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Application of Rectangular Feature for Detection of Parts of Human Body

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Abstract

Object detection is the broad area of research in exploring new technique for identifying or segmenting a part of an image. This work presents a probabilistic framework of assembling detected parts such as the face, legs, and hands of the human body in cluttered scenes. In this proposed work a technique based on rectangular feature is applied to the integral image and the outcome is a new representation comprising of the central coordinate, width and height. The experimental results show that the feature used by the detector is able to identify the parts efficiently.

Keywords: Object detection, Image processing, Rectangular feature, Human body parts, Feature extraction.

1. INTRODUCTION

According to the taxonomy proposed in [1], the techniques for object detection and tracking can be classified as shape-based [2],[3], feature-based [4], appearance-based [5], and hybrid [6], based on their geometric and rectangular properties. Shape-based methods can be classified as fixed shape and deformable shape. While the shape-based methods use a prior model of object shape and surrounding structures, the appearance-based methods rely on models built directly on the appearance of the object region. Hybrid methods combine feature, shape, and appearance approaches to exploit their respective benefits.

Object detection is an important element of various computer vision areas. The basic goal is to find an object of a predefined class in static images or video frames. Sometimes this task can be handled by extracting certain image features, such as edges, color regions, textures, contours, etc. Afterwards, some heuristics is applied to find configurations and/or combinations of those features characteristics of the object that one wants to detect [7].

Object identifying is the task of finding a given object in a static image or video sequence. For any object in an image, there are many 'features' which are interesting points on the object that can be extracted to provide a "feature" description of the object. This description extracted from an image can then be used to identify the object when attempting to locate the object in a output image containing many other objects [8][9].

Image identification is the process of partitioning a digital image into its integral parts or objects or regions. These regions share common characteristics based on color, intensity, texture, etc. The first step in image analysis is to segment an image based on detection technique (Edge-based, Region -based).In detection technique, region based identification partitions an image into regions that are similar according to a set of predefined criteria [10].

There are two main contributions of this work object detection framework. It will be briefly introduced first and will be described in detail in subsequent sections.

The first contribution of this proposed work is a new image representation called an integral image that allows quick feature evaluation. Motivated in part by the work of Papageorgiou et al[11] the detection system does not work directly with image intensities. Similarly, this research work uses a set of features which are reminiscent of Haar basis functions. In order to compute these features very rapidly at many scales the article introduces the integral image representation for images. The integral image can be computed from an image using a few operations per pixel. Once computed, any one of these Harr-like features can be computed at any scale or location in constant time.

The second contribution of this research study is a method for constructing a feature by selecting important features using the rectangular feature. Rectangular features are used for feature extraction. Recently, rectangular features have drawn increasing attention in object recognition because they can capture rectangular features in object images for the system.

This proposed work describes the new method for object detection based on rectangular feature.

This article described in the following manner:

Section 2 describe about Review of Literature. Section 3 presents an outline of Rectangular feature. Section 4 describe about the Proposed Method of the Human Body Parts detection. Methodology of Object detection is described in Section 5. In Section 6 presents an Experimental results. Section 7 describe about the Conclusion.

1.1 Feature Extraction

Feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be very redundant, then the input data will be transformed into a reduced representation set of features (also named feature vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

1.2. Motivation and Objective

Detection and tracking of human from images are important in many applications, such as visual surveillance, human computer interaction, and driving assistance systems. Detection.Eventhough this approach is applied in various fields like car and face detection, where we focus in this article for human body parts detection. So it is needed to detect the human body from an image. Various methods have been used for object feature extraction, such as raw pixel intensities [12], edges [13], wavelets [14], and rectangle features [15] of local binary pattern. However, determination of stable and flexible feature for object detection still remains a challenging problem. This research work focuses on Rectangular feature which is suitable for human detection.

