UF UNIVERSITY of FLORIDA
The Foundation for The Gator Nation

Engineering

Team Mic Jones

EEL4914 Senior Final Design Report Beatbox Sensei

Spring 2008 | Submitted April 21, 2008

The project is inspired by a hip hop art called “beatboxing.” Beatboxing primarily involves the art of producing drum beats, rhythm, and musical sounds using one's mouth, lips, tongue, voice, and more. This project uses two particular sounds, “boom” and “click”, respectively imitating the bass drum and snare, to send MIDI signals to computer software, which then outputs actual drum sounds. Possible uses include an alternate way for disabled people to play drums or for a new creative way to use the art of beatboxing.

Created by Mark Villena and Renee Pringle

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Tables and Figures Listing

Project Features / Objectives

The Beatbox Sensei features the following:

(within system)

- XLR 3-pin input
- Programmable Intelligent Computer (PIC18F4620)
- Musical Instrument Digital Interface output (MIDI)
- 210 Hz and 2100 Hz bandpass filtering
- LCD monitoring
- On/Off switch
- +9V/-9V power supplies via 9V batteries for operational amplifiers
- +5 V power supply (direct connect to outlet)

(external to system)

- M-Audio Audiophile external soundcard with MIDI input
- FL Studio music production software with MIDI capabilities
- Battery 2.0 – drum software used within FL Studio
- Sennheiser E825S dynamic microphone

The objective of the project was to somehow find a new and creative way to play drums without a drum set and to play them digitally. Beatboxing primarily involves the art of producing drum beats, rhythm, and musical sounds using one's mouth, lips, tongue, voice, and more.

Concept/Technology Selection

Figure 1

The team decided to use the PIC18F4620 as the main processor. This particular controller has been used by other programmers in MIDI related project and has been found to be easily programmable using Basic language. The PIC also has a built-in UART, which allows data to be sent serially (MIDI signals are serial). Figure 2 shows how the PIC is connected to a MIDI DIN socket. Figure 1 shows what the chip looks like.

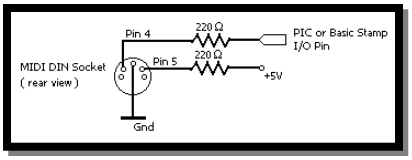


Figure 2

The input component is a Sennheiser E825S dynamic microphone with an XLR 3 connection, shown in Figures 3 and 4 respectively. We are using this type of microphone connection because most microphones have XLR adapters, and we want the system to cater to those microphones. We are using that specific microphone because it has a frequency range of 80 – 15 kHz.

Figure 4

Figure 3

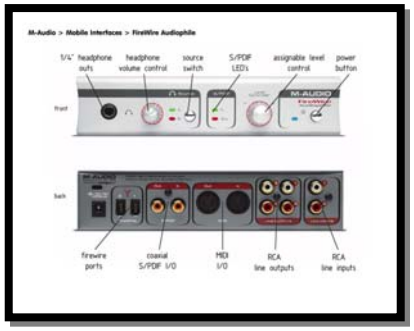


Figure 5

The component that takes in the MIDI signal is the M-Audio Firewire Audiophile external soundcard, shown in Figure 5. It is connected to my laptop via firewire. Its purpose is to receive the MIDI signals.

The software used to interpret the MIDI signal and output the drum sounds is called FL Studio by Image-Line. It is a sequencer used to produce music. In Figure 6, the software's MIDI system settings are shown. Figure 7 shows the program called Battery 2, which is part of the FL Studio software. This will be used to control the drum sound selections.

