Hand Gesture Recognition in Human-Computer Interaction

ICTU Student 177
Thai Nguyen University of Information and Communication Technology
Thai Nguyen University, Thai Nguyen, Vietnam
student177@ictu.edu.vn

***Abstract*—This thesis focuses on the development of a system for recognizing hand gestures in video, aiming to enable human-computer interaction through hand gestures. The system uses color and Haar-like feature-based approaches to detect and recognize hand gestures in various lighting conditions and hand shapes. The research evaluates the effectiveness of color normalization and Haar-like features in improving the accuracy and speed of hand gesture recognition. The system can detect hand gestures in both static images and webcam video. The study also discusses the challenges of hand detection, such as varying lighting conditions and hand shapes, and proposes combining multiple single-class AdaBoost classifiers based on Haar-like features to handle different hand shapes. The color normalization process is slow, taking an average of 600ms for a 640x480 image in JPG format, which limits the system's real-time processing capabilities.**

***Index Terms*—hand gesture recognition, color normalization, Haar-like features, image processing, video processing**

I. Introduction

The thesis provides an overview of methods for hand detection, including the use of specialized gloves and image/video processing techniques. It then delves into the challenges of hand detection in images, focusing on color and shape features. The research aims to develop a system capable of accurately detecting and recognizing hand gestures in various lighting conditions and hand shapes. The study reviews existing methods and highlights the need for a system that can handle diverse hand shapes and lighting conditions, which are common in real-world applications. The proposed system uses color normalization and Haar-like features to address these challenges [1].

II. Methods

The thesis describes the design of a system for hand gesture recognition, including color normalization, hand segmentation, and hand shape detection. It uses color spaces such as RGB, HSV, and YCbCr for color normalization. Haar-like features are also employed for shape and edge detection. The system is tested on both static images and webcam video. The color normalization process is slow, taking an average of 600ms for a 640x480 image in JPG format, which limits the system's real-time processing capabilities. The system can detect hand gestures with a recovery rate of up to 70.41%. The study also discusses the challenges of hand detection, such as varying lighting conditions and hand shapes, and proposes combining multiple single-class AdaBoost classifiers based on Haar-like features to handle different hand shapes [1].

Supervisor: ICTU Teacher 117, Thai Nguyen University of Information and Communication Technology.

III. Results

The results show that color normalization and Haar-like features can improve the accuracy of hand gesture recognition, especially in complex backgrounds. The system can detect hand gestures with a recovery rate of up to 70.41%. However, the color normalization process is slow, taking an average of 600ms for a 640x480 image in JPG format. The study also demonstrates that combining multiple single-class AdaBoost classifiers based on Haar-like features can enhance the system's ability to handle different hand shapes. The system can detect hand gestures in both static images and webcam video, but the slow color normalization process limits its real-time processing capabilities [1].

IV. Discussion

The thesis discusses the challenges of hand detection, such as varying lighting conditions and hand shapes. It suggests combining multiple single-class AdaBoost classifiers based on Haar-like features to handle different hand shapes. Additionally, it proposes normalizing color on clusters of pixels instead of individual pixels to reduce the time required for color normalization. The study also highlights the need for further research to improve the system's real-time processing capabilities. The proposed system uses color normalization and Haar-like features, but further improvements are needed to achieve real-time processing [1].

V. Conclusion

The research concludes that a good hand detection system should be able to accurately detect and recognize hand gestures in various lighting conditions and hand shapes. The proposed system uses color normalization and Haar-like features, but further improvements are needed to achieve real-time processing. The study suggests combining multiple single-class AdaBoost classifiers based on Haar-like features to handle different hand shapes and proposes normalizing color on clusters of pixels instead of individual pixels to reduce the time required for color normalization. These improvements could enhance the system's real-time processing capabilities and make it more suitable for practical applications [1].

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