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Subject Area	Sensor, Actuator and Communication Systems
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Single Pass Blob Analysis

Design and Implementation on an FPGA

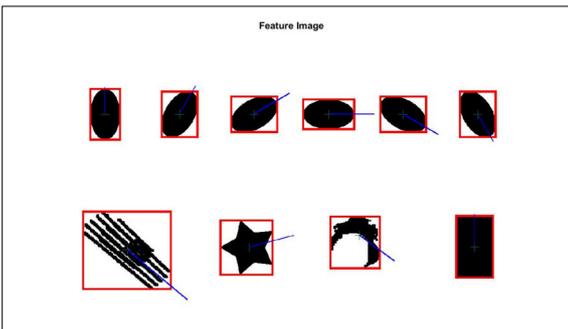


Camera system developed by Photonfocus

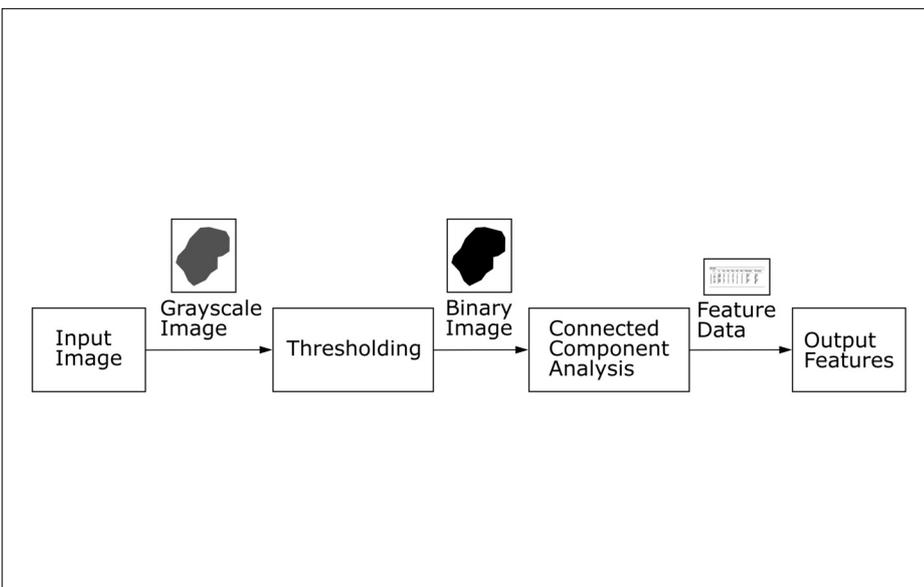
Introduction: Photonfocus is a Swiss company, which develops camera systems for industrial and metrology applications. In their devices, FPGAs are used to receive data from image sensors, process the data and interface with the imaging system. Through high speed interfaces, such as GigE Vision, USB Vision or CameraLink, image data is sent to the system CPU. Algorithms on the FPGA allow not only controlling the sensors and the interfaces but also pre-processing image data. Imaging systems can benefit a lot from a real time implementation in the FPGA. Photonfocus provides a variety of algorithms according to the customer needs. Blob Analysis is a standard algorithm in image processing. A blob is a region of pixels with similar brightness in an image. Such an object can be analysed to extract feature information. Possible features could be centroid, area or angle.

Objective: In this thesis, a blob analysis algorithm shall be implemented on an FPGA. A literature review has to be done to reveal existing implemented solutions. The focus shall be on single pass or stream based algorithms. These approaches do not need to store the whole image while processing. Extraction methods of different feature vectors shall be examined.

Result: Different kinds of single pass blob analysis algorithms were found in the literature. Hardware Performance considerations revealed that only parallel single pass algorithms can deliver the necessary throughput. Such a parallel algorithm was simulated and successfully validated using Matlab. Parallelization was achieved through separating the image into vertical slices. These slices are all processed in parallel. By combining feature results of each slice, blobs can be extracted from an image. A hardware implementation was planned and realised using VHDL. The correct execution of the algorithm was verified by simulation. The design was implemented on an FPGA and verification was made possible by using a Photonfocus camera system.



A binary image showing different clearly separated blobs. The image is overlaid with extracted feature data.



Block diagram of the implemented Blob analysis algorithm.