



CIRT DRONE USE IN CRASH INVESTIGATIONS

CIRT

- Critical Incident Response Team (CIRT)
- Specialized unit within the Tennessee Highway Patrol that assists members of the Department and outside agencies with crash and crime scene investigations
- Twenty (20) members located throughout the State

CIRT RESPONSIBILITIES

- Crashes with two (2) or more fatalities
- Fatal or critical injury crashes with the likelihood of felony charges
- Critical injury crashes involving departmental vehicles
- Departmental shootings
- High Profile crashes
- Any fatal crash in TDOT work/maintenance zones
- Large area crime scenes

Program

- Program development began in 2018
- Policy and Operating Procedures established in 2019
- Purchasing and receiving of equipment in 2019
- All CIRT members obtained FAA Part 107 in 2019
- Program went live on January 1, 2020

Note

- ***The following hardware (equipment) and software are not endorsements made by the Tennessee Highway Patrol. The following equipment and software are tools utilized by the Tennessee Highway Patrol.***
- ***The CIRT members are not surveyors. All members have been trained by surveyors to utilize the equipment to collect forensic measurements.***

sUAS Objectives for CIRT

- To increase officer safety by reducing the exposure to traffic
- To reduce the time on scene in order to alleviate secondary traffic crashes and traffic queues due to other mapping techniques

