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Solomon Systech Image Processor for Car Entertainment Application

Introduction

Mobile video has taken off recently as a fun, viable, and even necessary addition to in-car entertainment. Several new SUV and mini-van models feature mobile video components as factory options and a growing number of people have decided to retro-fit their vehicles with video entertainment systems.

There are a number of reasons for stepping up to mobile video, including:

- **Entertainment** – The car is a fun environment in which to play video games, watch movies, cartoons, local television and even satellite television. All of this is now available for use in the car, truck, van, or SUV as mobile video technology is now advanced.
- **Safety** - When the video system is connected to a navigation system, which provides turn-by-turn visual and voice directions, it aids in travel navigation efficiently and accurately.

Reflected from development trends, car entertainment systems have evolved from the traditional pure audio concentric, such as mp3 to a system incorporating video display capabilities which provides user manuals and navigation features in higher-end models . Car entertainment systems now also offer multi-zone entertainment capabilities and display sizes range from 3-inch” medium-size to higher-end 7-inch display models. Display content generally consists of both analog (e.g. DVD player output or digital broadcast TV) and digital information (e.g. using multi-media interface and fancy wallpaper). Solomon Systech Image Processor Chip, the SSD1921, possesses features matching these new market requirements.

Figure 1 - Examples of Car A/V system with 3" and 7" LCD displays



Figure 2 – SSD1921 solution in car A/V application

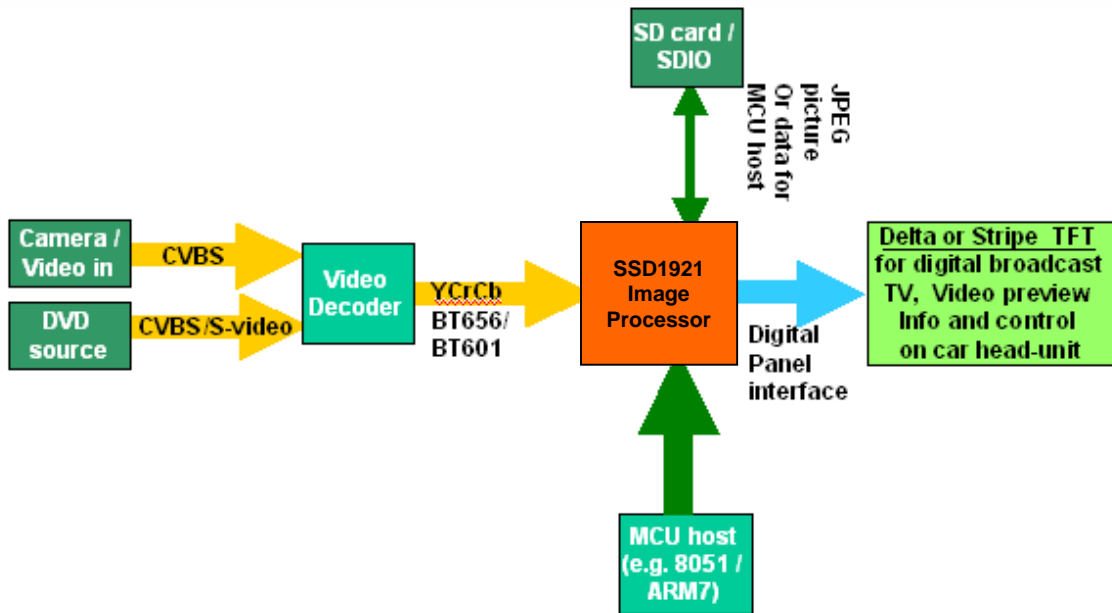
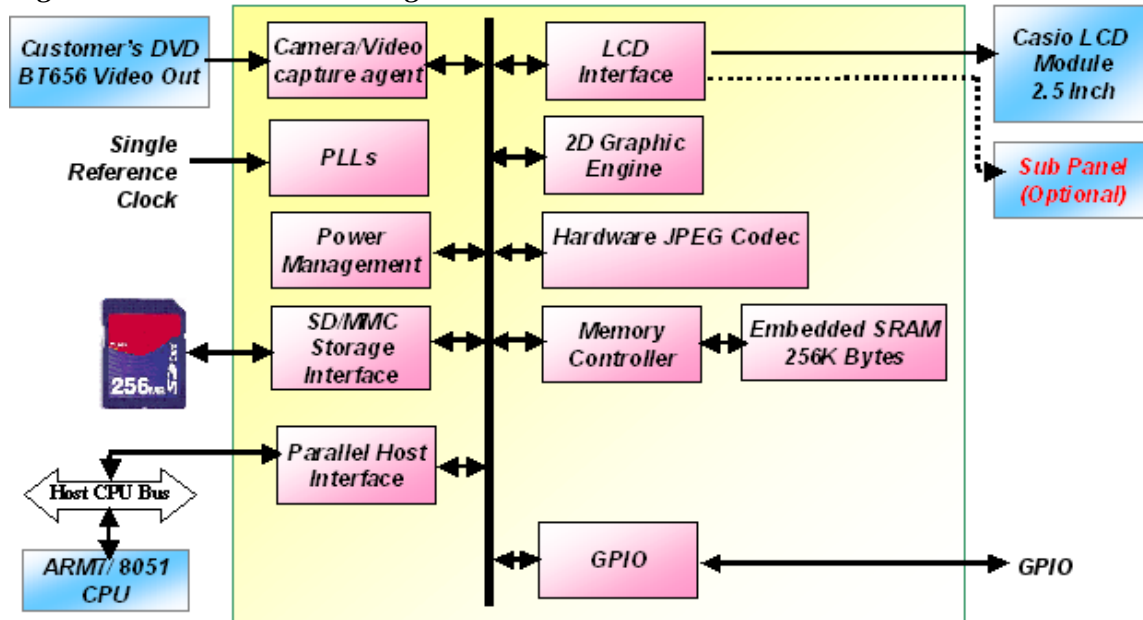


