Literature Search: LPCV for Disaster Management

IEEE UAV Drone

Object Tracking Subteam

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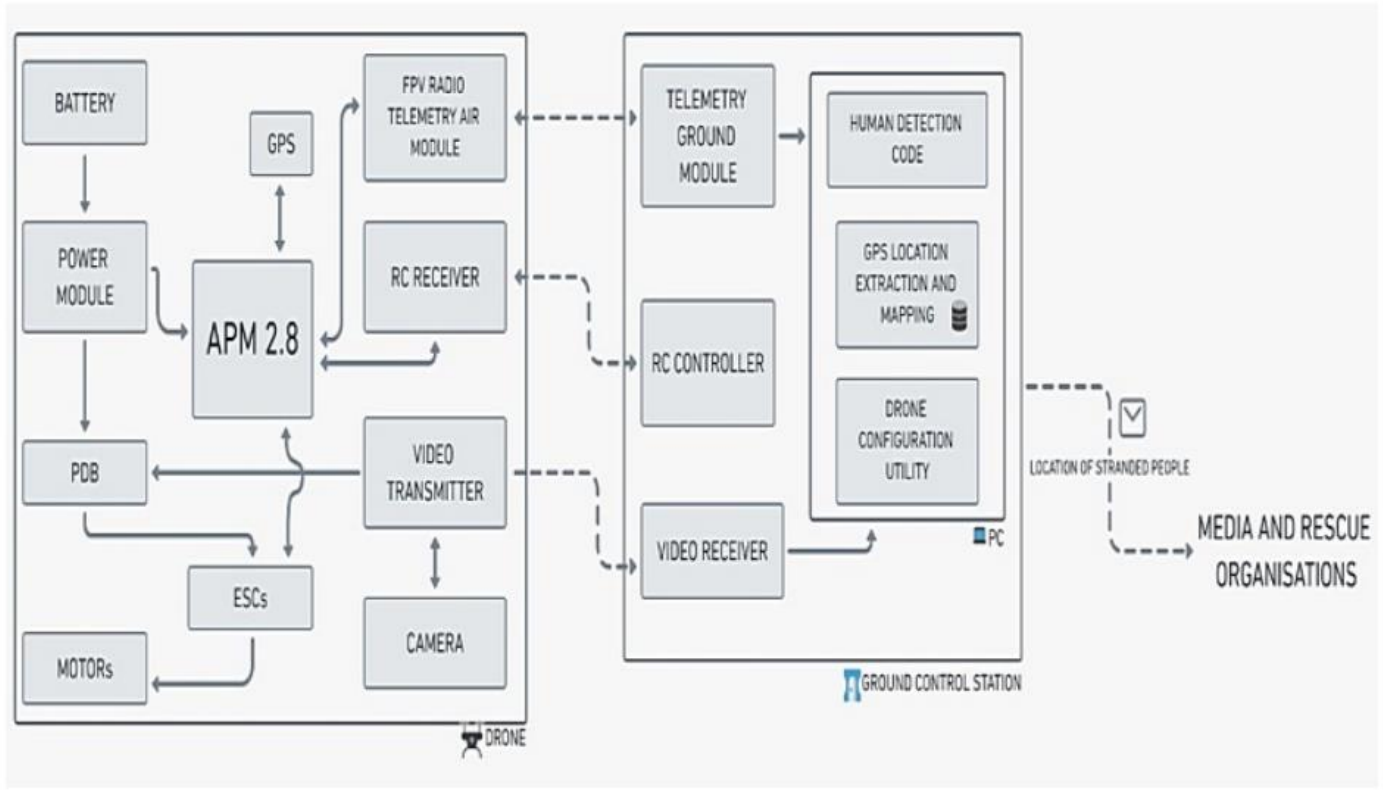
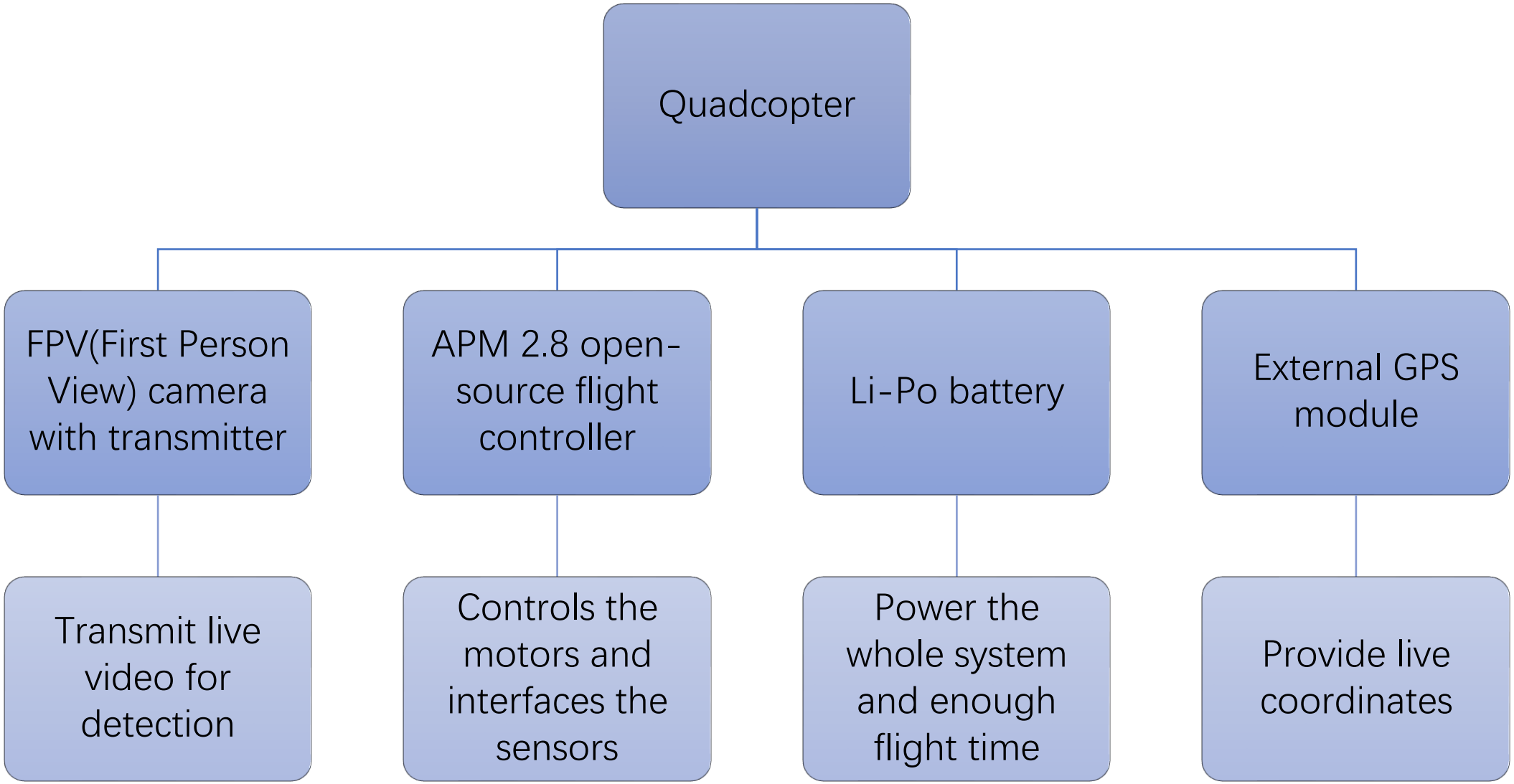
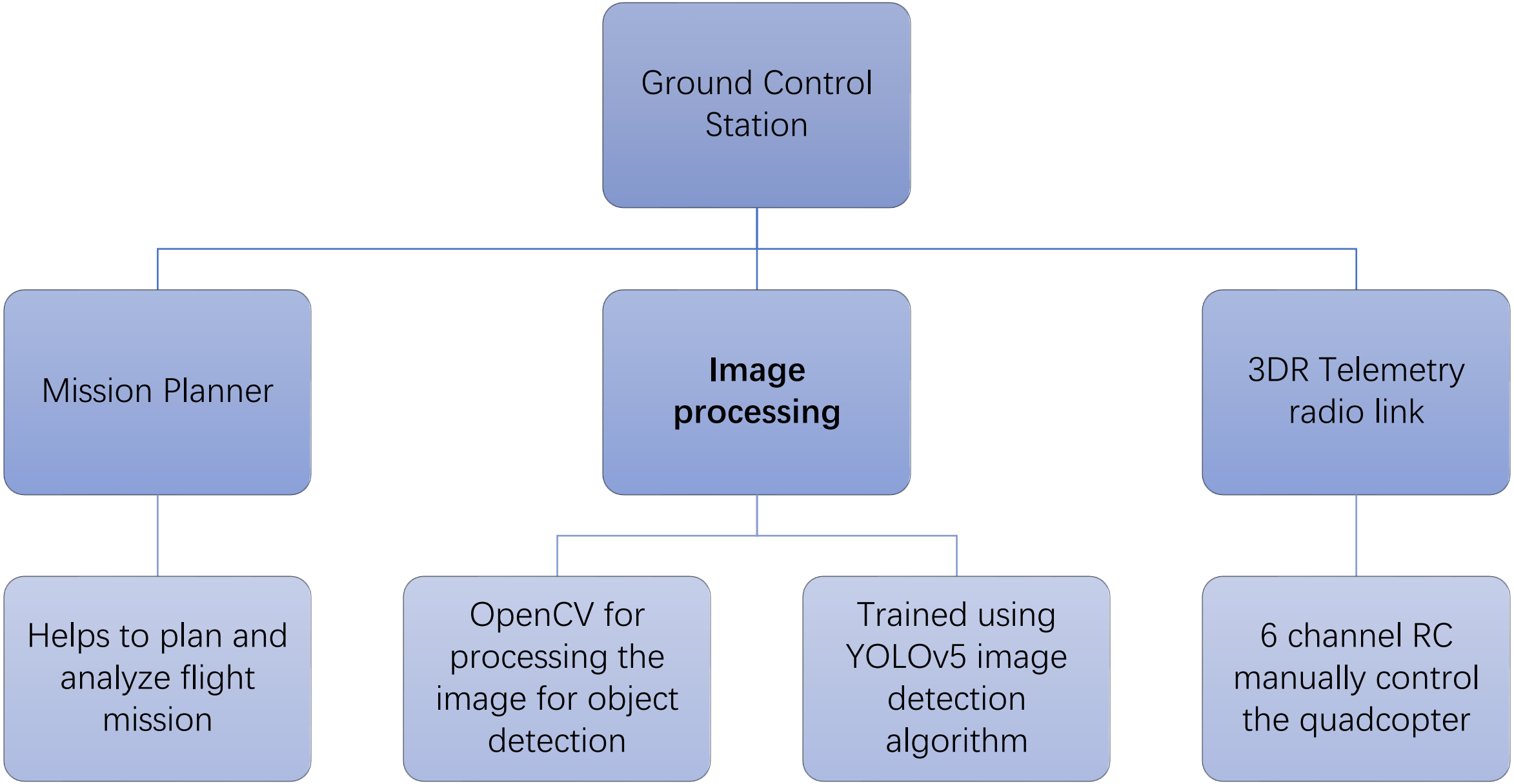