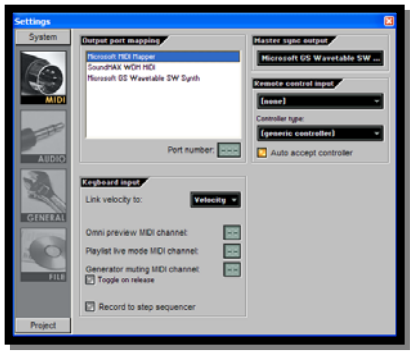


Figure 6

Figure 7

Project Architecture

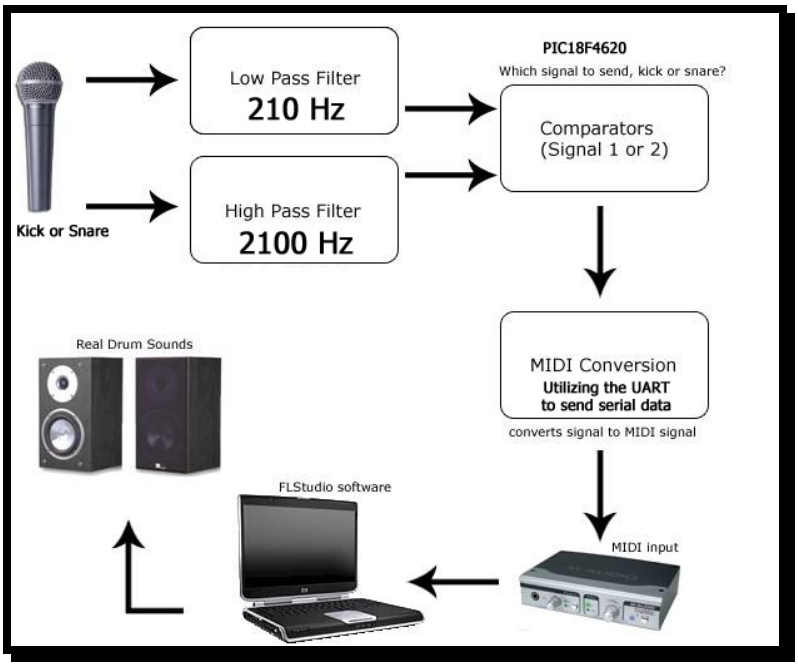


Figure 8

How the system works:

1. The microphone signal is sent to the XLR female receptacle socket, which has 3 pins. One pin is ground and the other is the signal.
2. The signal is amplified to about 2 Volts via a simple inverting amplification circuit using the UA741 chip. The circuit uses capacitors to omit any DC signals.
3. The output of the circuit comes from a capacitor connected to the output of the operational amplifier.
4. The signal is then sent to the band pass filters, one with cutoff frequency 210 Hz and the other 2100 Hz.
5. After the filters, both signals are amplified, to give an overall average max voltage of 4-5 V.
6. Then, a diode circuit is used to clip the signal such that the signal never goes negative.
7. The signal is then sent to the analog-to-digital port of the PIC, where the comparisons are made.
8. Depending on which sound is made (“boom” or “click”), one signal will be dominantly larger than the other.
9. After the proper signal is determined, the MIDI note C4 or C4# is sent via the UART.
10. The signal is sent through the MIDI output circuit then to the MIDI input of the external soundcard.
11. Then, FL Studio reads the signal and plays the specified note. C4 is designated as the bass drum and C4# is designated as the snare drum.

