Midway Design Review

Team Toccando
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Toccando

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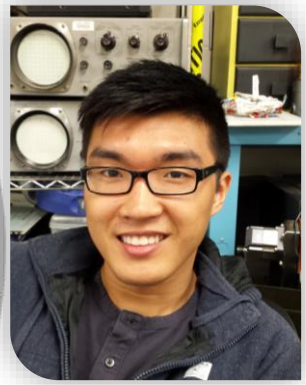

William Young, CSE

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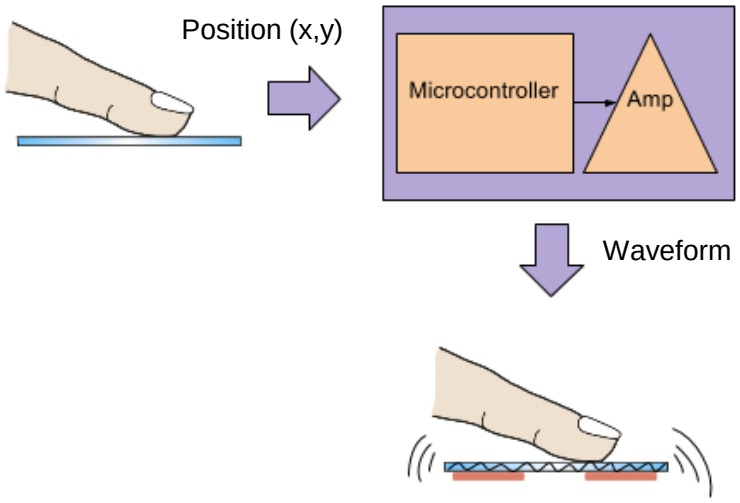
Toccando: A tactile feedback system

- Problem:
  With the invention of touch screens, much of the tactile user interface has been lost
- Solution:
  Tactile display that provides distinctive haptic feedback to the user.
- Technology:
  Use of ultrasonic frequencies to dynamically create low and high friction areas that are experienced as force on the user's finger when the finger is moving.

- Design:
  Four Main Components
  - V Android Phone
  - Microcontroller
  - Amplifier
  - Glass with piezos



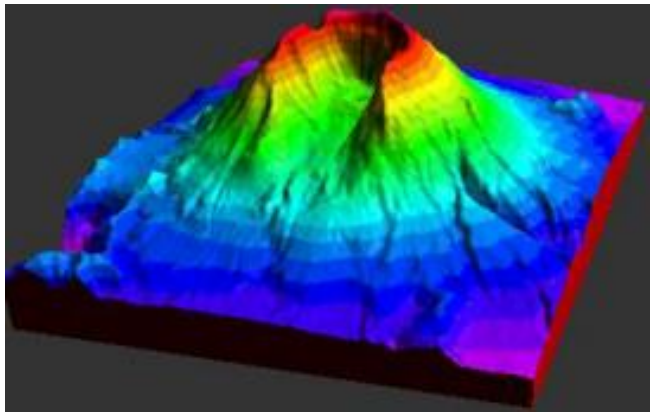
Why Toccando?

- Adding another dimension:
  Touch!

- Bringing technology closer to reality:
  The shape and texture of objects is important to the way we interact with the physical world

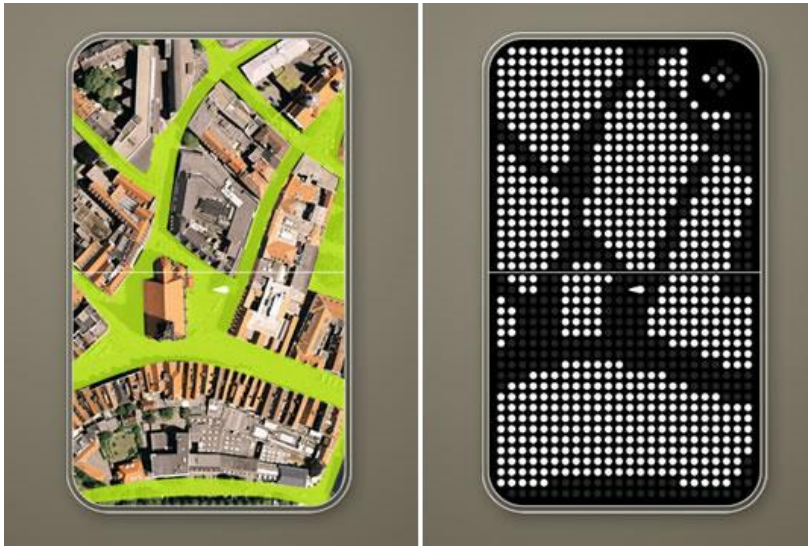
- Education:
  Allows the development of educational tools such as
  - Interactive maps

