

Bus Queue Jump Signal Pilot Program

Project Overview:

This project will augment the vehicle detection & classification software of existing smart camera technology located at three intersections along CTA routes to identify CTA buses and grant bus queue jump signals. A bus queue jump signal is a traffic signal phase that is exclusive to CTA buses and allows our buses to get a head start on traffic before the general traffic signal turns green.

This smart camera technology is licensed and managed by the Chicago Department of Transportation (CDOT) and this project would require close coordination between CDOT and CTA. The technology consists of a device including a camera connected to a computer, both of which are located at a city intersection. The camera, together with software on the computer, can identify vehicles passing through the intersection. This technology is connected to the traffic signal controller at the intersection, so it can send a request to adjust the signal based on information collected by the camera.

This project will consist of working with CDOT's smart camera technology vendor to further develop the software used by this device to specifically recognize the presence of CTA buses at an intersection. This work would utilize machine learning of this existing smart camera technology at over 550 locations. The ability to specifically recognize CTA buses will lead to a more efficient use of signal time by not granting queue jump signals when CTA buses are not present at the intersection. In addition, pedestrians waiting at the bus stop should be detected and counted as this will be another data input factored into the queue jump request. These improvements will be implemented and tested at intersections that already grant queue jump signals and will consist solely of the augmentations to the existing product software.

Upon successful completion of the pilot, the expectation is that this logic will be incorporated into smart intersection software for granting queue jump signals city-wide. The project is funded by a United States Department of Transportation (USDOT) Strengthening Mobility and Revolutionizing Transportation (SMART) grant. The scope of work will be completed within 12 months of notice to proceed.

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Scope of Work

Task 1 – Requirements Alignment

- Develop project schedule showing steps to project completion of Tasks 2 & 3 within 12-month timeframe
- Finalize intersections that have existing queue jump signals for testing in the pilot
- Define accuracy thresholds and error tolerances that are acceptable to CTA to recognize CTA buses using the proprietary smart intersection technology. Factoring and defining the following:
 - Other similar shaped buses
 - Different weather conditions
 - Bus stop waiting zones and pedestrian detection counting

Task 1 Deliverables

- Monthly updated project schedules
- Report identifying pilot intersections and accuracy thresholds and error tolerances

Task 2 – Data Collection and Model Development and Integration

- CTA Bus Detection
 - Collect and annotate video datasets of CTA buses at locations with the smart camera technology to use for machine learning
 - Train and validate machine learning models using the annotated videos. The machine learning will develop software that will allow the smart intersection devices to specifically recognize CTA buses.
 - Refine classification model with iterative testing at test intersections.
 - Integrate the machine learning-modeled software updates with the main product software for deployment in the field.
- Pedestrian Zone Occupancy Detection
 - Provide real-time counts of pedestrians waiting in bus stop waiting zones.
 - Determine how to use these counts as a factor in the timing of the queue jump request. Presence of humans by the bus stop sign or shelter, if present, are strong indicators that the bus will stop.

Task 2 Deliverables

- Interim reports showing progress in reaching accuracy thresholds and error tolerances with each stage of testing.

Task 3 – Deployment and Validation

- Deploy software including updates from the modeling process to devices at pilot intersections
- Validate performance of devices at pilot intersections by comparing device performance in recognizing CTA buses with manual counts of CTA buses through pilot intersections while also factoring in pedestrian counts in the bus stop waiting zone for the queue jump request
- Iterate software refinements as necessary to achieve accuracy thresholds and error tolerances
- Integrate filtering for “CTA Bus” into product interface to enable identification of CTA buses at other intersections with smart camera technology or provide automatic built-in feature for scalability to other queue jump locations with the same video detection system.

Task 3 Deliverables

- Comprehensive report showing model has successfully achieved accuracy thresholds and error tolerances
- Updated product software incorporating “CTA Bus” detection toggle option for all CDOT intersections or automatically set and enable all CDOT intersections with this feature in the proprietary software portal.