SENSORAY CO., INC.

516/616 MPEG Frame Grabbers

Programmer's Manual

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SENSORAY

1. Introduction

The Sensoray Models 516 and 616 is an MPEG video encoder decoder board. Some of the features include:

General

- Real time MPEG-2 and MPEG-1 video encoder and decoder
- Support for variable bit rate and constant bit rate
- IPB pictures to 15Mbps for constant bit rate and 10Mbps for variable bit rate
- Supports multiple resolutions (704x480, 640x480, 352x240, etc.)
- Support for NTSC, PAL
- During encoding and standby, video input is fed to output for easy adjustment
- Onboard audio CODEC

Video encoder
- Generates 13818 (MPEG-2) and 11172 (MPEG-1) compliant elementary streams (ES)
- Operates up to 30 frames per second
- Selectable bit rate

Video decoder
- Decodes both MPEG-1 and MPEG-2 streams
- Horizontal and vertical scaling

Video capture (616 board only)
- Supports downscaled (from 1x1 pixel to original size) uncompressed image capture.

Caption overlay
- Supports up to 80 characters color text above recorded video.

2. Software Components

The software contains the following files:

Filename	Function
sx16ioctl.h sx16core.h	Header files
driver/*.c, driver/*.h	Driver source files
sx16demo.c	Demo applications
Makefile	The rule to build driver and demo
sx16	Script to register device(s)

Table 1. Software Components (Linux)

2.1.   Installation Procedure

2.1.1. Driver Installation

- o   As root, enter the directory where the files have been installed.

- o   Type 'make clean'   --- This will remove any old object files.

- o   Type 'make'   --- Builds the driver.

- o   Type 'make install'   --- Installs the driver and makes the special files.

2.1.2. Loading the Driver

Model 516 notes: Before attempting to load the driver note the base address of your 516 (see hardware documentation); this is not applicable to the 616. The base address (io) is a required driver parameter for model 516, but should not be declared for model 616.

During loading process the driver registers itself as the first accessible entry in /dev/videoX name space, where X is a digit.

example 1: type 'insmod sx16.ko' for any number of model 616 boards.

example 2: type 'insmod sx16.ko major=195' for 616 boards, using alternate major.

example 3: type 'insmod sx16.ko io=0xcc0' for a single 516.

example 4: type 'insmod sx16.ko io=0xc80,0xcc0' for two 516 boards.

example 5: type 'modprobe sx16'. This requires that you have made the appropriate entries into the /etc/modules.conf file. See the modules.conf file.

Note: the name of driver's module is sx16.ko in new versions of Linux and sx16.o in some older versions.

2.1.3. Using the Driver from the Command Line

After the driver is loaded, standard redirection, pipes etc., can be used.

Examples:

for encoding:

'cp /dev/video1 test1.mpg'   (use ctrl-c to interrupt)
'cat /dev/video1 > test1.mpg'
etc...

for decoding:

'cp test1.mpg /dev/video1'   (use ctrl-c to interrupt)
'cat test1.mpg > /dev/video1'
etc...

If you have two cards, this should work too:

'cat /dev/video0 > /dev/video1'

2.1.4. Using the Driver from Applications

After the driver is loaded, application programs can manipulate the 516/616 hardware by means of standard module API methods: open(), close(), read(), write(), poll() and ioctl().

Before calling any other methods, open() must be called for each board to enable access to it. Similarly, close() must be called when you are done interacting with the board. Two or more applications may open one board simultaneously; for example, one application opens a board to read MPEGs and other application opens the same board to show result on the screen. The read() and write() functions can be used to pass mpeg data between the application and board. The poll() may be used to transfer mpeg data in either blocking or non-blocking mode. Hardware-specific functionality such as video bit rate, multiplexing format, etc. is accessed through the x16-specific IOCTL methods described in 'sx16.h' and 'sx16mod.c'. Video for Linux supported with v4l-specific IOCTL commands. Usually programmer does not call v4l commands directly, the hi-level functions such as XvPutVideo initiate transparent communication between the video system and a device driver via v4l.
Be sure that the device you want to use is a 516/616 board; other v4l device may support v4l commands, but may not support x16-specific commands.

3.   Demo Applications

A demo application, sx16demo, is provided to show how to use the driver in a typical application. This is a command line program without v4l features.
Type "make sx16demo" to compile this demo.

To demonstrate the video overlay you may try any common purpose v4l demo application or video player. The "xawtv" player has a simple xvideo.c demo, located in xawtv/debug directory. Please refer to this file and documentation provided with xawtv player to create your own applications.

