Masood Masoodian
Steve Jones
Bill Rogers (Eds.)

LNCS 3101

Computer Human Interaction

6th Asia Pacific Conference, APCHI 2004
Rotorua, New Zealand, June/July 2004
Proceedings

Springer

Lecture Notes in Computer Science 3101

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

Springer
Berlin
Heidelberg
New York
Hong Kong
London
Milan
Paris
Tokyo

Masood Masoodian Steve Jones
Bill Rogers (Eds.)

Computer Human Interaction

6th Asia Pacific Conference, APCHI 2004
Rotorua, New Zealand, June 29 - July 2, 2004
Proceedings

Springer

eBook ISBN: 3-540-27795-1
Print ISBN: 3-540-22312-6

Created in the United States of America

Visit Springer's eBookstore at: http://ebooks.springerlink.com
and the Springer Global Website Online at: http://www.springeronline.com

Preface

APCHI 2004 was the sixth Asia-Pacific Conference on Computer-Human Interaction, and was the first APCHI to be held in New Zealand. This conference series provides opportunities for HCI researchers and practitioners in the Asia-Pacific and beyond to gather to explore ideas, exchange and share experiences, and further build the HCI network in this region. APCHI 2004 was a truly international event, with presenters representing 17 countries. This year APCHI also incorporated the fifth SIGCHI New Zealand Symposium on Computer-Human Interaction.

A total of 69 papers were accepted for inclusion in the proceedings – 56 long papers and 13 short papers. Submissions were subject to a strict, double-blind peer-review process. The research topics cover the spectrum of HCI, including human factors and ergonomics, user interface tools and technologies, mobile and ubiquitous computing, visualization, augmented reality, collaborative systems, internationalization and cultural issues, and more. APCHI also included a doctoral consortium, allowing 10 doctoral students from across the globe to meet and discuss their work in an interdisciplinary workshop with leading researchers and fellow students. Additionally, five tutorials were offered in association with the conference.

The conference was also privileged to have two distinguished keynote speakers: Don Norman (www.jnd.com) and Susan Dray (www.dray.com). Don Norman's invited talk focussed on 'emotional design': the application of recent research on human affect and emotion to the design of products that are easier to use because they are also interesting and beautiful. Susan Dray's research combines expertise in interface evaluation and usability with a cross-cultural and organizational perspective.

The quality of this year's APCHI was the joint achievement of many people. We would like to thank all those who worked so hard to make APCHI a success: the referees for their time and effort generously donated to the reviewing process; the program committee for organizing the reviewing process, the presentations, and of course this volume of proceedings; the steering committee for their support of the APCHI series; and the local organizing committee for their excellent work in bringing the conference to fruition. Finally, we thank the authors and presenters as well as the APCHI 2004 attendees, whose contribution and participation were the crucial ingredients of an exciting and productive conference.

April 2004 Sally Jo Cunningham, Matt Jones

This page intentionally left blank

Organizing Committee

Conference Chairs	Sally Jo Cunningham, Matt Jones
Program Chairs	Steve Jones, Bill Rogers
Tutorials	Masood Masoodian, Anette Olsson
Doctoral Consortium	Chris Knowles, Peter Thomas
Treasurer	Kirsten Thomson
Venue and Logistics	Lyn Hunt, Aparna Krishnan, Beryl Plimmer
Marketing and PR	Lyn Hunt, Maree Talmage
Sponsorship	George Buchanan, Dave Nichols
Website	Dana McKay
Proceedings	Masood Masoodian

Steering Committee

Masaaki Kurosu
Lim Kee Yong

Program Committee

Elisabeth André	University of Augsburg
Mark Apperley	University of Waikato
Russell Beale	University of Birmingham
Mark Billinghurst	HIT Lab
Ann Blandford	Middlesex University
George Buchanan	Middlesex University
Richard Butterworth	Middlesex University
Adrian Cheok	National University of Sinagpore
Elizabeth Churchill	FXPAL
Andy Cockburn	University of Canterbury
Sally Jo Cunningham	University of Waikato
Suzanne Currie	Navman
Guozhong Dai	Institute of Software
Ernest Edmonds	University of Technology, Sydney
Peter Grierson	ANZ Bank
John Grundy	University of Auckland
Carl Gutwin	University of Saskatchewan
Masahito Hirakawa	Shimane University
Steve Howard	University of Melbourne
Matt Jones	University of Waikato
Steve Jones	University of Waikato
Elizabeth Kemp	Massey University
Chris Knowles	University of Waikato
Panu Korhonen	Nokia Research Centre
Aparna Krishnan	University of Waikato

