

Digital image processing algorithms for face segmentation and eye detection

Graduates	Hofmann Dani	Lutz Christian
Examiner / Expert	Prof. Brändle Erwin, HSR Prof. Dr. Chang Chip Hong, NTU	Theo Scheidegger
Industrial Partner	NTU, Singapore	
Room	6.007 μ PLab	Embedded Systems

Kurzfassung der Diplomarbeit

Face segmentation, eye detection and eye tracking respectively have been an active area of research over the past few years. At the Nanyang Technological University (NTU).in Singapore many students engage in these issues. The goal of this research is the development of future applications such as human computer interaction (HCI), where handicapped persons can control the mouse pointer with their eyes, or an alert system, which warn a car driver of his drowsiness. For such applications it is necessary to detect the eyes in a stream of frontal facial images captured by a web cam.

In past projects a lot of experience with different techniques of image processing has been gathered. One of the modern methods focused on image segmentation is skin color detection, based on hierarchical neuronal networks or on a Bayesian classifier. These methods allow to detect skin colored areas in a digital image of a person and to segment the image into face ore non-face regions. This is a means to segment facial regions from the background, which facilitate e.g. the detection of the eyes.

In our diploma thesis we selected some of these modern methods and also took some ideas form previous diploma projects and implemented them all in the programming language C++. Then we plugged our new algorithm into an existing GUI and made some enhancement. The result is a complete application, where you can modify methods and parameters on runtime. The application is now suited to compare the results of different methods and thus can be used as real-time test system.

We also enhanced our algorithm in a manner that it can handle facial images with a tilt. To reach this goal a simplified convolution algorithm has been developed, whereby the upright position of a face can be determined. All implementations take into account that the overall computation time has to be in a reasonable range, which is necessary that the algorithm can deal with a video stream.

The algorithm is organized into a number of cascading stages. At each stage along the cascade the search area for potential eye-positions is narrowed down. Time and robustness analysis were made to qualify the different methods and algorithms at each stage.

