INTRODUCTION

CES-SWaP designs and manufactures rugged embedded computers for demanding applications like Aerospace and Defense. Its presence on these markets is conditioned by its visibility in exhibitions, hence the importance of showing good product demonstration for its most versatile products.

The system supposed to be demonstrated is a XMC board with a user FPGA a high-performance PowerPC designed for airborne application. The target demonstration is the display of safety-critical information in form of a primary flight display.

This information should be displayed in a safety-critical way on a consumer LCD like this provided 7-inch device.

REALIZATIONS

A custom 2-layered PCB is realized to interface the XMC with the LCD. It routes not only the video signals but also the power supply of the LCD and the backlight.

Its size and shape make it integrable directly behind the LCD case.

Besides the monitoring of status signals amongst the system, the validation module verifies the good sequencing of frames with help of an integrated signature.

The CPU, when generating the frame, overwrites some bits with an incrementing counter.

The FPGA retrieves this counter and checks its continuity right before displaying the frame. If the counter is stuck, it means that the CPU cannot ensure the good generation of frame anymore, and that the displayed information is out of date. When the counter jumps, it means that a frame has been skipped.

SOFTWARE

Development of a software-only OpenGL renderer library based on MesqIT and implementable on VxWorks. 3D graphics can be rendered in real time without GPU.

RESULTS

The final demonstration simulates the execution of a primary flight display @30fps. The application is quite resource consuming and therefore demonstrates the performances of the board.

Linux CPU usage : 88.1% PWR consumption : 866mW
VxWorks na 719mW

CONCLUSION

The LCD displays a Primary Flight Display-like demo at 30FPS and is driven by an FPGA that can detect errors like a skipped frame or a frozen video stream. These kinds of errors can be devastating for safety-critical information like flight information.

The big achievement was to build a software-only implementation of OpenGL on a RTOS like VxWorks. The board can now do real-time 3D rendering without GPU at 30FPS and still have 12% of its CPU usage available.

ACKNOWLEDGMENTS

Thanks to CES for giving me the opportunity to realize this project. Special thanks goes to Dan Niculescu (CES) and René Beuchat (EPFL) for supporting me during these six months.