Impact of E-Scooters on Pedestrian Safety: A Field Study Using Pedestrian Crowd-Sensing

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The Goal
To understand the current state of pedestrian safety in our urban communities, and identify factors that impact pedestrian safety vis-à-vis e-scooter services.

The Approach
- Detect e-scooters near a pedestrian participant via the smartwatch in real-time.
- Trigger participant feedback and collect e-scooter related encounter data.
- Identify mobility trends and potentially unsafe spatio-temporal hotspots for pedestrians on-campus.

The Crowd-Sensing Setup
- Encounter detection and related feedback collection from a custom smartwatch app based on BLE data broadcasted by e-scooters.
- Loaned smartwatch equipped with encounter data collection app paired to the participant’s smartphone.
- 77 participants across two distinct environments: UTSA’s Main and Downtown campuses.
- A month-long study for each participant lasting from April 2019-June 2019.

Key Challenge
Real-time detection and logging of encounter data between pedestrian participants and e-scooters directly from a resource-constrained smartwatch with minimal encounter notification frequency.

Key Observations & Implications

Pedestrian and E-scooter Encounters
1. Predicted from the sensed BLE data (Ep)
2. Observed by the pedestrian participant (Ed)

Factor #1: Space
OBS: A vast majority of proximate encounters between e-scooter riders and pedestrians happened on narrow pedestrian paths such as sidewalks.
IMP: Conflicts and safety challenges for pedestrians and riders sharing the path owing to few bike lanes and shared-use paths in the study areas.

Table III: Space: Encounters by functional classification.

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Ep</th>
<th>Ed</th>
<th>Ep</th>
<th>Ed</th>
<th>Ep</th>
<th>Ed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Streets</td>
<td>998</td>
<td>709</td>
<td>146.1</td>
<td>60.7</td>
<td>6.9</td>
<td>2.3</td>
</tr>
<tr>
<td>Collector Streets</td>
<td>269</td>
<td>336</td>
<td>68.4</td>
<td>55.2</td>
<td>3.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Local Streets</td>
<td>1285</td>
<td>2255</td>
<td>176.0</td>
<td>171.8</td>
<td>8.3</td>
<td>6.6</td>
</tr>
<tr>
<td>Shared-use Paths</td>
<td>102</td>
<td>119</td>
<td>306.0</td>
<td>432.6</td>
<td>14.5</td>
<td>16.6</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>994</td>
<td>1163</td>
<td>617.8</td>
<td>470.7</td>
<td>29.2</td>
<td>18.1</td>
</tr>
<tr>
<td>Other/Unclassified</td>
<td>154</td>
<td>411</td>
<td>799.1</td>
<td>1410.0</td>
<td>37.8</td>
<td>54.2</td>
</tr>
<tr>
<td>Total</td>
<td>3802</td>
<td>4993</td>
<td>3322</td>
<td>4335</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Factor #2: Time
OBS: The average #encounters on specific days are higher than the rest of the week showing the occurrence of encounters follows closely with class schedules.
IMP: Higher chances of pedestrian-riders collisions and encounters near the class buildings during the days with the highest number of classes.

Factor #3: Space & Time
OBS: Local street encounters peak during mid-day and at 17:00, suggesting an increased interaction with pedestrians during lunch breaks and commuting.
IMP: Higher chances of conflicts for pedestrians and riders sharing the streets during those peak hours exacerbated by the lack of sidewalks in the areas.

Takeaways
Identified hotspot areas could be targeted to optimize transit options and remediate lack of adequate critical infrastructure.
The timing of frequent e-scooter encounters could be used in combination with other travel modes to compliment last-mile connections and reduce conflicts.
Space-time coordination may be more critical for special events and in separated land uses, as compared with mixed-use settings with activities spread throughout the night and day.

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