

Real-time Detection of Crowded Buses via Mobile Phones

Purpose: Accurate knowledge about the utilization of public transit vehicles by riders, such as bus fullness, is critical information for public transit planners. Automatic Passenger Counter (APC) information is used by transit planners to detect transit bottlenecks, assess overcrowding of vehicles, and provide rider experience. APC data may be a good measure of rider counts but can suffer from high error when considering individual due to compounding errors. The purpose of this research is to investigate a new technique for recording information about bus vehicle fullness using participatory sensing, via a user's smartphone accelerometer and GPS.

Approach: This study was organized into three linked sections. First, the team analyzed APC data for the Port Authority of Allegheny County (PAAC) to estimate its accuracy. Then direct field observations were used for measuring the relationship between bus fullness and riders standing on the bus. Accelerometer data from smartphones was also logged. Then the logs were used to provide training data to model a rider's current state, specifically if they were on a bus, and if they were standing or sitting.

Key Findings:

APC Data Accuracy

The data indicated that APC data is accurate for measuring the number of riders in aggregate, but with 43.6% error rate. It was determined the reliability of APC counts needs improvement before it can be used to measure the number of riders on buses in real-time.

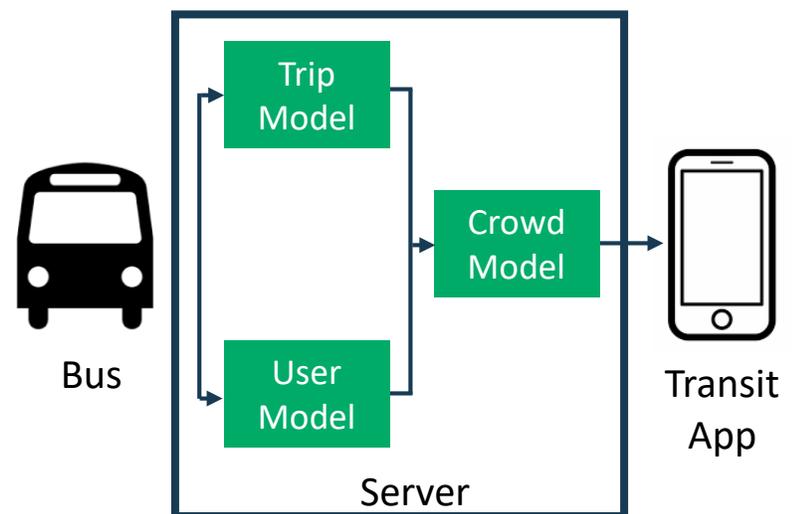
Bus Fullness, Standing and Sitting

There was a clear upwards trend showing that the number of riders standing is indeed predictive of the fullness of the bus.

Activity Detection

The model very accurately determines whether riders are standing on a bus. Therefore the results of these models can produce an accurate estimate of the number of people standing on a bus.

Conclusion: The team was able to achieve a model accuracy in the 95% range. In future work, the results of this research can easily be extended to many different public transit systems, such as trains or subways. Additionally, with more data the team could improve the results of the activity model and better learn the relationship between bus fullness and the number of people standing.



Research Team:

- Anthony Tomasic (Principal Investigator) <https://orcid.org/0000-0001-7864-0364>
- Alex Haig
- Shirley Anugrah Hayati

Project Record:

- <https://ppms.cit.cmu.edu/projects/detail/31>

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