# Team D3 - WoodWindMania

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

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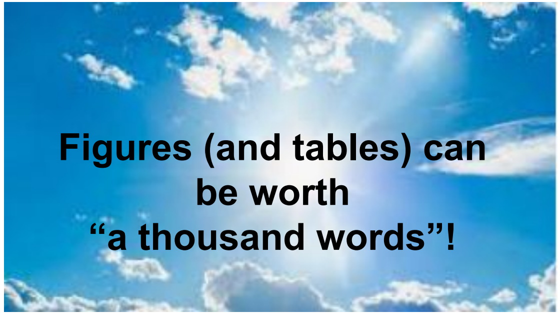


Make sure to cover
(refer to the Design Review Guidance):

- 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

- **Problem**: Learning woodwind instruments has a high cost associated with it and may not be practical to do in most environments
  - Lessons plus Instrument, which can cost around $1000
  - Not beginner friendly
- **Solution**: A digital woodwind learning tool that allows users to learn fingerings on a realistic woodwind controller, in this case a flute
- **Areas**: Hardware Design & Software Systems

WoodWindmania

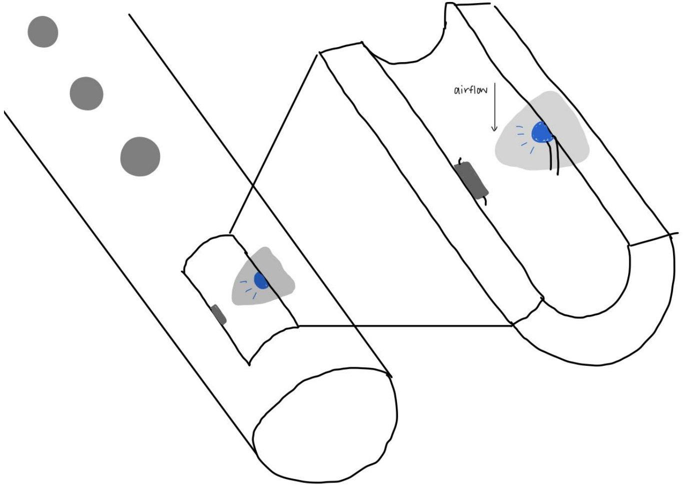
musical learning starts here

# Requirements

- **User Experience**
  - Comparison to real instrument
    - Physical dimensions: 1.3lbs, 26”x1”
    - User satisfaction: 4/5
  - Beginner friendly
  - Portability
- **Accuracy**
  - Note feedback, orientation feedback, breath control feedback >= 90%
- **Speed**
  - Latency <= 500ms

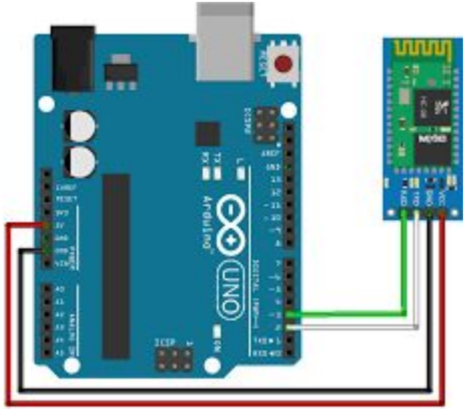
# Solution Approach: Hardware

- **Physical controller**
  - Use PVC pipe and 9 tactile buttons to detect notes
  - Gyroscope sensor mounted inside
  - Breath control
    - Obstacle detection using LED, photodiode, and a piece of latex to obstruct light
    - User must blow downward correctly to break beam
    - Air flow can be determined in photodiode reading by how much light is obstructed
  - Arduino nano mounted inside processes sensor input



# Solution Approach: Hardware

- **Wireless Connection**
  - Bluetooth, sends information in four bytes
    - 1 bit per button, 1 byte for gyroscope, 1 byte for breath control
  - HC06 Bluetooth Module
  - Serial.write()
    - 4 bytes/1200 bytes per second (9600 Baud Rate)

