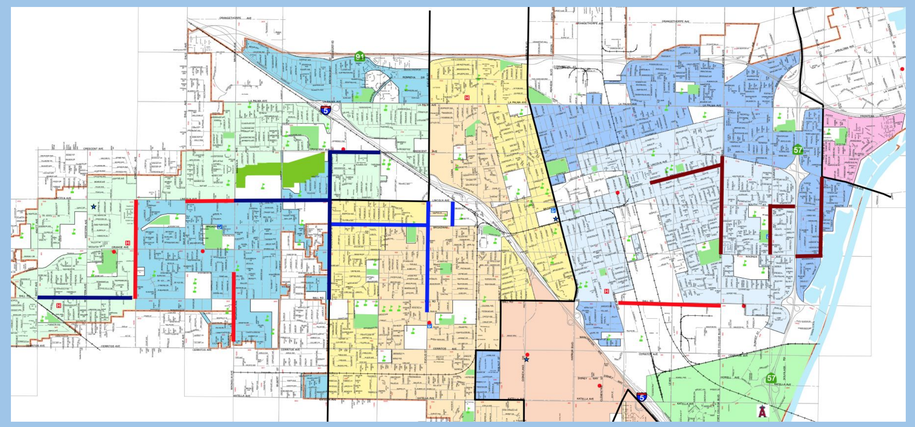
Project Description

To assist municipalities comply with the 2017 California state-wide Trash Amendments, which requires all municipalities to reduce water pollution by mitigating trash from entering waterways, the team of students has partnered with Fuscoe Engineering to research and implement artificial intelligence (AI) machine learning technologies. On-land visual trash assessments (OVTAs) are utilized to establish the expected trash loads on streets and sidewalks to compare to the level of trash once controls are imposed. These traditional OVTAs are very timely and expensive as they consist of having two municipal staff or consultants walk the roadways and qualitatively assign a grade to roadway segments based on observed trash presence. The research instead aims to input images captured via a vehicle-mounted camera to an AI model which will quantitatively and objectively analyze the roadways for trash load grading based on pixel ratios of trash within the captured photographs. The ultimate goal is to decrease the cost and time of traditional required assessments as well as improve the quality of the analysis. A secondary goal of the project is to design a regional trash capture best management practice (BMP) based on the results of the AI OVTA methodology where high trash loading is observed. These research efforts will be conducted primarily in the City of Anaheim.

Map of Routes



Project Constraints

- OVTA
  - Minimum amount of staffing to conduct a sufficient number of surveys to establish baseline trash generation.
  - Allocated capital to cover wages for printable materials and OVTA staffing
  - Maximum walkable distances per day for OVTA staffing
- Driving Method
  - Minimum amount of staffing and vehicles to conduct a sufficient number of surveys that will establish a substantive baseline trash generation.
  - Allocated capital to cover wages for staffing, vehicle, fuel consumption, vehicle liability insurance.
- Bucket Method
  - Minimum amount of staffing to conduct a sufficient number of surveys to establish baseline trash generation.
  - Allocated capital to cover wages for staffing and materials.
- AI Method
  - Minimum amount of staffing to operate vehicle and camera system simultaneously, and computational costs
  - Allocated capital to cover costs of DSLR camera, GPS logger, vehicle operation costs.

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Methodology

Four data collection methods were compared to assess trash accumulation in Anaheim. All methods required engineers to find suitable final routes prior to field work and at least two engineers to complete field work. Streets whose weekly sweepings were scheduled for the day after our group's availability were considered for analysis as candidate streets to ensure that the data included the street's maximum trash accumulation. Once candidate streets were selected, final routes were planned over multiple segments of at least 200-feet. The streets were assessed and graded on an A-D scale using the four methods

OVTA - Members adhered to the guidelines of EOA's *Protocol A – Street and Sidewalk Survey* and walked along final routes while visually grading streets.

Driving - OVTA was implemented while driving in a vehicle.

Bucket - Required that trash was collected in a bucket, marked at various depths indicating volume, as members walked 200-foot segments of the final routes.

AI - Utilized the company's recognition software to assess and grade the streets based on photos taken from a mounted camera while driving.

Cost Benefit Analysis

All four methods were compared in order to discern which would yield preliminary research. Based on the first round of trials, the average time to survey a 200-meter segment was as follows:

- Bucket Method - 4 minutes, 6 seconds
- Walking Method - 3 minutes 51 seconds
- Driving Method - 26 seconds
- AI Method - 24 seconds

Due to the subjectivity, potential inaccuracy and lack of time efficiency, the Walking and Driving Methods were discontinued. The two remaining methods, Bucket and AI, are both quantifiable and will be used to conduct the rest of the project's surveys. The project aims to calibrate the accuracy of the AI Method to that of the Bucket.