Walking Time Approximation for Smart Parking

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Introduction

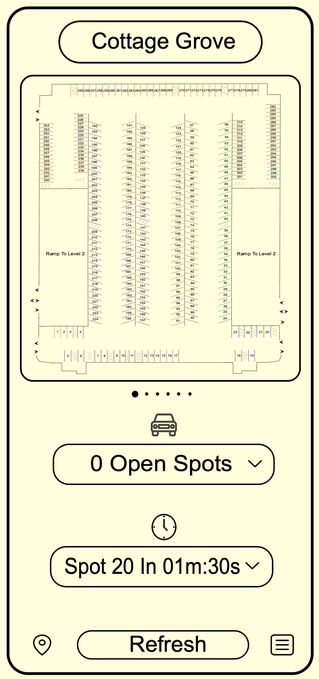
Predictive parking (smart parking) aims to anticipate openings in full lots at crowded venues or in parking-deprived areas.

- Traffic decongestion
- Reduced emissions
- Improved efficiency

Goals

Create a reliable algorithm to time a pedestrian's return to their vehicle using their smartphone's built-in accelerometer.

- GPS independence
- Adaptability to different venues
- Accessibility
- Minimizing hardware
- Minimize battery usage
- User experience

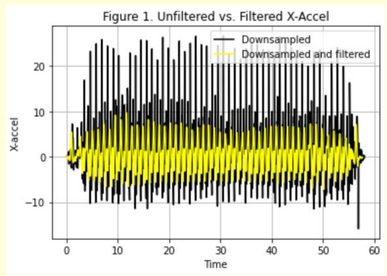


Methods

- 10 data points from 3 locations
- Recorded data at 50Hz
- Sample intervals taken between seconds 5-15 and 15-25
- Data filtration:
  a. Downsampled to 10Hz
  b. Simple moving average filter across past 10 data points
  c. Lowpass FIR filter w/ 2.5 Hz cutoff
- Linear regression model from Python package scikit-learn; chosen for efficiency with high-dimensional data
- ~10 versions constructed with different parts of dataset
- Data categorized to reduce parameters
- Sliding windows implemented to increase size of dataset

Results & Discussion

N = 5000 for linear regression model, 70/30 training/testing split



- Accelerometer data is incredibly noisy
- Data is very difficult to collect/simulate
- Sliding timestamps proved ineffective
- Filter script effectively prepares and formats data for model
- Lower number of parameters directly correlated with efficacy
- Categorization of data could prove useful, but further experimentation required to discern reasons for success in model
- Linear regression model possibly not the most effective for this task
- Note: scikit-learn linear regression allows for negative R^2 values

Table 1.	Median R^2 value		
% of data used	Raw data	Categorized data	Sliding interval
100	-1.25	-1.06	-5.61
75	-0.64	-1.09	-7.07
25	0.997	0.999	1.000

Future Research

- Explore more complex models
- Determine relative importance of individual parameters
- Data synthesis & unbiased collection
- Interfacing with GPS
- Axis independence
- Predicting time spent in vehicle before leaving
- Automation of process
- Mathematical model approach - formulas for effectiveness study and comparison

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matplotlib
pandas
scikit learn