Live Demonstration: Real-time Auto-exposure Histogram Equalization Video-system Using Frequent Items Counter

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***Abstract*—In this demonstration, a real-time auto-exposure Histogram Equalization (HE) video-system is presented. The video histogram is extracted in each frame by the Frequent Items Counter (FIC) core. Based on the HE Transformation Function (HE-TF), the camera exposure value is adjusted to fit the current luminance condition. The proposed system was developed on the VEEK-MT-SoCKit with an FPGA chip of Altera Cyclone V SoC and a 5-Megapixel (5-MP) Charge Coupled Device (CCD). The video resolution is 1280×800. The monitor display rate is at 60Hz while the CCD capture rate is at 24.28Hz to 38.98Hz depend on the exposure value. The histogram, the transformation function, and the camera exposure value are changed in each frame to satisfy the real-time requirement.**

I. System Overview

The demonstration system in this paper was developed based on our previous works of FIC [1]–[3]. The FIC implementation was first given in the paper [1] in 2017. Later, the FIC architecture was improved further and published in the paper [2] in July of 2018. Lastly, in the same year, the journal paper [3] of FIC, which is the extent writing of the conference paper [2], was published for providing more details and comparison results. In this demonstration, the real-time video Histogram Generator (HG), one of the FIC applications, was developed. Then, based on the HG, a full video-system of HE with the auto-exposure feature was built. The block diagram of the proposed system is given in Fig. 1.

In Fig. 1, the DDR3-RAM stores the content that will be displayed on the monitor. The Bayer-decoder decodes the raw picture to the RGB-picture. The two HGs in the system produce two histograms of the before and after the HE process. The two HGs and the HE operate on the luminance (Y) value only. The HE produces the HE-TF based on the smooth HE algorithm in [4]. The HE-TF is transferred to the Auto-exposure, and also stored in the T-table. Based on the received

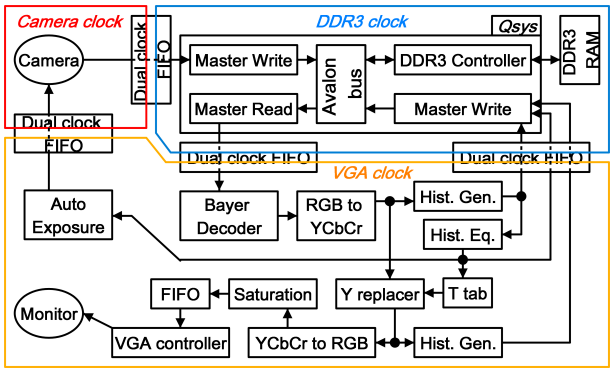

Fig. 1: The system block diagram on the VEEK-MT-SoCKit.

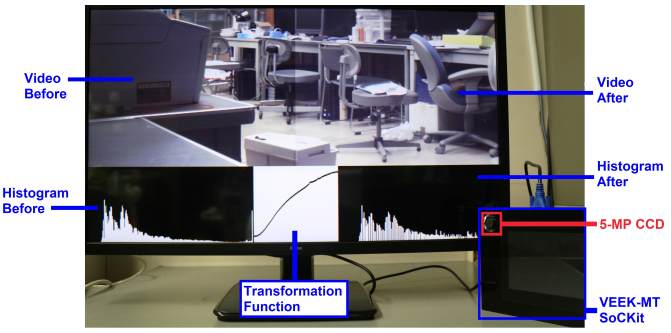

Fig. 2: The demonstration setup.

HE-TF, the Auto-exposure adjusts the camera exposure value according to the brightness condition of the current frame. The Y-replacer replaces the Y-value according to the T-table. Finally, the Saturation boosts up the RGB-color a little bit before the video stream is displayed on the monitor.

II. Demonstration Setup

Fig. 2 shows the demonstration setup with a VEEK-MT-SoCKit and a monitor. As seen in the figure, the histograms before and after the HE process were displayed on the bottom left and right corners, respectively. Furthermore, the HE-TF was also shown in between the two histograms. The video display area was divided into two parts of left and right to display the video before and after the HE process, respectively.

III. Visitor Experience

The visitors will learn about the real-time video histogram generator, one of the FIC applications. They can visualize the changes in the video histogram before and after the HE process. They can also visualize the changes in the HE-TF when the luminance condition is changed, which is further leading to a correction in the camera exposure time.

References

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