ECE477 MIDTERM DESIGN REVIEW: TEAM 12

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OUTLINE

- Project Overview
- Major Components
- Block Diagram
- Packaging Design
- Electrical Schematic
- PCB Layout
- Prototyping Progress
- Software Development Status
- Project Timeline
- Questions

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PROJECT OVERVIEW

GUITUTAR – GUITAR EMBEDDED LEARNING DEVICE

- Guitar teaching system designed to enable faster learning with minimal formal instruction
- Fretboard LED indication of notes to play
- String-fret switch matrix to analyze correctness on piezoelectric triggering strums
- App-controlled song, mode, and tempo selection
- Two primary operating modes:
    - "Learning"
    - "Real-time"

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PROJECT SPECIFIC SUCCESS CRITERIA

PSSC #1: An ability to interact with the system through an external user interface such as a phone or remote.

PSSC #2: An ability to interface the microcontroller with an external device via Bluetooth.

PSSC #3: An ability to recognize and process pitches played by a user through a sensing interface.

PSSC #4: An ability to display chords and notes on an LED array on the guitar neck.

PSSC #5: An ability to have the microcontroller support two modes for user learning and full playback.

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MAJOR COMPONENTS

Component	Description	Specifications	Function
Battery	Main power source	3.7V, 6600mAh Li-ion battery, 3.3A peak current	Main power source
Switch Matrix	Guitar string and fret	Conductive metal	Acts as a switch to indicate note/chord press
PIC32 Microcontroller	100-pin TQFP microcontroller	2.3V-3.6V, 15mA max per pin, 200mA max for all ports	Controls SRs, connects to Bluetooth, Piezo and Switch Matrix
Bluetooth Transceiver	Separate chip with onboard antenna	BT 4.2 Dual Mode, UART,3.3V to 4.2V op voltage	Connects phone to micro

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MAJOR COMPONENTS

Component	Description	Specifications	Function
Shift Registers	SMD shift register	2-6V 8-bit serial in, parallel out	Tells which LEDs to illuminate
PowerBoost 1000	Boost Converter and USB charger	3.7V to 5.2V,1000 mA charge rate	Allows 3.7V and 5.2V usage and recharge battery
LEDs	Blue light, clear package, 2.65V Forward Voltage, 2mA Operating Current	30mADC Forward Current,90mW power dissipation	Visual indication of note/chord position
Piezo Disc Element	Ceramic and Brass disc that detects vibrations	~2cm diameter, thin profile	Strum vibration detection

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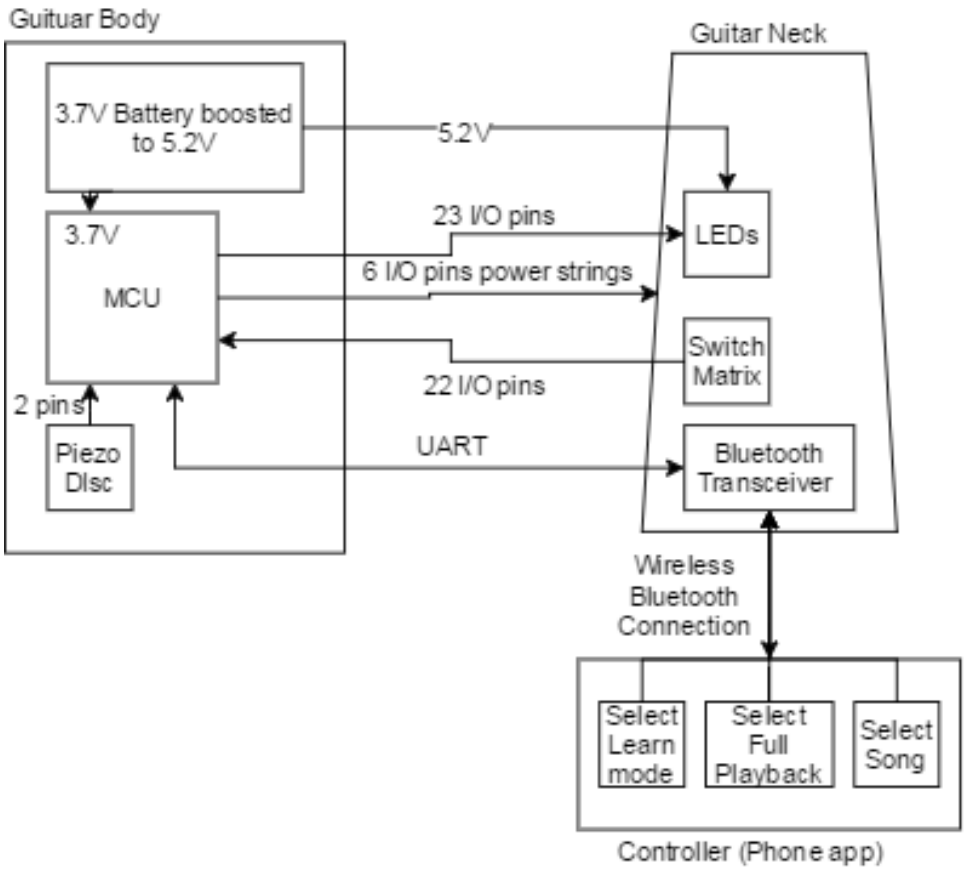
BLOCK DIAGRAM



