Real Time UAS Traffic Management Automation and Cellular Interface for UAS Traffic

The UAV-based system will dynamically manage work zone safety and traffic mobility challenges by interacting in real time with users.

Highlight | Feb 2021

Project No. 19ITSOSU01

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POP: March 2019– February 2021

The UAV-based system will dynamically manage work zone safety and traffic mobility challenges by interacting in real time with changeable message boards, motorist cellphones, traffic control station, and law enforcement personnel. The main tasks of the proposed system will be to collect traffic data via the UAV camera, analyze data to detect congestion and back-of-queue information, and alert motorists of stopped traffic conditions, delay times, and alternate route options. This will accomplish Tran-Set's Vision and Mission of advancing the state of the art in transportation research and development while helping to develop a new generation of transportation professionals through outreach and developments related to this research.

Background

Our groups current research forTran-Set research has proven that UAV data can be used to monitor traffic and detect vehicle motion now using YOLO v3 and v3 along with Tensor Flow. Data shows that the risk of traffic accidents increases when traffic congestion and queues develop in highway work zone areas. As speeds' variations increase on highways, the likelihood of traffic crashes rise. Restricted views of the road ahead caused by surface and road features such as hills, and curves along other obstructions such as work zone areas can make it hard for motorists to anticipate traffic slowdowns and react accordingly in order to avoid accidents. This contributes to a high number of back-of-queue, rear-end crashes which are the most common type of work zone crashes. Providing early warnings to motorists, road workers, and emergency personnel to help avoid crashes due to work-related traffic slowdowns is essential to increase highway work zone safety.

Project Summary

Experiments were conducted using UAS to monitor traffic and collect traffic videos for processing. Prototype software was created to analyze this data. The goal of this research was to perform preliminary experimentation and proof of concept development work for the use of UAS to monitor highway construction zone traffic in order to create real-time alerts for motorists, construction workers, and first responders. The main tasks of the proposed system were to collect traffic data via the UAV's camera, analyze collected data and to prove whether or not a UAV based highway construction zone monitoring system would be capable of detecting congestion and back-of-queue information, and alerting stake holders including drivers, construction workers, and first responders. Vehicle traffic data was processed using a machine learning algorithm and custom coding. From this data the speed and relative motion of vehicle traffic was detected using the combination of custom software and machine learning algorithms. Matlab was specifically used to process the large video data files generated by research experiments.

Status Update

After preliminary results proved the promise of vehicle speed detection using the algorithm that researchers developed additional research was conducted to calibrate the custom software's ability to calculate vehicle speed, crucial to reporting on the flow or stoppage of traffic in highway construction zones. Calibration experiments were performed by having one experimenter drive a commercially available vehicle at a set speed on a measured course while other researchers created video. This video data was then processed using custom software and comparisons were made between experimental speed data from video processing and actual vehicle speed as set by the driver. Results showed that the software was successful in detecting vehicle speed from zero mph to highway speeds. Calibration experiments were able to bring vehicle speed detection from video to within 2 mph of actual vehicle speed. A combination of commercially available machine learning algorithms, Matlab data processing software, and

custom coding by researchers was successful in creating a method for processing and analyzing highway traffic flow data. This project has proven that UAS monitoring of highway construction zones and real-time alerts to motorists, construction crews, and first responders is possible in the near term. Vehicle speeds from zero mph to highway speeds were detected.

Figure 1. Vehicle speed calibration experiments.

In order to conduct the research, researchers captured video data via a DJI drone near I-10 highway. After capturing this data, researchers isolated the region of interest (ROI) in the captured video data, i.e., the road area, and discarded the useless area in order to enable data processing, e.g., the sky area. The original video frame and the ROI are illustrated in Figure 2.

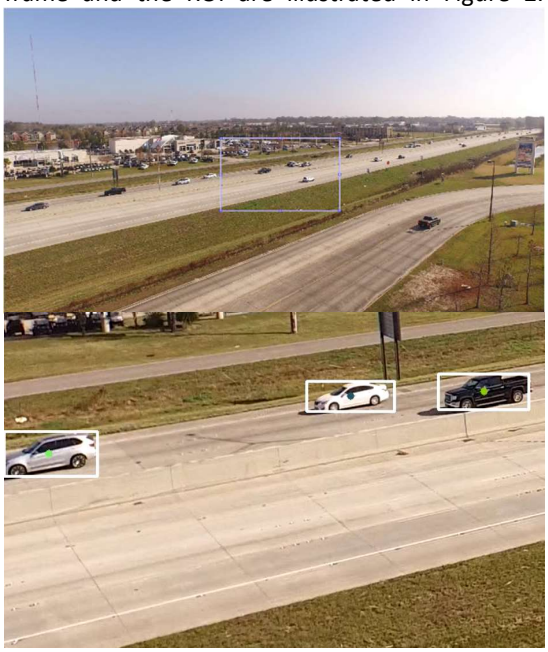

Figure 2. UAV based traffic immagery for traffic monitoring and control near highway work zones.

Impacts

This project has proven that UAS monitoring of highway construction zones and real-time alerts to motorists, construction crews, and first responders is possible in concept. Calibration experiments demonstrated the ability to detect vehicle speed from video to within 2 mph of actual vehicle speed. A combination of commercially available machine learning algorithms, Matlab data processing software, and custom coding by researchers was successful in creating a method for processing and analyzing highway traffic flow data, and research generated custom software was successful in detecting vehicle speeds from zero mph to highway speeds.

This research will lead to the creation of real-time interactions between the UAV traffic monitoring system and end users. This will help to advance Region 6 priorities by improving the use of existing transportation infrastructure, creating a safer environment for drivers, and by providing low costs solutions to traffic problems in highway construction zone areas by interfacing with existing cellular applications and driver notification and traffic alert technologies thus advancing Region 6 transportation needs.

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.