

Team B6 – (A)nywhe(R)e Piano

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Add your 12 slides after this slide... [remember, 12 min talk + 3 min Q/A]

For more information about formatting or importing slides see:

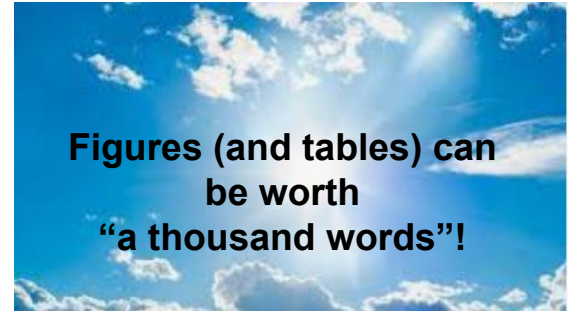
<https://gsuite.google.com/learning-center/products/slides/get-started/>

Make sure to cover

(refer to the Design Review Guidance):

- Use Case / Application
- Use-Case Requirements, especially quantitative
- Solution Approach (include Design Requirements here)
- System Specification / Block Diagram
- Implementation Plan (include Design Trade Study(ies) here; i.e why choose that implementation)
- Test, Verification and Validation Plans (including quantitative metrics with target values)
- Project Management

Consider that this slide already works as a introduction slide so use your first slide wisely

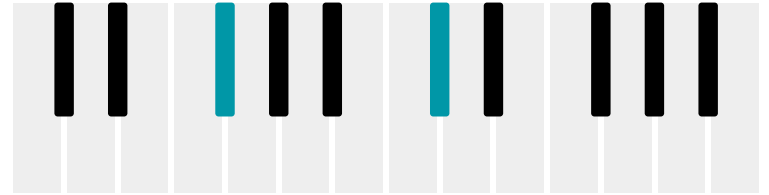


Use Case/Application

01

Problem

Music composition and arrangement requires using a piano (not portable & lacks accessibility). Online synthesizers not user-friendly & robust.



02

Solution

User will wear a glove of sensors, play notes on a printed piano key layout, use camera CV to detect notes, and phone for UI.



03

Areas

Software Systems, Analog Circuits, Hardware Systems, Embedded Devices, Signals & Systems



Quantitative Design Requirements (1)

Weight

0.5 lbs

Estimated Cost

\$60

**Phone Camera
Compatible**

iPhone/
Android

Playback

100 ms



Quantitative Design Requirements (2)

Volume Granularity

3 Levels

Simultaneous Notes

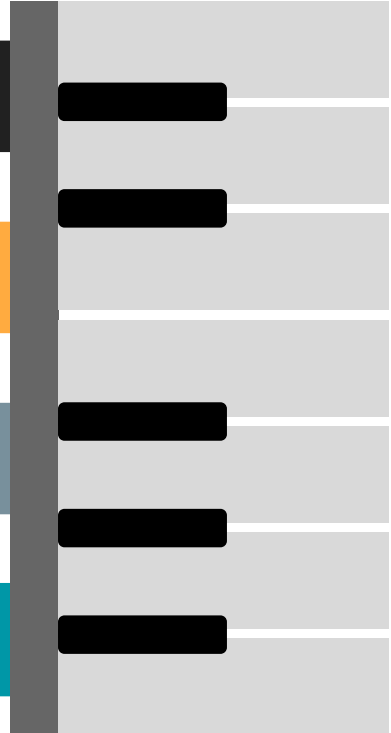
4

Note Accuracy

98%

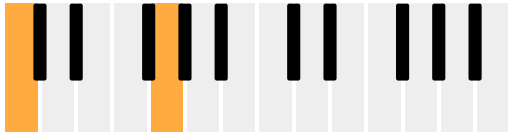
Note Range

49 Keys (2 octaves
at once)



Solution Approach (1)

1st



Gloves

Pressure sensors on fingers
PCB microcontroller on wrist
Bluetooth connection to phone