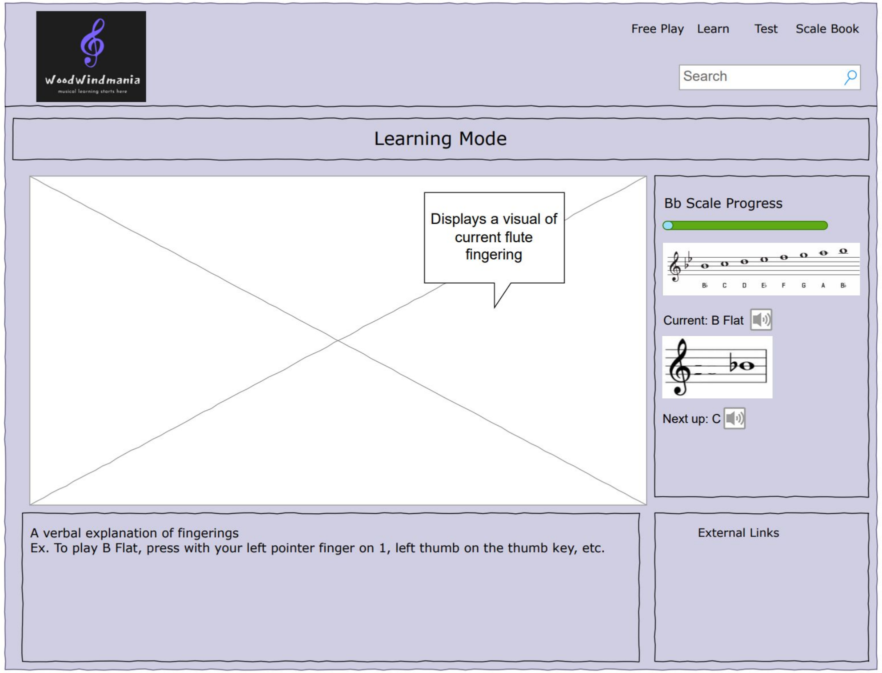


# Solution Approach: Hardware

- **Raspberry Pi**
  - Receives data from controller (fingerings, breath control, gyroscope)
    - Maps fingerings to note
    - Plays note based on incoming data
    - Sends data to application
  - Serial.readline()
  - Write to a .txt file that the application reads from

# Solution Approach: Software

- **Web Application**
    - Interprets data from the Raspberry Pi
    - Apache web server
    - SQLite for user database
    - Django framework used to display information
        - 7 major scales, flute fingerings ranging from E4 to D6
        - Feedback to the user such as correct positioning



Displays a visual of current flute fingering

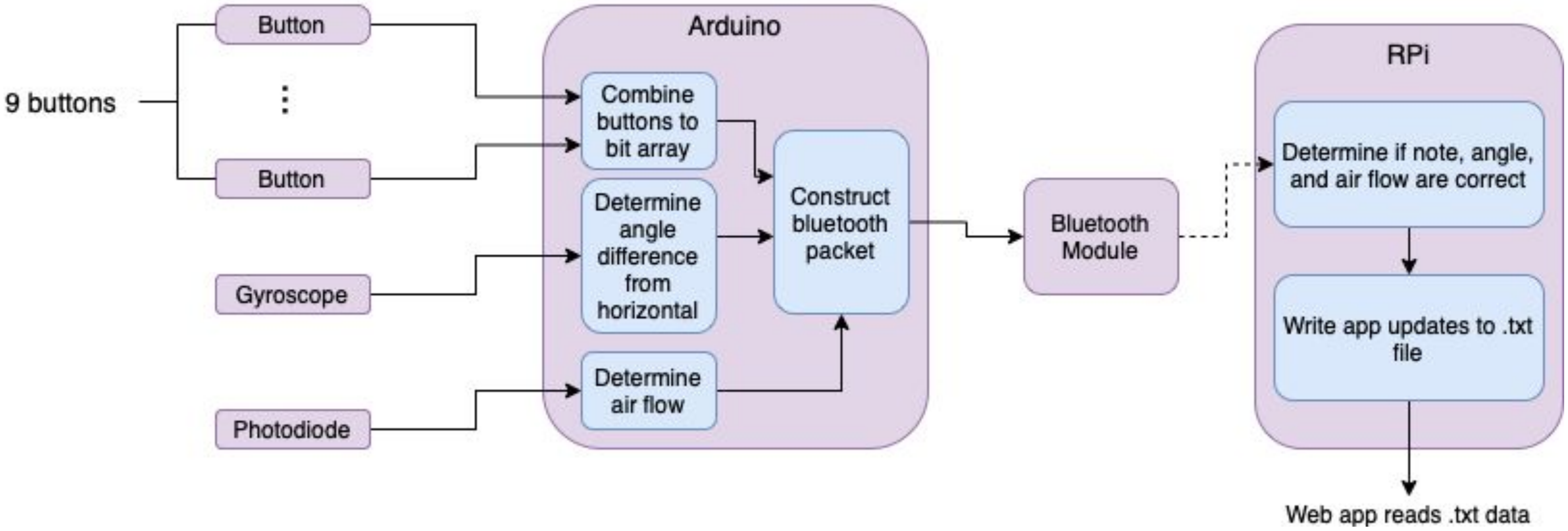
A verbal explanation of fingerings
Ex. To play B Flat, press with your left pointer finger on 1, left thumb on the thumb key, etc.

