WINTER 2016

MAESTRO

PROJECT UPDATE 1

FEBRUARY 3RD, 2016

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Fangda
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Emily Kirven
Fidelia Lam
Nilay Muchhala
J. Nick Smith
Daphna Raz

SCHOOL OF MUSIC, THEATRE & DANCE
UNIVERSITY OF MICHIGAN

MULTIDISCIPLINARY DESIGN PROGRAM

MEET THE TEAM

Name	Charu Dwivedi	Fangda	Wil Kacsur	Emily Kirven
School	College of Engineering - Sophomore	College of Engineering - Junior	College of Engineering - Junior	School of Music, Theater, and Dance - Sophomore
Major	Computer Science	Computer Engineering	Computer Engineering	Oboe Performance with Teacher Certification
Fun Fact	Broke his pinky toe 3 times	Didn't take any college entrance exams including the SAT	Mediocre guitar and trombone player	Went to high school in Atlanta at the same time Dr. Brown taught at Georgia Tech
Interests	Tennis, Super Smash Bros, Food	Music, soccer, animation-comics-games	Embedded Systems, Basketball, Rubik's Cube	Oboe, Michigan Marching Band

MEET THE TEAM

Name	Fidelia Lam	Nilay Muchhala	J. Nick Smith	Daphna Raz
School	School of Music, Theater, and Dance – 1st year Master's	College of Engineering - Sophomore	School of Music, Theater, and Dance – 1st year Master's	School of Music, Theater, and Dance – 1st year Master's
Major	Media Arts – Performing Arts Technology	Computer Science	Wind Conducting	Media Arts – Performing Arts Technology
Fun Fact	Took part of a two-week fellowship in a music technology lab in Belgium	Performed as part of an ensemble at Carnegie Hall twice	Had a video from his wedding go viral	Lived in Berlin and worked in a neuroscience lab for 3 years
Interests	Interactive Media Systems, Hiking	Music, Frisbee, Watching TV, Staying in Bed till Afternoon	Apple, batons, Chick-fil-A	Music, red wine

OUTLINE

- Project Context and Scope
  - Sponsor/Industry
  - Project Challenges
  - Success/Failure
  - Scope
- Stakeholder Objectives and Project Requirements
- Plan of Execution
  - End Goal
  - Development Strategy
  - Timeline

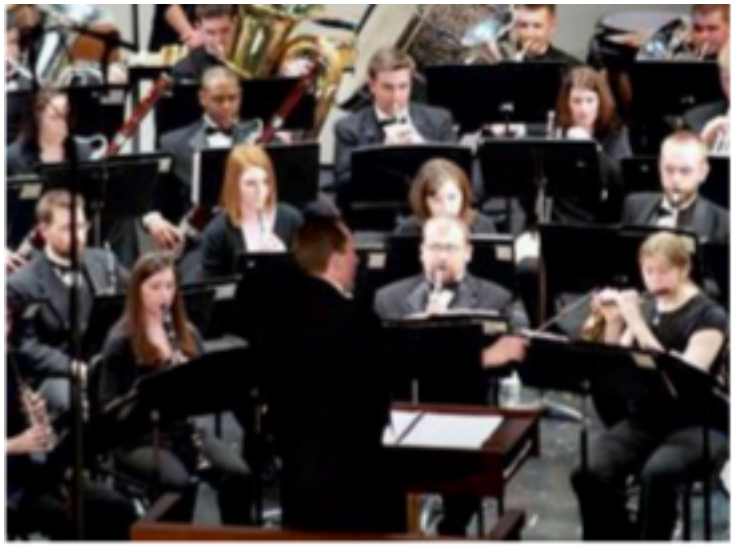
PROJECT CONTEXT & SCOPE

OUR SPONSOR

- Dr. Andrea Brown
  - Member of UM conducting faculty
  - Associate Director of the Michigan Marching Band
  - Guest Conductor of the Symphony Band
  - Professor of Beginning Conductor Class
  - Former professor at Georgia Tech
    - Origin of Maestro 1.0

WHAT IS CONDUCTING?

