WINTER 2016

MAESTRO

PROJECT UPDATE 2

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MULTIDISCIPLINARY DESIGN PROGRAM

OUTLINE

Project Overview

Stakeholder Objectives & Project Requirements

Possible Solutions

- Continuing Maestro 1.0
- Open CV
- Kinect
- Inertial Measurement Unit (IMU)

Concept Selection

Design Recommendation & Project Plan

Moving Forward

PROJECT OVERVIEW

- Students can practice conducting similarly to how musicians practice their instruments
  - Provide responsive feedback
  - At a high level, the Maestro interface becomes an instrument for conductors
- Students can practice gestures and conducting without the pressure of “performance” or self-consciousness

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 sample
Accurately detect gestures across multiple 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.
Responsive audio feedback	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	2	At least 75% respond with "attractive"	Survey Dr. Brown's COND 315 class: attractive / not attractive
Intuitive and simple-to-use UI	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

GENERATING OPTIONS

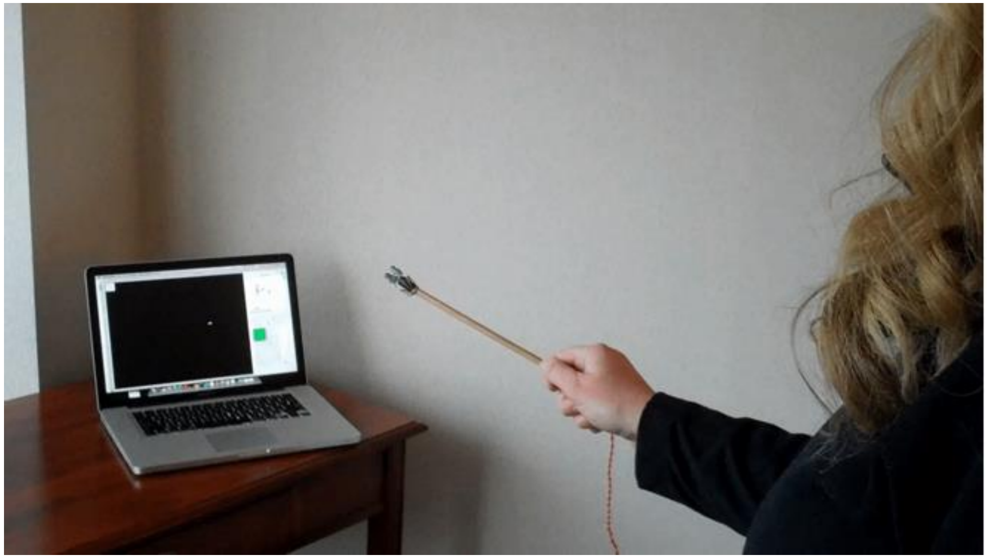
Searched academic journals for similar work