# Implementation Plan

- Data Pipeline
  - Controller -> Bluetooth -> Pi ->Webapp
- Buying hardware and connecting to Arduino
  - Arduino Nano, Bluetooth Module, Raspberry Pi, Buttons, Diodes/LEDs, gyroscope
  - Building flute controller out of PVC
- Writing Code
  - Writing code to process and send data to Raspberry Pi
  - Write code on Pi to process information, play note, and send to application
- Web Application
  - Hosted locally on pi

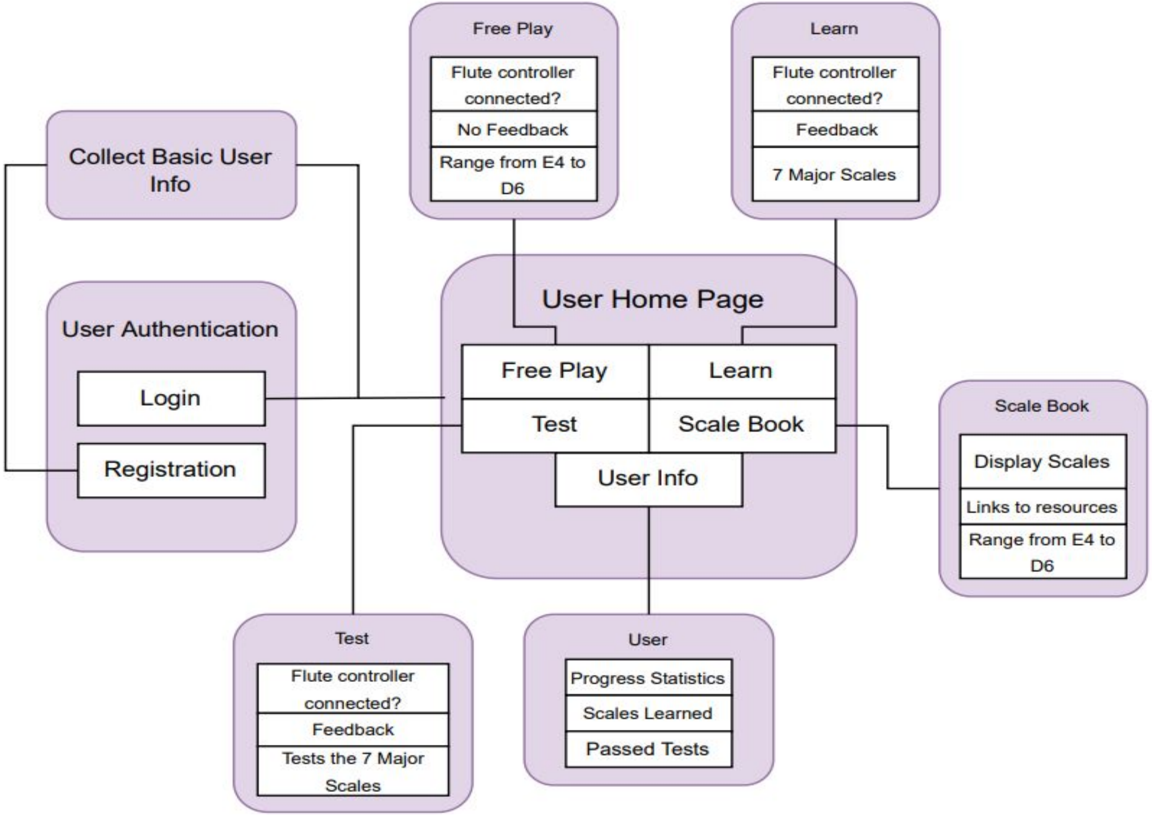
Total Cost: $50 + RPi

# Hardware Block Diagram



9 buttons
Button
⋮
Button
Gyroscope
Photodiode
Arduino
Combine buttons to bit array
Determine angle difference from horizontal
Determine air flow
Construct bluetooth packet
Bluetooth Module
RPi
Determine if note, angle, and air flow are correct
Write app updates to .txt file
Web app reads .txt data

# Software Block Diagram



Collect Basic User Info

User Authentication

Login

Registration

Free Play

Flute controller connected?