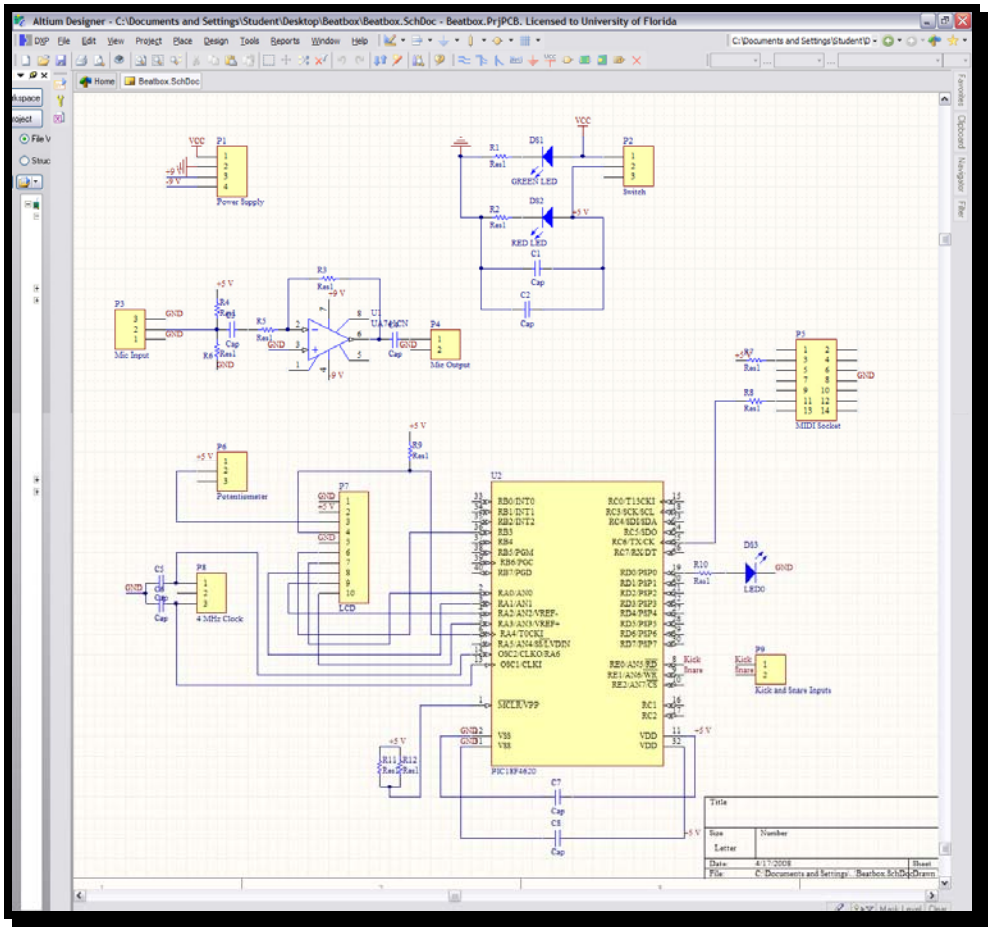

Altium Designer - C:\Documents and Settings\Student\Desktop\Beatbox\Beatbox.SchDoc - Beatbox.PrjPCB. Licensed to University of Florida
Beatbox.SchDoc
Power Supply
Switch
GREEN LED
RED LED
Mic Input
Mic Output
MIDI Socket
Potentiometer
4 MHz Clock
LCD
LED0
Kick and Snare Inputs
PIC18F4620

Figure 9

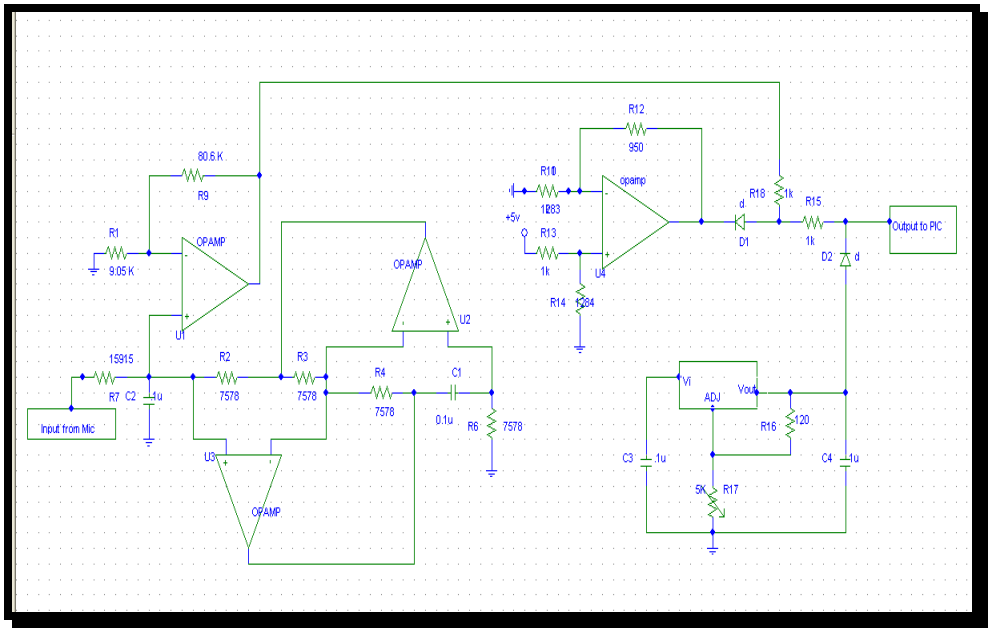


Figure 10

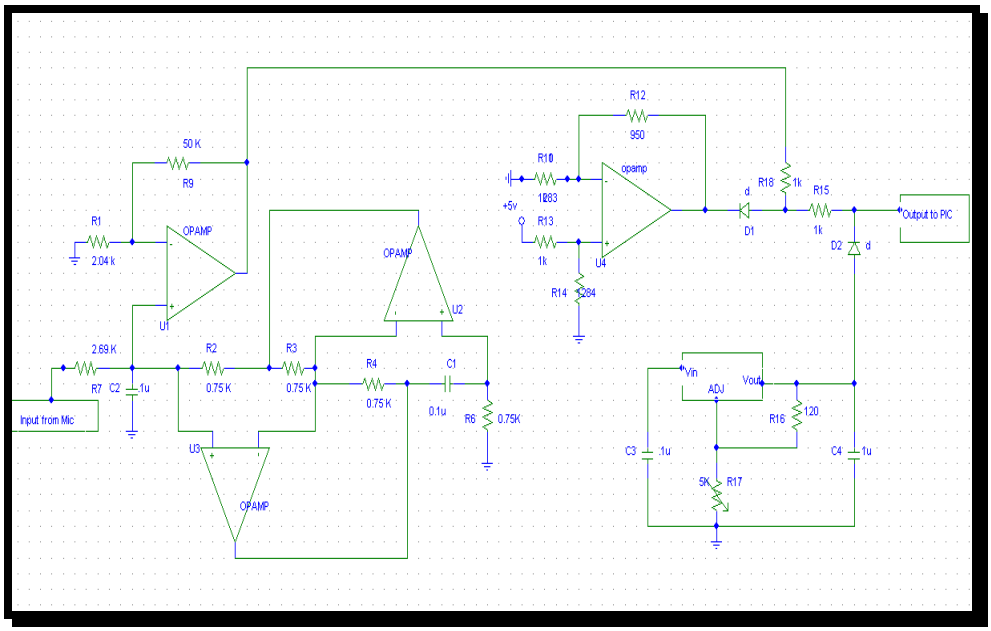


Figure 11

Division of Labor

Renee	Mark
Researching and learning Designing board Creating/designing the band pass filters Creating/designing the diode circuit Working on final report	Researching and learning Designing board Programming the PIC Providing external soundcard, computer software Working on final report