Researched gesture tracking applications in other fields

Previous experience and work of team members

Considered our unique design challenge

POSSIBLE SOLUTIONS



Maestro 1.0

OpenCV

Kinect

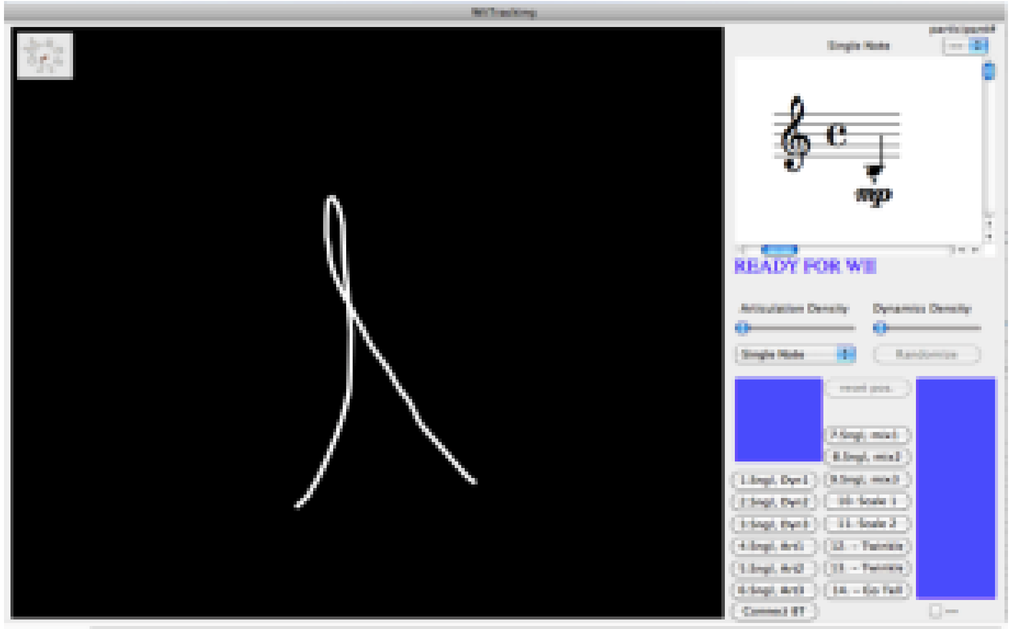
IMU

MAESTRO 1.0

Build off of work already done

Wii-mote used in conjunction with an LED at the tip of the baton

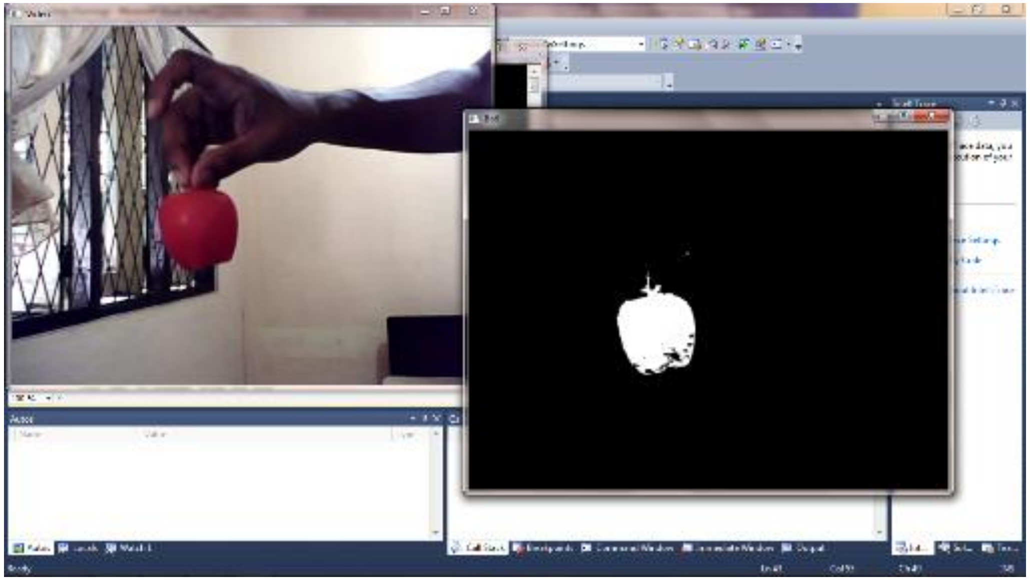
Work on developing a better algorithm for tracking and discerning gestures