2. REVIEW OF LITERATURE

Object detection is an important element of various computer vision areas. The basic goal is to find an object of a predefined class in static images. Sometimes this task can be handled by extracting certain image features, such as edges, color regions, textures, contours, etc. Paul Viola et al [16] proposed a new image representation called an integral image that allows for very fast feature evaluation. Hugo Proenc et al [17] proposed the notion of "triangular integral feature" to describe and model face properties. Also, show results of our face detection experiments that point to an increase of the detection accuracy when the triangular features are mixed with the rectangular in the candidate feature set, which is considered an achievement. The author [18] has proposed the Haar-like features and a large set of very simple "weak" classifiers, that use a single feature to classify the image as horse or without horse, were used to extract the features characteristics of the horse.

Alister Cordiner et al [21] proposed Generalised Integral Image Features (GIIFs) for face detection. The Haar-like features are thus a subset of the GIIFs. Due to the large feature set provided by the GIIFs, a genetic algorithm is developed to select the features for the optimal weak classifiers. Sri-Kaushik Pavani et al [19] proposed an extension of Haar-like features for their use in rapid object detection systems. These features differ from the traditional ones in that their rectangles are assigned optimal weights so as to maximize their ability to discriminate objects from clutter (non-objects). These features maintain the simplicity of evaluation of the traditional

formulation while being more discriminative.

Sanjay Pagare et al [20] proposed the new method for face detection and recognition that is based on rectangular feature. There are many methods for face recognition but this method for accurate face recognition using RBFNN (Radial Basis Function Neural Network). Paul Viola et al [22] proposed about new representation called integral image which allows the features used by our detector to be computed very quickly. Plagemann et al. [23] proposed a method to detect and identify body parts in depth images. Their method identifies points of interest that are based on the differences in geodesic distances, which coincide with salient points of the body. Paul Viola [24] proposed a machine learning for visual object detection which is capable of processing image rapidly and achieving a high detection rate. Papageorgiou et al [25] proposed system uses a set of training data of positive and negative example images as input transforms the pixel images to a Haar wavelet representation and uses a support vector machine classifier to learn the difference between in-class and out-of-class patterns. Gabriele Facciolo et al [26] was first proposed under the name of summed area table in the computer graphics community by Crow'84, in order to efficiently filter texture maps. It was later popularized in the computer vision community by Viola & Jones'04 with its use in their real-time object detection framework.

3. OVERVIEW OF RECTANGULAR FEATURES

The Object detection procedure classifies images based on the value of simple features. There are many advantages for using features rather than the pixels directly. Hence, feature based system is used in this work as it operates much faster than pixel-based system.

The simple features used are reminiscent of Haar basis functions which has been used by Papageorgiou et al [27]. A Haar-like features considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between there sums. This difference is then used to categories subsections of an image. More specifically, we use three kinds of features. The value of a *two-rectangle feature* is the difference between the sums of the pixels within two rectangular regions. The regions have the same size and shape and are horizontally or vertically adjacent (see Fig. 1). A *three-rectangle feature* computes the sum within two outside rectangles subtracted from the sum in a center rectangle. Finally a *four-rectangle feature* computes the difference between diagonal pairs of rectangles.

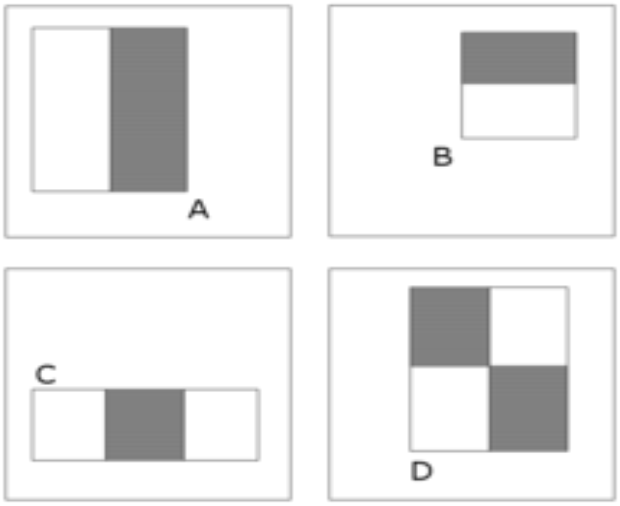


Figure 1: Three kinds of features

3.1 Integral Image

The integral image representation was introduced [28][29] with the purpose of evaluating sums of image values over axis aligned rectangular regions in constant time. Rectangle features can be computed very rapidly using an intermediate representation for the image which we call the integral image. The integral image is used as quick and effective way of calculating the sum of values in a input image or rectangular subset of a input image. It is mainly used for calculating the average intensity with in the input image.