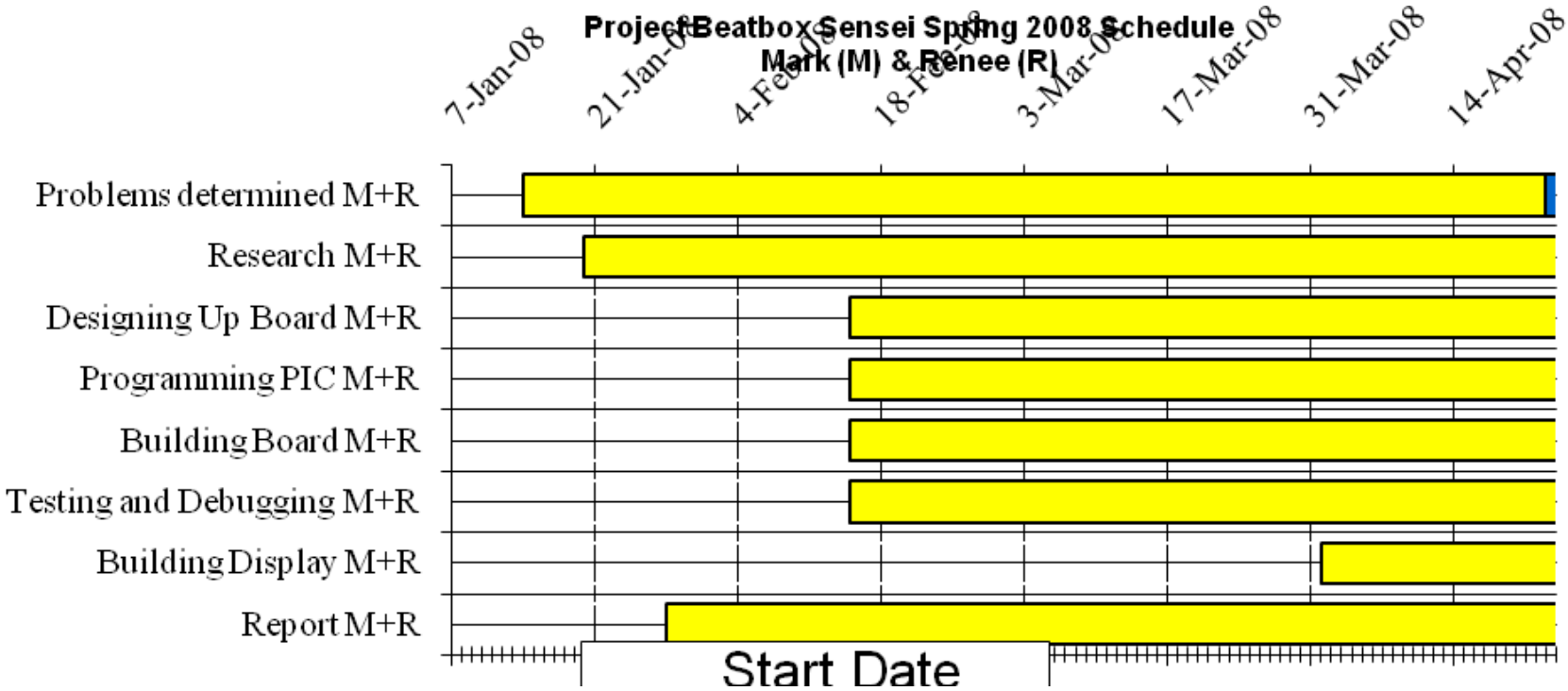
Figure 12

Bill of Materials

Considering the M-Audio Audiophile, Microphone, and Software are pre-owned

PIC18F4620 - $0.00
Resistors and capacitors and misc. - $0.00
MIDI cable - $6.00
XLR 3-pin female receptacle - $23.00
1V voltage regulators - $4.00

Total spent - $33


Project Beatbox Sensei Spring 2008 Schedule
Mark (M) & Renee (R)
7-Jan-08
21-Jan-08
4-Feb-08
18-Feb-08
3-Mar-08
17-Mar-08
31-Mar-08
14-Apr-08
Problems determined M+R
Research M+R
Designing Up Board M+R
Programming PIC M+R
Building Board M+R
Testing and Debugging M+R
Building Display M+R
Report M+R
Start Date