

Project Plan for Audio Effects System using a FPGA

Distribution:

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1. Overview

The purpose of this project is to create an audio effects system using an FPGA board, Basys3. The board will turn analog audio into digital audio and produce three effects. Spatial (Reverb), delay (Echo) and non-linear process (Distortion) effect. The audio will then be output through a DAC. These effects will only be active when switched on and can be used together. This would be very appealing to musicians and sound engineers as it would allow for an Easy and cheap FX system which would create amazing sounds in production of music. An audio FPGA FX already exists and is being sold by Antelope Audio.

This project is sent up for 2 semesters of final year and between the two it is estimated to be 20 weeks with a total cost of the project to be €9538. The plan for the year is to focus on digitizing audio for semester 1 and then deal with creating the effects in semester 2

2. Goals and Scope

2.1 Project Goals

Goals/Objectives	Priority	Comment/Description/Reference
Phase 1 Goals:		Semester One: Digitize Audio
#1	2	Use Xilinx application Vivado
#2	2	Use VHDL to program the Basys3
#3	1	Send audio into the Basys3 using an audio jack
#4	1	Digitize the received signal using the XADC
#5	3	Use the 7 segment display to show the note being played
#6	1	Output the digitized audio through a DAC
Phase 2 Goals:		Semester Two: Audio Effects
#1	1	Produce delay effect
#2	1	Produce non-linear processing effect
#3	2	Produce spacial effect
#4	2	Program slide switches to activate effects
#5	3	Program LED's to inform which effects are active
#6	3	Use slide switches and push buttons to alter effects

2.2 Project Scope

2.2.1 Included

- Production of three audio effects
 - Delay
 - Non-Linear Processing
 - Spatial
- VHDL to program the effects system
- Use of Xilinx application Vivado
- Digitization of audio sent in through the XADC
- Creation of an audio effects system on the FPGA Board Basys3
- Applying effect to audio
- The project will output the altered audio through a DAC
- Choice of effect through slide switches
- Alter effects through push buttons and slide switches

2.2.2 Excluded

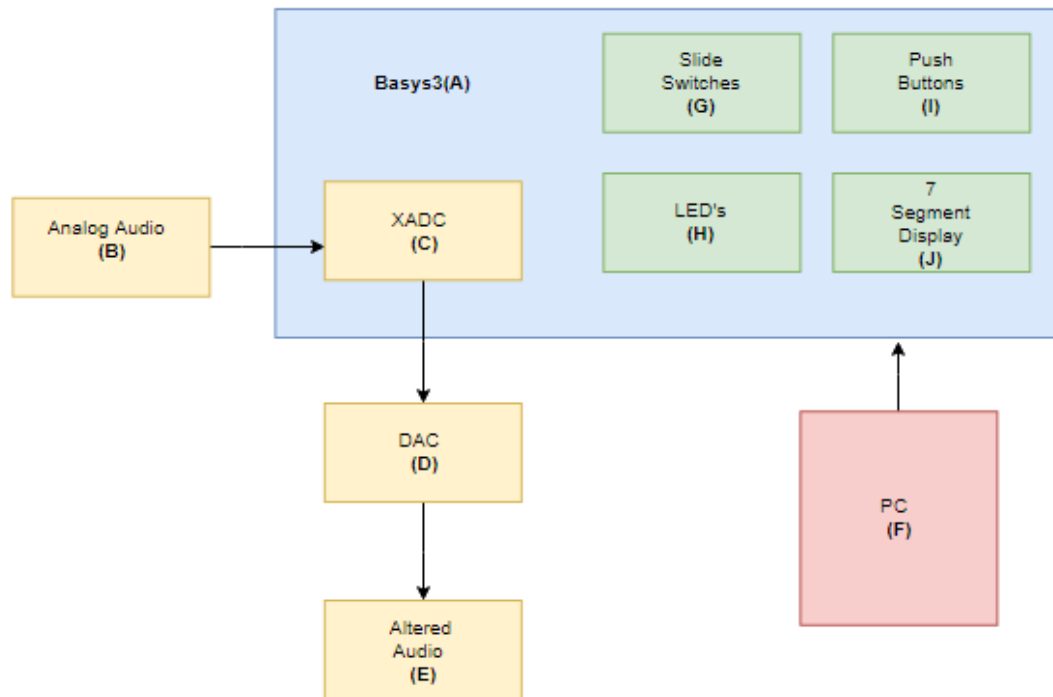
- Using ISE on Xilinx
- Creating audio
- Using VGA connector on Basys3
- Having an effect on constantly
- Will not overwrite the effect to original audio

3. Stakeholders

Name/Person/Organization	Impact/Importance
Dean Devereaux	Researching and producing the project
Paddy Collins(Supervisor)	Will give advice and help with providing equipment if necessary
Sound Engineers/Musicians	Will allow for a cheap DIY audio effects system to be on the market

4. Proposed Solution Diagram

4.1 Solution Diagram/Representation



4.2 Compliance Matrix of Solution

Objective	Blocks involved in satisfying
Use Xilinx application Vivado	F
Use VHDL to program the Basys3	A,F
Send audio into the Basys3 using an audio jack	A,B,F
Digitize the received signal using the XADC	A,B,C,F
Use the 7 segment display to show the note being played	A,B,C,F,J
Output the digitized audio through a DAC	A,B,C,E,F
Produce delay effect	A,B,C,F
Produce spacial effect	A,B,C,F
Produce non-linear processing effect	A,B,C,F
Program slide switches to activate effects	A,C,F,G
Program LED's to inform which	A,F,H