- Marketing:
  Clothing texture could be displayed to the consumer

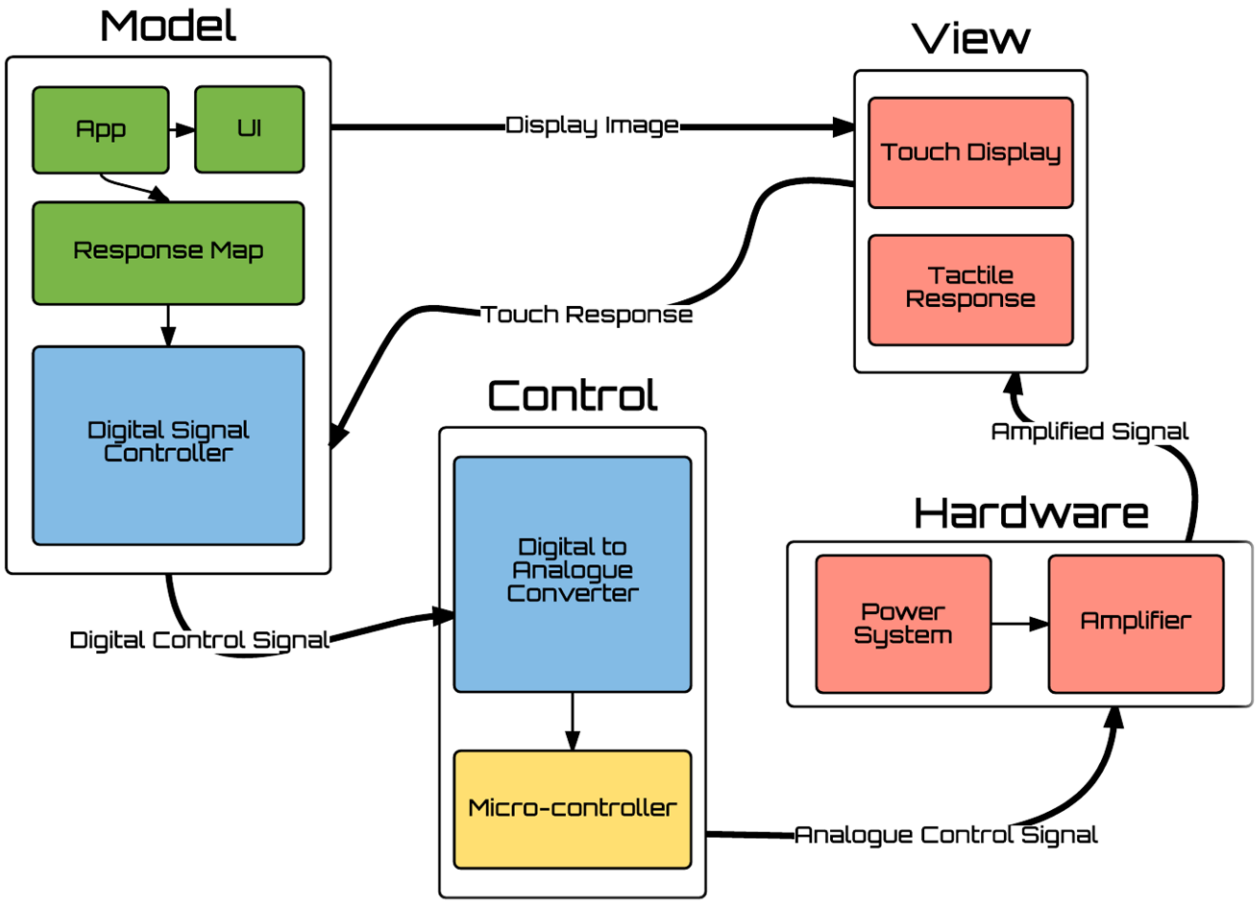


Applications of Tactile Feedback in Maps

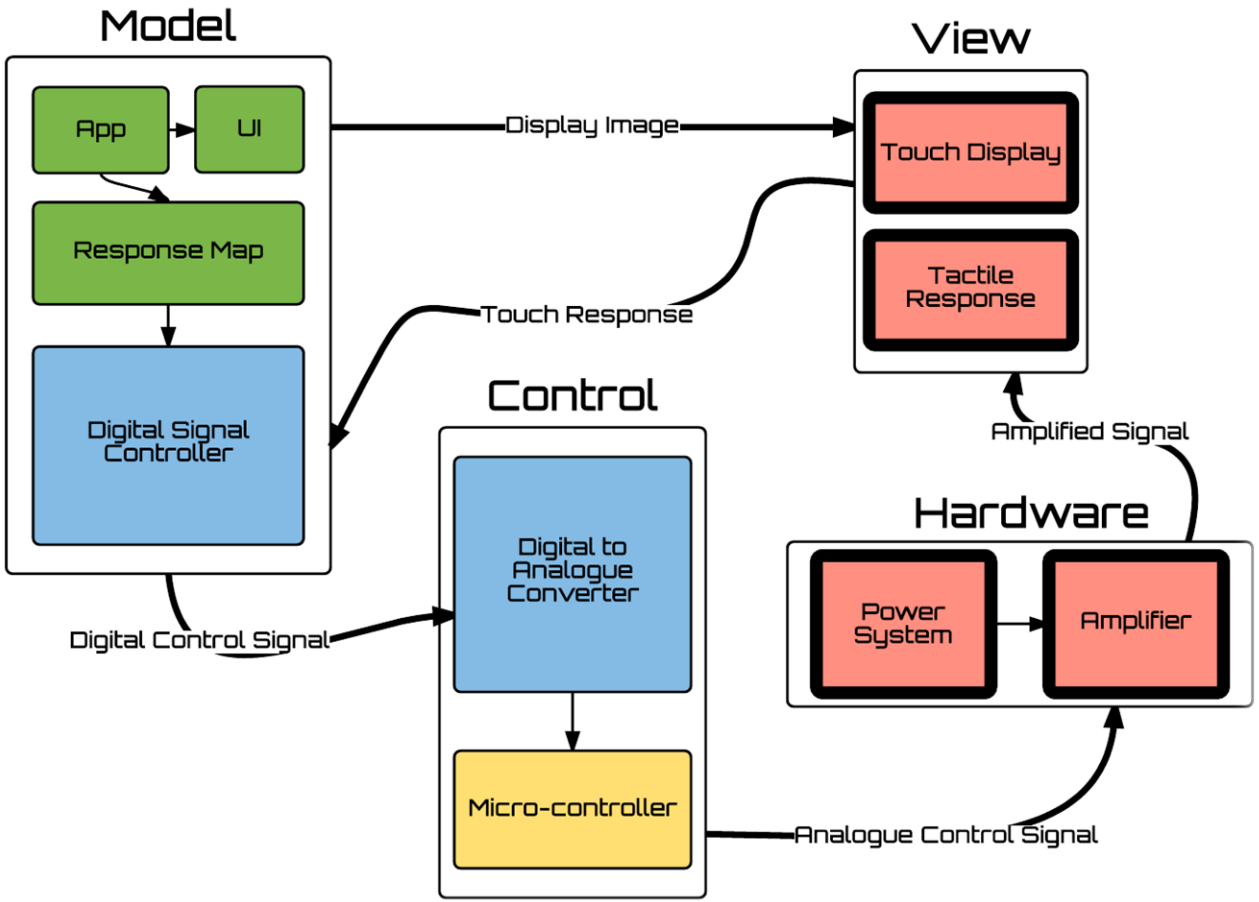
- Dimensionality of a map is modular, 2d or 3d options
- Allows visually impaired to experience electronic maps
- Gives tactile cues when visual cues may be distracting (eg. when driving)
- Could be used to add interactivity to maps used in education, tactile feedback could add more information, like topography



