DESIGN AND IMPLEMENTATION OF EMBEDDED MEDIA PLAYER BASED ON S3C2440

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ABSTRACT

This project proposes a method of understanding and implementing a light weighted media player using SDL based FFMPEG media player library on a SOC based board running on ARM9 hardware with LINUX as the target OS i.e., S3C2440 (also called as mini 2440) as core processor and select 1GB NandFlash as external memory. At the same time SD and USB interface are used for extending the storage. The most notable parts of FFMPEG are libavcodec, an audio/video codec, libavformat, an audio/video container mux and demux library, and the ffmpeg command line program for encoding and decoding multimedia files. In the software, initially the configured and optimized Linux operating system is transplanted to S3C2440, SDL library functions are used to design the player's interface and use SDL_FFMPEG library to decode the video files.

The proposed media player is reduced in the memory size to work for specific usage for given file formats and on predefined platform. Expected play effect of video and picture files can be achieved after software and hardware debugging. Results shows that this system has a lot of advantages of simple structure, small size, low power consumption, low cost and stable.

KEY WORDS: ARM9,S3C2440), SDL, FFMPEG, Linux.

I INTRODUCTION

Embedded Media Player is a kind of popular entertainment consumer electronic product and plays important role in people's life. Nowadays, People especially need it when they are in tourism, outdoor activities and travel. Based on this, S3C2440 is used as core processor and extend the external memory. In the software, initially the configured and optimized Linux operating system is transplanted to S3C2440, SDL library functions are used to design the player's interface and use SDL_FFMPEG library to decode the video files.

Current media players do not convert one format to another and do not support editing of audio\video. VLC media player can be long and complex for new developers. Code is written by expert C hackers and sometimes it is very hard to understand.

Embedded media player is a media player that is reduced in the memory size to work for specific usage for given file formats and on predefined platform. In general, formats supported by embedded media player can be of any specific type they are made for FFMPEG. Applications of embedded media player are used in handheld devices.

- Embedded media player requires very less memory space.
- The embedded media player provides simple structure between the interface, input, decoders and the outputs.
- The design goal is to ensure that an audio or video frame is played exactly at the right time, without blocking any of the decoder threads.
- Embedded media player is simple and easily understood by new developers.[16]

The embedded media player based on S3C2440 can be improved more upon and can be developed from the product point of view. In future, such kind of device can be made portable and can be carried easily along. The current media player can be developed as WD (western digital) live media player and use it to stream movies wirelessly.

Adding an initial user set-up upon the first use of the media player may prove beneficial. This set-up would include setting or detecting the Bluetooth com port used by the gesture magnitude set-up.

II. OVERALL DESIGN

A. HARDWARE DESCRIPTION

S3C2440 is the 32-bit RISC processor as Core Processer with 1GB NAND Flash and 64MB SDRAM outside. S3C2240 is famous for its low power consumption and high frequency, the frequency can reach 400MHZ, while its price is very cheap, so it can reduce the costs effectively. A 3.5-inch LCD touch screen W35 TPO is chosen and it can guaranty better picture quality. Because of the big sizes of the video files, the external storage may not be enough, so SD card and USB interface are used for extending the storage.
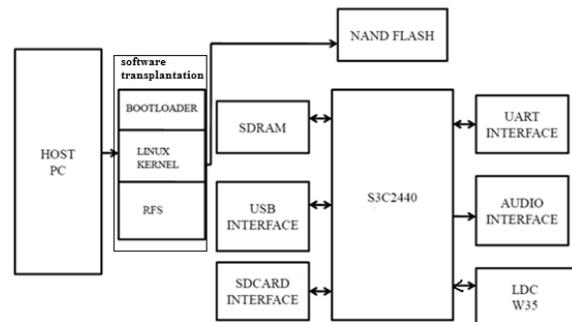

Figure 1. Block Diagram of Embedded Media Player

NandFlash is used for data storing so that the application software can be placed here.SDRAM is used as

dynamic memory when system works. SD card and U-disk is used as an external expansion memory to store files. Touch screen is used to display and choose menu. Audio interface is used to play audio information. UART port is used to interact with developers when in the development stage.

The figure.1 shows the block diagram of embedded media player. Initially, the supervivi boot loader, linux kernel, the qtopia RFS(Root File System) are ported onto the kit through personal computer by connecting a serial port and USB host device. The Norflash is used to store OS, boot loader and RFS as the Norflash is very fast compared to the Nand flash. The other application software can be placed in Nandflash memory.

