

# Intelligence from Surveillance Cameras

FINAL RESEARCH REPORT

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## Intelligence from Surveillance Cameras

Traffic 21 Project

**Final Report** 

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#### Accomplishments

After the 18 months of the project, we have developed a video analytics library in C/C++ on Linux. It can be used for live video analysis, including pedestrian detection, vehicle detection and traffic estimation from live video feeds. We worked with PennDOT TMC in District 11, PA and connected our video wall to their live traffic cameras through FIOS optical cables. Figure 1 shows the research assistant demonstrated the live demo of the traffic report of I-79N from live video s on highway. We developed a heuristic algorithm to estimate the speed of vehicles from low-frame rate video feeds. The demo video can be found from the link: <a href="https://www.youtube.com/watch?v=wH8HRHVQjwc">https://www.youtube.com/watch?v=wH8HRHVQjwc</a> This technology can be used for improving mobility and reducing traffic jams and pollution. It can be integrated as a part of Smart City systems. We also developed a machine learning algorithm that can detect lanes based on vehicle traffic in the video.



Fig.1 Real-time traffic report from live highway cameras

Our Post-Doc Manuel also developed a large interactive map of virtual Pittsburgh with live video feed from traffic cameras. The large touch screen is based on a set of near infrared lights and a web cam that is affordable to public spaces such as transit stations, airports, and traffic management centers. Figure 2 is a screenshot of the live demo video at one of Traffic 21 program meetings with PennDOT visitors: https://www.youtube.com/watch?v=d5BSYHf1wnY



Fig. 2 Interactive Map of Virtual City with Live Video Feed

### **Broader Impact**

We have published 6 book chapters and 1 journal paper from this project and follow-up studies:

- 1. Shashank Deshpande and Yang Cai, Pedestrian Detection, in R. P. Loce, R. Bala, and M. Trivedi (eds): Computer Vision and Imaging in Intelligent Transportation Systems, Wiley, May 2017
- Shashank Deshpande, Wiktor Muron and Yang Cai, Vehicle Classification, in R. P. Loce, R. Bala, and M. Trivedi (eds): Computer Vision and Imaging in Intelligent Transportation Systems, Wiley, May 2017

- 3. Yang Cai, Video Analytics, in Yang Cai's book, "Ambient Diagnostics," CRC Press and Taylor and Francis Group, 2014
- 4. Yang Cai, Pheromone Trails, in Yang Cai's book, "Instinctive Computing," Springer-London, 2016
- 5. Yang Cai, Perceiving Motion Patterns, in Yang Cai's book, "Instinctive Computing," Springer-London, 2016
- 6. Yang Cai, Fatigue Diagnosis, in Yang Cai's book, "Ambient Diagnostics," CRC Press and Taylor and Francis Group, 2014
- 7. Yang Cai, Andrew Bunn, Peter Liang and Bin Yang, "Adaptive feature annotation for large video sensor networks," Journal of Electronic Imaging 22(4), Oct-Dec. 2013

We have received two follow up grants: CIT Dean's Infrastructure Grant \$25K and Xerox \$80K. We used the Dean's Office grant to build a 8 monitors video wall, located in CIC 2219D. The wall wall and the video server received live video feeds from PennDOT TMC, District 11, PA. Figure 3 shows the video wall in the VIS lab today.



Fig. 3 Video Wall at CIC 2219D, VIS Lab

We submitted a proposal to PennDOT for \$1.2M and a local foundation for the follow-up projects, in collaborating with Mel Siegel from Robotics and Alan Black from LTI. Unfortunately, they did not fund our proposals.

This project enriched the PI's graduate courses ECE 18-798 and ECE 18-799K for many years. We have used the live videos for class term projects. The overall impact includes over 200 CIT graduate students, mostly MS students over 5 years.

Finally, we supported the outreach activities of Traffic 21, including short video about the program with professional production from CMU Media Tech Group:

- Traffic21 Program Summary: https://www.youtube.com/watch?v=J Y99C47A00
- Virtual City: https://www.youtube.com/watch?v=d5BSYHf1wnY (demo for a Traffic21 meeting)
- Vehicle Classification: https://www.youtube.com/watch?v=rVt7IHjZoo0
- Motion Intelligence of Smart City: https://www.youtube.com/watch?v=wH8HRHVQjwc