Figure 3 – SSD1921 block diagram



An overview of the Image Processor

Solomon Systech’s SSD1921 is an image processor featuring image capture and processing functions. Image content can be processed by the SSD1921 and displayed on various types of LCD panels, such as STN, CSTN, low-cost Delta panel and high definition stripe type TFT.

Figure 2 shows a solution for car A/V applications. The video decoder first converts the composite video or S-video to YCrCb BT656/BT601 and the output signal is then connected to the image processor’s video input port. If the video source already conforms to BT656/BT601 then the system design can be further simplified to bypass the video decoder. In most cases the video input may not always map to the display panel resolution on a 1:1 ratio. The SSD1921 has a “resizer” function that performs trimming and scaling to resize the image before being configured into the embedded SRAM. As a result, NTSC/PAL video source, with varied resolution, can be easily resized by this built-in scaling engine to fit LCD panels of various resolutions.

Once the frame buffer in the 256KB embedded memory is configured, the DVD image will be shown on the LCD screen. The image processor supports a maximum 640x480 delta arrangement (200KB) and 480xRGBx272 stripe pixel arrangement (255KB). Color depth of 1, 2, 4, 5, 16 and 32 bit-per-pixel can also be supported.

The built-in 2D graphic engine provides the sophisticated On-Screen-Display (OSD) effects, including on-screen display, semi transparent, font-acceleration of multi-languages, motion jpeg animation, zoom in and zoom out, virtual display, portrait display

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mode, overlay function, hardware cursor display, line drawing, BitBLT with raster operation, color fill and color expansion. The internal JPEG engine can provide highly customized user interface. For example, a user can capture his/her favorite DVD as a screen saver or wall paper, or can simply use his/her own picture, taken by 3rd party digital camera, as wall paper. To do so the user must pre-store the JPEG images into the SD/MMC card and the SSD1921 can then retrieve the pre-stored images back from the SD/MMC card, decoded and displayed on the LCD screen.

