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Past LSI Design Contests

Introduction

LSI Design Contest in Okinawa, which has been conducted as part of the lesson of the University of the Ryukyus Faculty of Engineering initially, will celebrate the 20th at the earliest in 2017. In the meantime, participation from universities and technical colleges in the country not only increased, participation from foreign universities in Korea, Indonesia, and Vietnam also increased steadily in Asia, it grew Design Contest international, which is also more than 100 cases of applicants now

Well, I think it is the design challenge of LSI Design Contest in Okinawa this year, but would like to try to "Human Detection by Histogram of Oriented Gradients".

In LSI Design Contest in Okinawa, we have presented the award of Electronics, Information and Communication Engineers of (Technical Committee on Smart Info-Media System) to the excellent design team from 2008. We expect applicants to design more unique to win this prize. Please try to challenge energetically!

Winners are invited conference in Okinawa, and we are planning to give original T-shirt to all participants.

ENJOY HDL! Let's meet in Okinawa!

What's New!

(2016/9/27) Updated the design specification.

(2016/9/16) Updated the design challenge this fiscal year.

(2016/9/15) Updated the 2017 edition page.

Guidelines for applicants

- Design challenge : "Human Detection by Histogram of Oriented Gradients"
- Design Specification
- Who can join : the team of 1-3 University or college students.

- The final report deadline : Friday, 27th Jan, 2017
- Report
- In this home page, we have used Synphony Model Compiler as a development tool;howver, applicants can freely use any type of architecutre as well as any EDA tools.
- Any Q&A: support@LSI-contest.com

About Presentation

- Contest Starting Time: Friday, 10th Mar, 2017 13:00
- Presentation 10-min, Q&A:5-min
- Prepare ppt file less than 10-slide.

Suggestion from judges

- We try to evaluate not only the speed and the area, but also your idea ,originality, uniqueness. But be sure to remember that we are not perfect, please make a good presentation to appeal us.
- We definitely take your school grade into account.
- We like fun ideas. Please do something different from others.

Access

- Place : 50th Anniversary Memorial Hall Department of Computer Science, University of the Ryukyus
- Address : Chihaya1,Nishihara City,Okinawa 903-0213,Japan
- Campus Map 30
- Date : Friday, 10th March, 2017, 13:00 ～18:00

LSI Contest Executive Committee

- Contest General Chair

  Prof. Hiroshi Ochi

  Kyushu Institute of Technology, Japan

  E-mail：ochi@cse.kyutech.ac.jp Tel: +81-0948-29-7692
- Contest Judge Member Chair

  Prof. Kazuhisa Wada

  University of the Ryukyus, Japan
- Executive Committee: LSI Design Contest Committee, Okinawa Prefecture
- Partner Organization: University of the Ryukyus, Kyushu Institute of Technology
- Sponsor: Synopsys, Electronic Device Industry News, Gigafirm, Analog Devices, Inc., Industry Association of Okinawa Technical Committee on Smart Info-media System(SIS),Eiginnering Sciences Society(ESS),IEICE
- Supporting Organization: Okinawa National College of Technology, CQ Publishing Co.,Ltd., Kyusyu Polytechnic College, Okinawa Polytechnic College.

20th LSI Design Contests･in Okinawa Design Specification - 1,2

1. Purpose

Include the human detection as one of image recognition technology. Human detection is a technique used in the digital camera, the automobile automatic brake system and monitoring system.
Therefore, this exercise is aimed at performing a hardware design of the operation unit as a theme of "human detection by Histogram of Oriented Gradients", conscious operations and cost calculation algorithm. The challenge of Level1, design the arithmetic unit of human detection by Histogram of Oriented Gradients. The challenge Level2, all of the input format is not restricted. Please aim to design a more unique computing unit.

2. Design enviroment

MATLAB, Synopsys Synphony
Synopsys® Synphony Model™ Compiler
Synopsys® Synplify Pro®
Synopsys® Design Compiler®
Mathworks® MATLAB® /Simulink®
These environments will be listed in our response to the design environment.
Synplify Pro/Premier or other logic synthesis tool
RTL handcoding(VHDL or Verilog-HDL)

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20th LSI Design Contests･in Okinawa Design Specification - 3

3. Development Environment

In recent years, studies have been actively carried out for the human detection from an image, a number of approaches have been proposed. I explain about human detection by Histogram of Oriented Gradients.