4. Functions Reference
The x16 Driver is designed to provide the application developer with full control over the frame grabber. All special data types used by the Driver are defined in sx16core.h and sx16ioctl.h files.

4.1. Standard Functions

The standard open(), close(), read(), write(), and ioctl() methods are available.
Description of the 'ioctl' parameters can be found in sx16ioctl.h and sx16core.h.

4.2. Control Codes

4.2.1. Video Functions

SX16_IOC_SET_INPUT

ioctl(handle, SX16_IOC_SET_INPUT, input);

Parameters

input
Video input. Must be between 0 and 3.

Return values

None.

Notes

Selects video input. Default value is 0.
Sensoray 616 board (Revision A) has only one input.

SX16_IOC_SET_INPUT_TYPE

ioctl(handle, SX16_IOC_SET_INPUT_TYPE, type);

Parameters

type
Video input type. Must be 0 for Composite Video or 1 for S-Video.

Return values

None.

Notes

Sets video input type. Default type is S-Video.

SX16_IOC_GET_INPUT_STATUS

ioctl(handle, SX16_IOC_GET_INPUT_STATUS, 0);

Parameters

Return values

Returns the status (positive), or an error code (negative).
Status is a combination of bit flags:

Bit	Name	Function
D0	RDCAP	ready for capture (all internal loops locked); active HIGH
D1	COPRO	copy protected source detected according to macrovision version up to 7.01
D2	WIPA	white peak loop is activated; active HIGH
D3	GLIMB	gain value for active luminance channel is limited [min (bottom)]; active HIGH
D4	GLIMT	gain value for active luminance channel is limited [max (top)]; active HIGH
D5	FIDT	identification bit for detected field frequency; LOW = 50 Hz, HIGH = 60 Hz

D6	HLVLN	status bit for horizontal/vertical loop: LOW = locked, HIGH = unlocked
D7	INTL	status bit for interlace detection; LOW = non-interlaced, HIGH = interlaced

Notes

Gets status of the video input currently selected. To be sure that the input is connected to video source just check bit D0.

SX16_IOC_SET_VIDEO_SYSTEM

ioctl(handle, SX16_IOC_SET_VIDEO_SYSTEM, system);

Parameters

system
Video system. Must be PAL (1) or NTSC (2).

Return values

None.

Notes

Sets output video system NTSC or PAL. Default value is 2 (NTSC).

SX16_IOC_SET_BITRATE

ioctl(handle, SX16_IOC_SET_BITRATE, rate);

Parameters

rate
Video bit rate in bits per second.

Return values

None.

Notes

Sets desired bit rate.

SX16_IOC_SET_MPEG

ioctl(b->handle, SX16_IOC_SET_MPEG, size);

Parameters

size
Picture size index.

Return values

None.

Notes

Sets picture size and compression system:

- ***S*IZE176_1**   MPEG-1**,** NTSC-**176x112** PAL-**176x144**
- ***S*IZE352_1**   MPEG-1**,** NTSC-**352x240** PAL-**352x288**
- ***S*IZE352_2**   MPEG-2, NTSC-**352x480** PAL-**352x576**
- ***S*IZE480_2**   MPEG-2, NTSC-**480x480** PAL-**480x576**
- ***S*IZE640_2**   MPEG-2, NTSC-**640x480** PAL-**640x576**, clipped from size 720
- ***S*IZE704_2**   MPEG-2, NTSC-**704x480** PAL-**704x576**
- ***S*IZE720_2**   MPEG-2, NTSC-**720x480** PAL-**720x576**
- ***S*IZE352_1_2** MPEG-1, NTSC-**352x240** PAL-**352x288**, MPEG1 stream with MPEG2 MUX
- ***S*IZE480_2_2** MPEG-2, NTSC-**480x480** PAL-**480x576**, DVD MUX(for playback)

SX16_IOC_SET_N

     ioctl(b->handle, SX16_IOC_SET_N, n);

Parameters

n
     Number of frames in Group of Pictures.

Return values

     None.

Notes

Sets number of frames in Group of Pictures. Default value is 3.
To optimize quality for PAL signals the 'n' should be set to 1.

SX16_IOC_SET_M

     ioctl(b->handle, SX16_IOC_SET_M, m);

Parameters

m
     Distance between I/P frames.

Return values

     None.

Notes

Sets distance between I/P frames. Default value is 15.
To optimize quality for PAL signals the 'm' should be set to 4.