No Feedback

Range from E4 to D6

Learn

Flute controller connected?

Feedback

7 Major Scales

User Home Page

Free Play

Learn

Test

Scale Book

User Info

Scale Book

Display Scales

Links to resources

Range from E4 to D6

Test

Flute controller connected?

Feedback

Tests the 7 Major Scales

User

Progress Statistics

Scales Learned

Passed Tests

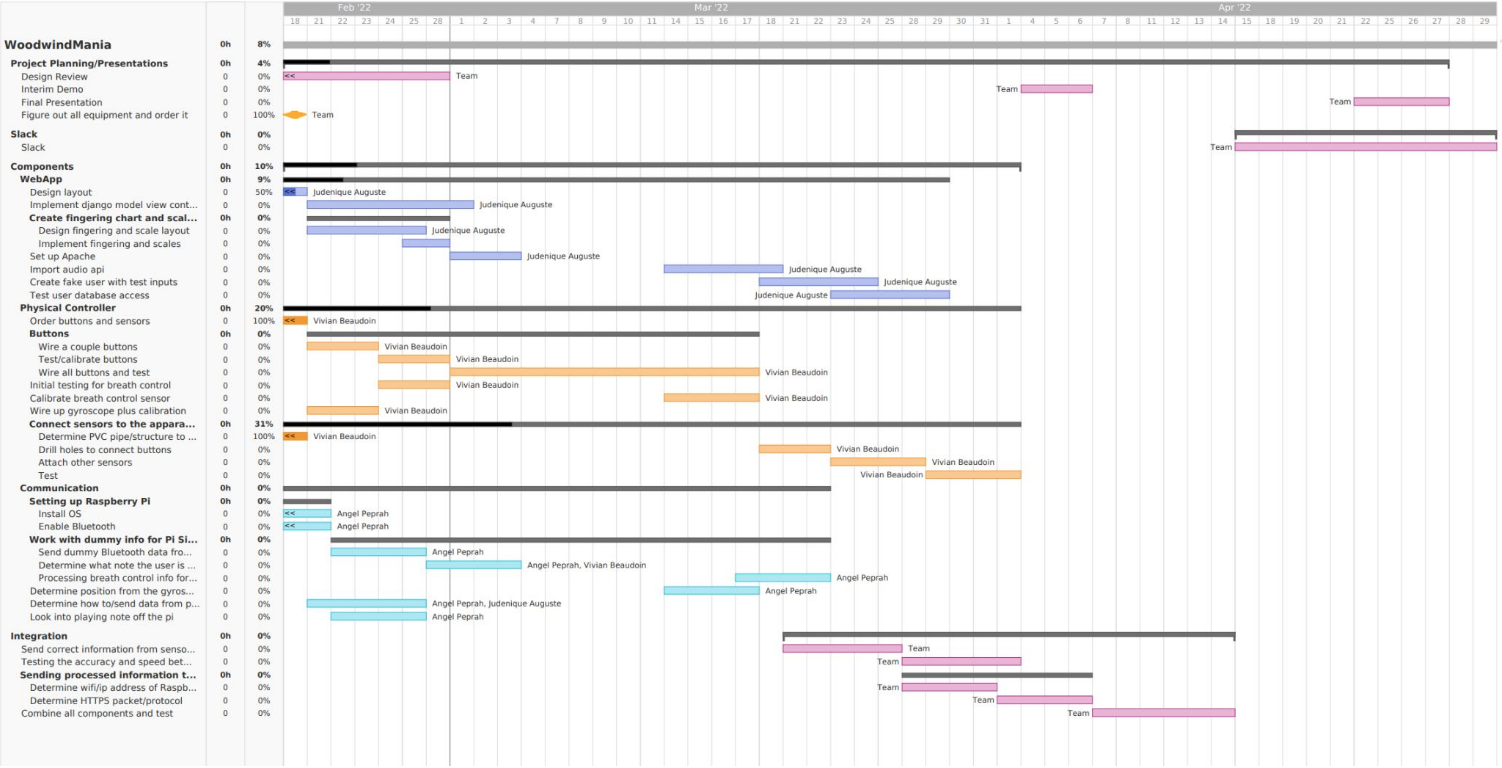
# Testing and Verification

| Requirement | Metric | Testing Strategy |
|---|---|---|
| Accurate Feedback | Note, orientation, breath control feedback >= 90% accuracy | Give correct/incorrect notes/orientations and determine feedback<br>Use correct/incorrect breath control, comparing to an actual flute |
| Speed | <= 500ms | Record time from user input to feedback |
| User Experience | 1.3lbs, 26”x1”<br>80% user satisfaction | Measure weight, width, length<br>Survey beginners on user experience |

