HiISP

FAQs

Issue **03**

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About This Document

Purpose

This document provides the solutions to the problems during development.

Related Version

The following table lists the product version related to this document.

Product Name	Version
Hi3518	V100

Intended Audience

This document is intended for:

- Field application engineers
- Software engineers

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Alerts you to a high risk hazard that could, if not avoided, result in serious injury or death.
WARNING	Alerts you to a medium or low risk hazard that could, if not avoided, result in moderate or minor injury.
CAUTION	Alerts you to a potentially hazardous situation that could, if not avoided, result in equipment damage, data loss, performance deterioration, or unanticipated results.

Symbol	Description
TIP	Provides a tip that may help you solve a problem or save time.
NOTE	Provides additional information to emphasize or supplement important points in the main text.

Change History

Changes between document issues are cumulative. Therefore, the latest document issue contains all changes made in previous issues.

Issue 03 (2014-02-26)

This issue is the third release, which incorporates the following changes:

Chapter 1 FAQs

In section 1.2.22, the description of consistency variance is updated.

Section 1.2.32 to Section 1.2.35 are added.

Issue 02 (2013-09-25)

This issue is the second release, which incorporates the following changes:

Chapter 1 FAQs

In section 1.2.27 and 1.2.28, the solution is modified in the **Solution** field.

Sections 1.2.30 and 1.2.31 are added.

Issue 01 (2013-06-30)

This issue is the first release, which incorporates the following changes:

Chapter 1 FAQs

In section 1.2.1, a caution is added.

In section 1.2.2, a solution is added to the **Solution** field.

In section 1.2.7, the code in step 2 is modified, the original step 5 is deleted, and the value of **u16IrisStopValue** is changed in step 6 in the **Solution** field.

In section 1.2.16, descriptions are added to the **Solution** field.

In section 1.2.20, a solution is added based on cause 2 in the **Solution** field.

In section 1.2.21, the solution is modified in the **Solution** field.

Sections 1.2.23 to 1.2.29 are added.

Issue 00B01 (2013-02-05)

This issue is the first draft release.

Contents

1 FAQs

1.1 Video Input

1.1.1 How Do I Adjust the Horizontal Blanking Area of a VI Channel?

[Question]

When the Hi3516 connects to the SONY IMX036 sensor and SONY3193 image signal processor (ISP), the ISP outputs 3-megapixel pictures and the VI picture is scaled to 720 x 576. In this case, vertical pins bars are displayed on the picture, and the luminance and chrominance of the picture are separated.

[Analysis]

In the output timing of 3-megapixel pictures, the horizontal blanking area is small. When the picture is vertically scaled, the xxx_HBLANK_WIDTH register of the corresponding channel must be configured. The register value is calculated as follows:

$$\frac{\mathbf{Tline} - \mathbf{out\_width} \times \mathbf{Tbus}}{\mathbf{Tbus}}$$

Where,

- **Tline** is the time that the IPS outputs a line of the picture, including the active area time and blanking area time of the picture.
- **Out_width** is the width of the picture output by the ISP.
- **Tbus** is the clock cycle of the Hi3516 VI bus.

Here is an example assuming the following: The output picture size of the ISP is 2048x1536, the horizontal front blanking is 116, the horizontal back blanking is 68, and the pixel clock is 54 MHz. Then, **Tline** is **2232 x (1/54 MHz)**, **out_width** is **2048**, the Hi3516 VI bus clock is 220 MHz, and **Tbus** is **1/220** MHz. Therefore, the value of xxx_HBLANK_WIDTH is 7047.

[Answer]

Write a calculated result (for example **7047**) to xxx_HBLANK_WIDTH.

1.1.2 How Do I Connect the Sensor with the LVDS Output Interface to the Chip?

[Question]

The Hi3516 or Hi3517 cannot connect to a sensor with the low voltage differential signaling (LVDS) output interface by adjusting the timing interface.

[Answer]

Convert the data transferred over the LVDS output interface by using the field-programmable gate array (FPGA).

1.1.3 Why Does the Aptina AR0331 Sensor Provide 1080p60fps and 1080p30fps Libraries?

[Question]

When the frame rate of the AR0331 1080p60fps library is decreased by 1/2, the AR0331 1080p30fps library is obtained. Why does the Aptina AR0331 sensor provide an independent AR0331 1080p30fps library?

[Analysis]

The AR0331 sensor supports two types of data output interfaces: parallel interface and HiSPi interface. The parallel interface can directly connect to the Hi3516 or Hi3517 and supports 1080p30fps rather than 1080p60fps. The parallel interface corresponds to the 1080p30fps library. The data transferred over the HiSPi interface (LVDS level) needs to be converted by using an FPGA. The HiSPi interface supports 1080p60fps and 1080p30fps and corresponds to the 1080p60fps library.

[Answer]

Choose the library file according to the hardware design.

1.2 ISP

1.2.1 What Do I Do If Picture Has a Crack When the Ambient Luminance Changes?

CAUTION

This issue is resolved in SDK SPC040 or later.

[Symptom]

When the Hi3516 connects to an OV2715 sensor, if the ambient luminance changes and the exposure time and gain are updated during automatic exposure (AE), the picture has a black line that looks like a crack.

[Analysis]

The exposure time and gain of a sensor must be updated in the vertical blanking region. Otherwise, the upper and lower parts of a frame have different luminance. As a result, a bad frame occurs.

For most sensors, the exposure time and gain registers have shadow registers. You can write to these registers at any time. The sensors store the modification information in the shadow registers. After end of frame is detected, sensors update the values of target registers based on the modification information in the shadow registers. This ensures that updated values take effect in the vertical blanking region and no bad frames occur.

The OV2715 sensor does not support shadow registers. The modifications to sensor registers take effect immediately, which causes bad frames.

[Solution]

The OV2715 sensor adds the group write function. This function allows the values of a set of registers to be updated in the vertical blanking region of a frame.

In **cmos.c**, the code for updating registers is modified as follows

```
sensor_write_register(0x3212, 0x00);//EnableGroup0

//Add the sensor registers to be updated.

sensor_write_register(0x3212, 0x10);//EndGroup0

sensor_write_register(0x3212, 0xA0);//LaunchGrou0
```

1.2.2 What Do I Do If Images Flicker If the Ambient Luminance Changes When the SDK Uses MN34041, OV9712, or IMX104?

[Symptom]

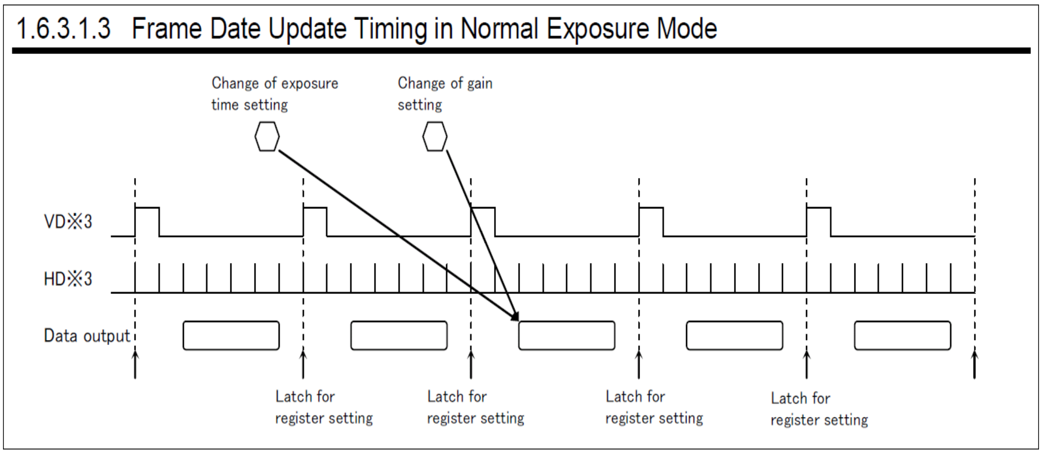
When the SDK uses the MN34041, OV9712, or IMX104 sensor, images flicker obvious if the ambient luminance changes. This problem does not exist when other sensors are used in the same SDK.

