Autonomous Aerial Assistance for Search and Rescue

Team F

Progress Review

March 1, 2017

Tasks

- Triangulating GPS location of signatures
- Exploration of tracking in aerial images
- Integration of RGB and thermal signature detection algorithm
- Initial work on data processing pipeline

Triangulating GPS location of signatures (1/2)

Inputs

- Pixel location of the identified signature in the image
- Camera GPS location and bearing
- Altitude above mean sea level (AMSL)

Output

- GPS location of the identified signature

Makes use of:

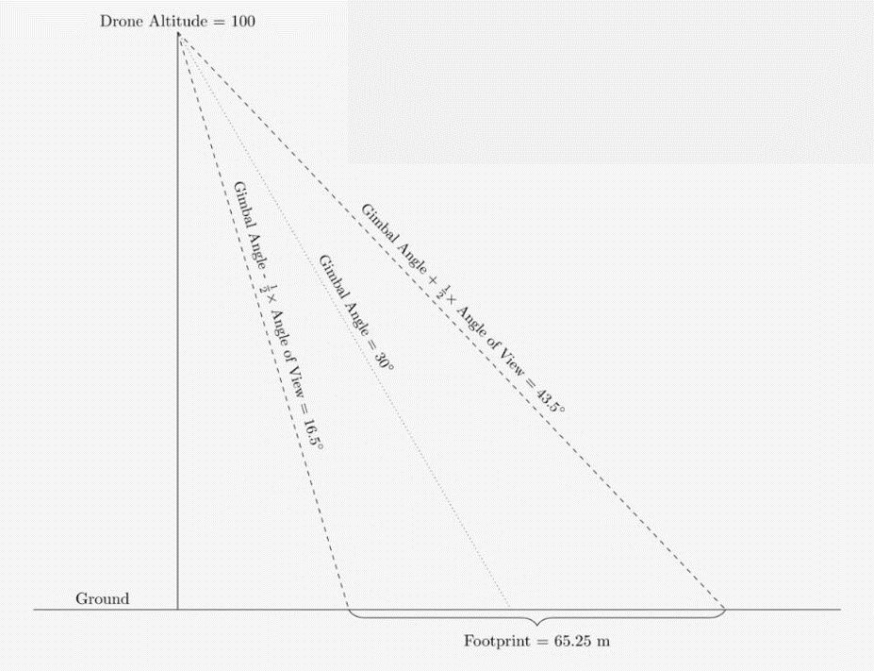
- Camera field of view
- Camera angle

Both can be changed depending on the camera

Triangulating GPS location of signatures (1/2)

Process followed:

1. Get altitude of the drone from the ground
   a. Google Maps API gives ground altitude
   b. Flight controller gives drone's AMSL
2. Use trigonometry to estimate image's ground footprint
3. Estimate the distance of the signature on ground plane (x,y) using interpolation



Triangulating GPS location of signatures (2/2)

Process followed:

4. Take the direction of the vector from drone location to signature location as change in bearing for drone's heading

5. Add the calculated change in bearing to drone's heading to calculate 'new bearing'

6. Using the gps location and bearing of the signature, calculate GPS location of the signature

Explore Tracking methods in aerial images

Lucas-Kanade Tracker with template update

- Find displacement between frames based on optical flow
- Different template update methods
- Cons: Drifting, Occlusion

