A smart camera for High Dynamic Range imaging

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Abstract: This paper describes the HDR-ARtiSt hardware platform, a FPGA-based architecture that can produce a real- time high dynamic range video from successive image acquisition. The hardware platform is built around a standard low dynamic range (LDR) CMOS sensor and a Virtex 5 FPGA board. Our video camera system is able to achieve a real-time video rate of 30 frames per second for a full sensor resolution.

Standard cameras capture only a fraction of the information that is visible to the human eye. This is specifically true for natural scenes including areas of low and high illumination due to transitions between sunlit and shaded areas. When capturing such a scene, many cameras are unable to store the full Dynamic Range (DR) resulting in low quality video where details are concealed in shadows or washed out by sunlight. High Dynamic Range (HDR) imaging techniques appear as a solution to overcome this

issue by encoding digital video with higher than standard 24-bit RGB format, and then increasing the range of luminance that can be stored. By limiting the exposure time, the image loses lowlight detail in exchange for improved detail in bright areas. By increasing the exposure time, the image is only detailed in the dark areas because of the pixel saturation in bright areas.

A complete FPGA-based smart camera architecture is described, which produces a real-time High Dynamic Range (HDR) live video stream from multiple captures. A specific memory management unit has been defined to adjust the number of acquisitions to improve HDR quality.

This smart camera is built around a standard CMOS image sensor and a Xilinx FPGA. It embeds multiple captures, HDR processing, data display and transfer, which is an original contribution compared to the state of the art. The proposed architecture enables a real-time HDR video flow for a full sensor resolution (1.3 Mega pixels) at 60 frames per second."

Index Terms - High dynamic range, smart camera, pipeline processing, real-time systems, specific memory management core, video signal processing.