

Active Shooter Tracking and Evacuation Routing for Survival (ASTERS)

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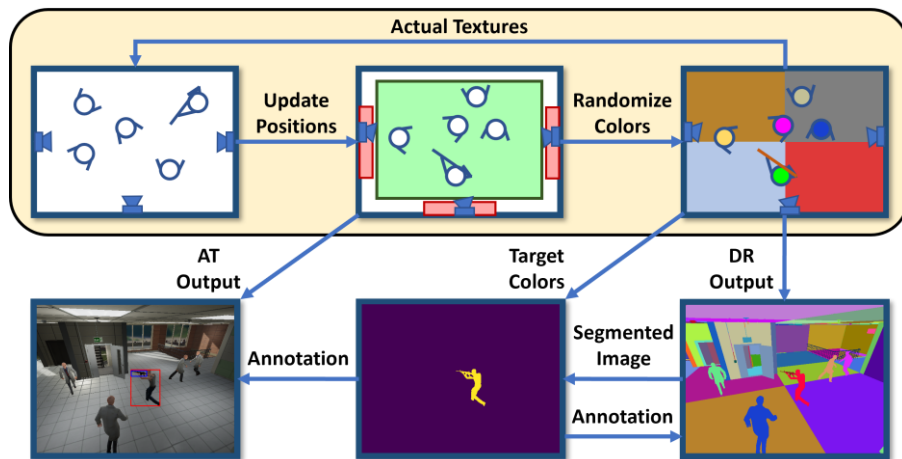


ASTERS – Active Shooter Tracking and Evacuation Routing for Survival

- Space:
 - Response to active shooting events in schools
- Problem:
 - *Uncertain knowledge about shooter's location and lack of guidance while escaping*
- Solution:
 - *Computer Vision based Gunman Detection*
 - *Optimized Routing of evacuees*
 - *Communication to Evacuees of Plans/Status*
 - *Education and Interaction with School Officials and security experts*
- Results:
 - *Training with a combination of actual texture, domain randomized synthetic data and real data produced highest precision (0.928)*
 - *ASTERS algorithm can reduce casualties by 56% and the time spent by evacuees in the shooter's line of sight by 52% compared to an intuitive natural response*
 - *Participants (n=123) escaped significantly more quickly with dynamic signs compared to static (p=0.07) and reverse crowd (p=0.04)*

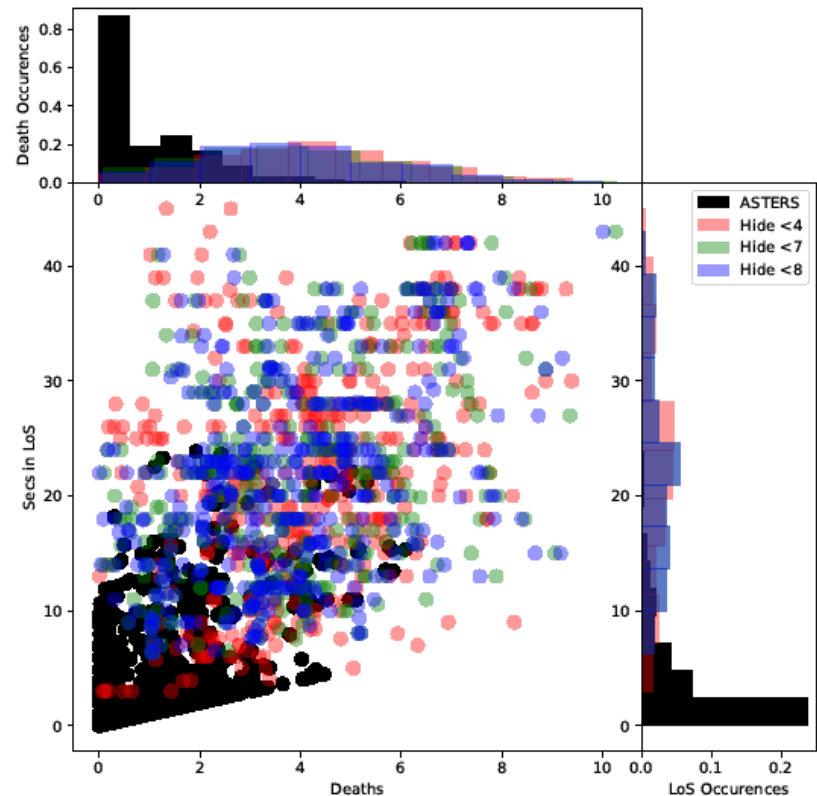
Results

Training with a combination of synthetic data (both actual texture and domain randomized) and real data produced highest precision (**0.928**).



