DRISI

Caltrans Division of Research, Innovation and System Information

Research Notes

Advanced Research

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Project Title:
Roadway Detector System Evaluation

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DRISI provides solutions and knowledge that improves California's transportation system

Evaluating the Performance of Traffic Detection Devices

Development of VideoSync, a software tool enabling easy verification of data gathered from Traffic Detection Devices through comparison with video ground truth.

WHAT IS THE NEED?

Efficiently managing and operating California's highway system requires round-the-clock reliable and accurate information on traffic speed and flow. This information is derived from data collected throughout the state by vehicle detection devices, which Caltrans obtains from various vendors. However, the devices do not always perform exactly as advertised. Testing often reveals that vendors' accuracy claims are overstated or based on ideal conditions measured during the middle of the day when the devices are easiest to check manually. Under less ideal conditions, such as twilight, fog, poor weather, and tra¬c congestion, they might have problems with accuracy.

However, many of the traffic sensors do not operate properly, making the data unreliable. To maximize the return on the investment made in these trac detectors, tools are needed that can diagnose and fix the problems.

On-call detection pilot support is also needed by the districts. The support includes validating data collected from various detection systems and troubleshooting cabinet, traffic controller, loops, and other issues.

WHAT ARE WE DOING?

We are developing a software tool called VideoSync, which can utilize video footage captured simultaneously with vehicle detection state data. This vehicle detection state data is gathered in real-time using the C1 Reader, a hardware device that is connected between the detector and a traffic controller. While this data collection is occurring, video footage of the traffic will also be captured. By comparing the collected data and the video footage, the accuracy of the vehicle detection device can easily be assessed.

The software will read both the captured data and video footage files. It will then generate line graphs for the captured data. When a detector's state is high, the line on the graph will be high. When the state is low, the line on the graph will be low.

These graphs will scroll in the window from right to left as the video plays, with the center of the graph lining up with the current video frame. By scrolling the graphs, users can see a particular detector channel go high or low at the same time a vehicle passes the detector in the video footage. In addition, a square overlay can be placed over the video footage which will fill with a translucent color when the corresponding detector is high. This makes for easy visual verification of the data.

The video footage can be played back at different speeds to ensure proper analysis or stepped through on a frame by frame basis. Users can also step through every instance of a detector going high or low in the vehicle state data, with the video footage jumping to the corresponding time. The displayed graphs can be set to different time scales, allowing broader or narrower views of the state data in relation to the current frame.

The captured video footage and vehicle data often will not line up perfectly. To compensate for this, VideoSync can apply a time offset. VideoSync can attempt to find this offset automatically by analyzing the video footage or it can be entered manually.

WHAT IS OUR GOAL?

The objective of this project is to develop tools and techniques to test the round-the-clock performance and accuracy of vehicle detection devices while they are operating in the field.

WHAT IS THE BENEFIT?

Caltrans now has a method to improve the reliability of the vehicle detection information received at its Traffic Management Centers. Additionally, this method can be used to evaluate new vehicle detection technology as it comes to market by comparing available products to traditional inductive loops and video ground truth. For example, a prototype has been developed and used to assess the ability of a new detector to recognize bicycles and distinguish them from cars and trucks.

For existing vehicle detection systems, this method can be used to diagnose issues. For example, if a detector has a high false positive rate, this tool can be used to assess possible causes. If vehicles from nearby lanes are triggering the faulty detector, it will be clearly visible in the video footage when jumping to each false positive in the graph.

Furthermore, this system can compare traffic detection systems to each other if they are both watching the same intersection. This allows the comparison to inductive loops, video detection, infrared, and new methods developed by prospective vendors.

WHAT IS THE PROGRESS TO DATE?

Further enhanced the Videosync capability of differentiating amongst cars by applying sharpness filter to the collected videos. This enhancement provides better vehicle detection.

