



Project Summary

Texas Department of Transportation

0-6432: Low Cost Wireless Network Camera Sensors for Data Collection and Traffic Monitoring

Background

Within the last decade, there have been tremendous technological advances in sensors, networking, and processing that not only make the connection between the physical world and cyber-informatics world possible, but also make such connections much more affordable. Many freeways and arterials in major cities in Texas are presently equipped with video detection cameras to collect data and help in traffic/incident management. With the proliferation of less-expensive cameras and the ability to link them via a Wi-Fi network to form a network of sensors, the Texas Department of Transportation (TxDOT) could feasibly use these relatively low-cost technologies in traffic surveillance, at a lower cost than the commercial off-the-shelf traffic surveillance systems.

An alternative to operator-based video monitoring is video analytics. With video analytics, the information processing is ideally performed at a remote site and only alarms are returned to the central location. Employing video analytics on-site at a traffic management center is also feasible. Either provides the promise of increased safety and system coverage while reducing costs and staffing requirements. While a number of vendors now have this technology available, it has not been tested in typical situations with respect to typical TxDOT needs, and no guidelines exist for when and where installations may be appropriate.

Although existing information infrastructures are in place throughout Texas, some districts have much more comprehensive coverage than others. For regions with extensive infrastructure, the challenges lie in integrating the new data acquisition technologies with existing systems and synthesize the information provided by both systems to provide a unified interface and service to the user without incurring substantial capital expenses and extensive maintenance effort.

What the Researchers Did

Researchers investigated how these new technologies can be used in the Texas transportation systems to improve the cost-effectiveness, accuracy, and timeliness of data collection. Carefully controlled experiments determined the throughput and output quality of various communication configurations. Configurations entailed antennas at several cost levels. Via a survey to which 20 districts responded, incidents, volume, and speed were found to be the functionalities most in demand for autonomous surveillance systems.

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The UNT team developed an autonomous surveillance system capable of levels of service ranging from sending only alerts to the TMC up to transmitting streaming video (as shown in Fig. 1). Both a commercial system and the team-developed demonstration system were tested.

Fig. 1. Streaming video from prototype system developed for TxDOT showing speed by lane and volumes



What They Found

Following are some of the findings:

- Communication
 - o Single-hop configurations (sensor to backbone) can use inexpensive antennas with little loss of throughput or quality.
 - o Multi-hop configurations require antennas with stable (small variation) throughput.
 - o In single-camera configurations, antennas across a broad cost range are adequate; multiple camera systems will require further study.
- Autonomous surveillance systems
 - o Precise calibration and operator-controlled camera movement are competitive goals.
 - o Specialized expertise is required for development.
 - o Camera placement (perspective) is very important; placement near the shoulder of the roadway with a height of less than 60 feet diminishes occlusion and facilitates self-calibration.
 - o If bandwidth is not an issue, placing autonomous surveillance processing at the Traffic Management Center is as effective as placing it adjacent to the camera.
 - o It would be cost-effective for TxDOT to develop and deploy its own freeway-oriented video analytics system if 20 or more installations are anticipated.

What This Means

The state of Texas and TxDOT are better prepared to extend freeway monitoring systems beyond the regions for which traditional infrastructure is available. The research in this project contributed to the knowledge of the viable configurations and suitable highway structures that offer the most promise for autonomous surveillance. TxDOT has gained new ideas with respect to options for replacing components as the existing infrastructure ages.

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