Audio Conductor

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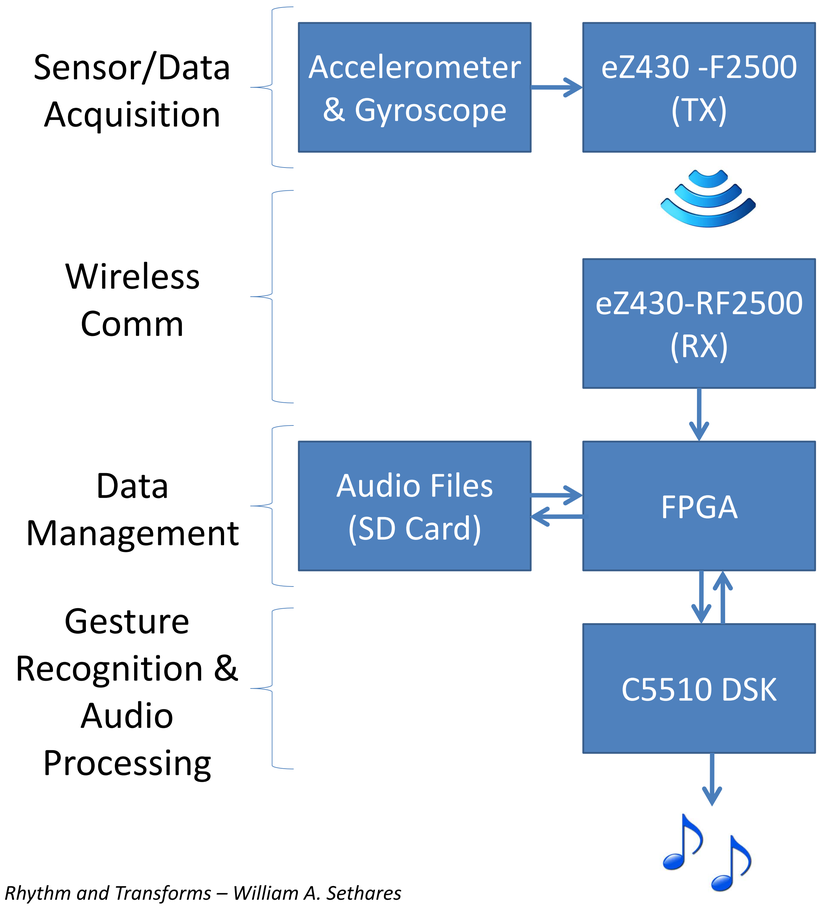
Overview

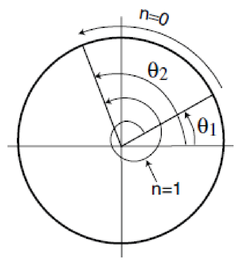
The Audio Conductor project aims to give users control of prerecorded music in real time, using gesture recognition. A wireless microcontroller constantly transmits accelerometer and gyroscope data back to a central unit. The central unit consists of an FPGA, which manages the audio and gesture data, and a C5510 DSK to do the processing. Using dynamic time warping, gestures for tempo and song selection can be recognized. The tempo of the output audio is then modified to match the user defined tempo using a phase vocoder. The phase vocoder allows us to change the audio's tempo independent of the audio's pitch.

