

ISP FPGA IP

Intel® ISP (Image Signal Processing) IP is designed to provide all the necessary correction tools.

Summary

Intel's ISP (Image Signal Processing) IP is designed to provide all the necessary correction tools to take the RAW image from the camera sensor array, interpolate, white balance, colour correct, noise reduce and condition the image prior to transmission or storage.

This IP is required to decode the output from a digital camera image sensor and turn it into a viewable image. Typically, the sensor output is not arranged in a conventional RGB raster image format, and instead uses a "Bayer" or similar arrangement of pixels.

Sensors often contain dead or noisy pixels and suffer from uneven lighting and other image quality anomalies that need to be resolved.

A typical implementation of the ISP Pipeline IP uses additional IP Cores such as the Omnitek High Dynamic Range (HDR) IP to condition the image and the Omnitek Warp IP to perform lens correction before the image is output.

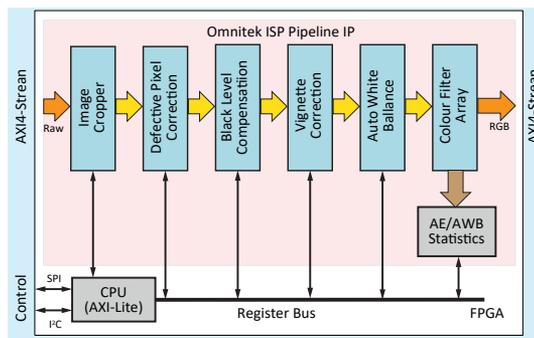


Figure 1. Functional block diagram of the ISP Pipeline IP

Key Features

- Very small FPGA resource footprint
- Very low latency (as little as 3 video lines)
- Input video format support for 8/10/12-bit Raw Sensor Image
- Image resolutions up to 4096 pixels x 2160 lines up to 120Hz
- Image Cropping
- Defective Pixel Correction
- Black Level Correction
- Auto White Balance
- Vignette correction
- Colour Filter Array Interpolation (for example; de-bayer or CFA)
- Focus Assist analysis
- Wide Dynamic Range support
- Bare Metal and Linux Support Libraries
- Available as an independent IP Core
- Fully compatible with Omnitek OSVP, HDR, Warp, Image Stitch and other IP Cores to provide a comprehensive image processing package.

Additional Requirements

The ISP IP requires an ARM processor or any AXI4-Lite CPU to allow configuration of each IP Block and to take measurements via the Register Bus.

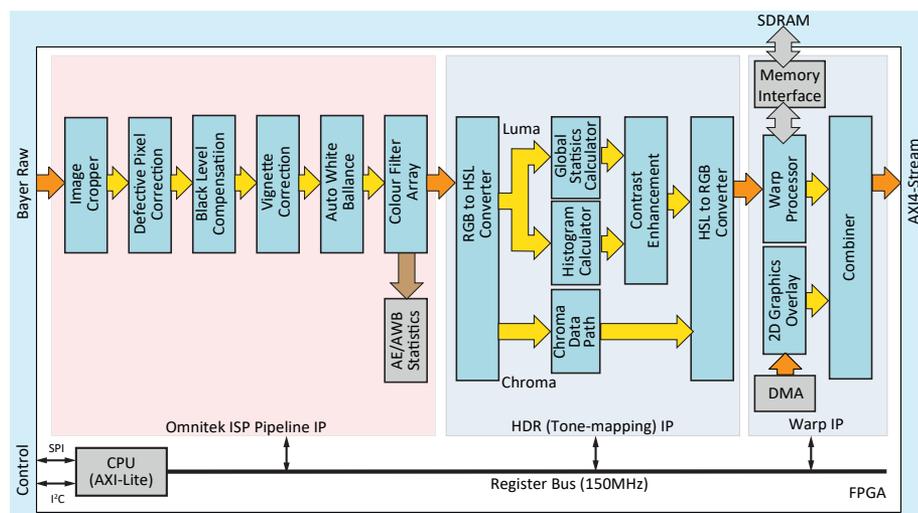


Figure 2. Typical Implementation of the ISP Pipeline IP

Applications

The ISP IP can be used in a range of applications including:

- Camera image correction
- Automotive image capture
- Medical imaging
- Multiple image stitching

IP Sub Blocks

The ISP pipeline contains multiple processing blocks to turn the sensor output into a high-quality image.

Image Cropper: The Image Cropper block is used to geometrically crop the sensor output to remove unwanted edges.

Defective Pixel Correction: The Defective Pixel Correction block is designed to identify and replace defective pixels by statistical analysis of each pixel and its neighbours.



Figure 3. Raw Image



Figure 4. Corrected Image

Black Level Correction: The Black Level Correction block is designed to remove any offset (or cast) that is present in the Red, Green and Blue components. Typically caused by sensor 'Dark Charge' and other artefacts.

Vignette Correction: The Vignette Correction block, which provides a 32x32 user defined matrix, is designed to remove intensity variations, typically circular in nature, caused by image aperture or zoom.



Figure 5. Raw Image



Figure 6. Corrected Image



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Auto White Balance: The Auto White Balance block is designed to compensate for the colour distortions caused by the light spectrum differences with respect to the CIE Standard Illuminant D65. This block also performs Auto Exposure.



Figure 7. Raw Image



Figure 8. Corrected Image

Colour Filter Array: The Colour Filter Array block is used to de-Bayer the image from the sensor to create a contiguous stream of Red, Green and Blue data.

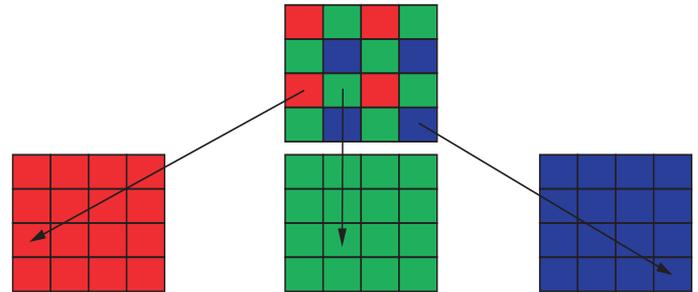


Figure 9. Colour Filter Array block diagram

AE/AWB Statistics feeds back information to the control software to allow the automatic correction of exposure and white balance.

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Intel provides a large range of complementary and modular in-house IP cores for video processing and connectivity. These IP cores can be used to create complete solutions for applications in Broadcast, ProAV, Aerospace/Defense, Medical, Automotive and more.

You can get more information on available video IP at www.intel.com/fpga-broadcast or contact an Intel sales representative for further inquiries.