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Text-Visual Prompting for Efficient 2D Temporal Video Grounding

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Introduction

What is temporal video grounding (TVG)?

TVG is to predict the starting/ending time points of moments described by a text sentence within a long untrimmed video.

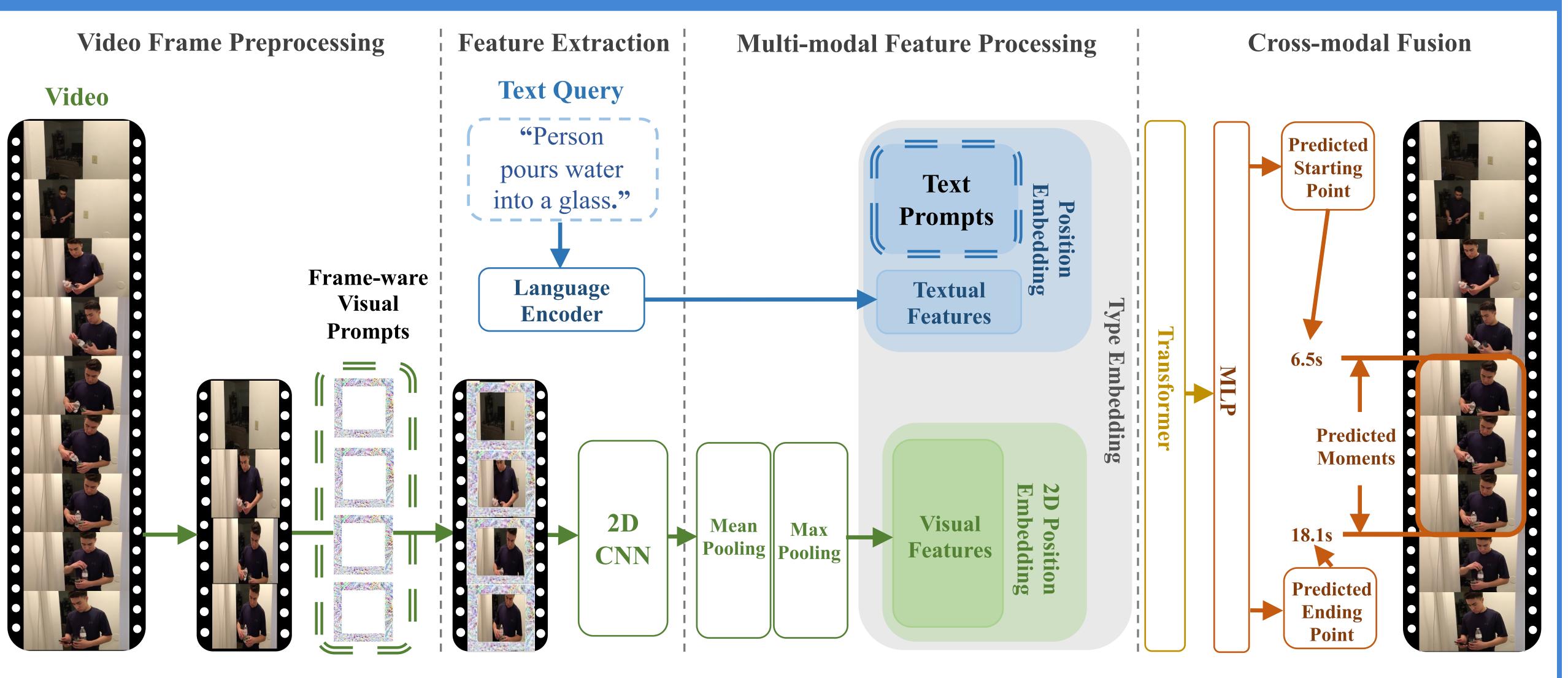
Motivation

High complexity of 3D CNNs makes extracting dense 3D visual features time-consuming, which calls for intensive memory and computing resources.

Challenges

How to advance 2D TVG methods so as to achieve comparable results to 3D TVG methods?

Text-Visual Prompting (TVP) Framework for TVG



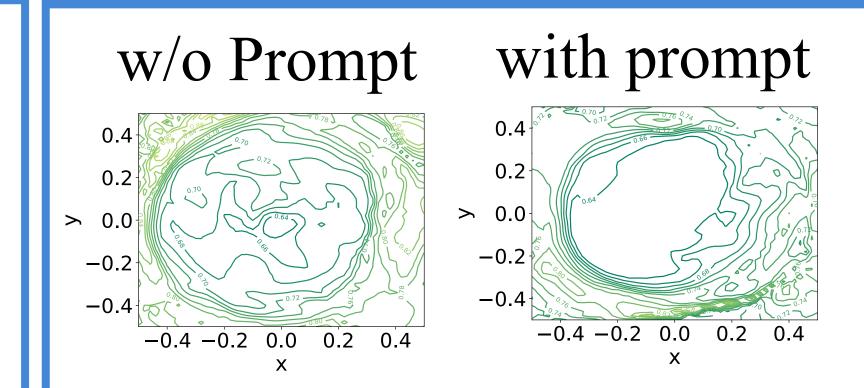
Loss Function Design

 $\mathcal{L} = \mathcal{L}_{tIoU} + \beta_1 \mathcal{L}_{dis} + \beta_2 \mathcal{L}_{dur}$

Temporal IoU Loss \mathcal{L}_{tIoU} : maximize overlapping between the predicted time interval and its ground truth.