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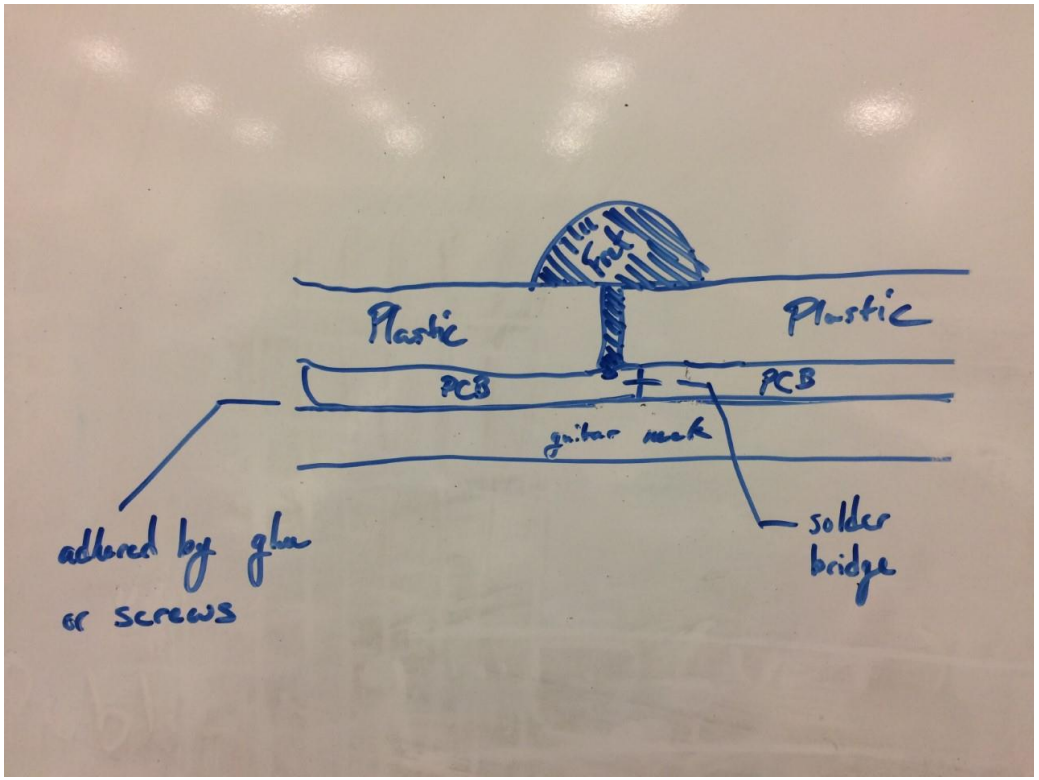
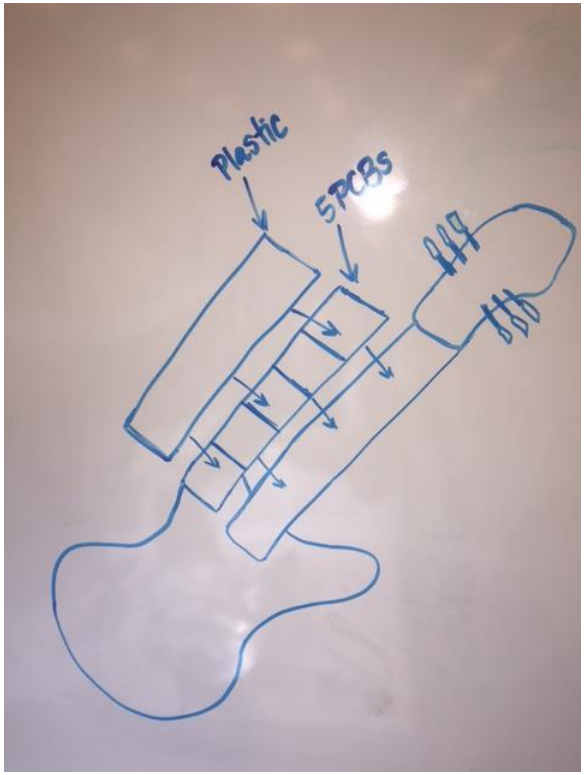
PACKAGING DESIGN





