

Postrum II: Posture Aid for Trumpet Players

Dalglish, M. Payne, C. and Spencer, S.

Postrum II is a Linux-based system for trumpet players that performs real-time analysis of posture through a combination of:

- Visual Feedback
- Haptic Feedback

About the Authors - Chris Payne

Current Position - Course Leader and Lecturer in Music/Music Tech and PhD student - South Staffordshire College

Background

- Pianist and Guitarist
- Current Lecturer in Further Education
- Dance Music Producer and DJ from 2000 till present
- 41 releases on International Hard House and Nu NRG Labels

Research Interests

- Music and Education
- Algorithmic Composition Design Models & Sonification Projects
- GUI design
- Music Software Design

Qualifications

- BA (Hons) Popular Music - University of Wolverhampton
- PGCE - Staffordshire University
- Qualified Teacher Learning and Skills - (QTLS) - Institute of Learning
- MSc - Music Technology - Staffordshire University

About the Authors - Dr Mat Dalglish

Current Position - Course Leader for MSc in Audio Technology - University of Wolverhampton

Research Interests

- Music Interaction - the Design of Musical Instruments
- Audio Synthesis - analogue and digital/hybrid systems
- Histories of Live Electronic Music
- Procedural Music for Game Design
- Open source Hardware and Software Development

Qualifications

- PhD - A Contemporary Approach to Expressiveness in the Design of Digital Musical Instruments - University of Wolverhampton
- MA - Media Arts - Coventry University
- BA (Hons) - Fine Art Coventry University

About the Authors - Steve Spencer

Current Position - Senior Lecturer in Music/Popular Music and PhD student - University of Wolverhampton

Research Interests

- Music and Education
- Trumpet Pedagogy

Qualifications

- MA in Education Management - Open University
- PGCE Music and Sports Studies
- BA (Hons) Music and Education
- LGSM Trumpet (Teaching)
- ALCM Trumpet (Performance)

Literature Review Posture Issues

Poor posture regarding brass instruments can produce negative results:

- **Poor tone** - Kelly [3], Whitener [2] and Dornbusch [4] note that poor posture can degrade respiratory function, stamina, embouchure and tone
- **Long-term injury** - can lead to back, shoulder and neck pain [5] Campos [6] Varney, and muscular weakness Dombusch[4].



Literature Review Posture Issues: Clinics

Clinics existing in the United Kingdom include:



Treat: Repetitive strain injury, carpal tunnel, stiff neck, shoulder and lower back pain etc

How: Analysing posture with instrument, diagnose through assessment, advice on exercises and performance-related rehabilitation



NHS Guy's and St Thomas's Musicians and Performing Arts Clinic London

Musicians and performing artists often need to continue working during rehabilitation and wherever possible treatment plans are sensitive to this.

Literature Review Posture Issues



**Ideal posture straight
back, equal stance**

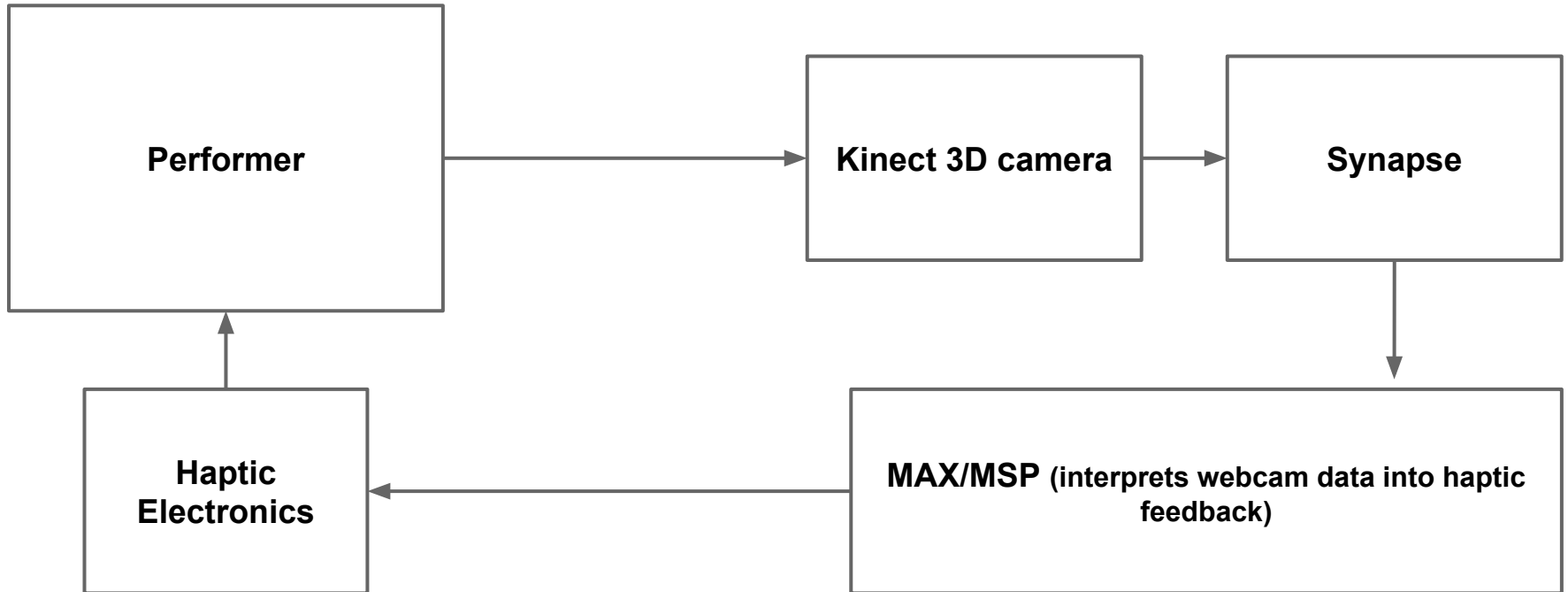
Head rotated forward

**Head rotated forward,
sternum collapsed**

**Excessive sideways
twisting**

A mention of the previous system - Postrum I

Postrum I resided on the Mac OS 10.9 operating system.



