Ah-Ah-Piu

Final Project Presentation

Spring 2013 CSEE4840 Embedded System Design
Final Project

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Content

- **Overview**
- **Architecture**
- **Hardware**(Audio, VGA & LED, Memory)
- **Software**
- **Lesson Learned**

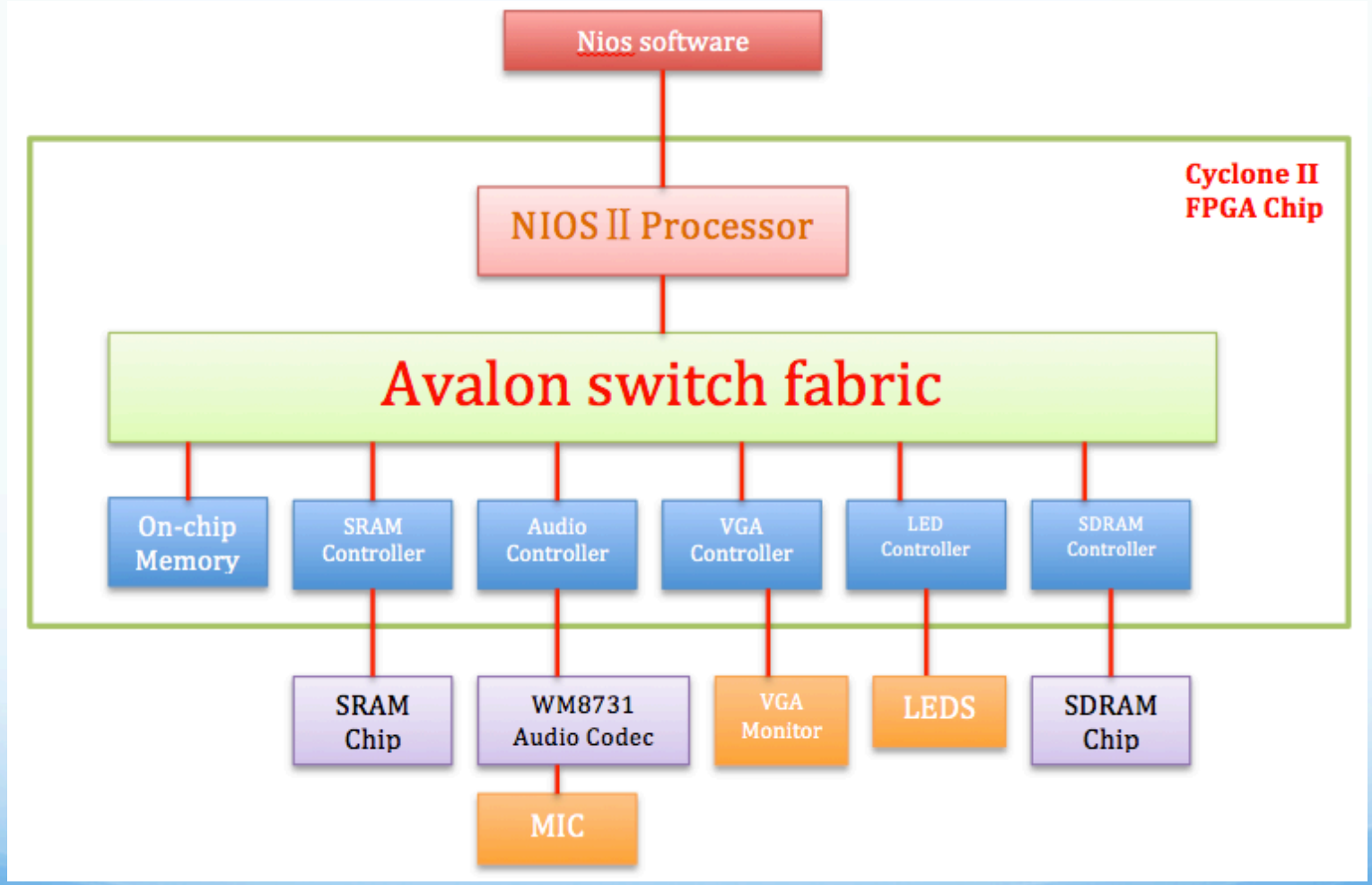
Overview

Description: Ah-Ah-Piu is a VGA displayed voice-controlled single-player platform video game.

Game Logic: The player's voice captured by the microphone controls the character in the game dodging and destroying the incoming enemies, in order to keep alive as long as possible and earn more points.

