

Blind User Accessible Insulin Pump

**ECE480 Senior Capstone Project
Fall 2014**

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Agenda

- Project Description
- Design Criteria
- Design Overview
- Design Components
 - Background
 - Design Implementation
- Schedule
- Testing Criteria

Project Description

- Asante Solutions, Inc. and RCPD
- Blind user focused insulin pump
 - 40% of diabetics are visually impaired



Project Description

Customers:

- Asante Solutions, Inc.
- Medical Community
 - Resource Center for Persons with Disabilities



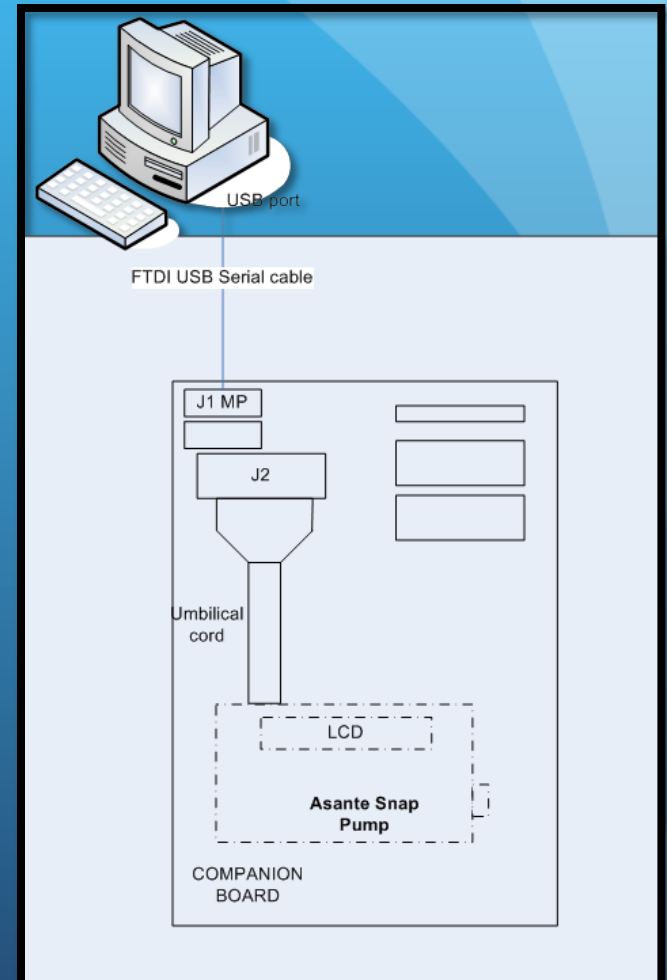
Asante Solutions, Inc.

➤ Requirements

- Separate unit

➤ Information

- Serial port with UART connection (ASCII 8-bit)
- Microcontroller
- Software model



Medical Community Feedback

➤ Doctors and Nurses

- ‘Simply that [insulin pumps] are not designed with [blind users] in mind’

➤ Blind Users

- Buttons
 - Distinguishable
 - Description on pump
- iPhone
 - VoiceOver



Design Criteria

➤ Essential

- Safety
- Cost
- Materials

➤ Aesthetics

- Product Design
- Intuitive Controls
- Size

Initial Speech Concept

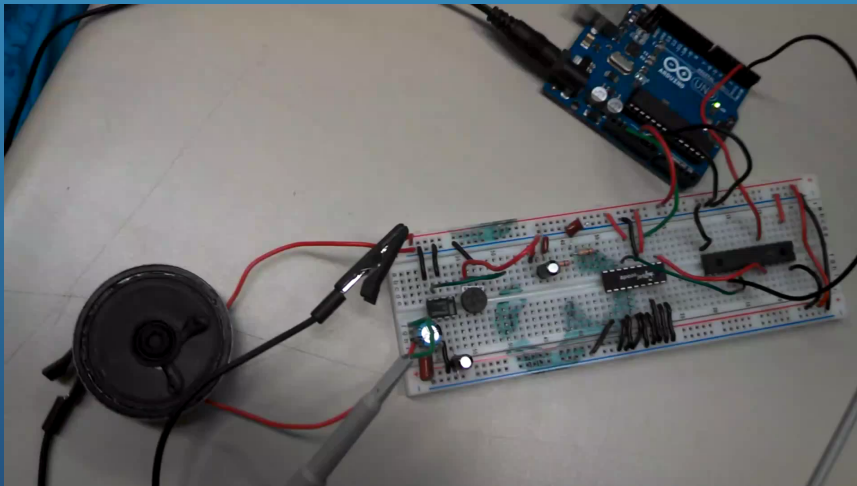
1)Text-to-Speech:

➤ Pros

- Less Programming
- Easy Word Addition
- Low Cost

➤ Cons

- Robotic Voice
 - Mispronunciations
- Large IC
- Requires External Microcontroller



Initial Speech Concept

2) Digital Speech:

➤ Pros

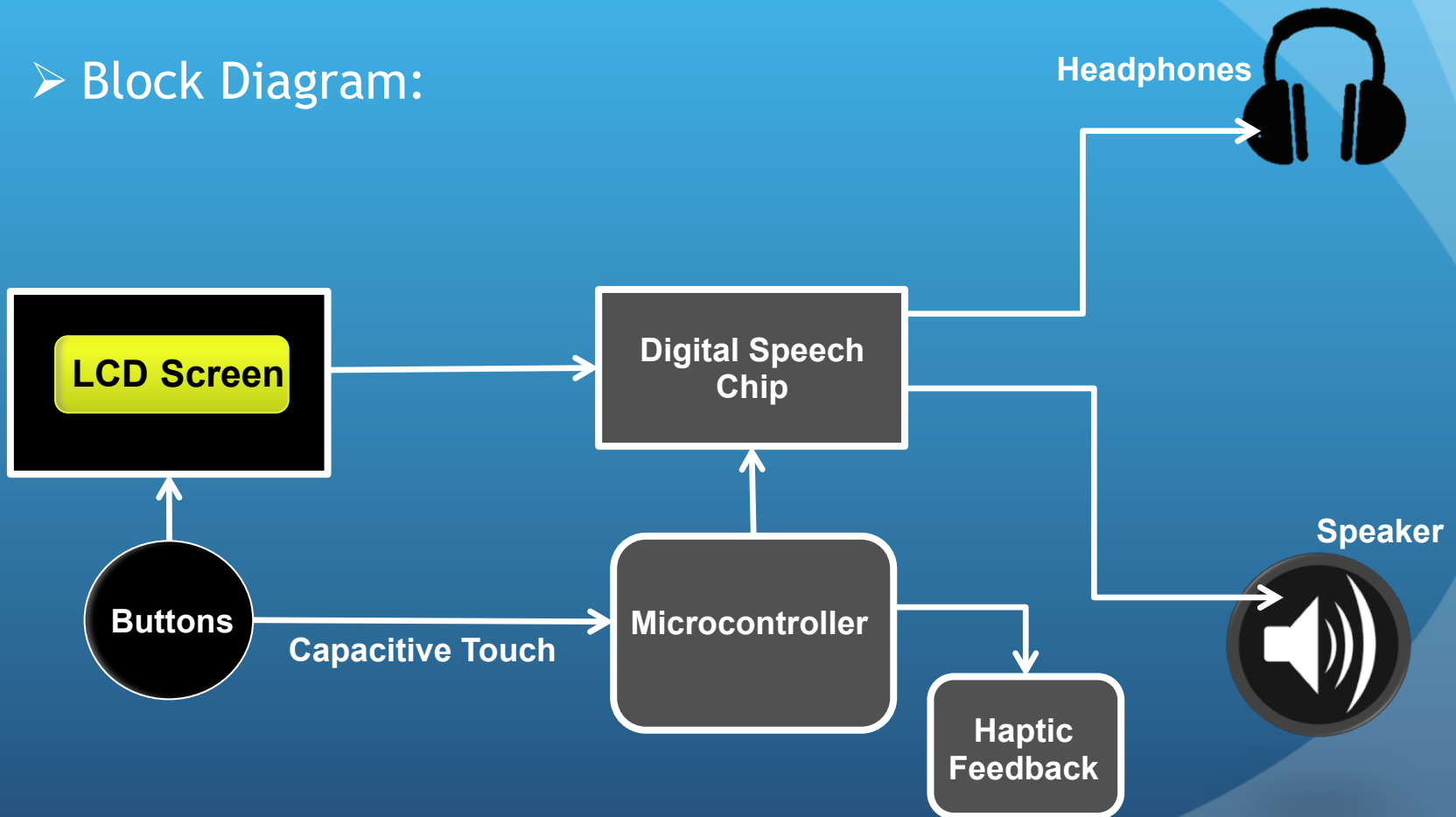
- Better Sound Quality
- More Speech Options
- More Language Options