A mention of the previous system - Postrum I

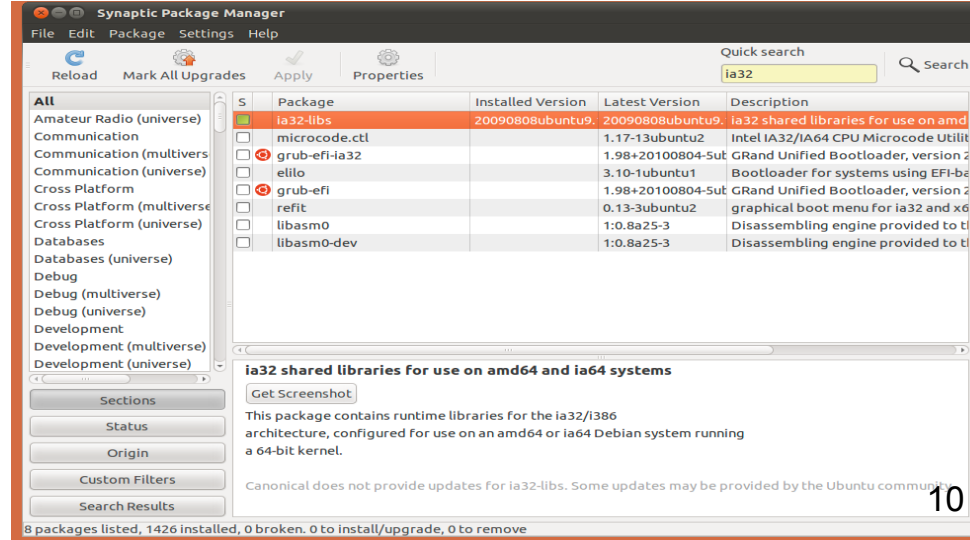
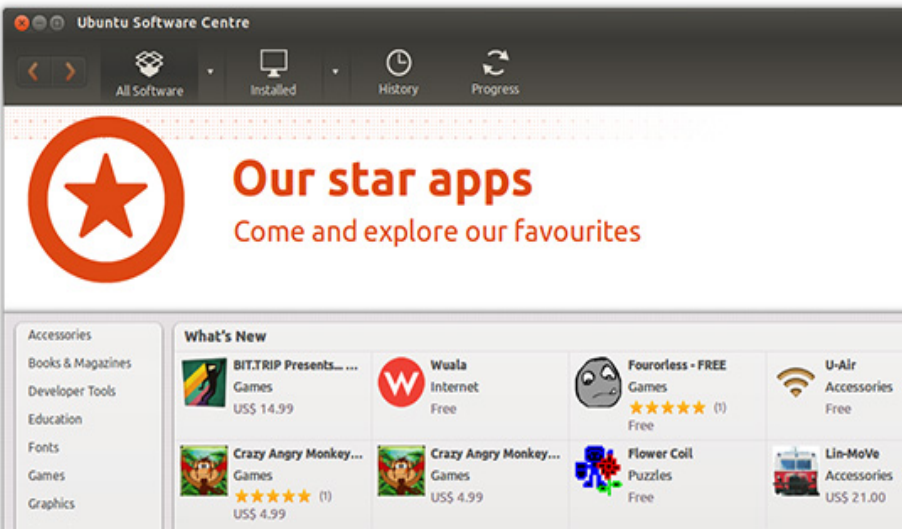
Postrum I resided on the Mac OS 10.9 operating system.



Transition to Ubuntu from MAX/MSP Mac OS

MAX/MSP to Puredata

Puredata (open source alternative) - porting the MAX/MSP patch to Puredata was deemed successful. Whilst installing Puredata on Ubuntu the Synaptic Package Manager proved invaluable, enabling a graphical way to install all the necessary Puredata libraries required for Postrum II.

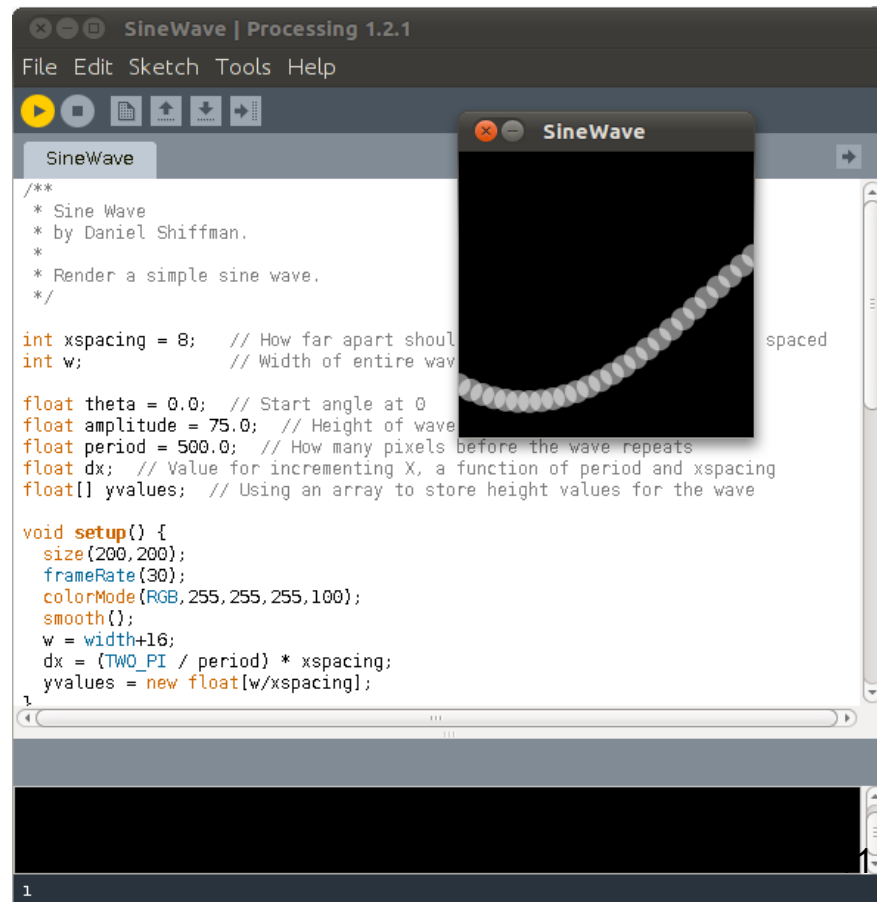


Transition to Ubuntu from MAX/MSP Mac OS

Processing in Ubuntu

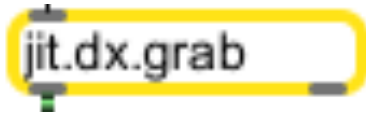
Processing (GUI - IDE) - the processing programming language by Ben Fry and Casey Reas can be easily downloaded as a *.TGZ and unpacked and 'bashed' in terminal

Used to create Postrum II GUI

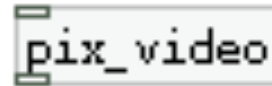


Transition from Jitter to GEM

Audio objects very similar between Max and Pd, but far less similarity between Jitter and GEM objects, requiring a complete rebuild.

