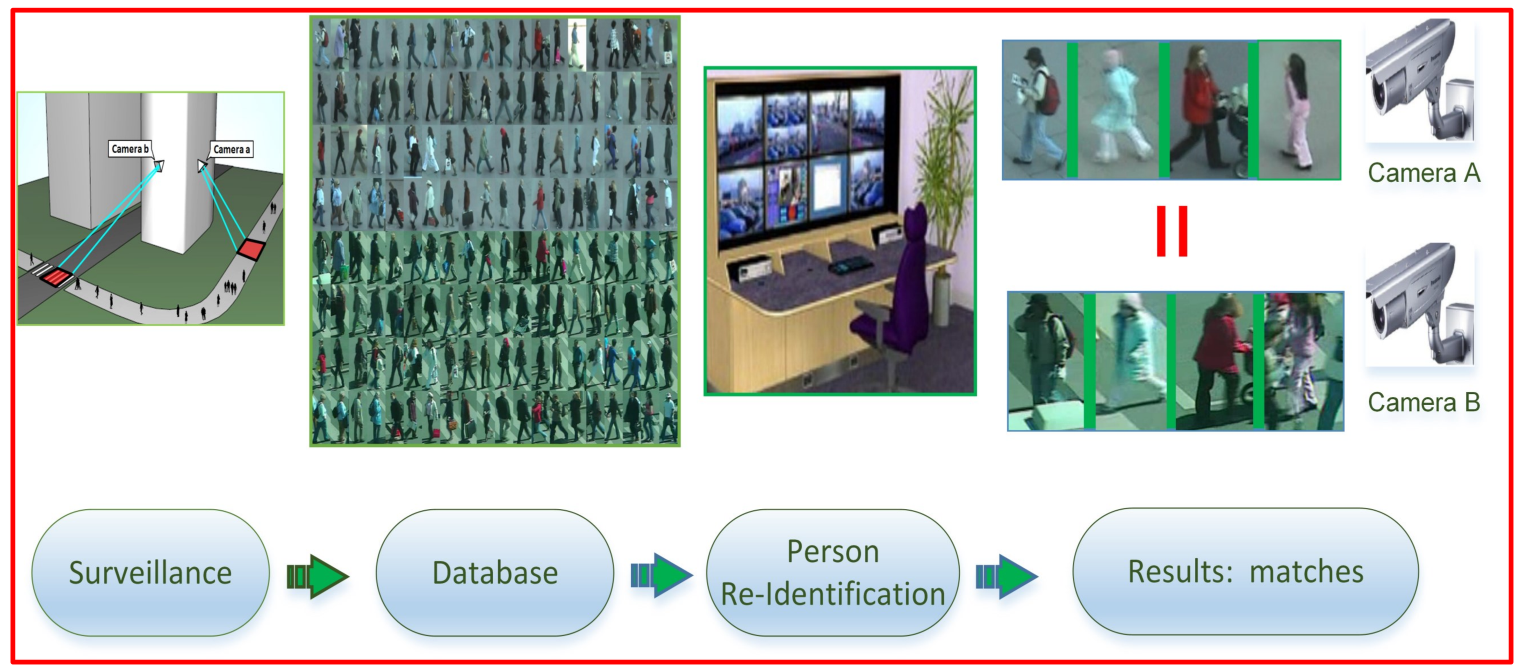
Salient Color Names for Person Re-Identification

Yang Yang[1], Jimei Yang[2], Junjie Yan[1], Shengcai Liao[1], Dong Yi[1], Stan Z. Li[1]
[1]National Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences
[2]University of California, Merced

Introduction

Person Re-Identification

Recognize an individual across a network of disjoint cameras.



Challenging

- Illumination
- Viewpoint
- Pose
- Low resolution

Solution

Fully utilize the information about the colors of clothes.

Feature Representation	Color names distribution & color histograms
Metric Learning	A fast and effective approach: KISSME
Person Matching	Cumulative Matching Characteristic (CMC)

Experimental Datasets

VIPeR Dataset.	PRID 450S Dataset.

• 632 image pairs of pedestrians
• Challenging in:
  • Pose
  • Illumination conditions
  • Low resolution
	• 450 image pairs of pedestrians
	• Challenging in:
	  • background interference
	  • Viewpoints
	  • Low resolution


VIPeR dataset


PRID 450S dataset

Contributions

- A novel and effective salient color names (SCNCD) based color descriptor is proposed for person re-identification;
- Background information is exploited to enrich the feature representation which is of good robustness against background interference and partial occlusions;
- To tackle different types of illumination changes, color names distribution and color histograms are fused in four color spaces.

