SSD192X

JPEG Encoding

Application Note

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1. Introduction

SSD1921 and 1928 had a JPEG engine which is able to encode a picture into JPEG format, and also able to decode a JPEG file and display on the display panel.

This document will be focusing on the encoding portion of the JPEG engine. It will be divided into 2 sections :

1) Setting of SSD192x registers for DV module

2) Description on usage of the encoder part of the JPEG engine, on how to set the various JPEG related registers for encoding a jpeg picture.

This document aims to help the user to be able to familiarize with SSD192X JPEG encoder engine fast, and be able to use it for different project requirements.

In this application note, we will use the DV input of the 192x as a source for JPEG encoder engine.

The application note of SSD 192X will contain many important references on how to calculate and set the register values. It will not be repeated in this document.

The document will indicate from time to time when to refer back to the application notes for further explanation.

2. DV input setting

This section will be on the setting of the DV input (for CMOS sensor) so that the JPEG engine will have a source input to encode a JPEG picture.

In this application note, we will assume the input size of the CMOS sensor to be 640x480, and how to scale it to 320x240 and display onto the QVGA panel.

2.1 Setting the input parameters of the CMOS sensor

For most of the CMOS sensor, there shall be a set of registers to be set internally (via I2C), which is provided by the sensor manufacturer.

On the reference code, the routine "*cam_hw_init()*" will be using the I2C to set the various parameters in the CMOS sensor.

2.2 Setting the registers on 192x

2.2.1 Scaling Ratio

⇨ These 2 registers (170 (horizontal), 171 (vertical)) will determine the value to be scale down from the input size of the CMOS sensor. The formula to calculate it is :**2 ^ (170 / 171)**

⇨ For an input of 640x480 to be display on a 320x240, the value of 170 and 171 shall be 1.

2.2.2 Cropping value

⇨ These registers (184-5 (horizontal), 188-9 (vertical)) will determine where would the pixels be extracted from the original pictures

⇨ For an CMOS input of 352x288, to be display on a 320x240, the values shall be register184 = 16, register 188 = 24
(This is provided 170 & 171 = 0)

2.2.3 Preview value

- ⇨ These registers (18C-D (horizontal), 190-1 (vertical)) will determine the size of the preview image on the panel before the scaling is done.

- ⇨ For an input of 640x480 to be display on a 320x240, the value of 18C & 18D shall be 640 and 480

2.2.4 Turning on the DV input module

To view the input signal on the TFT panel, a few registers must be set up.
Preview memory Address 1 & 2 -> register 19C & 1A0
Digital input Address 1 & 2 -> register 1B0 & 1B4

For a single preview window, please set all the registers above to be of the same value.

Do note that this is a 32-bit addressing, thus the max address shall not be more than 0xFFFF.

The other 3 registers to be set are register 1AC – 1AE.

Depending on the input source, it shall be set differently. For CMOS input, the default values are :
0x1AC -> 0x12
0x1AD -> 0
0x1AE -> 0x04

Finally, turn on the display by setting register 0x160 in 2 steps
A) Set bit 3 to 1
B) Set bit 2 & 4 to 1

2.2.5 Setting the LCD panel registers for viewing

This will not be discussed in this application note. If user had problem in setting up LCD module register, please refer to your nearest SSL engineer.

Once the DV module settings are done correctly, the user shall see the sensor input on the TFT screen clearly.

Please ensure this step is done correctly before proceeding to encode the preview to a JPEG file.

3. JPEG encoding

The figure below is used to describe the JPEG encoder engine and how the various setting of the registers will control the JPEG engine.