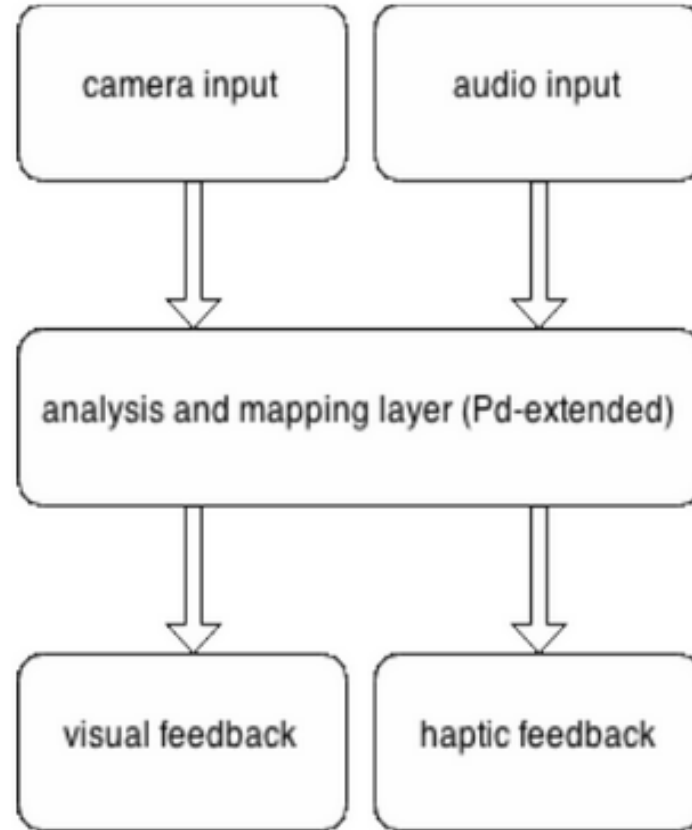


jit prefix

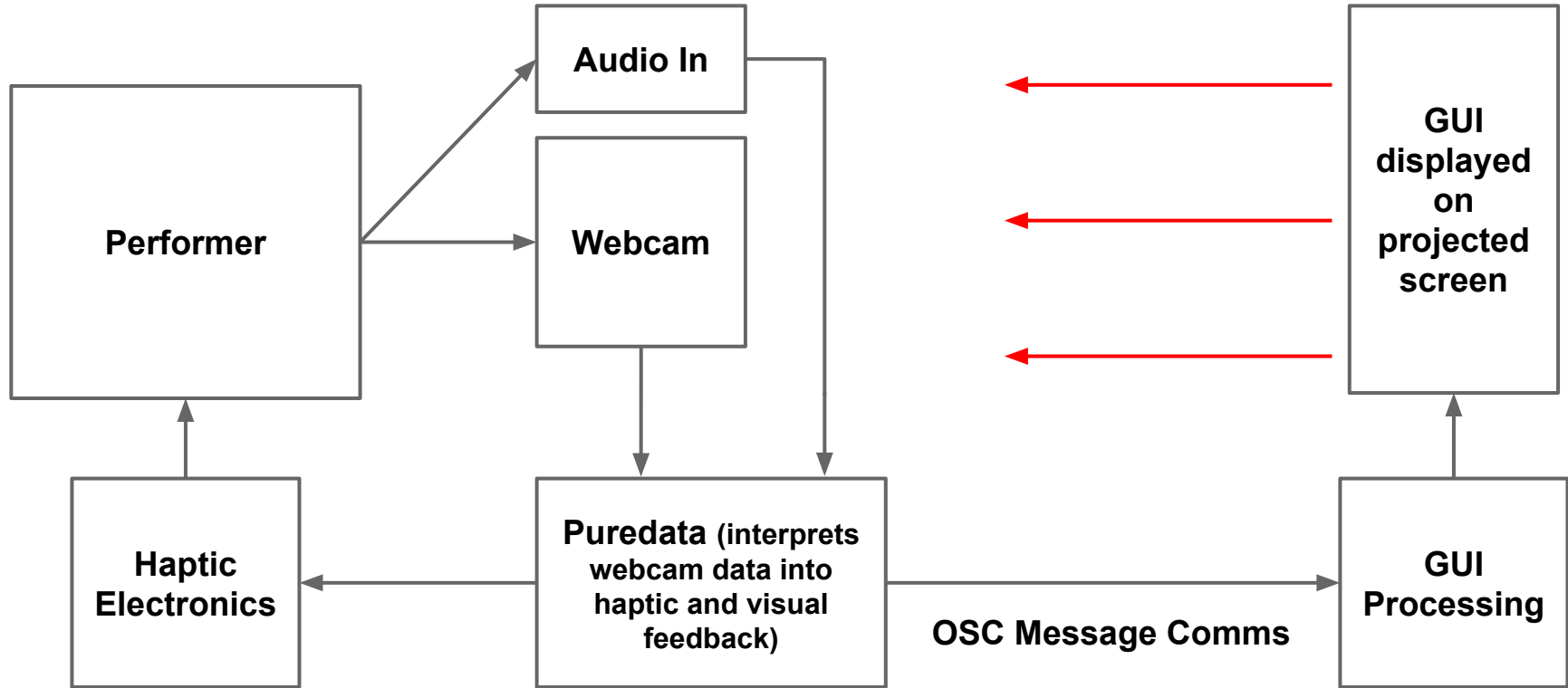


pix prefix

The Current System - Postrum II



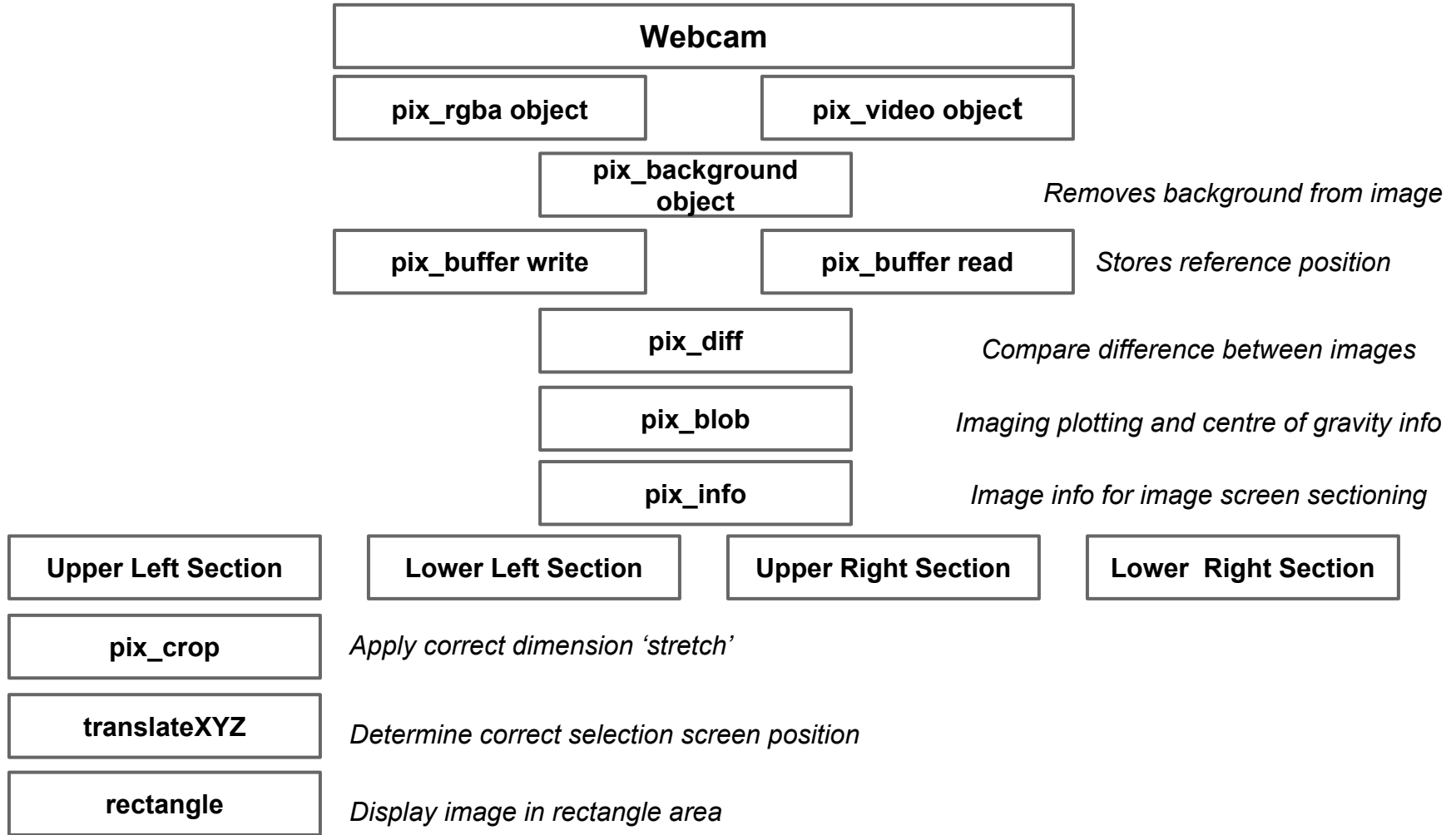
The Current System - Postrum II



Basic Postrum II Operation

- Background subtraction on real-time camera input - **Green Screen etc**
