Cross-Domain Video Anomaly Detection without Target Domain Adaptation

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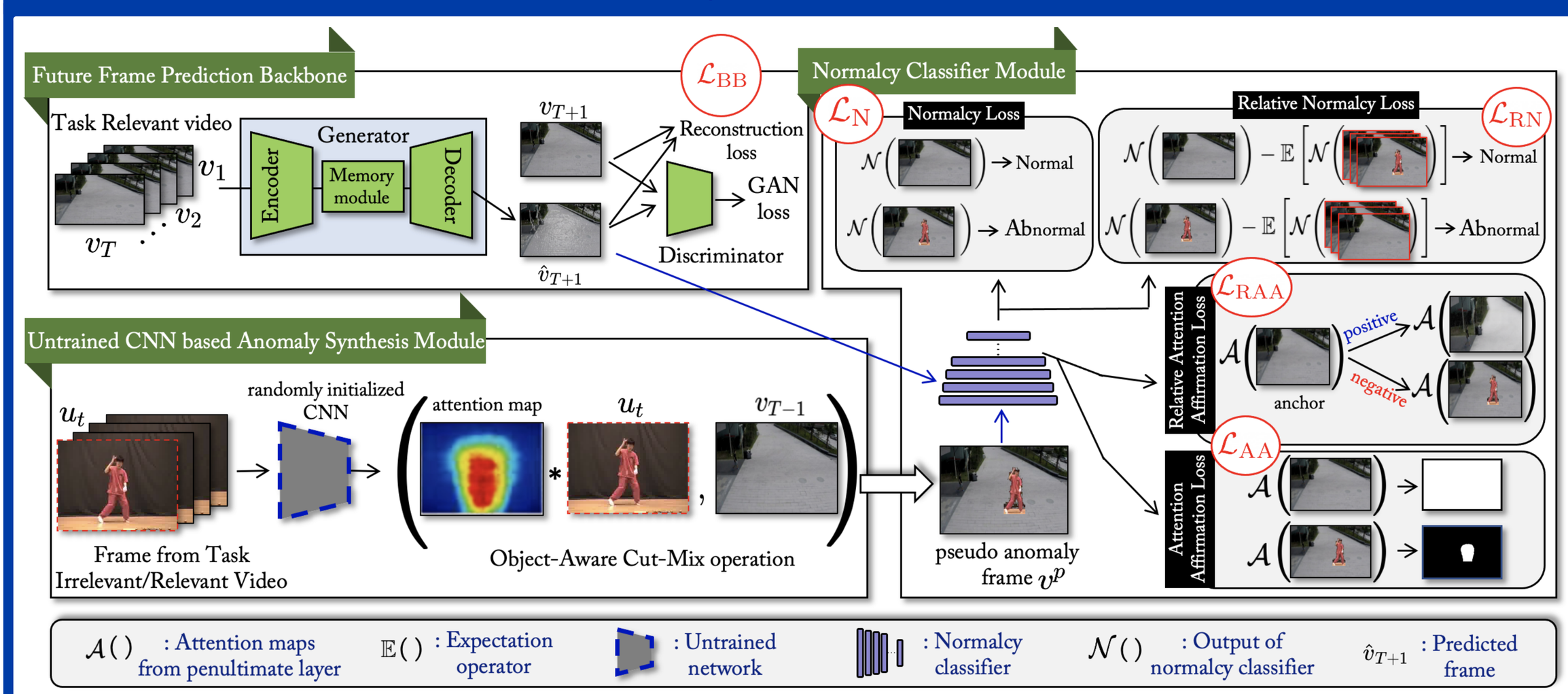
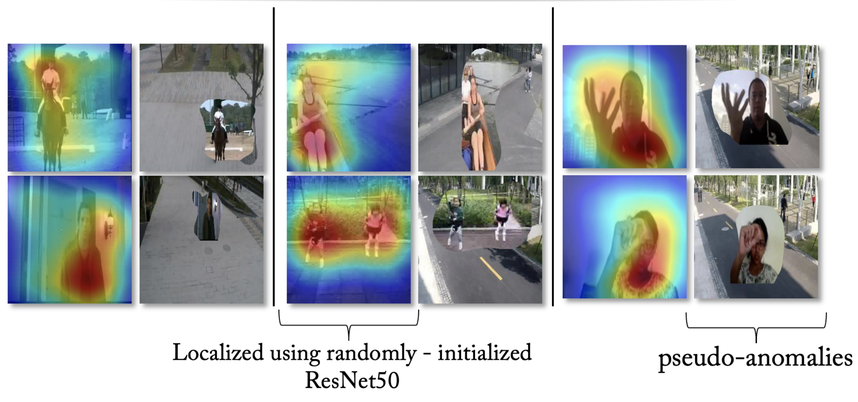
Proposed Framework



Key Takeaways

- Customers who may prefer to have an anomaly detection system that works "out-of-the-box."
- We propose '*Zero-shot Cross-domain Video Anomaly Detection* (zxVAD)' framework that is capable of learning relative normalcy from source domain and detect anomalies in target domain.
- For the first time, we also show that 'Task Irrelevant Datasets' can be utilized as source domain.
- Finally, we also demonstrate a method to create anomalous examples using randomly initlized CNNs without any training costs.