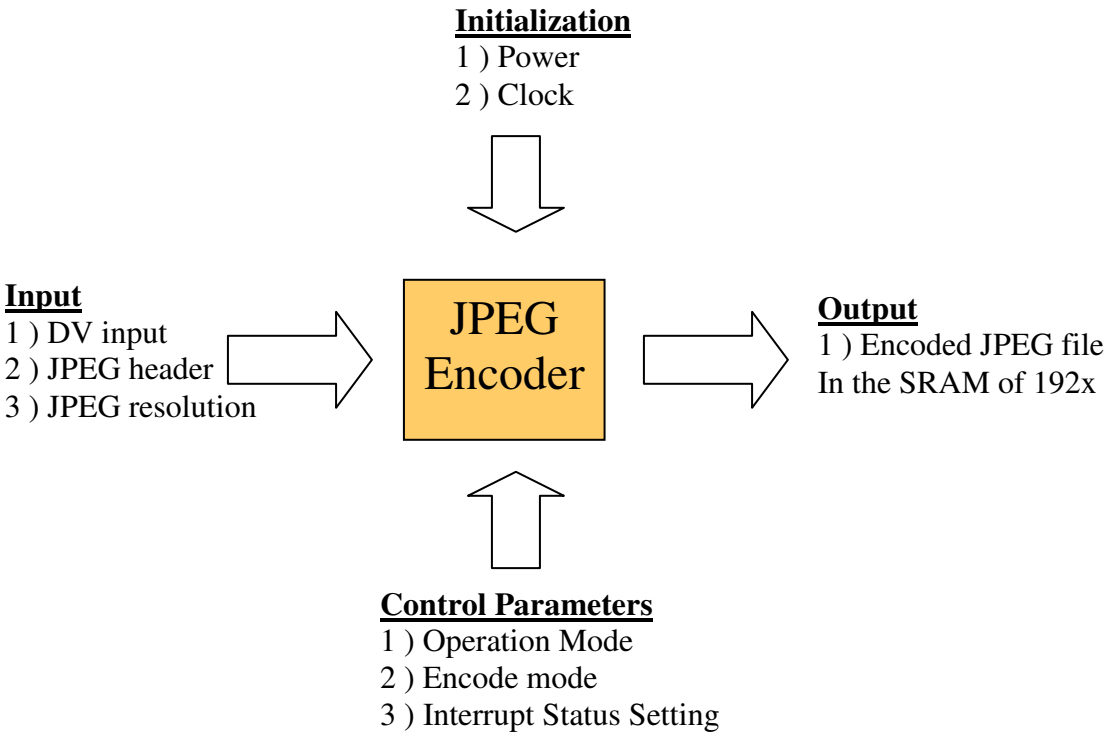

Figure 1 : JPEG encoder engine

3.1 Setting the registers for decoding

The steps below describe on the setting of various registers to decode the header and body of JPEG with reference to the above diagram.

3.1.1 Initialization

1) Enable the JPEG Codec (REG[380h] bit 0 = 1). This will turn on the codec and the clock to the JPEG engine

3.1.2 Control Parameters

1) Software reset the JPEG Codec (REG[402h] bit 7 = 1).

2) Set operation mode to encode & YUV422 (REG[400h] = 0x09)

3) Register 386 and 387 is the interrupt status register. Set it accordingly to different user requirement. (Refer to application notes for more detail)

3.1.3 Input

1) Set the JPEG Source Start Address (REG[410h] – REG[412h]). This address refer to the JPEG address where the source data is going to be captured.

2) Set the JPEG Destination Address (REG[414h] – REG[416h]). This address refer to the JPEG address where the encoded data for is stored (output).

(Note as JPEG engine is 32 bits addressing, hence the maximum address to be written shall not be more than 0xFFFF)

3) Set the JPEG FIFO Size (REG[3A4h]).
(Set the size in multiply of 8, Example, to set a 64K FIFO size, the value to write is 0x0F. For actual calculation, please refer to the application note.)

4) To generate JPEG header and the Huffman Table, one can refer to our application notes for explanation. A set of value are given as a reference in the code accompanying this application note.

5) The maximum file size can also be determine by REG[3B0h]).

6) For the DV input registers, the following are to be set :

Scaling ratio

⇨ These 2 registers (REG [172h] (horizontal) , REG[173h] (vertical)) will determine the value to be scale down from the input size of the CMOS sensor. The formula to calculate it is :
2 ^ (172 / 173)

⇨ For an input of 640x480 to be display on a 320x240, the value of 172 and 173 shall be 1.

Horizontal & vertical line buffer size

⇨ These 2 registers (REG [164h] (horizontal) , REG[168h] (vertical)) refers to the size of the for the horizontal and vertical capture size.
⇨ The actual calculation can be found in the application notes

Horizontal & vertical size of pre-encoded image

⇨ These 2 registers (REG [9F6] (horizontal) , REG[9F2] (vertical)) refers to the size of the of the horizontal and vertical resolution of the encoded image.

Do note that for JPEG file, there are certain rules to follow for the horizontal and vertical size. Please refer to table below:

Note
(1) The size of the image to be encoded must comply with the following specification:

YUV format	YUV420	YUV422	YUV411	YUV444
Horizontal Pixel Size	Multiples of 16	Multiples of 16	Multiples of 32	Multiples of 8
Vertical Pixel Size	Multiples of 16	Multiples of 8	Multiples of 8	Multiples of 8

3.2 Encoding the JPEG file

1) Start JPEG operation (REG[402h] bit 0 = 1).

2) Start capturing by setting REG[38Ah] bit 0 = 1).

3) The encoding process will begin with all the DV setting and JPEG encoding setting in place.

4) To check for the end of encoding, check for REG[404]. Once its equal to 0, the filesize (REG[3B4h]) not equal to 0, and REG[383h] equal to 0x2, the encoding is done.

5) The JPEG file is now stored from JPEG destination address in the 192x SRAM.

4. Saving JPEG file

There are 3 suggested ways to read out the encoded JPEG file in the SRAM of SSD192x.

1) Copy the file to storage device attached to the MCU (example, NOR flash) and use the JPEG decode function in 192x to decode the file and show it on the TFT panel.

2) Write the file to a SD card which is attached to 192x

3) Print out the values of the JPEG encoded file onto the console screen of the PC. Capture it as a log and save the file as a jpeg file. Use any photo viewer to display the picture on the PC.

Revision History of JPEG Encoder Application notes

Revison	Date	Changes	Author
1.0	14th Oct 2009	Initial Release	Aik Hong