- Guide player into reference position
- Capture reference image
- Average several frames of real-time camera input together (more frames = smoother)
- Find difference between averaged real-time image and reference image (per section)

Webcam Imaging Algorithm in Puredata

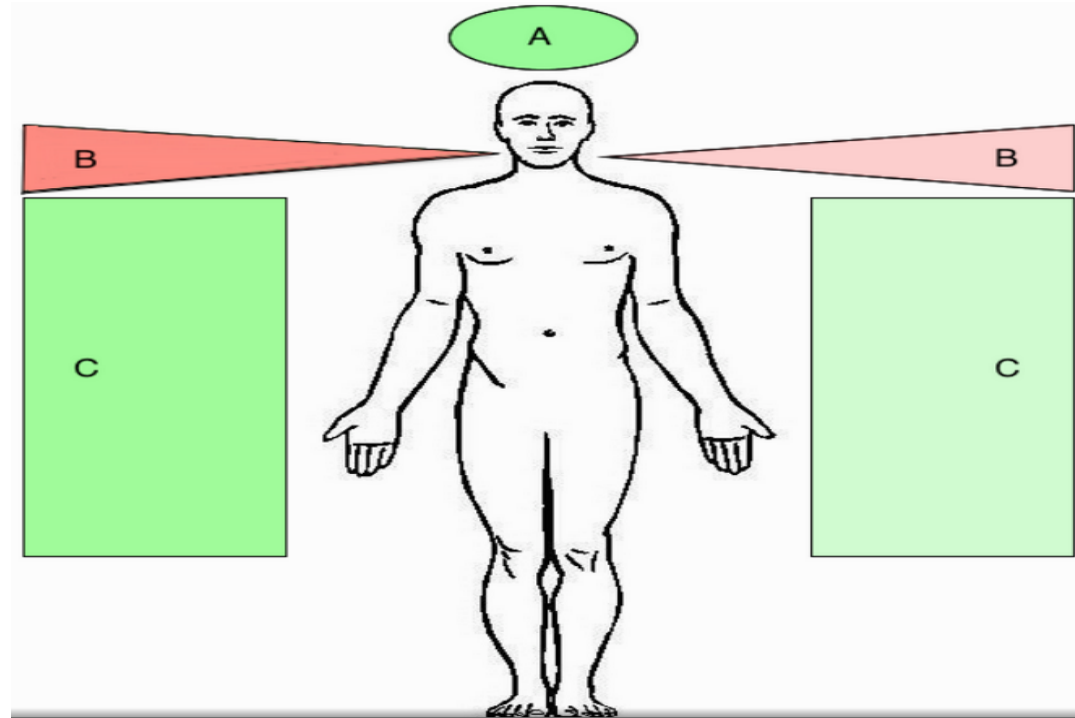
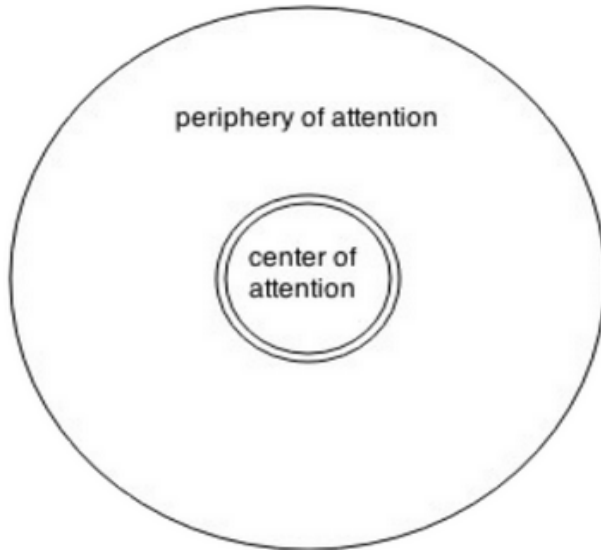


