ADD AUDIO PLAYBACK TO YOUR NEXT PROJECT – IT'S EASIER THAN YOU MIGHT THINK!

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This article is all about utilizing audio files stored on a USB Flash drive in unusual applications. If all you want to do is listen to your favorite tunes, then that's easy enough. Just purchase a garden-variety MP3 player, strap on a pair of headphones, and blast away. If, on the other hand, your creative adventures take you down paths that require your latest electronic inventions to have control over which audio file is played, then this article is for you. Grab a low-cost microcontroller, load your USB Flash drive with audio files, and fire up your imagination. This article will show how to select and play MP3 and other popular digital-format audio files directly from a USB Flash drive.

*Experience the **VMUSIC1** module for yourself! Visit the FTDI booth at the **Embedded Systems Conference** in San Jose, April 3-5.*

DATA ACCESS

The first challenge in playing an audio file is retrieving the file in question from the USB Flash drive. Since talking to a USB Flash drive is a "USB Host" type activity, data stored on it was once only accessible via a PC. What has been needed is a bridge of sorts between the microcontroller and the USB Flash drive that doesn't involve the bulk of a PC. Wouldn't it be nice if this could be done with a single, easy-to-use chip? The good news is that this call has since been answered. There is a new IC available from FTDI called the Vinculum (www.vinculum.com) that provides USB Host services and is unbelievably easy to use. Since the Vinculum is programmable, it is capable of much more than just interfacing a small microcontroller to a USB Flash drive for audio playback. This is, however, the application that we will be discussing here.

VINCULUM AND VLSI VS1003

To interface to the Vinculum IC, you simply connect a USB Flash drive to one side using a couple of resistors and capacitors, and your microcontroller's TX/RX/CTS/RTS serial interface to the other. That's it. The microcontroller activates its UART at 9600 baud and sends over serial commands like "DIR MYFILE.TXT" to see if the file is available and "RD MYFILE.TXT" to open it and retrieve the data in the file back into the microcontroler on the RX line. This is great if all you want to do is to read and write data files. What if you would like to play music or other audio files?

Not only is the Vinculum programmable, but it also has two interface ports available so that it can connect a microcontroller to both a USB Flash drive and an MP3 processor chip like the VLSI VS1003. Communicating with the VS1003 takes a bit more work, so the folks over at FTDI (www.ftdichip.com) developed a new module (Figure x) that combines the Vinculum, VS1003, and firmware called the VMUSIC1.

With the VMUSIC1 module, simply writing the serial command “VPF MYSONG.MP3” will start the playback of an associated song on the USB Flash drive.

APPLICATION

So now the stage is set. Using the VMUSIC module, we can select and play an audio file from a USB Flash drive using only our small micro. All we have to do now is decide how to use it. We could utilize a microcontroller to read a numeric value from a keypad that corresponds to an audio file and play that file; or we could use the digital inputs of a micro to read a series of switches, each switch initiating the playback of a different audio file; or, well, you get the idea…

I decided to select the audio file to be played by having a microcontroller read 4 bytes from an RFID tag, combine those 4 bytes to a 32-bit number, convert that number to hexadecimal ASCII string, append “.MP3” to the string and use that as the file name. Using this application, people participating in a scavenger hunt could obtain audio hints by holding the RFID/VMUSIC combination up to tags mounted at strategic locations. The audio files would then provide clues as to where to look next.

This system could also be used in museums or art galleries to describe a work of art. The patron would simply hold the player up to an RFID tag that is hidden behind a plaque to hear all available information about a given piece. With a little extra effort, the curator could even utilize an artist’s voice in the audio playback.

PROTOTYPE

Figure x displays a snapshot of the prototype platform. Additional pictures, as well as a PDF of the schematic, are available for download from www.dlpdesign.com/pub.shtml. Since I wanted the system to be small and lightweight, I decided to go with only two AA batteries as the power source. The RFID reader, VMUSIC1 module, and microcontroller all needed 5-volt power, so the first order of business was to incorporate a DC-DC converter. The TI UCC2941-5 was chosen due to its ease of use and availability. Otherwise, there are probably hundreds of other converters that would work. The DC-DC converter circuit is in the upper left quadrant of the schematic (Figure x.)

The RFID tags used here have two kinds of memory; a permanent serial number that cannot be changed, and 256 bytes of “user memory” arranged in groups of 4 bytes or “blocks”. I wrote a different 4-byte block of data to each of the 16 tags that corresponded to 16 different audio files. Before loading the USB Flash drive with the audio files, each file was renamed from the original name of the song to the xxxxxxxx.MP3 ASCII string as described earlier.

Since both interrupts and a data rate of 115,200 baud were required, it was necessary to use the micro’s only UART for communication with the DLP-RFID1 RFID reader. This meant that serial communication with the VMUSIC1 module would have to be done via software (not via a UART), which was not a problem since we only needed a rate of 9600 baud and no interrupts. In fact, if this system did not use the RFID reader with its high data rate requirement, we could have eliminated the crystal from the design altogether and used the microcontroller’s internal 8MHz oscillator instead.

I added a serial LCD display to be able to see the name of the audio file being played and an LED that was turned on to indicate when the micro was out of

Sleep Mode, requesting an RFID tag to trigger a song selection. In fact, all that is really needed to make the VMUSIC1 play music is 4 pins from a small microcontroller and a 5-volt power supply.

CONCLUSION

If you want to be able to say “I designed my own MP3 player” then yes, this platform could be used as the starting point. After all, all that’s needed to implement a player is some form of storage for the audio files, a power source, an (optional) LCD display, and a few buttons for song selection. However, with a little imagination, the VMUSIC1 module opens up a world of possibilities from interactive talking robots to adding voice or music to ANYTHING that has a microcontroller. So put on your thinking cap, grab your microphone, and start creating audio files. The VMUSIC1 module will handle the hard part of audio playback for you.