FPGA Digital Synthesizer

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6.111 Fall 2018

overview

interface

tone
generation

recording/
playback

control
module

extensions

checklist

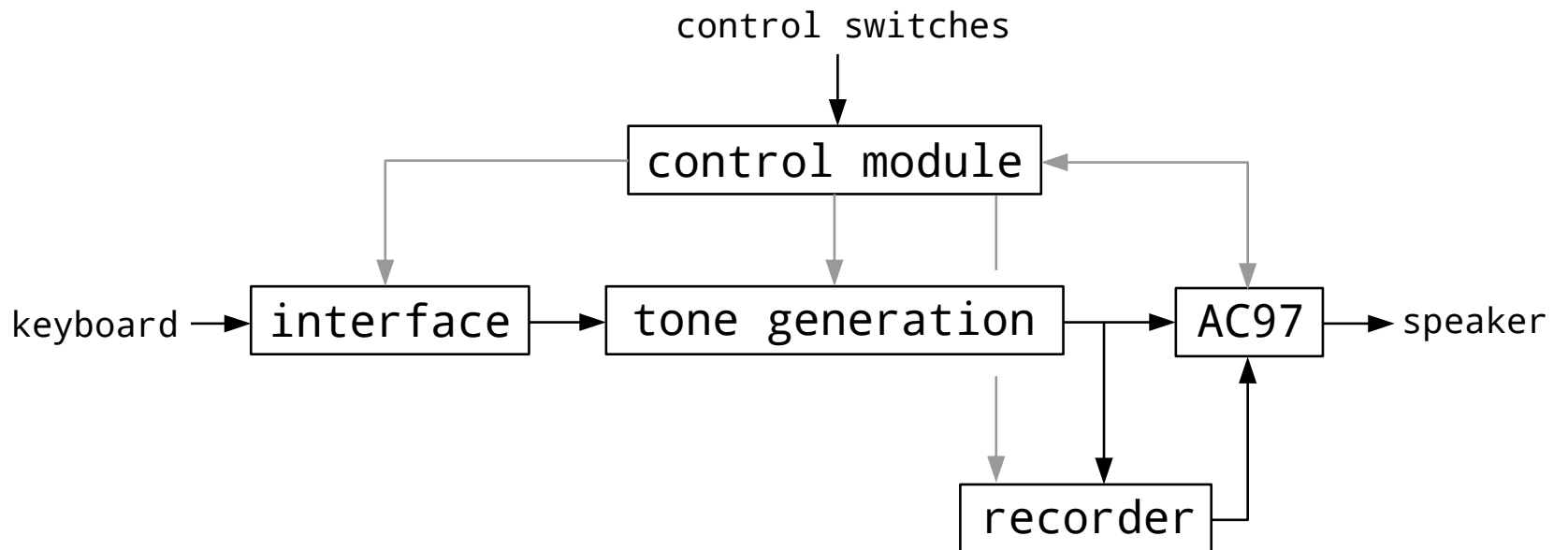schedule

System Overview

System Input
+ notes from keyboard
+ octave select
+ volume
+ ASDR/effect parameters
+ record/playback settings (mode)