➤ Cons

- Requires Additional Programming
- Data Loss

Design Overview

➤ Block Diagram:

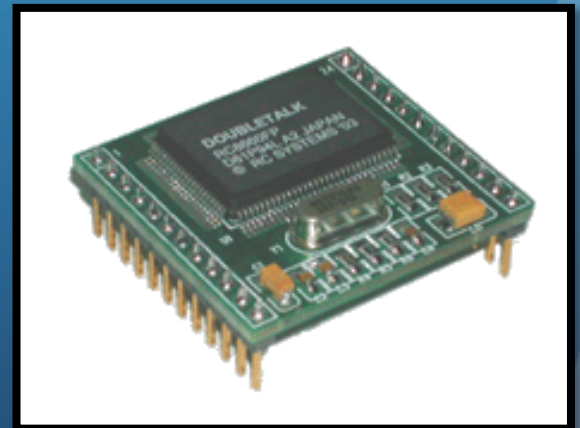


Design Components

- Digital Speech Chip
 - V-Stamp
- Button Feedback Response
 - Capacitive Touch
 - Haptic Technology
 - Microcontroller (MSP430)
- Audio System
 - External Speaker
 - Headphone Jack
- External Power Supply

V-Stamp

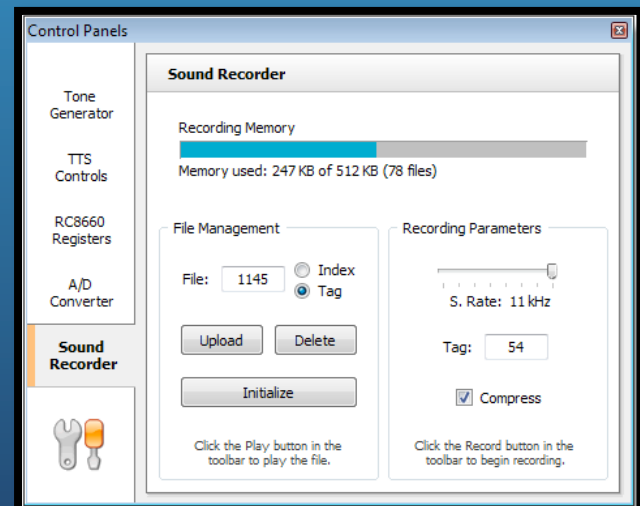
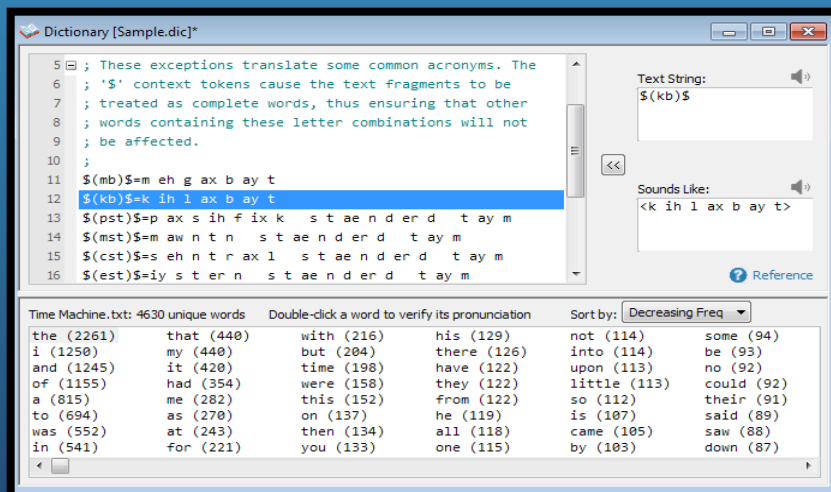
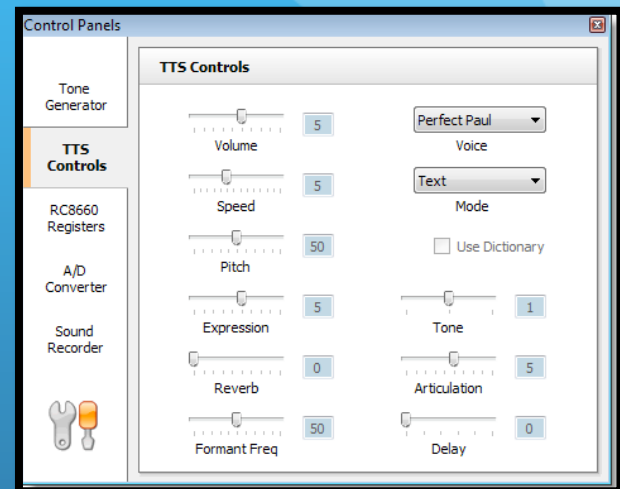
- Voice and Sound Synthesizer and Recorder
- Digital Speech and Text-to-Speech Capabilities
- Associate Incoming ASCII Code with Auditory Response
- V-Pod Development Board
 - Docking Station
 - RS232 Connection
 - Audio Subsystem
 - Microphone
 - I/O pins