[Analysis]

These sensors update the shutter (exposure time) register at frame N. The updated value of the shutter register takes effect at frame N + 2, and the updated value of the gain register takes effect at frame N + 1. To ensure that the updated values of the shutter register and gain register take effect at the same time, you are advised to update the shutter register, and then update the gain register a frame later.

Figure 1-1 shows the timing of the Panasonic sensor.

Figure 1-1 Timing of the Panasonic sensor



[Solution]

- Call HI_MPI_ISP_SetAEAttr() to set **enFrameEndUpdateMode** to **1**. Then the ISP updates the shutter register a frame earlier than the gain register, and the updated values of the shutter register and gain register take effect at the same frame. In this case, you are advised to set an appropriate base frame rate to implement anti-flicker but not call the anti-flicker API of the ISP.
- For the OV9712 sensor, call HI_MPI_ISP_SetAEAttr() to set **enFrameEndUpdateMode** to **2**, and set the macro **CMOS_OV9712_ISP_WRITE_SENSOR_ENABLE** in **Ov9712_cmos.c** to **1**. In this way, the screen does not flicker when the OV9712 sensor is used, and the anti-flicker function is not affected. However, the I^2C speed affects the system performance. You can set the macro definition **I2C_DFT_RATE** in the I^2C driver **Hii2c.c** to **400000** to increase the I^2C read/write speed.

1.2.3 How Do I Set the Base Frame Rate?

[Symptom]

The required base frame rates vary depending on application scenario and product resolution.

[Analysis]

The frame rate can be calculated by using the following formula:

Pixel clock frequency (CLK) = Picture width x Picture height x Frame Rate

Note that the picture width is the sum of the widths of the active region and blanking region, and the picture height is the sum of the heights of the active region and blanking region.

When the pixel clock is fixed, you can change the widths and heights of the active region and vertical blanking region to obtain various output frame rates.

[Solution]

The following describes how to switch the frame rate between 25 fps and 30 fps by using the AR0331 sensor as an example.

If the pixel clock frequency is 74.25 MHz, the picture width is 2200 pixels, and the picture height is 1125 pixels, the following condition is met when the output frame rate is 30 fps:

74250000 = 2200 x 1125 x 30

To switch the output frame rate to 25 fps but retain the picture height, you need to change the picture width. The picture width is calculated as follows:

74250000/(25 x 1125) = 2640

That is, when the pixel clock is fixed at 74.25 MHz, the pixel width is set to 2640 pixels, and the picture height is set to 1125 pixels, the output frame rate is 25 fps.

The reference code is as follows:

```
voidcmos_fps_set (cmos_inttime_ptr_tp_inttime, constHI_U8fps)
{
    switch(fps)
    {
        default://default30fps
        case30:
            sensor_write_register(0x300C, 0x044C);//Update the
picture width.
            p_inttime->lines_per_500ms=1125*30/2;//Update the 50
Hz/60 Hz anti-flicker parameter.
        break;
        case25:
            sensor_write_register(0x300C, 0x0528);//Update the
picture width.
            p_inttime->lines_per_500ms=1125*25/2;//Update the 50
Hz/60 Hz anti-flicker parameter.
        break;
    }
}
```

1.2.4 How Do I Reduce the Frame Rate?

[Symptom]

The defective pixel correction module of the Hi3516 requires the output sensor frame rate of 5 fps.

In low illumination, customers want to extend the exposure time by reducing the frame rate for more picture details.

[Analysis]

See the formula in section 1.2.3 "How Do I Set the Base Frame Rate?"

[Solution]

By using the AR0331 sensor as an example, the following describes how to set the defective pixel module to normal mode or defective pixel detection mode:

```
Void setup_sensor(intisp_mode)
{
    if(0==isp_mode)/*ISP'normal'isp_mode*/
    {
sensor_write_register(0x300C, 0x044C);//Restore the frame rate to 30 fps.
    }
    else if(1==isp_mode)/*ISPpixelcalibrationisp_mode*/
    {
//Set the output frame rate to 5 fps by changing the picture width. For details about how to calculate the picture width, see section 1.2.3 "How Do I Set the Base Frame Rate?"
        sensor_write_register(0x300C, 0x19C8);
        sensor_write_register(0x3012, 0x0460);//Set the exposure time to the maximum value.
        sensor_write_register(0x3060, 0x1300);//Set the analog gain to the minimum value.
        sensor_write_register(0x305E, 0x0080);//Set the digital gain to the minimum value.
    }
}
```

You can reduce the frame rate based on the base frame rate by calling vblanking_calculate and cmos_vblanking_update. vblanking_calculate is used to calculate the height of the vertical blanking region, and cmos_vblanking_update is used to update the value of the vertical blanking region height register. The following describes how to reduce the frame rate for the 5-megapixel pictures of 9P031:

```
HI_U16vblanking_calculate(cmos_inttime_ptr_tp_inttime)
{
//full_lines_del records the picture height at the expected frame rate. The value 1944 is the height of the active region.
p_inttime->vblanking_lines=p_inttime->full_lines_del-1944;
//Return the exposure time of the current frame.
returnp_inttime->exposure_ashort;
}
voidcmos_vblanking_update(cmos_inttime_const_ptr_tp_inttime)
{
//Update the vertical blanking region height register of the sensor.
sensor_write_register(0x06, p_inttime->vblanking_lines);
}
```

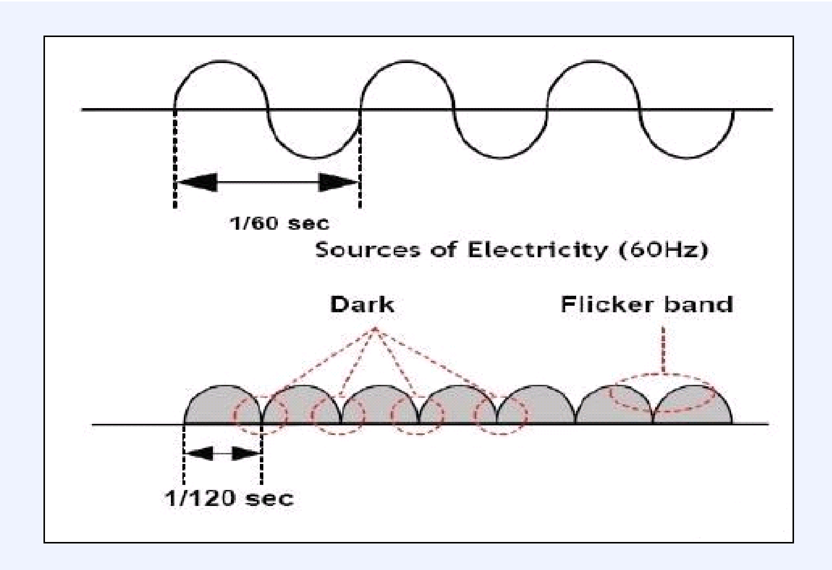
1.2.5 How Do I Implement 50 Hz/60 Hz Anti-Flicker for Various Sensors?

