

# Location Prediction With Sparse GPS Data

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## Overview

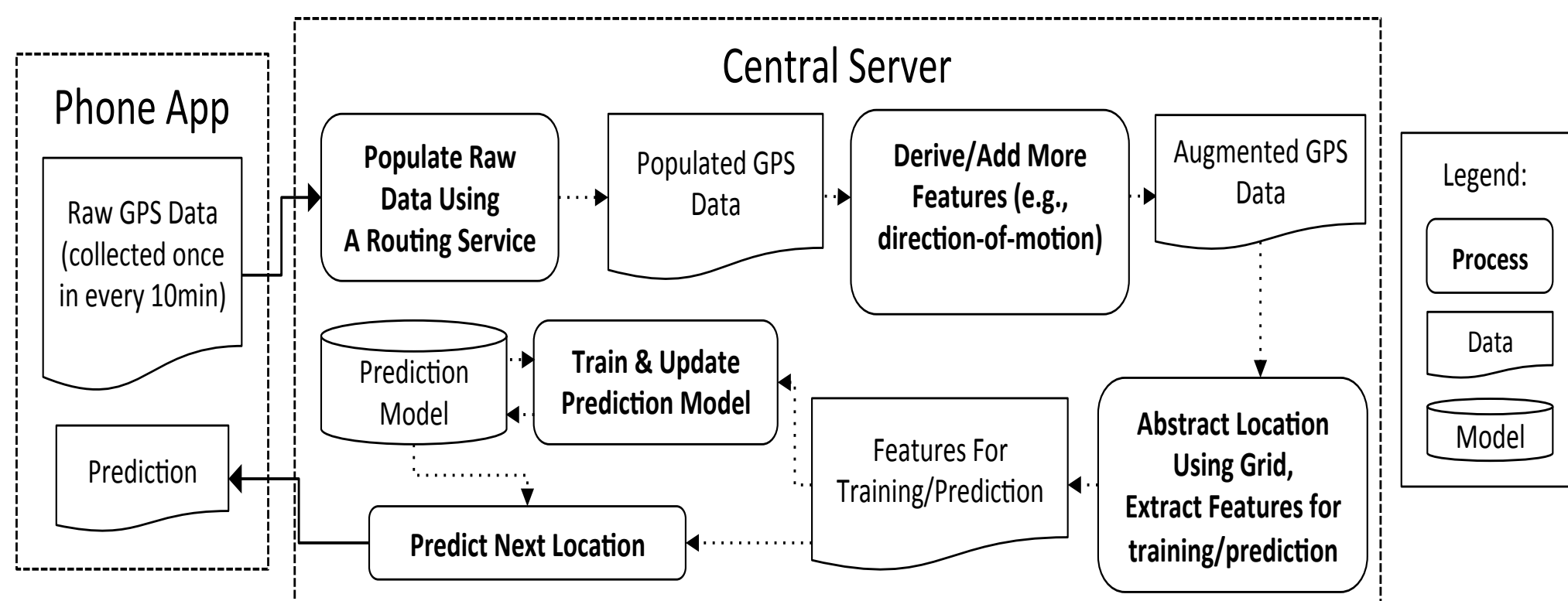
- Predicting the next location of a user based on their movement history is useful in building intelligent applications that can continuously assist users.
- Sparseness in GPS data arises from loss of GPS connection and imperfect behavior of the application and mobile sensors.
- Our data is sparse (collected once in every 10 minutes) as compared to dense data (such as that collected once in every 6 seconds).
- Sparseness makes learning patterns in movement history difficult.
- The low sampling rate also captures movement patterns that are along the same path but disjoint.