A single chip, integrated solution for system simplification

The major integrated features of Solomon Systech's SSD1921 image processor for car A/V application includes: video input port, JPEG codec, 2D graphic engine, SD interface, MCU and display interfaces. This single chip solution plays an important role in the system, reducing both cost and complexity.

The **video input port** on-chip will accept the common 8-bit digital video signal format YUV422 CCIR601 or CCIR656. While CMOS camera and CCD cameras also use these two interfaces designers can connect the camera image source to the SSD1921 video input port. Moreover, progressive video signal can directly input to the image processor with a maximum frame frequency of 15fps. Besides DVD playback function in today's car A/V product, still picture display such as menu and photo display is also an essential feature. The SSD1921 can support a maximum resolution of 1280 x 1024, equivalent to 1.3M pixel CMOS camera capture. If the video source is too large to display then the built-in decimation and clipping engine can resize and crop the video source with fix size decimation (1, 2, 4, 8, 16) to fit the display. Up to QVGA (320x240) 16bpp color depth image preview can also be performed by cropping and decimation. Furthermore, the chip features a color conversion capability, which includes fixed YUV to RGB color conversion implementation from YUV422 to RGB565 and from YUV422 to RGB888 format (32-bit with 8-bit alpha blending). The user can adjust Y, U, V components for brightness and contrast settings.

The built-in **JPEG codec** is a pure hardware codec, which completely offloads the computation from the MCU when doing JPEG encoding and decoding. The JPEG encoder compresses video input source to JPEG format and stores it in the embedded memory, with variable size of up to 1280x1024. Whereas the JPEG decoder receives a JPEG picture from the MCU or MMC/SD card and decodes to screen, where the size of the decoded image will be limited by the size of display or the size of embedded memory. Decimation and Clipping are the two algorithms for reducing the size of an image and reducing memory requirement. Bus bandwidth as well as power consumption can also be saved accordingly. Clipping decompresses a selected area of the full image. The non-integer decimation can be done in StretchBLT engine in 2D graphic engine. Since the maximum resolution of the video input port is 1280x1024, but the size of the embedded memory on-chip is 256KBytes only, it is impossible to start the JPEG compress after the entire frame is captured. The only way to do so is start the compression at the same time as the image frame is being captured.

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The image processor has a built-in **2D graphic engine** which is designed on the basis of Microsoft Windows GDI. It supports 7 major functions.

- (1) Screen panning and scrolling.
- (2) Image rotation including 0, 90, 180, 270 degree.
- (3) One cursor with three colors and transparency selection. Cursor blinking is available.
- (4) Line drawings.
- (5) Rectangle drawing.
- (6) Ellipse drawing.
- (7) Bit Block transfer (BitBLT). The purpose of the BitBLT engine is to off-load the work of the CPU for moving pixel data to and from the CPU and display memory. It also serves for moving pixel data from one location to another in the display memory, as the user can also easily move a pixel pattern in display memory and duplicate several times to produce a larger image by pattern fill BitBLT. Further, the color expansion function of the BitBLT engine has the advantage of storing data in bits, therefore saving memory. User can also apply boolean function to source and destination data, allowing higher flexibility in data management.

Similar to other Solomon Systech's controller IC, the SSD1921 has **integrated MCU interface and display interface**, its wide range of compatibility lessens design complexity. It supports most panel types, including: monochrome and color STN 4/8/12/16 bit interface, TFT 9/12/18 bit interface, 18 bit HR-TFT interface and 8 bit Serial TFT interface. For STN and CSTN panels, spatial and dynamic dithering is available to increase color depth. Furthermore, the SSD1921 provides direct interface with almost every kind of MCU, including low end 8-bit to high-end MCU products. These include Freescale 68K; Dragonball Series, Renesas SH3 and SH4 and Intel StrongARM/XScale.

Conclusion:

Car A/V is an already booming, highly potential market. Car A/V products will ultimately become an essential component in every vehicle of the future. An integrated single chip image processor is a great fit into any car A/V application and its valuable features and simple system design have allowed manufacturers to speed up their product launch.