V-Stamp

➤ RCStudio

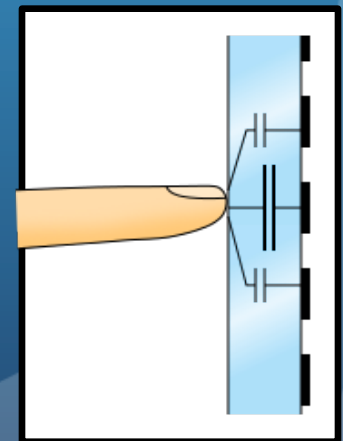
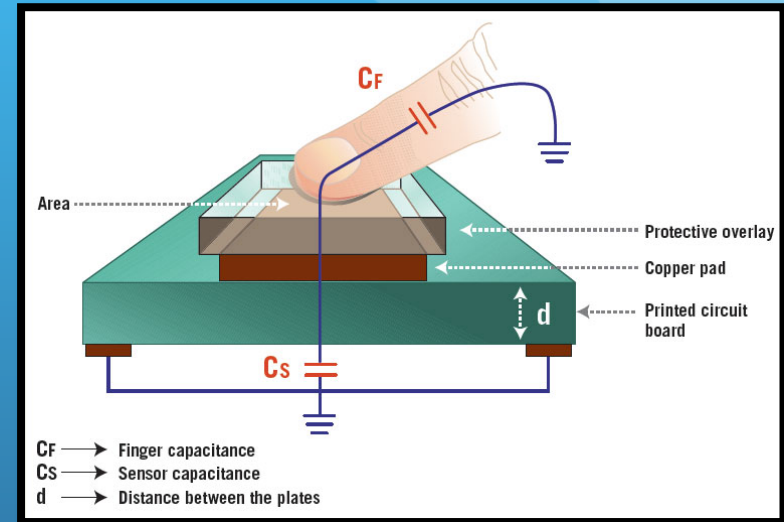
- V-Stamp Programming
- Simulation
- Control Panel
- Recorded Memory Library
- Exception Dictionaries



Capacitive Touch

Background:

- Change in Capacitance Used as Input
- Indirectly Measured Through Change in Voltage
- Surface Capacitance
 - Uniform electrostatic field
- Projected Capacitance
 - Electrostatic grid



Capacitive Touch

Implementation:

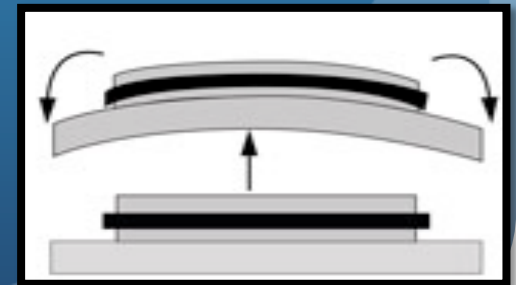
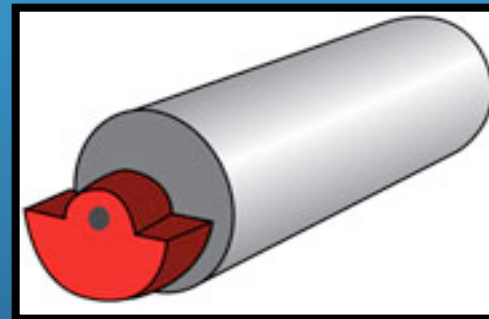
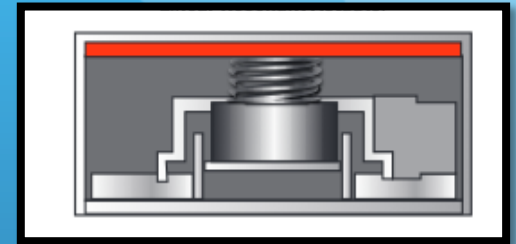
- Button Feedback
- Conductive Tape Attached to Buttons
 - Non-Invasive
- MSP430 controlled