Total height: 5.44mm

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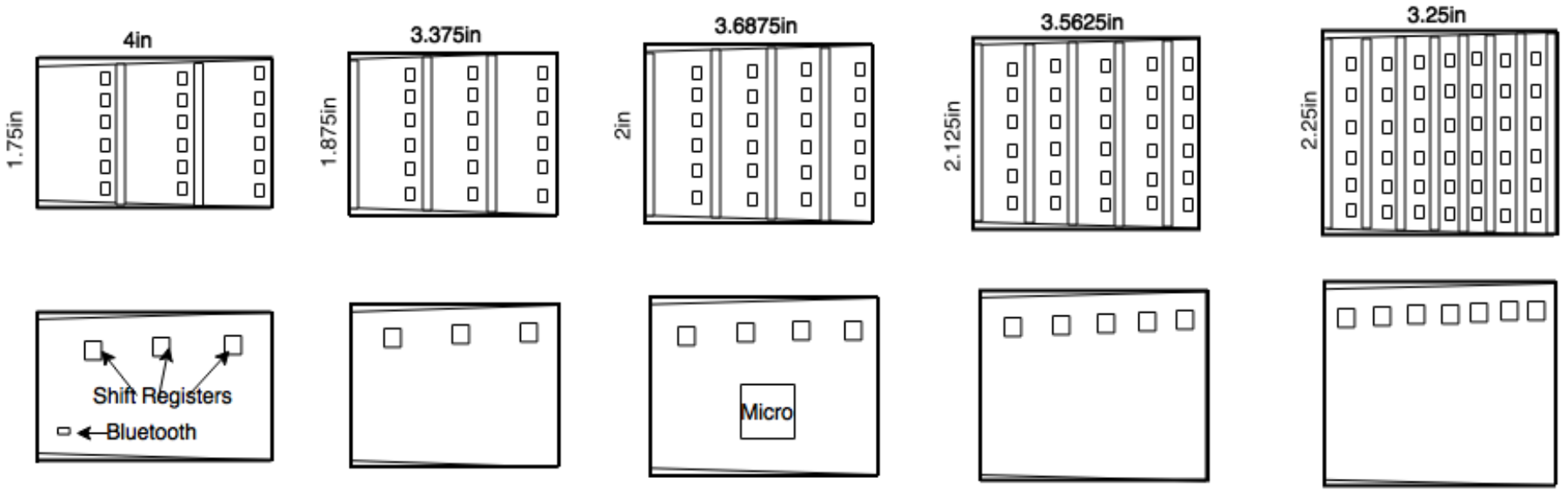

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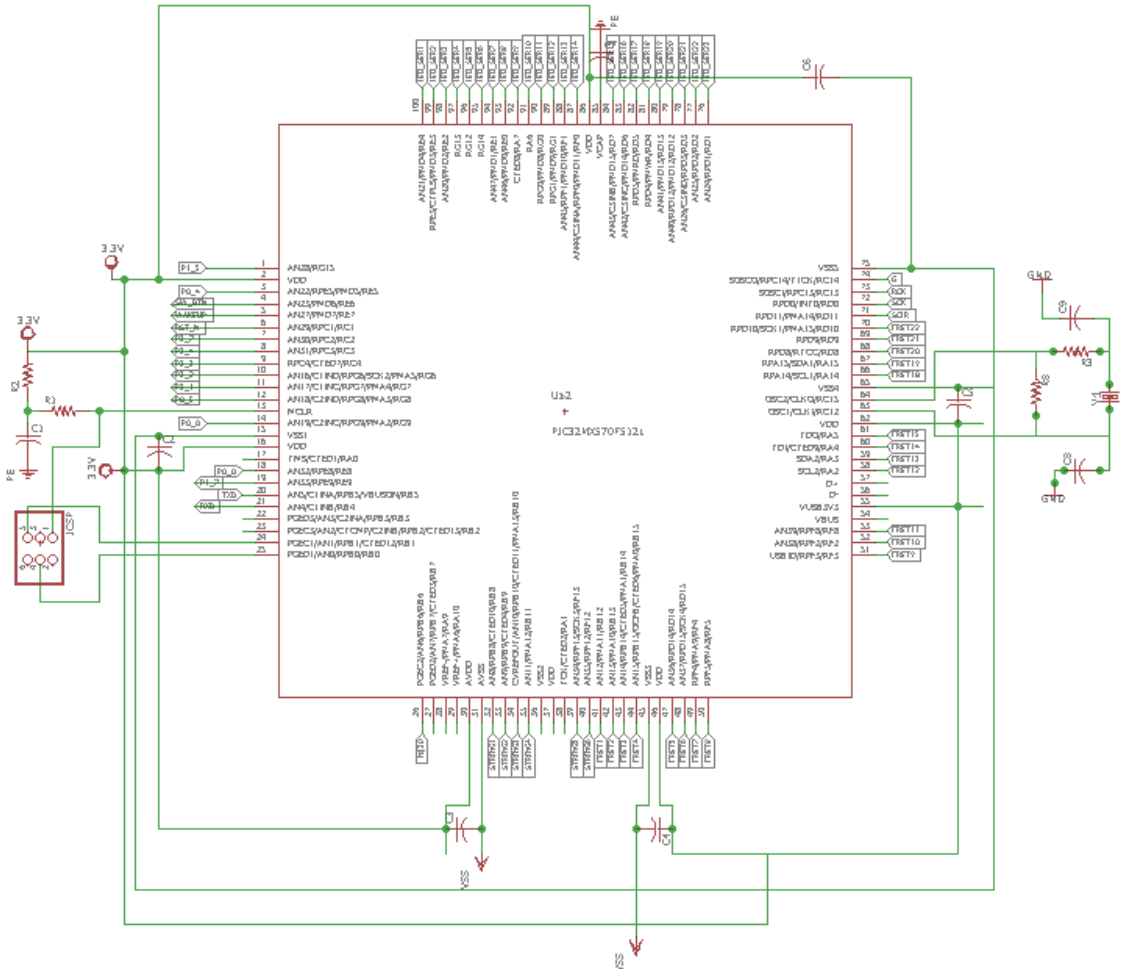
ELECTRICAL SCHEMATIC

