JPEG Decoder Overview

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PlayStation®Vita Programmer Tool Runtime Library Release 3.50

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1 Library Overview

Scope of This Document

This document describes the JPEG Decoder library (scejpegdec), which provides decoding functions for image data in JPEG format. The JPEG Decoder library also provides the conversion function from YCbCr444/422/420 to RGBA format. This document explains basic decoding procedures, procedures that depend on color space conversion during decoding, and restrictions and procedures for decoding non-YCbCr444/422/420 images as well as images outside the range of 64 x 64 pixels to 2032 x 1088 pixels.

Purpose and Features

The JPEG Decoder library decodes JPEG image data to generate image data that can be drawn as textures. Decoding is processed on the Codec Engine.

It supports color space conversion, a function for directly converting YCbCr422/420 to RGBA format both during decoding and after decoding. As for YCbCr444 format, limited function to decode and convert to RGBA format is provided. Although image data using color spaces other than YCbCr444/422/420 can be decoded, this library does not provide color space conversions to RGBA format for screen display. Such color space conversions must be performed separately.

Main Functions

The JPEG Decoder library provides the following main features.

- Supports some baseline and progressive files
  - Color space: 1 to 4, DCT precision: 8 bits, sequential scan/progressive scan, Huffman encoding
  - The space sampling of the first color dimension must be 1:1, and the space samplings of the second and subsequent color dimensions (if they exist) must all be the same
- Supports high-speed color space conversion functions using dedicated hardware (256-level YCbCr, conversion from YCbCr422/420 color space sampling to RGBA)
- Supports color space conversion functions using Codec Engine (256Level YCbCr, cconversion from YCbCr444 color space sampling to RGBA)
- Downscale function (reduce to 1/2, 1/4, 1/8)

Embedding in Program

The files required for using JPEG Decoder library are as follows.

Filename	Description
scejpeg.h	Header file
libSceJpeg_stub.a	Stub library file

Include scejpeg.h in source program (some other header files will also be included automatically). When building the program, link libSceJpeg_stub.a.

Sample Programs

Refer to the following sample program for the JPEG Decoder library.

samples/sample_code/audio_video/api_scejpeg/simple

This sample shows the basic usage of the JPEG Decoder library.

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References

For the JPEG format, refer to the following standard specifications as necessary.

- ITU-T Recommendation T.81 "Information technology - Digital compression and coding of continuous-tone still images - Requirements and guidelines"
  http://www.itu.int/rec/T-REC-T.81-199209-I/en
  ITU, updated 1992/09
- JPEG File Interchange Format Version 1.02
  http://www.jpeg.org/public/jfif.pdf
  Eric Hamilton, C-Cube Microsystems, updated 1992/09/01

(The above reference destination has been confirmed as of June 13, 2012. Note that pages may have been subsequently moved or its contents modified.)

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2 Usage

Basic Usage

Basic procedures to process decoding of Motion JPEG and JPEG files are explained here. The following is an overview of the process flow. Procedures for split decoding will not be described here.

(1) Initialize the library.

(2) Obtain the required buffer size for decoding and color space sampling.

(3) Decode JPEG data.

(4) Use the decode results for display.

(5) Repeat steps 2 to 4.

(6) Terminate.

(1) Initialize the library

Call `sceJpegInitMJpegWithParam()` to perform initialization. For maximum value of the split decoder of the structure specified in argument, specify 0. (The split decoder is not described here.) Appropriate value must be specified to the option by determining whether video memory or main memory is utilized as an input/output buffer region to pass data to the decoder. If you plan to use video memory only, specify `SCE_JPEG_MJPEG_INIT_OPTION_NONE`. If only the main memory is to be used, or both video and main memories are used, specify `SCE_JPEG_MJPEG_INIT_OPTION_LPDDR2_MEMORY` instead.

(2) Obtain the required buffer size for decoding and color space sampling.

When the required buffer size to decode JPEG data and color space sampling are unknown, use `sceJpegGetOutputInfo()`.

(3) Decode JPEG data

Use `sceJpegDecodeMJpegYCbCr()` to decode JPEG data to a YCbCr-format image. In addition to the JPEG data to be decoded and output data storage location, specify the working buffer, decode parameters and other appropriate items as arguments.

If an image in the RGBA format is required, call the color converting function to convert from the YCbCr format to the RGBA format. If the JPEG data's color space sampling format is YCbCr422/420, use `sceJpegMJpegCsc()`. If it is YCbCr444, use `sceJpegCsc()` to convert to the RGBA format.

If you know that the JPEG data's color sampling format to be handled is only YCbCr422/420, instead of calling `sceJpegDecodeMJpegYCbCr()` and `sceJpegMJpegCsc()` in a row, `sceJpegDecodeMJpeg()` can be called once to directly obtain image data in the RGBA format.

Note, however, that there are limitations in the image size that can be handled by the `sceJpegMJpegCsc()` and `sceJpegDecodeMJpeg()` functions that have YCbCr422/420 format color converting features. Image size must be within the range of 64 x 64 pixels to 2032 x 1088 pixels. This limitation is due to the limitation of the hardware exclusively performing color conversions.

(4) Use the decoded results

Use the decoded results for display to screen or image processing.

(5) Repeat steps (2) to (4).

If you wish to repeatedly decode multiple JPEG data such as playing Motion JPEG, repeat steps (2) to (4) until there is no more JPEG data to be decoded.