Let's try it out

Architecture



Hardware

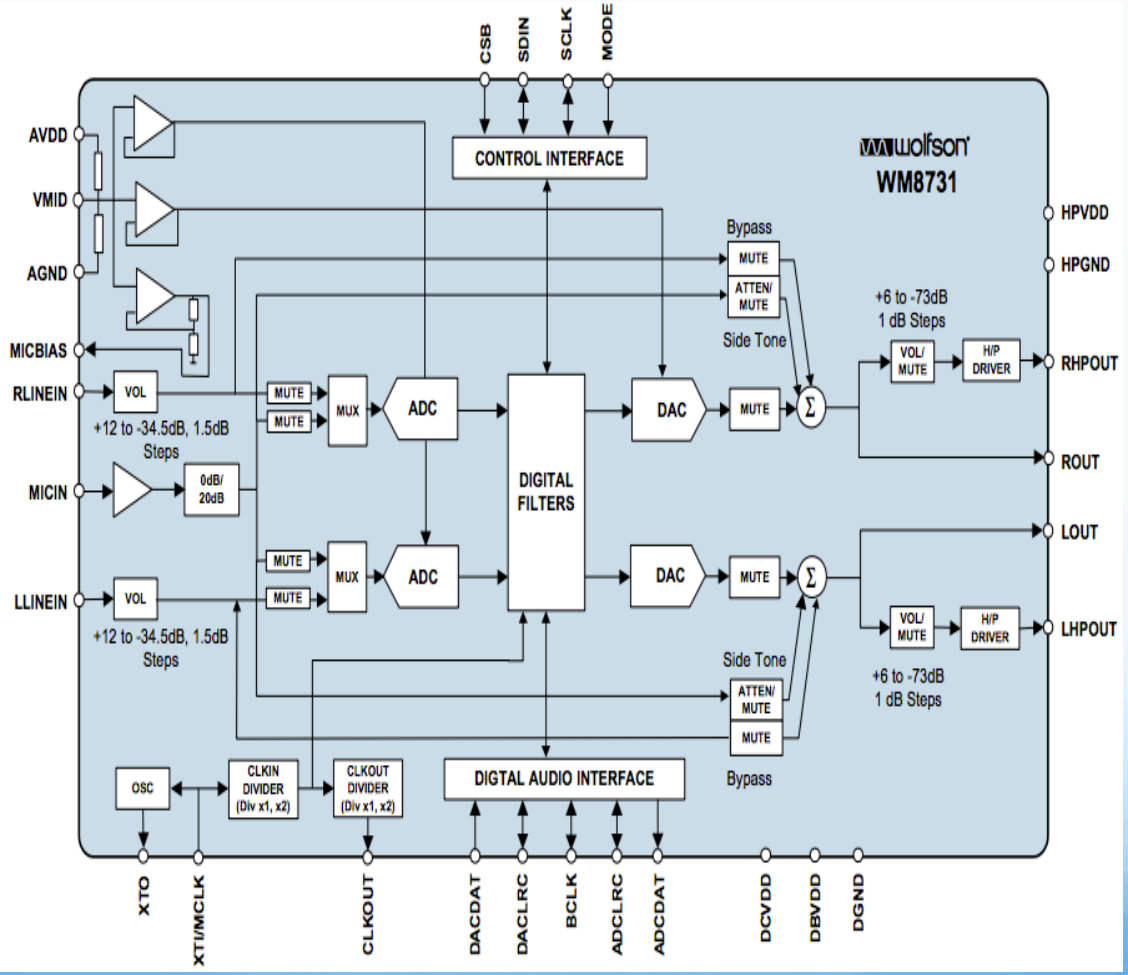
Audio

Wolfson WM8731 Audio Codec

It is a programmable stereo Codec device, contains two pairs of ADC and DAC to accommodate both left and right channels of stereo audio. The convertors support 16-32 bits resolution and 8-96 kHz sampling rate. The codec is programmable via 2-wire i2c control bus which initialize the Codec's 11 control registers from the control interface to set up the chip configuration. And the Codec communicate with the outside world through the digital audio interface.

Hardware

WM8731 Audio Codec



Hardware

Audio

Input: Capture the player's voice with the microphone, transform this signal into audio sound byte which represent the magnitude of the sound and provide it to the software.