OPEN CV

Captures frame by frame video data

Analysis is done through computer vision on each frame



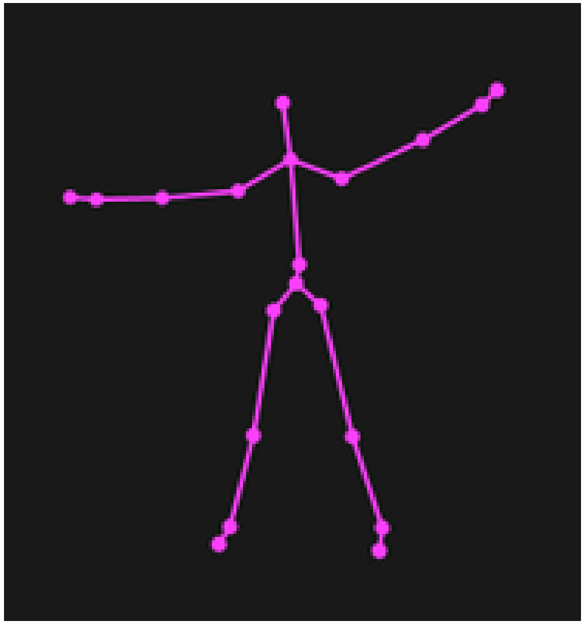
Microsoft Kinect

IR camera based technology used for motion tracking

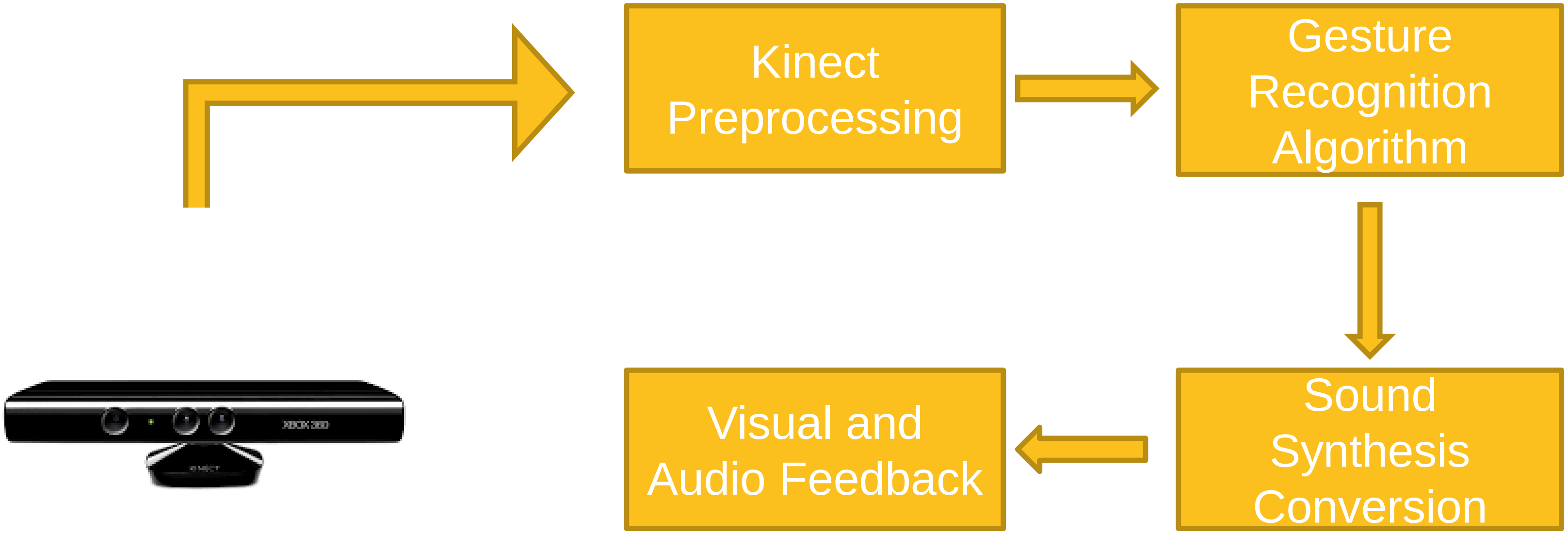
"Watches" user and captures 3D position data