Webcam to GUI Visual Feedback Algorithm in Puredata

Visual Feedback is influenced by:

Calm Technology - Weiser and Brown [11].

The shifting of interaction to the periphery of attention in an attempt to reduce information overload.



Webcam to GUI Visual Feedback Algorithm in Puredata

Calm Technology - Weiser and Brown (1996) [11]

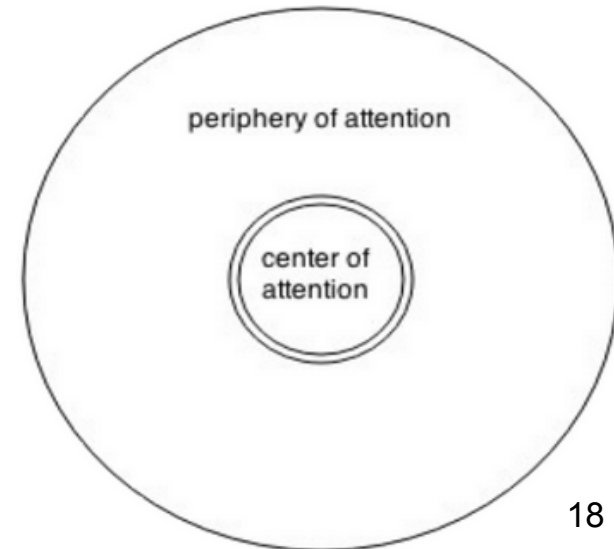
Why a need for calm?

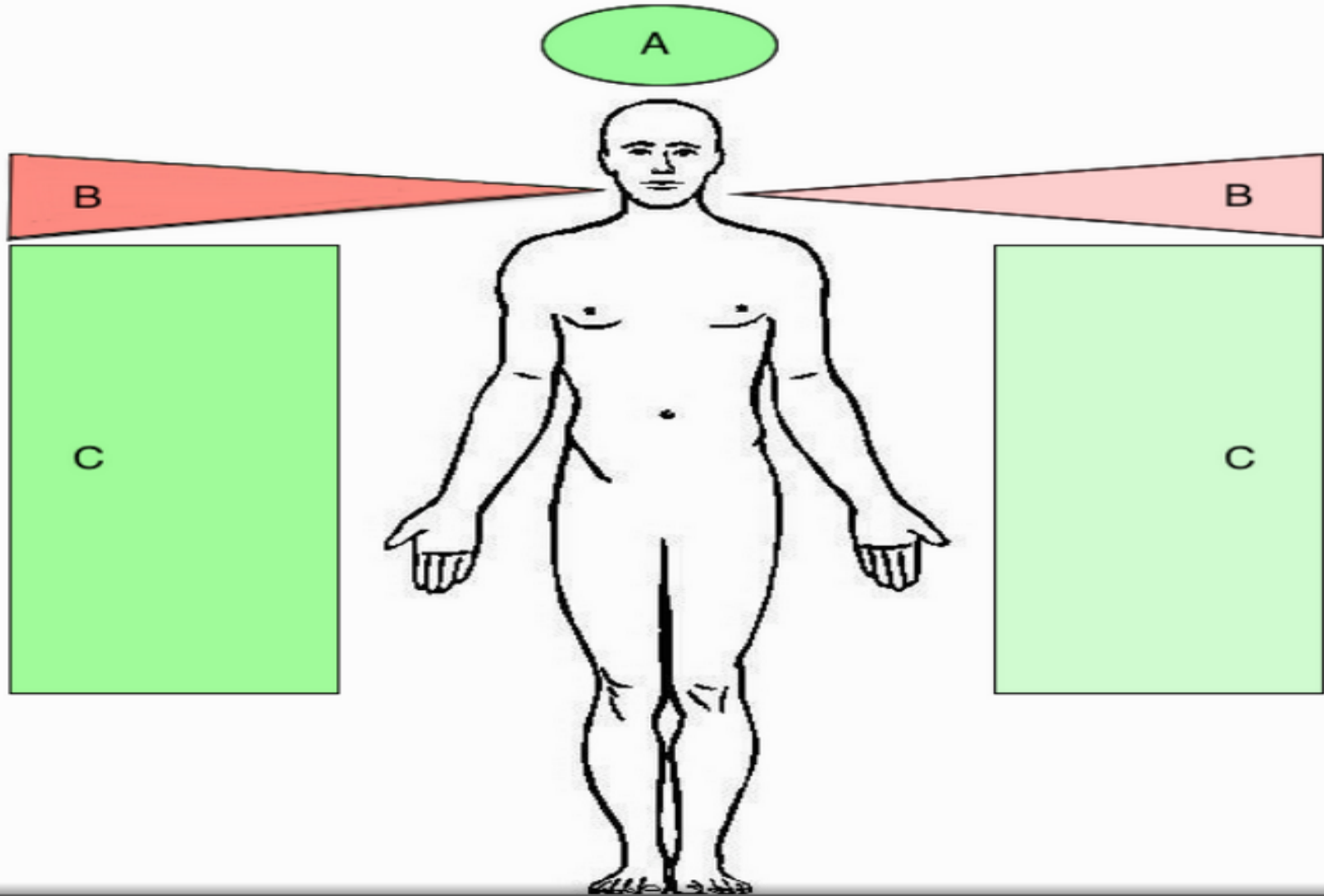
The move from mainframe/personal computing to **ubiquitous computing**

How does it work?