SYSTEMS

- Eight (8) DJI Inspire 2 with Zenmuse X5s Cameras
- 20 mega-pixel camera



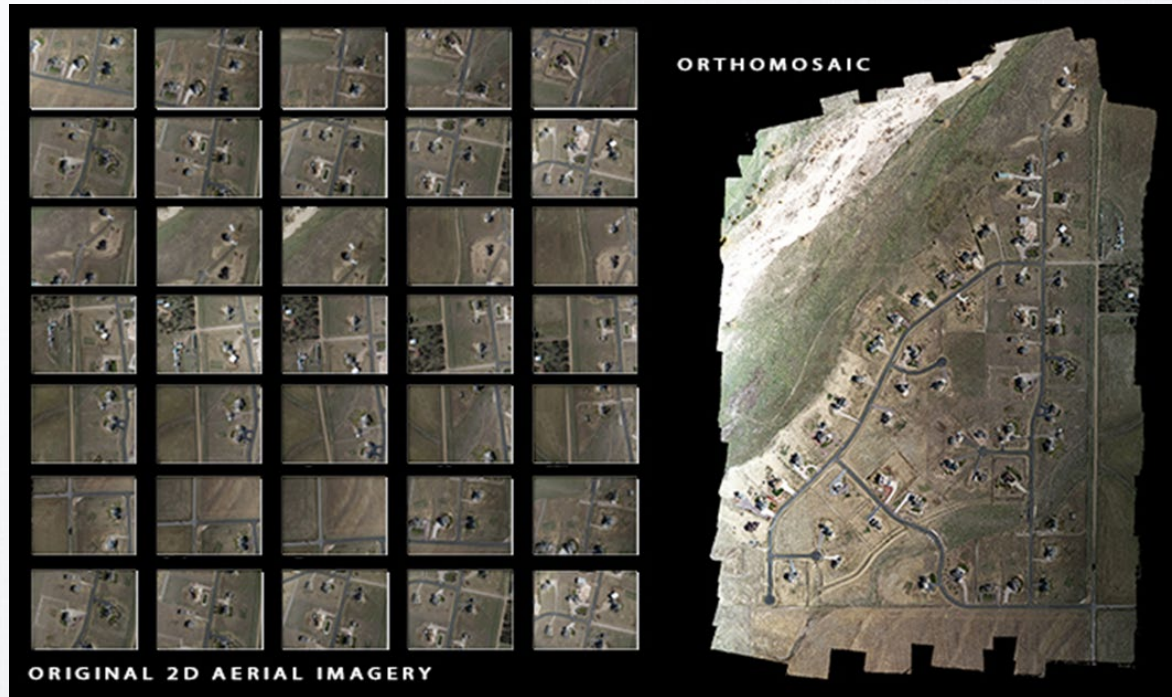
SYSTEMS

- Twelve (12) DJI Mavic 2 Pro
- 20 mega-pixel camera



sUAS Mapping

- Photogrammetry- The science of making measurements from photographs

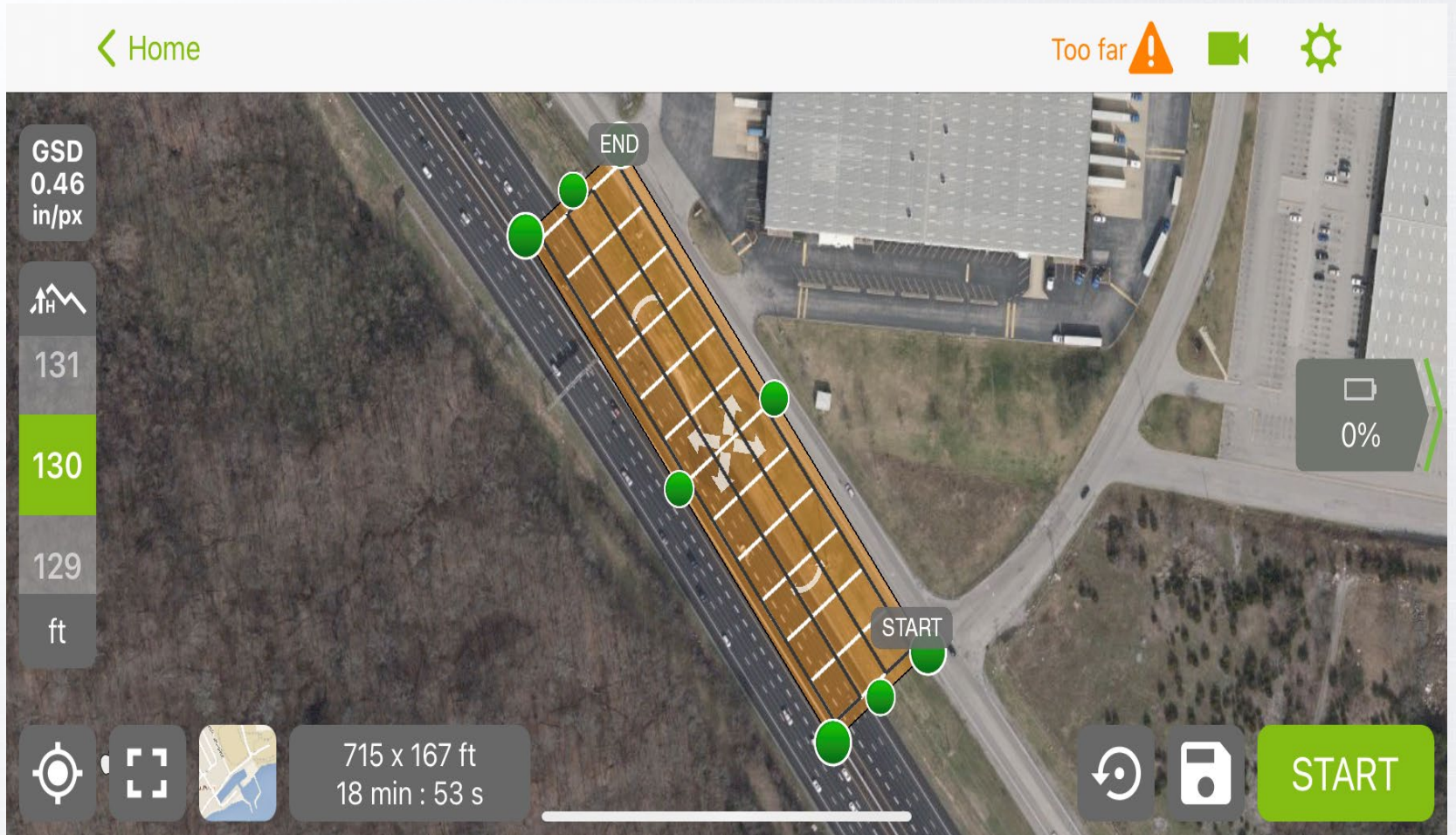


Photographs

- The drone photographs are captured either manually by the investigator or by using an application (App).
- DJI Go4 or Pix4D capture apps