Velocity easily calculated from position

30 frames per second



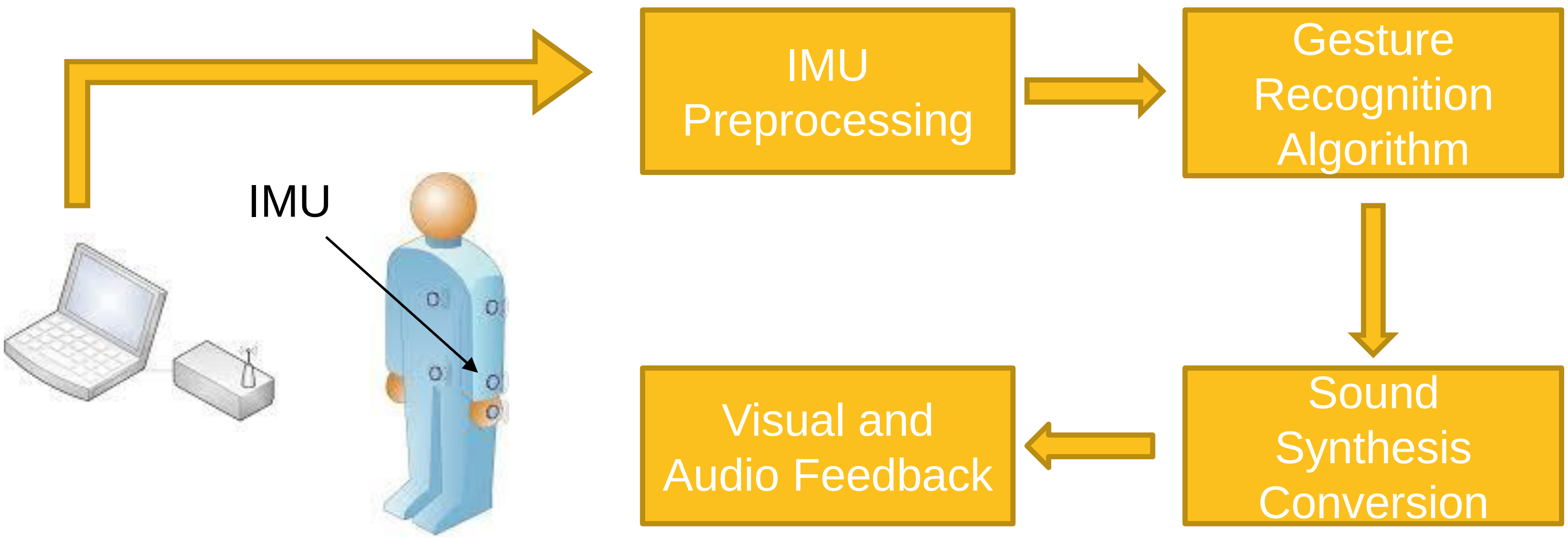
KINECT CONCEPT DIAGRAM



INERTIAL MEASUREMENT UNIT - IMU

Using Inertial Measurement Unit sensors to gather input data

Sensors would be attached on the arms of the user (number of sensors used and precise location of sensors to be determined)



CONCEPT SELECTION

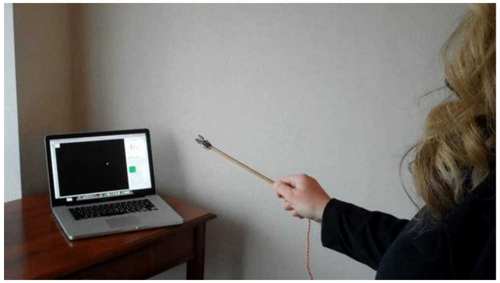
CONCEPT SELECTION

Split into smaller groups to explore pros and cons of each option

Consulted with experts (Dr. Wakefield, peers in mechanical engineering)

Judged based on:

- Robustness of data
- Speed
- Ease of use for user
- Ease of development



OpenCV

KINECT

ADAPTED PUGH TABLE

	Robustness of Data	Speed	Ease of Use (for User)	Ease of Development
Maestro 1.0	Reliant on being trained by Dr. Brown	Delay problems observed	Hard Requires outdated OS	Hard Software is severely outdated
OpenCV	Complete raw data	Dependent on camera being used	Very Easy Very Portable	Hardest All preprocessing has to be manually done
Kinect	Very robust processed data	30 fps	Very Easy Turn on device	Very Easy Joint recognition
IMU	Very robust raw data	Dependent on Arduino being used	Easy Strap on sensors	Easy Must filter/clean data

DESIGN RECOMMENDATION & PROJECT PLAN

PRIMARY OPTIONS

Kinect or IMU

(After significant data collection, a final product will be chosen)

How they will function

The user will stand facing a monitor and speakers and conduct a rhythmic assignment

- Kinect - uses camera technology to gather results
- IMU- attached to the wrist, hands, and arm to gather results

The "machine" will process the results of the user's gesture

- Visual (show shape of motion)
- Audio (processed based on motion)

The user will then decide if that sound aligns with their musical intent and then make adjustments in their gesture as needed to redefine the output on a second, third, etc. attempts.