<u>Dis</u>tance Loss \mathcal{L}_{dis} : minimize the normalized central time point distance. <u>Dur</u>ation Loss \mathcal{L}_{dur} : minimize the duration differences.

Loss Landscape Analysis



Performance

Metric

The percentage accuracy of predicted moments whose tIoU (temporal IoU) with the ground-truth moment is larger than threshold m.

Charades-STA

Type	Method	Visual Feature	m=0.3	Accuracy with Temporal IoU threshold m =0.5	m=0.7				
			110-0.5						
	CTRL [3]	C3D	-	23.63	8.89				
	ABLR [12]	C3D	_	24.36	9.01				
	BPNet [10]	C3D	55.46	38.25	20.51				
	LPNet [9]	C3D	59.14	40.94	21.13				
	QSPN [11]	C3D	54.70	35.60	15.80				
	TSP-PRL [8]	C3D	_	45.45	24.75				
3D TVG	TripNet [5]	C3D	54.64	38.29	16.07				
	DRN [13]	C3D	_	45.40	26.40				
	CPNet [6]	C3D	_	40.32	22.47				
	DEBUG [7]	C3D	54.95	37.39	17.92				
	ExCL [4]	I3D	61.50	44.1	22.40				
	VSLNet [15]	I3D	64.30	47.31	30.19				
	MAN [14]	I3D	-	46.53	22.72				
	MCN [1]	VGG	_	17.46	8.01				
2D TVG	SAP [2]	VGG	_	27.42	13.36				
Ours									
	Base		61.29	40.43	19.89				
TVP-Based	+ Visual Prompts	D - NI-4	65.38	44.31	20.22				

ActivityNet Captions

Туре	Method	Visual		Accuracy with Temporal IoU threshold m	
		Feature	m=0.3	m=0.5	m=0.7
3D TVG	CTRL [3]	C3D	28.70	14.00	-
	BPNet [10]	C3D	59.98	42.07	24.69
	LPNet [9]	C3D	64.29	45.92	25.39
	QSPN [11]	C3D	45.30	27.70	13.60
	TSP-PRL [8]	C3D	56.02	38.83	-
	TripNet [5]	C3D	48.42	32.19	13.93
	DRN [13]	C3D	_	45.45	24.36
	CPNet [6]	C3D	_	40.56	21.63
	ABLR [12]	C3D	55.67	36.79	-
	DEBUG [7]	C3D	55.91	39.72	-
	ExCL [4]	C3D	63.00	43.60	24.10
	VSLNet [15]	C3D	63.16	43.22	26.16
			Ou	ırs	
VP-Based 2D TVG	Base	ResNet	57.20	40.16	19.14
	+ Visual Prompts		60.12	43.39	23.71
	+ Text Prompts		60.48	42.58	24.39
	+ Both Prompts		60.71	43.44	25.03

[1] Hendricks. et al, Localizing moments in video with natural language. (2017). [2] Chen. et al. Semantic proposal for activity localization in videos via sentence query. (2019). [3] Gao. et al. Tall: Temporal activity localization via language query (2017). [4] Ghosh. et al. Excl: Extractive clip localization using natural language descriptions. (2019). [5] Hahn. et al. Tripping through time: Efficient localization of activities in videos. (2019). [6] Li. et al. Proposal-free video grounding with contextual pyramid network. (2021). [7] Lu. et al. Debug: A dense bottom-up grounding approach for natural language video localization. (2019). [8] Wu. et al. Tree-structured policy based progressive reinforcement learning for temporally language grounding in video. (2020). [9] Xiao. et al. Boundary proposal network for two-stage natural language video localization. (2021). [11] Xu. et al. Multilevel language and vision integration for text-to-clip retrieval. (2019). [12] Yuan. et al. To find where you talk: Temporal sentence localization in video grounding. (2020). [13] Zeng. et al. Dense regression network for video grounding. (2020). [14] Zhang. et al. Man: Moment alignment network for natural language moment retrieval via iterative graph adjustment. (2019). [15] Zhang. et al. Span-based localization. (2020)