Analyzing Pedestrian Activity with Computer Vision

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Druid Hill Park: A Matter of Funding
Objective:
Develop software that analyzes video streams to provide park usage statistics
How?

1. Object Detection and Tracking Algorithms

2. Data Visualization
Development Process: Object Detection and Tracking
Object Detection Algorithm

- Objects scored based on classified images
- Face detection: Haar cascades
- HOG Detector
- TensorFlow Single Shot Detection (SSD)
Object Detection: Challenges

False positives and negatives
Object Detection

Detecting people with TensorFlow
< Livestream >

Isolating objects using background subtraction
Tracking Algorithm: Early Stages

- Context used rather than from scratch
- Faster speeds with tracking
- Works by providing bounding box
Tracking Algorithm

- Hanging trackers
- Accumulation
- Tracking failures
Solution: Hungarian Algorithm

- Allows for the assignment of old objects to new objects using the context of previous frames

Diagram:
- One Object Deleted!
- One New Object!
Tracking + Hungarian Algorithm
Simplified “Radical” Algorithm

- Hungarian Algorithm applied to current and previous frame
- No tracking component
**Performance Evaluation**

### Performance Comparisons

**Detection Cycle/Tracking Buffer/Untracked Thresh**

<table>
<thead>
<tr>
<th>Video Cycle/Buffer/Untracked Thresh</th>
<th>Video 1</th>
<th>Video 2</th>
<th>Video 3</th>
<th>Video 4</th>
<th>Video 5</th>
<th>Avg. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20/5</td>
<td>17</td>
<td>27</td>
<td>13</td>
<td>10</td>
<td>22</td>
<td>23%</td>
</tr>
<tr>
<td>20/25/5</td>
<td>12</td>
<td>22</td>
<td>9</td>
<td>7</td>
<td>17</td>
<td>22%</td>
</tr>
<tr>
<td>Simplified</td>
<td>17</td>
<td>20</td>
<td>14</td>
<td>11</td>
<td>15</td>
<td>12%</td>
</tr>
<tr>
<td>Expected</td>
<td>13</td>
<td>21</td>
<td>17</td>
<td>12</td>
<td>15</td>
<td>-</td>
</tr>
</tbody>
</table>
Final Verdict

- Tracking implementation *currently* unsatisfactory
- Simplified Algorithm provides best performance
- Accurate pedestrian tracking = feasible!
Live Stream Demo

0 Cycles Per Detection
10 Unassociations Allowed

Total Pedestrians = 6
Usability
+
Data Visualization
Graphical User Interface

- Displays people count with boxes and percentages
- Text field allows user to input video file names and/or livestream URLs
Over 2.5 Hours on Live Data Collection

Pedestrian Data

< Alumni Weekend: Hopkins Livestream >
Future Steps

- Improve detection by training our own neural net
- Combine techniques to reduce tracking failures
- Extend detection to vehicles
- Additional GUI functionality i.e. graph toggling, data manipulation, etc.
Special Thanks!

Yair, Amy, Jacob
Questions?