Jonathan Lazar	Towson University
Kee Yong Lim	Nanyang Technological University
Christopher Lueg	University of Technology, Sydney
Saturnino Luz	Trinity College Dublin
Robert Macredie	Brunel University
Gary Marsden	University of Capetown
Masood Masoodian	University of Waikato
Dana McKay	University of Waikato
Dave Nichols	University of Waikato
Anette Olsson	University of Waikato
Fabio Paterno	CNR, Italy
Chris Phillips	Massey University
Chui Yoon Ping	Nanyang Technological University
Beryl Plimmer	University of Auckland
Patrick Rau	Chung Yuan Christian University
David Redmiles	University of California at Irvine
Bill Rogers	University of Waikato
Yuzuru Tanaka	Hokkaido University
Yin Leng Theng	Nanyang Technological University
Bruce Thomas	University of South Australia
Peter Thomas	Middlesex University
Kirsten Thomson	University of Waikato
Mike Twidale	University of Illinois
Stephen Viller	University of Queensland
Kwang Yun Wohn	Korean Institute of Science and Technology
Candy Wong	DoCoMo Labs
William Wong	Middlesex University
Kim Jin Woo	Yonsei University
Toshiki Yamaoka	Wakayama University
Michiaki Yasumura	Keio University
Alvin Yeo	UNIMAS, Malaysia

Sponsors

Department of Computer Science, University of Waikato
University of Waikato Usability Laboratory
IFIP Technical Committee No. 13 on Human-Computer Interaction (IFIP TC.13)
ACM SIGCHI, New Zealand Chapter (SIGCHI-NZ)
COMPUTERWORLD
Human Interface Technology Laboratory New Zealand (HITLabNZ)
Orbit Corporate Travel

Table of Contents

Full Papers

Short Papers

Doctoral Consortium

A Simple and Novel Method for Skin Detection and Face Locating and Tracking

Saleh A. Al-Shehri

P.O.Box 20219, Aseer Reigon, Al-Wadyeen, Saudi Arabia
SaaaS101@hotmail.com

Abstract. In many computer vision applications such as human-computer interaction (HCI) and human-motion tracking (HMT), face detection is considered the main step which is also the first step. To detect faces, skin color is considered the most appropriate feature to use. A simple arithmetic on RGB color space components is used in this paper to extract the skin. Elliptical shape fitting is used to locate the face. Then template matching is used to locate the eyes. A very good result is achieved using our simple algorithm. Up to our knowledge, we believe that our skin detection method is one of the most efficient methods being used today.

1 Introduction

Using skin color for face detection has taken the attraction of many researchers and become the subject of their researches [1-12]. Authors in [13] tabulated the major methods of face detection. A survey of human faces detection and recognition is given in [14]. Some image pixels values will be in skin and none-skin regions at the same time. This fact makes it very difficult to perfectly make the right decision for these pixels. Some researchers used the color histogram for skin detection [6,15]. Prior knowledge of skin color clustering and shape information are used to perform pixel level classification [1,2,5,10-12,16,17]. Different researchers used different color spaces [18]. In addition to skin color, geometric properties of faces were used to construct a method for face detection [1,2,9]. Generic algorithm and eigenfaces also used for faces detection [19]. Skin color classification using two discriminates namely: linear discriminate and Mahalanchin distance were presented in [7]. Fischer linear discriminate was used also with color-based segmentation [3]. Building skin color model by subtracting two adjacent image frames as a first step is presented in [6]. The rest of this paper is organized as follows: the main method for skin detection is presented in section 2 whereas steps of face detection and eye locating are discussed in section 3. Section 4 contains the results of applying our algorithm on three faces database [20-22]. A summary is given in section 5.