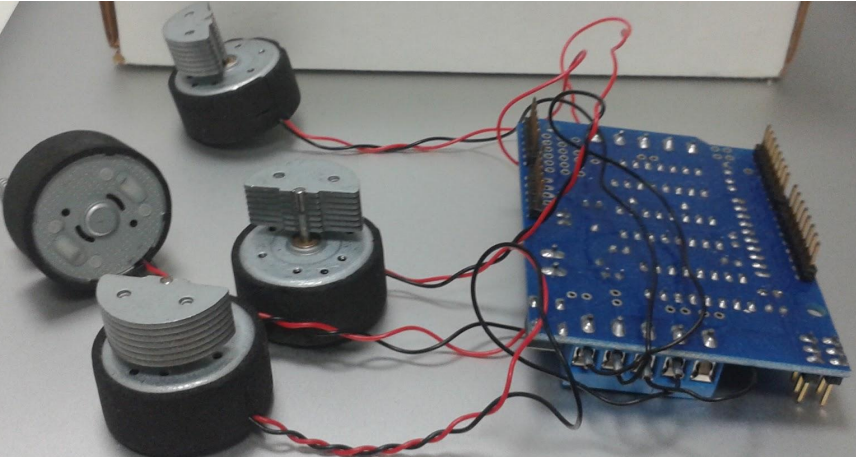
Produce a design that incorporates both the periphery and center of attention

Periphery and center of attention need to be interchangeable where possible





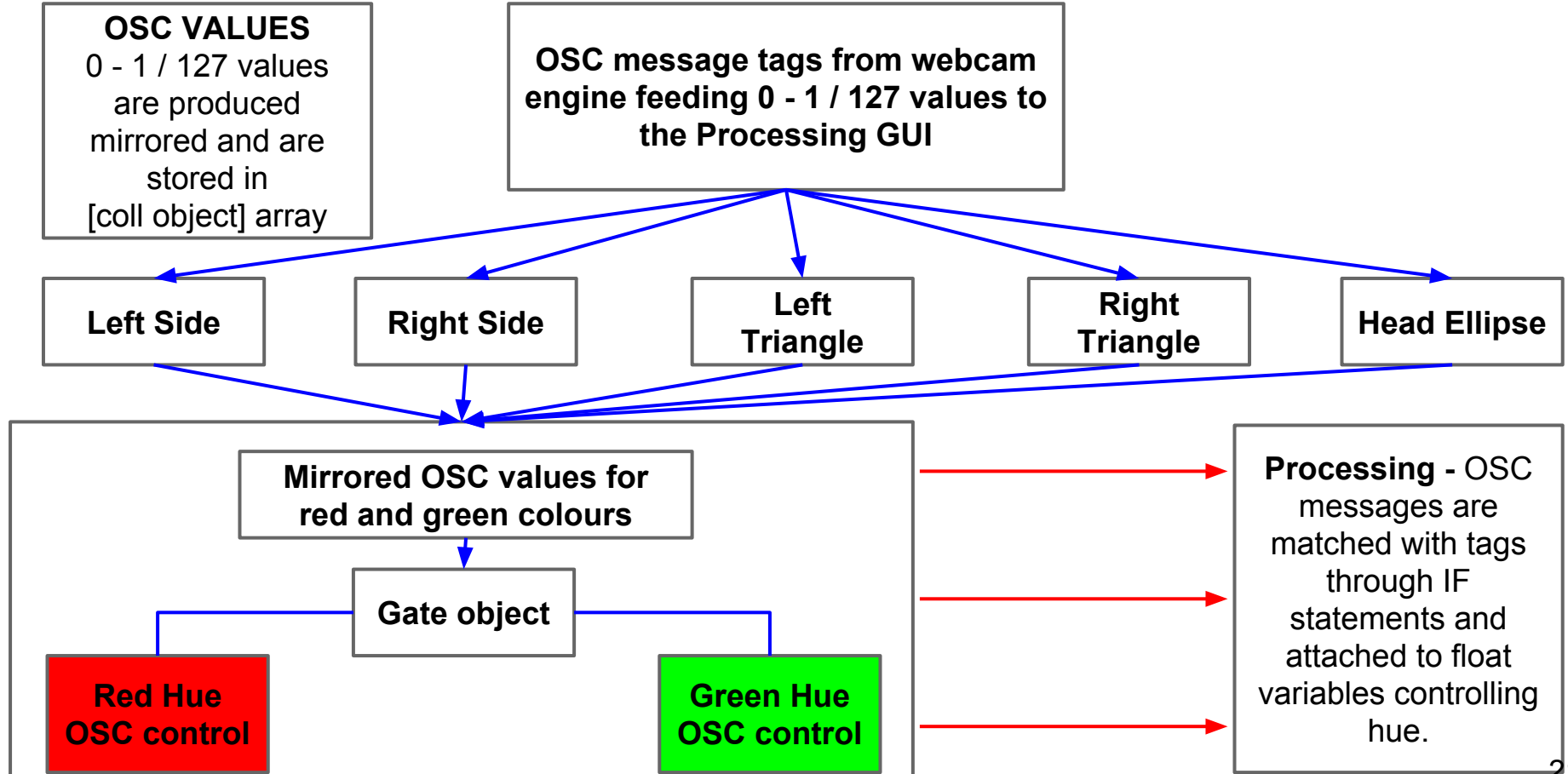
Haptic Feedback Algorithm



- Initially four motors were used
- One motor now used when performer doesn't respond to visual feedback.



Webcam to GUI Visual Feedback Algorithm in Puredata



Related Works - Mechanical Devices

- The Shulman System for Brass Matt Shulman - Trumpet specific



A system devised by Mat Shulman to aid trumpet posture, fatigue and tone through the promotion of desired playing habits.

The support arm transfers weight from the arms to the chest; thus enabling the player to feel the resonance of each note in the chest.

Related Works - Mechanical Devices

- ERGObrass for Trumpet van der Linden et al. (2011) - **Trumpet specific**



The trumpet support system transmits the whole weight of the arms and the instrument through the belt to the legs. The upper body can stay more relaxed as the player rests his hands on the trumpet, not the other way around.

Heinonen, A. (2011) *Relaxing Revolution* - ITGJ. p.48.

