Autonomous Accident Detection and Assessment

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Introduction

- Vehicle accidents occur frequently, causing congestion and delays
- The reason for delays are accident severity, authority response time, and investigation of the accident scene
- Manual assessment of accident scenes can take hours, preventing authorities from clearing accidents until they have finished their investigation
- Autonomously assessing accident scenes can speed up the assessment process and improve accuracy of scene analysis

Building the dataset

- To build the dataset, datasets and images from multiple online sources were combined
- Irrelevant images were discarded
- All images were labeled for:
  - Regular vehicles
  - Vehicles in accidents
  - Smoke
  - People
- Vehicles in accidents are defined as vehicles that are noticeable deformed, ablaze, or ajar
- The images were then randomly augmented to make it more resilient to adverse conditions by adding:
  - Horizontal flips
  - Horizontal and vertical shearing
  - Altering the brightness
  - Altering the exposure
  - Adding blur
  - Adding random noise
- From the 2,314 total images plus augmented images, the dataset is then divided between training images, validation images, and testing images

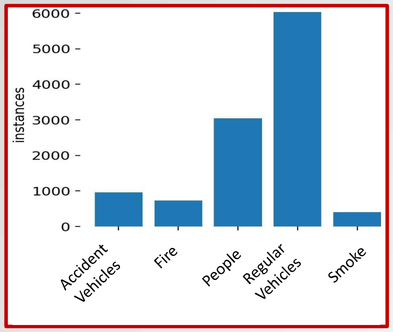

Figure 3. Dataset class composition

Objectives

- To develop methods of autonomous accident detection and assessment
- To evaluate the performance and computational cost of these methods

Building and evaluating the models

- Ultralytics' YOLOv5 was used to build a detection model
- This model was chosen for its implementation simplicity and accuracy over other models in Pytorch
- The models evaluate themselves at runtime using the validation dataset
- Novel images or videos can be labeled according to the classes of the model by running the YOLOv5 detect function
- The model analyzes an image, locates relevant classes, and adds a bounding box with confidence around an object of interest.

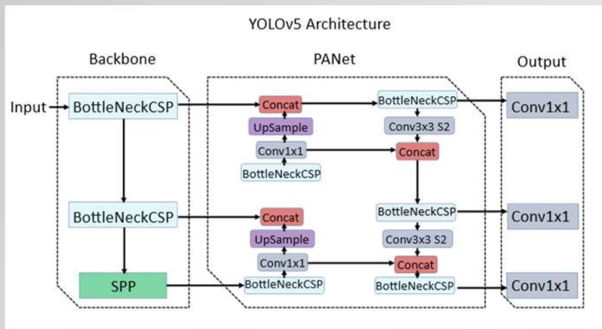

Figure 4. YOLOv5 structure

Class	Images	Labels	P	R	mAP@.5	mAP@.5:95
All	193	1202	0.632	0.495	0.465	0.199
Accident vehicle	193	113	0.689	0.566	0.544	0.241
Fire	193	72	0.519	0.361	0.255	0.085
Person	193	245	0.651	0.328	0.338	0.129
Regular vehicle	193	723	0.655	0.731	0.717	0.329
Smoke	193	49	0.647	0.49	0.469	0.211

Figure 5. Dataset prediction accuracy by class

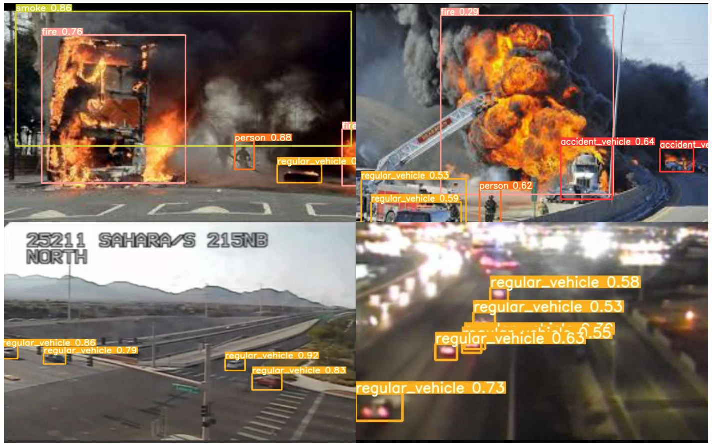

Figure 2. Scene detection example

Conclusions

- Accident scenes can be detected and assessed by object detection models
- For higher model accuracy, a more comprehensive accident and incident dataset must be created

Future Research

- The model could be tested using a drone, benchmarking performance differences between a cloud and drone-computer implementation
- More advanced datasets could be developed that gather information on specific accident parameters, such as damage estimation, lane blockage detection, and infrastructure damage

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