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Design Specification

20th LSI Design Contests･in Okinawa Design Specification - 3-1

3-1. HOG

Histogram of Oriented Gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. We can get quantity of strong characteristic from the shape change of the object by dividing a local domain into plural blocks, and making the incline of each the histogram.

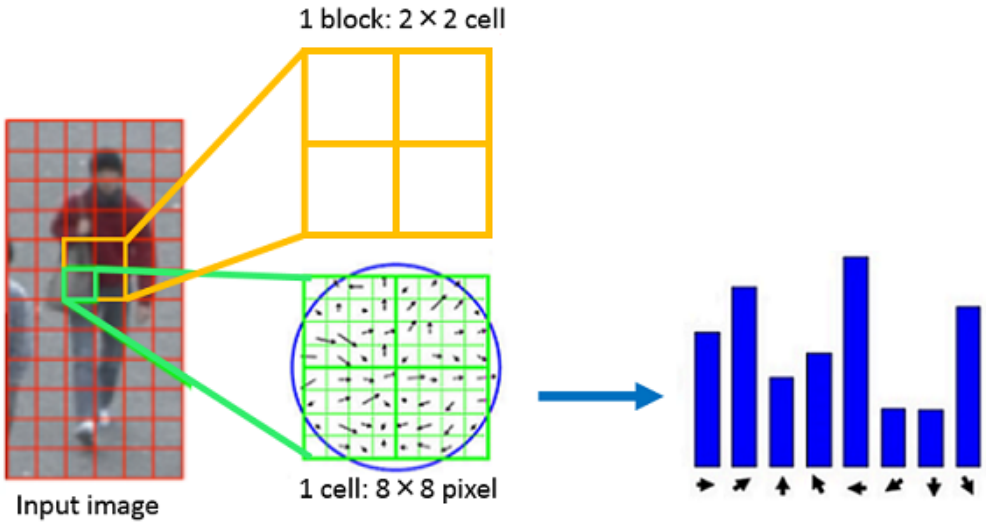

Fig 1：A flow until becoming histogram

･The following (1) - (5) is the process to get quantity of HOG.
(1) Resize an image to pixel size and read it in gray scale.

(2) Calculate gradient magnitude and gradient angle from the brightness of each pixel.

We calculated gradient magnitude and the gradient angle by the following expressions.

Gradient magnitude：

$$m(x,y) = \sqrt{f_x(x,y)^2 + f_y(x,y)^2}$$

Gradient angle：

$$\theta(x,y) = \tan^{-1}\frac{f_y(x,y)}{f_x(x,y)}$$

$$\begin{cases} f_x(x,y) = L(x+1,y) - L(x-1,y) \\ f_y(x,y) = L(x,y+1) - L(x,y-1) \end{cases}$$

(3) Calculate the histogram of gradient in each cell.

We quantized gradient angle each 20 degrees from zero degree to 180 degrees in 9 directions and calculate histogram in each cell domain.

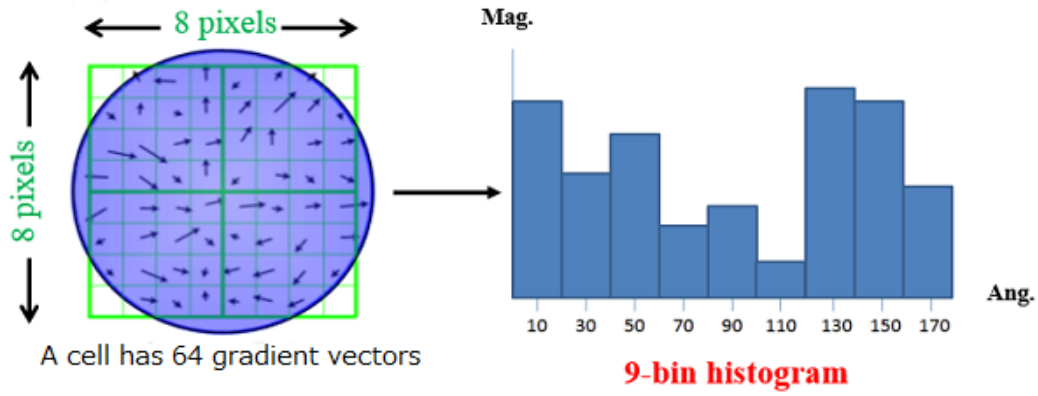

Fig 2：Histogram of 9 directions

(4) Normalize each block.

