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HLID: Histograms of Local Intensity Difference

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IEL Electronics Letters, 2013

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October 2, 2018

Outline

- Introduction
- Gradient Computation
- Block Description

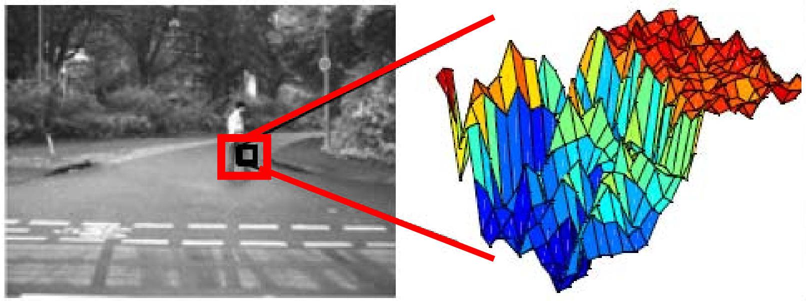
Introduction

- Origin of HLID
  - Detecting pedestrians in images is an important topic in many applications.
  - Extracting effective features to describe pedestrian is critical in pedestrian detection.
  - HOG is a widely used texture feature in describing pedestrian appearance in visible images.

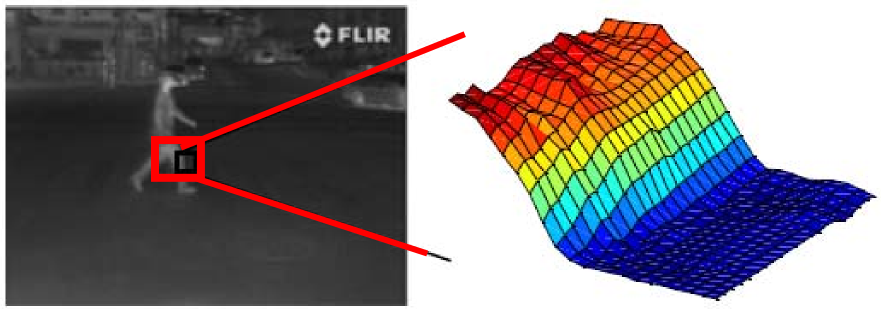
N. Dalal and B. Triggs, "Histograms of Oriented Gradients for Human Detection", CVPR, 2005

Introduction

- Origin of HLID
  - HOG may be not suitable for far infrared (FIR) images
    - Temperature changes in pedestrian are not significant.
    - FIR images generally lack of texture information.



