Soft Biometric Analysis: Multi-Person and Real-Time Pedestrian Attribute Recognition in Crowded Urban Environments

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# <sup>2</sup> Problem Statement

- Inspecting/observing the CCTV data by human operators is expensive
- Properties of the CCTV data:
  - Low-resolution
  - Various camera angles
  - Occlusion of the subjects
  - Different brightness and contrasts
  - Variation in human poses



# <sup>3</sup> Motivations

- Existing challenges in the literature:
  - Presence of more than one person in one shot
  - Presence of the subjects on a unique background
  - Cloth-changing re-identification



# 4 Contributions

- Applied Sciences Journal:
  - Human Attribute Recognition—A Comprehensive Survey
- Pattern Recognition Letters Journal:
  - SSS-PR: A short survey of surveys in person re-identification
- BIOSIG Conference:
  - Region-Based CNNs for Pedestrian Gender Recognition in Visual Surveillance Environments
- Image and Vision Computing Journal:
  - An attention-based deep learning model for multiple pedestrian attributes recognition
- Pattern Recognition Letters Journal:
  - Person re-identification: Implicitly defining the receptive fields of deep learning classification frameworks
- Image and Vision Computing Journal:
  - You look so different! Haven't I seen you a long time ago?

## Region-Based CNNs for Pedestrian Gender Recognition in Visual Surveillance Environments



## Region-Based CNNs for Pedestrian Gender Recognition in Visual Surveillance Environments

Images	Network	BIODI	Frontal	Rear	Lateral
	Base-Net	85.68	85.96	84.49	79.70
3	Frontal-Net	-	87.53	-	-
Ra	Rear-Net	-	-	85.18	-
	Lateral-Net	-	-	-	79.87
q	Frontal-Net	-	88.42	-	-
Iea	Rear-Net	-	-	85.13	-
ц <u>т</u>	Lateral-Net	-	-	-	78.09
uo	Frontal-Net	-	90.44	-	-
lyg	Rear-Net	-	-	87.44	-
Po	Lateral-Net	-	-	-	80.99
usion	Frontal-Net	-	92.19	-	-
	Rear-Net	-	-	88.86	-
E.	Lateral-Net	-	-	-	84.16



## Attention Based Multi-task Pedestrian Attribute Recognition Model



## Attention Based Multi-task Pedestrian Attribute Recognition Model

Advantage 1: Recognition of the local attributes are easier as the model search the related features in the body mask area

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Advantage 2: In crowded scenes, the model knows the region related to the reported attributes (Interpretable)



## An Augmentation Technique For Person Re-identification Frameworks



## 10 Cloth-changing Person Re-identification





## 12 Cloth-changing Person Re-identification



# Thank You

## Annex:

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What are soft biometrics?

Hard

Soft

Why soft biometrics?

#### Soft Biometrics

- Highly discriminative
- Difficult to capture

- New branch of identity science
- Visual cues to identify people
- Visible at a distance
- Invariant to angel and pose

Face [X] Fingerprint [X] Iris [X] DNA [X] Headwear [Navy Cap] Hair Colour [Black] Hair Length [Short] Skin Colour [Brown] Accessories [Black Rucksack] Gender [Male] Age [25-35] Weight [Average - Slender] Height [Average - Tall] Build [Slightly Muscular] Upper body [Navy coat, White T-shirt] Lower body [Beige Trousers]-Footwear [Brown Shoes]



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## Annex

# Pedestrian attribute recognition



Pedestrian Attribute Recognition

- ✓ Male
- ✓ Under 35 years of old
- ✓ Black T-shirt
- Black pants
- ✓ Sport shoes
- ✓ Short hairs





Person Re-identification

## 16 Annex

#### Project 1: Biometria e Deteção de Incidentes (BIODI)

- Objective 1: Data collection and annotation
- Objective 2: Survying the existing pedestrian attribute recognition methods
- Objective 3: Pedestrian attribute detection and person re-identification

#### Project 2: Cloud Computing Competence Centre (C4)

- Objective J: Aerial data collection with a drone from low altitudes (-10 meters)
- Objective 2: Survying the existing pedestrian attribute recognition methods
- Objective 3: Person re-identification under cloth-changing scenario

## **Duties:**

- Data collection and annotation and preprocessing
- Surveying the existing state-of-the-art models
- Designing deep learning frameworks
- Evaluating and comparing the performance of the proposed solutions with existing methods



https://tomiworld.com



### Panel



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#### Annotation tool





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## BIODI Dataset [2.5 hours video]

Description	Samples	Description	Samples	Description	Samples
Outdoor, Noon, Occlusion		Outdoor, Summer, Night		Outdoor, Winter, Night	
Outdoor, Fall, Evening		Outdoor, Summer, morning		Indoor, Spring, Occlusion	

Factors	Statistics
No. of videos, subjects, and BBs	216, 13876, 503433
Length of videos	7 minutes
Frame rate extraction	7 frames/sec.
Aspect ratio of BBs (Height/Width)	1.75
No. of BBs with frontal, rear, and lateral view	256485, 235564, 11384

Annex P-DESTRE Dataset [One hour video]

## Annotations:

- Identities
- Bounding boxes
- 16 person attributes
- Head pose

## Tasks:

- Pedestrian detection
- Pedestrian tracking
- Short-term re-identification
- Long-term re-identification



http://p-destre.di.ubi.pt/download.html