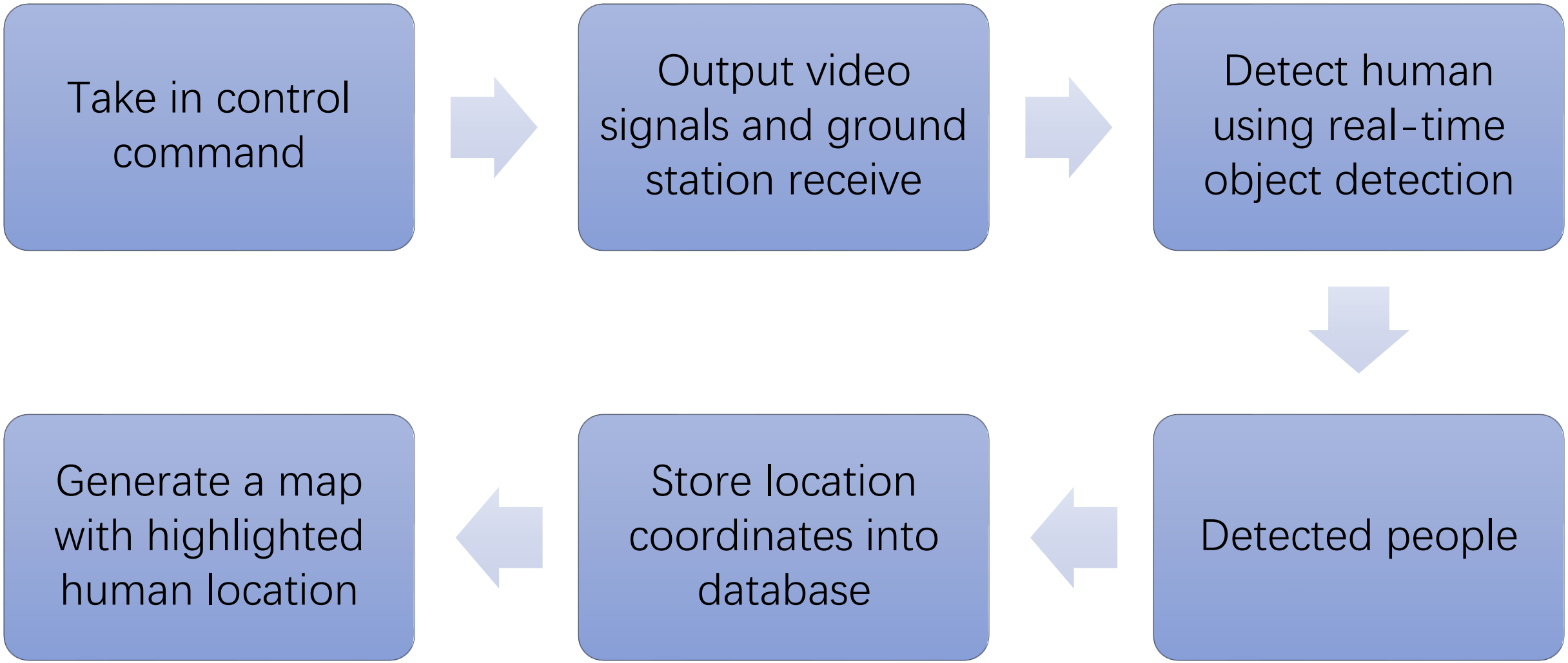
YOLOv5 based Open-Source UAV for Human Detection during Search And Rescue (SAR)