Feature Representation

SCNCD

Assume $Z = [z_1, z_2, ..., z_{16}]$ denotes a set of 16 color names, the probability of assigning *d* to a color name *z* is:

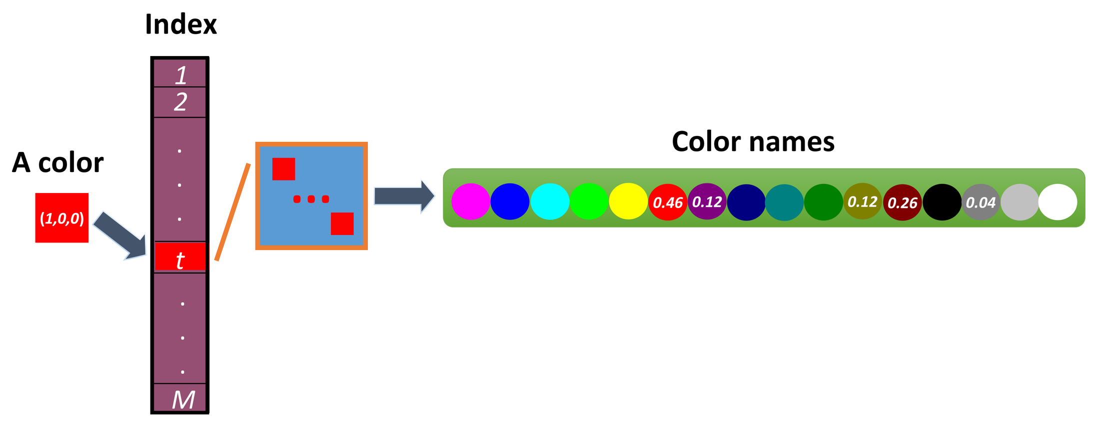
$$p(z|\boldsymbol{d}) = \sum_{n=1}^{512} p(z|\boldsymbol{w}_n)p(\boldsymbol{w}_n|\boldsymbol{d}),$$

with

$$p(z|\boldsymbol{w}_n) = \begin{cases} \dfrac{\exp\left(-\|\boldsymbol{z}-\boldsymbol{w}_n\|^2 / \frac{1}{K-1}\sum_{\boldsymbol{z}_l \neq \boldsymbol{z}} \|\boldsymbol{z}_l-\boldsymbol{w}_n\|^2\right)}{\sum_{p=1}^{K} \exp\left(-\|\boldsymbol{z}_p-\boldsymbol{w}_n\|^2 / \frac{1}{K-1}\sum_{\boldsymbol{z}_s \neq \boldsymbol{z}_p} \|\boldsymbol{z}_s-\boldsymbol{w}_n\|^2\right)} & , \quad if\ z \in KNN(\boldsymbol{w}_n) \\ 0 & , \quad otherwise \end{cases}$$

and

$$p(\boldsymbol{w}_n|\boldsymbol{d}) = \frac{\exp\left(-\alpha\|\boldsymbol{w}_n - \boldsymbol{\mu}\|^2\right)}{\sum_{l=1}^{512} \exp\left(-\alpha\|\boldsymbol{w}_l - \boldsymbol{\mu}\|^2\right)}.$$



Color Names Distribution

We partition an image into six horizontal stripes of equal size. Then, based on SCNCD, the color names distribution is obtained.

Image-foreground feature representation

Color names distribution + color histograms of image-only & foreground (in RGB, rgb, $l1\ l2\ l3$ and HSV color models) = $\mathrm{SCNCD_{all}}(ImgF)$