Combination	Number of images			Gunman detection			
	Real	AT	DR	P	R	mAP@.5	mAP@.5:.95
Real Only	100	-	-	0.545	0.350	0.354	0.175
	300	-	-	0.438	0.240	0.228	0.147
	500	-	-	0.266	0.220	0.142	0.093
AT→DR→Real	-	800	5000	0.036	0.070	0.004	0.001
	100	800	5000	0.702	0.390	0.411	0.240
	300	800	5000	0.626	0.310	0.326	0.168
	500	800	5000	0.928	0.259	0.323	0.216

ASTERS algorithm can reduce casualties by **56%** and the time spent by evacuees in the shooter's line of sight by **52%** compared to an intuitive natural response.

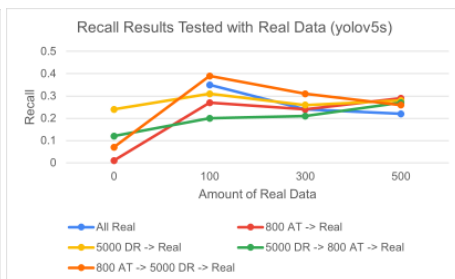


Backup Slides

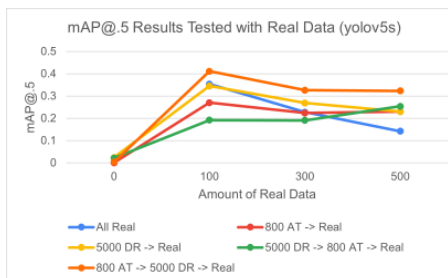
Computer vision based gunman detection



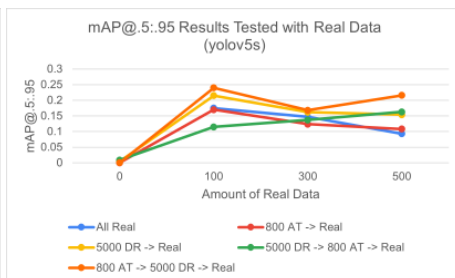
(a)



(b)

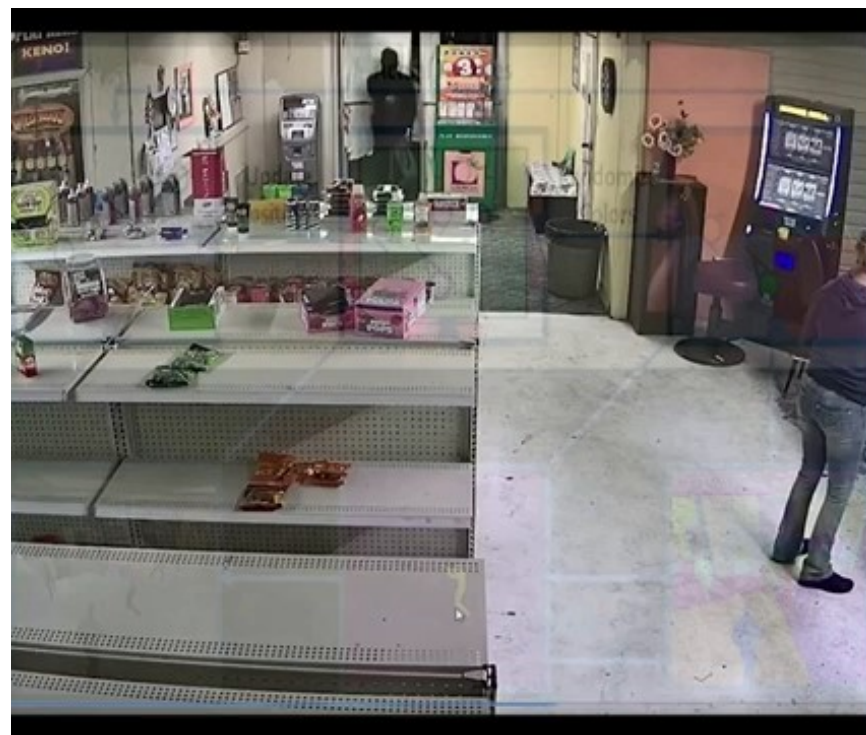
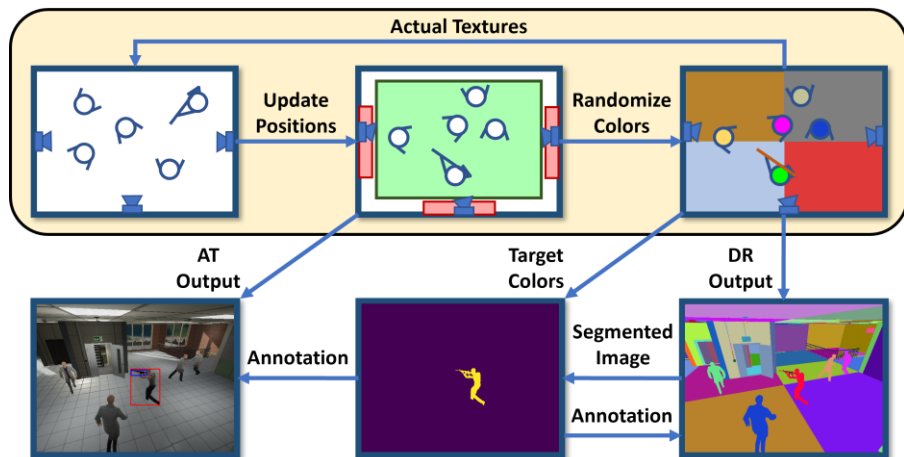