2nd



CV

iPhone cam attached to mount
to laptop
Finds which key is pressed

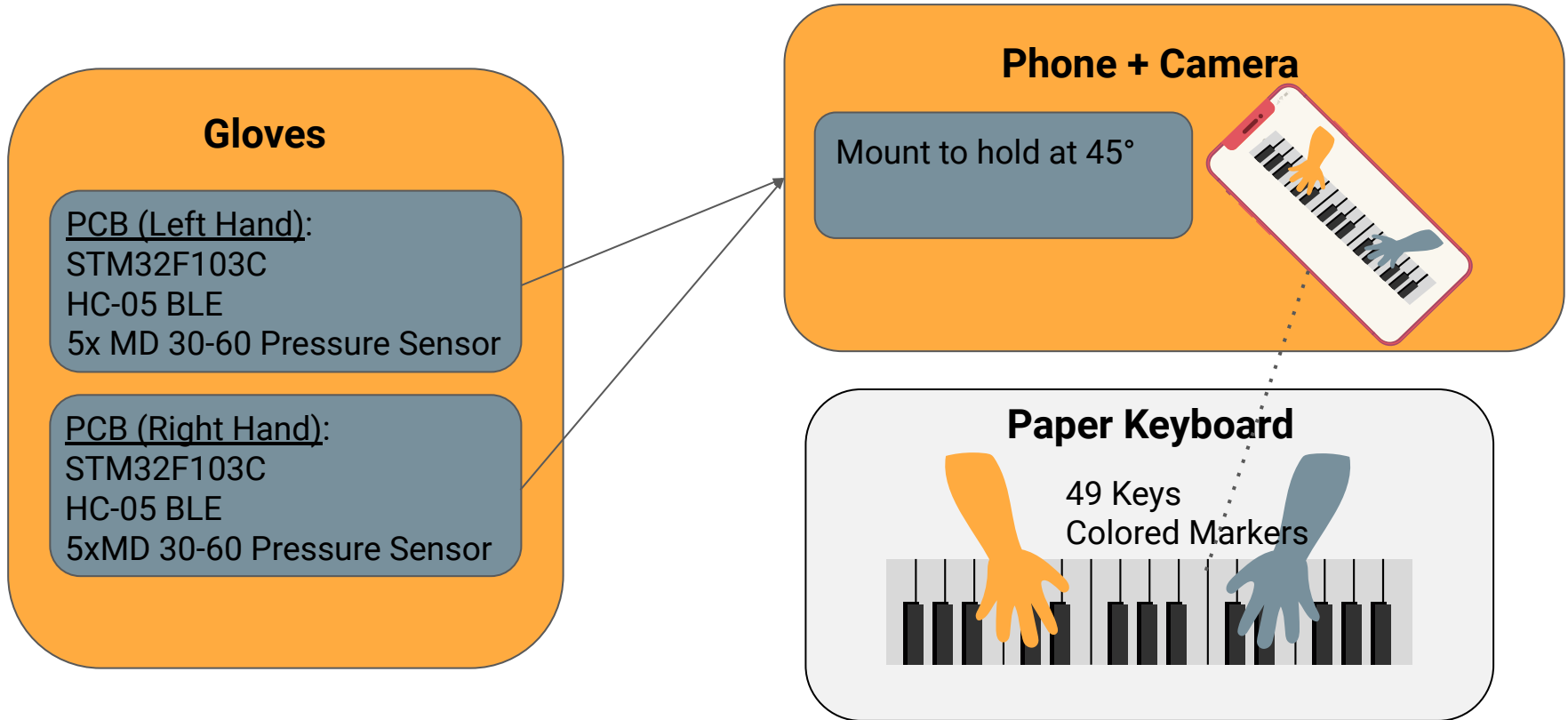
3rd



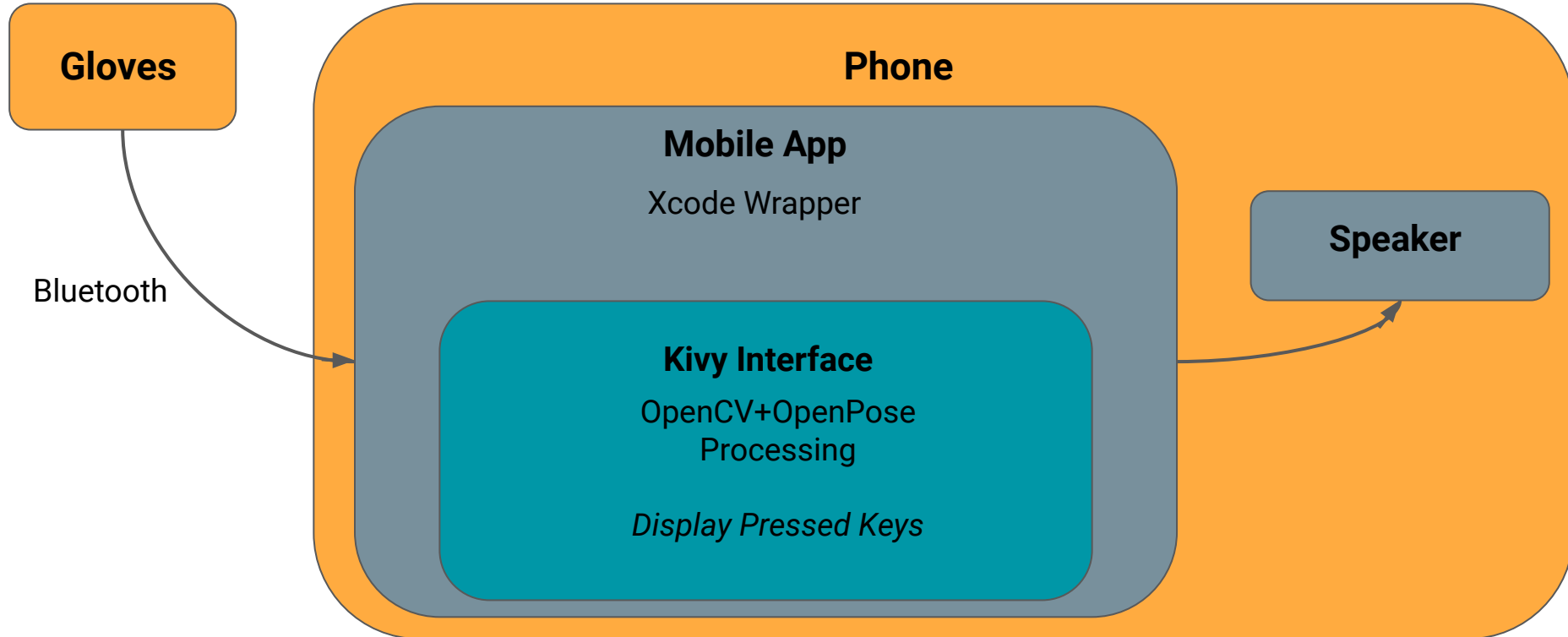
App-UI

Display note names
Save chords
Visualize volume of notes with
range of colors

Block Diagram: Physical Components



Block Diagram: Software



Block Diagram: CV & Audio Processing

CV

Octave Identification

- Colored Markers

10-Finger Identification

- Feature Extraction
- OpenPose

Key Identification

- Contour/Edge Detection

Audio Processing

Three threshold settings

Pre-recorded notes

- Time decay
- Pure tones option

Multiple notes through
speaker output

Implementation Plan



Testing, Verification, & Validation



Playback

8 notes, 2 octaves

Time to STM32, App, Speaker

Volume

“Loud, medium, soft”

Five testers, expected vs. output