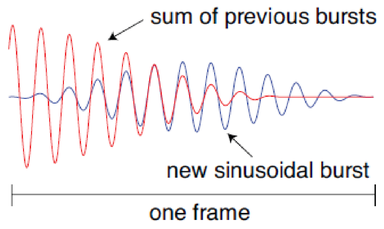
System Diagram

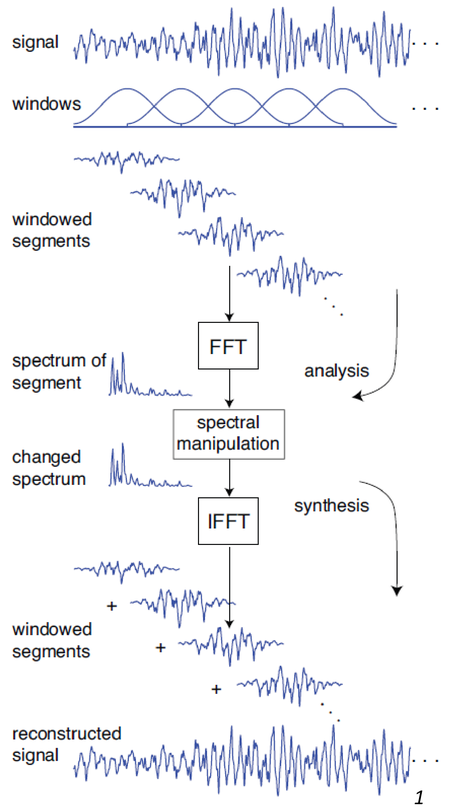


Audio Processing *Phase Vocoder*

Our audio processing algorithm implements a phase vocoder to control audio tempo, independent of pitch. Audio is stored on an SD Card in raw bit format. The C5510 requests 256 new samples at a time, with samples being skipped or repeated to change the tempo of the music. The C5510 keeps a buffer of 1280 samples to process. Two 1024 sample frames, offset by 256, are windowed and analyzed using an FFT algorithm. The phase of the right frame is interpolated to match the phase of the left, yielding a smooth sounding output. The right frame is then returned to the time domain with an IFFT and windowed again. Windowed outputs are added together to reconstruct the output signal.

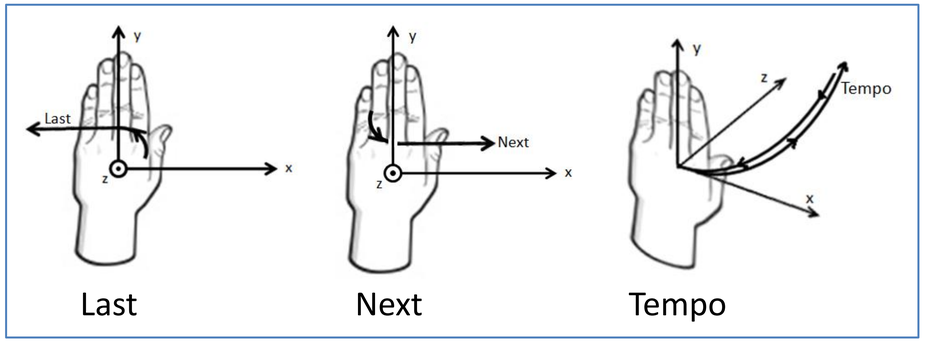


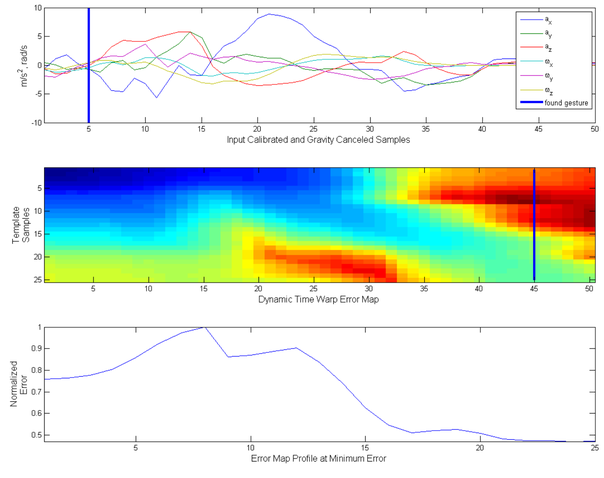




Gesture Recognition *Dynamic Time Warping*

Sampled signals depend on gesture speed, gesture amplitude, and user variance. In order to minimize these effects on gesture recognition, a dynamic time warping algorithm is used. Acceleration and angular velocity data is gathered, with gravity in the hand frame canceled to negate the effect of user body tilt. An error matrix is then calculated between each input sample set and each predefined gesture template, and propagated through to find the minimum error path. Based on the minimum error path, we develop indicators to detect a gesture.





1. *Rhythm and Transforms – William A. Sethares*