(c)



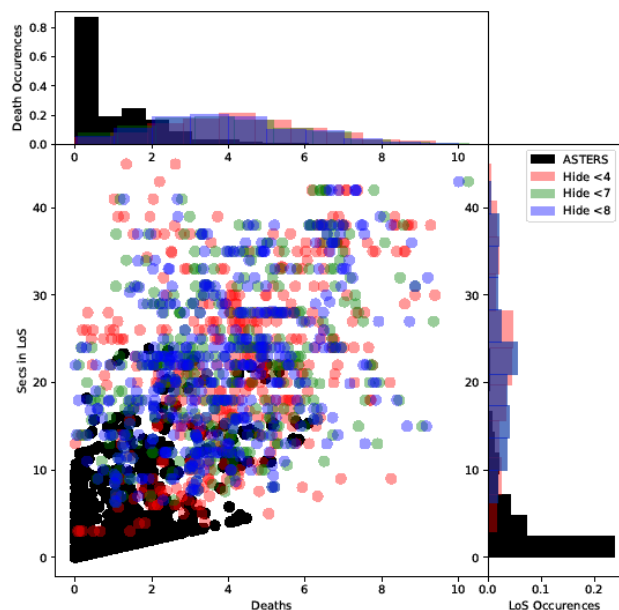
(d)

Combination	Number of images			Gunman detection			
	Real	AT	DR	P	R	mAP@.5	mAP@.5:.95
Real Only	100	-	-	0.545	0.350	0.354	0.175
	300	-	-	0.438	0.240	0.228	0.147
	500	-	-	0.266	0.220	0.142	0.093
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Optimized evacuee routing

Shooter Spawn			Exit						Hall						Room						Stairs								
			Rooms			Rooms and Halls			Rooms			Rooms and Halls			Rooms			Rooms and Halls			Rooms			Rooms and Halls					
Evacuee Distribution			0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1
Evacuee Speed			0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1
Hospital	ASTERS	Deaths	2.7	1.7	0.6	4.4	2.6	1.1	2.7	1.1	0.8	5.7	3.0	2.3	3.9	2.2	1.9	6.3	3.7	3.0	3.8	2.8	2.6	5.3	3.6	3.2			
		LoS	20.8	16.2	11.8	35.6	25.1	18.6	20.6	15.7	11.3	39.1	30.1	22.5	21.9	16.0	10.8	37.9	27.9	21.3	30.0	28.1	24.8	44.7	36.8	33.9			
	Best Natural Response	Deaths	5.6	5.4	5.7	8.8	8.6	8.1	5.0	5.0	4.5	8.6	7.9	7.7	6.3	5.8	4.8	9.6	8.3	7.0	5.1	4.4	4.3	8.0	7.0	6.4			
		LoS	34.2	33.7	34.0	53.2	52.0	52.1	33.9	35.7	35.7	58.8	61.0	60.4	33.7	34.1	34.4	52.1	53.0	52.8	38.5	36.3	36.4	58.6	55.6	55.7			
School	ASTERS	Deaths	0.7	0.3	0.3	1.0	0.6	0.6	1.0	0.7	0.4	2.6	1.9	1.6	2.0	1.3	1.2	2.6	1.4	1.3									
		LoS	4.2	2.8	1.3	10.1	7.6	5.8	3.8	1.9	1.4	12.2	9.4	8.0	5.9	2.2	1.5	8.8	3.4	2.3									
	Best Natural Response	Deaths	2.6	2.9	3.0	4.4	4.8	5.1	1.5	1.3	1.0	3.4	3.2	2.6	2.5	3.1	2.7	3.3	4.3	3.7									
		LoS	18.4	17.7	18.1	28.8	27.6	28.3	14.5	15.5	14.5	25.6	27.3	26.2	18.9	15.8	16.0	25.5	21.1	21.3									



Lessons learned

- Current practices leave a lot to be desired.
- In general, school personnel are very accepting of this idea and quick to see the value in this activity.
- Most feel more comfortable with a human-in-the-decision loop.
- Ethical dilemmas are too real for comfort.
- Funding drives most of the adoption decisions.
- But, if done right, there is immense potential for something like ASTERS to have a real impact.