We normalized each block by the following expressions.

$$v(n) = \frac{v(n)}{\sqrt{\left(\sum_{k=1}^{q\times q\times N} v(k)^2\right) + \epsilon}} \qquad (\epsilon = 1)$$

N：勾配方向数

v(n) is gradient angle histogram. q is cell size. N is the number of gradient angle. In addition, the denominator is a grand total of the quantity of HOG characteristic included in 1 block (q X q cell). For one cell, We normalize multiple times.

(5) Integrate all histogram.

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20th LSI Design Contests･in Okinawa Design Specification - 3-2

3-2. SVM

Support Vector Machine (SVM) is one of the pattern identification technique and is used for image recognition and speech recognition. We used linear SVM.

Let learn learning data of INRIA Person Dataset, and chooses hyperplane becoming margin maximum in hyperplane dividing into the data of the 2 level class. As a free library of linear SVM, We used LIBLINEAR.

The classifier of person or not person by 2 classes is shown in Fig 1.

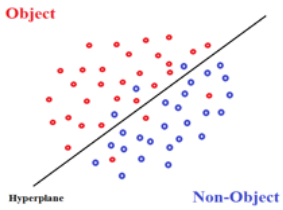

Fig 3：Figure of identification by the 2 classes classification

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Design Specification

20th LSI Design Contests･in Okinawa Design Specification - 3-3

3-3. Algorithm

The algorithm of the person detection using Histogram of Oriented Gradient based on the program that was designed in MATLAB® is shown below.
In addition, it was created and verified using MATLAB®R2012a (7.14.0.739).

- zip file：En_human_detection.zip

Image and m-file, mat-file are included in a zip file. Simulation of human detection is carried out when carry out 'humanDetector_16_09_13.m' which is this main m-file.

(1)Input image
Input the RGB image.

(2)Grayscaling and binarization
Since the detection process using a color image is difficult, the input image is converted into grayscale image. We use the NTSC Coef. method to grayscale of the image. The NTSC Coef. Method, in one method of converting from a color image to 256-level grayscale image, it can be calculated by the following equation.

$$Y=0.298912*R+0.586611*G+0.114478*B$$

Coefficients of this equation are obtained from the human visual characteristics experimentally for the color.

(3)Detection process
(3-1) Resize grayscale input image at different scales In our algorithm, the detection process uses an image window of fixed-size (128 x 64 pixels) to scan over the whole input image, and the size of the human body in each image varies at different scale. Therefore, algorithm needs to sequentially resize the original-size input image into images with smaller sizes (as long as the image window can be included in the resized input image).

(3-2) With each resized input image:
+ Scan the image window (of 128 x 64 pixels) over the image
+ At each position of scanning, compute the Histogram of Oriented Gradient (HOG) descriptor [1] for the image window.
+ Determine the image window to have human body or not, using the trained linear Support Vector Machine (SVM) classifier.
+ If the image window include a human body inside, save its position in the resized image (i.e. coordinates and the scaleused) and detecting score for the next step.

(4)Fusion of multiple detects
At each resized input image, there can be more than one detect around each unique human body. In other words, it is possible to have many overlapping detects over each human body in the input image. The final target is to fusing these overlapping detects so that there is only one detect for each human body.

(5)Output
Draw bounding boxes around true human bodies (if any) in the input image.

The flowchart of the algorithm is shown in Fig 4.