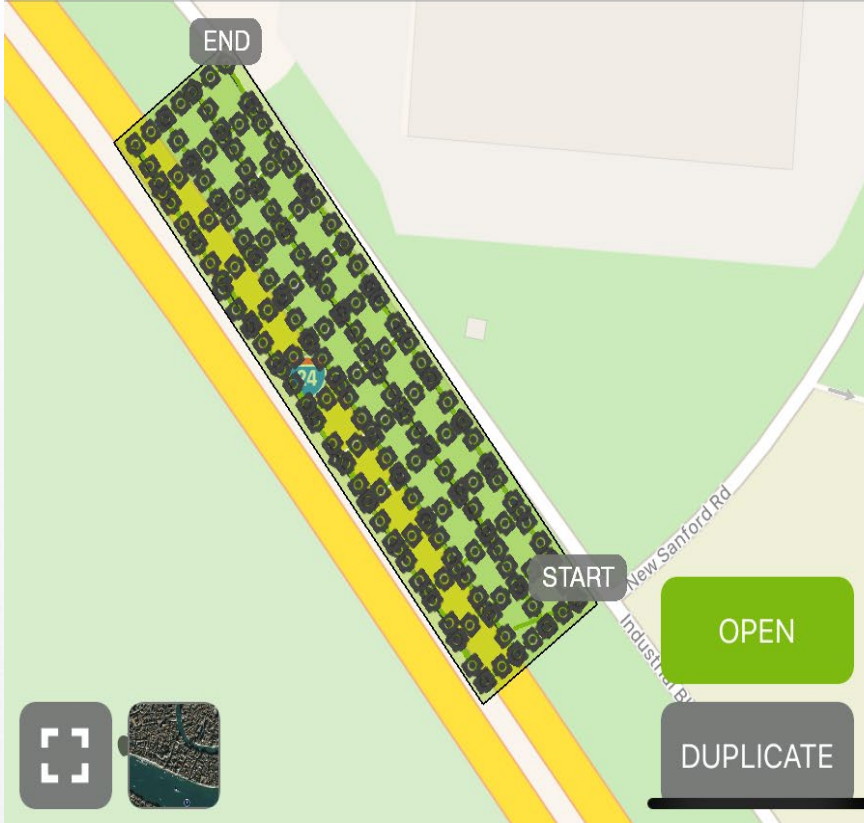
Pix4D Capture





Pix4D Capture


[Project List](#) Project 00014



Inspire 2

DOWNLOAD IMAGES	UPLOAD IMAGES
0 / 200 images <input checked="" type="checkbox"/>	0 / 200 images <input checked="" type="checkbox"/>

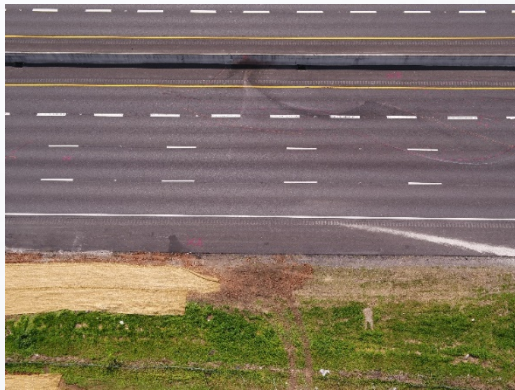
Mission has not been completely flown.
Open mission to resume and capture all images.