[Symptom]

When the default settings of the parameters for the HiSilicon SDK are used, anti-flicker does not work after being enabled.

[Analysis]

Figure 1-2 AC electricity waveform



As shown in Figure 1-2, even the sensor lines retain the same exposure time, their accumulated energy is different. The same line in the adjacent frames and the lines in the same frame have different luminance. As a result, the screen flickers.

If the exposure time is an integral multiple of the energy accumulation period, the entire luminance of a frame is even. Therefore, the exposure time must be an integral multiple of 1/100s at 50 Hz or an integral multiple of 1/120s at 60 Hz.

[Solution]

The Hi3516 ISP supports anti-flicker. The exposure time of the sensor is measured by line. The conversion ratio of lines to seconds varies depending on sensor type. You need to set the **lines_per_500ms** parameter to implement anti-flicker based on the sensor configuration. The value of **lines_per_500ms** is half of the line frequency. The parameter value is calculated as follows:

lines_per_500ms = Pixel clock frequency/(Picture width + Width of the horizontal blanking region)/2

1.2.6 What Do I do If Overexposure or Underexposure Occurs During AE?

[Symptom]

Overexposure or underexposure occurs during AE. The picture quality is not improved after the value of the **ae_compensation** parameter is adjusted.

[Analysis]

You can obtain the exposure time and gain in the current status by calling HI_MPI_ISP_QueryInnerStateInfo.

If the exposure effect is inconsistent with the current luminance, check the AI circuit. That is, the exposure time and gain are set to large values, but underexposure still occurs or the exposure time and gain are set to small values, but overexposure still occurs.

If the exposure effect is consistent with the current luminance, query the 5-segment histogram for AE. If the gray scales are too dense and the data of some segments is 0, check the picture width, picture height, and video input (VI) mask.

1.2.7 How Do I Check the AI Trigger?

[Symptom]

After the automatic iris (AI) trigger starts, the calibration program exits due to timeout or the return value of **Holdvalue** is incorrect.

[Analysis]

To check the AI trigger, perform the following steps:

Step 1 Check whether the iris can be turned on or off in either of the following ways:

Run the pulse-width modulation (PWM) driver:

```
./pwm_write040010001//The iris is turned on.
./pwm_write080010001//The iris is turned off.
```

Call the following application programming interfaces (APIs):

```
stAiAttr bIrisEnable=1;//Enable AI.
stAiAttr enIrisStatus=2;//The iris is turned off.
HI_MPI_ISP_SetAIAttr(&stAiAttr);
stAiAttr bIrisEnable=1;//Enable AI.
stAiAttr enIrisStatus=1;//The iris is turned on.
HI_MPI_ISP_SetAIAttr(&stAiAttr);
```

Step 2 Manually check whether the iris can be turned on or off smoothly, and determine the value range of **Holdvalue** by running commands similar to the following:

```
./pwm_write_0_400_1000_1//Turn on the iris.
./pwm_write_0_800_1000_1//Turn off the iris.
```

If the iris is turned on after **./pwm_write_0_400_1000_1** is executed and turned off after **./pwm_write_0_800_1000_1** is executed, the value of **HoldValue** ranges from 400 to 800.

```
./pwm_write_0_450_1000_1//Turn on the iris.
./pwm_write_0_750_1000_1//Turn off the iris.
```

....

If the iris is turned on after **./pwm_write_0_450_1000_1** is executed and turned off after **./pwm_write_0_750_1000_1** is executed, the value of **HoldValue** ranges from 450 to 750.

Decrease the value of pwm0 until the iris stops moving. Check whether the speed of turning on or off the iris decreases. The value range of pwm0 is the value range of **Holdvalue**.

Step 3 If exceptions occur in Step 1 and Step 2, check the AI circuit.

Step 4 Place the camera in a light box, provide a stable light source, and start the trigger.

Step 5 Restart the trigger.

If the trigger stops due to timeout, increase the value of **u16IrisTriggerTime**. After the trigger starts successfully, the value of **u32IrisHoldValue** is obtained. Then set **u16IrisStopValue** to the value of **u16IrisHoldValue** to speed up detection.

----End

1.2.8 How Do I Calibrate the AWB Coefficient and Color Correction Matrix Coefficient in Offline Mode?

[Symptom]

When the default color settings are used, color error occurs if automatic white balance (AWB) is tested by using Imatest under various light sources. The color error is obvious under the D65 light source.

[Analysis]

The optical filter affects the camera color. When various optical filters are used, color correction is required.

[Solution]

For details about how to calibrate AWB and the color correction matrix, see the *Calibration Tool User Guide*.

Note the following when capturing raw data:

- Ensure that the process of the client end is not running when you capture raw data by using ITTP_Stream.
- The saturation of the brightest white block of ColorChecker needs to retain at 80%. That is, after 8-bit raw data is captured, the average value range of the G components of the white block must be 200–210. If the luminance range is not appropriate, adjust the **ae_compensation** parameter by using ISP_Tool after starting the process of capturing raw data.

1.2.9 How Do I Detect Static Defective Pixels?

[Symptom]

The Hi3516 allows you to detect and correct a maximum of 1024 static defective pixels. Before detection, you must turn off the iris.

[Analysis]

To detect static defective pixels, perform the following steps:

Step 1 Check whether the functions of setup_sensor meet requirements (for details, see section 1.5), set the output frame rate of the sensor to 5 fps, set the exposure time to the maximum value, and set the gain to 0.

Step 2 Set the **u16BadPixelCountMin** and **u16BadPixelCountMax** parameter. You can set the parameters to rough values when initializing the sensor. For example, set **u16BadPixelCountMin** to **0x80** and **u16BadPixelCountMax** to **0x300**.

Step 3 Start to detect defective pixels.

Step 4 View the displayed information from the defective pixel detection module.

- If the detection is complete, set **u8BadPixelStartThresh** to the value of **u8BadPixelFinishThresh**, narrow the range of [CountMin, CountMax], and start the detection again. You will find that the detection time is reduced significantly.
- If the detection times out, the following similar information is displayed. It shows that the value fluctuates. This is because the values of **CountMin** and **CountMax** are inappropriate. You need to decrease the value of **CountMin**.

  .BAD_PIXEL_COUNT_LOWER_LIMIT2, b8

  .BAD_PIXEL_COUNT_UPPER_LIMIT1, 3ff

  .BAD_PIXEL_COUNT_LOWER_LIMIT2, b3

  .BAD_PIXEL_COUNT_UPPER_LIMIT1, 3ff

  .BAD_PIXEL_COUNT_LOWER_LIMIT2, b6

  .BAD_PIXEL_COUNT_UPPER_LIMIT1, 3ff

  .BADPIXELCALIBRATIONTIMEOUTc

Step 5 Call HI_MPI_ISP_GetDefectPixelAttr() to obtain the information about the defective pixel coordinates. Each time the camera restarts, you can call HI_MPI_ISP_SetDefectPixelAttr() to enable defective pixel correction and write the coordinate information to the memory in the ISP.

----End

1.2.10 What Do I Do If the Entire Sharpness Is Insufficient?

[Symptom]

The picture edges are blurry, which is similar to out of focus.

[Analysis]

The picture sharpness may be affected by the entire picture luminance, sharpness strength, denoising strength, or encoding bit rate. To locate the fault, do as follows:

- Check the sensor lens is clean, the lens film is removed, and the lens iris reaches the maximum scale.