Quadcopter
FPV(First Person View) camera with transmitter
APM 2.8 open-source flight controller
Li-Po battery
External GPS module
Transmit live video for detection
Controls the motors and interfaces the sensors
Power the whole system and enough flight time
Provide live coordinates


Ground Control Station
Mission Planner
Image processing
3DR Telemetry radio link
Helps to plan and analyze flight mission
OpenCV for processing the image for object detection
Trained using YOLOv5 image detection algorithm
6 channel RC manually control the quadcopter


Take in control command
Output video signals and ground station receive
Detect human using real-time object detection
Detected people
Store location coordinates into database
Generate a map with highlighted human location

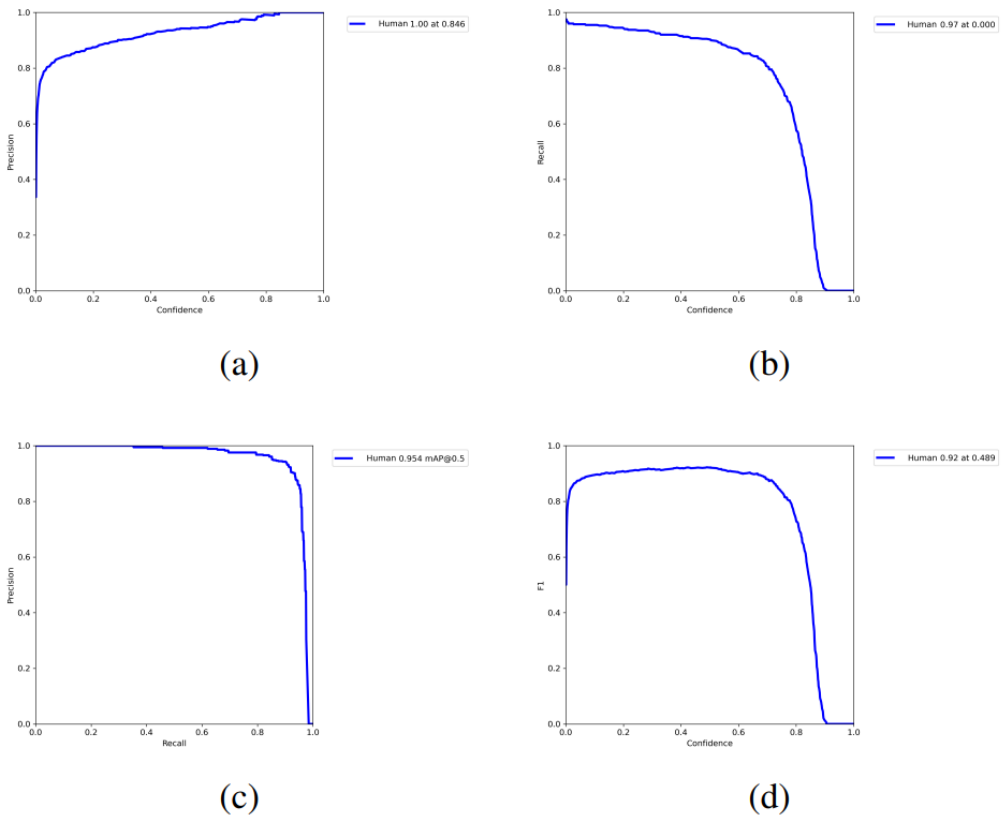


Fig. 4: Results of YOLO v5 training. a) precision vs confidence score graph. b) recall vs confidence score graph. c) precision -recall graph. It can be seen that the model has a mAP of 0.945. d) F1 score graph. The maximum F1 score is 0.92 at a confidence score of 0.489

TABLE I: TRAINING DETAILS

GPU	Tesla V100
Batch Size	1