The integral image at location x, y contains the sum of the pixels above and to the left of x, y, inclusive:

$$i(x,y) = \sum_{x' \le x, y' \le y} i(x',y') \tag{1}$$

ii(x,y) is the integral image and *i(x,y)* is the original image. Using the following pair of recurrences:

where

$$s(x,y) = s(x,y-1) + i(x,y) \tag{2}$$

$$ii(x,y) = ii(x-1,y) + s(x,y) \tag{3}$$

(where *s(x,y)* is the cumulative row sum, *s(x,-1)*=0 and *ii(-1,y)*=0) the integral image can be computed in one pass over the original image

Using the integral image any rectangular sum can be computed in four array references. Clearly the difference between two rectangular sums can be computed in eight references. Since the two-rectangular features defined above involve adjacent rectangular sums they can be computed in six array references, eight in the case of the three-rectangle features, and nine for four-rectangle features.

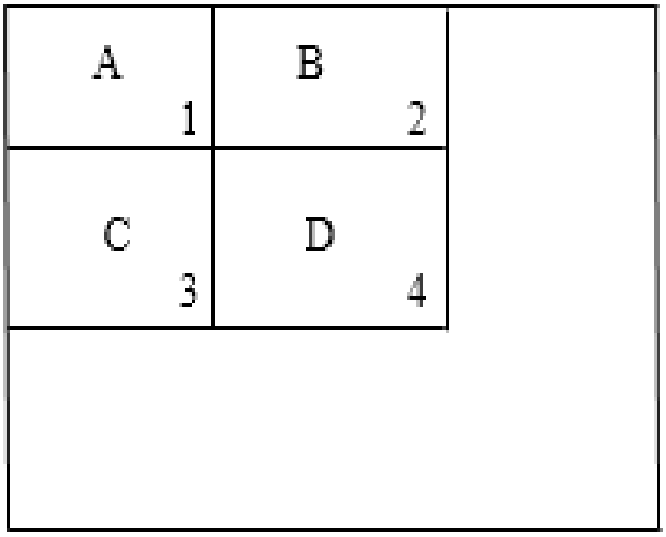


Figure 2: Four array reference

In the figure2 the sum of the pixels within rectangle D can be computed with four array references. The value of the integral image at location 1 is the sum of the pixels in rectangle A. The value at location 2 is A + B , at location 3 is A + C and at location 4 is A + B + C + D. The sum within D can be computed as 4 + 1 – (2 + 3).

4. PROPOSED METHOD

This research study presents a framework of assembling detected human body parts. The face, legs, hands are detected in cluttered scenes using the rectangular feature. First the image representation is performed. The second image processing using the rectangular feature. The rectangular feature considers the pixel values of the image. In the rectangular feature x, y, height and width are considered for calculating the pixel values on a particular point in an image. The overview of the proposed method is shown in Figure 3.