SX16_IOC_SET_STREAM_TYPE

     ioctl(handle, SX16_IOC_SET_STREAM_TYPE, type);

Parameters

   type
Type of MPEG stream. Must be one of the following:

STREAMTYPE_MUX   Multiplexed program/system stream,
STREAMTYPE_VES   Video elementary stream, no audio,

STREAMTYPE_AES   Audio elementary stream, no video,
STREAMTYPE_TRANSPORT   Transport stream.

Return values

None.

Notes

Sets type of the MPEG stream. Default value is STREAMTYPE_MUX.

SX16_IOC_SET_VBR

        ioctl(handle, SX16_IOC_SET_VBR, vbr);

Parameters

vbr
    Enables (1) or disables (0) variable bit rate compression

Return values

None.

Notes

Enables/disables variable bit rate compression. Default value is 0.

SX16_IOC_RW_STOP

        ioctl(b->handle, SX16_IOC_RW_STOP, 0);

Parameters

None.

Return values

Returns 0 on success. Returns an error code if any errors were detected.

Notes

Stops read/write. Sends "STOP" command to the board.
There is no START command; if the board is stopped, it will be started by first read/write command.

SX16_IOC_RW_PAUSE

        ioctl(b->handle, SX16_IOC_RW_PAUSE, 0);

Parameters

Return values

Returns 0 on success. Returns an error code if any errors were detected.

Notes

Pauses data flow. Sends "PAUSE" command to the board.
Application cannot *read/write* after the PAUSE command until RESUME or STOP command sent.

SX16_IOC_RW_RESUME

ioctl(handle, SX16_IOC_RW_RESUME, 0);

Parameters

Return values

Returns 0 on success. Returns an error code if any errors were detected.

Notes

Resumes data flow after pause. Sends "RESUME" command to the board.
Since the real time cannot be "paused", the time marks in the MPEG stream will have a gap from *pause_time* to *resume_time*. Some applications may indicate a timer error (lost data) on such places.

SX16_IOC_RW_RESET

ioctl(handle, SX16_IOC_RW_RESET, 0);

Parameters

Return values

Returns 0 on success. Returns an error code if any errors were detected.

Notes

Terminates any jobs and brings board to the default state.

SX16_IOC_SET_BRIGHTNESS

ioctl(handle, SX16_IOC_SET_BRIGHTNESS, brightness);

Parameters

brightness
Brightness. Must be between 0 and 255.

Return values

None.

Notes

Sets brightness on video input.

SX16_IOC_SET_CONTRAST

ioctl(handle, SX16_IOC_SET_CONTRAST, contrast);

Parameters

contrast
Contrast. Must be between 0 and 255.

Return values

None.

Notes

Sets contrast on video input.

SX16_IOC_SET_SATURATION

ioctl(handle, SX16_IOC_SET_SATURATION, saturation);

Parameters

saturation
Saturation. Must be between 0 and 255.

Return values

None.

Notes

Sets color saturation on video input.

SX16_IOC_SET_COLORBARS

ioctl(handle, SX16_IOC_SET_COLORBARS, bars);

Parameters

bars
Bars on/off. Must be 0 or 1.

Return values

None.

Notes

Video output internal color bar generator on/off. Affects to the video output only. Color bars cannot be visible in the video stream.

4.2.2. Text Overlay Functions

Note: not all boards support the Text Overlay Functions. Some boards support limited set of functions. Please refer your order and the hardware manual for your board.

SX16_IOC_GET_CAPTION_SETTINGS

ioctl(handle, SX16_IOC_GET_CAPTION_SETTINGS, setting_number);

Parameters

setting_number

Must be one of the following:
CAPTN_window   Caption window number.
CAPTN_xstart   Caption x start position.
CAPTN_xstop   Caption x stop position.
CAPTN_ystart   Caption y start position.
CAPTN_ystop   Caption y stop position.
CAPTN_scale   Caption scale.
CAPTN_color   Caption color.
CAPTN_transp   Caption transparency.
CAPTN_text   Caption text.
CAPTN_on   Caption on/off.

Return values

Value of setting indicated by *setting_number*.

Notes

Gets caption settings.

SX16_IOC_SET_CAPTION_WINDOW

ioctl(handle, SX16_IOC_SET_CAPTION_WINDOW, win);

Parameters

win
Number of caption window.

Return values

None.

Notes

Sets caption window number. Default number is 1.

SX16_IOC_SET_CAPTION_XSTART

ioctl(handle, SX16_IOC_SET_CAPTION_XSTART, x_start);

Parameters

x_start
Position of left edge of window. Default value is 0.

Return values

None.

Notes

Sets left caption window position.

SX16_IOC_SET_CAPTION_YSTART

ioctl(handle, SX16_IOC_SET_CAPTION_YSTART, y_start);

Parameters

y_start
 Position of upper edge of window. Default value is 0.