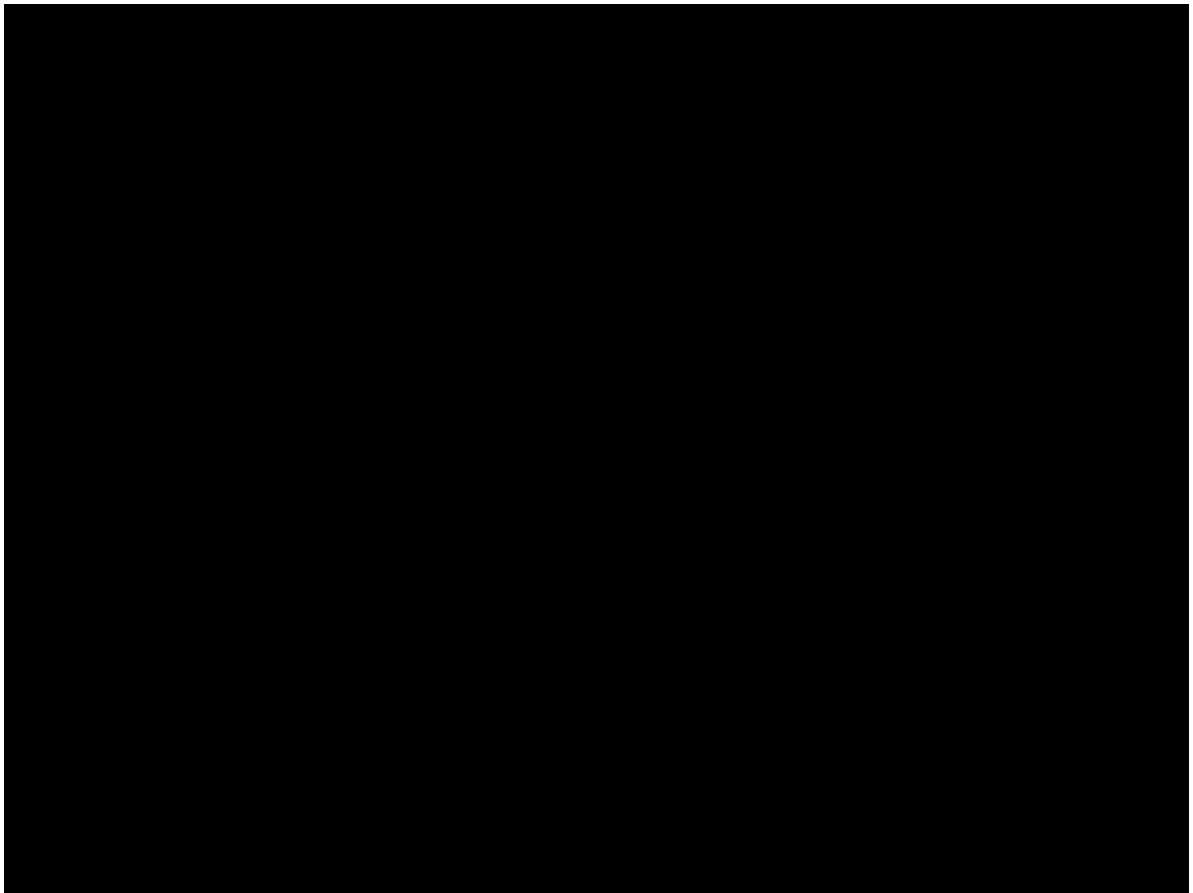
KLT feature tracker

- Extract features of template and track features
- Can deal with occlusion relatively well
- Cons: Cannot track moving objects with high speed,
  Lose feature points during tracking

Kalman Filter based tracker

- Consider probability of the object's motion
- Hard to build mathematical model if the camera is moving(may not be useful in our use case)

Explore Tracking methods in aerial images



Integration of RGB and thermal detection algorithm

Assumption

1. **Thermal signature detection**
   - Low resolution
   - Heated objects which are no humans (a lot of noises)
2. **RGB signature detection**
   - Higher resolution
   - Fewer noises
   - Higher accuracy

Method:

Weight updating mechanism

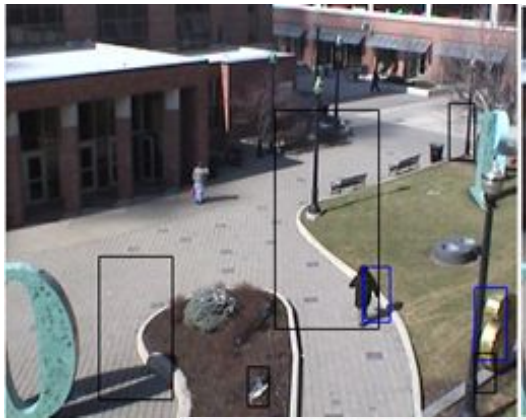
- Give every human candidates predicted in both RGB and thermal images a weight based on different overlapping performances. (the weight matrix)
- Determine the final RoIs with human by using a weight threshold.

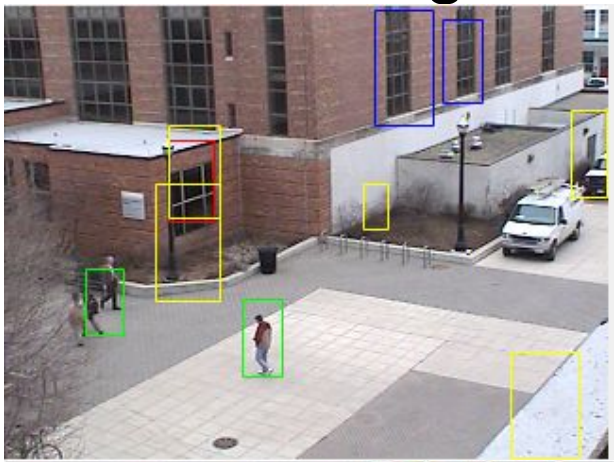
Integration of RGB and thermal detection algorithm

Weight	Description	Value
α1	RGB positive	3
α2	RGB negative	-1
α3	Thermal positive	2
α4	Thermal negative	-2
α5	RGB positive overlaps Thermal positive	5
α6	RGB negative overlaps Thermal positive	-1
α7	RGB positive overlaps Thermal negative	-2

Threshold	Description	Value
θ1	% of RGB positive overlaps Thermal positive	0.4
θ2	% of RGB negative overlaps Thermal positive	0.4
θ3	% of RGB positive overlaps Thermal negative	0.4
θ_weight	Choose the bounding boxes above this threshold to be human locations	1 - 3

Integration of RGB and thermal detection algorithm





Data processing pipeline

Upload
RGB
Thermal

Choose File No file chosen upload rgb video
cnn
blob_detector
edge_detector

Choose File No file chosen upload thermal video
cnn
blob_detector
edge_detector

Upload
RGB
Thermal

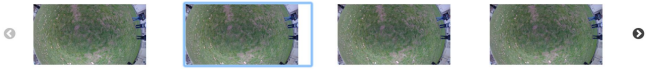


Image	Description
	Classn score : 1.0 Num signatures : 1.0
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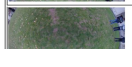	Classn score : 1.0 Num signatures : 1.0

Upload
RGB
Thermal

Image	Description
	Classn score : 1.0 Num signatures : 1.0
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Thanks!