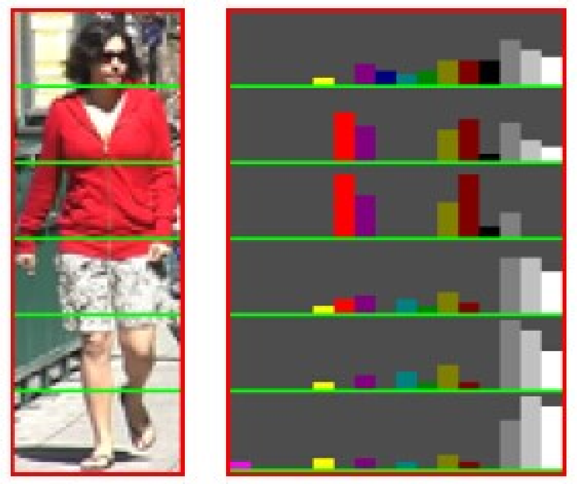
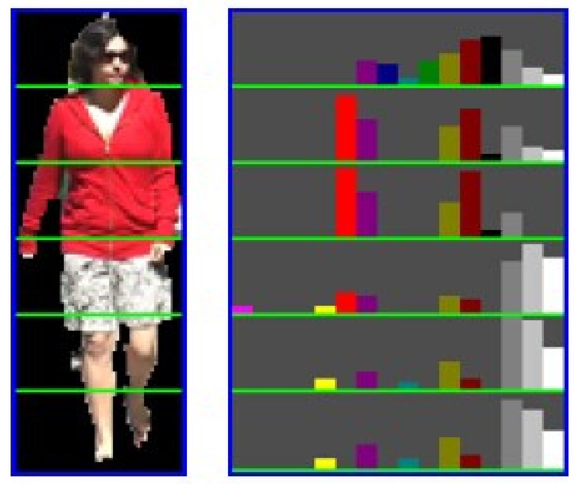


Image-only (RGB space)


Foreground (RGB space)

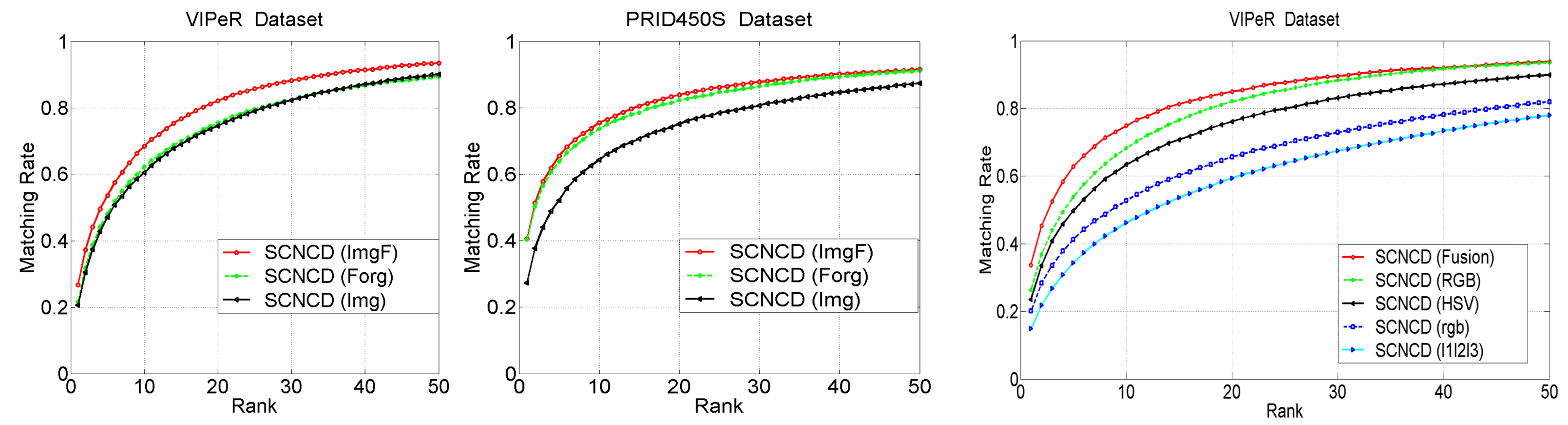
Experimental Results

Analysis of SCNCD

• Comparison with Other Color Descriptions

	VIPeR dataset				PRID 450S dataset			
Rank	1	5	10	15	1	5	10	15
Hist(RGB)	6.5	22.8	34.8	43.4	4.9	17.6	28.7	36.7
SCN[17]	11.9	32.3	45.9	55.0	6.6	20.7	31.6	39.3
SCR[8]	12.5	32.9	45.9	54.3	9.6	26.2	37.0	44.4
DD[10]	17.6	40.3	52.4	60.2	17.6	40.3	52.4	60.2
CN[27]	19.6	44.2	58.1	66.3	20.4	42.6	53.3	60.3
SCNCD(Ours)	**20.7**	**47.2**	**60.6**	**68.8**	**26.9**	**52.9**	**64.2**	**70.4**

