

PROJECT BRIEF

Fly-By Image Processing for Real-Time Congestion Mitigation

(STRIDE Project H2)

PROJECT OVERVIEW

Traffic monitoring is the key to detecting and easing congestion, but current state-of-the-art systems cannot detect or predict immediate congestion problems. Unmanned aerial vehicles (UAVs), also called drones, have the potential to provide real-time remote surveillance of high traffic areas. However, getting information about vehicle velocity from these images is not an easy task because the images are distorted due to the height of the camera, the camera’s resolution and focal properties, and the camera orientation.

GOAL

To determine the congestion on a road by using drone-mounted cameras.

PROCESS

Cameras mounted on drones were calibrated using a newly developed mathematical model. Lanes were defined to separate vehicle flows. The calibrated camera detected the location of vehicles using an existing object detection algorithm YOLOv3 (You Only Look Once). Then congestion was evaluated based on the calculated location and velocity of vehicles (Figure 1).

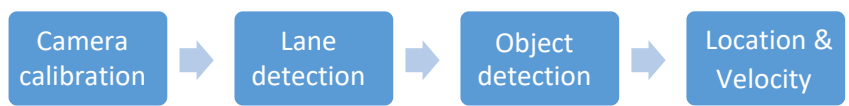


Figure 1: Detection Program Flowchart

Since the analysis required immense computational power, a Graphics Processing Unit (GPU) was used to process the videos in near real-time.

PRODUCTS

- The **Drone Perching Mechanism** allows drones to land on vertical or horizontal steel surfaces.
- The **Real-Time Vehicle Location Model** calculates the exact location of vehicles using images captured from cameras mounted on drones.

IMPACTS

A single drone can monitor a larger roadway segment compared to a fixed camera and/or embedded sensors in the roadway pavement. Drones can travel at higher speeds compared to ground vehicles without any restriction on traveling over a road network. The ability to collect real-time information on traffic can lower costs and reduce congestion.

WHO BENEFITS?

- U.S. Department of Transportation
- State Departments of Transportation
- Federal Highway Administration

RESEARCH TEAM

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PRODUCT DESCRIPTIONS

Drone Perching Mechanism

Drones were equipped with a perching mechanism that allowed it to land on vertical walls or upside down under horizontal steel surfaces such as a traffic light column or advertising board. Perching enabled the drones to shut down their power-consuming motors, thereby allowing the cameras to acquire video over an extended period from a fixed location.



Real-Time Vehicle Location Model

A mathematical model was created that relates the locations of objects on the image to real-world coordinates of the objects. Using the model, cameras were calibrated and real-time locations of vehicles could be determined. The model was experimentally verified.

PRODUCT APPLICATIONS

Currently, many state DOTs monitor and manage traffic at critical roadway segments using fixed infrastructure (e.g., roadside traffic cameras). Unlike fixed cameras, drones can be rapidly deployed to monitor or manage recurring (e.g., peak hour traffic congestion) and nonrecurring traffic congestion (e.g., major events and traffic incidents). In addition, drones can be used when traffic infrastructure is damaged due to extreme events (e.g., a hurricane, earthquake or wildfire) or along roadway work zones.

For more information on Project H2 (Fly-By Image Processing for Real-Time Congestion Mitigation), visit the [STRIDE Project page](#).

About STRIDE

The Southeastern Transportation Research, Innovation, Development & Education Center (STRIDE) is the 2016 Region 4 (Southeast) U.S. Department of Transportation University Transportation Center headquartered at the University of Florida Transportation Institute (UFTI).