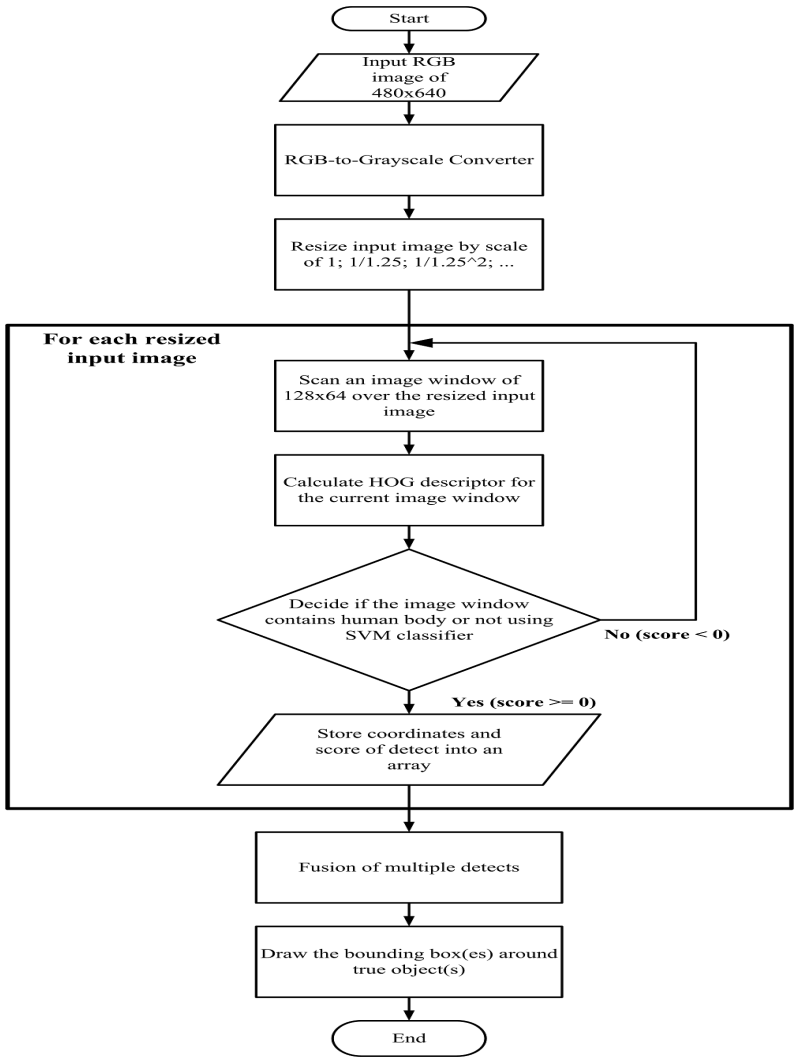

Fig 4：Flowchart of template matching

Reference

[1] 機械知覚&ロボティクス研究グループ, 中部大学 “局所特徴量と統計学習手法による物体検出” http://www.slideshare.net/MPRG_Chubu_University/ss-32258845

[2] 藤井 龍也, 中島 克人, 野口 祥宏, 西田 健次, " HOG と SVM による上半身検出器の特徴の抽出位置に関する考察", FIT2011（第10回情報科学技術フォーラム), pp.105-106, 2011.
http://ci.nii.ac.jp/els/110009622743.pdf?id=ART0010089832&type=pdf&lang=jp&host=cinii&order_no=&ppv_type=0&lang_sw=&no=1473992065&cp=

[3] INRIA Person Dataset,
http://pascal.inrialpes.fr/data/human/

[4] LIBLINEAR -- A Library for Large Linear Classification,
http://www.csie.ntu.edu.tw/~cjlin/liblinear/

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20th LSI Design Contests･in Okinawa Design Specification - 4

4. Challenge

- 1. Level1:For beginners

In the basic challenge, along the following main flow, it will be carried out the design of the circuit for performing the human detection by Histogram of Oriented Gradients of image.

1. Input the image (static image or moving image)
2. Converting input image to the grayscale image
3. Human detection by HOG and classifier
4. Fusion multiple
5. Output the resulting image
（As can be seen by a third party, you should mark the matched portions of the resulting image.）

About input and output
Input：image (static image or moving image) (Size:640×480）
Output：Resulting image (Size:640×480）
※In Level1 we may be we change about the input and output.

- 2. Level2:For experts

In free challenge, have them create a circuit for human detection by Histogram of Oriented Gradients a variety of algorithms.

About input and output
Input：image (static image or moving image) (Size:Arbitrary Values）
Output：Resulting image (Size:Same of Searching image）

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