- Definition of conducting by Michael Haithcock, Kevin Geraldi and Brian Doyle[1]
- Form of communication specific to musicians
- Somewhat analogous to sign language
  - In a live performance, wordless communication is paramount
- Hands, arms, posture, and face influence *direction* of music



TECHNICAL CHALLENGE

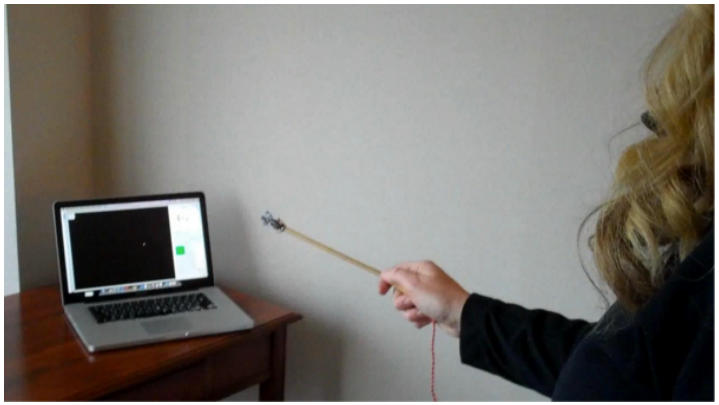
- Capturing nuance and expressivity of gesture
  - In contrast to beat-based conducting projects
- Receiving reliable data
- Classifying and interpreting large amounts of data
- Responding quickly and efficiently

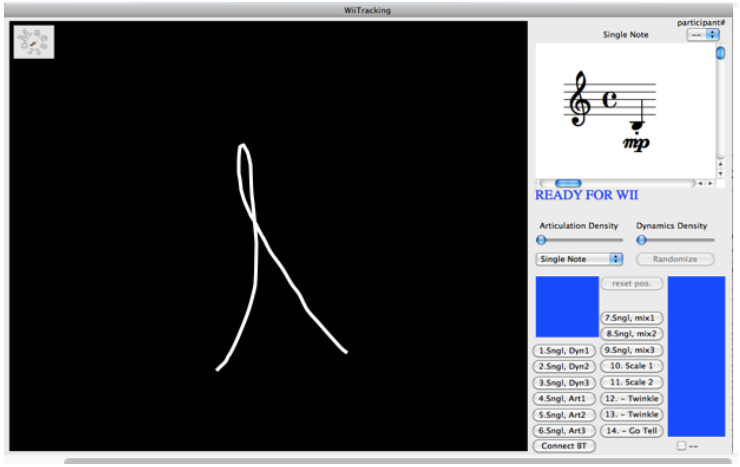
CURRENT TECHNOLOGY

- Technologies currently associated with gesture tracking in a musical context
- Prior research on human motion analysis
- Kolesnik and Wanderley, McGill study[2]

MAESTRO 1.0

- Maestro Overview [3]
- Challenges:
  - Could not register changes of direction
    - Only single sounds
    - Volume and note length could only increase
  - Not user-friendly
    - 3 pieces of equipment and proctor required
  - Gesture did not greatly affect audio output





DEFINITION OF SUCCESS & FAILURE

- Success:
  - User-friendly
  - Robust gesture analysis
  - Malleable audio output
  - Well-documented database for prospective future project teams
- Failure:
  - Hard to use
  - Unreliable and/or delayed gesture analysis and audio response

MAESTRO 2.0 BASELINE SPECIFICATIONS

- Shape a single sound

- Properties we can change:
  - Dynamics
  - Articulation
  - Length

- External Constraints
  - Each conductor has their own style
  - Signal delivery + processing takes time

STAKEHOLDER OBJECTIVES & PROJECT REQUIREMENTS

STAKEHOLDER OBJECTIVES

- System will assist beginning conductors in the following:
  - Train the body in principled movement
  - Understand and utilize gestural tools for communication
  - Develop and reinforce basic conducting techniques
  - Grow as a musician and ensemble leader