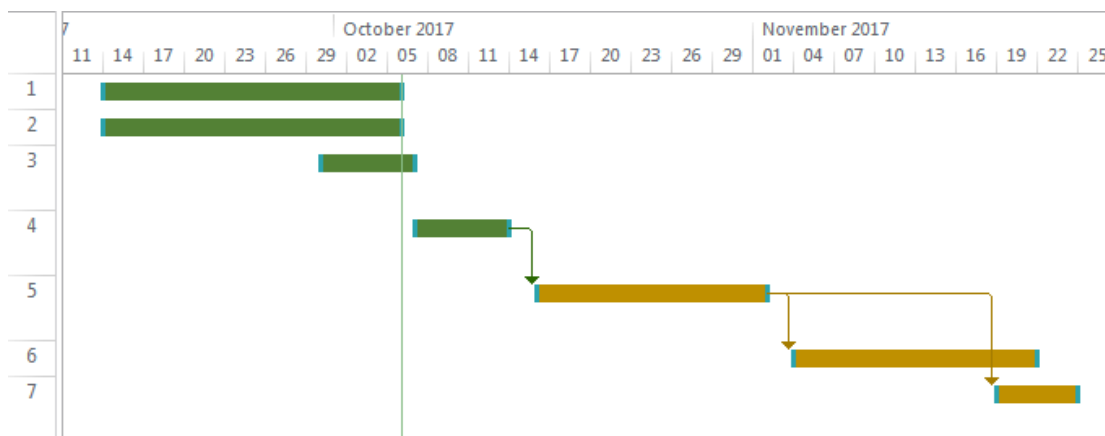
Objective	Blocks involved in satisfying
effects are active	
Use slide switches and push buttons to alter effects	A,C,F,G,I

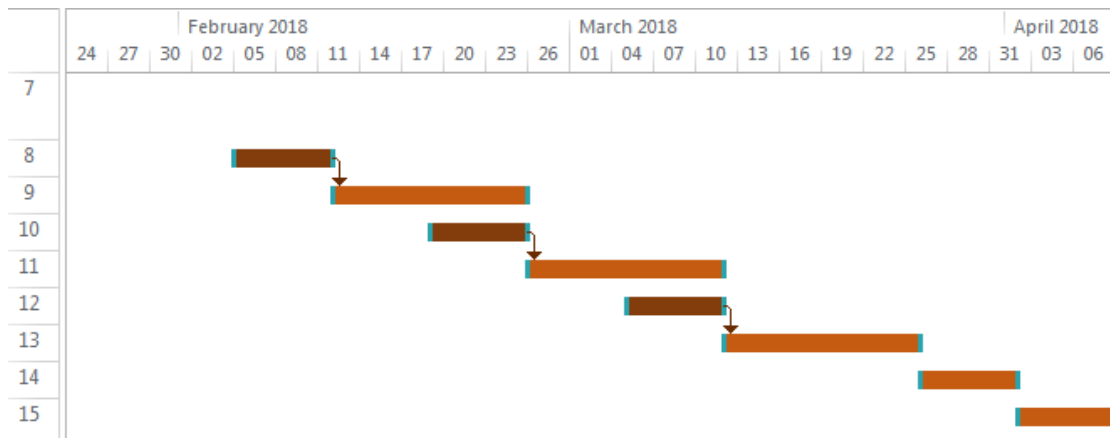
5. Schedule and Budget

5.1 Work Breakdown Structure and proposed Schedule

Work Tasks	Description	Duration
	Semester One	11 Weeks
#1	Review VHDL	16 days
#2	Research Basys3	16 days
#3	Examine Vivado/Basys3 tutorials	6 days
#4	Research digitization of audio	6 days
#5	Program XADC to digitize audio	13 days
#6	Program DAC to output audio	13 days
#7	Program 7 Segment display to highlight note played	6 days
	Semester Two	9 Weeks
#8	Research Delay effects	6 days
#9	Program Delay Effect	11 days
#10	Research Non-Linear effects	6 days
#11	Program Non-Linear effect	11 days
#12	Research Spacial effects	6 days
#13	Program Spacial effect	11 days
#14	Program Switches and LEDs for effects	6 days
#15	Program Switches and Buttons to alter effects	6days

5.2 Schedule Chart





5.3 Deliverables and Milestones

Milestones	Description	Planned Date
Semester One		
M0	Demo on Basys3	06/10/2017
D0	Project Plan	07/10/2017
M1	Digitize Audio	01/11/2017
D1	Progress Report	04/11/2017
M2	Output Audio	20/11/2017
D2	Semester One Report	02/12/2017
M3	Display Note Played	24/11/2017
D3	Semester One Presentation	04/12/2017
Semester Two		
M4	Delay Effect Functional	19/02/2018
D4	Project Report	24/02/2018
M5	Two Effects Functional	24/03/2018
D5	Semester Two Report	28/04/2018
M6	Alter between effects and change level of effects	06/04/2018
D6	Poster and Presentation	30/04/2018

5.4 Budget

Category	Description	Budget
Human Resources (internal)	€20 per hour @ 10 hours weekly @ 20 weeks	€4000
Human Resources (external)	€50 per hour @ 5 hours weekly @ 20 weeks	€5000
Purchases (COTS)	Basys3	€126
	Pmod I2S	€12
Premises	Cork Institute of Technology	n/a
Tools	Vivado	n/a
Travel costs	76km a week @20 weeks	€400
Total		€9538

6. Risk Management

Risk	Description
Risk 1:	Internal ADC not efficient enough to input real time audio
Risk 1: Recovery	Alternative external ADC
Risk 2:	Unable to apply effect to Basys3
Risk 2: Recovery	Research a 4 th effect to apply
Risk 3:	Research and Programs get corrupted
Risk 3: Recovery	Save Work in multiple locations

7. Revision

Rev. ind.	Page (P) Chapt. (C)	Description	Date Dept. /Init.
-	---	Original Version	7/10/2017