Real-time Road Accident Scene Recognition Using Computer Vision Applied to Drone Imagery

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Introduction

- Rapid urbanization has led to a variety of problems in road traffic, such as recurrent congestion and traffic accidents.
- To mitigate these problems, it is necessary to monitor and analyze traffic volumes in order to anticipate or detect anomalies in road traffic.
- This work proposes a solution for traffic accident scene recognition using computer vision applied to drone imagery.

Materials and method

1. System overview

Figure 1. Accident scene

Traffic accidents are sudden, unforeseen or perhaps foreseeable events that cause damage to people, property and the environment (Figure 1).

2. **Method** The method used in this work is an approach for detecting accident scenes in road traffic images and locating the accident site in real time. It involves the collection and transmission of real-time traffic image and video data, the analysis of the data for accident detection and location

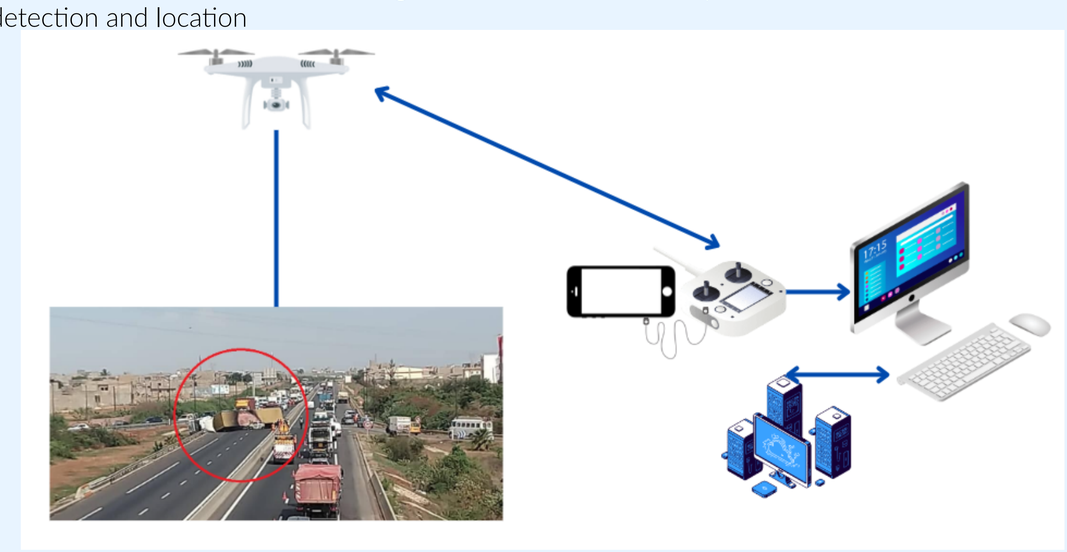

Figure 2. System modeling

3. Materials and tools

Figure 3. UAV Mavic Air 2S

- **UAV Mavic Air 2S:** data collection;
- **Android phone:** mapping mission planning;
- **A computer:** hosting the gnrgps tool for extracting coordinates;
- **YOLOv8:** model for train, validation and test.

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4. **Dataset** The model was trained and tested on an image database consisting of a set of 6123 urban road images distributed as follows:
   - 4287 images or 70% for model training;
   - 1224 images or 20% for validation;
   - 612 images or 10% for testing.
   - The images are annotated with Roboflow and a part of the dataset (train, valid) has been provided in open access by the Roboflow platform.
   - The images collected by the drone are used to test the detection.

Results

The pre-trained weight yolov8x was used for training, validation and testing of the model due to its performance.

1. Train and validation

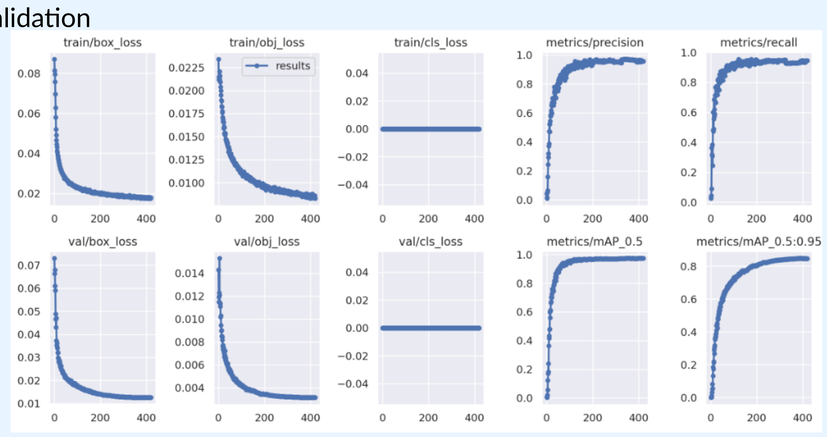


Figure 4. Training graphs

- Training and validation images are 640 x 640.
- The model is trained on Roboflow with confidence and overlap thresholds of 50%.

