# Modular Capacitive TouchPads
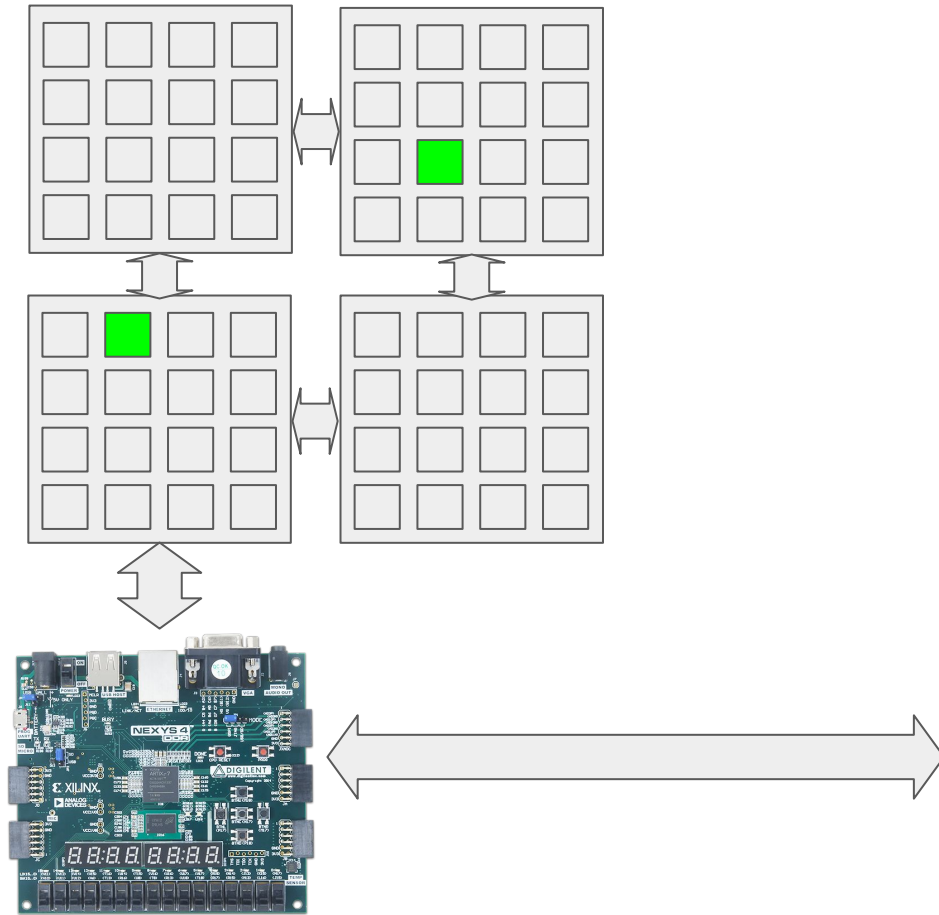
Aaron Pfitzenmaier
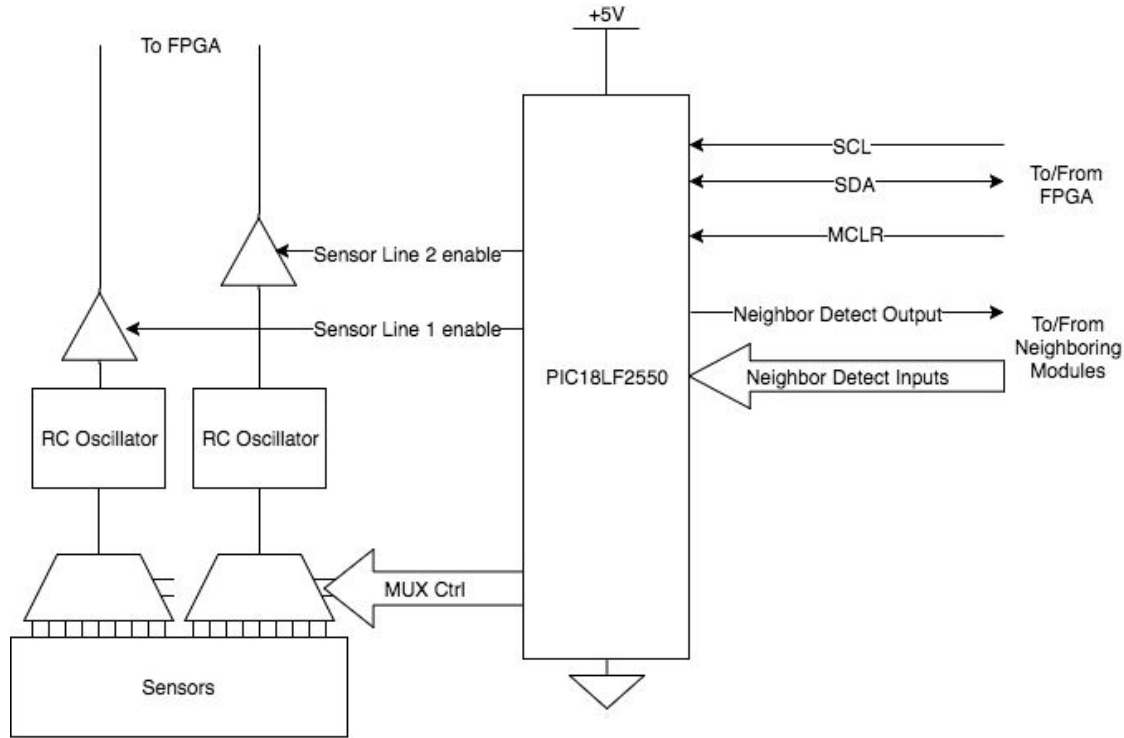
Daniel Sheen