System Output
+ audio from AC97
+ LEDs for setting visualization

control switches

→ control module ←

keyboard → interface → tone generation → AC97 → speaker

recorder

overview

interface

tone
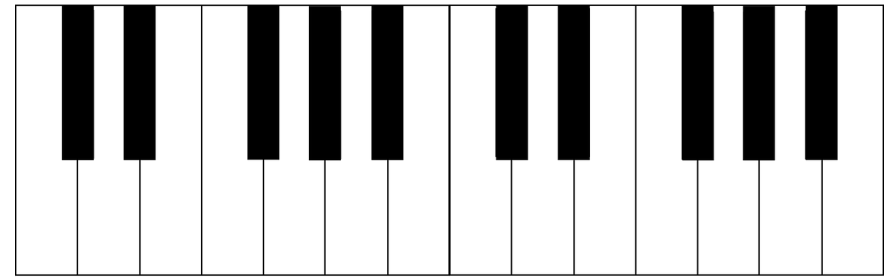generation

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module

extensions

checklist

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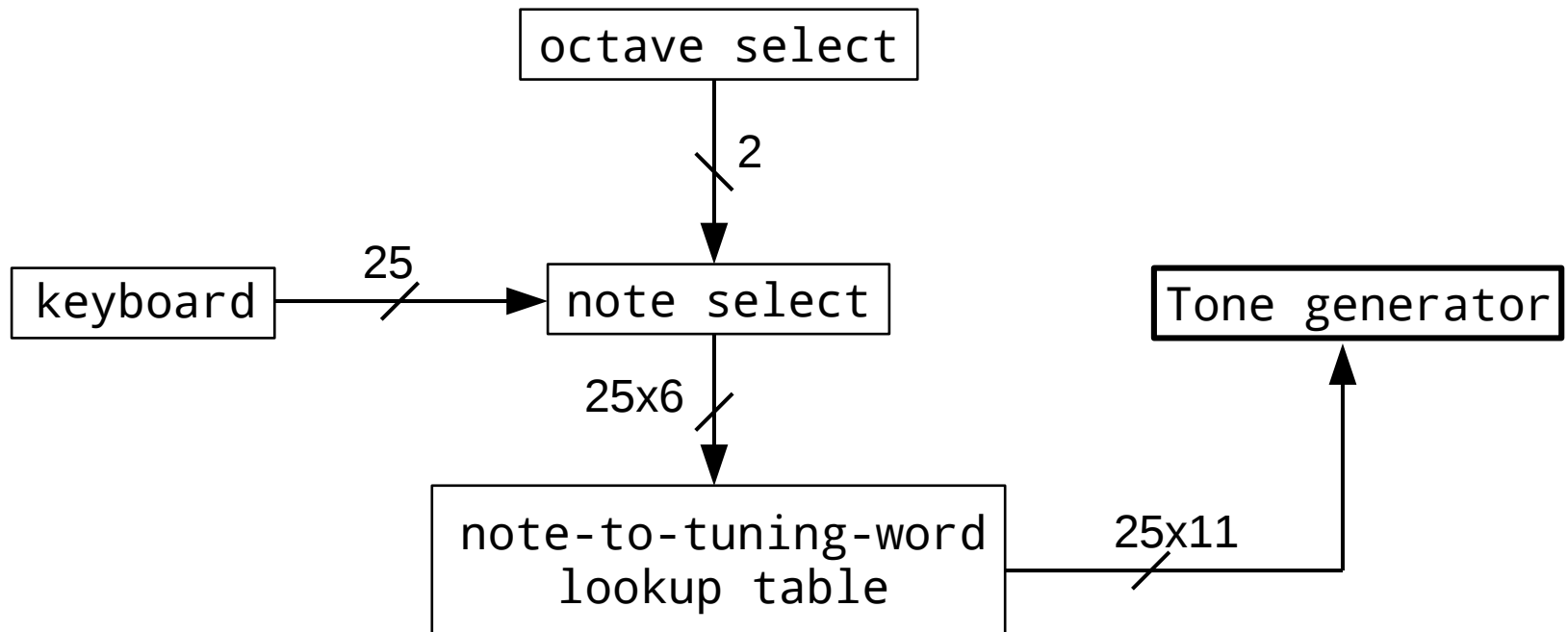
Input Interface

