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Evaluating and Validating Technology Options for Estimating Transit Vehicle Occupancy in Real Time

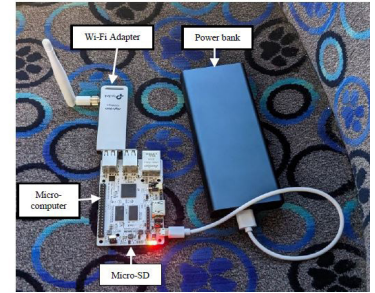
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Current Situation

As Florida's population continues to grow, transportation agencies are considering ways to make transit more efficient. Currently, many transit systems lack accurate, real-time occupancy data for buses and trains. This limitation not only affects passenger decisions about when and how to travel, but also how well agencies can plan services. Tracking ridership in real-time can help support transit planning and investments, and boost passenger confidence.



Hardware (on the right) used to conduct a Wi-Fi probe data collection in Lynx bus (left).



Research Objectives

The objective of this project was to identify and compare suitable technologies that could provide cost-effective and reliable information about occupancy levels. The team assessed numerous technologies, including Wi-Fi, Bluetooth, infrared sensors, cameras, and crowd-sourced data.

Project Activities

Following a literature review, the Florida State University research team identified that Wi-Fi, particularly Wi-Fi probing, was promising due to its ability to capture data with minimal new hardware. However, they also found that Media Access Control (MAC) address randomization, which protects user privacy by obscuring device identity, was a significant issue for real-time data capture. The team then conducted several pilot studies at transit systems across Florida, including StarMetro in Tallahassee, Lynx in Orlando, and Miami-Dade Transit in Miami. These pilot studies used Wi-Fi technology to track the number of mobile devices onboard public transport, using these devices as a proxy for estimating the number of passengers. Because MAC addresses often change for privacy reasons, the team developed data-driven algorithms to predict the number of passengers more accurately. These algorithms processed the Wi-Fi data and achieved a strong predictive performance. The models were quite successful in explaining the variation in passenger counts.

Project Conclusions and Benefits

The project determined Wi-Fi technology was a viable tool for estimating vehicle occupancy, despite the issues with MAC address randomization. By leveraging data-driven methods, even limited and noisy Wi-Fi data could be used to predict real-time occupancy with satisfactory accuracy. The project also noted that extending data collection over longer periods could improve prediction accuracy even further.

Real-time occupancy data could help transit agencies manage their services more effectively and improve the passenger experience.

For more information, please see fdot.gov/research.