



An In-Depth Exploration of Person Re-Identification and Gait Recognition in Cloth-Changing Conditions

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Motivation

Cloth-Changing Problem

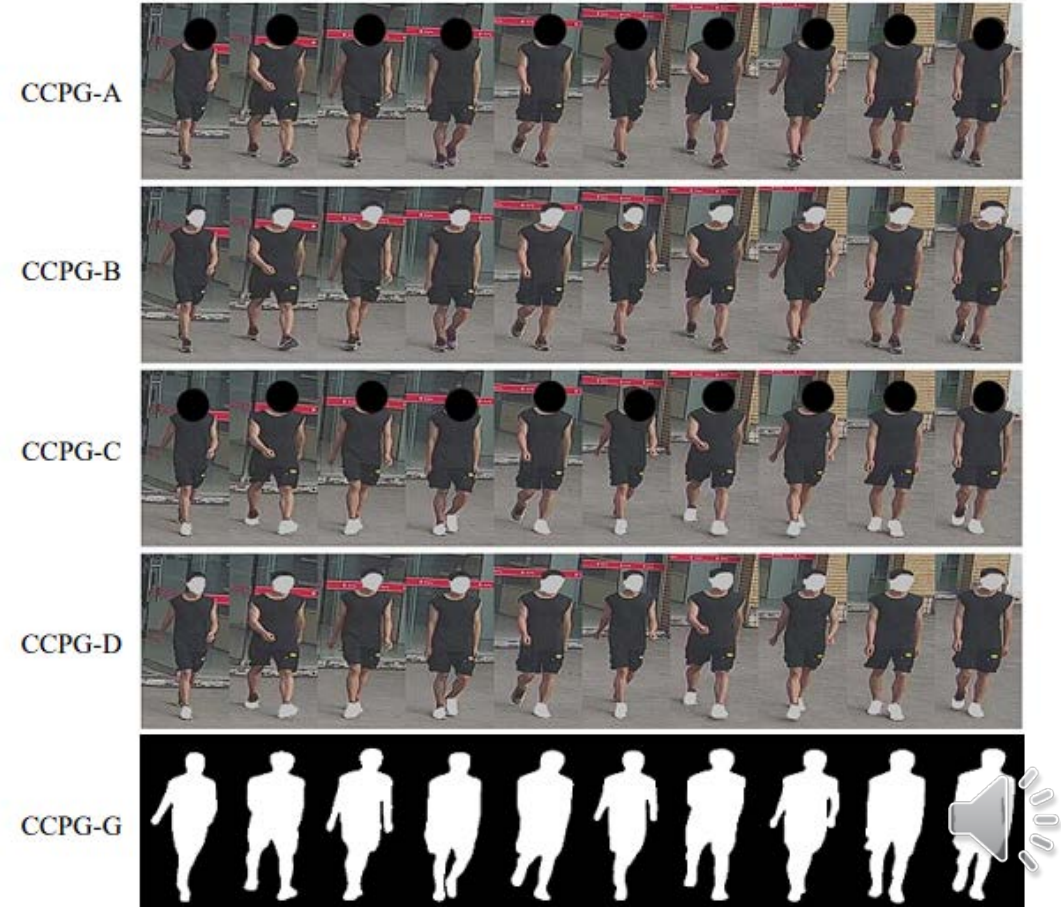
1. There are relatively few studies on **video-based person re-identification**.
2. **Gait recognition** has been extensively studied and is robust to appearance information, but limited in specific experimental conditions.

Does gait recognition present a superior solution to the cloth-changing problem?



