"You can't improve what you don't measure" - An end-to-end pilot project of collecting bicycle traffic data using pneumatic counters

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SURE EXP+ Undergraduate Research

Introduction

Bicycling is a promising mode of transportation to make our communities more sustainable, healthier, and more equitable. Motor vehicle traffic volumes, often measured by the Annual Average Daily Traffic (AADT), have been widely used in making engineering decisions. However, little data on bicycle traffic volumes have been collected and used in most U.S. cities.

A bike counter records the bicycle traffic volume at a fixed location. The data collected by the bike counter(s) can be used to improve the accessibility and safety of bicycle travel. The data can also be used for city planning purposes to suggest/justify the implementation of safer bike infrastructures. The bike counter used was the Eco-counter TUBES pneumatic tube counter [1].

Objectives

1. Set up the Eco-Counter bike counter, create documentation/tutorial videos,
2. Collect preliminary bike traffic data at a multi-use path (Rouge Getaway Trail, Dearborn) and a protected bike lane (N Division St, Ann Arbor),
3. Perform data analysis on the collected traffic data,
4. Develop and deploy a public-facing interactive online dashboard.

Methods

Set up and installation: A tutorial video was created to explain the step-by-step process of setting up and collecting data from the counter. The link to the setup tutorial video is (`https://www.youtube.com/watch?v=dvMzmCewGzg`).

(a) Multi-use path (Rouge Getaway, Dearborn) (b) Protected bike lane (N Division, Ann Arbor)

Figure 1. Setting up the counter

Validation study: A validation study of the counter's accuracy was conducted. A GoPro camera was set up and recorded the bike trail in front of the counter. three one-hour segments of the trail were recorded. The results of the study are displayed in Table 1. The accuracy stated by Eco-Counter is +/-3%. The study found a lower overall accuracy of 10%, but the value could be the result of the limited number of data points in our study.

Table 1. Validation study results

Date	Time	Counter	Actual
6/14/22	4:00-5:00 PM	10	10
6/16/22	3:00-4:00 PM	1	1
6/16/22	4:15-5:15 PM	7	9

Results

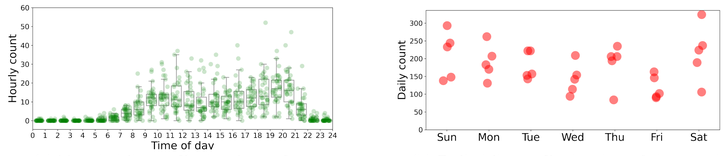
The bike traffic data was collected for 5 weeks at the Dearborn Rouge Getaway Trail with a total of 6,218 bicycles counted. See Table 2 for summary data.

Table 2. Bike traffic summary data

	Total traffic	Average daily traffic	Percentage (%)
Both directions	6,218	177.7	100.0
Eastbound	3,167	90.5	50.9
Westbound	3,051	87.2	49.1

Bike traffic patterns by the time of day and day of the week: A plot of how the traffic varies through the time of day is displayed in Figure 2a. There are two peaks in traffic volume based on the time of day. The first peak is around 11:00AM - 12:00PM. The second peak is larger than the first and happens around 6:00PM - 9:00PM. The daily traffic counts versus the day of the week is plotted in Figure 2b. There is generally more traffic on the weekends than on the weekdays.

Both plots in Figure 2 suggest the trail is primarily used for recreational purposes rather than commuting. This can be seen by the traffic peaks occurring in the evening after typical work hours as well as the increased traffic on the weekends.



(a) Hourly bike traffic by time of day (b) Daily bike traffic by day of the week

Figure 2. Bike traffic patterns by time of day and day of week

Bike traffic patterns by outdoor tempurature: Figure 3 shows the hourly traffic count versus the hourly temperature. The temperature data was collected from the website Weather Underground [2]. The data was filtered and only the daylight hours (7:00AM - 9:00PM) were included. An additional filtering process removed the hours when it rained. These filtering processes remove two known factors other than temperature that could impact bike traffic. A regression analysis was performed and a significant (p-value < 0.001) second-order polynomial relationship was found. The number of bikes on the path increases as the temperature increases until it peaks at 79 degrees Fahrenheit. The bicycle traffic decreases as the temperature increases beyond 79 degrees Fahrenheit.

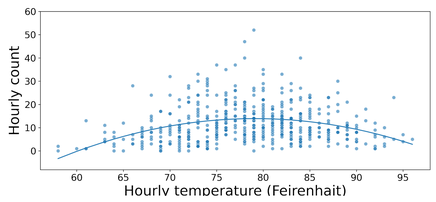


Figure 3. Hourly bike traffic counts by temperature

$$\text{Bike Traffic} = -228.0157 + 6.1174 \cdot \text{Temp} - 0.0387 \cdot \text{Temp}^2$$

A public-facing interactive online dashboard

We also built a public-facing interactive dashboard that allows other researchers, traffic engineers, city planners, and the general public to freely explore the bike traffic data. The dashboard supports customizing the dates (from a calendar), traffic directions, and data resolution (up to 15-minutes). There is a tooltips feature (Figure 5c) that is activated when the mouse hovers over a bar from the chart. The tooltips display the time, count, direction, and day of the week. The dashboard was developed using the Dash framework created by Plotly on Python and was deployed using the Heroku cloud platform (`https://umd-bicycle-traffic-data.herokuapp.com`). Figure 4 shows the top of the dashboard with controls allowing the user to interact with the data.

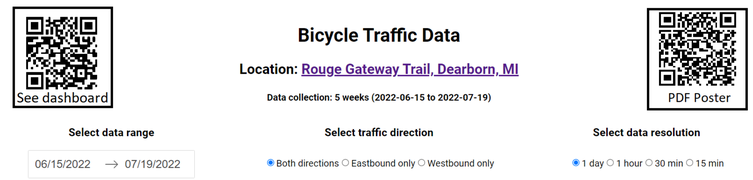
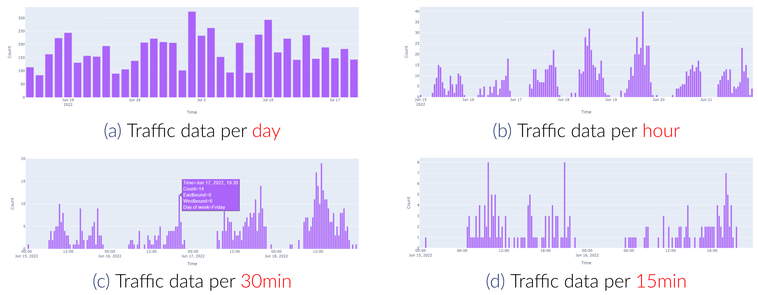


Figure 4. A screenshot of the interactive dashboard of bike traffic



(a) Traffic data per day (b) Traffic data per hour

(c) Traffic data per 30min (d) Traffic data per 15min

Figure 5. Interactive dashboard of bike traffic data at user-customizable resolutions

Skill: Technology

- Learned how to set up and install the Eco-Counter pneumatic bike counter at two locations and created technical documentation and a tutorial video.
- Used Python to process, analyze, and model the bike traffic data leading to a better understanding of bike traffic patterns.
- Used open-source Plotly Dash and Heroku to develop and deploy a free public-facing interactive dashboard of bike traffic data.

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References

[1] Eco-Counter. Tubes - short term bike traffic studies - eco-counter.

[2] Weather Underground. Romulus, mi weather history.