Output: Play the sound effect and background music from the headphone

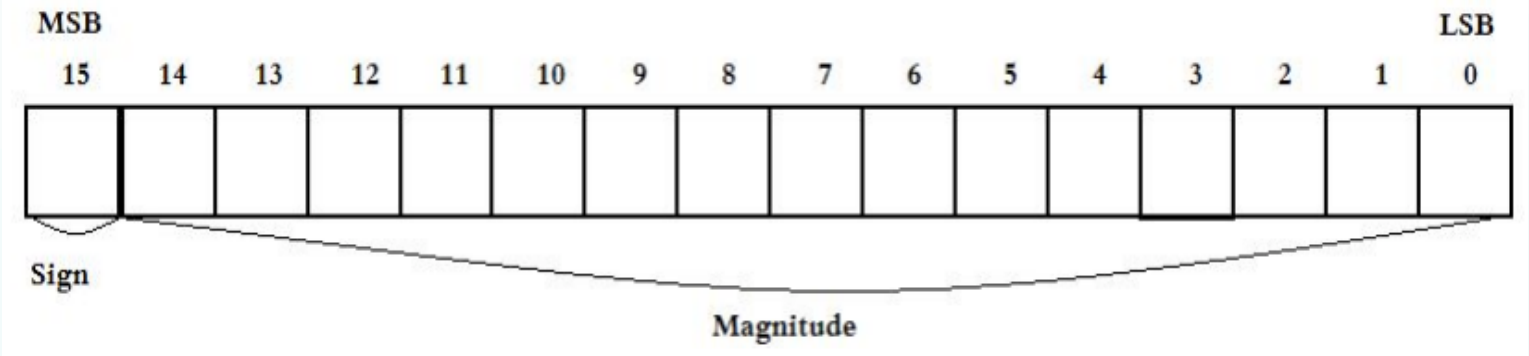
Hardware

Input

- The Codec perform the ADC on a 8kHz sampling rate and 16 bits resolution.
- Take the outputted digital data from ADCDAT signal, use a module to de-serialize the raw single-bit bit stream into 16 bits .WAV format.
- In the module we spilt external system generated reference clock (25MHz) to 8kHz and 128kHz, load every consecutive 16 bits into an array (sound byte) and with the help of audio controller, write the sound byte into one address of the register.