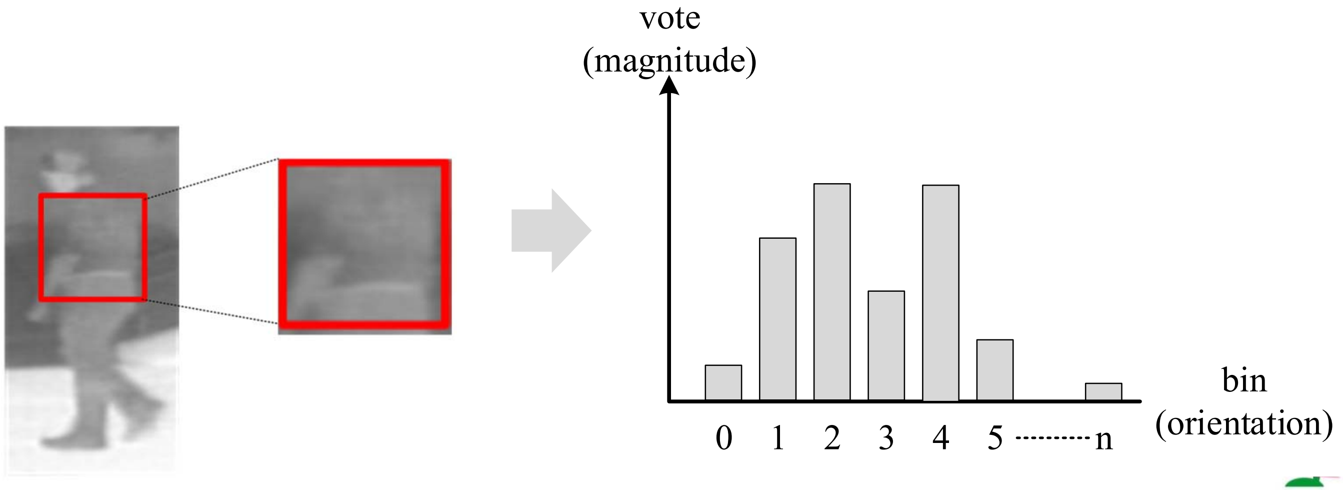
Visible Image



FIR Image

Introduction

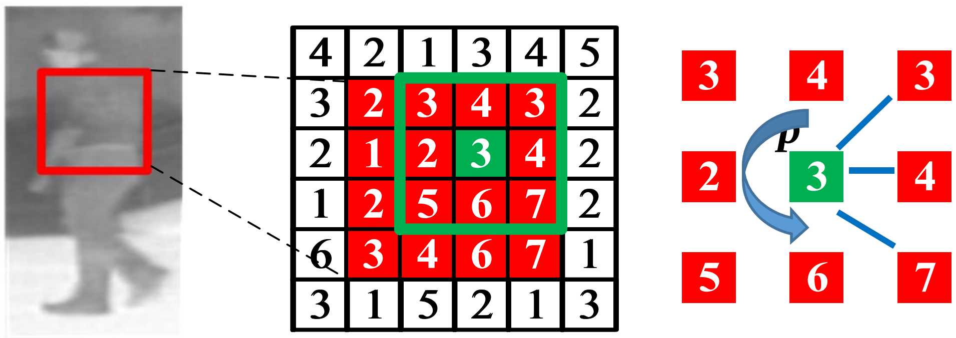
- HOG v.s. HLID
  - They are both features in describing the texture of a block in a form of histogram of oriented gradient.
  - They differ in the way in computing gradient orientation and magnitude.



Gradient Computation

- Gradient Magnitude $m(.)$
  - Definition: $m(p)$ is the maximum intensity difference of the point p and its 8 neighbors

$$m(p) = \max_{q \in N_8} | I(p) - I(q) |$$



$I(.)$

$$m(p) = \max\{\boxed{|3-4|}, \boxed{|3-3|}, \ldots, \boxed{|3-7|}\}$$

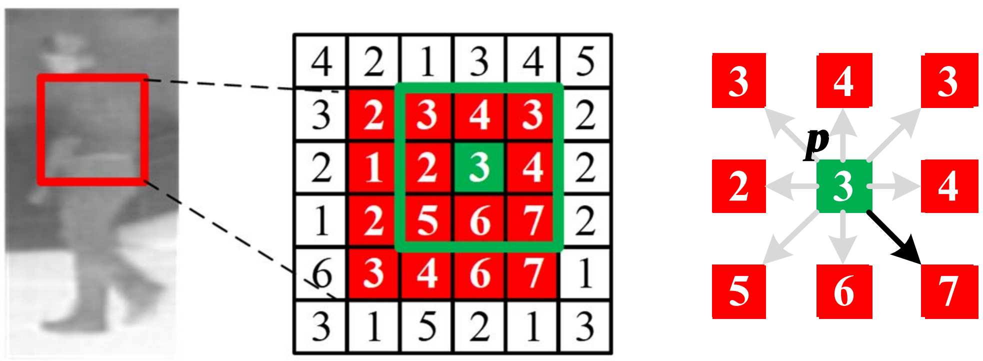
$$m(p) = \max\{1,0,1,0,1,2,3,\boxed{4}\}$$

$$m(p) = 4$$

Gradient Computation

- Gradient Orientation $\theta(.)$
  - Definition: $\theta(p)$ is the direction of the point p to its neighbor with maximal intensity difference

