INTERACTIVE MULTIMEDIA ART WITH BIOLOGICAL INTERFACES

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INTRODUCTION

This paper is intended as an investigation of new environment for interactive multimedia art with biological sensors and biological feedback. The key concept is "listen to, watch and control/interact the physiological performance". I have developed two styles of sensors for performance with bio-sensor technology and microelectronics: (1) 16-channel electromyogram sensors detecting live performance with both arms and hands, (2) bi-directional breath pressure sensor for SHO (traditional musical instrument) performance. I have also developed a biological feedback system with 8-channel contacts driven like low frequency massage device. These biological interfaces are incorporated with interactive multimedia authoring system and performing system by the concept of algorithmic composition.

ELECTROMYOGRAM SENSOR

At first, I report the development of a compact 16-channels electromyogram sensor for interactive media-art performances. I have developed many types of sensor systems and Human-Computer interface systems as a part of my researches, and this system called "MiniBioMuse-III" is the third step of my original EMG interfaces. The front-end sensing circuit designed with heat-combined dual-FETs detects 8-channel EMG signals per one arm with high gain and cancels the common-mode noises. For each arm, 18 (2*(8CH+GND)) sensing contacts placed on the rubber arm belt are small silver disks and direct wired and connected to each front-end circuit (Fig.1-2). Total 16 analog signals are demultiplexed and converted (8bits resolution A/D) to digital information by single chip CPU (Hitachi H8), then transmitted as MIDI information. This CPU runs not only as configurable system for time-domain resolutions via MIDI control, but also runs as software DSP (digital filter) to suppress the Ham-noise of environmental AC power supply. The multimedia processing-authoring-performing system is constructed in Max4/MSP2 environments and displays all 16 channels

electromyogram information in realtime (Fig.3). This graphic information helps not only the performer but also the audience to recognize the relationship among sound, graphics, behavior and gesture in the performance. [1]-[5]