PEDAGOGICAL CONDUCTING MODEL

- Dr. Brown's Pedagogical Conducting Model
  - 1. Introduction to Conducting
  - 2. Principles of Movement
  - **3. Single Sounds**
  - 4. Multiple Sounds
  - 5. Components of Navigation
  - 6. Beginning Score Study

- Our system will focus on the 3rd part of the module

Stakeholder Requirement	Relative Priority	Specification	Measurement Methodology
Accurately detect beginning, middle, and end of gesture	1	Success rate of 80% or higher	Calculate success rate of each part of gesture based on multiple tests using Emily and Nick as samples
Accurately detect across subjects	1	Success rate of 80% or higher	Calculate success rate of detection based on a sample consisting of Dr. Brown's COND 315 students
Informative audio feedback based on how gesture was executed by student	2	System response time of 30ms or less on average	Run multiple tests of our device using Emily and Nick and time the audio feedback lag using a stopwatch
Attractive audio feedback mapped to gestures	2	At least 75% respond with "attractive"	Survey Dr. Brown's COND 315 class: attractive / not attractive
Intuitive UI for all	3	Average of 3.5 on Likert scale	Survey Dr. Brown's COND 315 class using a Likert scale of 1-5 on intuitiveness and ease of use of UI

MAESTRO 2.0 REACH GOALS

- Reach Goals:
  - Have both tutorial and sandbox mode
  - Synthesize multiple sounds (chords!)
  - Both speech and sound mode

GESTURE TRACKING

- Each conducting gesture has a preparation (beginning)
  - Could be useful for predicting
- Multiple preparations for same conducting gesture
- We cannot “cage in” our users
- Technical details:
  - Currently researching into IMU’s, Open CV, Kinect, and GRT