Hardware

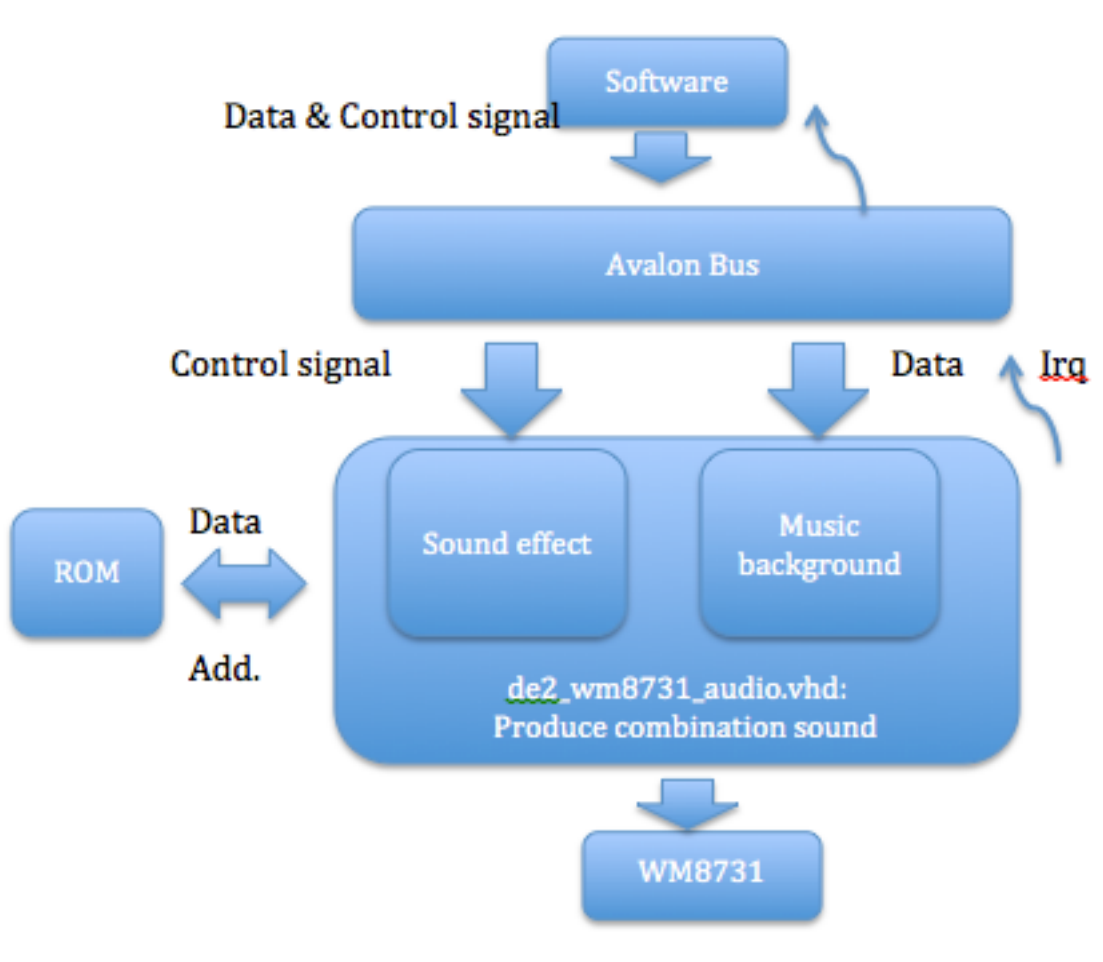
Input



the software read the sound byte from the register, it will get an integer that ranging from 0 to 65,535. If the most significant bit is 0, then the integer ranges from 0 to 32,767 represents increasing magnitude. Otherwise, the integer ranges from 32,768 to 65,535 in decreasing order of magnitude.

Hardware

Audio_out



Hardware

VGA

- 216-color Web color map

  Save storage space; Maintain high resolution.

- 4 layers

  Many elements need separate process.

- Separate control of each element

  Individual movement controlled by software

Hardware

VGA

- Communicate

  Buffer used in communication with software.

  Fetch color map index stored in SRAM.

Hardware

LED

- Directly controlled by processor

  Four digitals are written to separate buffer address.

  Decode and print digital value.

Hardware

Memory allocation

1. On Chip Memory

   Store the sound effect

2. 512k SRAM

   Store image data, using two projects instead of a MUX

3. 8M SDRAM

   Include Pll

Software

- Audio Input Categorization
- Collision Detection
- Game Logic

Lesson learned

Hardware

Audio

register	address	data								
	B15 - B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
R0	000000	LRIN BOTH	LIN MUTE	0	0	LINVOL				
R1	000001	RLIN BOTH	RIN MUTE	0	0	RINVOL				
R2	000010	LRHP BOTH	LZCEN	LHPVOL						
R3	000011	RLHP BOTH	RZCEN	RHPVOL						
R4	000100	0	SIDEATT		SIDE TONE	DAC SEL	BYPASS	INSEL	MUTE MIC	MIC BOOST
R5	000101	0	0	0	0	HPOR	DAC MU	DEEMPH		ADC HPD
R6	000110	0	PPW OFF	CLK OUTPD	OSCPD	OUTPD	DACPD	ADCPD	MICPD	LININPD
R7	000111	0	BCLK INV	MS	LR SWAP	LRP	IWL		FORMAT	
R8	001000	0	CLKO DIV2	CLKI DIV2	SR				BOSR	USB/ NORM
R9	001001	0	0	0	0	0	0	0	0	ACTIVE
R15	001111	RESET								

Set up the control register using the de2_i2c_av_config.v file

R2, R3:
LHPVOL and RHPVOL Volume control;
LZCEN left zero crossing detect enable;
LRHPBOTH left headphone controlling both channels

R4:
INSEL Input selected
MUTE MIC
SIDE TONE
MIC BOOST

Lesson learned

Hardware

Audio

1. Figure out the clock divider meaning in sample program, and calculate the proper clock frequency.
2. Do not code the same file in two or more programs at the same time, or you may miss some modification.
3. When doing large scale replacing of code, do it in gedit, rather than in Quartus or Nios2. The latter is much slower, and may leads to program crash.

Lesson learned

Hardware

VGA

- DSP for images
  - Photoshop to convert 216-color map image.
  - Matlab to extract bit data for image.

- Separate layers design
  - relieve the work load of process.
  - reduce compiling time.

Lesson learned

Hardware

Memory Allocation

- ROM: we should use a .mif file to describe the content in ROM.
- SRAM: Since there are some different matrix in the SRAM, We have to know the exact address and offset for each data.
- SDRAM: Due to the frequency problem, we have to add a PLL core to unify its clock with NIOS-2 CPU. Moreover, the BGM is also stored in the SDRAM.

We have created a new algorithm to calculate the correct address from SRAM to VGA.

Thanks for watching !
Hope you enjoy our game!