

摘 要

人体的皮肤颜色是人体的一个重要特征，肤色检测被广泛的应用于人脸跟踪、人脸检测、手语识别、敏感图像过滤等领域中，具有重要的理论研究意义和实际应用价值。因而近年来吸引了大量的研究人员对其进行研究，尤其是近十年来，肤色检测技术更是得到了长足的发展。但是，对目前肤色检测研究现状的分析表明肤色检测问题仍有待于更加深入的研究：1. 目前已经提出的肤色检测技术多采用阈值固定的肤色模型，缺乏对不同光照环境下、不同图像背景的自适应性；2. 模型参数多为离线固定，无法针对每幅图像形成具有针对性的模型；3. 对于图像中存在的大量混淆背景缺乏有效的去除手段，导致肤色误检率过高。

针对以上问题，本文试图在分割阈值自适应、动态肤色建模、混淆背景去除等方面进行探讨，以尽可能的提高肤色检测性能。具体而言，本文的主要研究工作包括：

1. 对于已有肤色检测算法进行了分类与概括，重点介绍了四种较具代表性的肤色检测算法，并在一个较大规模的数据集上比较了它们的实际检测性能。

2. 提出了一种基于统计颜色模型的自适应阈值肤色检测算法。根据图像的肤色概率分布直方图和四条启发式规则找到最优分割阈值候选点，然后利用 ANN 算法得到最优阈值，同时提出了一种图像关系运算，可以在一定程度上去除混淆背景。

3. 提出了一种人体肤色动态建模的检测方法。利用人脸检测结果，结合混合高斯模型，以人脸肤色为样本在线建立了具有针对性的人体肤色模型。

4. 提出了一种去除图像中混淆背景的有效方法。结合肤色概率方差直方图与混合高斯模型，采用逐段处理的方法去除图像中的多种混淆背景。

关键词：肤色检测；自适应阈值；统计颜色模型；动态肤色模型；混淆背景去除

Adaptive Skin Color Detection

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Skin color is an important feature of human, and it has been widely used in the area such as face tracking, face detection, hand recognition, objectionable images filtering system and so on. In the last decades, skin detection has been widely studied and many improvements have been achieved, however the state-of-the-art of skin detection are far from perfection. 1) Most of proposed methods employ skin models with fixed threshold, therefore are lack of adaption to the various illumination and image contents. 2) All the skin models are fixed offline, therefore lack of pertinence to the individual image. 3) The bothersome confusing backgrounds occurred frequently in images are not payed enough attentions, which play a major role in the false detection rate in the skin detecton.

For aforementioned reasons we try to discuss from three aspects to improve the performance of skin detection, including adaptive segmentation thresholds, dynamical skin modeling and confusing backgrounds eliminateion. The main contributions of the thesis includes:

1. A large skin images database are set up and conventional skin detection approaches are empirically studied on this database.
2. A skin detection method based on adaptive thresholds is proposed, which can find the optimal threshold candidates through combining skin probability distribution histograms (SPDH) and four heuristic clues, then an ANN classifer is used to find the optimal threshold. In order to eliminating confusing backgrounds an image relation operation is also introduced.
3. An on-line skin color model is presented. Since a human face has the similar skin color distribution with the human body, we can use the skin pixels in a detected face to build the skin color model of human body dynamically by GMM.
4. An effective confusing backgrounds elimination method is proposed. Through applying skin probability variance histogram and GMM, we can eliminate confusing backgrounds in images.

Keywords: skin color detection, adaptive threshold, skin probability map, dynamic skin model, confusing background elimination