DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Automated Video Incident Detection (AVID) System

Integrate Automated Video Incident Detection (AVID) into the TMC central system to enable the existing CCTV cameras to proactively detect abrupt changes in traffic conditions on the freeway in real time and visually alert TMC operators by automatically displaying the traffic condition on the TMC monitors.

Transportation Safety and Mobility

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Project Title:
Automated Video Incident Detection (AVID) System

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WHAT IS THE NEED?

Detection and verification of incidents on major freeways is one of the most critical functions for incident response. Studies show that every seven minute delay in detection results in one additional mile of queue in the system. Therefore, early detection and verification of an incident results in less congestion and faster restoration of traffic flow. Transportation Management Centers (TMCs) verify incidents by manually monitoring closed-circuit television (CCTV) cameras once the incident is identified. Otherwise the cameras are idle most of the time, performing no functions when not being used for incident verification. Currently, TMC operators detect incidents by monitoring CHP logs and news media, viewing the Advanced Transportation Management System (ATMS) map, or receiving calls from commuters. However, if the Department had a method to automatically detect incidents using existing CCTV cameras, TMC operators could detect and respond to incidents more rapidly.

WHAT WAS OUR GOAL?

The goal was to integrate Automated Video Incident Detection (AVID) into the TMC central system to enable the existing CCTV cameras to proactively detect abrupt changes in traffic conditions on the freeway in real time and visually alert TMC operators by automatically displaying the traffic condition on the TMC monitors.

WHAT DID WE DO?

The original scope of work involved three primary tasks: a literature search to review commercial video detection systems, an evaluation of candidate commercial AVID systems, and a pilot implementation of the selected AVID system using video

feeds from the District 12 TMC CCTV cameras. However, during the project, funding for the California Traffic Management Laboratories (CTMLabs) at the University of California at Irvine (UCI) was unexpectedly terminated by Caltrans. The original proposal assumed the availability and maintenance of a dedicated fiber optic communications link between UCI and the Caltrans District 12 TMC that allowed for the control and capture of TMC CCTV feeds by UCI researchers. The demise of CTMLabs rendered the communications and computing infrastructure upon which the work was intended to be carried out no longer available. As a result, the scope of the project was modified to focus on an expansion of the literature review into a synthesis of not only AVID systems, but to consider the range of technologies available for Automated Incident Detection (AID) and system monitoring. In this synthesis, the researchers studied the impacts of big data and machine learning techniques being introduced due to the accelerating pace of ubiquitous computing in general and Connected Autonomous Vehicle (CAV) development in particular. They explored more recent data sources for AID that have seen limited deployment in production systems but offer significant potential. They discussed the changing role of the TMC and how new data can be integrated into TMC processes most effectively.

WHAT WAS THE OUTCOME?

The researchers identified fundamental tradeoffs in Automated Incident Detection (AID) systems: The Mean Time-to-Detect (MTTD) will generally increase with improving Detection Rate (DR) and decreasing False Alarm Rate (FAR). Therefore, TMCs should prioritize their desired functionality when defining specific requirements. The researchers recommend minimizing FAR since operator fatigue from high false alarm rates could lead to AID systems being ignored. They reviewed numerous studies and practical deployments where difficulty with environmental conditions, e.g. lighting and weather, necessitate frequent calibration and maintenance. Because no one incident detection technology is optimal, and new technologies, e.g. Connected Autonomous Vehicle (CAV) are on the horizon, the researchers recommend that TMCs prioritize Date Fusion (DF) and machine learning algorithms to integrate current and future data sources.

WHAT IS THE BENEFIT?

This research provided decision makers insight into the current state of Automated Incident Detection (AID) technology and recommendations for an approach to integrating it into existing Traffic Management Center TMC operations. Eventual implementation of AID systems could significantly reduce the time needed for incident detection, verification and response initiation, resulting in a considerable reduction in delays and congestion associated with freeway incidents.

IMAGES

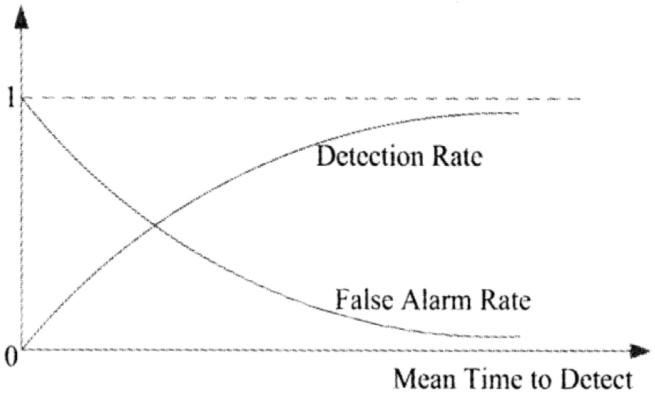

Image 1: Relationship betweem MTTD, DR, and FAR