



# Ukulele Instrument Tutor

ECE 445: Senior Design Presentation

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# Presentation Overview

1. Introduction
2. Objective
3. Overview
4. Functional Tests
5. Successes and Challenges
6. Additional Tests
7. Future work

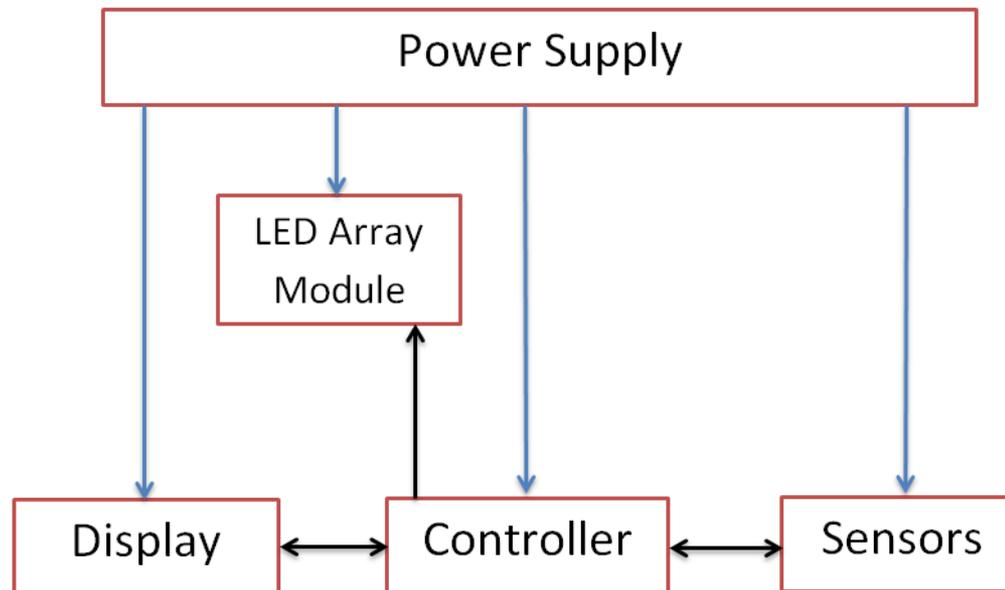


# Introduction

- Motivation
  - Doesn't exist in market
- Objectives
  - Main function
  - Requirements
- Benefits
- Features



# System Overview (Hardware)



Key:

 Data Flow

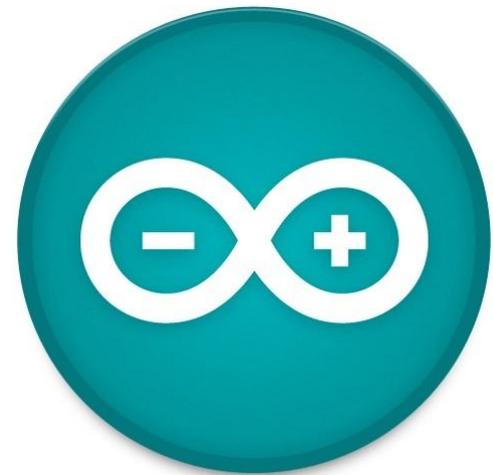
 Power Supply

# System Overview

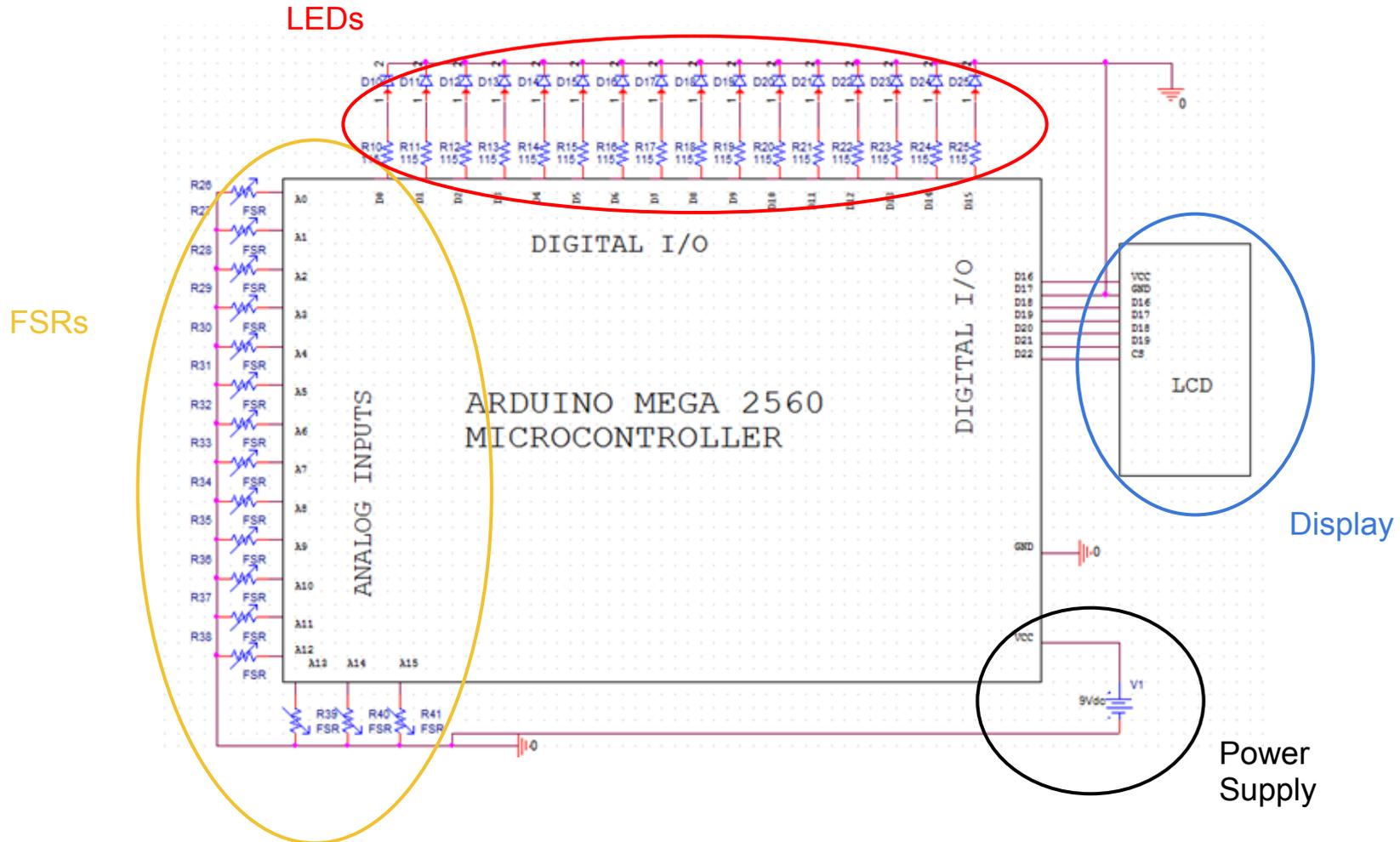
## (Software)

- Arduino

- Note display and detection
- Menu navigation
- Notes, Chords, and Song selection
- Display notes, chords on LCD
- Song storage



# Components

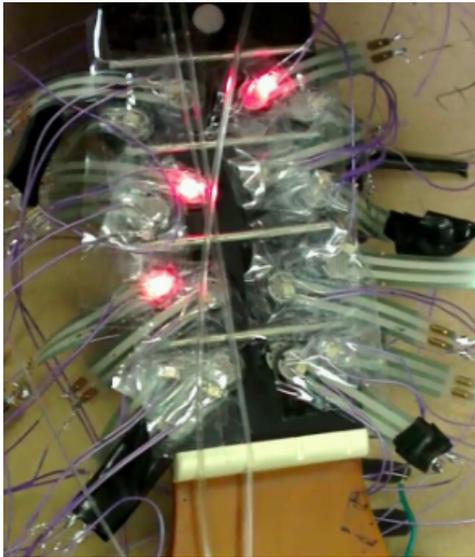


# Microcontroller

- Arduino Mega 2560
  - Features: 54 Digital I/Os, 16 Analog Inputs, 4kB EEPROM memory, 256 kb flash memory
  - Flash memory will store the ukulele tutor program
  - FSRs use analog pins (ADC)
  - The LEDs, LCD use digital pins



# LED Array



- Light intensity varies with current.
- 16 surface mount LEDs.
- LED sequential logic.