MCU



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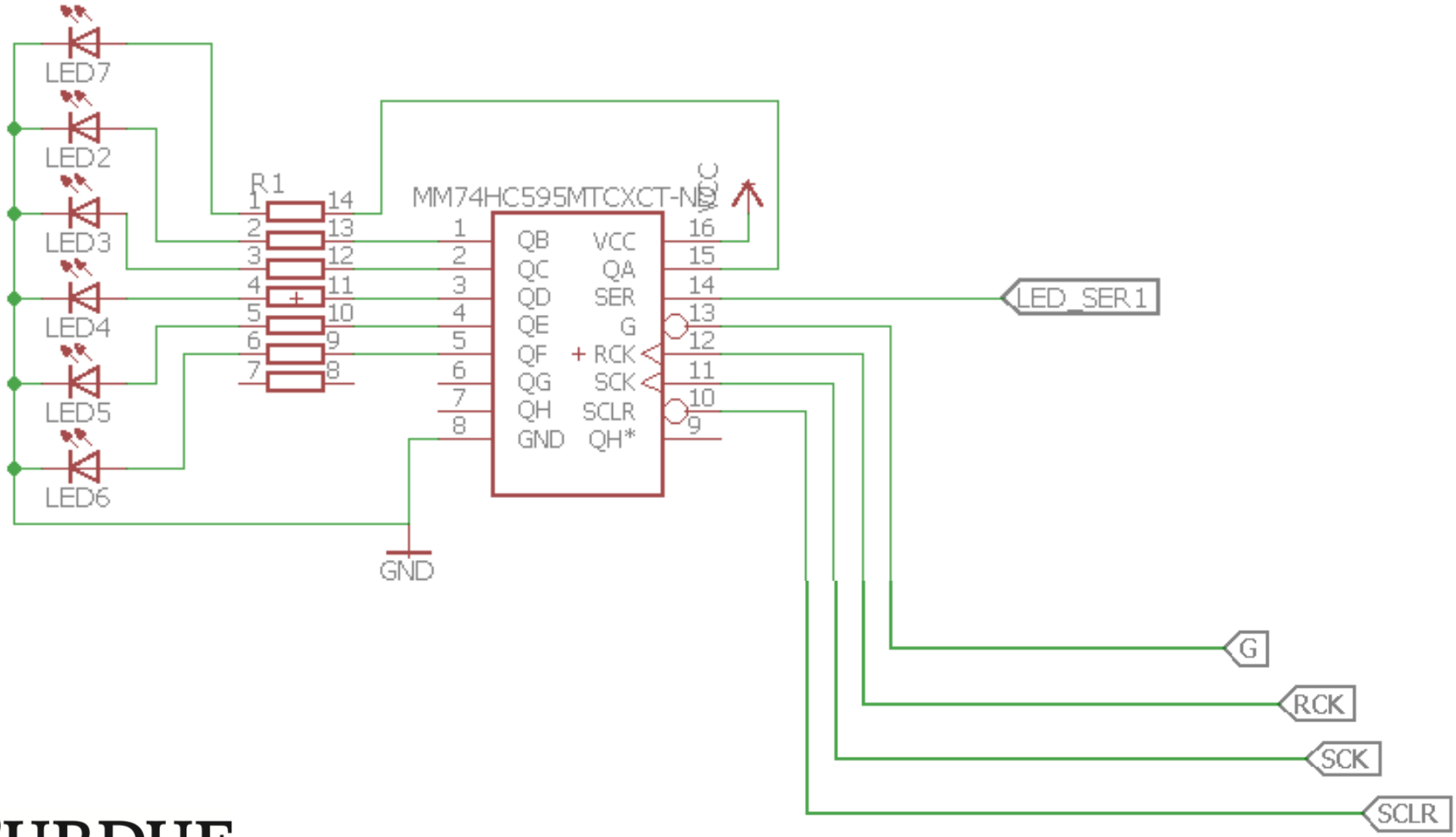
ELECTRICAL SCHEMATIC