System Input
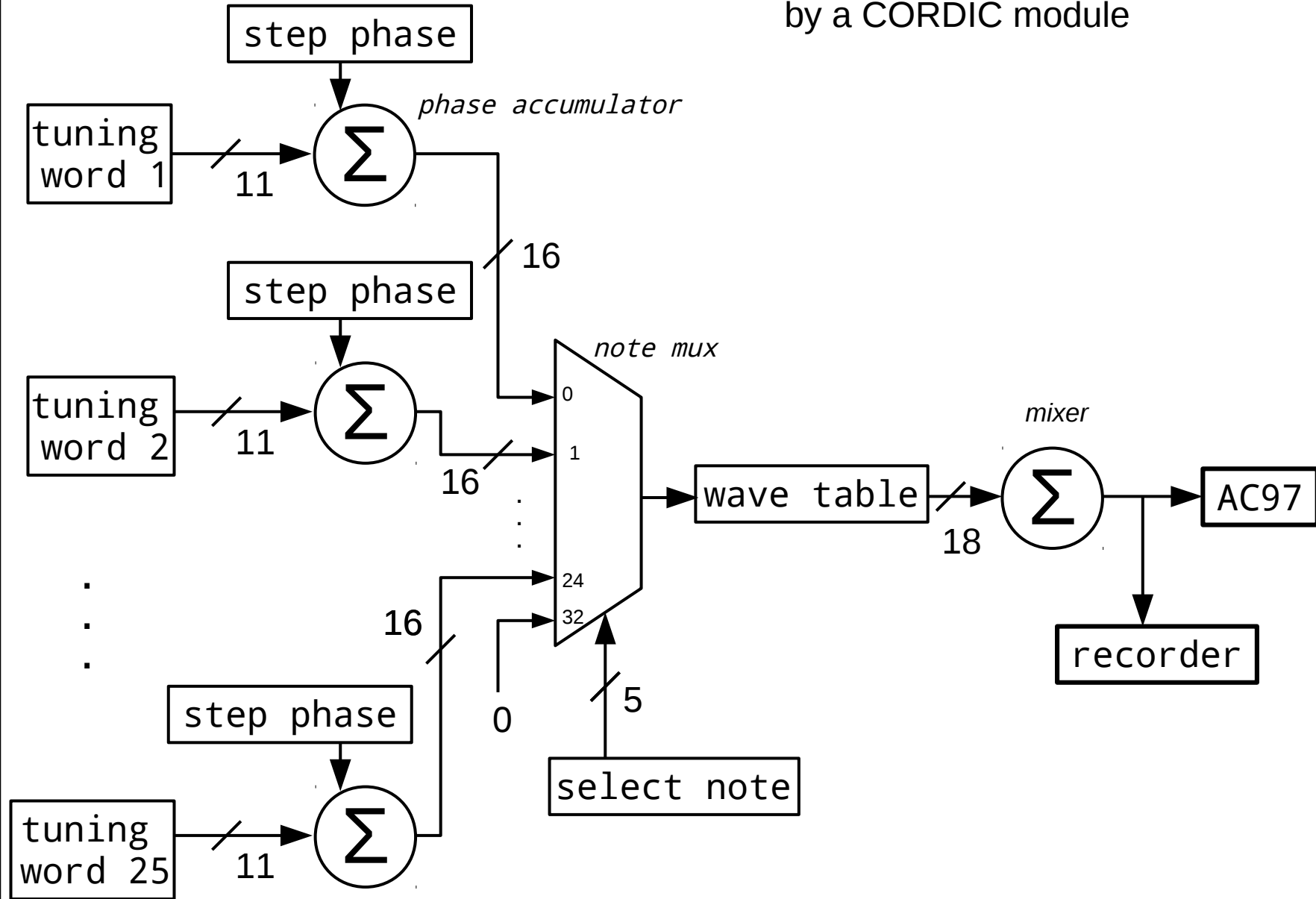+ Two octaves worth of "keys"
+ Octave select
+ Buttons vs. MIDI

* 56 possible notes (5 octaves)

```
                    ┌──────────────────┐
                    │  octave select   │
                    └──────────────────┘
                             │
                             │ 2
                             ▼
┌──────────┐  25   ┌──────────────────┐        ┌──────────────────┐
│ keyboard │──────▶│   note select    │        │  Tone generator  │
└──────────┘       └──────────────────┘        └──────────────────┘
                             │                           ▲
                        25x6 │                           │
                             ▼                           │
                    ┌────────────────────┐   25x11       │
                    │ note-to-tuning-word │──────────────┘
                    │   lookup table      │
                    └────────────────────┘
```