IDENTIFYING RISKS

Processing delays

- Lag of no more than 30 milliseconds

Financial/technological availability for future users

Software malfunctions

Incorrect IMU placement by users

Fragile nature of IMUs

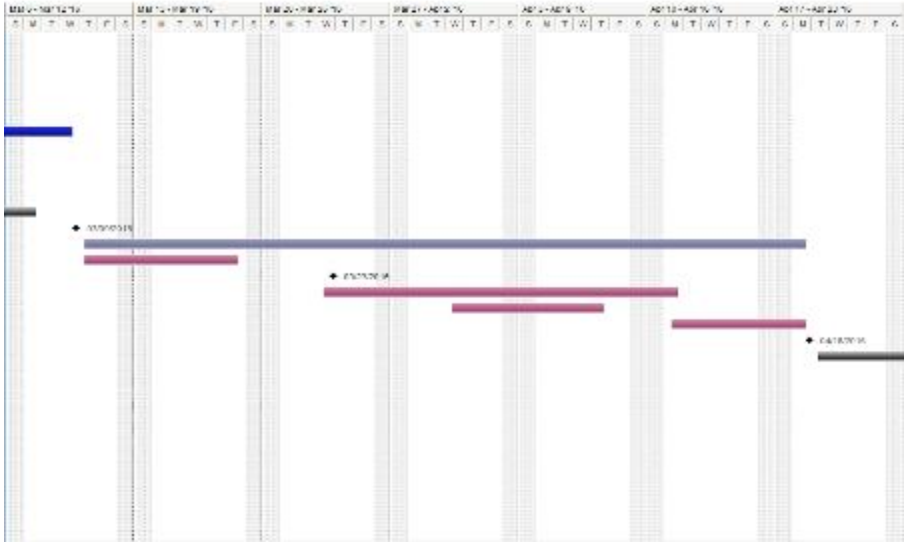
Lack of technical support for users

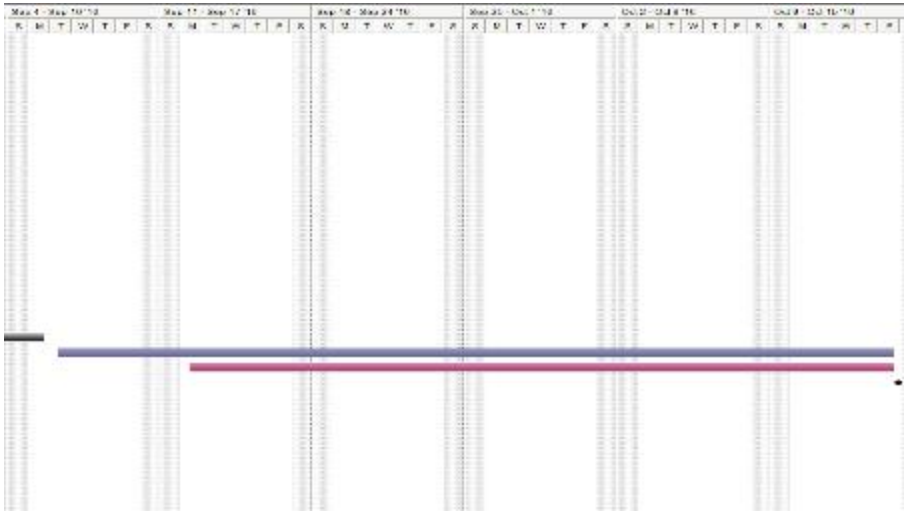
MOVING FORWARD

CONTINUING PROJECT PLAN

<u>Project Timeline Highlights</u>

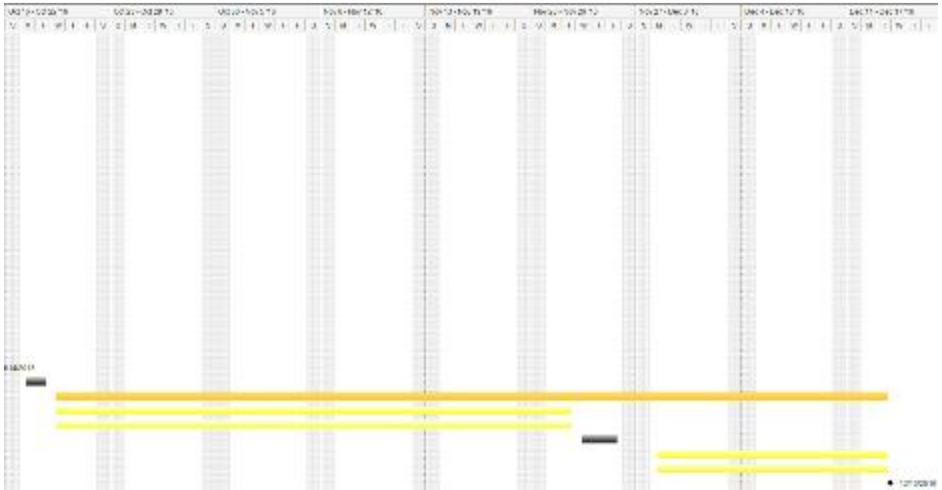
Project Update 2 – 3/09/2016
Decide on Input Type - 3/23/2016
Gather Gesture Data – 3/30/2016
Finish Official Prototype – 4/11/2016
Plan for Summer Work – 4/11/2016
End of Winter Term – 4/18/2016
Project Update 3 – 10/14/2016





CONTINUING PROJECT PLAN

Name	Duration	Start	Finish
Project Update 1	21d	01/06/2016	02/03/2016
Brainstorm	16d	01/06/2016	01/27/2016
Conducting Demonstration	1d	01/12/2016	01/12/2016
Prepare Project 1 Presentation	8d	01/20/2016	01/29/2016
Practice Project 1 Presentation	3d	02/01/2016	02/03/2016
Project Update 1 Presentation	1d?	02/03/2016	02/03/2016
Project Update 2	25d	02/04/2016	03/09/2016
Decide on Potential Technologies/Order them	7d?	02/04/2016	02/12/2016
Filter Top Choices for Prototype Development	4d	02/12/2016	02/17/2016
Prepare Rough Prototype	5d	02/17/2016	02/23/2016
Present Rough Prototypes	1d	02/24/2016	02/24/2016