LED ARRAY AND SHIFT REGISTER



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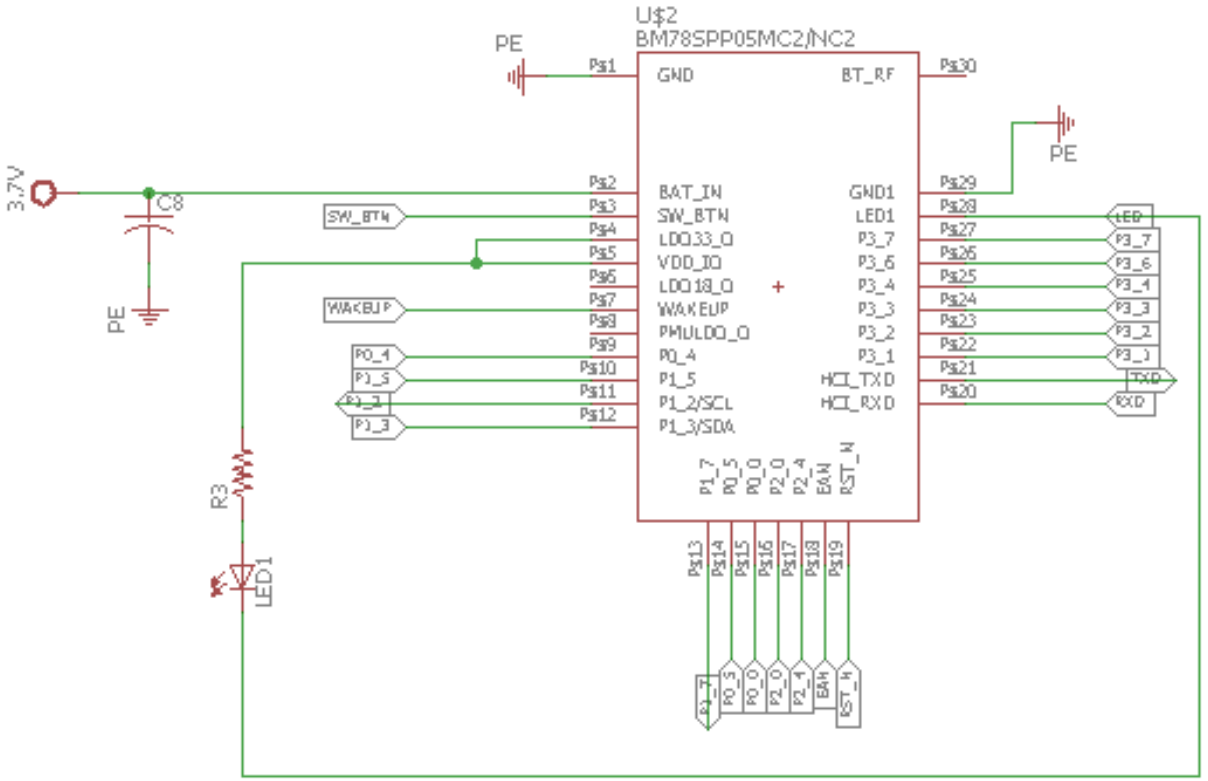
ELECTRICAL SCHEMATIC

BLUETOOTH MODULE



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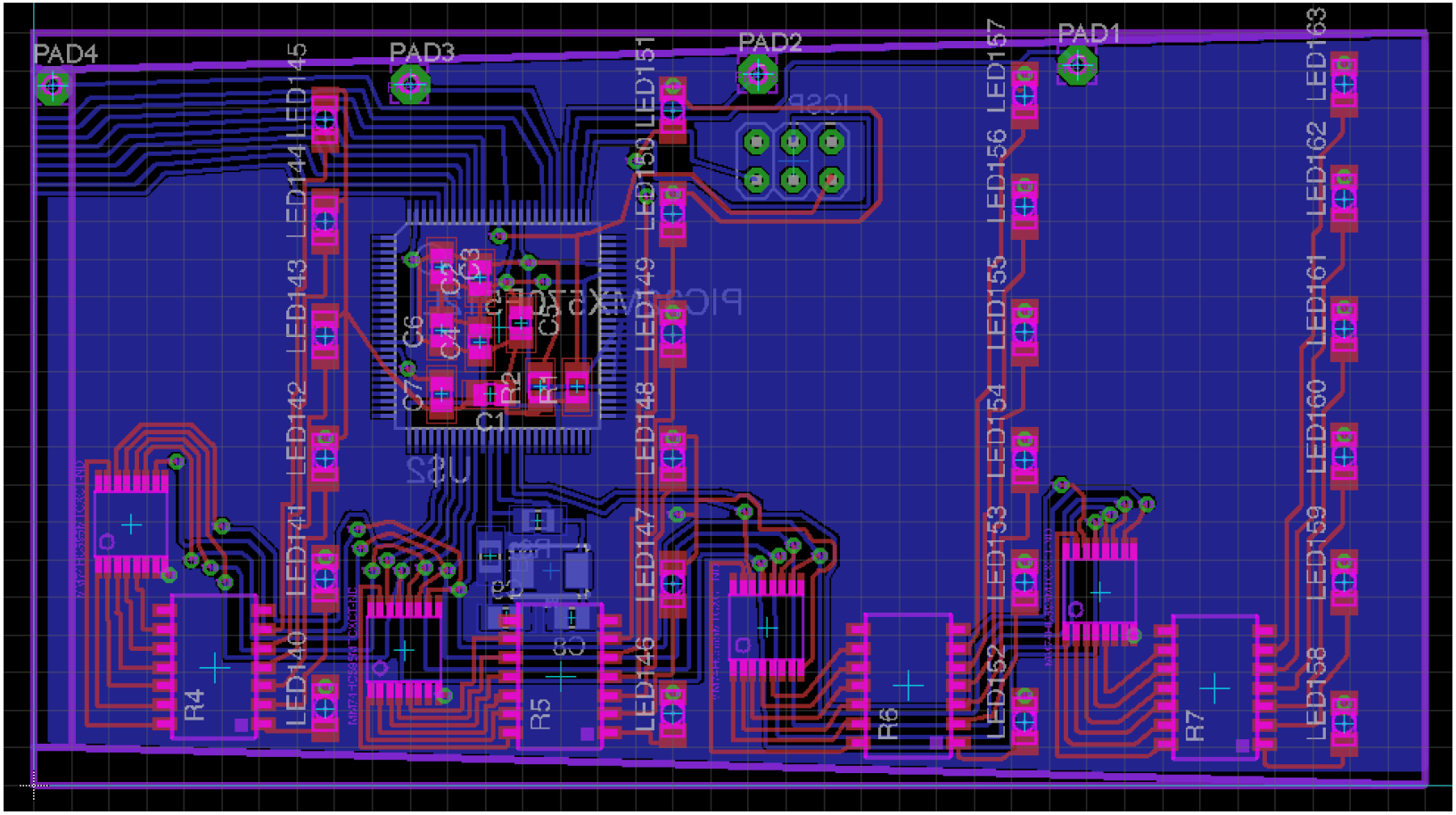
PCB LAYOUT