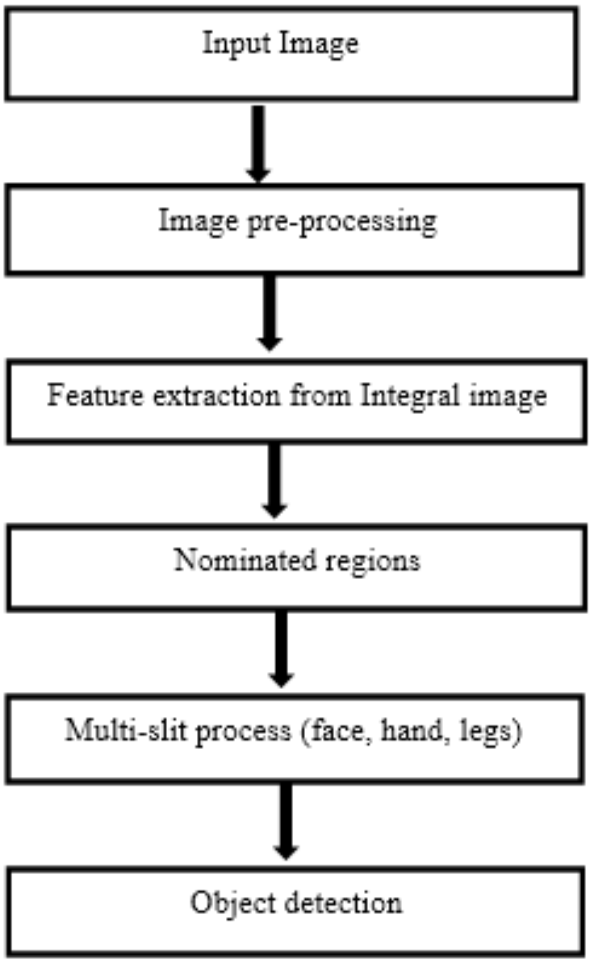


Figure 3: System Overview

4.1 Algorithm for Proposed Method

Step 1: Read the input image.

Step 2: Compress and reduce the size of the image.

Step 3: Apply the rectangular feature to the integral image.

Step 4: Detect the parts of the human body.

Step 5: Crop the detected parts.

5. METHODOLOGY OF OBTAINING RECTANGULAR FEATURES

5.1 Object Detection

Object detection is one of the fundamental challenges in computer vision. In this study consider the problem of detecting and localizing generic objects from categories such as people in static image is considered. This is a difficult problem because objects in such categories can vary greatly in appearance. Changes in illumination,

changes in camera position as well as digitization artifacts, all produce significant variations in image appearance, even in a static scene. Detecting a human body parts in the static image, it is difficult to describe because of objects of interest. People are articulate bodies it is difficult to define a single technique that describe a human body parts. However, what kinds of features are stable and flexible for object detection still remains a problem. The ultimate goal is choosing a image representation for an human parts detection is finding one that yields high interclass-class variability, while at the same time achieving low intra-class variability [30]. This article focus a rectangular feature used in integral image representation for object detection. The face, legs, hands are detected in cluttered scenes using the rectangular feature. Human body parts detection is the first stage of an automatic object recognition system, since an object has to be located in the input image before it is recognized. For an input image object detection can be done by detecting all the body parts and locating their exact positions and size. Usually, human body parts detection is a two-step procedure: first the whole image is examined to find regions that are identified as "object", after the rough position and size of a face are estimated. So, face detection is most concerned with roughly finding the face in large, complex images, achieved by accurate detection of facial features. Likewise, all the parts of the human body - left hand, right hand, left leg and right leg are accurately detected by using the rectangular features.(see refer Figure 4 and 5).

