

UTC Spotlight

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New York University



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Using Video Feeds from Public Traffic Cameras and Computer Vision to Analyze Social Distancing and Travel Patterns during the COVID-19 Pandemic

Researchers at the Connected Cities for Smart Mobility towards Accessible and Reliable Transportation (C2SMART) University Transportation Center (UTC), led by Professor Kaan Ozbay at New York University, have developed a continuous, real-time pedestrian detection framework that uses public traffic camera feeds and deep learning-based video processing to analyze sidewalk and roadway density. This framework allows researchers to capture critical data on pedestrian, cyclist, and vehicle flows and densities without any additional infrastructure investment. It also provides data that assist with answering both traditional transportation planning questions, as well as novel questions such as how often pedestrians maintained the recommended “6 feet” of social distance during the COVID-19 pandemic.

C2SMART COVID-19 Dashboard

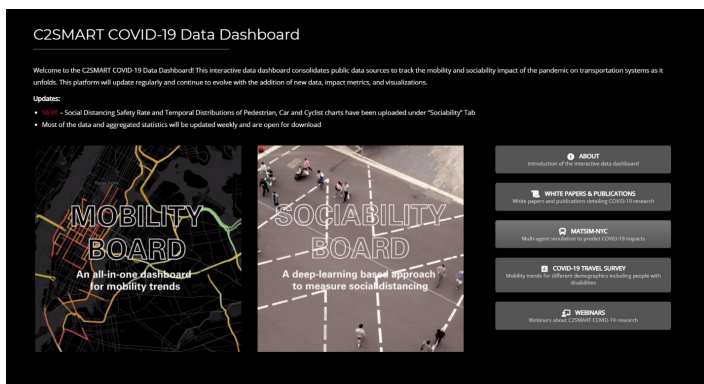
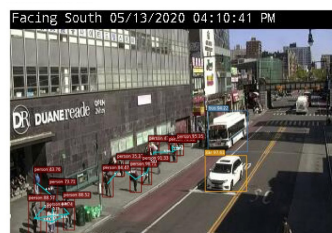


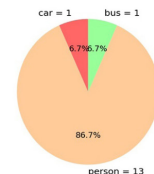
Image Source: C2SMART Center, New York University

This research showcases the feasibility of tracking density and physical distancing, which have previously been more difficult to track than metrics like volumes and congestion. Using publicly available video footage from existing traffic cameras in New York City and Seattle, researchers from multiple consortium universities, including both graduate and undergraduate students, trained computer vision to identify vehicles, pedestrians, and other objects on city blocks where traffic cameras had previously been installed. Due to both the low-resolution nature of the existing camera feeds, and the conversion of vehicles, cycles, and pedestrians into untraceable objects, this privacy-preserving visual recognition process prevents collection and/or leak of any identifying information for the human subjects in the camera footage.

Example of object detection and social distancing approximation output.



Number of objects detected in the current frame:



Social Distancing: 15 close contacts are detected.

Image Source: C2SMART Center, New York University

The C2SMART team developed a novel video-to-real distance approximation-based method without the use of field measurement and homographic computing. By calculating the specific real-pixel distance rate for each person with a fixed real-height assumption and the pixel height obtained from the videos, the technology can approximate the distance between pedestrians without any facial features or other personally identifiable information. This generalized, reference-free distance approximation method allows the implementation of large-scale social distance calculations under different environment conditions (for example, cameras with different angles). In the case of measuring social distancing, if the distance is less than a threshold of 6 feet, the event is flagged and recorded.

Initial results indicated that early in the COVID-19 pandemic, densities were lower and individuals in New York City and Seattle were able to reduce their contact rate. As daily infection rates decreased over the course of 2020, densities were observed to increase, while the ability to social distance on city sidewalks decreased, especially at locations like bus stops, intersection corners, and crosswalks, and at busier times of day.

Continuously tracking close contact or high pedestrian density in cities can help reveal exposure hotspots and provide decision-makers with data to deploy appropriate countermeasures. Monitoring pedestrian density and distribution, and temporal variations in behavior, can assist with evaluating risk of viral exposure and the efficacy of relevant public interventions in reducing community transmission during public health crises. Mapping social distancing behaviors also allows urban planners and engineers to better analyze a new normal of urban mobility.

Importantly, the fully remote approach allows for data collection without deploying humans in the field. This provides not only

Heatmaps of clustered pedestrians (distance < 12 ft.) at different locations.