S3C2440 Microcontroller

The S3C2440 offers outstanding features with its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd. The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length. By providing a complete set of common system peripherals, the S3C2440 minimizes overall system costs and eliminates the need to configure additional components.[9]

ARM9TDMI

ARM9TDMI is a successor to the popular ARM7TDMI core, and is also based on the ARMv4T architecture. Cores based on it support both 32-bit ARM and 16-bit Thumb instruction sets include:

- ARM920T with 16KB each of I/D cache and an MMU
- ARM922T with 8KB each of I/D cache and an MMU
- ARM940T with cache and a Memory Protection Unit (MPU)[15]

Nandflash Memory

K9K8G08U0A a kind of 1 GB Nandflash as external memory. NandFlash is used for data storing so that operating system, Boot Loader and other application software can be placed here. NOR flash memory gets high in price while an Sdram and a Nandflash memory is comparatively economical, motivating some users to execute the boot code on a Nandflash and execute the main code on an Sdram. The figure.2 shows the block diagram of Nandflash memory. In order to support Nandflash boot loader, the S3C2440 is equipped with an internal Sram buffer called 'Steppingstone'. When booting, the first 4 Kbytes of the Nandflash memory will be loaded into Steppingstone and the boot code loaded into Steppingstone will be executed. Generally, the boot code will copy Nandflash content to Sdram. Using hardware ECC, the Nandflash data validity will be checked. Upon the completion of the copy, the main program will be executed on the Sdram.[9]
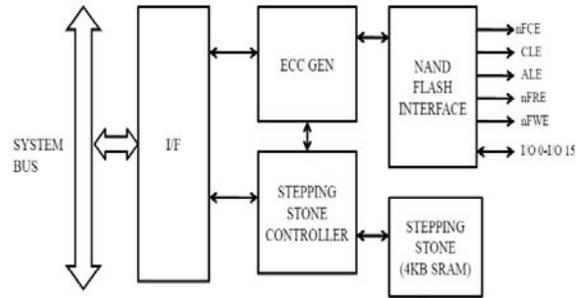

Figure 2. Block Diagram of NandFlash Memory

SDRAM

The 64Mb SDRAM uses an internal pipelined architecture to achieve high-speed operation. SDRAMs must be powered up and initialized in a predefined manner. Operational procedures other than those specified may result in undefined operation.[14]

Secure Digital card

Secure Digital (SD) is a non-volatile memory card format developed by the SD Card Association (SDA) for use in portable devices. SD comprises several families of cards the, Standard-Capacity (SDSC) card, a High-Capacity (SDHC) card an extended-Capacity (SDXC) card family[13]
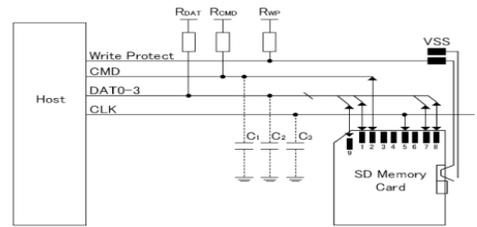

Figure 3. SD Card Interface

UART Interface

Universal Asynchronous Receiver Transmitter. It takes parallel data and transmits serially. It receives serial data and converts to parallel. It Supports 5-bit, 6-bit, 7-bit, or 8-bit serial data transmit/receive (Tx/Rx) and external clocks for the UART operation (UEXTCLK). It can be operated with programmable baud rate.[9]

LCD Display

The LCD controller in the S3C2440 consists of the logic for transferring LCD image data from a video buffer located in system memory to an external LCD driver.The LCD controller can be programmed to support different requirements on the screen related to the number of horizontal and vertical pixels, data line width for the data interface, interface timing, and refresh rate.
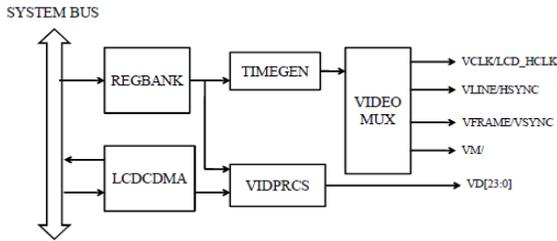
Figure 4. LCD Controller Block Diagram