PCB 3 – CENTER LED ARRAY AND MCU



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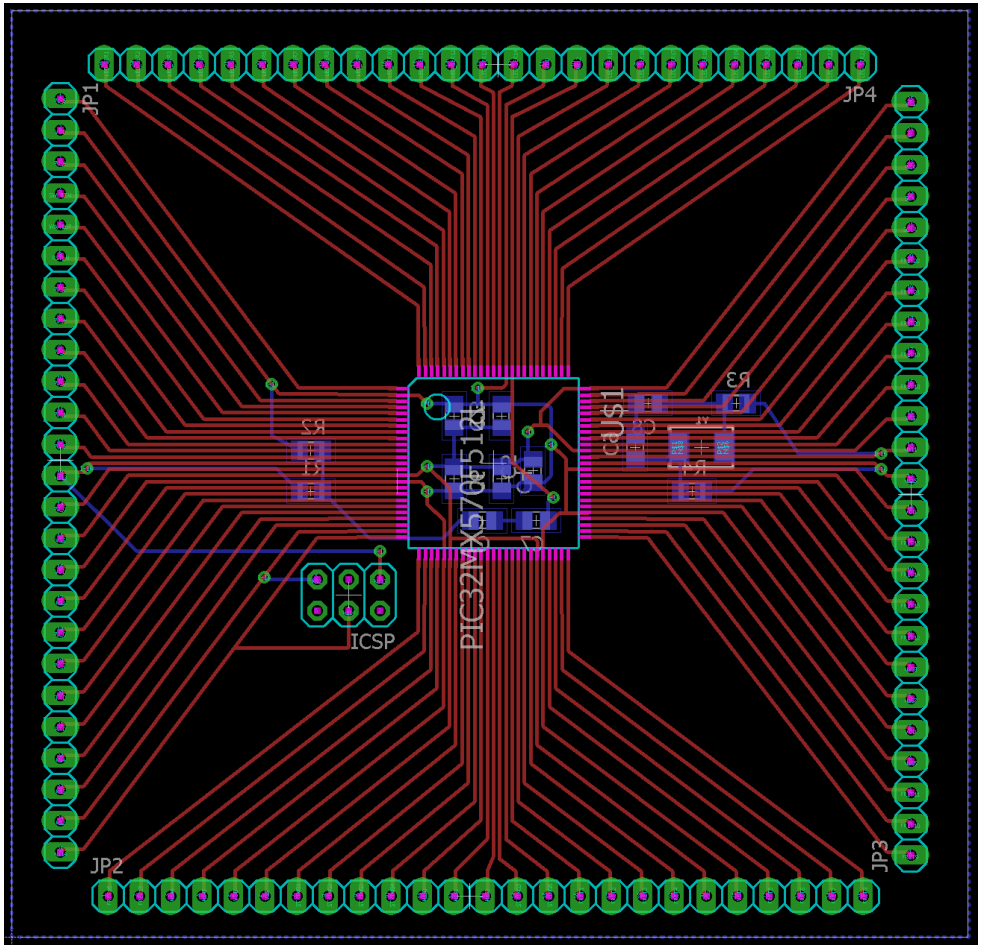
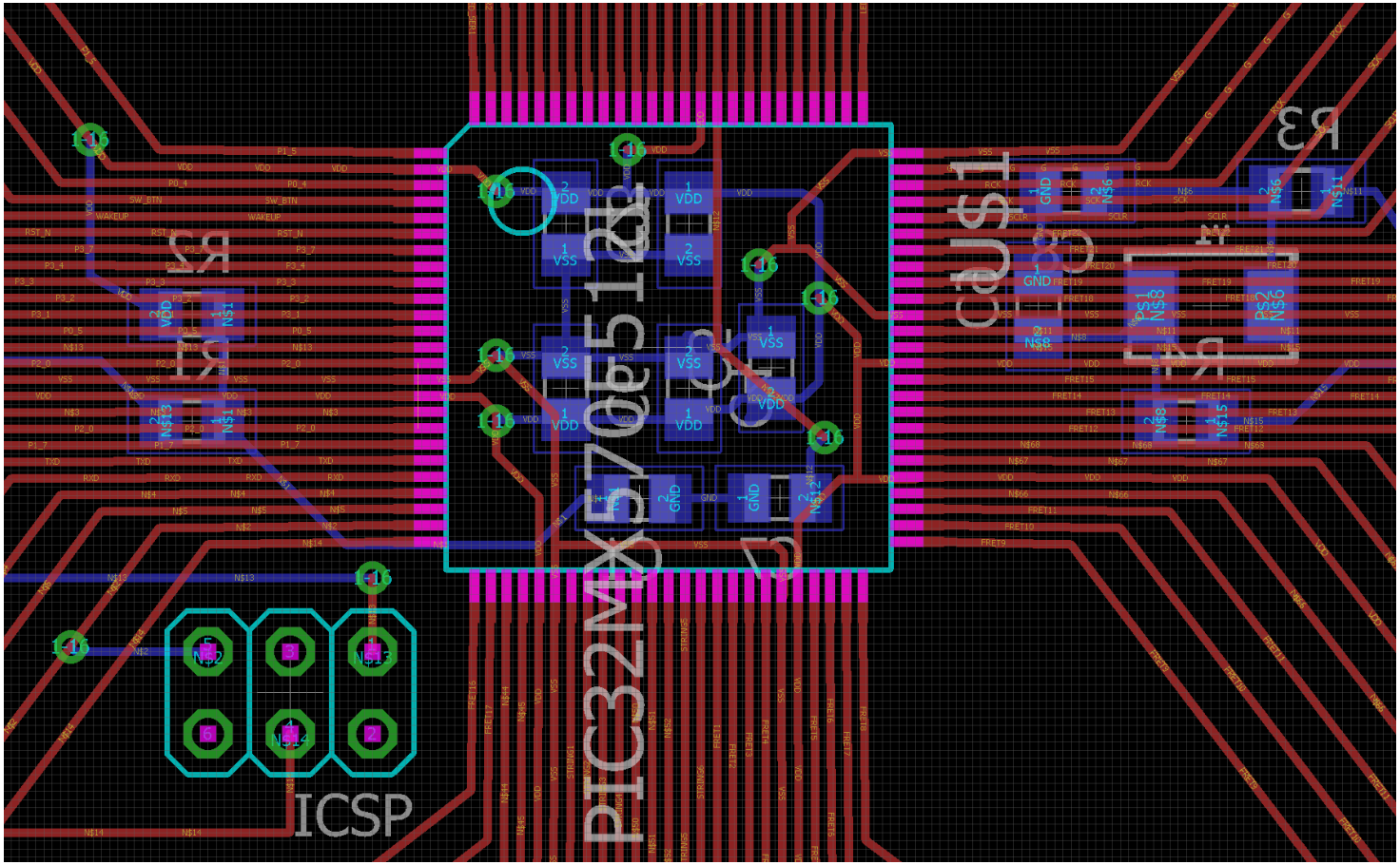
PCB LAYOUT