Return values

None.

Notes

Sets upper caption window position.

# SX16_IOC_SET_CAPTION_SCALE
 ioctl(handle, SX16_IOC_SET_CAPTION_SCALE, scale);

Parameters

scale
 Font scale. Must be one of the following:
 OVL_SCALE_X1 scale = 1:1.
 OVL_SCALE_X2 scale = 2:1.
 OVL_SCALE_X2V scale = 2:1 (only vertical).
 OVL_SCALE_X4 scale = 4:1.

Return values

None.

Notes

Sets caption font scale.

# SX16_IOC_SET_CAPTION_COLOR
 ioctl(handle, SX16_IOC_SET_CAPTION_COLOR, color);

Parameters

color
 Caption color. Must be one of the following:
 OVL_WHITE white.
 OVL_BLACK black.
 OVL_RED red.
 OVL_GREEN green.
 OVL_BLUE blue.
 OVL_YELLOW yellow.
 OVL_CYAN cyan.
 OVL_MAGENTA magenta.

Return values

None.

Notes

Sets caption color.

SX16_IOC_SET_CAPTION_TRANSPARENCY

ioctl(handle, SX16_IOC_SET_CAPTION_TRANSPARENCY, transp);

Parameters

transp
Caption transparency attribute. Must be one of the following:
OVL_TRANSP_T   transparent.
OVL_TRANSP_BBKGND   black background.
OVL_TRANSP_T_BKGND   transparent text on a background.
OVL_TRANSP_B_BKGRD   black text on a background.

Return values

None.

Notes

Sets caption transparency attribute.

SX16_IOC_SET_CAPTION_TEXT

ioctl(handle, SX16_IOC_SET_CAPTION_TEXT, text);

Parameters

text
Null-terminated string of caption text.

Return values

None.

Notes

Sets caption text.

SX16_IOC_SET_CAPTION_ON

ioctl(handle, SX16_IOC_SET_CAPTION_ON, on);

Parameters

on
Caption on/off. Must be 0 or 1.

Return values

None.

Notes

Sets caption on/off.

4.2.3. Audio Functions

SX16_IOC_SET_AUDIO_VOLUME

ioctl(handle, SX16_IOC_SET_AUDIO_VOLUME, volume);

Parameters

volume
Volume. Must be between 0 and 63.

Return values

None.

Notes

Sets audio volume. Parameter means negative value in dB (0 – maximum volume, 63 – minimum volume).

SX16_IOC_SET_AUDIO_MUTE

ioctl(handle, SX16_IOC_SET_AUDIO_MUTE, mute);

Parameters

mute
Mute. Must be 0 or 1.

Return values

None.

Notes

Sets audio mute (0 – sound is on, 1 – sound is off).

SX16_IOC_SET_AUDIO_FORMAT

ioctl(handle, SX16_IOC_SET_AUDIO_FORMAT, format);

Parameters

format
Audio format number.

Return values

None.

Notes

Sets audio format:
  AFMT_MPEG1_LAYER1   MPEG-1 Layer I
  AFMT_MPEG1_LAYER2   MPEG-1 Layer II

SX16_IOC_SET_AUDIO_ BITRATE

ioctl(handle, SX16_IOC_SET_AUDIO_ BITRATE, bitrate);

Parameters

bitrate
Audio bit rate: see table below.

Return values

None.

Notes

Sets audio bit rate.

Bitrate **value**	**Bit Rate (kbps)**	
MPEG	Layer I	Layer II
1	32	32
2	64	48
3	96	56
4	128	64
5	160	80
6	192	96
7	224	112
8	256	128
9	288	160
10	320	192
11	352	224
12	384	256
13	416	320
14	448	384

4.2.4. Digital I/O Functions

Note: Different models have different number of IO pins. Please refer the hardware manual for your board.

SX16_IOC_GET_GPIO

ioctl(handle, SX16_IOC_GET_GPIO, 0);

Parameters

None.

Return values

State of GPIO

Notes

Reads state of GPIO pins: active input is low (when input is pulled down, bit is set to 1).

SX16_IOC_SET_GPIO

ioctl(handle, SX16_IOC_SET_GPIO, state);

Parameters

state
    State of GPIO

Return values

None.

Notes

Sets state of GPIO pins: active output is low (output is pulled down when bit is set to 1).
To use a pin as input, set this state to 0 (output is pulled up with resistor).

4.3.   Other commands

Some other commands and modes may be found in the header files. Such codes were left to
internal use or for compatibility with older revisions of software. Sensoray may change these codes
without a notice.