- Check the picture luminance is appropriate. You can adjust the luminance by setting the **ae_compensation** parameter.
- Set the encoding bit rate to a high rate.
- Read the current sharpness strength by using the PC_Tool or manually set the sharpness strength to the maximum value.
- Disable the 2D and 3D denoising modules.

1.2.11 What Do I Do If Luminance Is Insufficient Under an Infrared Light?

[Symptom]

In low illumination, the picture is dark under an infrared light even the exposure time and gain are set to maximum values.

[Analysis]

Check the optical filter. Typically, the optical filter allows the lights at a wavelength of at most 650 nm. As the wavelength of most infrared lights is 850 nm, the optical filter filters them, which causes poor sensitivity effect.

You can increase the digital gain for the ISP.

[Solution]

Ensure that the IR-Cut is switched to nigh mode.

You can also enable lens shading and set the shading scale to 2. Then the ISP provides the digital gain two times of the normal mode.

1.2.12 How Do I Switch Old and New AE Algorithms?

[Symptom]

If a new AE algorithm is provided and the old AE algorithm is also available in the later version, how do I switch the AE algorithms?

[Analysis]

The ISP supports the new and old AE algorithms. You can select an AE algorithm by setting the underlying **mode pattern** parameter.

[Solution]

- Modify the load3516 script **insmod hi3516_isp.ko ae_alg=0**. "ae_alg=0" indicates that the old AE algorithm is used and "ae_alg=1" indicates that the new algorithm is used.
- Change the boundary threshold for the 5-segment histogram in **coms.c**. The threshold for the new AE algorithm is {0xD, 0x28, 0x60, 0x80}, and the threshold for the old AE algorithm is the original value.

1.2.13 Why Does the Picture Blink During AE When a WDR Sensor Works in WDR Mode?

[Symptom]

When a wide dynamic range (WDR) sensor such as 9M034 works in WDR mode, the picture blinks during AE. Then the picture becomes stable.

[Analysis]

In WDR mode, the dynamic range compression (DRC) module of the ISP is enabled and the default DRC strength is 0xFF. This increases the picture luminance. The darker a region is, the more the luminance is increased. When the picture luminance is being adjusted by using the AE algorithm, the DRC module provides negative feedback. AE is performed every two frames but the DRC adjustment takes effect for each frame, which causes the picture to blink.

In theory, the picture also blinks if the DRC module is enabled in linear mode. However, the DRC strength value is not large typically. You will not notice that the picture blinks.

[Solution]

To resolve this issue, reduce the DRC strength value.

1.2.14 What Do I Do If Vertical Bars Occur in Images in Low Illumination?

[Symptom]

Vertical bars occur in images in low illumination for some sensors such as AR0130 and ov9712.

[Analysis]

Vertical bars are fixed pattern noises (FPNs) of sensors become more and more when the digital gain of sensors increases. Currently, there is no limitation on the digital gain of sensors. The digital gain is great in low illumination mode. Therefore, vertical bars are obvious.

[Solution]

- Adjust the gamma to ensure that the gain of vertical bars is not too high. Gamma with higher contrast is recommended.
- Decrease the maximum digital gain of sensors by using the Demo. The severity of vertical bars varies according to different sensors. Decrease the maximum digital gain based on the actual situation. The maximum digital gain is recommended to be less than 2x.
- Decrease the frame rate and prolong the exposure time to reduce vertical bars.

1.2.15 How Do Improve Image Permeability?

[Symptom]

The image is blurry and its permeability is poor.

[Analysis]

Permeability is determined by definition and contrast. If the definition is not good or the contrast is low, the permeability is poor. Light leaking may also cause poor permeability.

[Solution]

- Cover the place that leaks light. Note that the back of the sensor may leak light.
- Increase contrast by setting gamma with higher contrast.
- Improve the definition. For details, see section 1.2.10 and section 1.2.20.

1.2.16 How Do I Set the Gamma with Higher Contrast?

[Symptom]

The contrast of the picture is low and the picture is blurry.

[Analysis]

Contrast is very important for transparency. The default gamma table has lower contrast, which is good to display details in dark regions. If higher contrast is required, adjust the gamma table.

[Solution]

- Adjust the gamma table. Higher contrast indicates higher saturation. Adjust the target value of saturation when you use different gamma tables.
- Default gamma table:

  0, 120, 220, 310, 390, 470, 540, 610, 670, 730, 786, 842, 894, 944, 994, 1050,

  1096, 1138, 1178, 1218, 1254, 1280, 1314, 1346, 1378, 1408, 1438, 1467, 1493, 1519, 1543, 1568,

  1592, 1615, 1638, 1661, 1683, 1705, 1726, 1748, 1769, 1789, 1810, 1830, 1849, 1869, 1888, 1907,

  1926, 1945, 1963, 1981, 1999, 2017, 2034, 2052, 2069, 2086, 2102, 2119, 2136, 2152, 2168, 2184,

  2200, 2216, 2231, 2247, 2262, 2277, 2292, 2307, 2322, 2337, 2351, 2366, 2380, 2394, 2408, 2422,

  2436, 2450, 2464, 2477, 2491, 2504, 2518, 2531, 2544, 2557, 2570, 2583, 2596, 2609, 2621, 2634,

  2646, 2659, 2671, 2683, 2696, 2708, 2720, 2732, 2744, 2756, 2767, 2779, 2791, 2802, 2814, 2825,

  2837, 2848, 2859, 2871, 2882, 2893, 2904, 2915, 2926, 2937, 2948, 2959, 2969, 2980, 2991, 3001,

  3012, 3023, 3033, 3043, 3054, 3064, 3074, 3085, 3095, 3105, 3115, 3125, 3135, 3145, 3155, 3165,

  3175, 3185, 3194, 3204, 3214, 3224, 3233, 3243, 3252, 3262, 3271, 3281, 3290, 3300, 3309, 3318,

  3327, 3337, 3346, 3355, 3364, 3373, 3382, 3391, 3400, 3409, 3418, 3427, 3436, 3445, 3454, 3463,

  3471, 3480, 3489, 3498, 3506, 3515, 3523, 3532, 3540, 3549, 3557, 3566, 3574, 3583, 3591, 3600,

  3608, 3616, 3624, 3633, 3641, 3649, 3657, 3665, 3674, 3682, 3690, 3698, 3706, 3714, 3722, 3730,

  3738, 3746, 3754, 3762, 3769, 3777, 3785, 3793, 3801, 3808, 3816, 3824, 3832, 3839, 3847, 3855,

  3862, 3870, 3877, 3885, 3892, 3900, 3907, 3915, 3922, 3930, 3937, 3945, 3952, 3959, 3967, 3974,

  3981, 3989, 3996, 4003, 4010, 4018, 4025, 4032, 4039, 4046, 4054, 4061, 4068, 4075, 4082, 4089, 4095
- Gamma table with high contrast:

0, 54, 106, 158, 209, 259, 308, 356, 403, 450, 495, 540, 584, 628, 670, 713, 754, 795, 835, 874, 913, 951, 989, 1026, 1062, 1098, 1133, 1168, 1203, 1236, 1270, 1303, 1335, 1367, 1398, 1429, 1460, 1490, 1520, 1549, 1578, 1607, 1635, 1663, 1690, 1717, 1744, 1770, 1796, 1822, 1848, 1873, 1897, 1922, 1946, 1970, 1993, 2017, 2040, 2062, 2085, 2107, 2129, 2150, 2172, 2193, 2214, 2235, 2255, 2275, 2295, 2315, 2335, 2354, 2373, 2392, 2411, 2429, 2447, 2465, 2483, 2501, 2519, 2536, 2553, 2570, 2587, 2603, 2620, 2636, 2652, 2668, 2684, 2700, 2715, 2731, 2746, 2761, 2776, 2790, 2805, 2819, 2834, 2848, 2862, 2876, 2890, 2903, 2917, 2930, 2944, 2957, 2970, 2983, 2996, 3008, 3021, 3033, 3046, 3058, 3070, 3082, 3094, 3106, 3118, 3129, 3141, 3152, 3164, 3175, 3186, 3197, 3208, 3219, 3230, 3240, 3251, 3262, 3272, 3282, 3293, 3303, 3313, 3323, 3333, 3343, 3352, 3362, 3372, 3381, 3391, 3400, 3410, 3419, 3428, 3437, 3446, 3455, 3464, 3473, 3482, 3490, 3499, 3508, 3516, 3525, 3533, 3541, 3550, 3558, 3566, 3574, 3582, 3590, 3598, 3606, 3614, 3621, 3629, 3637, 3644, 3652, 3660, 3667, 3674, 3682, 3689, 3696, 3703, 3711, 3718, 3725, 3732, 3739, 3746, 3752, 3759, 3766, 3773, 3779, 3786, 3793, 3799, 3806, 3812, 3819, 3825, 3831, 3838, 3844, 3850, 3856, 3863, 3869, 3875, 3881, 3887, 3893, 3899, 3905, 3910, 3916, 3922, 3928, 3933, 3939, 3945, 3950, 3956, 3962, 3967, 3973, 3978, 3983, 3989, 3994, 3999, 4005, 4010, 4015, 4020, 4026, 4031, 4036, 4041, 4046, 4051, 4056, 4061, 4066, 4071, 4076, 4081, 4085, 4090, 4095, 4095

- Gamma table with higher contrast:

0, 27, 60, 100, 140, 178, 216, 242, 276, 312, 346, 380, 412, 444, 476, 508,
540, 572, 604, 636, 667, 698, 729, 760, 791, 822, 853, 884, 915, 945, 975, 1005,
1035, 1065, 1095, 1125, 1155, 1185, 1215, 1245, 1275, 1305, 1335, 1365, 1395, 1425, 1455, 1485,
1515, 1544, 1573, 1602, 1631, 1660, 1689, 1718, 1746, 1774, 1802, 1830, 1858, 1886, 1914, 1942,
1970, 1998, 2026, 2054, 2082, 2110, 2136, 2162, 2186, 2220, 2244, 2268, 2292, 2316, 2340, 2362,
2384, 2406, 2428, 2448, 2468, 2488, 2508, 2528, 2548, 2568, 2588, 2608, 2628, 2648, 2668, 2688,
2708, 2728, 2748, 2768, 2788, 2808, 2828, 2846, 2862, 2876, 2890, 2903, 2917, 2930, 2944, 2957,
2970, 2983, 2996, 3008, 3021, 3033, 3046, 3058, 3070, 3082, 3094, 3106, 3118, 3129, 3141, 3152,
3164, 3175, 3186, 3197, 3208, 3219, 3230, 3240, 3251, 3262, 3272, 3282, 3293, 3303, 3313, 3323,
3333, 3343, 3352, 3362, 3372, 3381, 3391, 3400, 3410, 3419, 3428, 3437, 3446, 3455, 3464, 3473,
3482, 3490, 3499, 3508, 3516, 3525, 3533, 3541, 3550, 3558, 3566, 3574, 3582, 3590, 3598, 3606,
3614, 3621, 3629, 3637, 3644, 3652, 3660, 3667, 3674, 3682, 3689, 3696, 3703, 3711, 3718, 3725,
3732, 3739, 3746, 3752, 3759, 3766, 3773, 3779, 3786, 3793, 3799, 3806, 3812, 3819, 3825, 3831,
3838, 3844, 3850, 3856, 3863, 3869, 3875, 3881, 3887, 3893, 3899, 3905, 3910, 3916, 3922, 3928,
3933, 3939, 3945, 3950, 3956, 3962, 3967, 3973, 3978, 3983, 3989, 3994, 3999, 4005, 4010, 4015,
4020, 4026, 4031, 4036, 4041, 4046, 4051, 4056, 4061, 4066, 4071, 4076, 4081, 4085, 4090, 4095, 4095

CAUTION

The preceding three gamma tables apply only to the linear mode. In WDR mode, if you want to use the gamma tables that have the same effect as those in linear mode, generate the gamma tables by using the following Matla code:

```
    % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % 
% function gamma_wdr = linear2wdr(gamma_lin, size)
% get gamma_RGB_wdr curve from gamma_RGB_linear curve
%
% gamma_lin: input, gamma curve in linear mode
% size     : input, the size of gamma curve
% gamma_wdr: output, gamma curve in wdr mode
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % 

    function gamma_wdr = linear2wdr(gamma_lin, size);

x = [0:size-1];

y = x./(size-1);
y = y.^2;
y = y.*(size-1);

    for i = 1:(size-1)
   a = fix(y(i));
   b = y(i)-a;
   gamma_wdr(i) = (1-b) * gamma_lin(a+1) + (b) * gamma_lin(a+2);
end

gamma_wdr(size) = gamma_lin(size);
                  gamma_wdr = uint16(gamma_wdr);
```

1.2.17 What Do I Do If a Yellow Concentric Circle Occurs in the Middle of the Image Output by OV9712?

[Symptom]

A color cast concentric circle occurs in the middle of OV9712. The circle is yellow.

[Analysis]

OV9712 CRA does not match with the monitoring lens, which leads to color cast.

[Solution]

- You can solve this problem by using the lens shading correction module in ISP. **cmos.c** of OV9712 has a group of default correction parameters. The lens shading is closely related to lens. The default parameters cannot perfectly match each type of lens. You need to correct parameters by using your lens. In lens parameters, parameters of the lens shading correction module are greatly affected by the rear focus length and the size of the iris.

- In low illumination, if you use correction parameters in normal illumination, loud noise is generated and ambient brightness is higher. Use the correction table limiting the maximum gain or disable lens shading correction function in low illumination.

1.2.18 How Do I Solve the Color Cast Problem?

[Symptom]

Color cast occurs in the picture. Generally, the cast is red.

[Analysis]

Color cast occurs due to the optical filter. Currently, ISP parameters are adjusted for the optical filter with the maximum frequency of 635 nm. Therefore, for some Demo optical filters with the maximum frequency of 650 nm, red cast occurs. Red cast is more common when the infrared light such as low color temperature light (incandescent) and sunlight is strong.

[Solution]

If you use your own optical filter to correct color again, the model of the reference optical filter is IRC30 and 650 nm±5 nm.

1.2.19 What Do I Do If Brightness and Contrast Are Low in Low Illumination?

[Symptom]

Brightness is lower than that of compared benchmark in low illumination.

[Analysis]

- Cause 1: Irises of lens are different. The larger the F value, the greater the iris is, and more luminance flux reaches the sensor.
- Cause 2: Sensors are different. The differences of the optical-to-electrical (O/E) efficient conversion determine the luminance and contrast in low illumination.
- Pause 3: Brightness of the image is different from the benchmark because the brightness value of the image is low. The values of brightness and contrast of some products are modified to improve brightness.
- Cause 4: The frame rate of some products decreases in low illumination and the exposure time is prolonged. Therefore, the picture is brighter.