Multi-Note Volume Comparison

Play 4 notes

Unit test for successive playing

Multi-note Volume Threshold

Play multiple notes

Unit test for successive playing, at modified volume. Calculate superimposed volume.

Testing, Verification, & Validation



Note Accuracy

Play 49 keys

Compare with chromatic tuner

Note Range

2 Octaves

Play up to 2 octaves at the same time

CV Edge Cases

1 finger, two notes

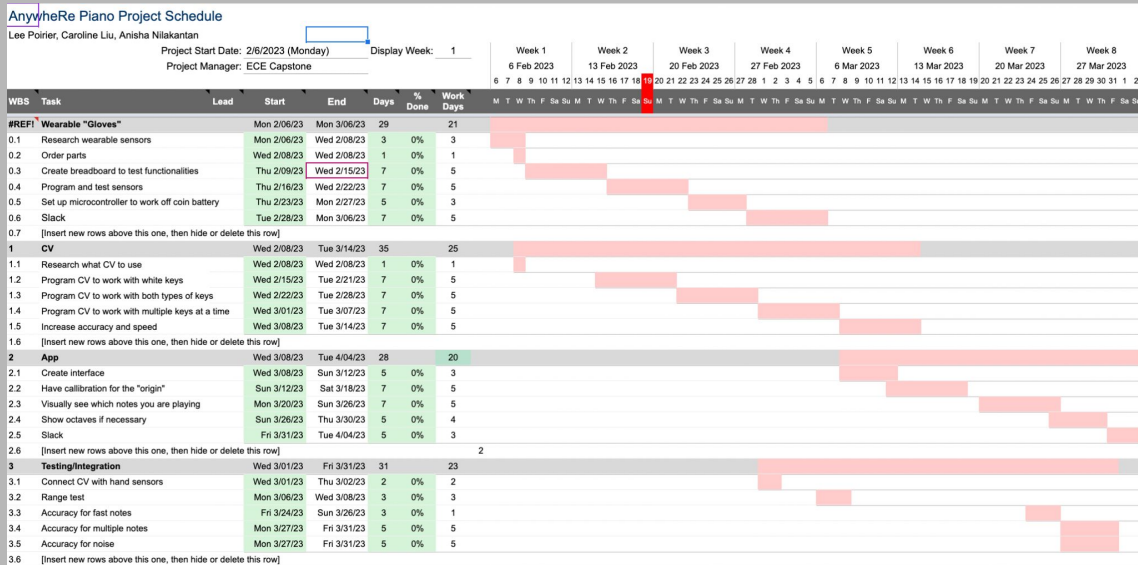
Between b/w, b/b, w/w. Graph results to find patterns.

Time Delay

Successive vs Synchronous

Compare sound to real piano, using metronome to time duration of each note.

Project Management



Schedule

Nish
Pressure Thresholding
Xcode + Kivy Interface

Caroline
PCB and Glove
Design

Lee
CV processing

All:
Testing + integration

Further Design Extensions