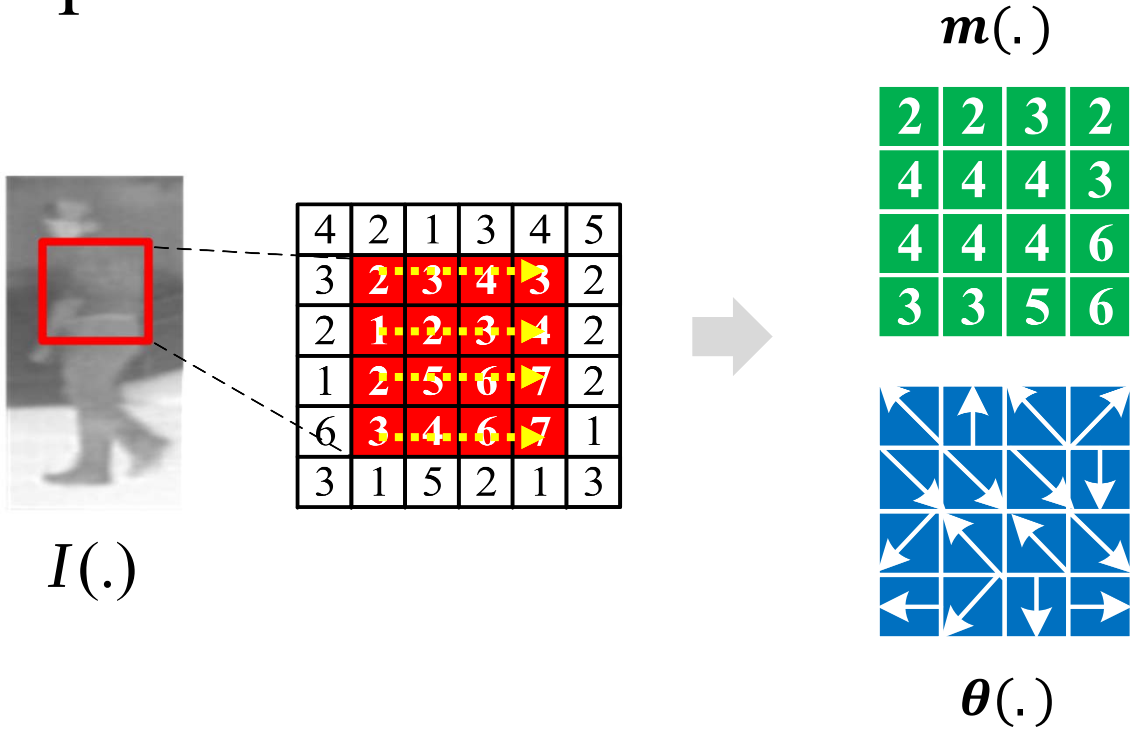
$$\theta(p) = \arg\max_{q \in N_8} |I(p) - I(q)|$$