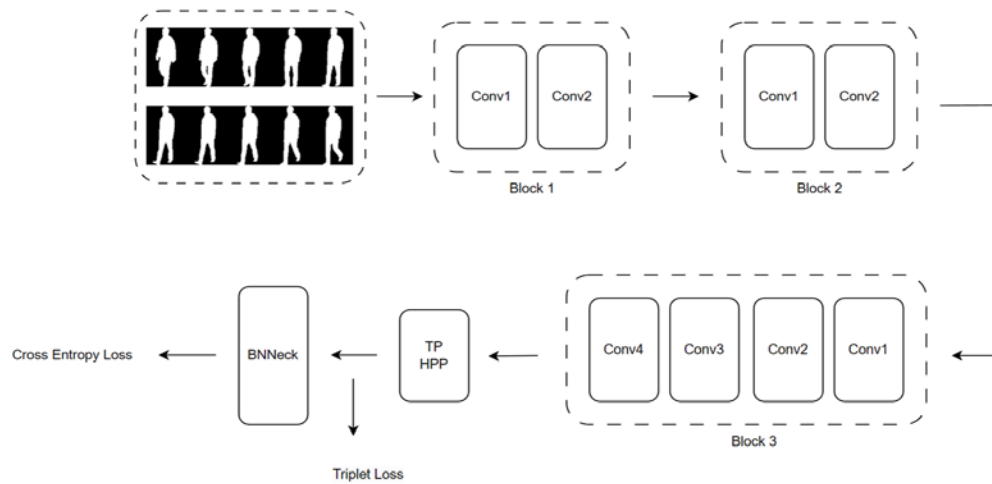
CCPG Benchmark

Dataset	CCPG
IDs	200
Seqs	16566
Views	10
Environment	Indoor&Outdoor
Data Type	RGB&Silhouette
Dressing	Finer Cloth-Changing



CCPG Benchmark

The architecture of the proposed OGBase-AUG



Block	Layer	In_C	Out_C	Kernel_Size	Stride	Padding
Block_1	Conv_1_BN	1	32	5	2	2
	Conv_2_BN	32	32	3	1	1
	Max_Pooling	-	-	2	2	0
Block_2	Conv_3_BN	32	64	3	1	1
	Conv_4_BN	64	64	3	1	1
	Max_Pooling	-	-	2	2	0
Block_3	Conv_5_BN	64	128	3	1	1
	Conv_6_BN	128	128	3	1	1
	Conv_7_BN	128	256	3	1	1
	Conv_8_BN	256	256	3	1	1



Exploration Experiments

(a) ReID on CCPG-A and CCPG-B VS gait recognition. (shoes not masked)

Dataset	Method	CL-Full		CL-UP		CL-DN	
		top-1	mAP	top-1	mAP	top-1	mAP
CCPG-A	AP3D	90.1	60.7	89.2	71.3	96.2	76.5
	BiCnet-TKS	87.5	60.5	90.4	73.7	90.8	76.4
	PSTA	89.5	66.6	92.5	80.0	93.0	80.3
	PiT	87.6	65.3	92.2	80.7	94.3	80.8
CCPG-B	AP3D	86.7	60.1	89.3	77.2	87.2	74.6
	BiCnet-TKS	84.2	57.9	87.0	73.0	90.8	76.8
	PSTA	88.2	65.3	91.2	79.3	92.3	79.4
	PiT	85.1	60.1	92.7	78.0	92.8	78.4
CCPG-G	OGBase	78.4	44.5	82.3	58.3	86.0	59.3
	GaitSet	77.7	46.4	83.5	59.6	83.2	61.4
	GaitPart	77.8	45.5	84.5	63.1	83.3	60.1
	GaitGL	69.1	27.0	75.0	37.1	77.6	37.6
	AUG-OGBase	84.7	52.9	88.4	67.5	89.4	67.9

(b) ReID on CCPG-C and CCPG-D VS gait recognition. (shoes masked)