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Tone Generation

*wave table may be replaced by a CORDIC module

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Recording and Playback

System Input

+ uses both ZBT memories
+ able to record approx. 1.5 minutes of audio (18b samples @ 12kHz)
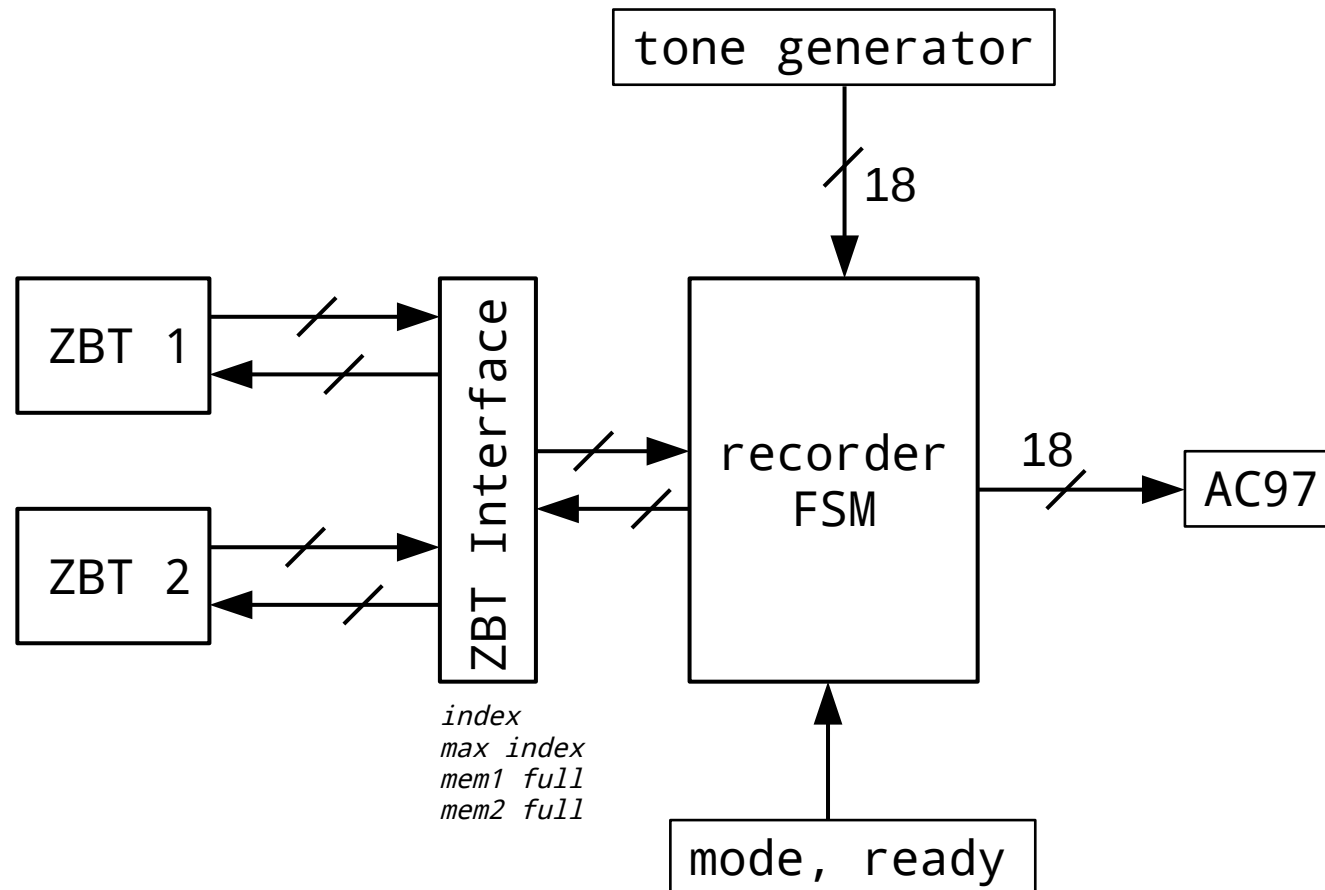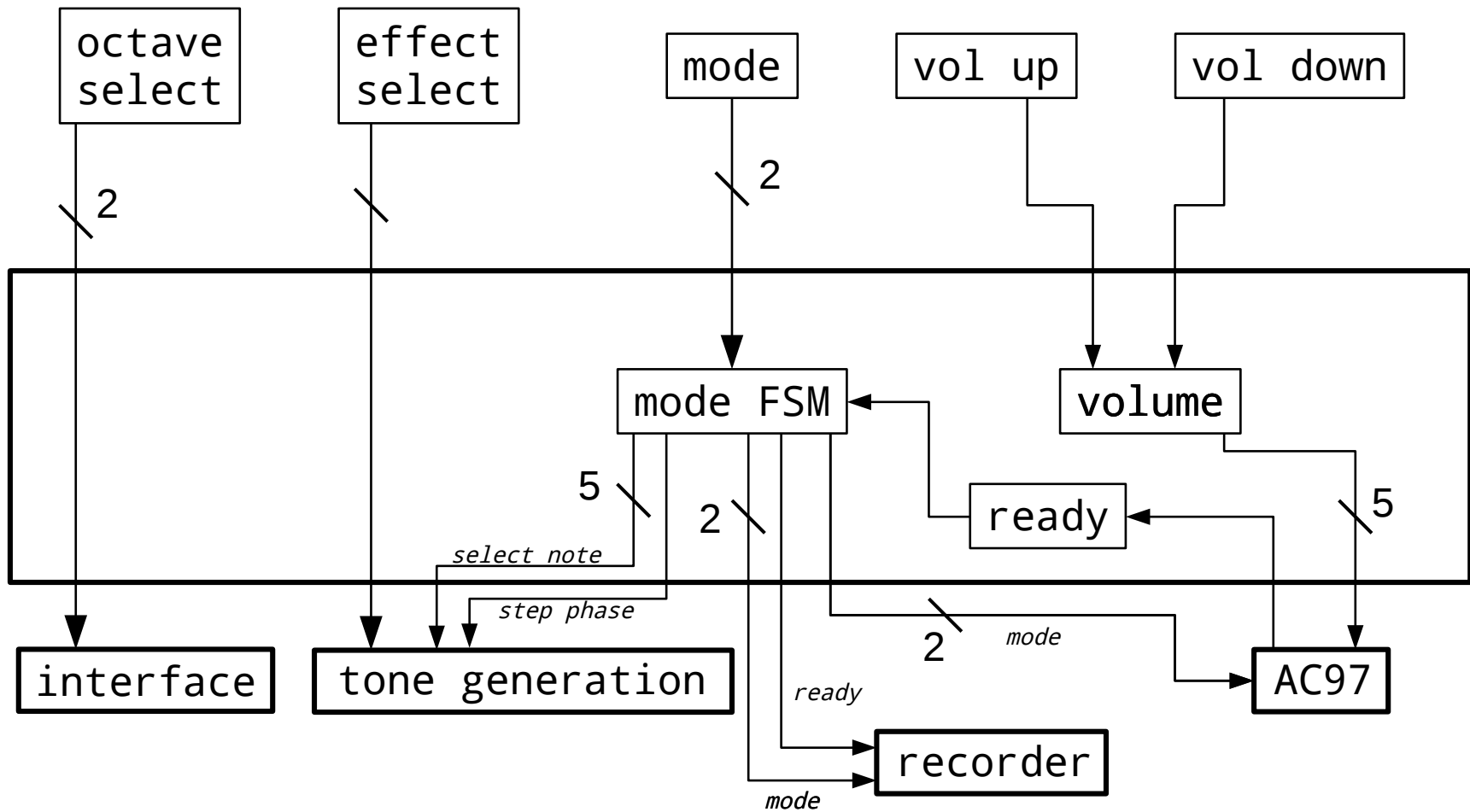
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Control Module

Beyond the Basics

MIDI Keyboard
+ more ergonomic input
+ protocol interfacing
+ serializes input

ADSR Enveloping
+ makes instrument sound more "real"
+ adjustable

Audio Effects
+ overtones
+ reverb
+ echo

Fancier Record/Playback
+ recording multiple samples/tracks
+ looping/record over playback
+ extra memory

Checklist

Commitment
    + functional synthesizer with no "special features" (effects, enveloping)
    + button input
    + basic recording functionality

Goal
    + MIDI input
    + multi-track recording & looping
    + enveloping and at least one static effect

Stretch
    + multiple effects
    + adjustable effects
    + extra memory

Project Schedule

As of right now...
  + research
  + basic design finalized
  + wave table tone generator implemented

Nov 12 – Nov 18 (this week!)
  + test tone generator
  + implement mixing
  + implement/test CORDIC module

Nov 19 – Nov 25
  + finish memory recording/playback
  +integrate memory, interface, and tone generator

Nov 26 – Dec 02
  + MIDI keyboard integration
  + ASDR enveloping
  + work on stretch goals

Dec 03 – Dec 09
  + work on stretch goals
  + final integration and testing

Questions?