M. Masoodian et al. (Eds.): APCHI 2004, LNCS 3101, pp. 1-8, 2004.

2 Skin Detection

Large number of image sources produces the needed images in RGB format. In many researches, the authors claim that other color spaces such as CIF-x, HSV are more appropriate than the RGB space [2,7,13,16,18]. It was shown that this is not true [11,23]. This implies that the transformation form RGB color to another color space is an extra processing step. Brand, J. stated that R/G > 1 and the red color is the predominant color in the human skin color [11]. This property in addition to other equations has been used to classify the skin color pixels. Our main observation is that when G component is subtracted from R component of the RGB color representation the pixels values for none-skin become relatively small whereas for skin pixels values are high. It is supposed that the image quality and resolution is sufficient enough. The next step is to automatically separate the two regions representing skin and none-skin regions. We need to find the best two values where the R-G values for the skin pixels reside. We observed that all R-G values are relatively small except for the skin pixels. We used tanh() function to saturates all R-G values. We recognized that R-G values start increasing sharply at the skin boundary pixels to give tanh() value of 1 which means that R-G is about 20. So we picked a lower threshold value of skin R-G values to be 20. By practice, we found the upper limit to be 80. We used Matlab 6.1 running on 1.7 GHZ CPU with 256 MB of RAM. The following summarizes the skin detection process:

- acquire an image in RGB
- calculate R-G
- if $20 < R\text{-}G < 80$ then R-G pixel is a skin otherwise non-skin

According to [13,15] most of the face databases designed for face recognition, usually contain grayscale images. Whereas collected images from WWW have properties that make them suitable for experiments [15]. So, we have chosen our test images to be from WWW and from different face databases to provide us with more generality [20-22]. Figure 1 (a-d) show the image of a human face before and after skin detection. This method can be used also with complex background as shown in figure 2 and figure 3.

3 Face and Eyes Locating and Tracking

After locating the skin region the largest object which is supposed to be the face is located. Its centroid , majoraxis and minoraxis lengths are determined. The best fitting ellipse is calculated. Objects with semi-skin color may be classified as skin objects which will produce some errors in the skin color classification process. In addition, the neck is not covered most of the time. To reduce the effect of these problems, some image properties can be used. First, the face is an elliptical. Second, the face will be most probably in the upper part of the human in a given image.

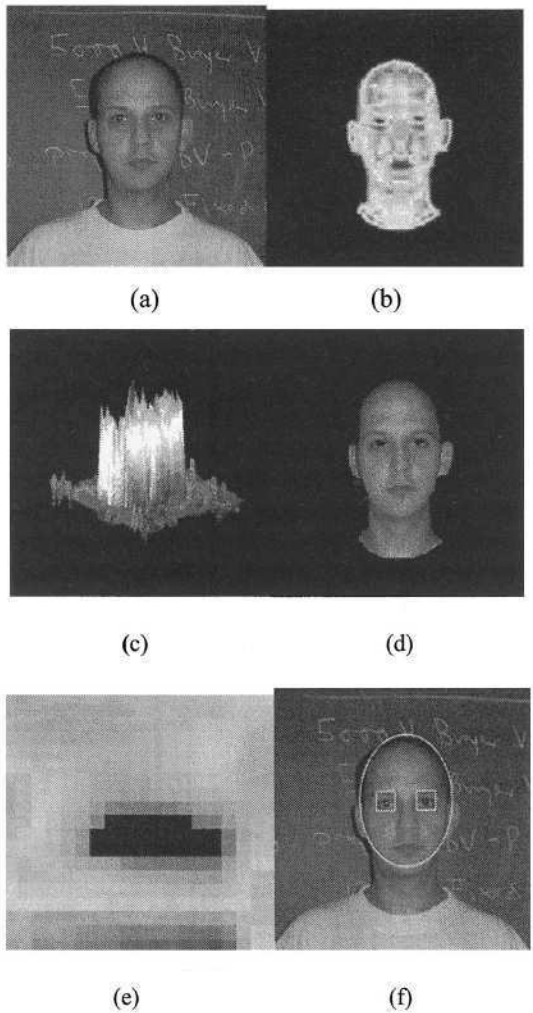
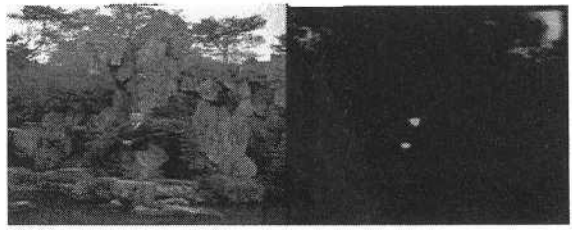


