MJPEG Decoder (v01.00.13) on HDVICP2 and Media Controller Based Platform

FEATURES

- Supports baseline sequential mode
- Supports extended sequential mode with some constraints
- Supports YUV 444, YUV 422, YUV 420, and Gray scale chroma sub-sampling formats as input (single scan as well as multiple scans)
- Supports all resolutions ranging from 32x32 to 4096x4096
- Maximum of four Huffman tables each for AC and DC DCT coefficients supported
- Supports sub-frame data synchronization for input and output buffers
- Supports slice level decoding
- Supports spatial error concealment
- Supports 8-bit and 16-bit quantization tables
- Supports YUV 444 planar, YUV 422 IBE (YUYV) and YUV 420 semi-planar chroma sub-sampling formats for output
- Supports decoding of custom Huffman tables
- Supports parsing of JFIF, Exif and comment markers
- Supports restart management for bitstream with Define Restart Interval Marker (DRI) and Restart Marker (RST)
- Supports thumbnail decoding. Thumbnail can be in JFIF or Exif marker segment. Thumbnail can be RGB as well as JPG.
- Supports scaling for YUV444 and YUV400 images
- Supports graceful exit under error conditions
- Supports Limited Pixel Range
- Does not support Arithmetic decoding
- Does not support source images of 12 bits per sample
- The other explicit features that TI's MJPEG Decoder supports are
  - eXpressDSP Digital Media (XDM IVIDDEC3) interface compliant
  - Supports multi-channel functionality
  - Supports booting of HDVICP2
  - Implements different power optimization schemes
  - Independent of any operating system
  - Ability to get plugged in any multimedia frameworks (eg. Codec Engine, OpenMax, GStreamer, etc)

PRODUCT PREVIEW

Description

JPEG is an international standard for color image compression. This standard is defined in the ISO10918-1 JPEG Draft International Standard | CCITT Recommendation T .81. JPEG supports baseline sequential mode with both interleaved and non-interleaved input format and progressive mode. MJPEG (Motion JPEG) is JPEG used in video mode (for continuous image encoding/ decoding in JPEG format).

Performance and Memory Summary

This section describes the performance and memory usage of MJPEG Decoder.

Table 1 Configuration Table

CONFIGURATION	ID
Baseline Sequential interleaved decoder (4:2:0 input and 4:2:0 Semi Planar Output), sliceSwitchON = DISABLE	MJPEG_DEC_001
Baseline Sequential interleaved decoder (4:4:4 input and 4:4:4 Planar output), sliceSwitchON = DISABLE	MJPEG_DEC_002
Baseline Sequential interleaved decoder (4:2:0 input and 4:2:0 Semi Planar Output), sliceSwitchON = ENABLE	MJPEG_DEC_003
Baseline Sequential interleaved decoder (4:2:2 input and 4:2:0 Semi Planar Output), sliceSwitchON = ENABLE	MJPEG_DEC_004

Table 2 Cycles Information - Profiled on DM816x REV-A2 EVM with Code Generation Tools Version 4.5.1 for HDVICP2 and Version 5.0.3 for Media Controller .

CONFIGURATION ID	HDVICP2 PERFORMANCE STATISTICS (MEGA CYCLES PER SECOND) (1)(5)		
	TEST DESCRIPTION (2)	AVERAGE(3)	PEAK(4)
MJPEG_DEC_001	davincieffect_qcif_yuv420_sp.mjpeg (176 x 144, Baseline Sequential)	6.13	6.46
	flower_cif_420.mjpeg (352x288, Baseline Sequential)	10.16	10.4
	jump_640x352_420sp.mjpeg (640x352, Baseline Sequential)	16.33	16.55
	fire_D1_420sp.mjpeg (720x480, Baseline Sequential)	22.6	22.83
	pedestrian_1920x1080p_420sp.mjpeg (1920 x 1080, Baseline Sequential)	112.60	113.10
MJPEG_DEC_002	bus_352x288_444.mjpeg (352x288, Baseline Sequential)	16.27	16.51
	container_720x576_444.mjpeg (720 x 576, Baseline Sequential)	51.39	51.59
	pedestrian_1920x1080_444.mjpeg (1920 x 1088, Baseline Sequential)	235.49	235.70
MJPEG_DEC_003	pedestrian_720p_420.mjpeg (1280x720, Baseline Sequential) with numSwitchPerFrame = 1	52.41	52.50
	pedestrian_720p_420.mjpeg (1280x720, Baseline Sequential) with numSwitchPerFrame = 2	55.83	56.12
	pedestrian_720p_420.mjpeg (1280x720, Baseline Sequential) with numSwitchPerFrame = 3	58.8	59.10
	pedestrian_720p_420.mjpeg (1280x720, Baseline Sequential) with numSwitchPerFrame = 4	61.70	62.03
	pedestrian_1080p_420.mjpeg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 1	112.60	113.10
	pedestrian_1080p_420.mjpeg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 2	115.87	116.02
	pedestrian_1080p_420.mjpeg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 3	118.78	118.96
	pedestrian_1080p_420.mjpeg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 4	120.94	121.86
MJPEG_DEC_004	lambhorgini_1280x720_422yuyv.jpg (1280x720, Baseline Sequential) with numSwitchPerFrame = 1	70.83	71.40
	lambhorgini_1280x720_422yuyv.jpg (1280x720, Baseline Sequential) with numSwitchPerFrame = 2	74.27	74.82
	lambhorgini_1280x720_422yuyv.jpg (1280x720, Baseline Sequential) with numSwitchPerFrame = 3	77.29	77.74
	lambhorgini_1280x720_422yuyv.jpg (1280x720, Baseline Sequential) with numSwitchPerFrame = 4	80.19	80.66
	pedestrian_1080p_422ibe.jpg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 1	152.93	153.12
	pedestrian_1080p_422ibe.jpg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 2	156.41	156.57
	pedestrian_1080p_422ibe.jpg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 3	159.35	159.52
	pedestrian_1080p_422ibe.jpg (1920x1080, Baseline Sequential) with numSwitchPerFrame = 4	162.27	162.46