Number of Epochs	300
Training Time	5.935 hours
GFLOPS	16.4

YOLOv5s

This version has unique features employed like Mosaic augmentation, 16-bit floating point precision and adaptive anchor boxes which improve the model generalizability, inference speed, accuracy and overall robustness of the model.

Model	size (pixels)	mAP^{val} 0.5:0.95	mAP^{test} 0.5:0.95	mAP^{val} 0.5	Speed V100 (ms)	params (M)	FLOPS 640 (B)
YOLOv5s6	1280	43.3	43.3	61.9	4.3	12.7	17.4
YOLOv5m6	1280	50.5	50.5	68.7	8.4	35.9	52.4
YOLOv5l6	1280	53.4	53.4	71.1	12.3	77.2	117.7

Fig. 5: Snapshot of real time human detection

References

- Sruthi, M. S., et al. "YOLOv5 based Open-Source UAV for Human Detection during Search And Rescue (SAR)." *2021 International Conference on Advances in Computing and Communications (ICACC).* IEEE, 2021.
- https://pytorch.org/hub/ultralytics_yolov5/

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Drone Aided Machine-Learning Tool for Post-Earthquake Bridge Damage Reconnaissance

Z. Ma, E. Zhao, G. Granello and G. Loporcaro

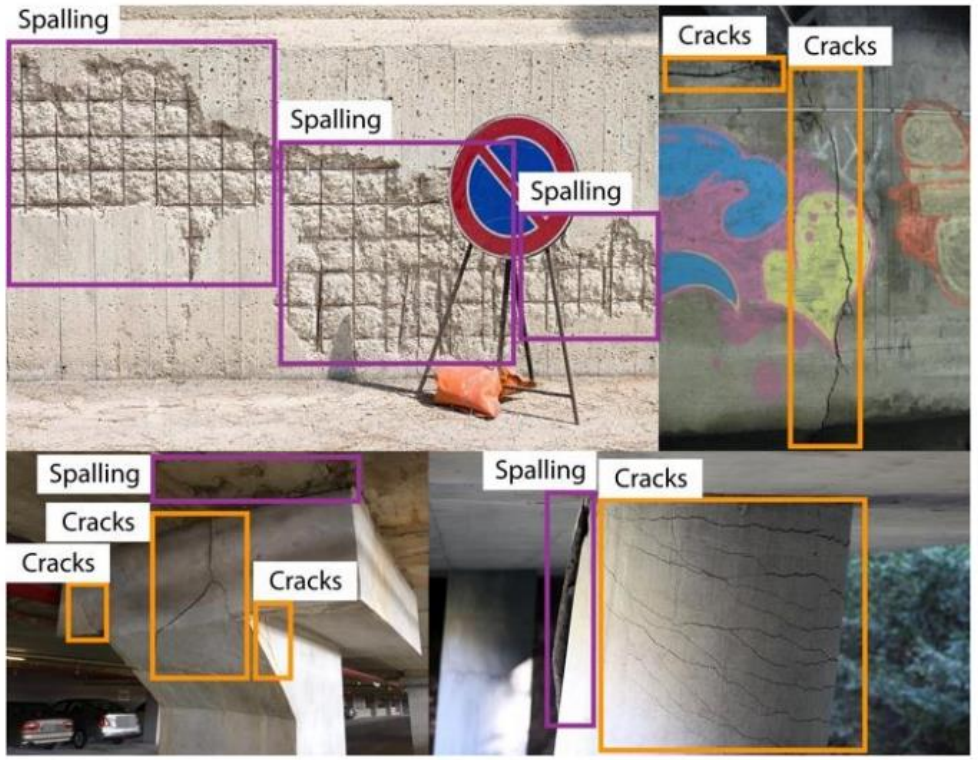
17 th World Conference on Earthquake Engineering, 2020