2. Recognition results

Figure 5. Recognition results

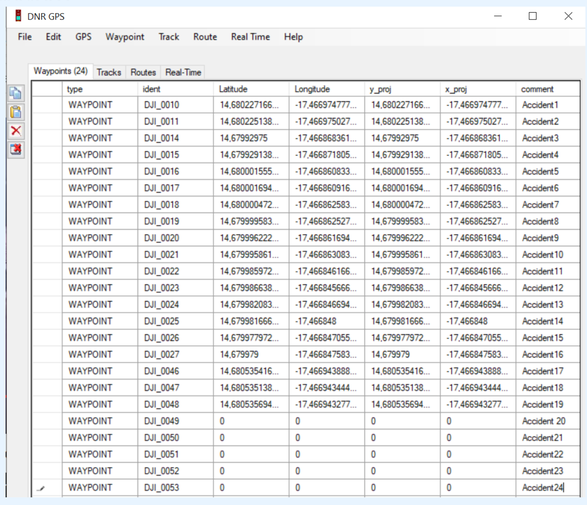
- Various accident scenes are recognized in aerial images and video sequences.
- The metrics used to evaluate the performance of our model were computed by Roboflow 100 and are: mean accuracy (mAP), precision, recall and F1 score. The model performance are showed in table below:

mAP	Precision	Recall
95.3%	94.4%	91.3%

Table 1. Performance table

- These rates show a good performance of the model.
- The results are satisfactory in spite of some cases of false negatives observed on roads with an advanced level of deterioration.

3. Image coordinate extraction



type	ident	Latitude	Longitude	y_proj	x_proj	comment
WAYPOINT	DJI_0010	14,680227166...	-17,466974777...	14,680227166...	-17,466974777...	Accident1
WAYPOINT	DJI_0011	14,680225138...	-17,466975027...	14,680225138...	-17,466975027...	Accident2
WAYPOINT	DJI_0014	14,67992975	-17,466868361...	14,67992975	-17,466868361...	Accident3
WAYPOINT	DJI_0015	14,679929138...	-17,466871805...	14,679929138...	-17,466871805...	Accident4
WAYPOINT	DJI_0016	14,680001555...	-17,466860833...	14,680001555...	-17,466860833...	Accident5
WAYPOINT	DJI_0017	14,680001694...	-17,466860916...	14,680001694...	-17,466860916...	Accident6
WAYPOINT	DJI_0018	14,680000472...	-17,466862583...	14,680000472...	-17,466862583...	Accident7
WAYPOINT	DJI_0019	14,679999583...	-17,466862527...	14,679999583...	-17,466862527...	Accident8
WAYPOINT	DJI_0020	14,679996222...	-17,466861694...	14,679996222...	-17,466861694...	Accident9
WAYPOINT	DJI_0021	14,679995861...	-17,466863083...	14,679995861...	-17,466863083...	Accident10
WAYPOINT	DJI_0022	14,679985972...	-17,466846166...	14,679985972...	-17,466846166...	Accident11
WAYPOINT	DJI_0023	14,679986638...	-17,466845666...	14,679986638...	-17,466845666...	Accident12
WAYPOINT	DJI_0024	14,679982083...	-17,466846694...	14,679982083...	-17,466846694...	Accident13
WAYPOINT	DJI_0025	14,679981666...	-17,466848	14,679981666...	-17,466848	Accident14
WAYPOINT	DJI_0026	14,679977972...	-17,466847055...	14,679977972...	-17,466847055...	Accident15
WAYPOINT	DJI_0027	14,679979	-17,466847583...	14,679979	-17,466847583...	Accident16
WAYPOINT	DJI_0046	14,680535416...	-17,466943888...	14,680535416...	-17,466943888...	Accident17
WAYPOINT	DJI_0047	14,680535138...	-17,466943444...	14,680535138...	-17,466943444...	Accident18
WAYPOINT	DJI_0048	14,680535694...	-17,466943277...	14,680535694...	-17,466943277...	Accident19
WAYPOINT	DJI_0049	0	0	0	0	Accident 20
WAYPOINT	DJI_0050	0	0	0	0	Accident21
WAYPOINT	DJI_0051	0	0	0	0	Accident22
WAYPOINT	DJI_0052	0	0	0	0	Accident23
WAYPOINT	DJI_0053	0	0	0	0	Accident24

Figure 6. Image coordinate extraction

This tool extracts geographic coordinates, comprising latitude and longitude. These data are stored in a database for decision-making purposes.

Conclusion

The model has high accuracy, precision, recall on both training and testing datasets which mean that it effectively learns patterns from pre-processed accident data and generalizes wellin new cases.

References

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[3] S. M. Butt, "A Review Paper on Accident Detection System Using Intelligent Algorithm for VANET," *Journal of Information Engineering and Applications*, vol. 6, no. 5, pp. 25–30, 2016.