Our Block Diagram



View and Hardware



Glass Touch Surface

- Requirements
  - Must vibrate at a frequency greater than human hearing range (~20 kHz)
  - Provide a tactile sensation to the user
  - Should be thin glass (< 2mm thick)
  - Power output should be ~1W
- Progress
  - Obtained glass of varying thicknesses (0.7 mm, 0.9 mm, 1.1 mm)
  - Obtained piezos (35 mm)
  - Vibrations were easily detectable at low frequencies (50-500 Hz)
  - Resonant frequency in test cases found to be at 7k Hz

Glass Touch Surface

- Challenges and Solutions
  - Challenge:
    Raise the resonant frequency to ultrasonic range
  - Proposed Solution:
    Need to provide more power to piezos
  - Note: Solution developed through correspondence with Mr. Craig Shultz and Mr. Joe Mullenbach at Northwestern University.
    (Phd students who have published papers on tactile feedback and variable friction surfaces)

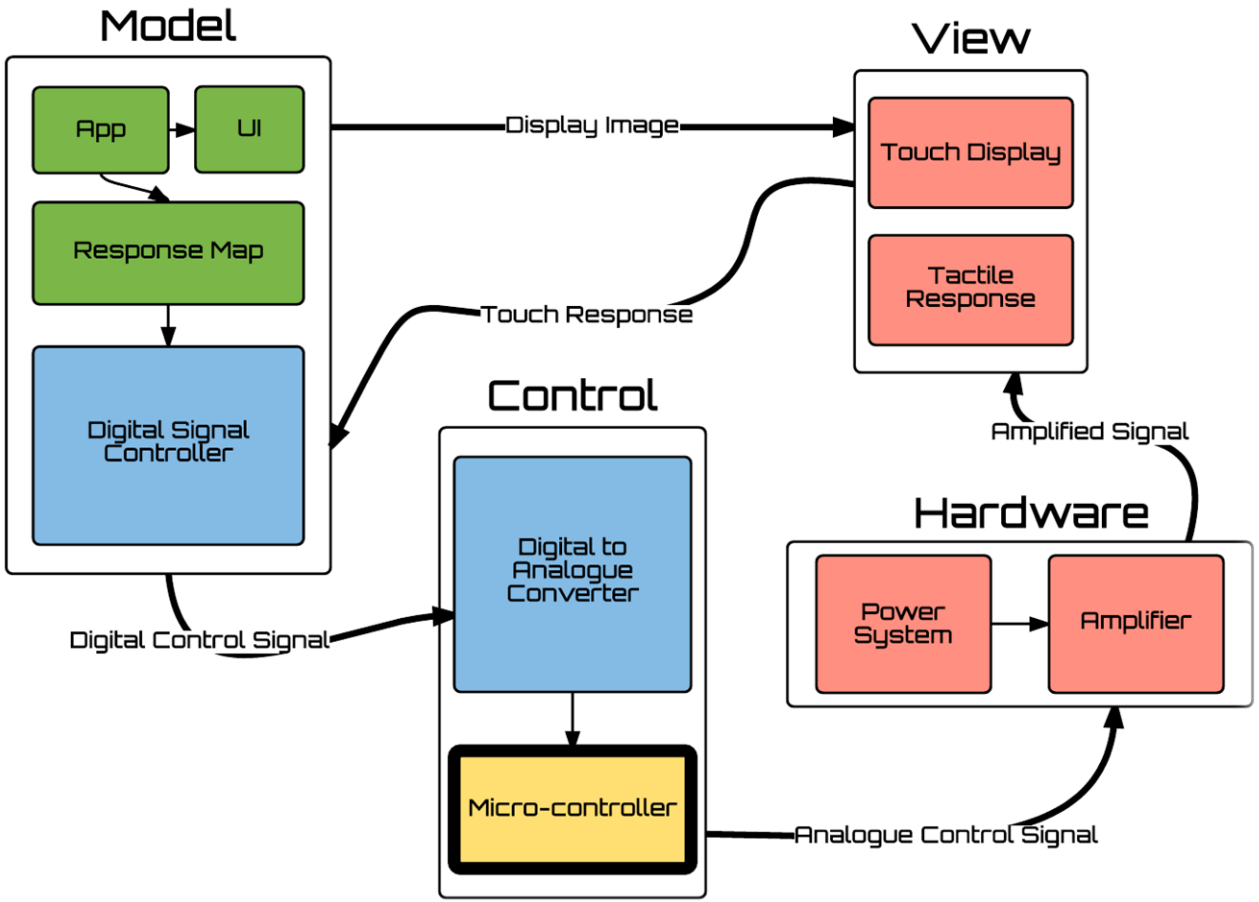
Amplifier Circuit

- Requirements
  - Must take in ~5-6V and amplify to ~40-60V
  - Lightweight
- Progress
  - Currently implemented as transformer
  - Still need to boost amperage
- Experiments
  - Stereo amplifier
  - Darlington pair

Power System

- Requirements
  - Lightweight (0.8oz or about 23g)
  - Inexpensive
  - 5V DC Delivery (to power microcontroller)
- Progress
  - To be ordered