Damage types

- Two classes: “Cracking” and “Spalling”
- No “Corrosion” since it’s hard to be distinguished from spalling

Table 1 – Statistics of detected damages in the training database

Number of Annotations		
Classes	Training	Testing
Cracking	533	47
Spalling	207	27



Framework

- Pretrain Faster R-CNN using **Structural ImageNet Database**
  - 5,911 images (224 × 224) regarding damaged and undamaged structures

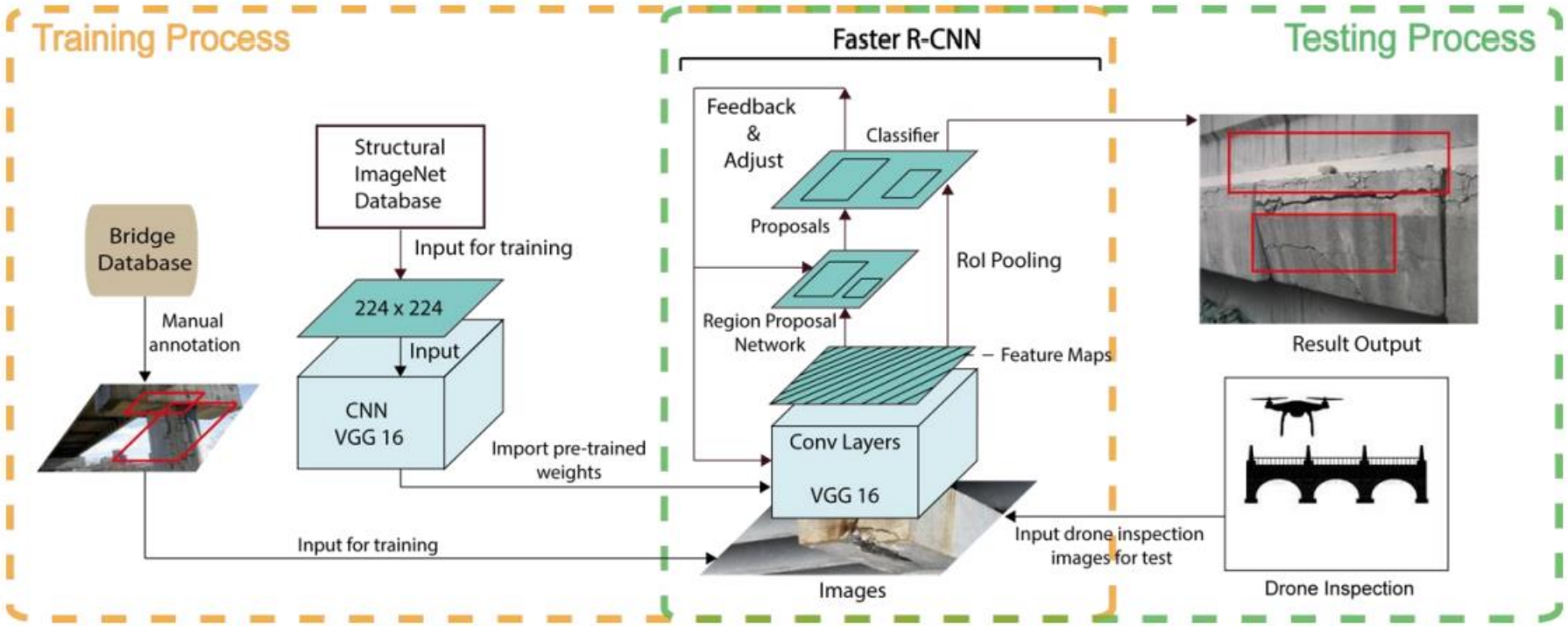


Fig. 4 – The flowchart of the training and testing process with faster R-CNN implemented

