Visual Model of Parking in Downtown Bozeman

Project Summary

The focus of this project was to model the effects of parking occupancy in Downtown Bozeman, Montana. More specifically, the goal was to provide a visual model for the Bozeman City Parking Commission that could be used as a visual tool to help the members better understand quantitatively how different factors affect parking concerns. The results of the Current State Model and Future State Model will achieve this goal, while providing data driven recommendations for future implementations.

Data Collection

The foundation for the models was created using SIMIO software.

- **Step 1:** The paths lengths were measured using the interactive Downtown Bozeman map
- **Step 2:** Stop sign intersection logic was created for 3-way and 4-way intersections
- **Step 3:** Street light intersection logic was created for 3-way and 4-way intersections
- **Step 4:** The on-street and off-street parking spots were represented with servers
- **Step 5:** The parking logic was created for both on-street and off-street parking options

Current State Model

The Current State Model was created by adding the appropriate data to the skeleton of the model.

- **Step 2:** At each intersection turning probabilities were implemented
- **Step 3:** The appropriate size of each intersection was implemented and adjusted
- **Step 4:** Interarrival times were added as sources at each of the perimeter intersections
- **Step 5:** The occupancy rates were implemented to each parking option, on-street and off-street
- **Step 6:** Animations were added to the model

Future State Model – Year 2045

The Future State Model was built by using the Current State Model as a base and changing the data accordingly.

- **Step 1:** The adjusted 2045 inter-arrival times were implemented

Model Validation and Limitations

The Current State Model was validated to ensure an accurate data output.

- **Step 1:** The occupancy rate from the output of the SIMIO models were exported into excel
- **Step 2:** The model occupancy rate was compared to the WTI occupancy rates
- **Step 3:** The occupancy rate percent error was calculated
- **Step 4:** Systematic changes were made to each model to get mitigate the percent error as much as possible

The project limitations are as follows:

- **Data:** The foundational data that was used in this project was collected in 2017 and the new data that was collected was in winter of 2021 during a global pandemic. The assumption that the data had a linear relationship had to be made due to lack of past occupancy rate data.
- **Time:** This project had an ambitious scope that was able to be met. However, with more time there is a possibility of more data collection and a wider confidence interval.

Acknowledgements: Michael Veselik | Montana State University IMSE Faculty | WTI

Key

- Occupancy Rate
  - 0% - 59.99%
  - 60% - 84.99%
  - 85% - 100%

<table>
<thead>
<tr>
<th>Intersection Name</th>
<th>Inter-arrival rate</th>
<th>Right</th>
<th>Left</th>
<th>Straight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Car/min</th>
<th>Right</th>
<th>Left</th>
<th>Straight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Passenger Loading Zone

A passenger loading zone is an area specifically for the use of loading and unloading passengers.

**Possible Positive Outcomes**

- A decrease in traffic disturbances
- The number of cars parking for a short term, less than 5 minutes, are not taking up ideal on-street parking spots for longer term business patrons

Incremental Paid Parking

This form of paid parking is based on demand to set the price of parking.

**Possible Positive Outcomes**

- More even occupancy rates through the downtown area
- On-street parking is seen as more of a short-term option