Dataset	Method	CL-Full		CL-UP		CL-DN	
		top-1	mAP	top-1	mAP	top-1	mAP
CCPG-C	AP3D	68.4	31.4	72.8	50.2	86.4	58.9
	BiCnet-TKS	68.6	37.6	76.3	59.9	79.2	60.9
	PSTA	66.3	39.0	74.4	59.3	86.2	68.2
	PiT	60.7	35.2	67.2	58.3	82.4	67.2
CCPG-D	AP3D	55.1	27.3	60.4	49.0	80.1	63.3
	BiCnet-TKS	64.5	36.9	72.3	59.8	78.7	62.3
	PSTA	62.6	37.6	73.8	60.2	83.9	67.8
	PiT	57.1	30.8	68.4	55.4	79.1	65.3
CCPG-G	OGBase	78.4	44.5	82.3	58.3	86.0	59.3
	GaitSet	77.7	46.4	83.5	59.6	83.2	61.4
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Gait recognition is a potential solution for addressing the cloth-changing problem.



Thanks for your listening !



Criminal Cases Involving Disguise Through Clothes Change

Alleged shoplifter tried to evade officers by changing clothes:
Hamilton police

Murder suspects 'slipped away from police after changing clothes in
mosque to evade capture'

Accused Q train subway killer held without bail, changed clothes to
evade capture: DA

...



Cloth-Changing Person Re-identification is IMPORTANT !

Datasets Survey

Video-based ReID Datasets

Dataset	IDs	Tracklets	Views	Environment	Data Tpye	Cloth-Changing
CASIA-A [31]	20	240	3	Indoor	RGB	✗
CASIA-B [37]	124	13,640	11	Indoor	RGB, Silh.	✓
CASIA-C [29]	153	1,530	1	Outdoor	Infr., Silh.	✗
OU-MVLP [28]	10,307	288,596	14	Indoor	Silh.	✗
FVG [40]	226	2,856	1	Outdoor	RGB	✓
GREW [44]	26,345	128,671	882	Outdoor	Silh., Flow, Pose	✓
Gait3D [41]	4,000	25,309	39	Indoor	Silh, Pose, Flow	✗
CASIA-E [25]	1,014	778,752	26	Outdoor	Silh., Infr	✓