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(6) Terminate

When the JPEG Decoder is no longer needed, call `sceJpegFinishMJpeg()` to perform termination processing. This will release resources allocated at initialization.

Main APIs Used for Basic Processing

API	Description
`sceJpegInitMJpegWithParam()`	Initializes the library
`sceJpegGetOutputInfo()`	Obtains JPEG decode output information
`sceJpegDecodeMJpegYCbCr()`	Decodes JPEG data (no color space conversion)
`sceJpegMJpegCsc()`	Color space conversion of YCbCr422/420 data into RGBA
`sceJpegCsc()`	Color space conversion of YCbCr444 data into RGBA
`sceJpegDecodeMJpeg()`	Decodes YCbCr422/420 JPEG data into RGBA
`sceJpegFinishMJpeg()`	Terminates the library

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Usage Procedure for Files with an Image Size Not Supported for Color Space Conversion or Files Using a Color Space Other Than YCbCr444/422/420

Although this library can decode images with an image size outside the range of 64 x 64 pixels to 2032 x 1088 pixels, or JPEG data of color spaces other than YCbCr422/420, it cannot perform color space conversion quickly for this kind of data due to memory size and hardware constraints. Color space conversion of YCbCr444-formatted JPEG data can be done via Codec Engine, but may be slower than a hardware-based conversion.

To display data to which this library cannot perform color space conversion, obtain pre-color space converted data in decoding processing with `sceJpegDecodeMJpegYCbCr()`, then perform the required color space conversion by the user application.

If the required decode result is smaller than the image size of the JPEG data, the decode result can be reduced to 1/2, 1/4 or 1/8 of the original size by using the downscale function. If the reduced image size is between 64 x 64 pixels and 2032 x 1088 pixels, color space conversion can be performed.

Data Format of the Decode Result

The decoded and color space converted result obtained from `sceJpegDecodeMJpeg()` and the color space converted result obtained from `sceJpegMJpegCsc()` or `sceJpegCsc()` are stored in RGBA (32-bit) format as images that were raster scanned from top left to bottom right. The α value is always 255. If the size of the original JPEG image does not fill the vertical and horizontal size specified for the frame buffer, the area for the part that is greater than the size of the JPEG image is not changed.

The Y, Cb, and Cr components of the decoded result obtained from `sceJpegDecodeMJpegYCbCr()` are each stored in separate frame buffer areas as images that were raster scanned from top left to bottom right. The number of bits per pixel is 8 for each component (Y, Cb, and Cr). The frame buffer size for each color dimension is the pixel size of the original JPEG image rounded to MCU units (a multiple of 16 for 4:2:0), with the pitch difference added to the width. Pitch difference refers to the padding area of one line per component (Y, Cb, and Cr) when the number of bytes is not a multiple of 16, and is required when using the dedicated hardware for color space conversion.

Since the color space sampling for Motion JPEG is fixed at 4:2:0, the ratio of frame buffer sizes for the Y component and for the non-Y color spaces is 4:1. Also, the frame buffers for each dimension are arranged exactly in Y, Cb, Cr order with no gaps in between.

As an example, when a 720x480 pixel JPEG file is decoded using the YCbCr format, the Y frame buffer will be the 345600 (=720 x 480) bytes starting from the buffer address specified for the decoded output, the Cb frame buffer will be the 88320 (=(360 + 8) x 240) bytes starting after the end of the Y frame buffer (including the 8-byte pitch difference), and finally the Cr frame buffer will be the 88320 bytes starting after the end of the Cb frame buffer.

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3 Precautions

Data Without a DHT Segment

Depending on the type of Motion JPEG data, the JPEG data may not contain a Define Huffman Table (DHT) segment, in which case the JPEG standard recommended Huffman code will normally be used. To decode this kind of data, specify `SCE_JPEG_MJPEG_WITHOUT_DHT` for the *decodeMode* argument when calling the Motion JPEG decoding function. When this argument is specified and the data contains no DHT segment, the recommended table will be used. If the data contains a DHT segment, the contents of that table will be used. However, when `SCE_JPEG_MJPEG_WITHOUT_DHT` is specified, the time required for JPEG decoding will increase slightly. Therefore, due consideration is required when setting this parameter.

Buffer Restrictions for Positioning I/O Data

Because this library is processed on the Codec Engine, the following restrictions apply to buffers that position I/O data.

(1) Input data buffer passed to decoding functions

This must be a physical address in a continuous area. However, conditions are even stricter when simultaneously calling decoding functions from several threads. They must have a physical address in a continuous area and fulfill 256-byte alignment.

(2) Output data buffer passed to decoding functions, quantization coefficient buffers, and I/O data buffers passed to color space conversion functions

This must have a physical address in a continuous area and fulfill 256-byte alignment.

To allocate a physical address in a continuous area, the buffer must be positioned within the video memory or physical continuous area of the main memory. For details on memory allocation, refer to the "Kernel Reference" document.

Handling Image Sizes That are Not Integer Multiples of the MCU Size

When JPEG data which has a vertical and horizontal image size that is not exactly a multiple of the MCU size is decoded, the output data will be expanded to a multiple of the MCU size. In other words, when a 360x270 pixel JPEG image is decoded using YCbCr420 format (MCU size is 16x16 pixels), the YCbCr data that is obtained will be 368x272 pixels. The color space conversion of this data in RGBA will also be the same size. Therefore, a frame buffer of that size is required. Display this data making sure that the application deletes unnecessary parts as needed.

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