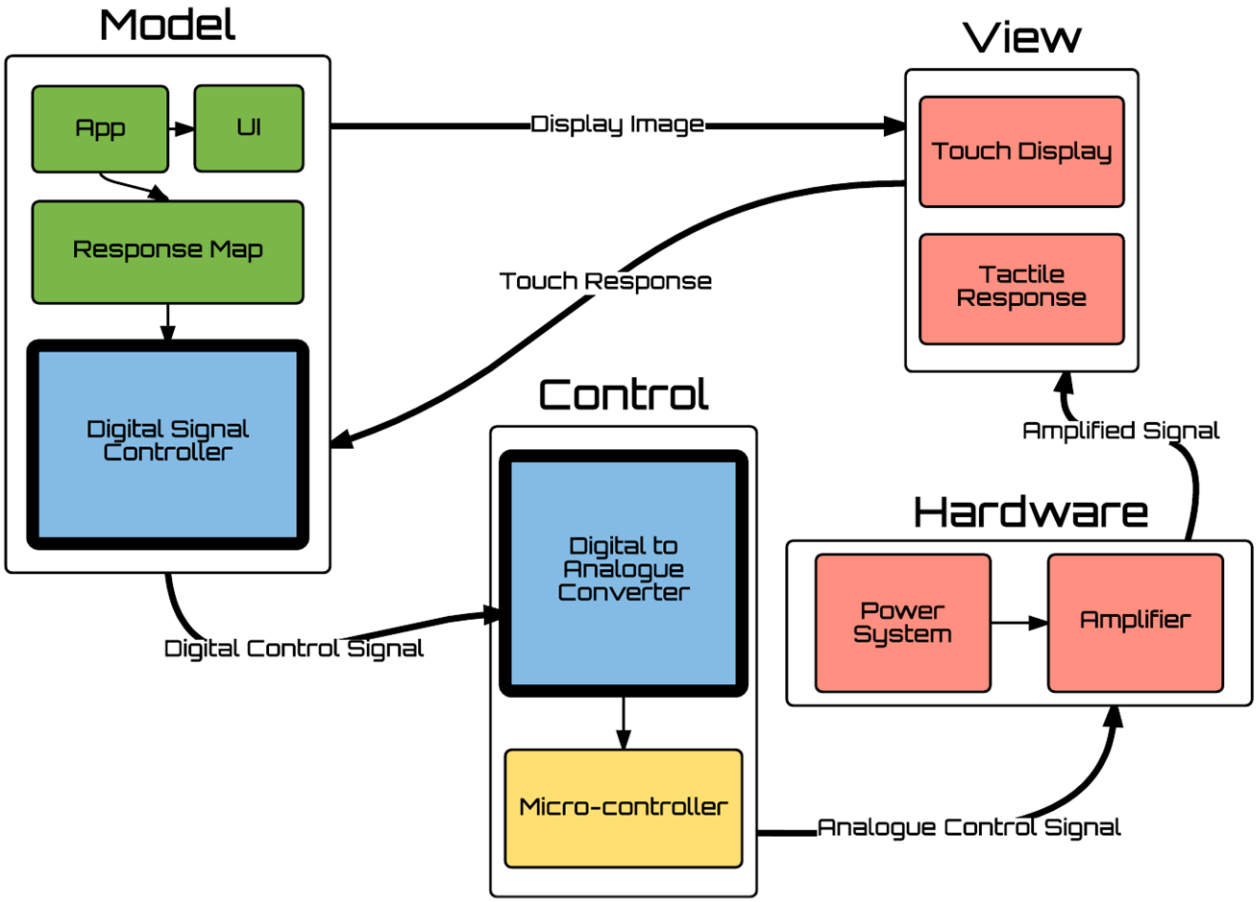
Microcontroller



Microcontroller

- Requirements
  - Lightweight
  - Energy Efficient
  - Inexpensive
- Originally planned to use:
  - ATmega32
- Progress
  - A Using Mega32u4 breakout board for USB compatibility
  - Receives HID signals from PC