[Solution]

- For cause 1: Compare the definition by using the same lens (the same vendor and the same model).
- For cause 2: Compare the definition by using the same sensor.
- For cause 3: Adjust the color space conversion (CSC) of the VI. You are advised to increase brightness to improve the brightness of the entire picture and increase contrast to improve the contrast of entire picture.
- For cause 4: You can manually decrease the frame rate by using the Demo, which is not recommended in actual application.

1.2.20 What Do I Do If the Definition Is Low in Illumination?

[Symptom]

The definition is low in low illumination.

[Analysis]

- Cause 1: The definition is closely related to lens. The focal length and object distance affect the definition. The depth of field is great if the focal length is short. The depth of field is great if the object distance is long.
- Cause 2: The ISP software has default adjustment mechanism. When the noise is high, sharpening strength automatically decreases and denoising strength increases. The definition decreases in low illumination due to this mechanism.

[Solution]

- For cause 1: Compare the definition by using the same lens (the same vendor and the same model).
- For cause 2: The adjustment mechanism has open parameters. You can balance the definition and denoising effect as required. In low illumination, you can increase the 3D denoising strength to reduce noises.

1.2.21 What Do I Do If the Color is Over Bright in Low Illumination?

[Symptom]

The color is over bright in low illumination.

[Analysis]

As customers like pictures with bright colors, the default saturation of the Demo is high.

[Solution]

Set the saturation based on gains by using the saturation adjustment mechanism.

1.2.22 What Are the Appropriate Initialization Parameter Values for the AI Calibration Program?

[Symptom]

The message "timeout" is displayed when the AI calibration program is running. Then the program exits.

[Analysis]

- A timeout error occurs for the following reasons:
  - The values of **u16IrisCloseDrive** and **u16IrisStopValue** are too small. As a result, the iris is always opened.
  - The value of **u16IrisTriggerTime** is too small. In most cases, the default value of **u16IrisTriggerTime** is used.

The principle of the AI algorithm is that the iris is automatically controlled based on brightness variance in the current environment.

Before using an IP camera lens with AI, you must perform AI correction.

The following describes the definitions and parameters related to AI. For details, see the *HiISP Development Reference*.

- Definitions and parameters
  - **u16IrisCloseDrive** is used to close the iris and is an input parameter for AI correction. A larger parameter value indicates a faster speed for closing the iris. The parameter value cannot be too large. When the iris is slowly closed, the configured value is the optimal value.
  - **u32IrisHoldValue** is used to retain the current status of the iris and is an output parameter for AI correction.
  - **u16IrisStopValue** is used to set the initial value for retaining the current status of the iris and is an input parameter for AI correction. If the initial value is greater than or less than the **u32IrisHoldValue** value, the AI calibration program searches for the actual **u32IrisHoldValue** value for multiple times.
  - **u16IrisTriggerTime** is used to set the maximum correction time and is an initialization parameter. The parameter value unit is frame. If the **u16IrisTriggerTime** value is exceeded, a timeout error occurs.
- Implementation of AI correction

  The AI calibration program drives AI hardware to perform correction by using the PWM module. The AI calibration program first opens the iris to the largest extent and records the luminous flux. Note that the luminous flux is the maximum value.

  Then **u16IrisCloseDrive** is set to close the iris. When the luminous flux is less than 1/4 of the maximum value, the current luminous flux is recorded as **illumination_a** and **u16IrisStopValue** is set. Several frames later, the current luminous flux is recorded as **illumination_b**. At last, **illumination_a** and **illumination_b** are compared as follows:
  - If **illumination_a** is equal to **illumination_b** or their difference is small, the iris is stable, and the **u32IrisHoldValue** value is equal to the **u16IrisStopValue** value.
  - If **illumination_b** is less than **illumination_a**, the iris is still being closed, and the current **u16IrisStopValue** value is greater than the actual **u32IrisHoldValue** value. In this case, the program decrease the **u16IrisStopValue** value and compares **illumination_a** with **illumination_b** again.
  - If **illumination_b** is greater than **illumination_a**, the iris becomes larger, and the current **u16IrisStopValue** value is less than the actual **u32IrisHoldValue** value. In this case, the program increases the **u16IrisStopValue** value and compares **illumination_a** with **illumination_b** again.

[Solution]

Set appropriate values of **u16IrisStopValue** and **u16IrisCloseDrive**.

- The values of **u32IrisHoldValue** and **u16IrisCloseDrive** vary according to AI hardware no matter whether the AI hardware is from the same lot. This is the consistency variance feature of electronics. Before using the AI hardware of the same lot, you need to select samples, obtain their **u32IrisHoldValue** values, discard abnormal values, and then calculate the average value after correction. The average value of **u32IrisHoldValue** is used as the initial value of **u16IrisStopValue**, which accelerates AI correction. If there are consistency variances between AI hardware of the same lot, the **u16IrisStopValue** and **u16IrisCloseDrive** values of the AI hardware are quite different. In this case, set **u16IrisStopValue** to a value that is slightly less than the minimum value, and set **u16IrisCloseDrive** to a value that is slightly greater than the maximum value. In this way, the results can be automatically corrected but correction may be slow for some lenses.

- To obtain the initial value of **u16IrisCloseDrive**, run the PWM program, and view the open and close status of the iris.
- To obtain the initial value of **u16IrisStopValue**, determine the maximum value for opening the iris and the minimum value for closing the iris. Any value between the maximum and minimum values is the initial value of **u16IrisStopValue**.

1.2.23 What Do I Do If the Picture Is Not Clear or White Borders Appear on Object Edges?

[Symptom]

The picture is not clear or white borders appear on the edges of objects such as fonts or leaves.

[Analysis]

The definition depends on the following two factors when the picture is focused:

- Denoising strength. Higher denoising strength indicates more blurry pictures.
- Sharpen strength. Higher sharpen strength indicates clearer pictures.

Typically, white borders appear on object edges because the sharpen strength is too high.

[Solution]

Adjust the picture definition by setting the denoising strength and sharpen strength:

- The Hi3518 allows you to set the denoising strength based on gains by calling HI_MPI_SetDenoiseAttr(). Higher denoising strength indicates that more noises are processed and more details are lost. The sensor noises increase when the gain increases. To retain more details, you are advised to increase the denoising strength when the gain increases and set lower denoising strength under a low gain. The following uses the **Aptina_cmos.c** driver of the Aptina sensor as an example. In **Aptina_cmos.c**, **snr thresh** in **st_isp_agc_table** of static cmos_isp_agc_table is **{0x23, 0x2c, 0x34, 0x3e, 0x46, 0x4e, 0x54, 0x54}**. When the sensor gain ISO is 100, the denoising strength is 0x23; when the sensor gain ISO is 200, the denoising strength is 0x2c; when the sensor gain ISO is 400, the denoising strength is 0x34, and so on.

  In ***xxx*_cmos.c**, the values of **snr_thresh** in **st_isp_agc_table** are default values. You can change the default values based on the application scenario or call HI_MPI_SetDenoiseAttr().
- The Hi3518 allows you to set the sharpen strength by calling HI_MPI_ISP_SetSharpenAttr(). Higher sharpen strength results in higher sharpness, more obvious white borders, better permeability, and more noises. Sharpness adjustment involves sharpness enhancement of object edges and flat regions. When the sharpness of flat regions increases, more details are displayed, but more noises appear. When the sharpness of object edges increases, the picture is more clear. You are advised to decrease the sharpen strength when the gain increases. The following also uses the **Aptina_cmos.c** driver of the Aptina sensor as an example. See **static cmos_isp_agc_table** and **st_isp_agc_table** in **Aptina_cmos.c**.