Two locations in District 4 have been identified for the evaluation of the Infra-Red Traffic Logger (TIRTL). Traffic data and videos will soon be collected, and VideoSync will also be used for the evaluation. We are currently waiting for the Hare harness which connects the Hare to the Type 334 cabinet terminal block. The vendor should soon be completing assembling the harness. The TIRTL and loops evaluation had been scheduled with District 4 (Ahmad Fahimi and Keith Aidun) on January 11, 2022 at Walnut Creek onramp.

Developed data labeling system in VideoSync in order to generate training data for automation of analysis process. This data will be used to experiment with and train machine learning models to automate or make easier the manual process of dataset analysis. Implemented semantic versioning system and packaged several releases in order to keep track of changes between versions of VideoSync. Implemented quality of life improvements to Event Logger such as hotkey saving between sessions, separate save/save as functionality, and save change tracking to avoid unnecessary save dialog boxes.

Finished the first half of the next major milestone goal of partially automating analysis for VideoSync. This includes creating a system in VideoSync to compare C1 data channels against each other and tag that data. Tagging the data involves marking false positives, false negatives, etc found in the C1 data when compared to a reference channel to create training data for machine learning algorithms. Completed functionality for this system and completed tagging of a sufficient amount of data. Implemented the ability to export this data to CSV format for analysis with machine learning algorithms."

IMAGES

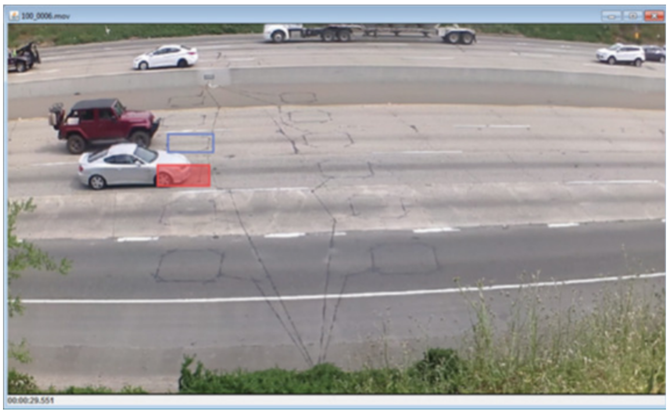

Image 1: VideoSync Prototype Video Screenshot

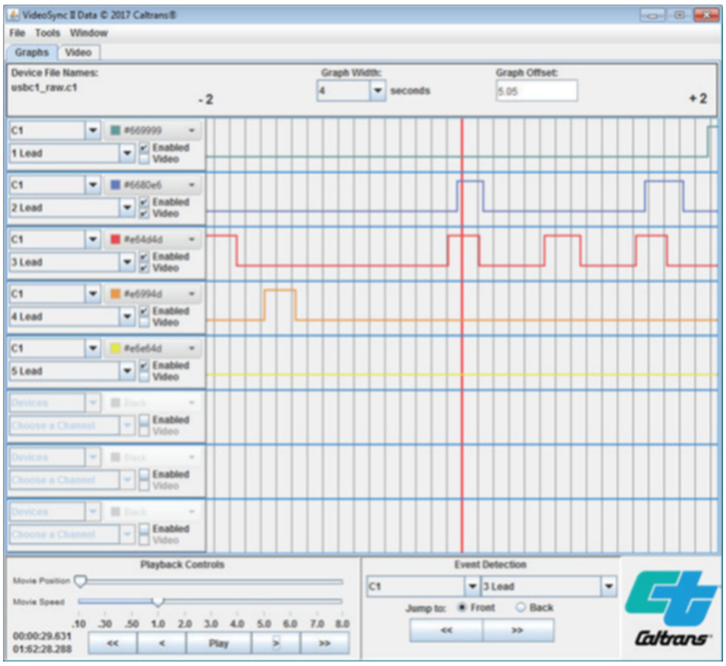

Image 2: VideoSync Prototype Main Window