Scene Mapping using sUAS and Pix4D

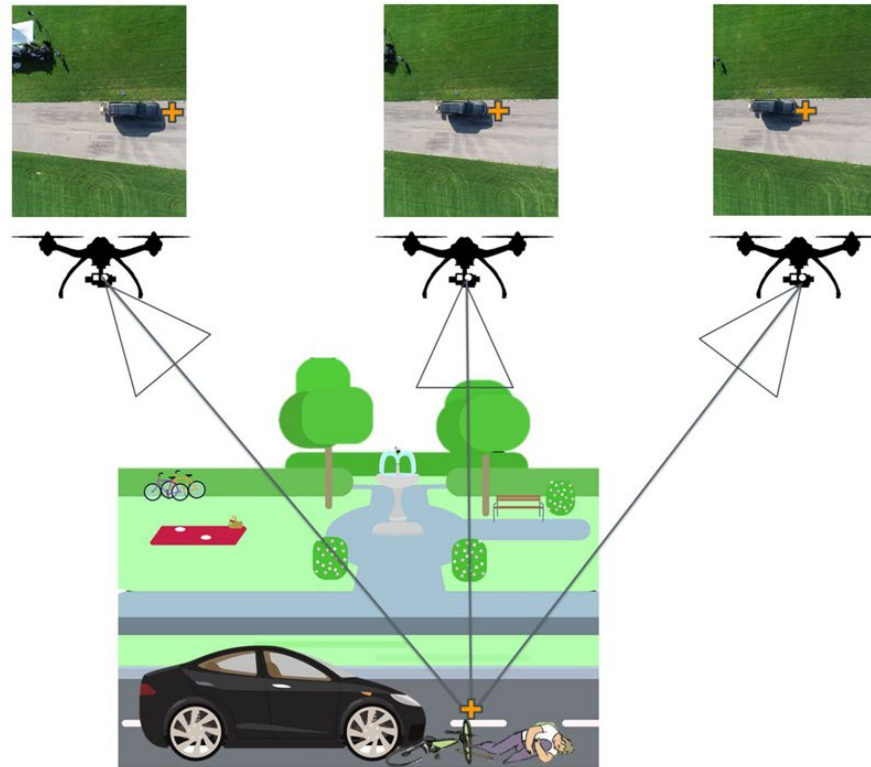
- Sequential photographs of a crash site





Scene Mapping using sUAS and Pix4D

Multi-ray Photogrammetry
FROM IMAGES TO 3D POINTS



www.pix4d.com



Scene Mapping using sUAS and Pix4D

- Each point in the orthomosaic is tied to multiple photographs





Completed Orthomosaic





3D Point Cloud Generated from Ortho





Results seen by CIRT

- CIRT was requested to map a crash site on Interstate 24 in Rutherford County. Since the crash had occurred several days prior, the interstate would have to be shutdown for traditional mapping. This section included four (4) travel lanes and an entrance ramp.
- Using the sUAS, a rolling roadblock was initiated instead of a shutdown. The CIRT members utilized two (2) drones. A total time of the rolling roadblock and CIRT members to clear was 27 minutes. Using traditional mapping methods, this would have resulted in 1.5 – 2 hours of lane closures.



Results seen by CIRT

- CIRT was requested to assist in documenting a crash scene in Montgomery County. The local agency requested specifically for 3D scanning to be completed. The CIRT member completed 13 scans with the 3D scanner. Each **scan** averaged about 6 minutes for a total of **78 minutes** in total. The same CIRT member utilized his **sUAS** to fly the scene. This resulted in **11 minutes** in total.
- This also allowed later data quality comparison which demonstrated sub-inch accuracy point-to-point.



Results seen by CIRT

- CIRT was requested to assist a local agency with documenting a two-vehicle, triple fatal crash in Putnam County. The crash occurred at a major intersection (multiple travel and turn lanes on all intersecting roadways). The local agency used a **3D scanner** which took a total of **6 hours** to complete (roadway shutdown). CIRT spent **26 minutes** on scene documenting the crash with a **sUAS**.
- As a result, the local agency has purchased and in the process of training up members of their fatal crash team with sUAS technology.