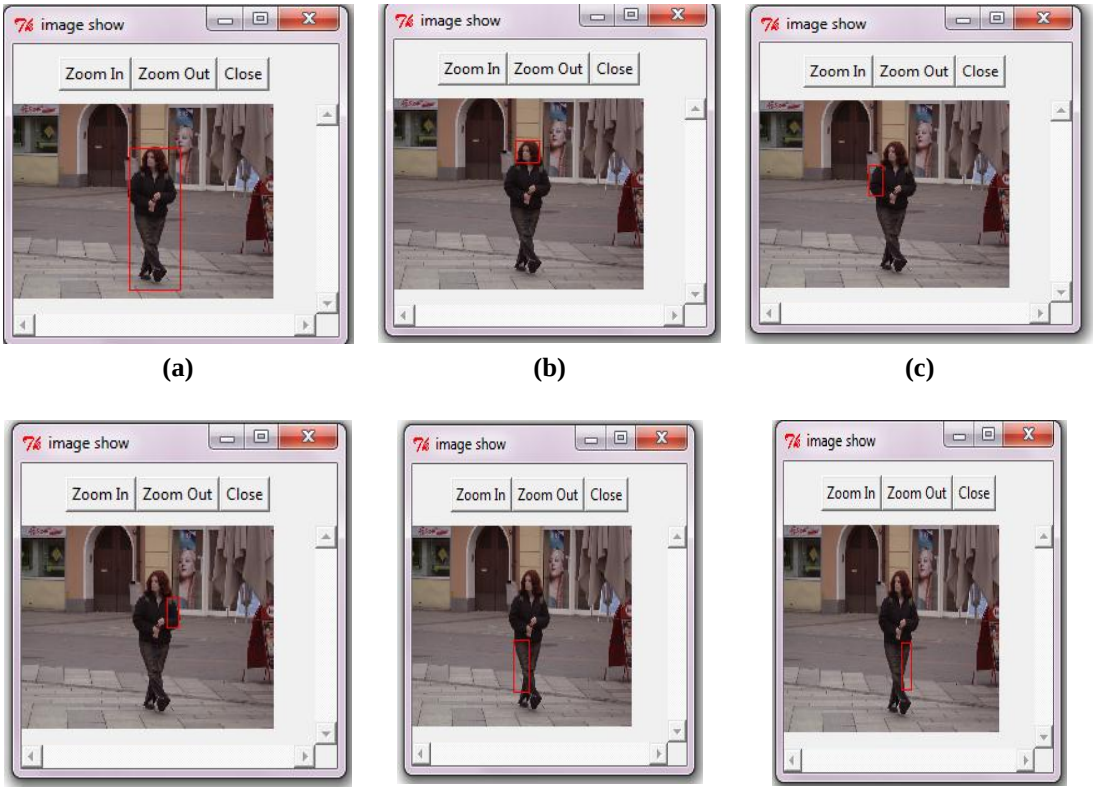
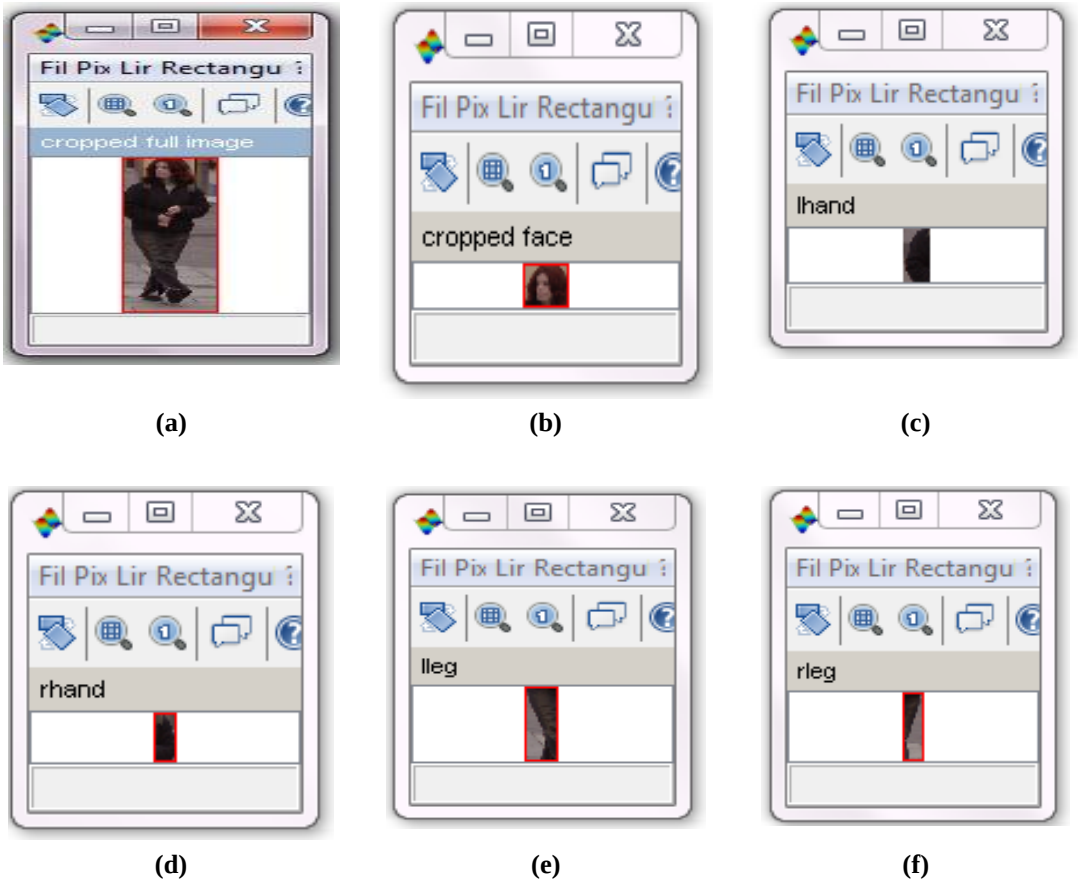