# Risks/Unknowns/Mitigations

- Issues with hardware (sensors malfunction, broken connection)
  - Mitigation: Testing systematically, changing sensors for best fit
- Unstable communication
  - Mitigation: Send dummy data once hardware is implemented
- High latency
  - Mitigation: Analyze communication speeds and optimize as soon as possible
- Very different feel from real flute (breath control, buttons, weight)
  - Mitigation: Prioritize testing components when adding

# Project Management



| | | | |
|---|---|---|---|
| **WoodwindMania** | 0h | 8% | |
| **Project Planning/Presentations** | 0h | 4% | |
| Design Review | 0 | 0% | Team |
| Interim Demo | 0 | 0% | Team |
| Final Presentation | 0 | 0% | Team |
| Figure out all equipment and order it | 0 | 100% | Team |
| **Slack** | 0h | 0% | |
| Slack | 0 | 0% | Team |
| **Components** | 0h | 10% | |
| **WebApp** | 0h | 9% | |
| Design layout | 0 | 50% | Judenique Auguste |
| Implement django model view cont... | 0 | 0% | Judenique Auguste |
| **Create fingering chart and scal...** | 0h | 0% | |
| Design fingering and scale layout | 0 | 0% | Judenique Auguste |
| Implement fingering and scales | 0 | 0% | |
| Set up Apache | 0 | 0% | Judenique Auguste |
| Import audio api | 0 | 0% | Judenique Auguste |
| Create fake user with test inputs | 0 | 0% | Judenique Auguste |
| Test user database access | 0 | 0% | Judenique Auguste |
| **Physical Controller** | 0h | 20% | |
| Order buttons and sensors | 0 | 100% | Vivian Beaudoin |
| **Buttons** | 0h | 0% | |
| Wire a couple buttons | 0 | 0% | Vivian Beaudoin |
| Test/calibrate buttons | 0 | 0% | Vivian Beaudoin |
| Wire all buttons and test | 0 | 0% | Vivian Beaudoin |
| Initial testing for breath control | 0 | 0% | Vivian Beaudoin |
| Calibrate breath control sensor | 0 | 0% | Vivian Beaudoin |
| Wire up gyroscope plus calibration | 0 | 0% | Vivian Beaudoin |
| **Connect sensors to the appara...** | 0h | 31% | |
| Determine PVC pipe/structure to ... | 0 | 100% | Vivian Beaudoin |
| Drill holes to connect buttons | 0 | 0% | Vivian Beaudoin |
| Attach other sensors | 0 | 0% | Vivian Beaudoin |
| Test | 0 | 0% | Vivian Beaudoin |
| **Communication** | 0h | 0% | |
| **Setting up Raspberry Pi** | 0h | 0% | |
| Install OS | 0 | 0% | Angel Peprah |
| Enable Bluetooth | 0 | 0% | Angel Peprah |
| **Work with dummy info for Pi Si...** | 0h | 0% | |
| Send dummy Bluetooth data fro... | 0 | 0% | Angel Peprah |
| Determine what note the user is ... | 0 | 0% | Angel Peprah, Vivian Beaudoin |
| Processing breath control info for... | 0 | 0% | Angel Peprah |
| Determine position from the gyros... | 0 | 0% | Angel Peprah |
| Determine how to/send data from p... | 0 | 0% | Angel Peprah, Judenique Auguste |
| Look into playing note off the pi | 0 | 0% | Angel Peprah |
| **Integration** | 0h | 0% | |
| Send correct information from senso... | 0 | 0% | Team |
| Testing the accuracy and speed bet... | 0 | 0% | Team |
| **Sending processed information t...** | 0h | 0% | |
| Determine wifi/ip address of Raspb... | 0 | 0% | Team |
| Determine HTTPS packet/protocol | 0 | 0% | Team |
| Combine all components and test | 0 | 0% | Team |