• Color Models and foreground and background



Comparison with the State-of-the-art Methods

VIPeR dataset

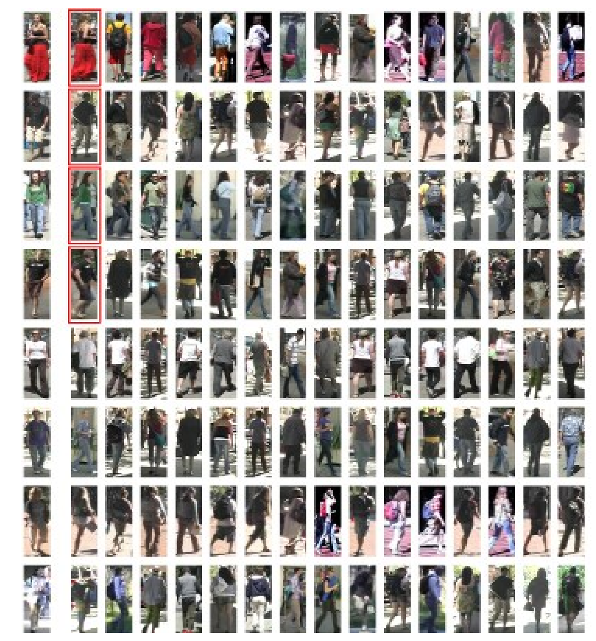
Rank	1	5	10	15	20	25	30	50
PRDC[32]	15.7	38.4	53.9	-	70.1	-	-	-
Fusing+PRDC[15]	16.1	37.7	51.0	-	66.0	-	-	-
RPLM[6]	27	-	69	-	83	-	-	95
EIML[5]	22	-	63	-	78	-	-	93
KISSME[11]	19.6	-	62.2	-	-	80.7	-	91.8
KISSME* [20]	27.0	-	70.0	-	83.0	-	-	95
eSDC-ocsvm[31]	26.7	50.7	62.4	-	76.4	-	-	-
RankBoost[12]	23.9	45.6	56.2	-	68.7	-	-	-
LF[19]	24.2	-	67.1	-	-	85.1	-	94.1
Salience[30]	30.2	52.3	-	-	-	-	-	-
$\mathrm{SCNCD_{all}}(ImgF)$	**33.7**	**62.7**	**74.8**	**81.3**	**85.0**	**87.7**	**89.6**	**93.8**
Final($ImgF$)	**37.8**	**68.5**	**81.2**	**87.0**	**90.4**	**92.7**	**94.2**	**97.0**

PRID 450S dataset

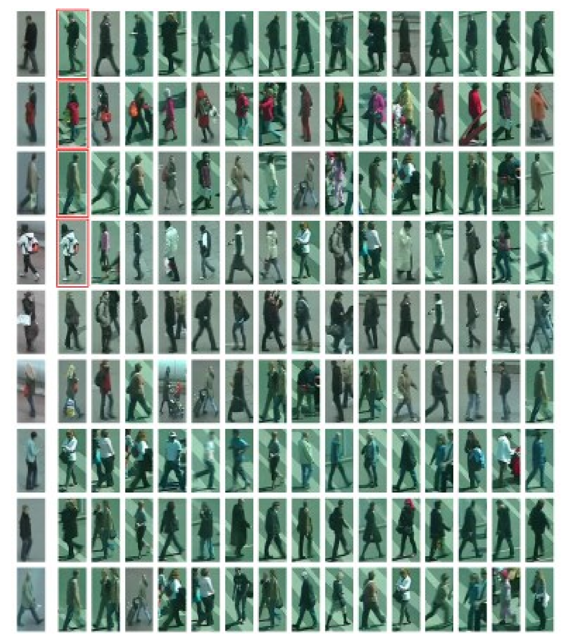
Rank	1	5	10	15	20	25	30	50
KISSME* [20]	33.0	-	71.0	-	79.0	-	-	90.0
EIML[5]	35	-	68	-	77	-	-	90
$\mathrm{SCNCD_{all}}(ImgF)$	**41.5**	**66.6**	**75.9**	**81.1**	**84.4**	**86.7**	**88.4**	**92.4**
Final($ImgF$)	**41.6**	**68.9**	**79.4**	**84.9**	**87.8**	**90.0**	**91.8**	**95.4**

Success and Failure Cases

VIPeR dataset



PRID 450S dataset



Homepage: http://www.cbsr.ia.ac.cn/users/yyang/main.htm **Email:** smileyoyon@126.com