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

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ABSTRACT

In this paper, one of the Frequent Items Counter (FIC) applications, the real-time video Histogram Generator (HG), was developed. The video histogram was extracted in each frame by the HG module. Then, the full system of auto-exposure Histogram Equalization (HE) video-system was built which can operate in the real-time setting.

I. SYSTEM OVERVIEW

The system was based on our previous works of FIC [1-3]. The first architecture of FIC was given in 2017 [1]. Then, the improved architecture was published in July 2018 [2]. Lastly, in the same year of 2018, the journal paper [3], which is the extent writing of the conference paper [2], was published for providing more details and comparison results.

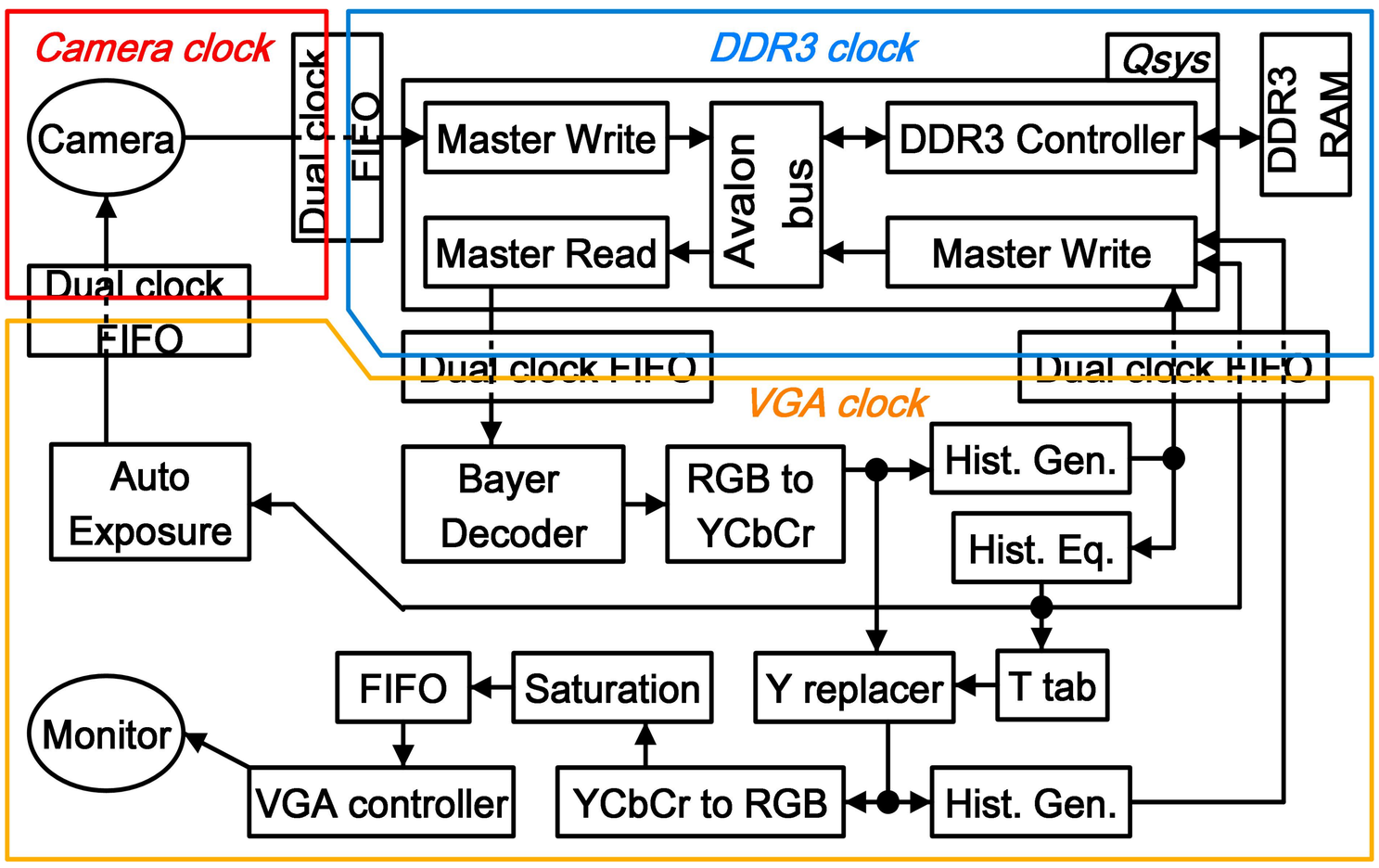

Fig. 1: The system block diagram.

Fig. 1 gives the block diagram of the proposed video-system of Histogram Equalization (HE) with the auto-exposure feature.

