Child and Adult Classification Using Ratio of Head and Body Heights in Images

Omer F. Ince, J. S. Park, J. Song, and B. W. Yoon

***Abstract*—Pedestrian detection is a challenging problem. There are various researches to detect people in digital images. Besides, to recognize children from adults in digital platforms is helpful for applications which are created to people's good account. For instance, if Closed Circuit Television (CCTV) which is located on traffic lamb detects child who is walking through pedestrian way, system could make some adjustment in a good way. Aim of this article is to detect children and adults separately in digital images. While we employed our method, we applied Haar Cascades which is widely used technique in object detection. At first, we detected head and full body of pedestrians, then we used relative measurements. So we did proportioning head size to body size of pedestrians. By this technique, we tried to discriminate children and adults. Our results were not %100 accurate but it gave a clue to improve ourselves. It seems that it's improvable for now.**

***Index Terms*—Absolute measurement, adult and child classification, Haar-like feature, pedestrian detection, relative measurements.**

I. Introduction

Object detection is a technology that is connected with image processing that handles sample detection from semantic objects. Detecting objects in visual studies has serious history. As the technology developed and demands in practical areas increased, researches diverged to this area for people's good account. By object detection, certain classes such as pedestrians, vehicles, and also subsets like gender classification or age classification can be detect in digital images and videos. Too many applications in various areas of computer visions about object detection had been done.

The main purpose of object detection is to pinpoint the location of target in the scene. It is required to be impeccable and fast in detecting objects and understanding situations with video processing. One of the most significant stages of object detection is feature selection. To make impeccable real time object detection, features need to be robust, differential, and easy to calculate [1].

As the time goes by, children are having more active role in society. They do not pay attention to objects such as vehicles, other people on the street. On the other hand they should be more careful than adults in traffic. Moreover, they can be used for making data set in the field of health, sociology, traffic etc [2].

Classifying of people's appearance whether adult or child is one subclass of pedestrian detection by getting some kind of mileage out of object detection. To get information about physical appearance in society is required in the so many fields. For that purpose, many effective methods for age detection is represented since applications needed to determine locations and presences.

One of these methods is ratio of head to body size. It is medical fact that in after life, head size of human becomes much smaller than body size at younger ages. That is the one of reasons why children look so much pretty. Starting from this point of view a new method can be developed.

In this paper, we describe detection of people whether adult or child by using ratio of head and body heights. Main frame of our work is detecting pedestrians in the scene and proportion their heights of head to body. After that, we use reference table which is about classification of ages of people. Occlusions of particular body parts which are in the screen were omitted.

We are not interested in making the most accurate algorithm for heights estimation problem. We just focus on problem of classifying non-occluded pedestrians. This paper is arranged as follows. In Section II the related work about the kinds of features that can be used for adult & child detection and what kinds of works have been done are given. In Section III, proposed algorithm is explained in detail. Results and considerations are given in Section IV. Finally, conclusions is given in Section V.

II. Related Work

A. Previous Works

Up to now, there are not so many researches published on the predication of people's age from image. In the first instance, Kwon & Lobo [3] started predication of people's age from digital facial images where they described a method of classify into three groups as babies, young adults and senior adults. On a limited database, %100 accuracy is not applicable in real world applications. To complete similar age group classification, another technique which is based on craniofacial development theory was proposed [3]. But the approach is frustrated again due to limited data sets in this way very hard to calculate its robustness while put into practice on real data set conditions.

There is also another method which is proposed by W.B Horng, C.P. Lee and C.W. Chen [4]. This method put an extra group into account as middle aged adults to Kwon & Lobo's

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work. The biggest restriction in this method is that they cannot detect children and younger adults than 40 years old. They only can detect babies. Despite everything, results were satisfactory and to find features, the analysis is pretty complex.

Lanitis [5] started up Active Appearance Models. To estimate the age, combined shape and texture parameters are dismissed by using classifiers. Simple quadratic fitting, shortest distance classifier, and Neural Network and age estimation accuracies of these classifiers are compared. Geng [6] suggested statical modeling on ageing patterns. it was based upon guess that multiple images of various ages are available for each person.

B. Histogram of Oriented Gradient Feature

On the detection of human body parts, various features can be used. Histogram of Oriented Gradient (HOG) is feature that is used for object detection. Main frame is counting occurrence of gradient orientation circumscribed part of an image. Key point for HOG descriptor is that local object appearance and shape in digital image can be described by distribution of edge directions or intensity gradients. To get better accuracy, localized histograms should be normalized.

C. Haar-Like Features

Haar-like Features can be given as another example of using features for object detection. Name comes from Haar wavelets and features were used for the first real time face detection. Viola and Jones [7] developed Haar-like Feature from idea of using Haar wavelet. Haar-like Feature considers rectangular regions which are near each other in detection window, tots up intensities of pixels in each region and assesses the difference between these tots. To categorize subsections of images, these differences are used.

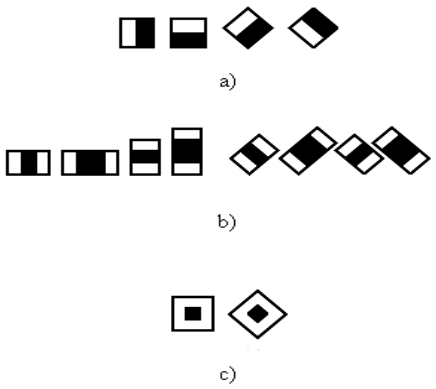


Fig. 1. Example of Haar-like feature sets.

In Fig. 1, Haar-like feature sets can bee seen. In the detection process of the Viola-Jones object detection framework, Haar-like feature is calculated while window of the target size is stood back. Next, threshold that separates non-objects is compared to this difference. The main advantage of a Haar-like feature is speed of calculation.

