摘　要

人脸目标及其特征的检测和分析技术是一个特定内容的图像处理和模式识别问题。在复杂、非限定环境下检测大小和角度未知的人脸及其特征是一项比较困难的工作，主要原因是人脸结构和纹理变化较大，加上无约束背景下不可预知的光照成像条件以及人脸表面的某些遮挡因素如眼镜、胡须等的特殊变化，增加了目标及特征提取的困难。

作为解决上述问题所做的努力的一部分，我们在已经提出的“人脸重心模板”这一基于规则的技术基础之上，改进并发展了人脸重心模板技术，提出一种能够处理与适应光照变化的人脸重心模板技术。

改进的人脸重心模板匹配技术相对于原有的人脸检测有很大的优越性，主要表现在能够对人脸所处环境下的高光、偏光和低光光照变化进行一定程度的补偿与恢复，使检测精度获得相当大的提高，经实验验正，改进前与改进后的人脸重心模板技术在人脸目标的检测精度上提高了 15%。

基于改进的人脸重心模板技术，研究了相应人脸面部特征提取和检测技术。

就人脸面部特征提取而言，人脸的下眼睑和下颌边缘特征往往难以提取和表达，进而影响了进一步的人脸特征定位和分析工作。为此，本文提出了一个“广义尺度边缘”提取的框架，可以较好地解决诸如下眼睑和下颌这种或大或小尺度小下灰度缓慢变化构成的边缘提取问题。

在人脸面部特征定位这一方面，由于人脸重心模板技术内在的高级结构语义信息，使得人脸面部特征的检测和定位可以在一个相对正确的局部区域范围内开展更加细致深入的分析和识别工作。据此，设计了一个人眼瞳孔定位模板和相应的知识规则用以提取和定位眼部特征，包括眼睛部位的位置和大小，眼睛轮廓线的曲线参数描述等。

在以上两部分内容的基础之上，更进一步地考虑了一个很实际的“去伪存真”的人脸特征分析问题：通过对被检测人脸以及其面部特征的检测分析对人脸的真伪性和活性进行判别。本文讨论了基于知识规则的直方图技术和基于学习的 SVM 方法在卡通人脸上的真伪性分析和照片人脸上的活性判别问题上的应用及性能。

关键词：图像处理；模式识别；人脸重心模板；人脸检测；人脸特征检测；人脸真伪性分析 ；人脸活性判别分析

ABSTRACT

Human face and facial feature detection is a specific problem of pattern recognition. Detecting faces whose sizes, angles and locations are unknown in a complex background is a difficult task, for which the main reason is the variety of human face configuration and texture, as well as additional facial changes as glasses and mustache and unknown light condition.

As a part of the efforts to solve the problem, based on a novel technique of Human Face Center-of-Gravity Template (FCGT) Matching, we improved the FCGT technique, which can be used in detecting faces under strong illumination variations.

Improved FCGT technique has a significant advantage, which can make some compensation to illumination variations by strong, weak and side lighting conditions. Experiments show that improved FCGT technique increases 15% correct detection rate for face detection.

Based on improved FCGT technique, we suggest several techniques on facial features extraction and detection.

As for facial feature extraction, edges of lower eyelid and jaw are usually difficult to extract, which affect the succeeding work on location and analysis of facial features. We proposed a frame on general-scale-edge extraction, which can solve these problem well.

As for facial feature location, we design a pupil template and relative rules to localize eye region features, including position and size of eye, and shape description of eyelid.

Finally, a histogram rule based method and a SVM learning based method is suggested to solve the problem of removing sketch false faces and discriminating liveness of human faces.

Keywords: image processing, pattern recognition, face center-of-gravity template, face detection, facial feature location, face true-false analysis, liveness analysis