Advantages

- Rapid Documentation and Scene Clearance.
 - Many cases can be documented in minutes.
- High Resolution Documentation.
 - You eliminate the need to go back for more.
- Limited Traffic Exposure for Scene Personnel.
 - Through time and the need of physical contact.
- Reduced Personnel Numbers Required On-Scene.
 - Often, one person can do what took three.
- Rolling Roadblocks versus Complete Road Blockage.
 - See slide on traffic control.

Limitations

- Response Time
 - Trained and equipped personnel may have extended response times to some areas.
- Weather / Light
 - While it may be possible to fly in the dark or with wet roads, the ability to capture data is greatly reduced.
- Ground Control Requirements
 - See Ground Control (Next) Slide

Ground Control

- Internal Testing has proven that Forensically Mapped GCPs are vital to achieve the highest accuracy possible.
- By Forensically Mapping GCPs with survey equipment, we have consistently seen sub-inch accuracy.
- Hand measurements / visual scaling can result in good but not great accuracy that can be =>3 inches.
- Forensic mapping allows for cross platform validation of field sensors.



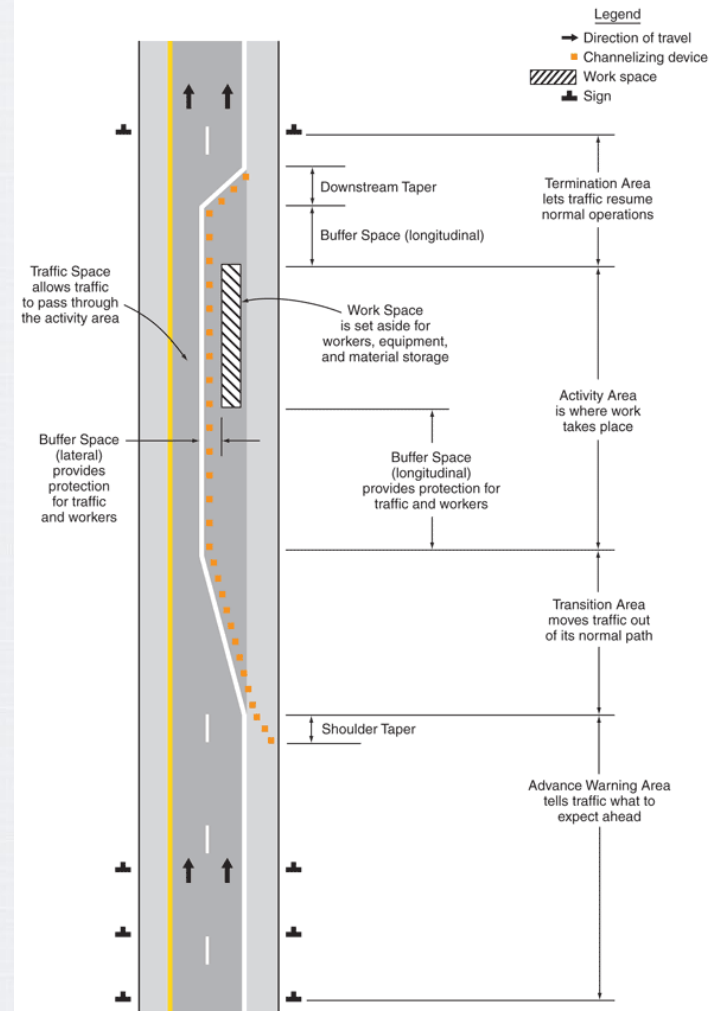
Ground Control



Traffic Control While Mapping

- Multiple studies have shown drastic time reductions by employing UAS as compared to survey tools.
- None of these studies have discussed Traffic Control times.
- While mapping times are drastically reduced, Temporary Work Zone times may be completely eliminated requiring only rolling road-blocks.

Figure 6C-1. Component Parts of a Temporary Traffic Control Zone



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