Overview

- Blocks of 16 capacitive touch sensors that can be connected together in any configuration
- FPGA is physically connected to only one block
- Layout and status of each sensor displayed on monitor
- Each individual sensor can be used to control various outputs
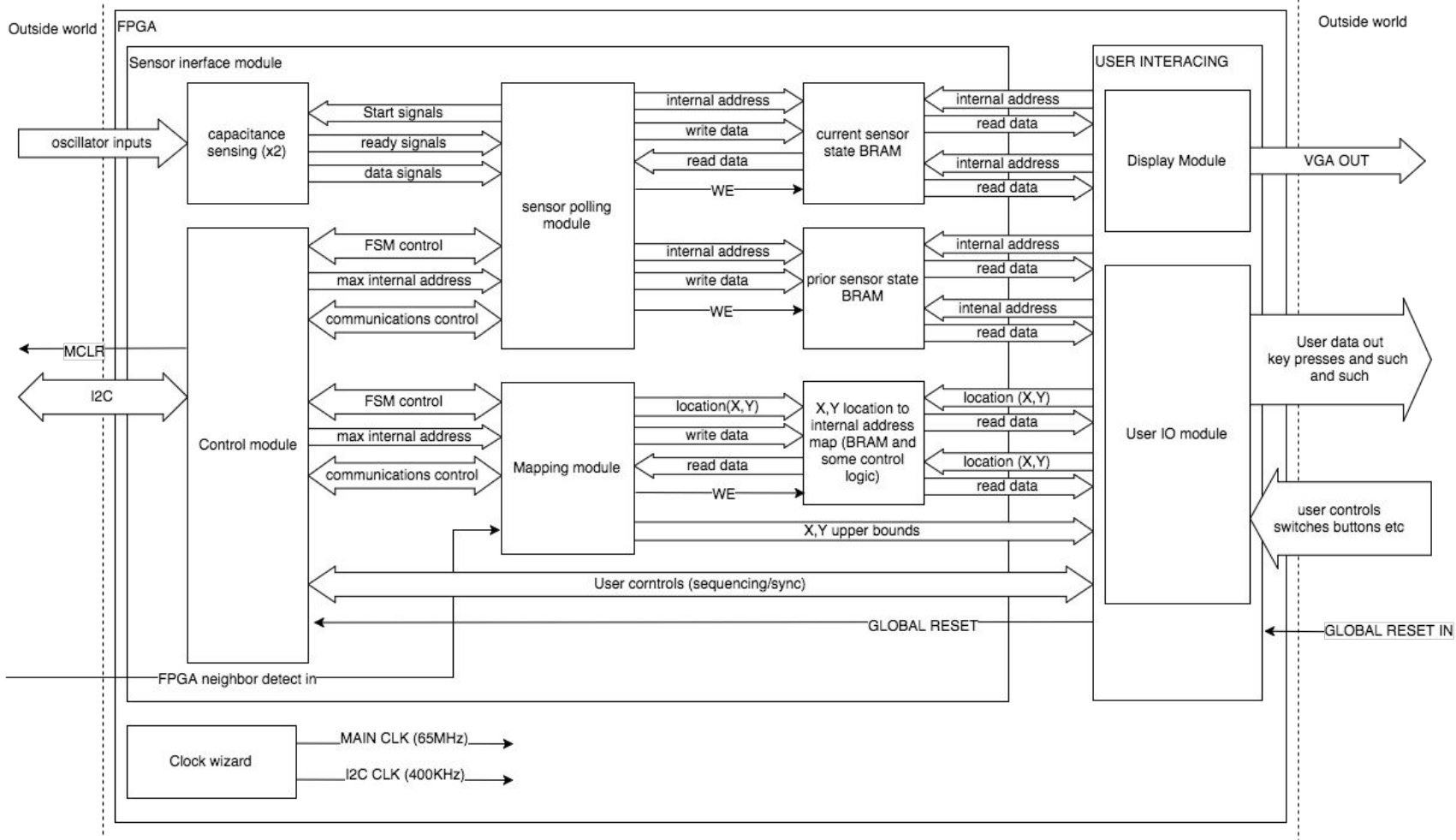   - Capacitive touch based switches, keyboard, sliders
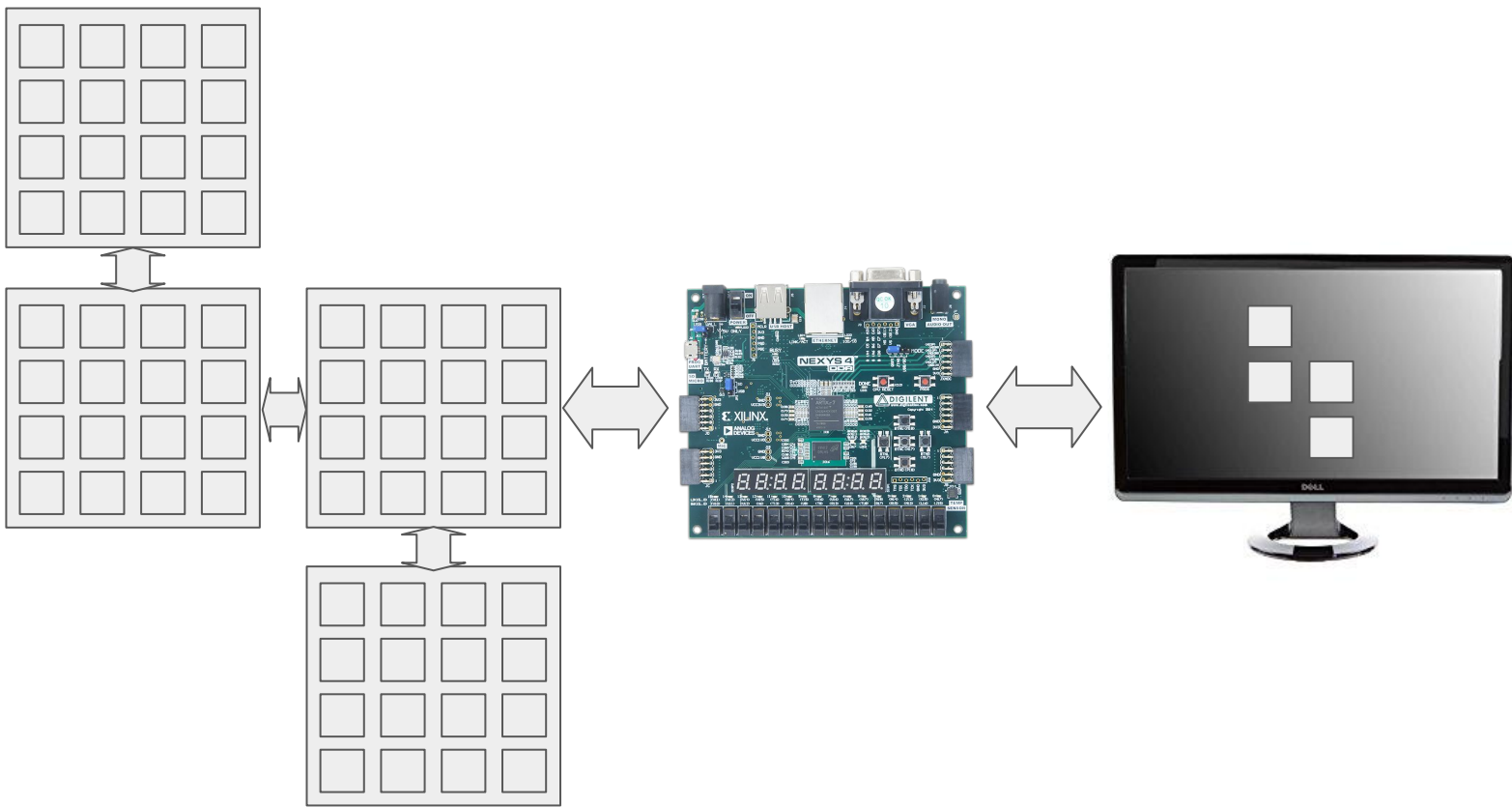
Touchpad Block Circuit