(1) Measured on DM816x REV-A2 EVM having Cortex-A8 @ 1GHz, HDVICP2 @ 533MHz, Media Controller @ 250 MHz, L3 interconnect @ 500 MHz and DDR2 @ 400 MHz and there could be a variation of around 1-2% in the numbers.
   a) Media Controller code is placed in cacheable memory region in DDR.
   b) No latency from system at process call and processing unit as frame (no sub-frame level communication) is assumed.
   c) All Luma 2D Video buffers of codec being in TILED_8 Bit Memory and all Chroma 2D Video buffers of codec being in TILED_16 Bit Memory

(2) Streams have been compressed with Quantization Tables and Huffman Tables suggested in the JPEG Standard document.

(3) Average is computed based on worst case cycles having 2 extra output frame buffer. Average is calculated @ 30fps

(4) Peak is based on worst case cycles having no extra output frame buffer. It is computed based on peak among 30 frames @30fps.
(5) Cycles measured for positive streams. Decoding error streams of same resolution with error concealment enabled will consume significantly higher Mega cycles.

Table 3 Memory Statistics of Media Controller - Generated with Code Generation Tools Version 5.0.3

CONFIGURATION ID	RESOLUTION	MEMORY STATISTICS(1)							
		PROGRAM MEMORY	DATA MEMORY						TOTAL
			INTERNAL	EXTERNAL(2)				STACK	
				PERSISTENT(3)			CONST		
				TILED8 (numBufs x Width x Height)	TILED16 (numBufs x Width x Height)	TILED PAGE / RAW	RAW		
MJPEG_DEC_001 MJPEG_DEC_002 MJPEG_DEC_003 MJPEG_DEC_004	All	13	0	0	0	13	255	2	283

(1) All memory requirements are expressed in kilobytes (1 K-byte = 1024 bytes) and there might be rounding to next integer K-byte. Stack can be kept in internal/external memory, negligible performance impact can be observed in Media Controller cycles if it is placed in external memory.
(2) Codec's request of memory container can be over-ridden by application, adhering to the below rules
  a. TILED PAGE can be overridden by RAW
  b. TILED8, TILED16 can be overridden by TILED PAGE, RAW
  c. TILED16 can be overridden by TILED8, RAW, TILED PAGE
  However, in case of overriding of 2B and 2C, there can be some performance impact.
(3) Persistent memory is instance specific and does not include I/O buffers.

Table 4 Split-up of Media Controller Internal Data Memory Statistics

CONFIGURATION ID	DATA MEMORY - INTERNAL(1)		
	SHARED		INSTANCE
	CONSTANTS	SCRATCH	
MJPEG_DEC_001, MJPEG_DEC_002, MJPEG_DEC_003, MJPEG_DEC_004	0	0	0

(1) Internal memory refers to on chip memory. If the system doesn't have enough internal memory, then external memory can also be used. Memory requirements are expressed in kilobytes.

Notes

- I/O buffers:
  - Input buffer size = 3060 KB (assuming worst case for 1920x1088, YUV444 image)
  - Output buffer size = 6120 KB (for 1920x1088, YUV444 image)
- None of the buffers at input and output level is accessed by Media Controller processor hence the data should be valid in DDR (not in cache)
- Total data memory for N non pre-emptive instances = Constants + Runtime Tables + Scratch + N * (Instance + I/O buffers + Stack)
- Total data memory for N pre-emptive instances = Constants + Runtime Tables + N * (Instance + I/O buffers + Stack + Scratch)
- MAIL BOX FIFO #0 and #1 are used and user numbering for Media Controller as 2 and for HDVICP2 as 3 is assumed
- It is assumed that RTS library from ARM is available in system because few symbols like

memcpy are used in codec
- All constants and Input/Output Buffers to decoder are assumed to be in VDMA addressable space in DDR

References

- ITU-CCITT recommendation T.81 (reproduction of ISO/IEC 10918-1)
- eXpressDSP Algorithm Interoperability Standard (TMS320 Algorithm Interface Standard)
- MJPEG Decoder on HDVICP2 and Media Controller Based Platform User's Guide

Glossary

Term	Description
Constants	Elements that go into .const memory section
Scratch	Memory space that can be reused across different instances of the algorithm
Shared	Sum of Constants and Scratch
Instance	Persistent-memory that contains persistent information - allocated for each instance of the algorithm

Acronyms

Acronym	Description
CCITT	Committee Consultative International Telephone and Telegraph
DCT	Discrete Cosine Transform
DRI	Define Restart Interval Marker
DSP	Digital Signal Processing
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JFIF	JPEG File Interchange Format
JPEG	Joint Photographic Experts Group
MJPEG	Motion JPEG
RST	Restart Marker
XDM	eXpressDSP Digital Media

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