  //sharpen_alt_d

  {0x50, 0x45, 0x40, 0x38, 0x34, 0x30, 0x28, 0x28},

  ISO100 ISO200 ISO400 ISO800 …

  The **Sharpen_alt_d** values correspond to the sharpen strength for object edges. The strength varies according to gains.

//sharpen_alt_ud

{0x3b, 0x38, 0x34, 0x30, 0x2b, 0x28, 0x24, 0x20},

ISO100 ISO200 ISO400 ISO800 …

The **Sharpen_alt_ud** values correspond to the sharpen strength for flat regions on objects.

In ***xxx*_cmos.c**, the values of **sharpen_alt_d** and **sharpen_alt_ud** in **st_isp_agc_table** are default values. You can change the default values based on the application scenario or call HI_MPI_ISP_SetSharpenAttr().

The **uu_slope** parameters in the demosaic parameters also affect the sharpen strength especially the sharpness of the details in dark regions and the regions without large color and brightness differences. You can set the sharpen strength by setting **uu_slope** of the st_isp_demosaic data structure in **cmos.c** or calling HI_MPI_ISP_SetDemosaicAttr.

1.2.24 What Do I Do If Horizontal Bars Appear in Bright Regions When the Sensor Works in WDR Mode?

[Symptom]

Horizontal bars appear in bright regions when the sensor works in WDR mode. When an object is moving in highlight regions, abnormal color blocks appear around object edges.

[Analysis]

If the sensor works in WDR mode under an indoor light source, especially when anti-flicker is enabled, the short exposure data is used for bright regions, and the long exposure time is set to the anti-flicker time. However, anti-flicker cannot be ensured in the short exposure time (1/16 of the long exposure time).

[Solution]

The Hi3518 and Hi3516 support three WDR sensors:

- Aptina 9M034
- Aptina AR0331
- Sony IMX104

The output data of the WDR sensors includes short exposure data and long exposure data. When the analog gain increases, the short exposure data is used for the bright regions of the picture. The short exposure time is shorter than the minimum exposure time required for anti-flicker, which causes horizontal bars. For the 9M034 and AR0331, as a short exposure frame and a long exposure frame are combined after being transmitted to the analog gain amplifier, horizontal bars can be reduced by decreasing the exposure time or the maximum analog gain. However, this issue cannot be resolved.

1.2.25 How Do I Select Gamma Tables?

[Symptom]

The picture quality becomes poor when the same gamma table is used but the scenario is switched.

[Analysis]

The same gamma table does not apply to all scenarios.

[Solution]

You are advised to select the gamma table based on the actual scenario:

- In an outdoor scenario, select a gamma table with higher contrast to ensure picture permeability.
- In an indoor scenario, select a gamma table with lower contrast to retain more details in black regions while ensuring permeability.
- In a low-illumination scenario, select a gamma table with higher contrast to ensure picture definition and permeability.

1.2.26 How Do I Implement Backlight Compensation?

[Symptom]

The target object is dark in the backlight scenario.

[Analysis]

In the backlight scenario, backlight compensation can be implemented by increasing the entire luminance of the picture.

[Solution]

Implement backlight compensation in either of the following ways:

- Increase the AE weight of the specified region.
- Enable the DRC module.

The static AE statistics of the Hi3518 are divided into 15 x 17 zones. To change the luminance of a zone, you can change the AE weight of the zone by setting the weight table. The following are the default AE weights of zones for the Hi3518:

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,2,2,2,2,2,2,2,1,1,1,1,1},

{1,1,1,1,1,2,2,2,2,2,2,2,1,1,1,1,1},

{1,1,1,1,2,2,2,2,2,2,2,2,2,2,1,1,1,1},

{1,1,1,1,2,2,2,2,2,2,2,2,2,2,1,1,1,1},

{1,1,1,1,2,2,2,2,2,2,2,2,2,2,1,1,1,1},

{1,1,1,1,1,2,2,2,2,2,2,2,2,1,1,1,1,1},

{1,1,1,1,1,2,2,2,2,2,2,2,2,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1},

{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1}

You can also call HI_MPI_ISP_SetAEAttr to increase the AE weight of the specified zone. Then exposure is performed on the specified zone based on the configured luminance to implement backlight compensation. Note that if the AE weight of the target object is too large, overexposure occurs in the bright zones around the target object.

1.2.27 How Do I Increase the White Balance Accuracy in the Outdoor Scenario?

[Symptom]

In the outdoor scenario, the white balance that is calibrated indoors sometimes becomes inaccurate and color casts occur.

[Analysis]

Color casts are caused for multiple reasons. Ensure that no color casts occur in the indoor light boxes. That is, the white balance and color reproduction parameters need to be calibrated based on each sensor and optical filter. In addition, check whether the fluorescent lamp for white balance is accurately simulated sunlight.

[Solution]

Based on the requirements of color calibration of the light boxes, take three 24-color pictures in raw data format at different color temperatures in sunlight. The color temperature below 5000 K, color temperature of about 6500 K, and color temperature above 7500 K are recommended. Typically, the color temperature is low at noon and high at nightfall and dawn. The colors in the outdoor scenario become more accurate after white balance is calibrated based on the three pictures in raw data format.

The color temperature of sunlight in the outdoor scenario is not low, but the color temperature of street lamps is low. If the color temperature is low, switch the white balance mode to manual mode or calibrate a group of white balance parameters again under street lamps. You can use street lamps as the lowest color temperature and configure white balance parameters of the medium-to-high color temperature under sunlight.

1.2.28 What Do I Do If Detail Loss Occurs When the Camera Slightly Moves?

[Symptom]

When the camera flickers or a hand-held camera is used, details are lost in the picture and the picture is blurry.

[Analysis]

The details of a moving object are reduced when the default 3D denoising strength is used. The default 3D denoising strength is too large in common scenarios.

[Solution]

Call HI_MPI_VPSS_SetGrpParam to set the time-domain denoising strength (**u32TfStrength**), the chrominance denoising strength (**u32ChromaRange**), and the spatial-domain denoising strength (**u32SfStrength**) in the proportion of 1:1:1 or 2:1:1 until noises are not obvious and enough details are retained when the camera slightly moves.

The application layer needs to adjust the VPSS parameters based on the current gain. That is, when the gain increases, the 3D denoising strength needs to be gradually increased to balance the denoising effect and retained details during slight movement.

The following is an example for reference. Call HI_MPI_ISP_QueryInnerStateInfoEx to obtain the current ISO (again x dgain x isp_dgain x 100) and rate the ISO eight levels including 100, 200, 400, 800, 1600, 3200, 6400, and 12800. Calibrate a group of appropriate VPSS parameters for each ISO and save them. The application layer obtains the current ISO at an internal (the interval of two frames is recommended), and then obtains appropriate VPSS parameters by using interpolation based on the ISO level. For details, see **sample_iq**.

Coding also affects the definition in motion status.

1.2.29 How Do I Modify the Configurations of the Registers of the Sensors in Kernel Mode or User Mode?

[Symptom]

The screen may flicker when the registers of the sensors are configured in user mode.

[Analysis]

The register of the sensors are configured over the I^2C or SPI bus. Because the user-mode thread is not scheduled in a timely manner and the I^2C or SPI bus speed is slow, the configured time of the sensor exposure register and gain register may be inconsistent, which results in flicker.

In kernel mode, the sensor registers are configured when interrupts are reported. The registers can be configured in a timely manner, but the system performance deteriorates. For the sensors that use the I^2C bus, you can set the macro definition **I2C_DFT_RATE** in the I^2C driver **Hii2c.c** to **400000**. In this way, the I2C read/write speed is increased, but some I^2C devices may be incompatible.