Haptic Technology

Background:

- Recreates Sense of Touch in Electronic Devices through Vibrations
- Microcontroller
- Haptic Driver
- Haptic Actuator
 - Linear Resonant Actuator
 - Eccentric Rotating Mass
 - Piezo



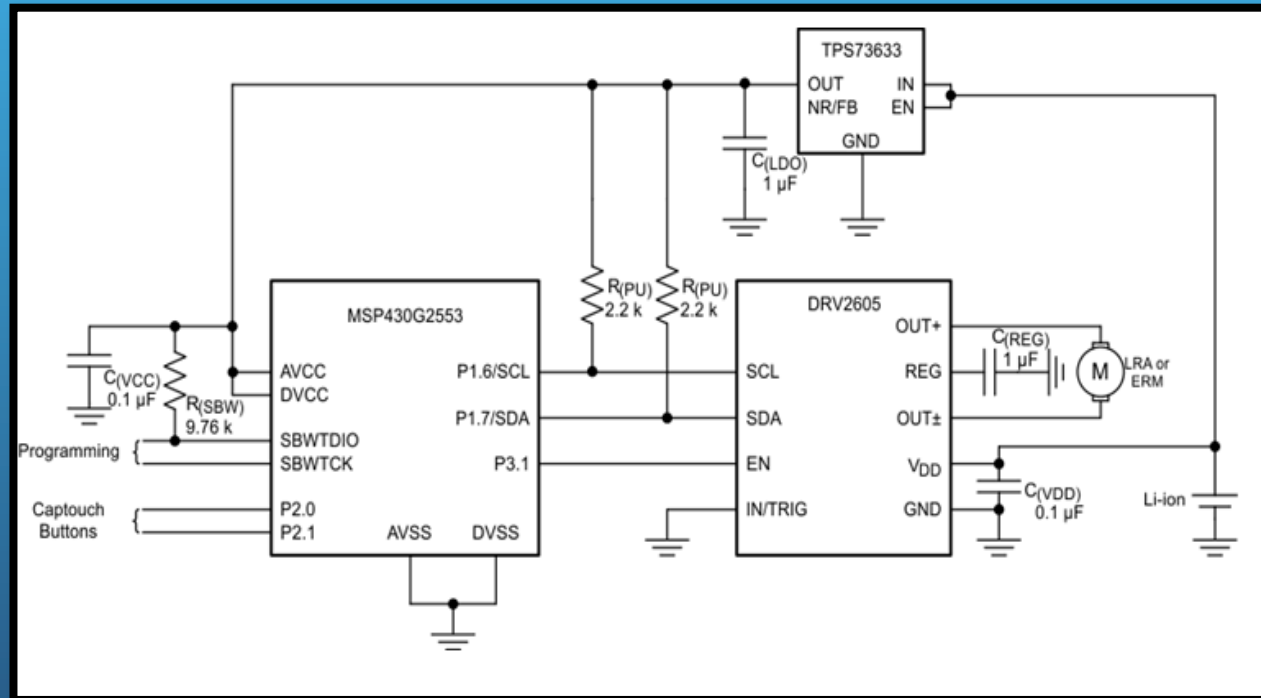
Haptic Technology

Implementation:

- Tactical Button Feedback
- Motor Vibrations: Button Notification
- Components:
 - MSP430
 - DRV2605 Driver
 - Linear Resonant Actuator
- Time Permitting

Haptic Technology

Complete Design:



MSP430

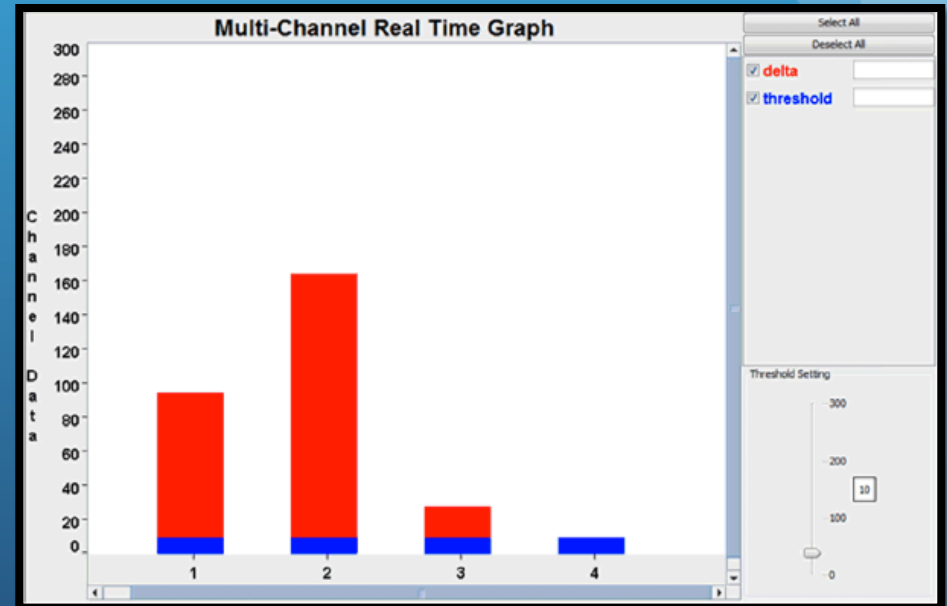
Background:

- Ultra Low Power Microcontroller
- Mixed Signal
- 16 Bit CPU
- 16 KB Flash Memory
- Universal Serial Communication Interface
- 16 General Purpose Input/Output Pins
 - 8 Channel Comparator
 - 8 Channel ADC

MSP430

Implementation:

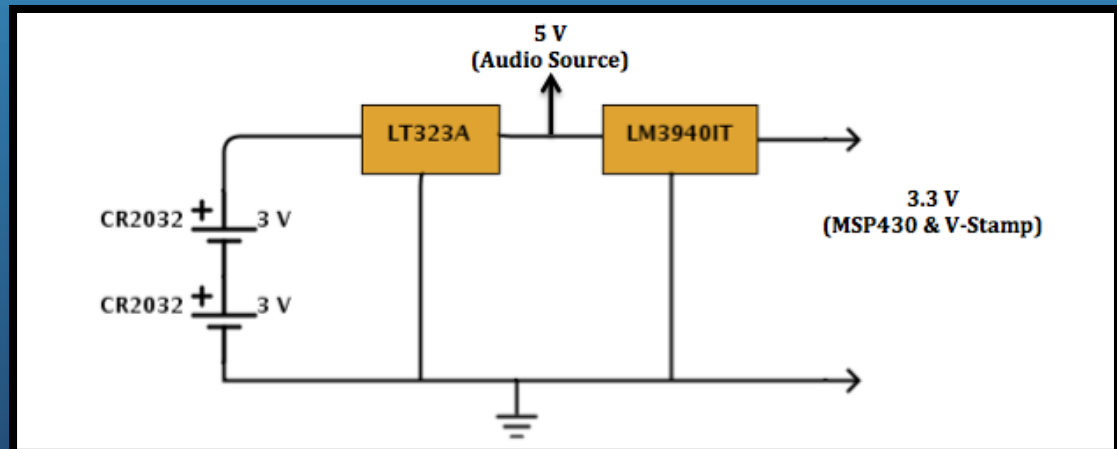
- Inputs:
 - Capacitive Touch
- Outputs:
 - Haptic Driver
 - V-Stamp: Read Portion of ASCII Code for Selected Button
- Testing: Touch Pro Tool