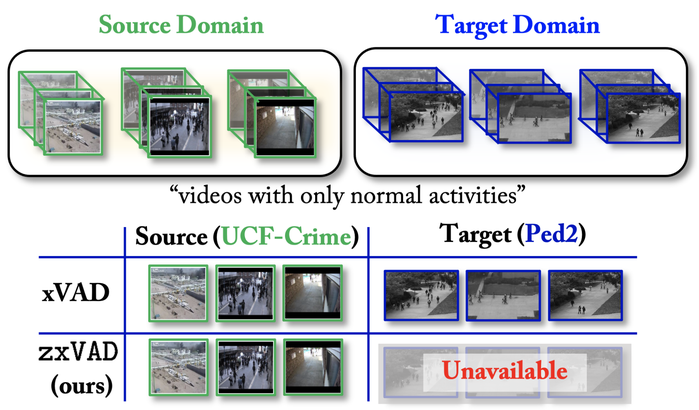
No-cost Anomalies



Efficiency and Same-dataset Testing

Method	Efficiency Metrics: Parameters (↓) (millions)	GMACs (↓)	Energy (↓) (Joules)*	Storage (↓) (MegaByte)	FPS (↑)	Same Dataset Testing: SHT_{dc}	Ped2	SHT
rGAN [1]	19.0	1384.52	–	79.85	2.1	70.11	96.90	**77.90**
MPN [2]	12.7	55.09	10.65	53.14	166.8	67.47	96.20	73.80
zxVAD	**8.73**	**43.10**	**6.81**	**34.92**	**208.5**	**70.85**	**96.95**	71.60

Problem Statement



Cross-dataset Testing

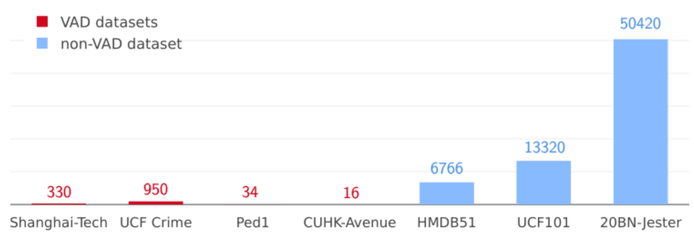
VAD Training Data (Input to $\mathcal{G}(\cdot)$)	Auxiliary Data (Input to $\mathcal{O}$)	Method	VAD Testing Data: Ped1	Ped2	Ave
SHT	N/A	rGAN [1]	73.10	81.95	71.43
SHT	N/A	MPN [2]	74.45	90.17	74.06
SHT	SHT	zxVAD	**76.14**	95.78	82.28
SHT	HMDB	zxVAD	75.62	95.74	**83.19**
SHT	UCF101	zxVAD	75.41	**95.80**	82.25
SHT	Jester	zxVAD	75.93	95.62	82.49

VAD Training Data (Input to $\mathcal{G}(\cdot)$)	Auxiliary Data (Input to $\mathcal{O}$)	VAD Testing Data: Ped1	Ped2	Ave
HMDB	HMDB	76.66	**91.53**	**81.92**
UCF101	UCF101	75.67	85.84	81.78
Jester	Jester	**78.12**	91.23	78.06

Ablation Study

Loss Functions: $\mathcal{L}_{BB}$	$\mathcal{L}_{N}$	$\mathcal{L}_{RN}$	$\mathcal{L}_{AA}$	$\mathcal{L}_{RAA}$	AUC (%) on SHT_{dc}
✓					68.32
✓	✓				68.99
✓	✓	✓			69.33
✓	✓	✓	✓		69.61
✓	✓	✓	✓	✓	**70.85**

Current VAD datasets are small!



Error Maps

Conclusions

- We identify a new unsupervised xVAD problem of detecting anomalies in the target domain where no target domain training data are available.
- To tackle this problem, we propose a novel framework named 'Zero-shot Cross-domain Video Anomaly Detection' (zxVAD) which learns "relative" normalcy.

References

[1] *Few-shot scene-adaptive* · · · , in ECCV, 2020.
[2] *Learning normal dynamics* · · · , in CVPR, 2021.