[Solution]

In the SDK, the register configuration mode for the sensors is changed to kernel mode by default. In **cmos.c**, **CMOS_XXXX_ISP_WRITE_SENSOR_ENABLE** is provided and is enabled by default.

The **frame_end_update_mode** member is added to the cmos_isp_default_t data structure in **cmos.c**. The definition of **frame_end_update_mode** is the same as that of **enFrameEndUpdateMode** in HI_MPI_ISP_SetAEAttr.

- If **frame_end_update_mode** is **0**, the sensor registers are configured in user mode, and the settings of the exposure time and gain registers take effect in the same frame.

- If **frame_end_update_mode** is **1**, the sensor registers are configured in user mode, and the setting of the exposure time register takes effect one frame later than the setting of the gain register.
- If **frame_end_update_mode** is **2**, the sensor registers are configured in kernel mode. The default value of **frame_end_update_mode** is **2**.

CAUTION

If the default configuration mode is set to kernel mode in cmos.c, enFrameEndUpdateMod in HI_MPI_ISP_SetAEAttr is fixed at ISP_AE_FRAME_END_UPDATE_2. If the default configuration mode is set to user mode in **cmos.c**, **enFrameEndUpdateMod** in HI_MPI_ISP_SetAEAttr is **ISP_AE_FRAME_END_UPDATE_0** or **ISP_AE_FRAME_END_UPDATE_1**.

1.2.30 How Do I Create Real-Time Threads?

[Symptom]

The HI_MPI_ISP_Run thread created in user mode cannot be scheduled in real time, which results in flicker.

[Analysis]

User-mode services are complex. Consequently, not all frames of the ISP thread are responded. The solution is to create real-time threads.

[Solution]

Example code:

```
pthread_attr_t attr;
struct sched_param param;
int newprio = 50;

pthread_attr_init(&attr);
pthread_attr_setschedpolicy(&attr, SCHED_RR);
pthread_attr_getschedparam(&attr, &param);
printf("-->default isp thread priority is %d , next be %d --<\n",
param.sched_priority, ;
param.sched_priority = newprio;
pthread_attr_setschedparam(&attr, &param);

if (0 != pthread_create(&gs_IspPid, &attr, (void* (*)(void*))HI_MPI_ISP_Run,
{
    printf("%s: create isp running thread failed!\n", __FUNCTION__);
    return HI_FAILURE;
}
pthread_attr_destroy(&attr);
```

CAUTION

If ISP threads are created in real time, the scheduling of other threads may be affected. This needs to be considered by users in a comprehensive manner.

1.2.31 How Do I Accelerate AE Convergence?

[Symptom]

AE convergence is too slow especially when the luminance changes from dark to bright.

[Analysis]

The AE control policy is related to the 5-segment histogram of the statistics information. The 5-segment histogram needs to be adjusted.

[Solution]

Perform the following modification through the HI_MPI_ISP_SetExpStaInfo interface:

Modify the original thresholds of the 5-segment histogram to **0x28**, **0x60**, **0xa0**, and **0xc0**.

Modify the original target values of the 5-segment histogram to **0x60**, **0x50**, **0x28**, **0x18**, and **0x10**.

After the preceding modification, to increase the convergence speed, set **Ae_step** to a larger value by using the HI_MPI_ISP_SetAEAttrEx interface.

1.2.32 How Do I Set the Maximum Gain?

[Symptom]

In low illumination, the maximum gain needs to be limited to obtain better picture quality. However, the picture flickers when AE is enabled after the maximum values of **Dgain** and **ISPDgain** are limited.

[Cause Analysis]

The **Again** precision of most sensors is low. If the high-precision **Dgain** and **ISPDgain** are limited, the luminance cannot be accurately controlled.

[Solution]

The maximum values of **Again**, **Dgain**, and I**SPDgain** are not limited. Instead, the maximum system gain (**SystemGainMax**) is limited. **SystemGainMax** is calculated as follows: **SystemGainMax = Again** x **Dgain** x **ISPDgain**. The method of allocating the gain by the AE module can be ignored.

1.2.33 What Do I Do If AWB Is Susceptible to Interference?

[Symptom]

When hands swing or a car runs in the front of the lens (the car occupies most region of the picture), AWB is susceptible to interference. As a result, the picture has a color cast.

[Cause Analysis]

AWB is susceptible to the color skin or some car colors, which causes AWB errors.

[Solution]

Do as follows to alleviate interference:

- Set the AWB parameter **u16Speed** to decrease the convergence speed.
- Set the AWB algorithm to the advanced algorithm. If the environment illuminant does not gradually change (not affected by sunlight) and there is only the indoor illuminant, increasing the value of the advanced AWB parameter **u8Tolerance** also alleviates interference.

1.2.34 What Do I Do If the Exposure Time Is Limited in ME Mode for the 3A Version?

[Symptom]

The exposure time is limited to 65535 lines in manual exposure (ME) mode for the 3A version.

[Cause Analysis]

The limitation is defined by the data structure of the exposure time parameter for the 3A version.

[Solution]

Set bit 0 of the external register (0x016C) of the AE module. If bit 0 is set to **1**, the limitation on the exposure time is disabled. The default value is **1**. Do as follows:

Call HI_MPI_ISP_SetCfg(HI_U32 u32Addr, HI_U32 u32Value), and set **u32Addr** to **0x2016C** and **u32Value** to **0**.

1.2.35 What Do I Do If the Color Is Affected by the Black Level Offset at a High Color Temperature?

[Symptom]

At a too high or too low temperature, the picture still has a color cast after AWB correction.

[Cause Analysis]

At a too high or too low temperature, the stability is affected when a sensor captures pictures. At a high temperature, the sensor black level has an offset, and the actual black level is several times the black level at the ambient temperature. In this case, the picture has a color cast after AWB correction. In the ideal case, the ratio of the red component to the green component is the same for the gray points with different luminance (R = K x G). R indicates the red component captured by the sensor, G is the green component captured by the sensor, and K is the ratio of the red component to the green component. The sensor offset is F0 at the ambient temperature and is F1 at a high temperature (F0 < F1).

The gain of channel R at the ambient temperature is calculated as follows:

Nomal_R/G = (K x G + F0 – F0)/(G + F0 – F0) = K

The gain of channel R at a high temperature is calculated as follows:

High_R/G = (K x G + F1– F0)/(G + F1 – F0)

F0 < F1 (black level offset at a high temperature)

The sensor spectrum chart shows that the light sensitivity of the green color is stronger than that of the red and blue colors for most sensors.

- K < 1
- High_R/G − Nomal_R/G= (1 − K) x (F1 – F0)/(G + F1 – F0) > 0
- High_R/G > Nomal_R/G

The gain of the channel R is calculated as follows:

Rgain = G/R = 1/(R/G)

Therefore, **High_Rgain** is less than **Normal_Rgain**. The gain of the channel R is small.

It is inferred that gain of channel B is also small at a high temperature so that the picture must have a green cast at a high temperature.

[Solution]

The following formula is used:

High_R/G − Nomal_R/G= (1 − K) x (F1 – F0)/(G + F1 – F0)

G reflects the luminance. A larger G value indicates a smaller difference between **High_R/G** and **Nomal_R/G**. That is, higher luminance indicates less sensitivity to the black level offset. You are advised to increase the value of the AWB parameter **BlackLevel** (default value is 0x40 before) to reduce interference to the gain due to the black level offset.