Structural Imagenet Database

(a) No damage

(b) Minor damage

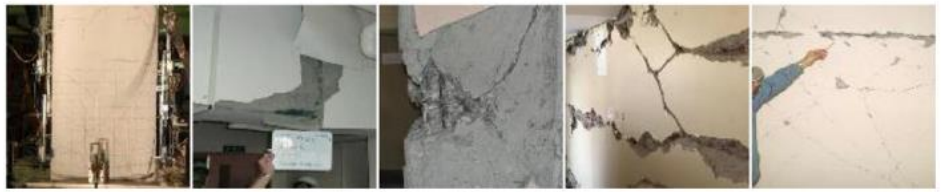
(c) Moderate to heavy damage

Fig. 4. Sample images used in damage level evaluation.

(a) No damage

(b) Flexural damage

(c) Shear damage



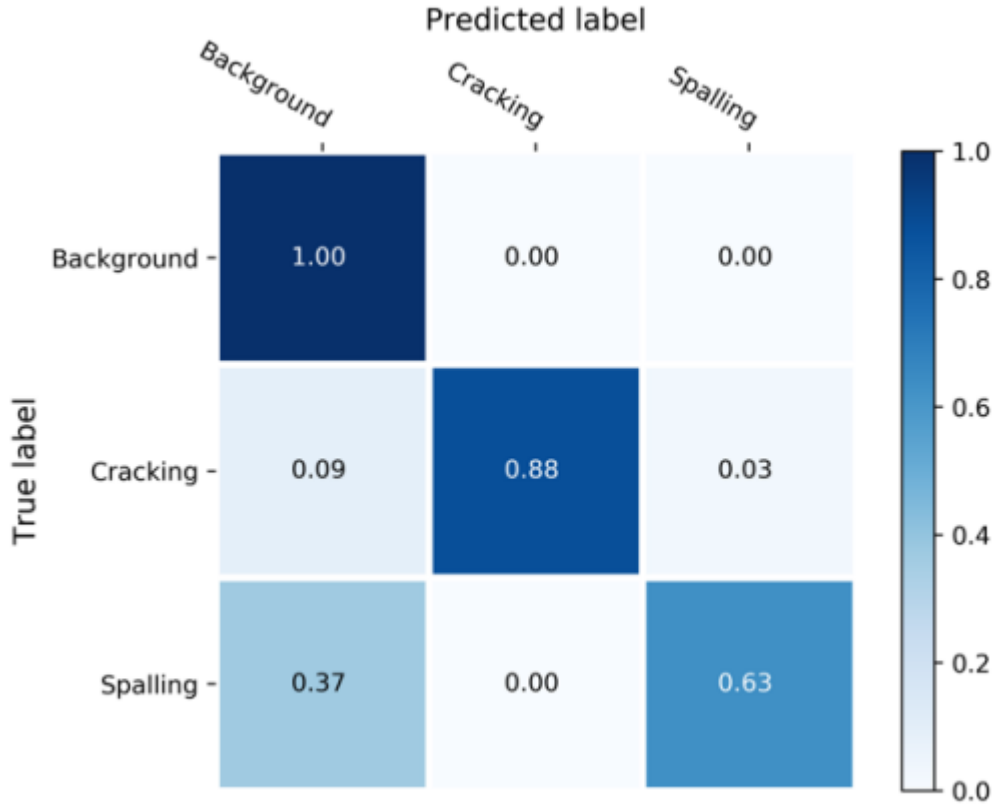
(d) Combined damage

Fig. 5. Sample images used in damage type determination.

Data Collection Methods

- Drone weave between the piers beneath the deck
  - Ensure the flight path has adequate angles to cover the surface of the bridge
- Pay more attention to locations susceptible to damages
  - Bottom and end of decks, top of bridge piers and abutments, and connections between deck and piers
  - Require some architectural knowledge to collect useful data
- If the annotations of many spalling damages contain features like high contrast or the same color, the machine could misunderstand these as the key features that should be referred to

- Evaluation Metric
  - Same as Detection Metric
- Compute Cost
  - Intel Xeon CPU E3-1230 processor
  - 5.1 secs / frame (5472x3648)



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Thank you!

Have an awesome rest of your day!

Slides: `https://cs.purdue.edu/homes/jsetpal/lit-search.pdf`