The figure.3 shows S3C2440 LCD controller used to transfer the video data and to generate the necessary control signals, such as VFRAME, VLINE, VCLK, VM, and so on. In addition to the control signals, the S3C2440 has the data ports for video data, which are VD[23:0]. The LCD controller consists of a REGBANK, LCDCDMA, VIDPRCS, TIMEGEN. The REGBANK has 17 programmable register sets and 256x16 palette memory which are used to configure the LCD controller. The LCDCDMA is a dedicated DMA, which can transfer the video data in frame memory to LCD driver automatically. By using this special DMA, the video data can be displayed on the screen without CPU intervention. The VIDPRCS receives the video data from the LCDCDMA and sends the video data through the VD[23:0] data ports to the LCD driver after changing them into a suitable data format. The TIMEGEN consists of programmable logic to support the variable requirements of interface timing and rates commonly found in different LCD drivers. The TIMEGEN block generates VFRAME, VLINE, VCLK, VM.

The S3C2440 LCD interface has a 41 Pin 0.5mm pitch white connector, which contains common LCD control signals. They can be directly connected to a Touch Panel.[9]

USB Host and Device Interface

The USB Host library is an embedded USB stack supporting USB MSC (Mass Storage Class) and HID (Human Interface Device) classes. It has been designed to be high-performance while using as little memory as possible.

ARM Editions provides USB Device and USB Host support for embedded systems. The USB Device Interface uses standard device driver classes that are available with all Windows PCs. [12]

Audio Interface

Professional soundcards are usually described as "audio interfaces", and sometimes have the form of external rack-mountable units using USB, FireWire, or an optical interface, to offer sufficient data rates. The emphasis in these products is, in general, on multiple input and output connectors, direct hardware support for multiple input and output sound channels, as well as higher sampling rates and fidelity as compared to the usual consumer soundcard. In that respect, their role and intended purpose is more similar to a specialized multi-channel data recorder and real-time audio mixer and processor, roles which are possible only to a limited degree with typical consumer soundcards.[4]

B. SOFTWARE DESCRIPTION

Software Description gives an overview of software routines, device drivers that comprise the software system and Flow chart of the Media player. It deals with SDL_FFMPEG Library and application development and implementation of Media player on the S3C2440.
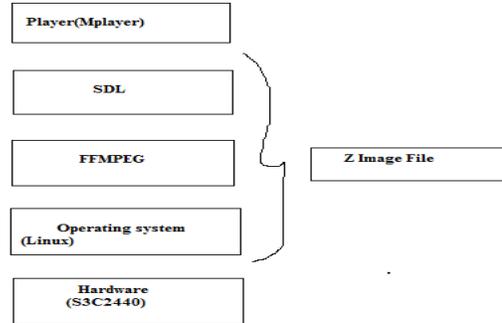

Figure 5. Implementation steps of Media player
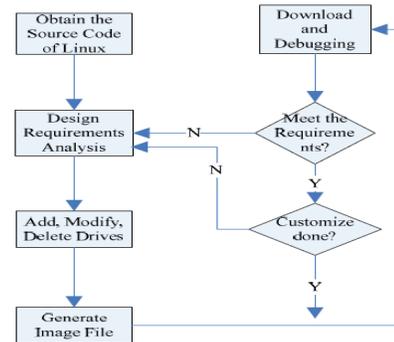
Operating system customization

Figure 6. Linux System Development Steps

Linux is a huge operating system, so it can be optimized. Some of the functions can be removed such as network, power management, wireless communication, hard disk, etc., and just retain some useful function. The command (make menu con fig ARCH=arm CROSS_COMPILE=arm-linux-,) is entered in the root directory of the kernel to remove and configure the Linux's kernel. This is a graphical interface, so it is easy to choose. The basic steps to customize the operating system are shown in figure 6.[5]

SDL (Simple Direct Media Layer)

Simple Direct Media Layer is a cross-platform multimedia library. It is mainly to provide a unified programming interface for cross-platform, also for application software development especially provide convenient for code transplant. SDL is written in C, provides functions to user by library, and also provides a large number of other programming language interface. In making the player, SDL is used to output the audio and video of the media file.[7]

MEDIA PLAYER'S CORE DESIGN

FFMPEG

The core of media player is to encode and decode the video and audio files, then to realize the synchronization between the audio stream and video stream. There is a powerful library called FFMPEG, it provides a complete solution to the audio and video stream. The core of FFMPEG is a library called libavcodec which has a big advantage in encoding and decoding audio and video files. FFMPEG is a complete, cross-platform solution to record, convert and stream audio and video. It includes libavcodec - the leading audio/video codec library.[8]