U of M BREAK	8d	02/25/2016	03/07/2016
Project Update 2 Presentation	1d	03/09/2016	03/09/2016
Project Update 3	28d	03/10/2016	04/18/2016
Experimentation with Technology	7d	03/10/2016	03/18/2016
Decide on Input Type	1d	03/23/2016	03/23/2016
Design Blueprints	14d	03/23/2016	04/11/2016
Gather Gesture Data from Input Type	7d	03/30/2016	04/07/2016
Finish Official Prototype/ Plan for Possible Summer Work	6d	04/11/2016	04/18/2016
End of Winter Term	1d?	04/18/2016	04/18/2016
U of M Break	100d?	04/19/2016	09/05/2016
Project Update 3	29d	09/06/2016	10/14/2016
Testing, Debugging, Updating "Machine"	25d	09/12/2016	10/14/2016
Project Update 3 Presentation	1d?	10/14/2016	10/14/2016
U of M BREAK	2d?	10/17/2016	10/18/2016
Final Presentation	40d	10/19/2016	12/13/2016
Continue Testing, Debugging, Updating	25d	10/19/2016	11/22/2016
Fine-Tune User Interface, Make Small Changes	25d	10/19/2016	11/22/2016
U of M BREAK	3d?	11/23/2016	11/25/2016
Continue Testing, Debugging, Updating	12d	11/28/2016	12/13/2016
Continue Fine-Tuning User Interface, Making Small Changes	12d?	11/28/2016	12/13/2016
Sponsor Handover	1d?	12/13/2016	12/13/2016



CONTINGENCY PLAN

Broken Hardware during Prototyping/Experimenting

Timeline is too short for team members

Sponsors not available when needed

Team not working well together

QUESTIONS?

