A simplified method for human height estimation in video surveillance

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***Abstract*—This paper presents a simple method for estimating human height in video surveillance. Given that, the camera is at horizontal height and zero tilted angle. Certain parameters such as reference height, detected pixel height and display resolution are taken into account. These parameters are calculated using a visual perception based formula proposed in the paper. The experimental results show that the proposed method can detect human height with the absolute error of 5 cm from ground.**

I. Introduction

Advances in the image resolution and quality of digital cameras in the last few years have increased the image analysis capability of modern video surveillance systems. The main advantage of this method is it provides the simplest solution for height estimation in video surveillance in comparison with other methods. The challenging task of detection is done using HOG descriptor while height is estimated using a simple formula which will be discussed later on.

II. Literature Review

HOG (Histograms of Oriented Gradients)is a type of feature descriptor to generalize the object in such a way that the same object (in this case a person) produces as close as possible to the same feature descriptor when viewed under different conditions. The entire person is represented by a single feature vector, as opposed to many feature vectors representing smaller parts of the person.

The HOG person detector uses a sliding detection window which is moved around the image. At each position of the detector window, a HOG descriptor is computed for the detection window. This descriptor is then shown to the trained SVM, which classifies it as either person or not a person.[3]

To recognize persons at different scales, the image is subsampled to multiple sizes. Each of these sub-sampled images is searched. Thus, image is detected.After that a function draws a rectangle around the human body. The height is then estimated using the following purposed formula.[2]

III. Proposed Method

This method is based on concept of visual perception. Parameters we used here are as follow,

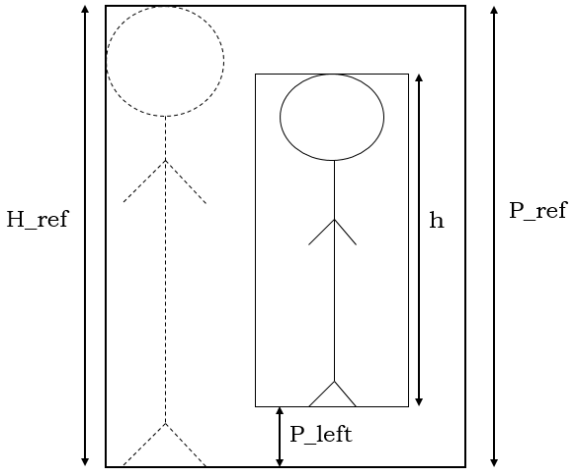


Fig. 1. Parameters

- 'P_ref' is Pixel reference and equal to total pixel present in height of screen.
- 'H_ref' is reference height of the person in 'cm' and pixel height equivalent to 'P_ref'.
- 'h' is pixel height detected by HOG.
- 'P_left' is difference between 'P_ref' and bottom most coordinate of detection box.
- 'Height' is predicted height.

This formula is used for camera at horizontal height and with zero tilt angle.

According to visual perception if referred person moves to and fro with respect to frame of camera there will be change in its pixel height. If person moves backward there will be decrease in pixel height of person and there will be increase in P_left value then,

$$P\_left = P\_ref - (y + h - pad\_h) \tag{1}$$

where (y+h-pad_h) is the coordinate of detection box with respect to y-axis/scale. According to visual perception, predicted

height is directly proportional to pixel height (h) and inversely proportional to (P_ref - $(2 \times P\_left)$)

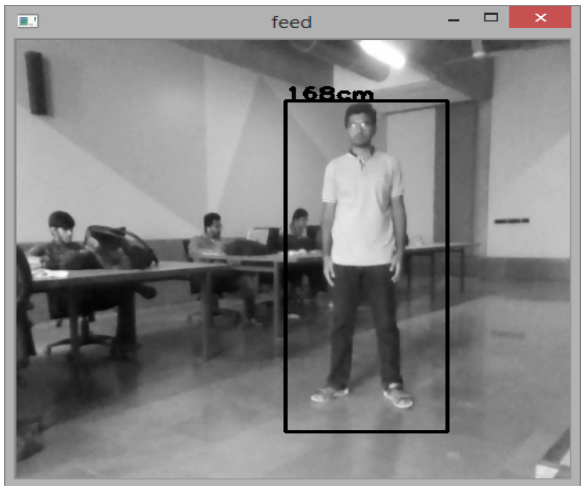
$$Height = \frac{h \times H\_ref}{P\_ref - (2 \times P\_left)} \tag{2}$$

IV. Current Challenges

- Surface of Ground
  - The ground surface not being on the same level or the floor not being flat. In such case, substantial error of height estimation will be caused.

- Walking habit of human.
  - All humans have different walking habits, some walk with bowed head, some with forward leaning pose, such cases provide error in detection which will cause substantial error in result.

V. Result



VI. Future Work

- Tilt angle component
  - The formula(equation 1 and equation 2) are used for camera at horizontal height and with zero tilt angle, in future, we will add the component of tilt angle in the formula.

- Accuracy
  - The target is to minimise the absolute error and achieve accuracy.

References

[1] Shengzhe Li, Van Huan Nguyen, Mingjie Ma, Cheng-Bin Jin, Trung Dung Do and Hakil Kim, *A simplified nonlinear regression method for human height estimation in video surveillance* Li et al. EURASIP Journal on Image and Video Processing, 2015.

[2] Pedestrian Detection OpenCV. *PyImageSearch*. N.p., 07 Sept. 2016. Web. 28 Feb. 2017.

[3] *HOG Person Detector Tutorial* HOG Person Detector Tutorial Chris McCormick. N.p., n.d. Web. 28 Feb. 2017.