# Display

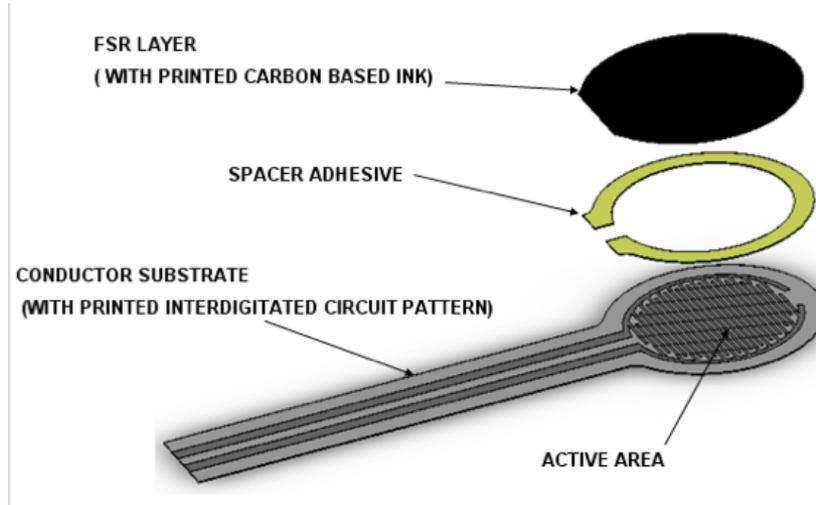


- SainSmart 16x2 LCD Keypad module
- 6 buttons
- lcd.print, lcd.setCursor, lcd.clear

# User Interface



# Force Sensitive Resistor (FSR)



1 <sup>st</sup> String	A	A#/Bb	B	C	C#/Db
2 <sup>nd</sup> String	E	F	F#/Gb	G	G#/Ab
3 <sup>rd</sup> String	C	C#/Db	D	D#/Eb	E
4 <sup>th</sup> String	G	G#/Ab	A	A#/Bb	B

- Resistive vs Capacitive
- FSR composition
- analogRead()
- Placed at each location of fretboard