III. Proposed Algorithm

In this part, we introduce our proposed algorithm which is used to detect children and adults in digital images. Implementation steps are shown in Fig. 2. The algorithm consists of several steps, but it can be divided into two main parts. First part is detection of pedestrian and its face. Second is to calculate and determine the child and adult classifying.

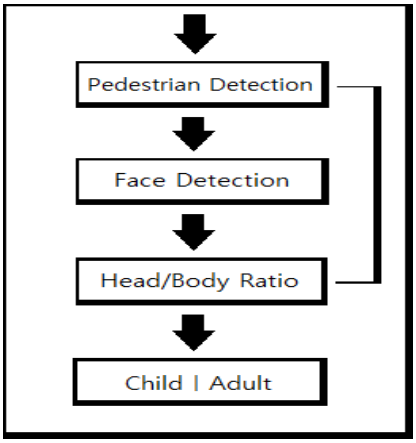


Fig. 2. Block diagram of the detecting adults and children in digital images.

To detect pedestrian in digital image, it is trained with Haar-like feature by Adaboost algorithm which can be efficient and be used for pedestrian detection problem.

In a digital image, there are various objects. To detect pedestrian or pedestrian's head in digital images is applicable while ROI (Region of Interest) is pedestrian or pedestrians' head. To implement, we used Haar Cascade detector.

After we detected body, our new region of interest would be pedestrian body. After that, we needed to detect head of pedestrian. In this stage we employed Haar cascade detector. By doing these steps, we finished first two steps which is shown in block diagram.

For third step, we needed to calculate head and body ratio by equation (1).

$$r = \frac{l_H}{l_B} \quad 0 < r < 1 \tag{1}$$

l_B and l_H are heights of body and head, respectively. r means the ratio of l_B and l_H.

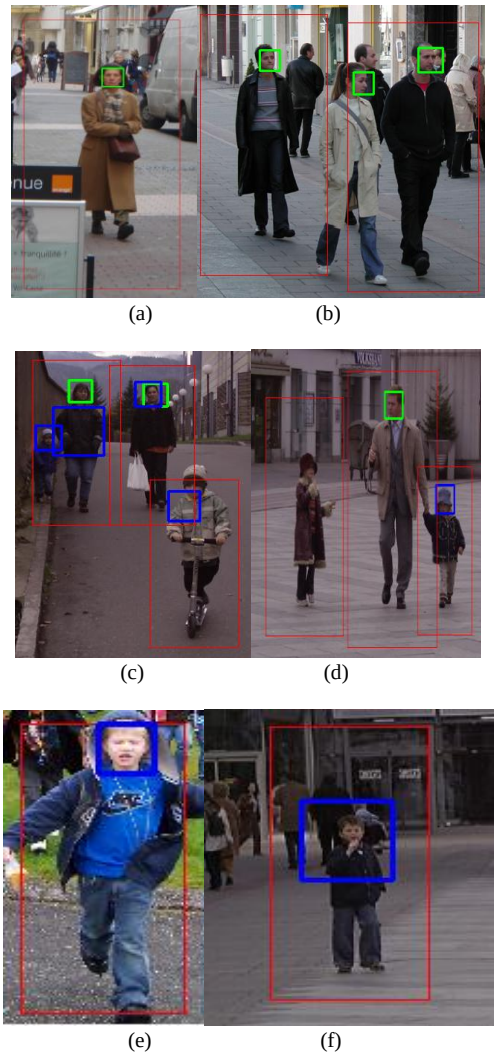
The main reason of this calculation is that people's head height becomes relatively smaller than body height while they grow up. In digital images, we can not measure absolute value of people's heights from pixels. So, we need to solve this problem. If we apply relative measurement which is related to proportioning head to body height, we would solve that problem. By this idea, we can classify pedestrian as child or adult. If head over body ratio is around 0.2, we can then classify that pedestrian is child. If that ratio is around 0.15, that means pedestrian is adult. In this implementation, we used OpenCV's default Haar based cascade.

IV. Results and Considerations

After algorithm part is done, we passed to testing process. In the testing stage we used various images which are from INRIA person dataset and CVC-CER-01(Computer Vision Center) pedestrian dataset. All training and testing processes are employed on 2.60 GHz computer with using Microsoft

Visual Studio 2010 and OpenCV 2.2.

In output images, adult pedestrians were marked as green rectangular and children were marked as blue rectangular. Green and blue rectangles are located on pedestrian face. Red rectangle represents pedestrian body. There were some false positives and true negatives observed in certain images but they are tolerable for now.



(a) (b) (c) (d) (e) (f)

Fig. 3. Captures of results for detecting children and adults.

Fig. 3(a) and Fig. 3(b) can be good examples of successful adult detection. All adults were shown with green rectangular which was our goal as we mentioned above. There are some false positives and true negative can be seen in Fig. 3(c) and Fig. 3(d). In Fig. 3(c), algorithm detects children and adults separately but somehow it detects also two more children who are not in image. In Fig. 3(d), everything is detected correctly but girl's head was missed, it may be because of our data sets' inadequacy. We get accurate children detection result in Fig. 3(e) and Fig. 3(f). System detected children just like we aimed.

V. Conclusion

In this paper, it is proposed to classify adult and child in digital images. We showed a new approach which is related with relative measurement for classification problem. Absolute measurement can not be done in digital images, because every single pixel may represent different length, so we concentrate on relative measurement. Even though it can not exactly estimate heights of pedestrian, it showed that this approach can classify adult and child effectively. In the future study, we will focus on improving the accuracy of the performance and estimating heights of pedestrians.

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