STAMP BOARD



PCB LAYOUT

STAMP BOARD



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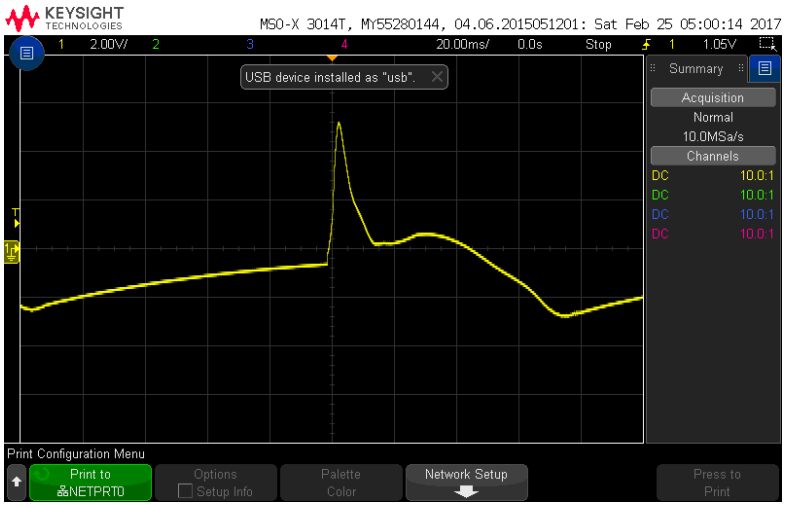
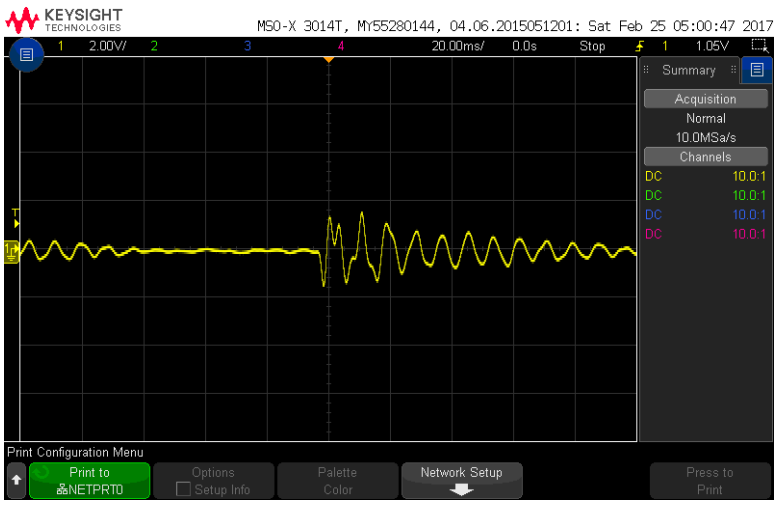
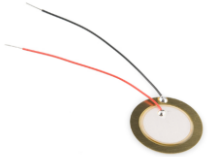
PROTOTYPING PROGRESS

PIEZOELECTRIC STRUM DETECTOR

- Able to detect small vibrations in close proximity (i.e., hitting a table)
  - Detection is cleaner with weight applied to element
- Needs testing on guitar to test body vibration detection
- Need a method of filtering out unwanted vibrations