Other Interactive Digital Systems

Numerous interactive systems aimed at improving musicians' posture, some with haptic feedback, but not trumpet specific. For example:

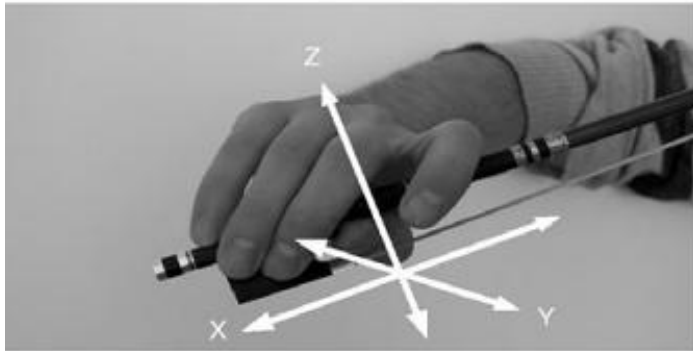
- The Music Jacket - van der Linden et al. (2011) - Violin specific
- Augmented Haptics - Grosshauser and Hermann (2009) - Violin specific
- 3D visual feedback system for piano posture - Mora et al. (2007) - Piano specific
- Motion analysis of ensembles using Kinect - Hadjakos et al. (2013) - Violin duo

Other Interactive Digital Systems

- Augmented Haptics - Grosshauser and Hermann (2009) - Violin specific

A system that adopts tactile feedback as well as real-time feedback using a closed-loop scenario.

Acceleration and gyroscope sensors are used within a violin bow



Grosshauser and Hermann (2009) argue this system could be used for a variety of additional applications including dance and sport.

Other Interactive Digital Systems

- The Music Jacket - van der Linden et al. (2011) - **Violin specific**

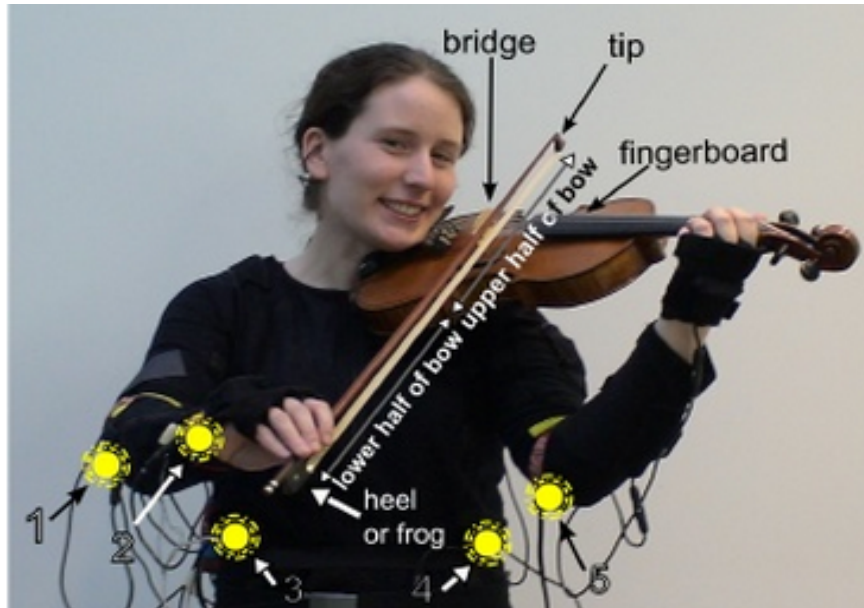


Figure 1. Motor placement in final version of MusicJacket. Motor 1 = move right arm forward, motor 2 = move right arm back, motors 3, 4, 5 = straighten up and lift violin.

The Music Jacket adopts motors to 'nudge' performers into place in real-time.

- Uses the Animazoo IGS-190-M motion capture system (very expensive)
- Arduino control board
- Openframeworks used to integrate the systems

Other Interactive Digital Systems

- 3D visual feedback system for piano posture - Mora et al. (2007) - Piano specific

The piano posture system adopts a VICON MX 3D Motion Capture System

Exports to a BVH file format for skeletal analysis

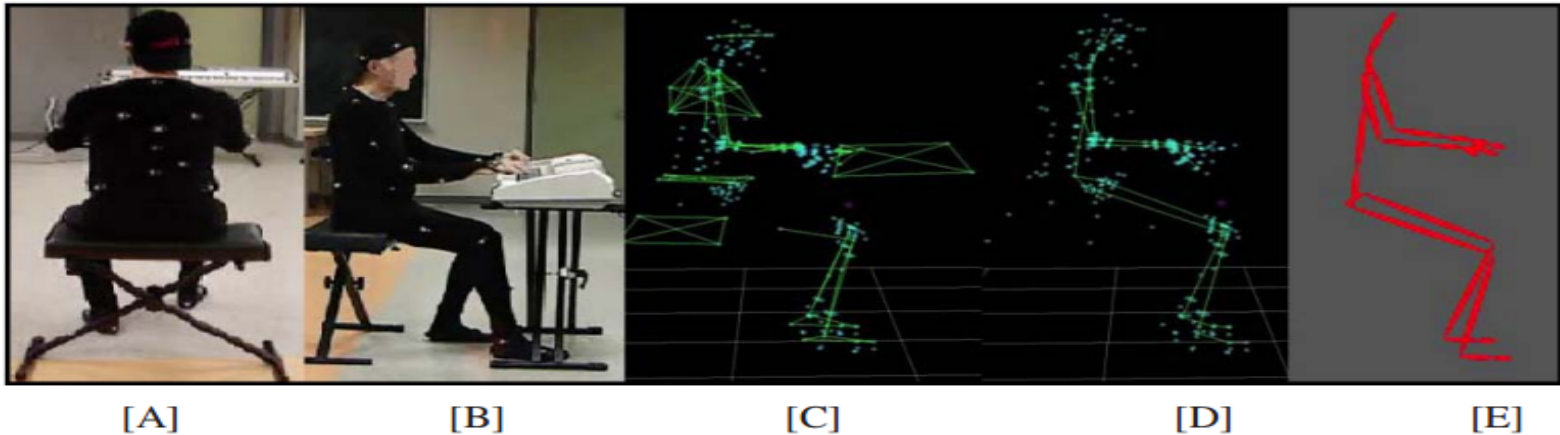


Fig. 2. [A] Back view of subject and its markers. [B] Data is acquired via Motion Capture System. [C] Markers are cleaned and labeled. [D] Anatomical converter estimates joints. [E] Data is converted to .BVH to use with tool.