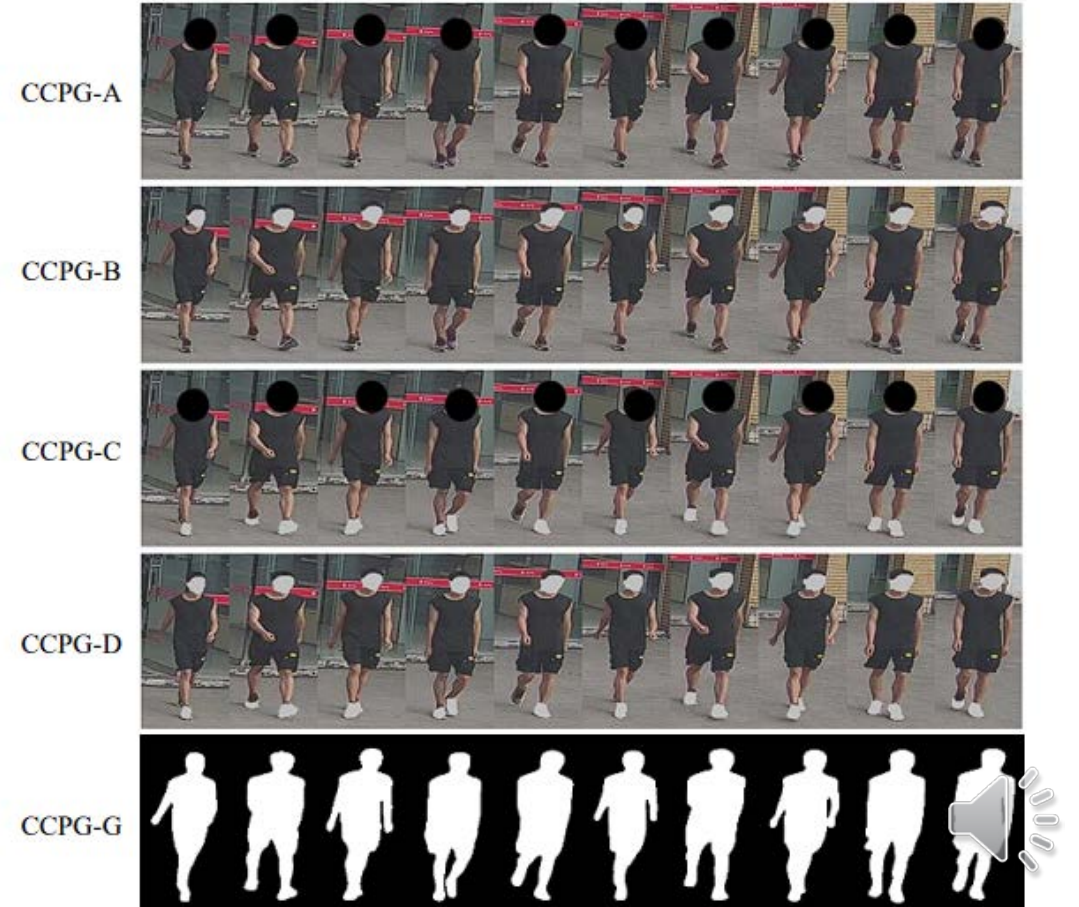
Gait Recognition Datasets

Dataset	IDs	Tracklets	Views	Cloth-Changing
PRID-2011 [11]	200	400	2	✗
iLIDS-VID [32]	300	600	2	✗
MARS [42]	1,261	20,715	6	✗
Duke-Video [35]	1,812	4,832	8	✗
Duke-Tracklet [15]	1,788	12,647	8	✗
LPW [26]	2,731	7,694	4	✗
LS-VID [14]	3,772	14,943	15	✗
CCVID [8]	226	347,833	1	✓

