Live Demonstration: Hitting a Table Tennis Ball with a Programmable Vision-System-on-Chip

Jens Döge, Christoph Hoppe, Andreas Reichel, Peter Reichel, Nico Peter and Holger Priwitzer
Fraunhofer Institute for Integrated Circuits IIS, Germany
E-mail: jens.doege@eas.iis.fraunhofer.de

***Abstract*—This demonstration presents the benefits of using a Vision-System-on-Chip for image processing tasks with very high latency demands between image acquisition and processing.**

Concurrent Full Paper: J. Döge, C. Hoppe, A. Reichel, P. Reichel, N. Peter and H. Priwitzer: "Low-Latency Image Acquisition and Processing with a Programmable Vision-System-on-Chip", Paper ID: 2729

I. Demonstration

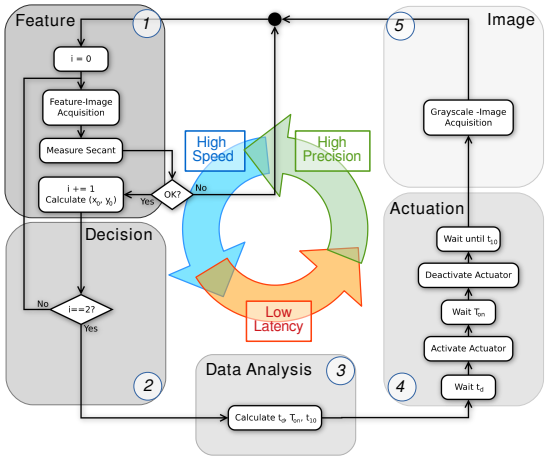

Figure 1. VSoC-Integrated Sensor and Actuator Control.

In contrast to conventional image processing systems consisting of an image sensor and a dedicated processing unit (PC and/or FPGA), using a Vision-System-on-Chip (VSoC) allows for implementing complex vision-based control tasks using solely the VSoC and its general-purpose interfaces, without having to rely on external hardware. Such an image processing task is schematically depicted in Figure 1. It can be roughly divided into five steps: feature acquisition (1), feature-based control (2), precise data analysis (3), actuation (4) and image acquisition (5).

It is not always necessary to include all of the above steps. However, with this demonstration, an exemplary implementation of this general procedure shall be illustrated.

II. Demonstration Setup

Figure 2 illustrates the demonstration setup. It consists of a pipe with a plunger at the bottom and an opto-mechanical setup with a VSoC-camera, a solenoid and background-illumination at the top.

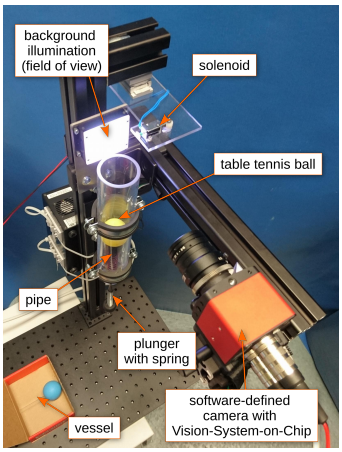

Figure 2. Experimental Setup.

The ball is put in motion within the tube by means of a spring with unknown preload determined by the visitor. At the exit of the pipe, the VSoC observes the passing ball and determines its position and velocity. The solenoid is triggered to deflect the ball, such that its trajectory ends within the vessel on the table. Additionally, a gray-value image is acquired at the estimated passing time, capturing the exact moment when the ball is hit by the plunger.

III. Visitor Experience

Visitors insert a table tennis ball into a transparent pipe with a spring-loaded plunger attached to at the bottom. By pulling and releasing the plunger, the ball is propelled upwards. The actuator's plunger deflects the ball to precisely hit a predetermined vessel independent of the initial velocity.

The whole image acquisition and processing task as well as the control of the actuator are performed by the software-programmable VSoC, without the need for additional hardware. To demonstrate the fusion of data processing and image acquisition based on calculated trigger information on the same VSoC, an image of the actuator hitting the ball is captured. Such a low-latency feedback loop greatly benefits from the VSoC: Not only would the required operations in the feature extraction and measurement phase exceed the processing capabilities of similarly low-power microcontrollers, but the highly adaptive sensor readout scheme also rules out the use of conventional imaging systems.