

Frontiers
in
Artificial
Intelligence
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VISUAL AFFECT RECOGNITION

Ioanna-Ourania Stathopoulou
George A. Tsihrintzis

IOS
Press

It is generally known that human faces, as well as body motions and gestures, provide a wealth of information about a person, such as age, race, sex and emotional state. This monograph primarily studies the perception of facial expression of emotion, and secondarily of motion and gestures, with the purpose of developing a fully automated visual affect recognition system for use in modes of human/computer interaction.

The book begins with a survey of the literature on emotion perception, followed by a description of empirical studies conducted with human participants and the construction of a 'face image database'. On the basis of this work, a visual affect recognition system was developed, consisting of two modules: a face detection subsystem and a facial expression recognition subsystem.

Details of this system are demonstrated and analyzed, and extensive performance evaluations and test results are provided. Finally, current research avenues leading to visual affect recognition via analysis of body motion and gestures are also discussed.



ISBN 978-1-60750-596-9 (print)

ISBN 978-1-60750-597-6 (online)

ISSN 0922-6 89 (print)

ISSN 1879-8314 (online)

2-4

VISUAL AFFECT RECOGNITION I.-O. Stathopoulou and G.A. Tsihrintzis

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Amsterdam • Berlin • Tokyo • Washington, DC

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ISBN 978-1-60750-596-9 (print)

ISBN 978-1-60750-597-6 (online)

Library of Congress Control Number: 2010930894

Publisher

IOS Press BV

Nieuwe Hemweg 6B

1013 BG Amsterdam

Netherlands

fax: +31 20 687 0019

e-mail: order@iospress.nl

Distributor in the USA and Canada

IOS Press, Inc.

4502 Rachael Manor Drive

Fairfax, VA 22032

USA

fax: +1 703 323 3668

e-mail: iosbooks@iospress.com

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PRINTED IN THE NETHERLANDS

VISUAL AFFECT RECOGNITION

Frontiers in Artificial Intelligence and Applications

Volume 214

Published in the subseries

Knowledge-Based Intelligent Engineering Systems

Editors: L.C. Jain and R.J. Howlett

Recently published in KBIES:

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- Vol. 210. O. Kutz, J. Hois, J. Bao, B. Cuenca Grau (Eds.), Modular Ontologies – Proceedings of the Fourth International Workshop (WoMO 2010)

ISSN 0922-6389 (print)
ISSN 1879-8314 (online)

PREFACE

Human faces, as well as human body motion and gestures, provide a wide range of information about a person's identity, race, sex, age, and emotional state. In this monograph, we study the perception of primarily facial expression of emotion and secondarily of motion and gestures. Our aim is to develop a fully automated visual affect recognition system, which could be useful in novel/future modes of human-computer interaction that include user affect recognition. Our studies begin with a survey of the literature on emotion perception from the scientific - psychological and medical - point of view. Based on these studies, we are led to the following conclusions: (1) a number of brain parts play a significant role in emotion perception and expression, (2) there are six 'basic emotions' that arise very commonly, namely: 'anger', 'disgust', 'fear', 'happiness', 'sadness' and 'surprise' and, (3) there is cultural specificity in emotion perception and expression. The latter assumption is further corroborated by two empirical studies that we conducted on humans. In these empirical studies, the participants were shown face images and asked to classify the emotions. The difference in the correct classification rates demonstrates that there is cultural specificity in the ways people express and recognize emotions. Moreover, from our empirical studies, we were able to identify the emotion classes that are present during a typical human-computer interaction session, namely 'happiness', 'sadness', 'surprise', 'anger', 'disgust', 'boredom-sleepiness', as well as the emotionless state that is referred to as 'neutral'. Towards building our visual affect recognition system, we constructed our own face image database. This database consists of two sets of face images, all in both front and side view: (1) low quality images acquired with use of web cameras and (2) high quality face images acquired with use of high resolution digital cameras. On the basis of these empirical studies, we developed our own visual affect recognition system which consists of two modules: (1) a face detection subsystem and (2) a facial expression recognition subsystem. Our face detection subsystem uses neural network-based classifiers. For our facial expression recognition subsystem, we considered neural network-based and other classifiers, but concluded that Support Vector Machine-based Classifiers demonstrated better results. Details of our visual affect recognition system, such as feature extraction, classifier design, are demonstrated and analyzed along with extensive performance evaluations and test results. Current research avenues in the directions of visual affect recognition via analysis of human body motion and gestures are also discussed.

ACKNOWLEDGEMENTS

A great portion of this monograph is based on the doctoral research of the first author, Dr. Ioanna-Ourania Stathopoulou, which was conducted under the supervision and advice of the second author, Prof. George A. Tsihrintzis. During the course of Dr. Stathopoulou's doctoral studies, the authors were supported by research funds of the General Secretariat of Research and Technology of the Greek government, under the auspices of the PENED-2003 basic research program. The authors acknowledge and appreciate this support greatly.

The authors also acknowledge Prof. Maria Virvou's advice on a number of issues and encouragement during the course of authoring this monograph, which have proved crucial.

Dr. Stathopoulou also thanks her fellow labmates in room 212 for various stimulating discussions, help, and encouragement, as well as for all the fun they had during their student years. However, her deepest gratitude goes to her family for their unflagging love and support throughout her life.

Prof. Tsihrintzis dedicates this monograph to his parents, wife and three daughters for their unconditional love and encouragement.

The authors are indebted to Prof. Lakhmi C. Jain of the University of Australia and Dr. Robert J. Howlett of University of Brighton for agreeing to include our monograph as a volume in the *Knowledge-based Intelligent Engineering Systems* subseries of the *Frontiers in Artificial intelligence and Applications* series of IOS Press which they are Editors of.

Finally, the authors are grateful to Mr. Maarten Fröhlich and the editorial staff at IOS Press for their wonderful work.

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University of Piraeus, Greece, June 2010

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