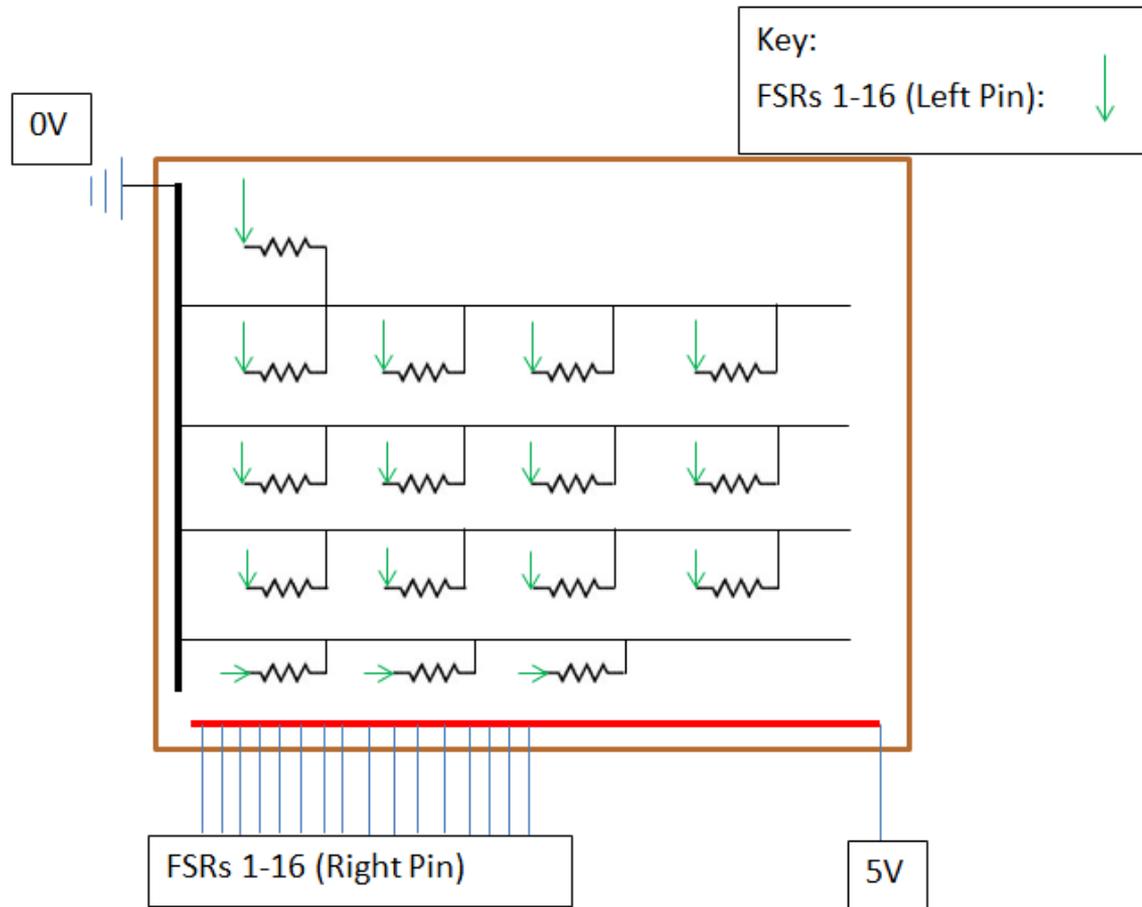
# Sample Code

```
case 5:{
    //Dmajor = 5, 6, 7

    do{
        do{
            do{
                digitalWrite(ledPin5, HIGH);//turns LED on
                digitalWrite(ledPin6, HIGH);//turns LED on
                digitalWrite(ledPin7, HIGH);//turns LED on
                fsrValue5 = analogRead(fsrPin5);//reads FSR
                fsrValue6 = analogRead(fsrPin6);//reads FSR
                fsrValue7 = analogRead(fsrPin7);//reads FSR
                if (fsrValue5 >= 200){
                    if (fsrValue6 >= 200){
                        if (fsrValue7 >= 200){
                            digitalWrite(ledPin5, LOW);//turns LED off
                            digitalWrite(ledPin6, LOW);//turns LED off
                            digitalWrite(ledPin7, LOW);//turns LED off
                        }
                    }
                }
            }
        }
    }while (fsrValue5 < 200);
    }while (fsrValue6 < 200);
    }while (fsrValue7 < 200);

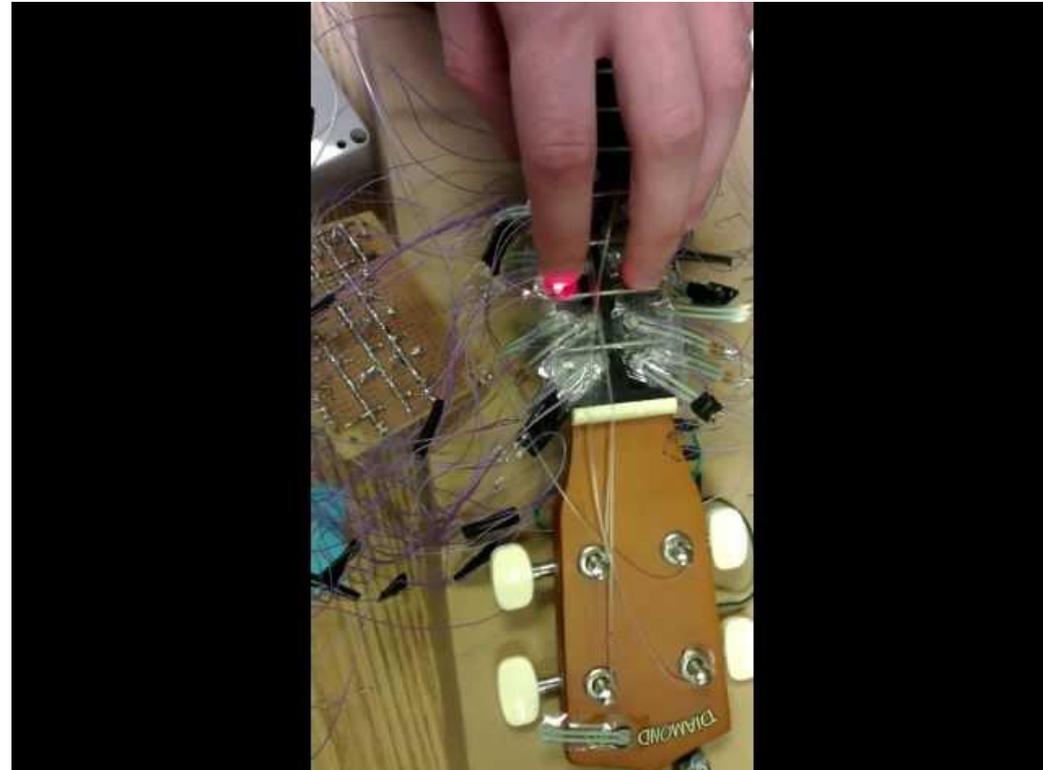
}
break;
```

# Vector Board Design



# Final Tests & Verifications

- LCD Menu navigation
- Using buttons to go through songs, chords, notes.
- Proper display of notes, chords, songs.
- Continuity Tests (components on vector board, FSRs, LEDs)





# Success and Challenges

- FSR calibration
- Damaged components
- Acquiring data from the FSRs
- Code functionality and debugging
- Mechanical issues (broken components, adhesives, soldering, component positioning on ukulele)

# Conclusion & Future Development

- Overall System
  - Performs as designed
- Future Development
  - More sensors, more accuracy (FSRs)
  - Better placement of components on ukulele
  - Larger Song Library
  - Record songs and create games
  - Interface with PC (upload midi files, get FSR data, etc.)



# Thank You!

- Professor Singer
- Ryan May
- Lydia Majure
- Skot Wiedmann





# Questions?