PROJECT EXECUTION

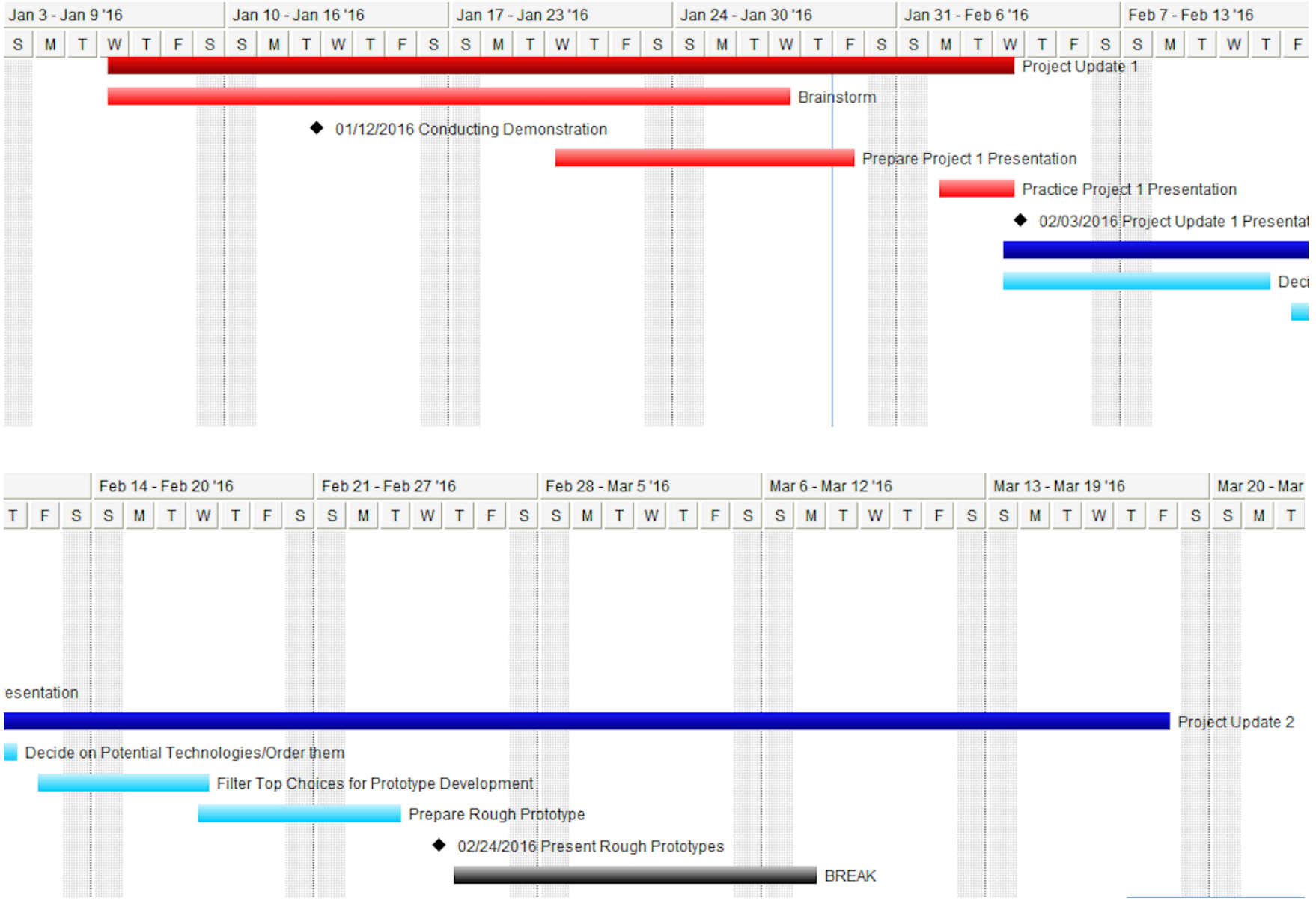
DELIVERABLES

- System will:
  - Provide real-time audio feedback
  - Track user's gestures effectively
- System will be installed in practice spaces in SMTD
  - No need for third-party interface
- A well-maintained online wiki for future Maestro teams

PROPOSED DEVELOPMENT STRATEGY

- Agile development strategy with adaptable timeline

- Current strategy at this point is to divide and conquer
  - Four technical teams
  - Strategy will be implemented until spring break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01/12/2016 Conducting Demonstration
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Practice Project 1 Presentation
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Project Update 2
Decide on Potential Technologies/Order them
Filter Top Choices for Prototype Development
Prepare Rough Prototype
02/24/2016 Present Rough Prototypes
BREAK