Figure 4: Object detection of (a) full image (b) face (c) left hand (d) right hand (e) left leg (f) right leg

5.2. Rectangular Crop

Cropping an image extracts a rectangular region of interest from the original image. To crop an image in rectangular form just select two coordinates on the image. Image cropping requires a pair of (*x, y)* coordinates that define the corners of the new, cropped image. The rectangular feature is useful for object detection because it is the first step of any object recognition system. Hence the human body is detected using the rectangular feature. To get rectangular features easily use the mathematical function that is x and y coordinates of the cropped image. The rectangular features are the feature ones that sum up the pixels in rectangular area and involve in sum of the image pixel area.



(a) **(b)** **(c)**

(d) **(e)** **(f)**

Figure 5: Cropped images of (a) full image (b) face (c) left hand (d) right hand (e) left leg (f) right leg

6. EXPRIMENTAL RESULTS

In this research work, the proposed object detection method is tested on INRIA PERSON data set. This system is implemented using MATLAB, SCILAB software. The results after applying the rectangular feature or integral image is shown in Fig.6.

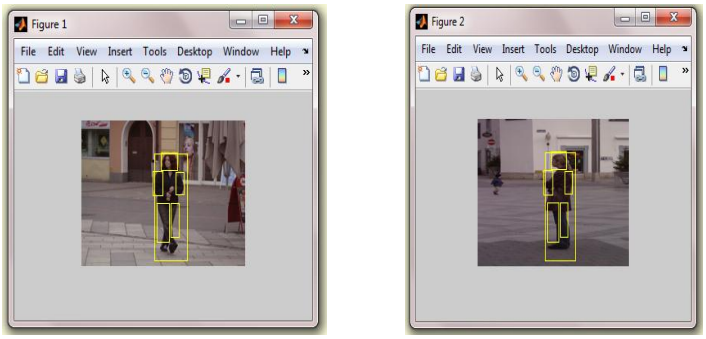


Figure 6: Human Body parts detection.

The comparative results of the detection rate of different parts of the human body such as of full images, face, left hand, right hand, left leg and right leg etc. using the proposed method and existing component detector algorithm is shown in Table 1.

Table 1: Detection rate of Objects

Human parts	Detection rate using rectangular feature (%)	Detection rate of component detector (%)
Full image	100	98
Face	90	80
Left hand	80	78
Right hand	76	64
Left leg	95	60
Right leg	93	59

Figure 7: Detection rate of different Human Body parts

Figure 7 is used to denote the detection rate of different parts of the human body. From the table it is evident that the detection rate using the proposed technique is higher than the existing component detector for all parts of the human body.

7. CONCLUSION

In this work an object detection technique in images have been proposed. This technique is useful for detecting human parts using of human using rectangular feature that can be used for broader applications in computer vision. Experimental results proposed technique exhibit high detection accuracy for human body parts. The study is about to generalizing the things that are useful for detecting parts of the human body through rectangular feature. The rectangular feature is used for the object detection purpose and feature extraction. It is concluded that Human Body parts detection using rectangular feature shows the better results. The future work is to explore techniques for object detection in other computer vision applications

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