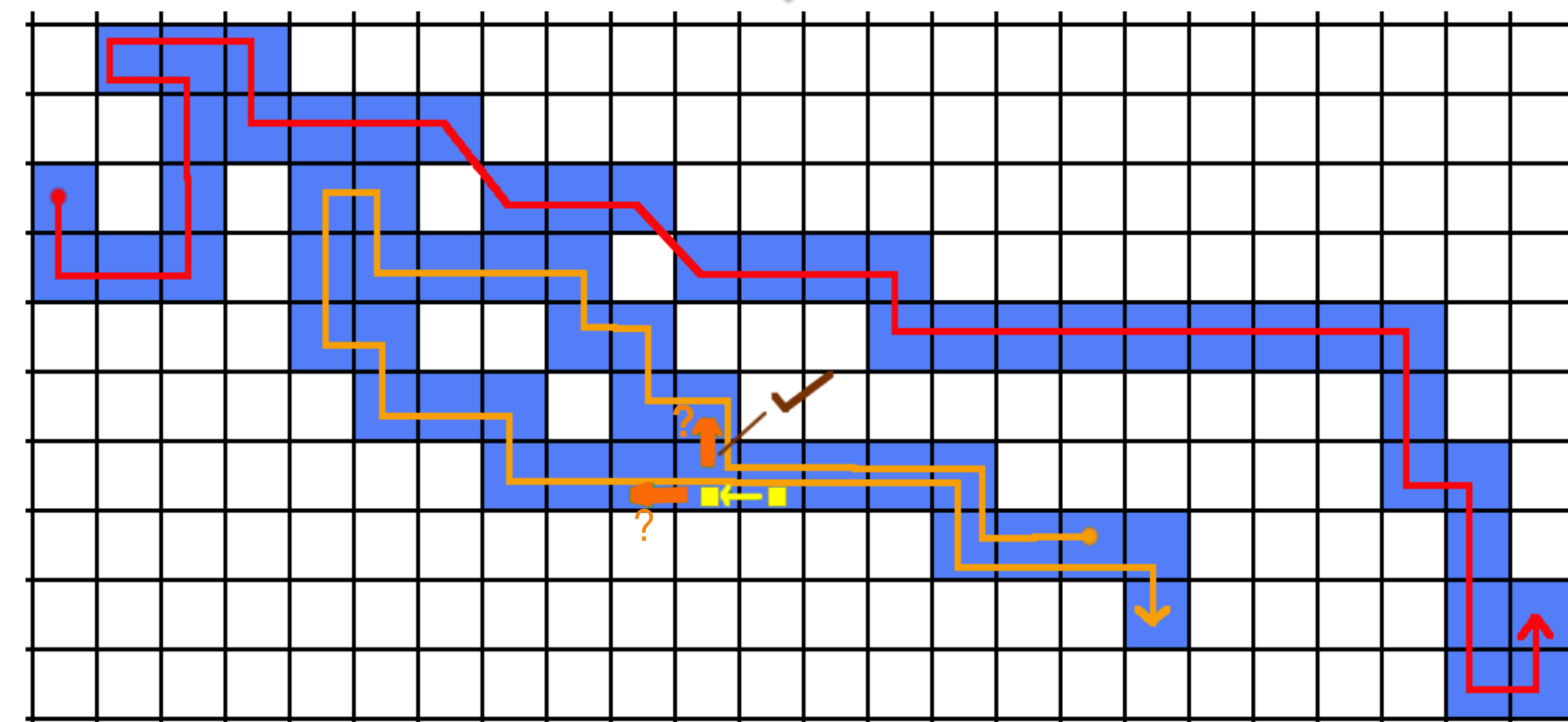
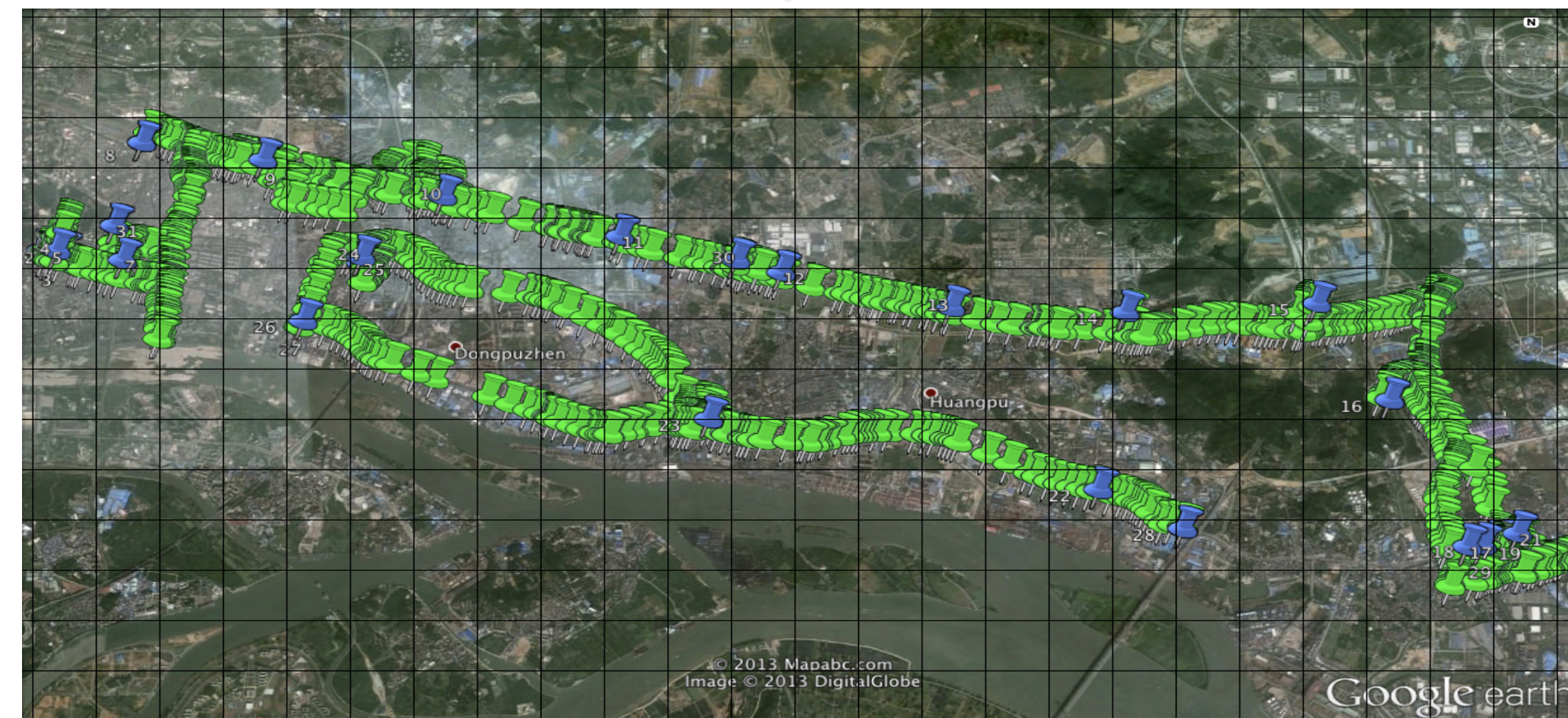
Red and blue points were recorded on different days, along the same path