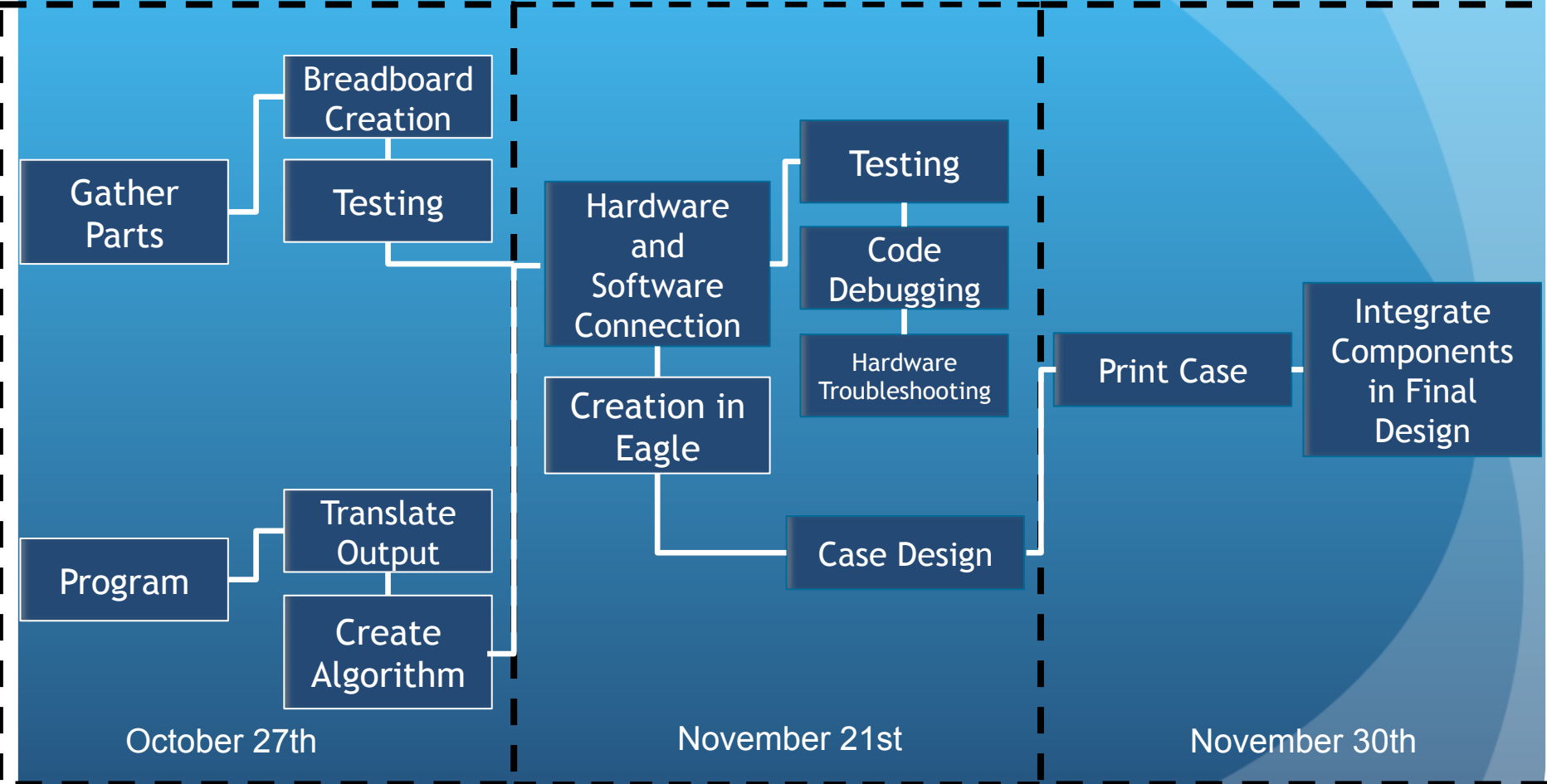
Touch Pro Tool

Power Supply

- External Battery Source
- Need: 5V (Audio Components) and 3.3V (MSP430 & V-Stamp)
- Two CR2032 Lithium Coin Cell batteries
- Two Voltage Relators (LT323A & LM39401T)



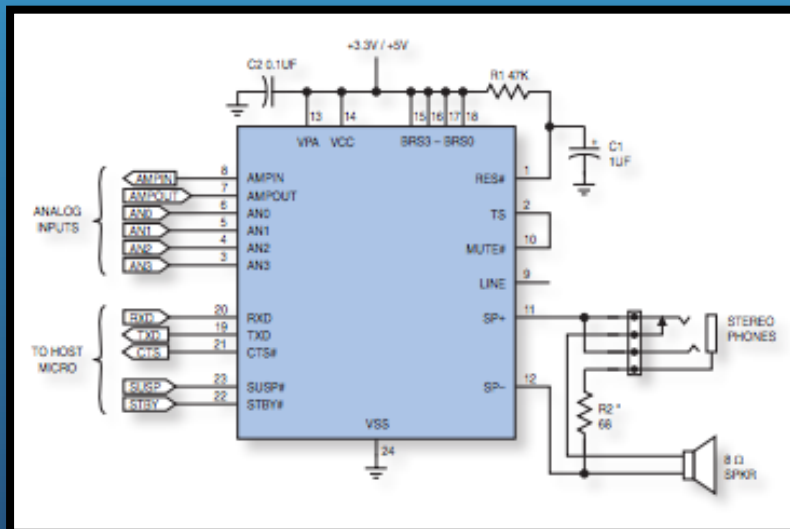
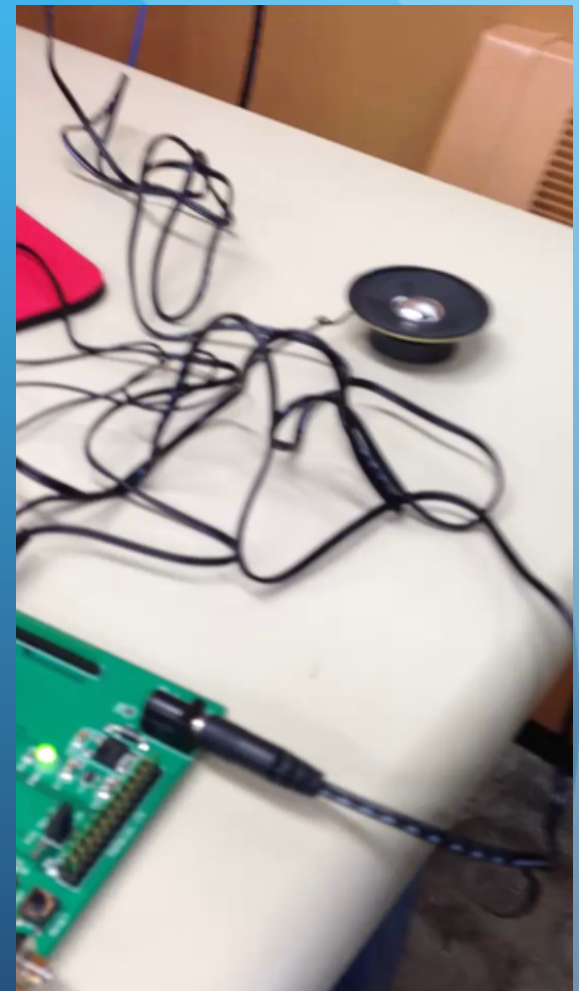
Schedule