- PIC microcontroller switches inputs/outputs and has I2C communication with Nexys 4

- RC oscillators generate square wave with period related to sensor capacitance

- Check for touch by counting edges in a given time interval

- Neighbor detect pins to determine layout

Outside world | FPGA

Sensor inerface module

USER INTERACING

oscillator inputs

capacitance sensing (x2)

Start signals
ready signals
data signals

sensor polling module

internal address
write data
read data
WE

current sensor state BRAM

internal address
read data

internal address
read data

Display Module

VGA OUT

MCLR

Control module

I2C

FSM control
max internal address
communications control

internal address
write data
WE

prior sensor state BRAM

internal address
read data

intenal address
read data

FSM control
max internal address
communications control

Mapping module

location(X,Y)
write data
read data
WE

X,Y location to internal address map (BRAM and some control logic)

location (X,Y)
read data

location (X,Y)
read data

User IO module

User data out
key presses and such
and such

X,Y upper bounds

User corntrols (sequencing/sync)

user controls
switches buttons etc

GLOBAL RESET

GLOBAL RESET IN

FPGA neighbor detect in

Clock wizard

MAIN CLK (65MHz)

I2C CLK (400KHz)

Outside world

Control module

- Tracks addresses of connected sensor blocks
- Handles I2C communications
- Hardware Sequencing
  - Switching between mapping and sensor polling modules
  - Address scan to identify connected sensor blocks
  - Possible continuous boundary scan for hot swap implementation
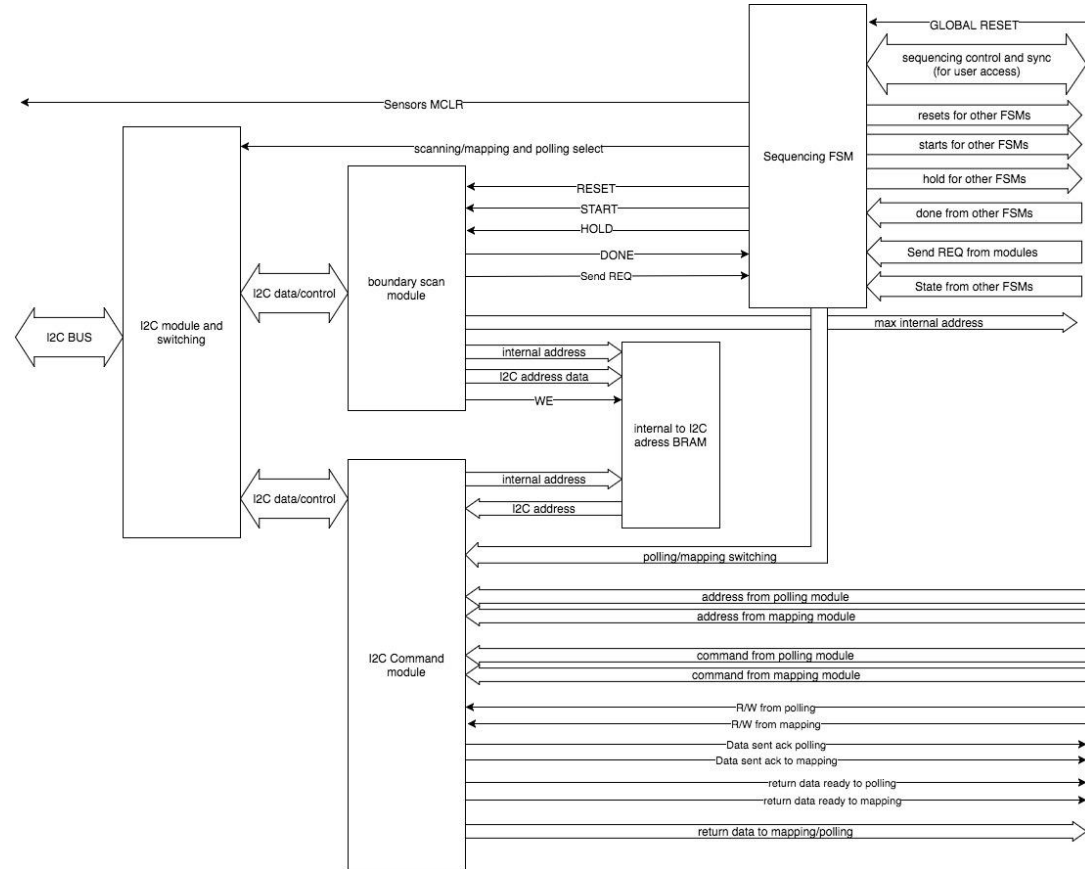
Mapping module (tricky)

- Called by control module on startup or reconfiguration
- Polls sensor blocks over I2C to determine which is next to which
- Generates map from XY coordinates in array to addresses
- Makes address lookup table available to user hardware
    - use for keyboard-like things where we care about physical position of a sensor
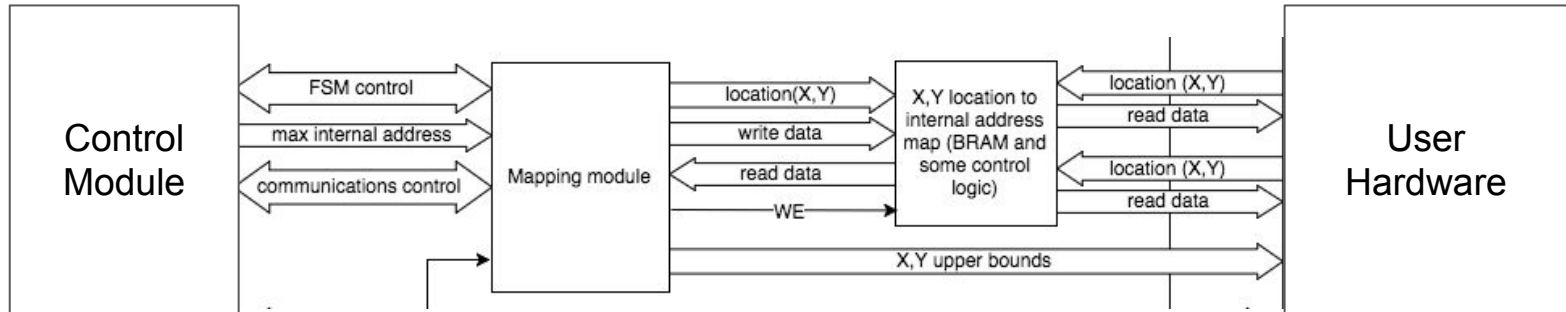
Timeline

Nov 10: Finalize and build touchpad block design

Nov 17: Complete Sensing, Polling, and Main Control modules,
Ensure these modules all work with a single block
At this point, all of our baseline goals should be met

Nov 22: Finish Mapping module and basic User Interface
At this point, all of our main goals should be met

After Thanksgiving: Work on hot swapping capability
Use EDS PCB mill to fabricate better sensor boards