

Technology Report

CS-400

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Introduction

This document will describe the research that was conducted to further understand the technologies that will be used in designing the car MP3 player. The hardware devices that were candidates for components in the design will be compared, and reasons for rejecting or selecting a device will be stated.

MP3 Files

The MP3 music format is a streaming audio file that is highly compressed. At the end of a streaming MP3 file is usually an ID3 tag. This tag holds some information about the song in the audio file including artist, title, track number, year, album, a music type code, and comments. More information about the format of this tag can be found at www.id3.org. The final product will use this tag to display song and artist information about the song while it is playing.

MP3 Decoder Chip Selection

In recent years, many companies have been creating IC's to decode MP3 files into an audio stream. Since this eliminates specific knowledge about the MP3 streaming audio format, we can concentrate our development on other areas.

The MPEG decoder was the first decision that needed to be made. Since the entire project is based around MP3 decoding, a good decision concerning the decoder chip used was important. This chip also helped determine what microcontrollers would best suit the needs of the project.

Chips Considered

- VS1001 by VLSI Solutions
- Samsung TL7232MD
- STA016T by STMicroelectronics
- TMS320DA250 by Texas Instruments
- RSM88136A by Rosun Technologies
- MAS3507D by Micronas
- PT8401 by Princeton Technology

Pros and Cons

VS1001k

Pros

- On-Chip DAC
- Use as a coprocessor
- Serial interfaces
- Supports Off-Chip DAC
- Variety of sources for information
- Relatively inexpensive(\$20-\$25 per chip)

Cons

- Only SMD packaging available

TL7232MD

PROS

- On-chip DAC
- Serial input
- Supports off-chip DAC

CONS

- 64 pin flat package only
- Fixed operation voltage

STA016T

PROS

- Serial Input
- Interfaces with many different chips
- Many applications

CONS

- 64 Pin flat package
- Off-chip DAC only

TMS320DA250

PROS

- Low Power Consumption

CONS

- Tough to find information
- Offchip DAC

RMS88136A

PROS

- Works with HC11
- Low Power Consumption

CONS

- 128 Pin Flat chip

MAS3507D

PROS

- Serial interface
- Variable voltage
- Works well with Micronas Off-chip DAC

CONS

- 44 pin Flat
- No On-Chip DAC

PT8401

PROS

- Serial Interface
- Built in Equalizer

CONS

- Lack of information
- 44 pin Flat
- No On-Chip DAC

Selected Device

The VS1001k by VLSI Solutions has been chosen due to its versatility, small size and features. The on-board DAC was a major help in deciding upon this feature and the serial interface was also a major influence in this choice. It also seems to have a relatively inexpensive price. For the prototype there is an easily debuggable 28 pin SMD and when production would come around there is a smaller 44 BGA(Ball Grid Array)

package with the same features. Size, cost, and the on-chip DAC were three of the main factors in deciding upon this chip and this chip excelled in those categories.

Storage Device

The storage device will be responsible for storing the mp3 data for future use. Ideally, the device will be removable to allow storing data from a PC and retrieving that data in a vehicle. The device needs to be durable to handle fluctuating weather conditions and vibrations from driving along the road. The standard computer hard drive is the best candidate for high capacity storage. We looked at several other options, but none of them offered the capacity that would be required to store a reasonable amount of MP3s.

ATA Interface

The standard hard drive interface is the ATA (AT-attachment) interface. This interface is a standardized version of the IDE interface that was developed by Western Digital. The hard drive is controlled using several 8-bit control and command registers. These registers allow the hard drive to be setup for a specific operation. If the operation is a READ command, data is read from a 16-bit data register. Likewise if a WRITE operation is specified, the host must write 16-bit data into the data register. Overall the ATA interface is very simple.

FAT32 Format Structure

Once communications with the hard drive are present, the next step would be to read the data off of the hard drive. Microsoft has developed a standard storage structure called FAT or File Allocation Table. The file allocation table, stored towards the beginning of the drive, holds the directory structure, and where each file on the disk starts. A file,

when stored on the disk, is not necessarily stored sequentially. There is a starting block of data, which holds the data itself and the location of the next block of data. In order to read a file from the disk, first the location of the first block is found in the file allocation table, then that is used to get the first block of data, which will point to each subsequent block until the entire file is read from the hard drive.

Microcontroller

At the heart of the project is the microcontroller. It will have the responsibility of forwarding data to the MP3 decoder chip, reading MP3 data files off of a hard disk, controlling the ATA interface of the hard disk, providing feedback to the user, and retrieving input from the user.

Components Considered

- Motorola family microcontrollers
- Microchip PIC microcontroller family
- Atmel ATmega microcontroller family

Pros and Cons

Microchip PIC

Pros

- Wide operating voltage
- Fast clock speeds
- Reprogrammable (FLASH versions)
- Inexpensive
- SPI interface available

Cons

- Unfamiliar assembly language
- Requires Expensive Programmer

Motorola Microcontroller

Pros

- Familiar assembly language
- Fast clock speeds

- Reprogrammable (FLASH versions)
- Inexpensive
- SPI interface available

Cons

- Non-flexible operating voltages

Atmel

Pros

- Wide operating voltage
- Fast clock speeds
- Reprogrammable (FLASH versions)
- Larger amounts of FLASH and RAM
- Inexpensive
- SPI interface available
- JTAG programming interface

Cons

- Unfamiliar assembly language

Components Selected

The Atmel family of processors was chosen because of their wide variety of features, extra amounts of FLASH and RAM compared to the other two chips, and their JTAG programming interface. This allows us to use simple hardware to program our device.

USB

The universal serial bus technology will be used to interface the PC to a storage device. This technology will allow the user to “hot plug” the storage device into their PC without restarting the machine.

USB Interface

A device will be needed to interface USB to an ATA storage device. This device should handle formatting data to allow proper transfer across each of the protocols.

Chips Considered

The PDIUSB series is a high performance, low-cost and feature-optimized USB interface series from Philips Semiconductors. It allows conventional peripherals to be upgraded to

USB devices to take advantage of the simple "hot plug and play" capability of the bus, easily and at low risk.

Pros and Cons

PDIUSB12

Pros

- High-speed Parallel Interface (up to 2 Mbytes/s)
- USB Revision 2.0 compliant
- Suited for components such as "External Mass Storage (Zip Drive)"
- Low power consumption
- Backward compatible with revision 1.1 specifications
- Low Price (\$4.43)

Cons

- Currently not in stock
- Surface mount device

PDIUSBP11AD

Pros

- Currently in stock
- Full Speed Device 12Mbps
- Lowest Price (\$3.05)

Cons

- Old standard using a slow transfer (approximately 12MB/s)
- Surface mount device