Important Functions of SDL

SDL_Init(SDL_INIT_AUDIO|SDL_INIT_VIDEO|SDL_INIT_TIMER)

/*initialize the system*/

SDL_ffmpegOpen(avifile); /* open file from arg[1] */

mutex = SDL_CreateMutex(); /* initialize the mutex */

SDL_ffmpegSelectVideoStream(file, 0); /* select the stream we want to decode*/

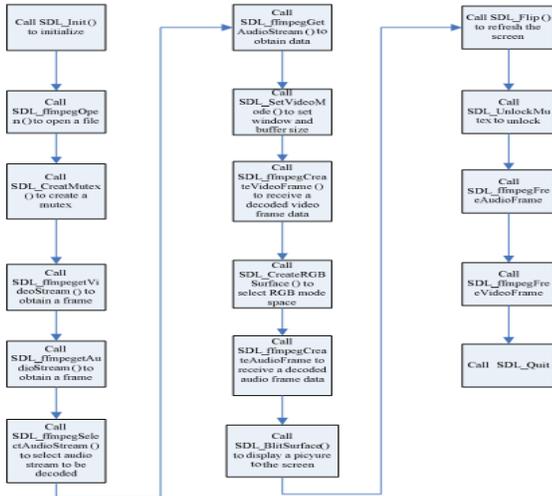
Figure 7. Flow Chart of the audio and video stream

SDL_ffmpegStream *stream = SDL_ffmpegGetVideoStream(file, 0); /* print frame rate of video stream */

SDL_ffmpegSelectAudioStream(file, 0); /* select the stream we want to decode*/

stream = SDL_ffmpegGetAudioStream(file, 0); /* print frame rate of audio stream */

SDL_ffmpegVideoFrame   *videoFrame   = SDL_ffmpegCreateVideoFrame(); /* create a video frame which will be used to receive the video data. */

SDL_ffmpegValidAudio(file) /* check if a valid audio stream was selected */

SDL_ffmpegGetAudioFrame(file, audioFrame[i]);   /* fill frame with data */

SDL_CreateRGBSurface(0, screen->w, screen->h, 24,

0x0000FF, 0x00FF00, 0xFF0000, 0);/* create an RGB surface*/

SDL_ffmpegCreateAudioFrame(file, frameSize); /* create a audio frame */

SDL_BlitSurface(videoFrame->surface, 0, screen, 0); /* blit RGB surface */

SDL_Flip(screen); /* flip screen */

SDL_ffmpegFreeAudioFrame(audioFrame[i]); /* clean up audio data*/

SDL_ffmpegFreeVideoFrame(videoFrame); /* clean up video data */

SDL_ffmpegFree(file); /* after all is said and done, we should call this */

SDL_Quit();/*quit the SDL */[1]

III . EXPERIMENTAL RESULTS

Immediately on power-up the friendly ARM logo is displayed. As the system OS, boot loader, RFS are already ported on kit the board starts booting itself.

The board is shipped with a preinstalled supervivi in Nor Flash. When the system boots from Nor Flash it will enter the BIOS and in the meantime the red LED1 on the board will be flashing. While booting, the system will be performing a power-on self-test, locating and initializing peripheral devices, and then finding, loading and starting an operating system.

After booting the system automatically displays the menu and also with other icons. As per the requirement, the command is to be given in the terminal. So we terminal icon is chosen. Touch screen is provided to choose menu. The command is given in the terminal to play the file. The command can be given with the help of virtual keyboard which is provided in the terminal.

Figure 8. playing video file

CONCLUSIONS

Expected play effect of video and picture files can be achieved after software and hardware debugging. Practical effect can be seen in Figure.8. Actual result shows that this system has a lot of advantages such as simple structure, small size, low power consumption, low cost, stable. Therefore we have enough reasons to believe that this product has a broad market prospect after making series of follow-up comprehensive development in current fierce competition

A Simple Direct Media Layer (SDL) is a cross platform multimedia library for playing audio/video files. Embedded media player is a media player that is reduced in the memory size to work for specific usage for given file formats and on predefined platform. In general, formats supported by Media player can be of any specific type they are made for FFMPEG.

The player is rock solid playing damaged MPEG files, and it plays bad AVI files which are unplayable with the famous Windows Media Player. Expected play effect of video and picture files are achieved after software and hardware debugging.

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