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Research Results

Improvement of Transit Automated Passenger Count Data

A working group that includes transit agencies of San Francisco Bay Area, municipal and regional representatives and private industry. The group confronted key questions.

Modal

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Project Title: Working Group to Address Automatic Passenger Counting (APC) Problem

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WHAT WAS THE NEED?

Transit service has been very cost-ineffective, and the level of service, when measured by connectivity and service frequency, has generally been undesirable across most suburban regions in California. The recent development of Connected Vehicle technologies (broadly defined as communication and positioning technologies) and real-time information about the overall transportation systems (both transit and highway networks) has begun to make dynamic transit operation feasible. Dynamic transit operations, including Dynamic Dispatch (T-DISP) and Connection Protection (T-CONNECT) can substantially improve transit service quality by providing faster, more convenient, and cost-effective trips to the traveling public. T-CONNECT application scenarios are intended to improve the successful transfer between modes (from car to bus, train to bus) and between different bus routes of an individual agency. T-CONNECT enables public transportation providers and travelers to communicate, improving the likelihood of successful transit transfers. T-DISP application scenarios are intended to adjust transit operations to be more responsive to travelers' demand and traffic conditions. UC Berkeley California Partners for Advanced Transportation Technologies (PATH) proposes transforming current fixed-route operations into dynamically focused transit services in suburban regions across California.

WHAT WAS OUR GOAL?

The goal is to confront key questions, such as the value of automated passenger count (APC) data, what would incentivize transit agencies to cooperate – provide access to passenger counting, what should be a feasible integrated end-to-end solution, what technologies, primarily for passenger counting, must be considered, who would be

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invited to participate in the challenge, and what will be the role of transit agencies, how to ensure that APC data end up in the public domain. This research include functional prototypes or live deployment with an agency.

WHAT DID WE DO?

Transit ridership data comes from automated passenger count (APC) systems. APC systems are electronic machines that count the number of passengers that board and disembark at every bus stop. APC systems are supposed to generate robust ridership information on a stop-by-stop basis and to enable assessment of bus occupancies on different segments of bus routes. APC data can be used to assess bus utilization, to determine schedule adherence, and to determine whether bus routes need more or less running time to get between endpoints. In the mid- and post-COVID environment the real-time APC data can help travelers plan their trips to avoid overcrowded transit. To summarize, accurate APC data are critical for effective transit planning, efficient operation and traveler comfort.

This research organized and ran a Working Group to address the APC issues. The working group included transit agencies of San Francisco Bay Area, municipal and regional representatives and private industry.

WHAT WAS THE OUTCOME?

The findings of this project can be summarized as follows:

- Present APC sensing technology is as good as it gets: it has 98-99% accuracy.
- APC technology provides more information than just passenger counts: sensors can reliably distinguish between passengers, baggage, and objects like wheelchairs, bicycles, or strollers.
- Present APC workflow allows real time publishing of passenger counts using GTFS-RT. GTFS-rt is an open-data extension of the standard General Transit Feed Specification (GTFS) that allows public transit agencies to broadcast live transit updates to applications like Google Maps. The decision about real-time ridership reporting lies with a transit provider – technology is not an obstacle.
- Transit agencies cite these causes for not making ridership public in real time:
  - "Raw" (aggregated from sensors) APC data is of poor quality and needs extensive processing, not possible in real time, before it can be published.
  - Not all buses are equipped with APC, and data extrapolation is needed.
  - APC data are uploaded from buses not in real time, but at the end of the day – when buses return to the garage.
- Poor data quality is the main cause. Given that APC sensors are highly accurate, passenger counts get skewed due to:
  - Malfunctioning on-bus equipment – sensors, global positioning system (GPS), central processing unit (CPU), communication channels.
  - Bad integration into an automatic vehicle location (AVL) system.
- APC data quality can be ensured through:
  - Monitoring the health of on-bus equipment.
  - Collecting APC data independently from AVL – to allow comparison and validation.
  - Periodic validation against manual counts obtained from on-bus cameras.
- Maintenance of APC data quality needs investment that transit providers are generally unwilling to provide. The APC problem is solved for them as soon as they can produce ridership data good enough for the National Transportation Database (NTD) reporting.
- Incentives are needed for transit agencies to improve their APC data for real-time publishing. This report provides a list of potential use cases

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of APC data, but roughly they fall into three categories:

- Forcing the agencies to make improvements through tightening of the Federal Transit Administration (FTA) requirements for NTD reporting by establishing an APC quality standard similar to the Verband Deutscher Verkehrsunternehmen (VDV 457) used in Germany. VDV 457 is a guidance for the usage of Automatic Passenger Counting (APC) systems in public transport. It has been developed by the Association of German Transport Companies and sets standards for the accuracy required for passenger counting in vehicles. And/ or, make funding of certain projects for transit agencies contingent on their commitment to provide real-time APC data.
- Creating a competition for transit ridership data providers by using alternative data sources including Automatic Fare Collection (AFC) companies, mobile app vendors and mobile operators.
- Indicating ways of money-saving or a commercial value of APC data.

• Possible pilot projects can be developed around these incentive classes.

WHAT IS THE BENEFIT?

This research is urgent to support transit agencies in their critical need. Due to the COVID-19 Pandemic, transit ridership has collapsed throughout California and the nation. Potential transit riders are concerned about increased COVID exposure through transit use. In addition, transit agencies need the best, most current information to better manage their scarce resources and advocate further resources in the right areas. This research is critical in providing the information to ensure the public that transit is safe and not overcrowded and to allow decision-makers to best manage their funding.

IMAGES

People Counting Technology	Advantages	Disadvantages
IR break beam	Low cost, simple operating concept	Low accuracy (~85%) Sensitive to alignment
Thermal	Highly accurate (> 95%)	Expensive Sensitive to environmental conditions
Video	Highly accurate (~98%) Image processing software generates rich data sets	Expensive Can suffer from inconsistent lighting May incur data protection and privacy issues
Bluetooth	Low cost, simple to install	Low accuracy (80% - 90%). Passers-by must have a mobile phone in order to be counted

Image 1: Table showing types of APC technologies.



Image 2: Riders wait in line to board a bus. Source: FierceElectronics

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