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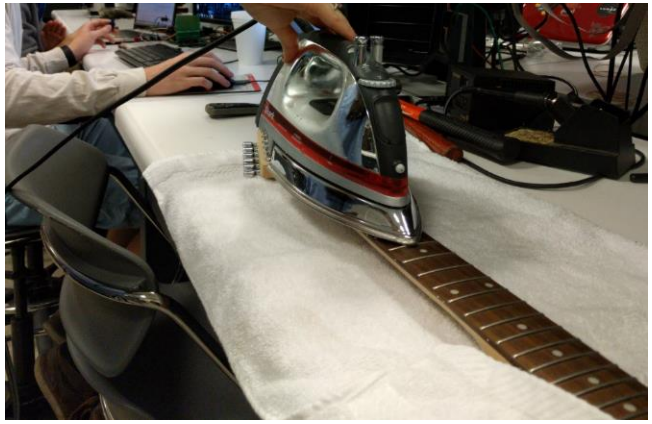
PROTOTYPING PROGRESS

GUITAR FRETBOARD REPLACEMENT

- Have successfully removed stock rosewood fretboard from guitar
- Frets are planned to be removed from the original fretboard
- PCB needs to be received in order to test securing to the guitar neck
- Plastic overlay needs to be designed, purchased, and tested



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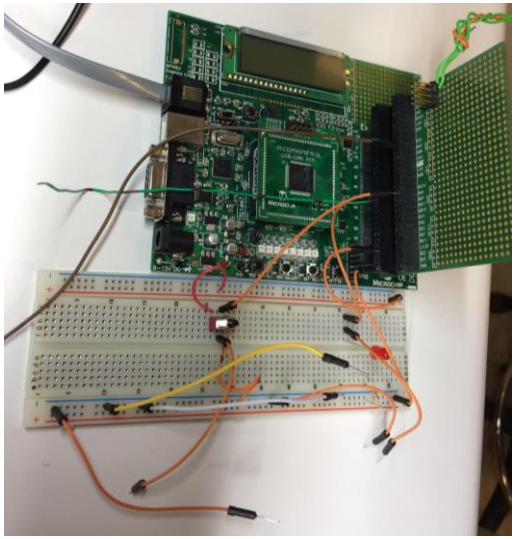
PROTOTYPING PROGRESS

GPIO

- Able to drive individual LEDs and transition states on switch actuation
- Able to drive individual LEDs and transition states with "real time" delays
- Currently being tested alongside LED and shift register combination
- Needs testing with LED matrix and switch matrix combination



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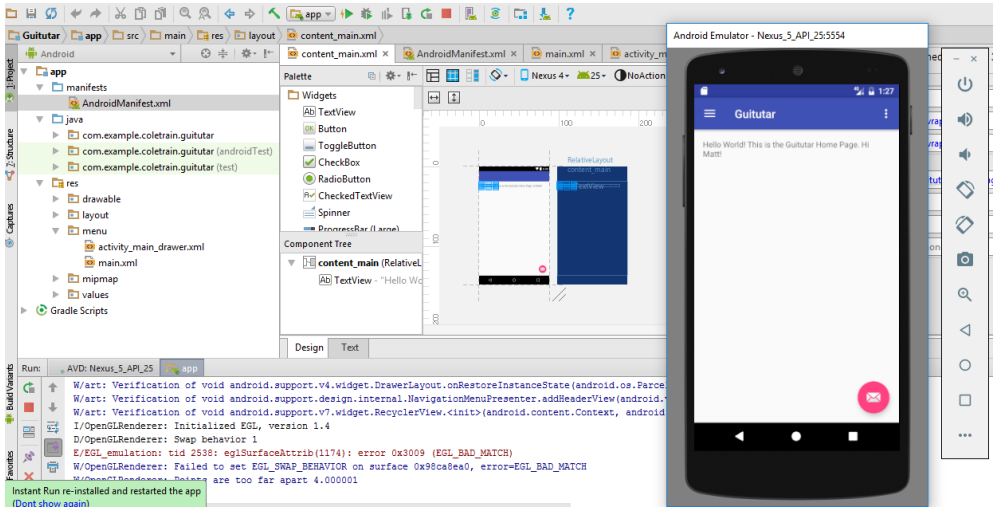
PROTOTYPING PROGRESS

ANDROID APPLICATION DESIGN

- General application startup and button navigation done.
- Communication to and from the phone and microcontroller through Bluetooth and UART in development.
  - Modules with Harmony (microcontroller) and Android Studio (phone) already exist but lack testing.
- Song storage and selection to start soon.



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SOFTWARE DEVELOPMENT STATUS

- Completed
  - Note Encoding Structure
  - Song Structure
  - General GPIO Operation
- In Testing
  - Application/Device Communication Interface
    - USART Driver
    - Bluetooth Socket (Android)
- In Development
  - String-Fret Switch Matrix GPIO
  - LED Matrix Display Interface
- Not Yet Started
  - Guitutar Device Control Flow

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PROJECT TIMELINE

Week	Planned Task(s)
8	Formal Design Review, LED matrix component testing,Stamp board submission
9	Finalize PCB and send in for fabrication, finalize GPIO prototyping
10	Spring Break
11	Finalize app development, begin communication interfacing testing
12	Receive PCB, solder components, begin system integration
13	Finalize packaging, debug system integration
14	Finalize project – packaging, integration, and interfacing
15	User-experience testing and adjustment
16	Spark Challenge

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Questions?