Fig. 1. Face locating. (a) original image. (b) R-G image. (c) R-G image in mesh style.(d) skin detection. (e) the used template. (f) face and eyes after detection

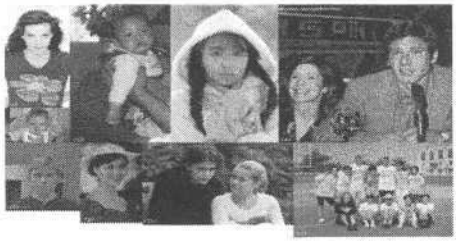
This is true for most of the applications that require skin detection. Also, there is a content relation between the height and the width of the human faces [1,19]. The centroid is then shifted a little upper which produce better ellipse fitting. The following summarizes the face locating steps:

- connected objects are found
- area, centroid, minoraxis and majoraxis are calculated for all objects
- the object with largest area is the candidate face
- centroid, minoraxis and majoraxis with the face's property that (majoraxis = 1.4 x minoraxis) are used for ellipse fitting



(a) (b)

Fig. 2. Images with small areas of skin can be processed too. (a) original image. (b) image after skin detection where face and hand are at the center



(a)

(b)

(c)

Fig. 3. Skin detection with complex background. (a) original image. (b) R-G image. (C) image after skin detection. Some detection errors can be seen

Simple MatLab functions such as bwLabel, regionprop(for area, centroid, majorAxis and minorAxis) were used in the above process. Once the face is located the next step is to locate the eyes. There are several methods which can be reviewed in [4,7,9,16,19,24]. Template matching is considered one the most famous one. However, building a good eye template is not a trivial step [3,4,7,10,11,16,24]. Using our R-G algorithm, we did not need to build our eye template form many sample images. Instead, one image is enough to manually construct a good eye template. The steps are follows:

- considering the upper half of the face
- template matching is done using square difference calculation
- the two minimas are the centers of the two eyes

Figure 4 shows the result of using this eye template and a larger template to locate the eyes of people using the databases [20-22]. We used the fact that the eyes are located in the upper half of the face to reduce the search window. Our simple method for face tracking is just to locate the best elliptical face as we briefly did then apply it for every frame. By this method the face will be tracked more rapidly and accurately. Figure 1 (e and f) show the template which was constructed using one image and the result of face and eyes detection.

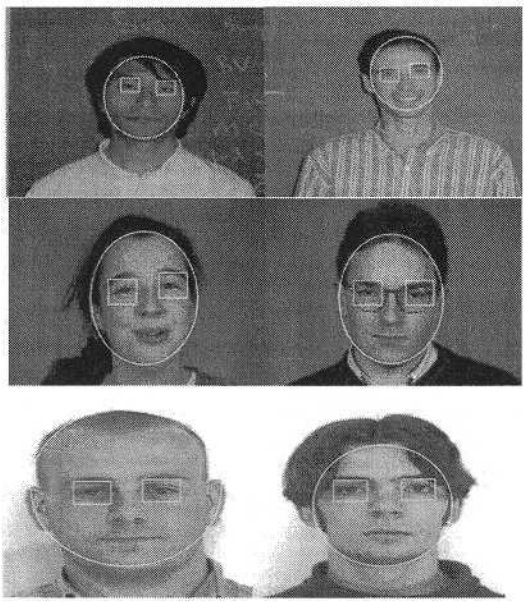


Fig. 4. Some people images after face and eyes locating

4 Results and Discussion

After applying our method to 67 faces images collected from [20-22], we reached more than 96% in face locating and 76% in eyes locating. Table 1 summarizes the