Recent Milestones

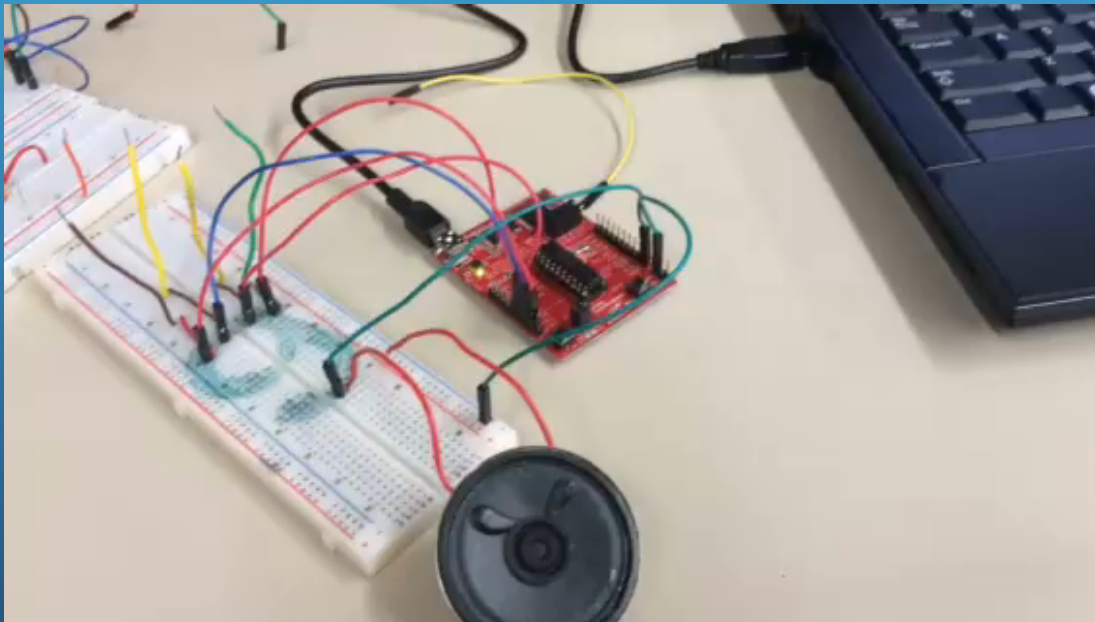
➤ V-Stamp

- Speaking ASCII Characters via Text-to-Speech
- V-Pod Replicated on Breadboard
- Words/Phrases Recorded in Memory Bank



Recent Milestones

- Capacitive Touch
 - Programmed with Energia
 - Wires Output Different Speaker Tones



Testing Criteria

➤ Unobtrusive

- For User
 - Temperature
 - Size/Weight
- For Insulin Pump
 - Non-interfering

➤ Intuitive

- Response Priorities
- Understandable

➤ Power Consumption

Questions?