$\theta(p) = \searrow$

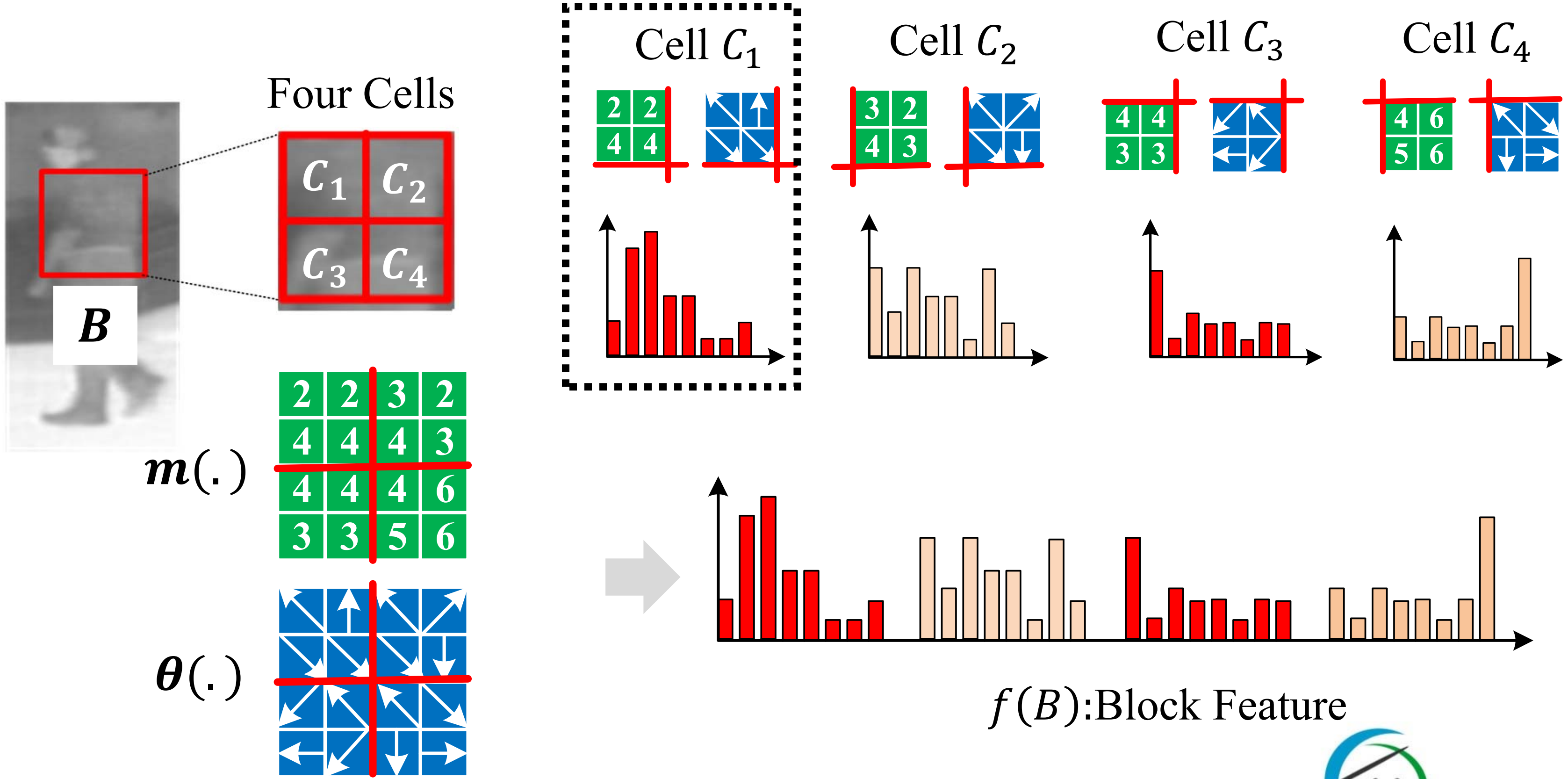
Gradient Computation

- Example



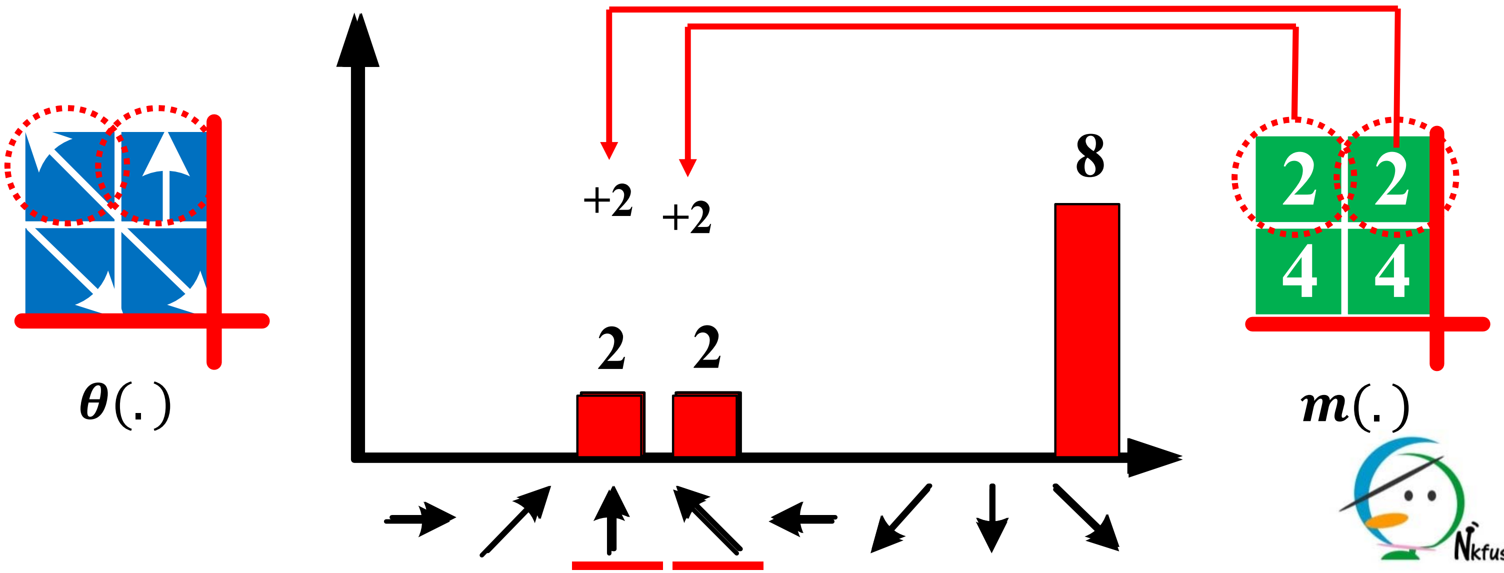
Block Description

- Overview



Block Description

- Cell Description
  - Form a 8-D cell descriptor by voting mechanism
    - $\theta(.)$: voting index
    - $m(.)$: voting weight



Block Description

- Concatenation and Normalization
  - concatenate the four 8-d feature vectors to form a 32-d block feature vector

$$f(B) = \{v_0, v_1, \ldots, v_{31}\}$$

  - normalize the block feature to unity

$$f(B) = \frac{1}{Z}\{v_0, v_1, \ldots, v_{31}\}$$

Normalization Term

L1-Norm: $Z = \left(|v_0| + |v_1| + \ldots |v_{31}|\right)$

L2-Norm: $Z = \left(\sqrt{(v_0)^2 + (v_1)^2 + \ldots + (v_{31})^2}\right)$


thank you
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