## Approach

- To deal with sparseness, we used Google Directions API to find the shortest distance between every consecutive pair of points in the data.
- We create a grid and map the resulting points to grid-blocks.
- We used this data to with various prediction models to predict the next grid-block the user will be in.



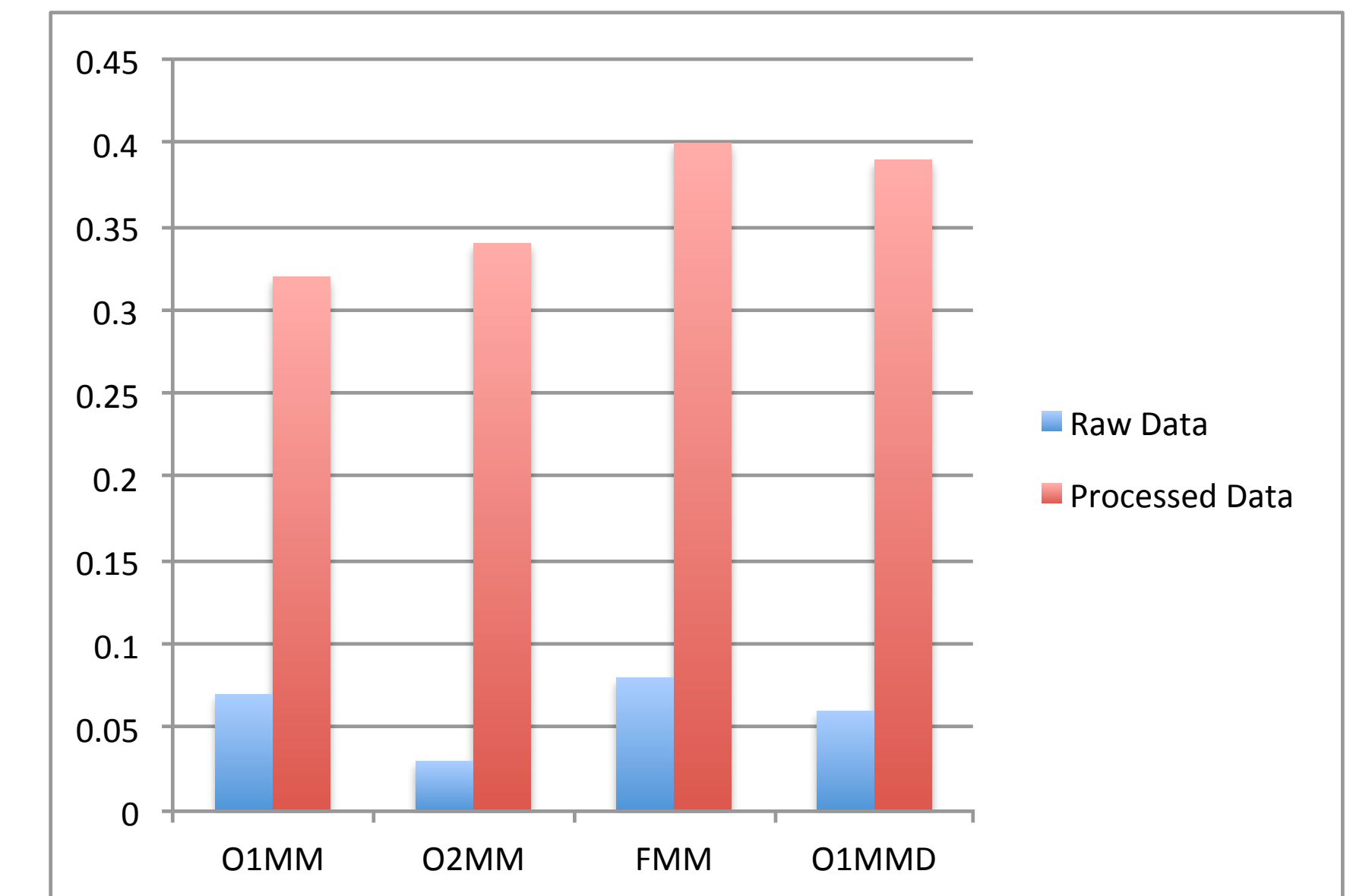