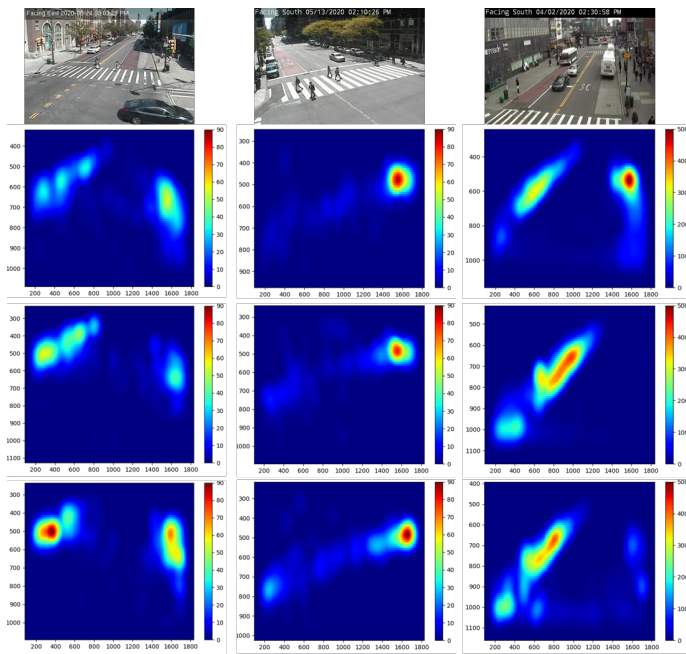


Image Source: C2SMART Center, New York University

labor savings, but also a safe alternative during a public health crisis in which disease spread is a concern. Further, since the project methodology relies on pre-existing deployed equipment, it is low-cost and highly scalable. Any city could adapt this research to its own traffic camera infrastructure.

This processed data along with many public data sources, has been integrated into C2SMART Center's free and publicly-available [COVID-19 Data Dashboard](#), which provides an interactive tool to understand the pandemic's impact on transportation. The sample traffic camera footage and resulting social distancing and density data is displayed on a "[Sociability board](#)." The C2SMART dashboard also integrates many publicly available data sources, including vehicular traffic volume, speed, transit and paratransit ridership, micro mobility trends, freight movement, and risk indicators like crashes and speeding tickets. The platform is based on cloud computing and data mining techniques for data acquisition and processing and supports interactive data visualization and analytics for quantifying mobility and sociability metrics. The data sources are displayed in a user-friendly dashboard and are continuously updated giving researchers and interested members of the public access to dynamic information about the changing state of mobility during the pandemic and beyond.

As an ongoing effort, this Artificial Intelligence (AI)-based object tracking approach will be extended to cover 100 camera locations to continuously evaluate the changes in crowd density and social distancing between pedestrians. With cloud computing power, it is possible to translate these findings in near real-time, tracking density trends during a city's reopening phases, including during special events where crowding may occur. These findings can also be used for predictive analysis like determining an ideal "Open Street" location or forecasting future cycling rates.

This AI-based solution can also be used to support effective response strategies for future public health crises. C2SMART conducted a [COVID-19 mobility survey](#) as a parallel effort to explore the pandemic's impact on behavior across different demographics, with special attention paid to individuals with a disability, low-income households, and other disadvantaged or underrepresented groups in transportation research and planning. As the project evolves, the dashboards can be used to monitor and evaluate changes in travel behavior and transportation modes, tracking changes to guide cities to make equitable, sustainable, and effective decisions as they adapt to meet both the long- and short-term outcomes of the pandemic on all travelers.

C2SMART COVID-19 Sociability Dashboard.

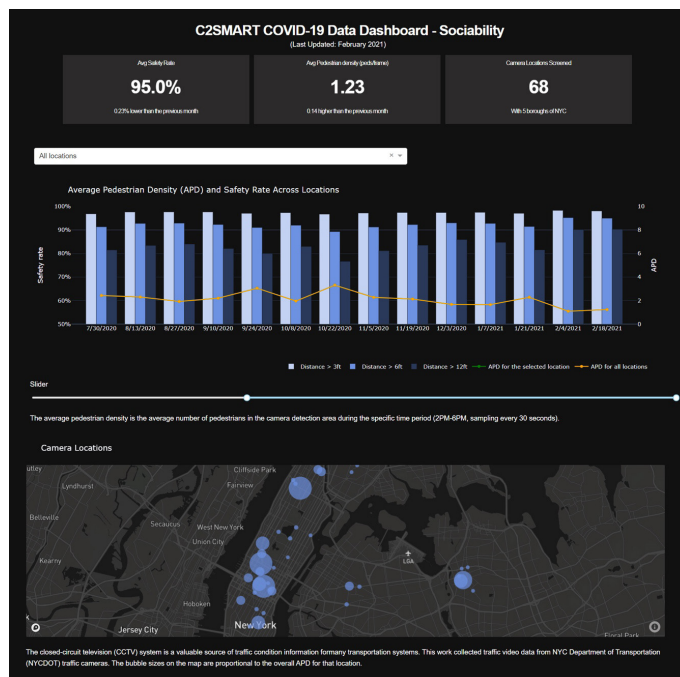


Image Source: C2SMART Center, New York University

About This Project

This study was funded by the U.S. Department of Transportation as part of the University Transportation Centers program, and was created in response to the COVID-19 pandemic by C2SMART Center (<https://c2smart.engineering.nyu.edu/>) researchers led by Professor Kaan Ozbay (kaan.ozbay@nyu.edu) of New York University, and Professor Xuegang "Jeff" Ban of the University of Washington. Research partners at Old Dominion University and Ulteig Engineers, Inc. also assisted with model evaluation and data analysis. Traffic camera data was extracted from <https://webcams.nycctmc.org/> and was originally compiled by the New York City Department of Transportation (NYCDOT).

This newsletter highlights some recent accomplishments and products from one University Transportation Center. The views presented are those of the authors and not necessarily the views of the Office of the Assistant Secretary for Research and Technology or the U.S. Department of Transportation.



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