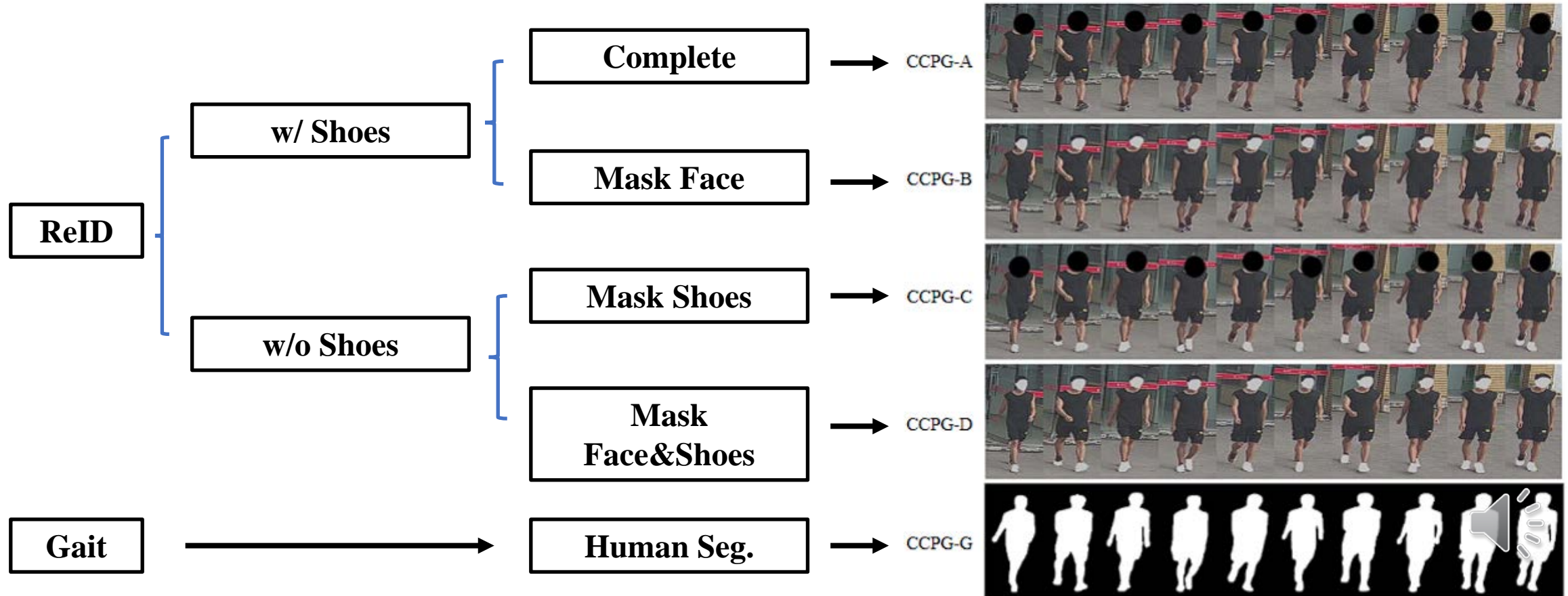


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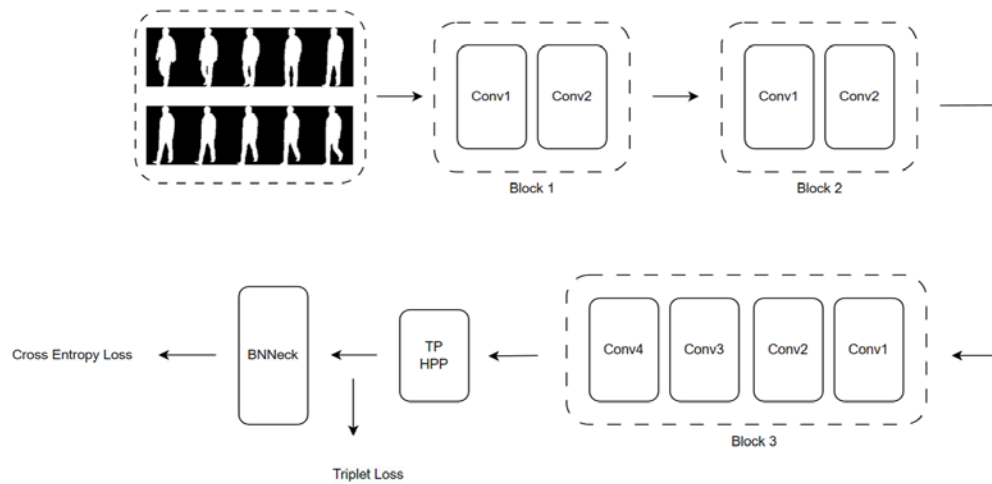


Modification on Facial Information and Shoes Information



CCPG Benchmark

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1. Evaluation Metrics

$$Rank - n = \frac{1}{N} \sum_{i=1}^N [\text{match}(i, 1 : n)]$$

$$mAP = \frac{1}{N} \sum_{i=1}^N AP(i)$$

2. Evaluation Settings

Train		Test			
IDs	Types	IDs	Setting	Query	Gallery
000, 002, ...,99	U0D0, U0D0BG,	100, 101, ... , 199	CL-Full	U0D0,	U1D1, U2D2,
	U1D1, U2D2,		U0D0BG	U3D3	
	U3D3,U0D3,U1D0		U3D3	U0D3	
			CL-DN	U1D0	U1D1



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Findings

- (1) In the CL-Full and CL-UP settings, gait recognition methods can surpass the video-based ReID methods, and it suggests that gait recognition has more potential on addressing the cloth-changing problem.**
- (2) For certain partial cloth-changing situations, video-based ReID still has good performance, especially in the CL-DN setting. But the results indicate that the performance of video-based ReID methods decreases with increasing levels of cloth-changing on the human body, which means that these video-based ReID methods are fragile to appearance variations.**



Thanks for your listening !