Other Interactive Digital Systems

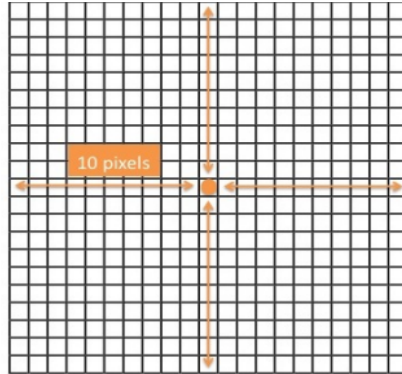
- Motion analysis of ensembles using Kinect - Hadjakos et al. (2013) - **Violin duo**

An system for analysing ensemble positioning and performer interactions. Head motion data is captured fundamentally and analysed and visualised accordingly. System has two fundamental stages:

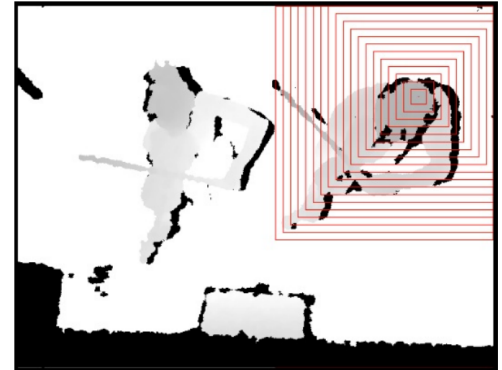
- **Head position detection** - Head detections and positioning
- **Ellipse matching** - Head direction through pixel depth and ellipse direction



Dark areas = close & distance errors
Light areas = distance from camera



Neighbourhood area around performer head
measured multi directionally with 10 pixels

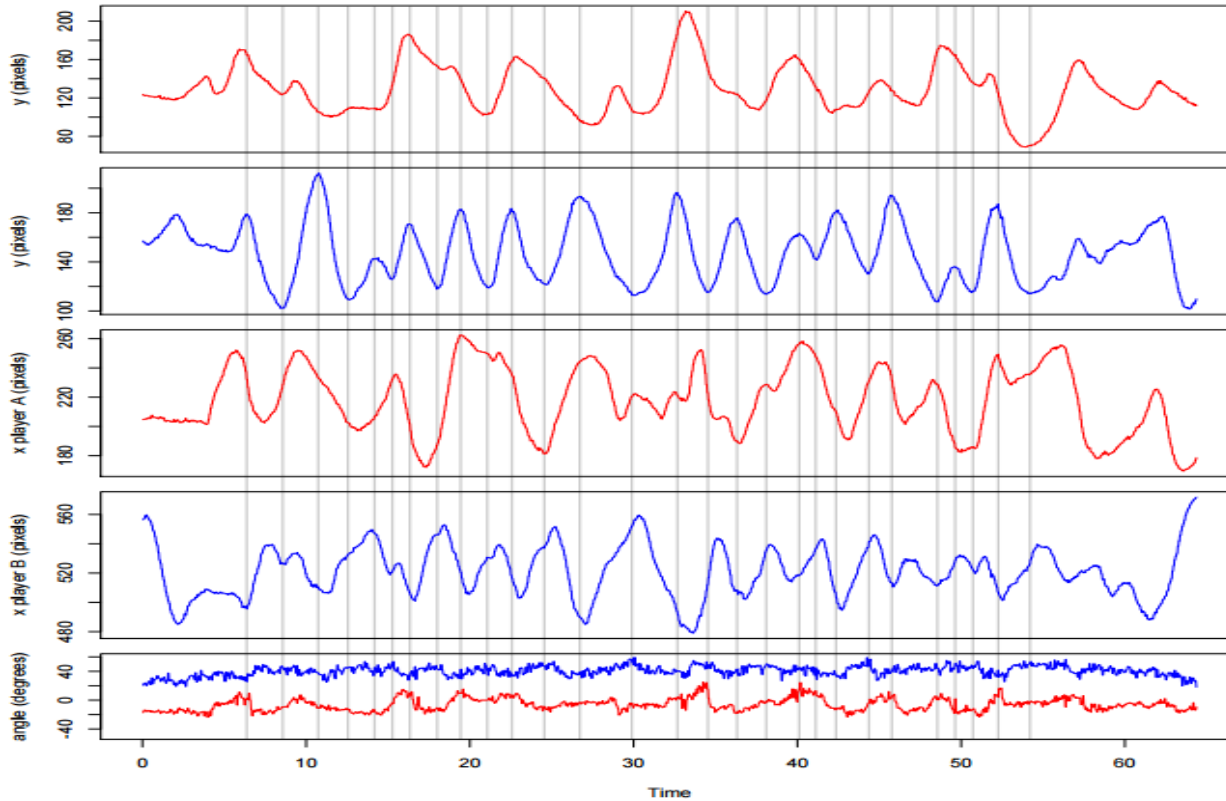


Shaded area is excluded to find second
performer

Other Interactive Digital Systems

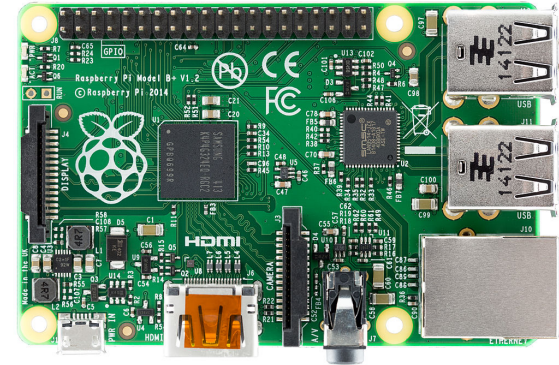
- Motion analysis of ensembles using Kinect - Hadjakos et al. (2013) - Violin duo

Example data taken from testing



Points for Discussion and Future Work

- A transition to the Linux Raspberry PI format would enable greater portability for practice rooms
- Long term measurement of posture in experience trumpet players
- Comparable for additional instruments and their systems for postural measurement
- Multi webcam system - further development of the webcam algorithms regarding multi-cam set ups with regards to head tilting and general plotting
- Consequently how would this open source system compare to 'closed' source alternatives?



Future Development - A Multi-Camera System