PRE-PU2 GANTT CHART

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Project Update 1	21d	01/06/2016	02/03/2016
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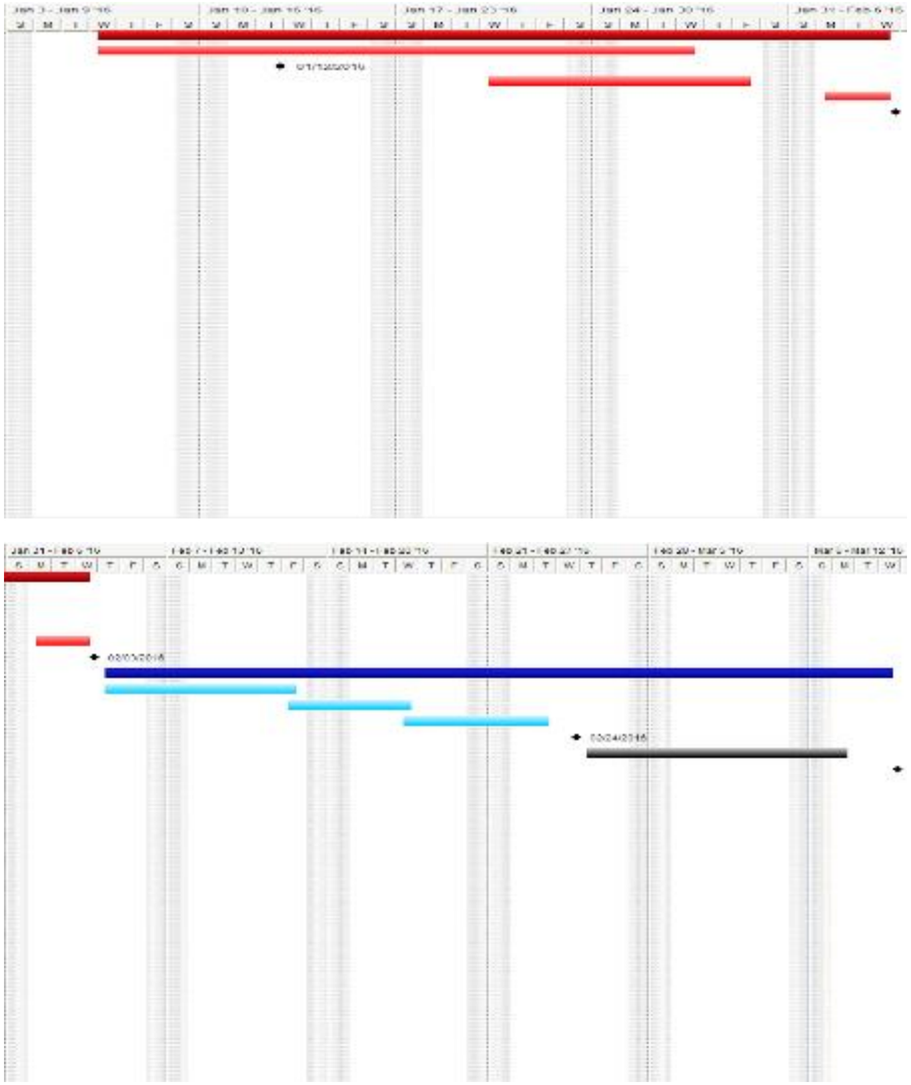

FULL GANTT CHART

Stakeholder Requirement	Relative Priority	Specification	Measurement Methodology
Accurately detect beginning, middle, and end of gesture	1	Success rate of 80% or higher AND system is in agreement with expert opinion	Calculate success rate of each part of gesture based on multiple tests using Emily and Nick as sample. Will have a minimum of X gestures (in discussion with sponsor-Feb. 3, 2016)
Accurately detect across subjects	1	Success rate of 80% or higher AND system is in agreement with expert opinion	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 timer function
Attractive audio feedback mapped to gestures	2	At least 75% respond with "attractive"	Survey Dr. Brown's COND 315 class: attractive / not attractive
Intuitive User Interface (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

AGREED FOLLOW UP ACTIONS

- Stakeholder Requirement slide changes
- Addition of Project Justification/Student Stakeholder slide
- See "Proposed Development Strategy" and "Timeline Highlights" for next steps.

FEASIBILITY

- Maestro 1.0 has established a problem and viable solution to helping beginning conductors
- Great strides have been made in motion tracking technology since Maestro 1.0
  - Kinect 2 huge improvement over Kinect 1
- Skill sets that each MDP team member brings to the table
  - ie: software design, hardware development, gesture technicians
- Expertise/experience of the sponsor and faculty mentor
- Financial assistance through MDP/ grant money