- ***DDR3-RAM:*** stores the display content.
- ***Bayer-decoder:*** decodes raw picture from the camera to RGB.
- ***Two Histogram Generators (HG):*** produce two histograms of the before and after the HE process. They operate on the luminance of the Y-value only.
- ***Histogram Equalization (HE):*** produces the Transformation Function (HE-TF) based on the smooth HE algorithm in [4].
- ***Y-replacer:*** replaces the Y-value according to the HE-TF stored in the T-table.
- ***Saturation:*** boots up the RGB-color a little bit before streaming out the video to display on the monitor.
- ***Auto-exposure:*** adjusts the camera exposure value based on the received HE-TF to fit the current luminance condition.

II. DEMONSTRATION SETUP

Fig. 2 gives the system is setup with an FPGA board and a monitor. The system used the VEEK-MT-SoCKit with the FPGA chip of Altera Cyclone V SoC and a 5-Megapixel (5-MP) Charge Coupled Device (CCD).

The figure shows the videos before and after the HE process, the histograms before and after the HE process, and the HE-TF in between the two histograms.

- The video resolution is 1280x800.
- The monitor display rate is at 60Hz.
- The CCD capture rate is at 24.28Hz to 38.98Hz depend on the exposure value.
- The histogram, the HE-TF, and the camera exposure value are changed in each frame to satisfy the real-time requirement.

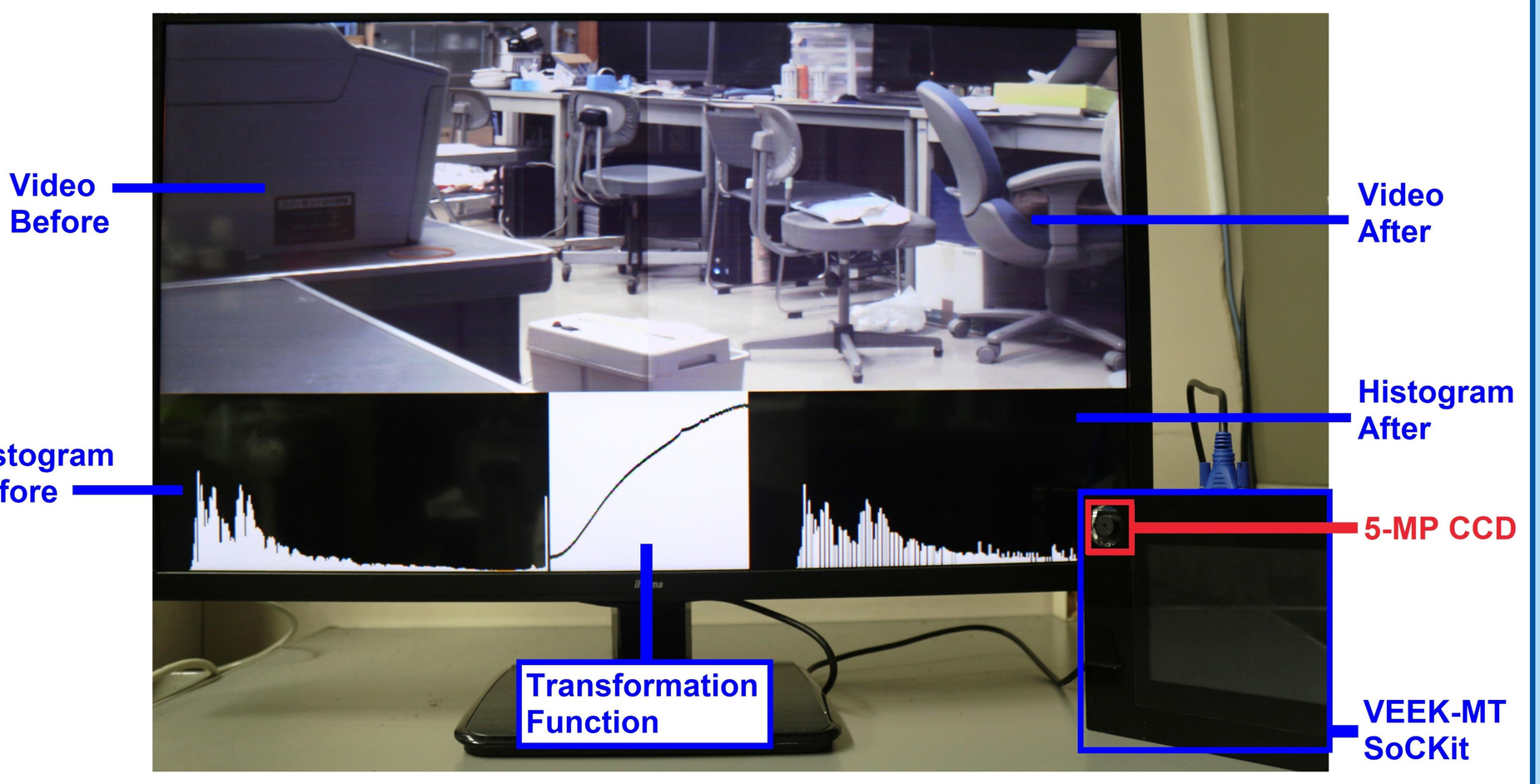

Fig. 2: The system setup.

REFERENCES

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