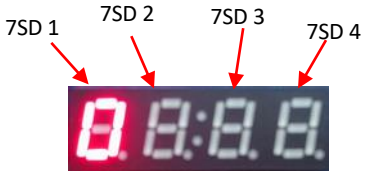
AY1718 Semester 2 EE2026 Audio Effects Project Report

Student A: WANG HAOZHE (A0168337W) Student B: WANG SHUHUI (A0173413M) Group: Monday

Task	Feature	Input	Description	Output Display
1	Real-time system	{SW15, SW14, SW13}	Set {SW15, SW14, SW13} to 3'b**000** to output real-time audio signal.	Seven segment display displays mode 0*
2.A.	Delay Owner: Wang Haozhe	{SW15, SW14, SW13}	Set {SW15, SW14, SW13} to 3'b**001** to output audio signal with 1s delay.	Seven segment display displays mode 1 and 1 second delay*
2.A.	Delay improvement (Real-time Pitch Shifter) Owner: Wang Haozhe	{SW15, SW14, SW13} & SW10	Set {SW15, SW14, SW13} to 3'b**011** and set SW10 to 1'b**0** to output a real-time audio signal with 40kHz pitch shift frequency. Set SW10 to 1'b**1** to output a real-time audio signal with 30kHz pitch shift frequency.	Seven segment display displays mode 3 and the pitch shift frequency*
2.B.	Musical instrument Owner: Wang Shuhui	{SW15, SW14, SW13} & {SW6, SW5, …, SW0}	Set {SW15, SW14, SW13} to 3'b**010**; SW6, SW5, …, SW0 correspond to musical notes of B, A, G, F, E, D, C (the white keys) respectively, turn on a switch to play the musical note continuously.	Seven segment display displays mode 2, pitch mode and musical note*
2.B.	Musical instrument improvement Owner: Wang Shuhui	{SW15, SW14, SW13} & {SW6, SW5, …, SW0} & {SW8, SW7}	Set {SW15, SW14, SW13} to 3'b**010**; SW6 & SW5, SW5 & SW4, …, SW1 & SW0 correspond to musical notes of $A^{\#}/B^{b}$, $G^{\#}/A^{b}$, $F^{\#}/G^{b}$, $D^{\#}/E^{b}$, $C^{\#}/D^{b}$ (the black keys) respectively, turn on two switches together to play the musical note continuously; and {SW8, SW7} controls the pitch of the musical note, which allows musical note to increase from C_4 (when the switches are set to 2'b**00**) to A_7 (when the switches are set to 2'b**11**).	Seven segment display displays mode 2, pitch mode and musical note*
3	Extra feature 1 (Seven Segment Display)	{SW15, SW14, SW13} & SW12 & SW11 & SW10 & {SW8, SW7} & {SW6, SW5, …, SW0}	**<u>Mode Numbers for Features in the Audio Effects System</u>** **0: Real-time audio signal** **1: Audio signal with 1s delay** **2: Musical Instrument** **3. Real-time pitch shifter** **4: Playback pitch shifter** **All mode numbers are displayed on 7SD 1** Set {SW15, SW14, SW13} to 3'b**000** to display **0 (mode number)** on 7SD 1.	 **Mode 0**
			Set {SW15, SW14, SW13} to 3'b**001** to display **1 (mode number)** on 7SD 1 and **1 (time delayed in seconds)** on 7SD 4.	 **Mode 1, 1 second delay**
			Set {SW15, SW14, SW13} to 3'b**010** to display **2 (mode number)** on 7SD 1 and set {SW8, SW7} to 2'b**00,** 2'b**01,** 2'b**10** or 2'b**11** to display **4, 5, 6 or 7 (pitch mode)** respectively on 7SD 3 and set {SW6, SW5, …, SW0} according the description in musical instrument and musical instrument improvement to display the corresponding musical note on 7SD 4. The sharp (#) symbol is denoted by a decimal point.	 **Example: Mode 2, 4th pitch mode, C note**  **Example: Mode 2, 4th pitch mode, C# note**

			Set {SW15, SW14, SW13} to 3'b**011** and SW10 to 1'b**0** to display **3 (mode number)** on 7SD 1 and **'4'** and **'0' (40 kHz pitch shift frequency)** on 7SD 3 and 7SD 4 respectively. Set SW10 to 1'b**1** to display **'3'** and **'0' (30kHz pitch shift frequency)** on 7SD 3 and 7SD 4 respectively.	 **Mode 3, 40kHz pitch shift frequency**  **Mode 3, 30kHz pitch shift frequency**
			Set {SW15, SW14, SW13} to 3'b**100** to display **4 (mode number)** on 7SD 1 and set SW12 to 1'b**0** and SW11to 1'b**1** to display letters **'REC' (recording mode)** on 7SD 2, 3 and 4 respectively. Set {SW15, SW14, SW13} to 3'b**100** to display **4 (mode number)** on 7SD 1 and set SW12 to 1'b**1** and SW11 to 1'b**0** to display the **playback frequency in kHz** on 7SD 3 and 4.	 **Mode 4, recording mode**  **Example: Mode 4, 10kHz playback frequency**
3	Extra feature 2 (Playback Pitch Shifter)	{SW15, SW14, SW13} & SW11 & SW12 & wireless mouse	Set {SW15, SW14, SW13} to 3'b**100** and set SW12 to 1'b**0** and SW11 1'b**1** to record audio sample (audio sample duration cannot exceed 4s). Set {SW15, SW14, SW13} to 3'b**100** and set SW12 to 1'b**1** and SW11 to 1'b**0** to playback the audio sample recorded. Left click and move the mouse to increase the playback frequency and right click and move the mouse and decrease the playback frequency.	Seven segment display displays mode 4 and 'REC' or playback frequency*
3	Extra feature 3 (DC-offset Filter)	N.A.	Displays the instantaneous volume (0-12) of the output audio sample by lighting up LEDs LD0 to LD11 on the FPGA. For example, if no LEDs are alight means that the volume is zero, if 1 LED is alight means that the volume is 1 and so on.	{LD0, LD1, LD2, …, LD10, LD11} light up to display instantaneous volume

*Extra feature item. Refer to Extra feature 1 for detailed description.

Project Feedback

The improvement for the basic tasks challenged our understanding of the concepts behind the basic tasks and how we could apply those concepts to help us make the improvements. Being creative with way we used the peripherals on the FPGA to create special features was also very enjoyable. Overall the project was very enjoyable. The tasks and improvements of the project helped us to understand better how sound is processed in digital systems and how data is transmitted from the FPGA to other peripherals that can be attached to the FPGA.

References

Seven segment display code was referenced and adapted from www.fpga4student.com : http://www.fpga4student.com/2017/09/seven-segment-led-display-controller-basys3-fpga.html

USB mouse input code was referenced and adapted from www.fpga4student.com : http://www.fpga4student.com/2017/12/how-to-interface-mouse-with-FPGA.html