## Steps



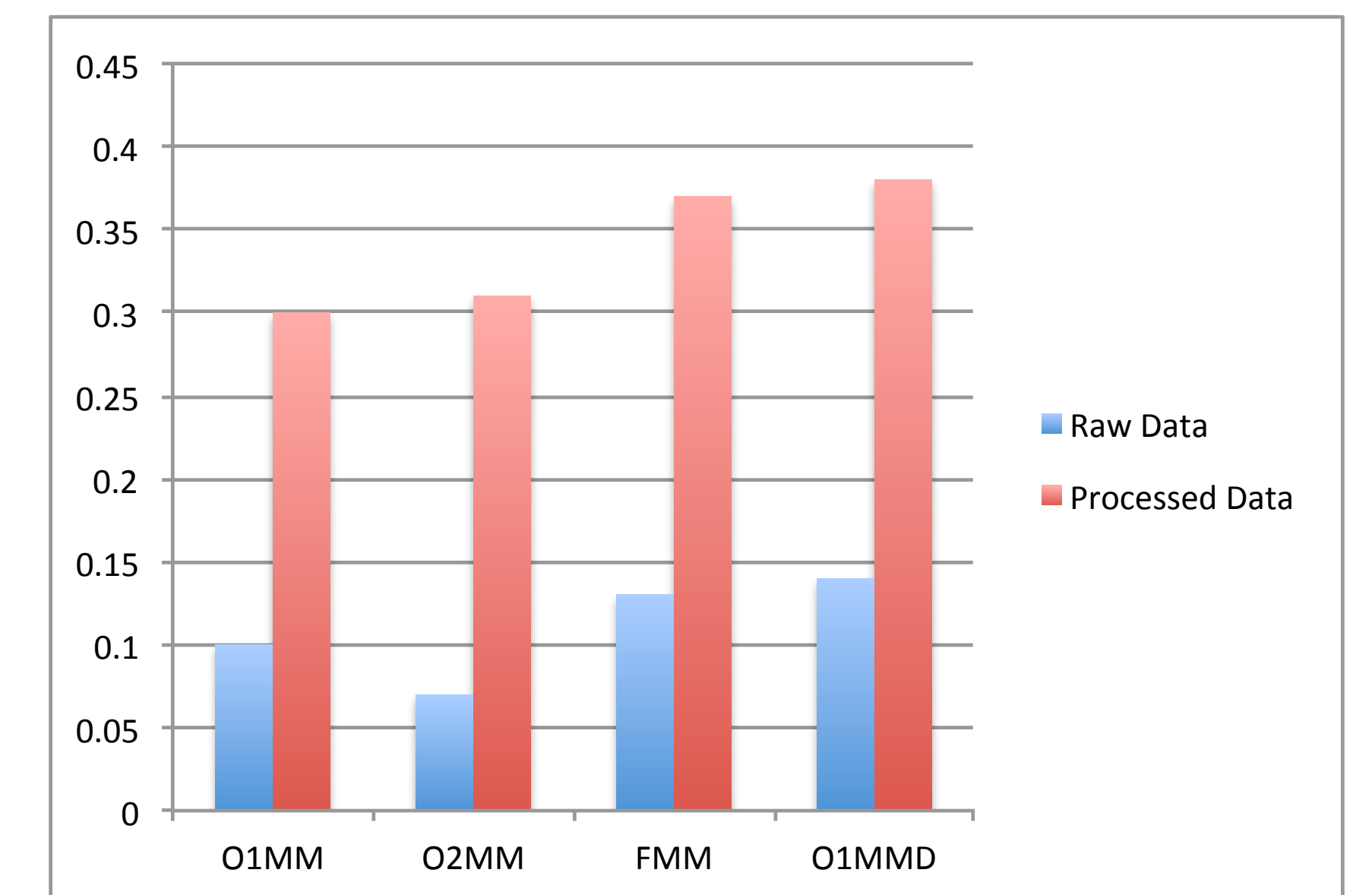
## Prediction Models

- Order-1 Markov Model (O1MM)
- Order-2 Markov Model (O2MM)
- Order-2 Markov Model with fallback on order-1 Markov Model (FMM)
- Order-1 Markov Model with direction-of-movement feature (O1MMD)

## Results (Prediction Accuracies)



Leave-One-Day-Out Cross-Validation



Sequential