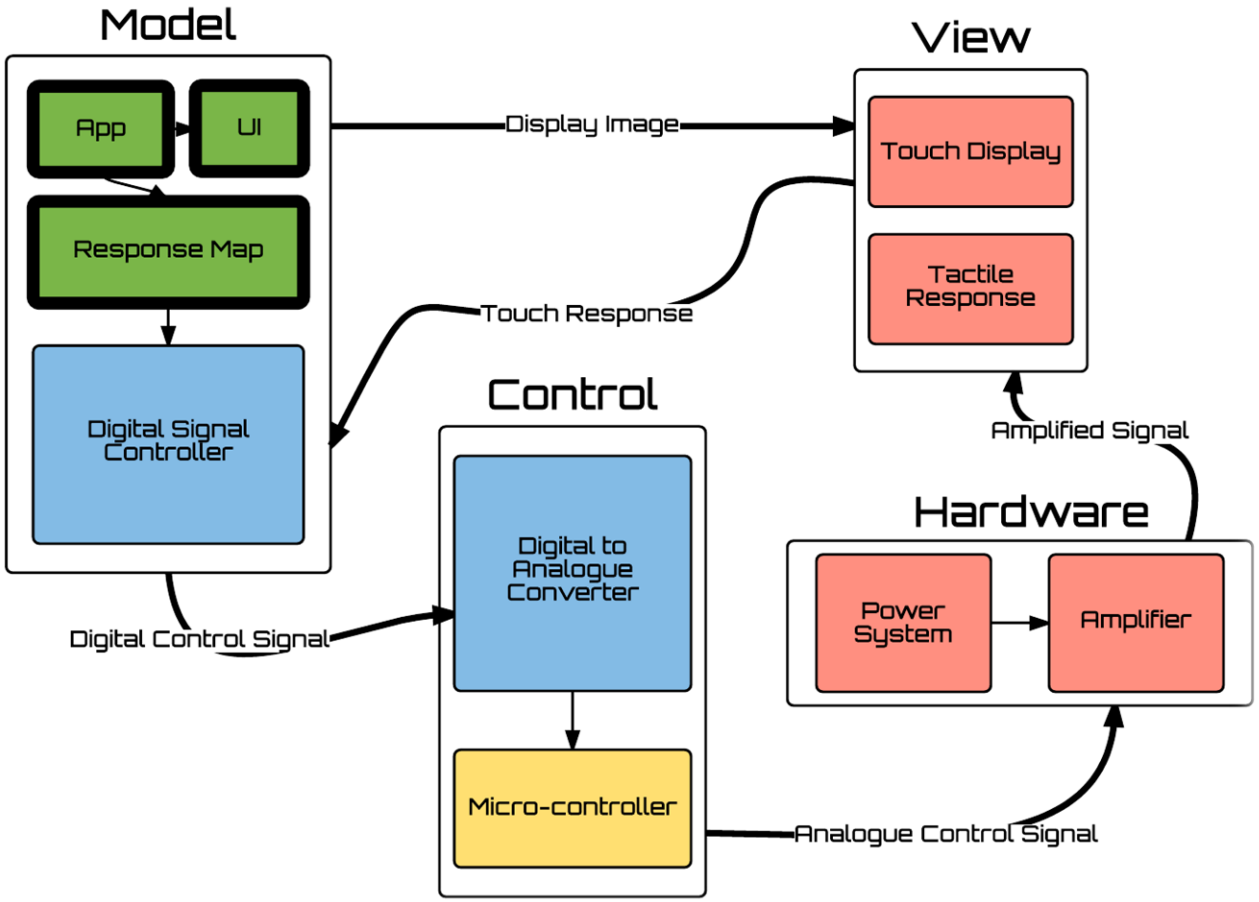
Hardware Software Interface



Interfacing Hardware and Software

- Requirements
  - Integration should be seamless
  - Fast response time (open accessory protocol)
- Progress
  - Trial with pre-existing HID Terminal defines Android as Host
  - Need the Android to be in accessory mode
  - App interface is in development

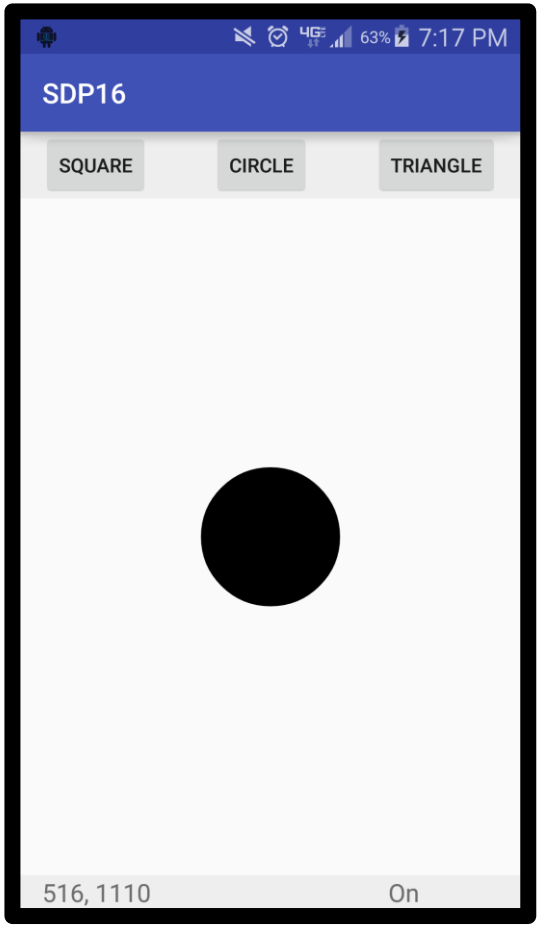
Application Level



Application

- Requirements
  - Android Application
  - Internal phone hardware (finger positioning)
  - Fast and smooth usability

- Progress
  - Rudimentary UI is able to recognize finger position
  - Determines whether finger is on/off a shape



Proposed MDR Deliverables

- Proof of Concept
  - Binary tactile system – ACHIEVED
  - Microcontroller producing desired waveform- UNDER DEVELOPMENT

    (A function generator is being used for testing)
- Simple Android Interface
  - Preliminary UI- ACHIEVED
  - Detection of Input Location- ACHIEVED

Individual Responsibilities

- Ygor:
  - Debugging Hardware
  - Pspice Simulations
  - Darlington Pair Experiment
  - Research on harmonic oscillator
- Casey:
  - Glass cutting and piezo wiring
  - Debugging Hardware
  - Amplifier experimentation
- Esther:
  - Microcontroller communication
  - Research and correspondence with researchers
  - Organization
- Will:
  - App development
  - Hardware debugging
  - Microcontroller waveform programming

Proposed CDR Deliverables

- Fully connected System (Esther)
  - Android communicates with microcontroller and microcontroller generates signal to piezos
- Android Map Application (Will)
- Progress on Sensation Desired (Casey and Ygor)

Thank You

Follow us to the SDP Lab for a Demo!