Design and Implementation of Image Processing and Compression Algorithms for a Miniature Embedded Eye Tracking System

Résumé du projet de recherche (Langue 1)
In this thesis proposal we consider the case of an embedded system connected to a CCD sensor inserted on glasses for precise eye tracking purposes. The goal is to propose and implement a video region of interest extractor and compression algorithm when considering the algorithm cost and the power consumption. A high resolution image should be compressed while keeping a precise definition of the pupil region of interest in order to post process pupil localization. The gaze data are the fastest and the most responsive of all signals from the human. It is expected to play a major role in the control of an increasingly large and complex digital world. SuriCog is a start-up on the market of precise eye tracking systems. They have developed algorithms that identify gaze direction by using the combination of the analysis of two systems: a camera mounted on glasses (WEETSY), close to one of the eyes, which determines pupil localization, and an external smart sensor (p-BOX) which localizes head direction. The combination of these two sources gives the gaze direction. In this thesis, we consider only the transmission of high resolution images from the embedded sensor to the remote system. This use-case permits to demonstrate the impact of the load balancing between a processor and FPGA considering the power consumption and the real time processing. A first implementation of the whole system consists in transmitting the video acquired by a high speed CCD sensor embedded on glasses to a remote system which processes it. Several real time algorithms are used to compute the gaze direction. Although the embedded system may process the frames on site, for instance to determine the position (x, y) of the pupil, and transmit only the result, some specific applications require the transmission of the whole frame to perform other kinds of analysis.

Résumé du projet de recherche (Langue 2)
This thesis focuses thus on the design of some real-time image processing (region of interest or saliency extractors) and compression algorithms for the pupil video sequences. Further, these video processing algorithms should implemented on processor and on FPGA and compare these implementations performances in terms of power consumption.