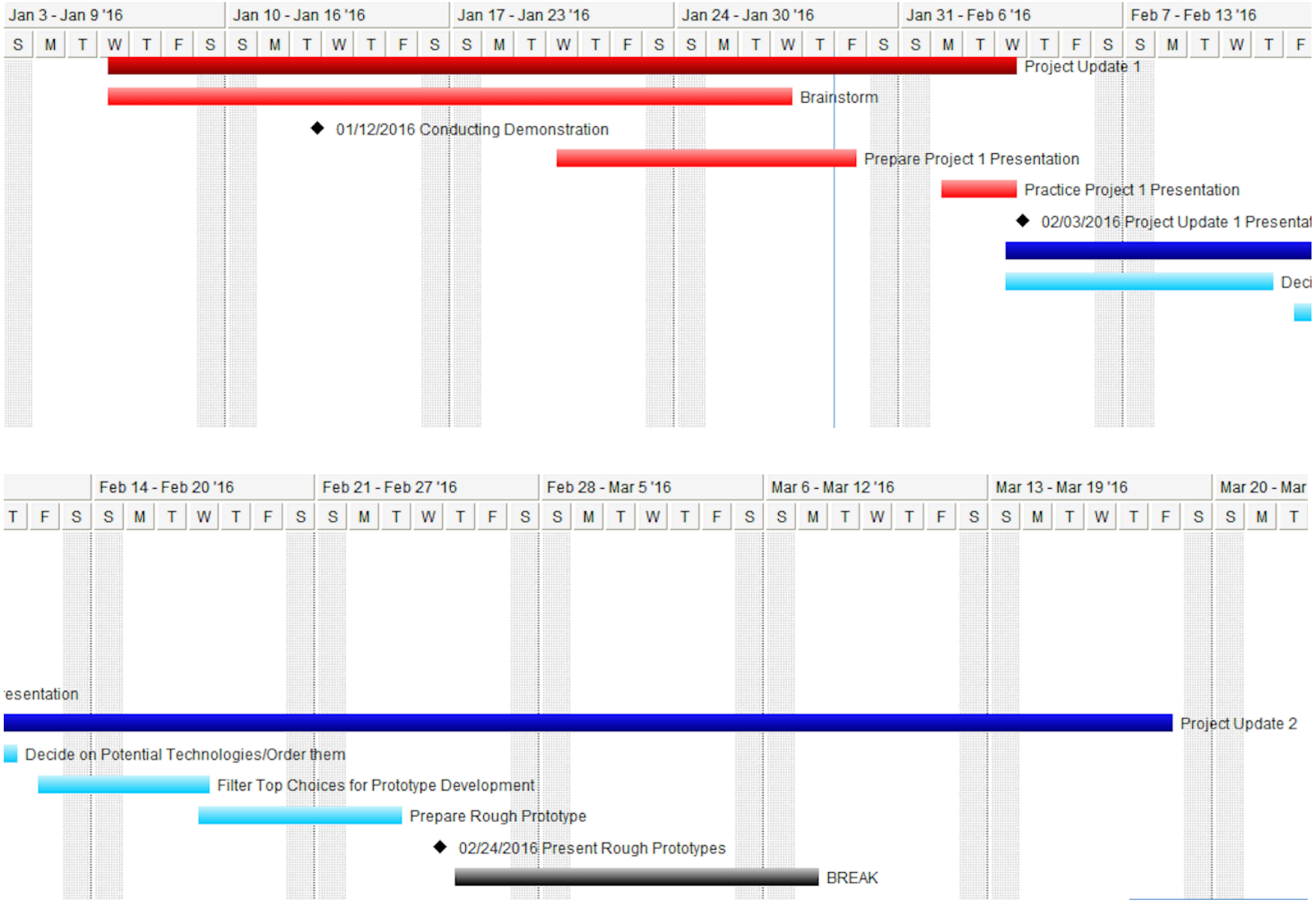
TIMELINE HIGHLIGHTS

- Conducting Demonstration – January 12th, 2016
- Beginning to explore and prototype – February 4th, 2016
- Present rough prototypes and select most viable solution – February 24th, 2016
- Begin preparing for Project Update 2 – February 24th, 2016
- Summer plans

REFERENCES

- [1] Doyle, Brian et al. *Conducting Textbook Draft: Chapters 1-9, Appendices*. 2011. Unpublished manuscript.
- [2] Kolesnik, Paul and Marcelo Wanderley. “Recognition, Analysis and Performance with Expressive Conducting Gestures.” 2004.
- [3] Maestro 1.0

QUESTIONS?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BREAK

Stakeholder Requirement	Relative Priority	Specification	Measurement Methodology
Accurately detect beginning, middle, and end of gesture	1	Develop method of classification or mapping using an algorithm	Calculate rate of success within subjects, including error measurements
Accurately detect across subjects	1	Algorithm understands relative variance in gesture style and size between students	Collect system output data using Dr. Brown's COND 315 class as our sample. Perform ANOVA.
Informative audio feedback based on how gesture was executed by student	2	Single tone/beat that will modulate based on speed/size/type of gesture	Response time of <= 30ms
Attractive audio feedback mapped to gestures	2	Engineering a well developed sound synthesis system	Up to Dr. Brown's discretion
Intuitive UI for all	3	Using UX design principles to develop an easy-to-use interface	Case studies with beginning students

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