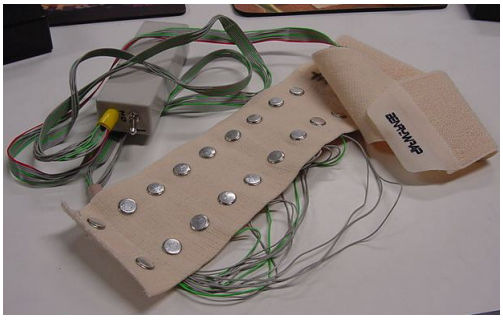

Figure.1 the sensing rubber belt

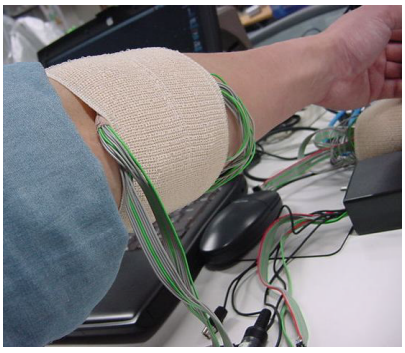

Figure.2 wearing the sensing belt on the left arm

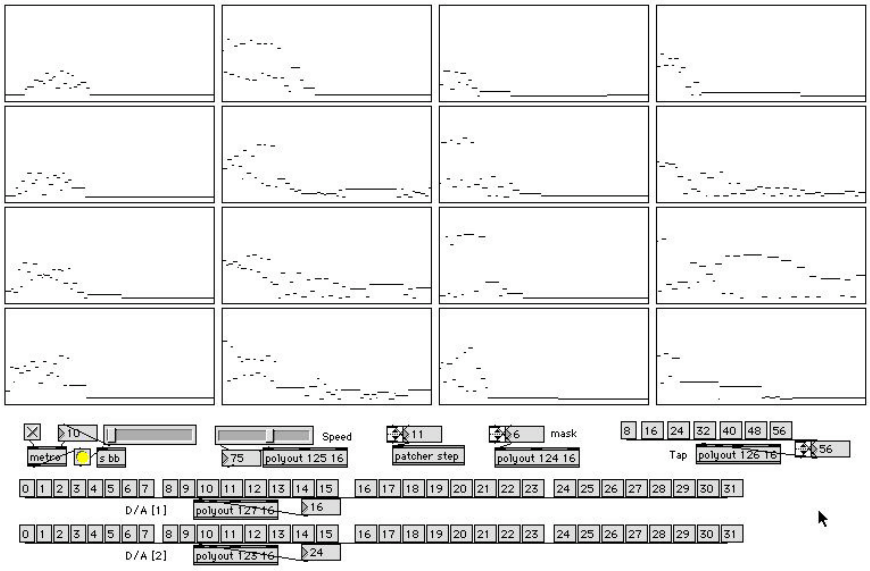

Figure.3 the screenshot of Max4/MSP, displaying 16 channels EMG signals

SHO BREATH SENSOR

Secondly, I report the development of a compact bi-directional breath pressure sensor for SHO. SHO is the Japanese traditional musical instrument, a mouth organ. The SHO player blows into a hole in the mouthpiece, which sends the air through bamboo tubes which are similar in design and produce a timbre similar to the pipes in a western organ. The breath stream of each bamboo tube is very critical, and it is very difficult to detect the value of the bi-directional pressures for each bamboo pipe. I found that normal SHO uses 15 bamboos with reed but 2 bamboos are used only for decoration, not used for sound generation. So I replaced one bamboo with the "sensing pipe" which connected a small air pressure sensor module (Fig.4). This sensor detects the bi-directional air pressure value of the "air room" of the bottom of the SHO. Output signal from the air-pressure sensor module is converted (8bits resolution A/D) to digital information by single chip CPU (H8), then transmitted as MIDI information. I also produced an original Max4/MSP2 patch to detect and convert the sensor information into universal parameters of

performance. The patch also displays the breath sensor information graphically in real time (Fig.5). The left windows shows the direct breath data of the sensor, and the right window shows the absolute value of the bi-directional information. The sampling rate of breath sensing is about 200Hz. The MIDI receiver cannot receive the maximum speed (125KHz), so the CPU software detects only the changes of data. [6]

Figure.4 the air-pressure sensor for SHO

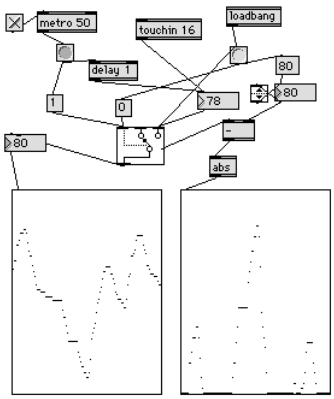

Figure.5 Max/MSP screenshot of SHO breath

BIOLOGICAL FEEDBACK SYSTEM

Thirdly, I report the development of a compact 8-channel biological feedback system for interactive media-art performances. The feedback signal is high voltage electric pulse (about 100V) like low frequency massage device (Fig.6). The waveshape, voltage and density of pulses are real-time controlled with MIDI from the Max/MSP system (Fig.7). The purposes of this feedback are: (1) detecting performer's cues from the system without being understood by audience, (2) delicate control of sounds and graphics with the feedback feeling in virtual environment, (3) live performance of outside of anticipation with the electric trigger.

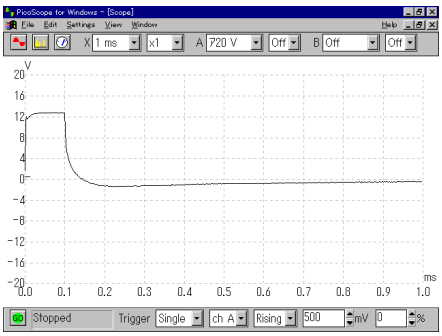

Figure.6 pulse signal of the feedback (1/10 [V]scale)

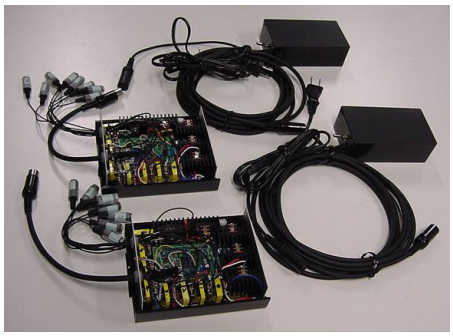

Figure.7 original biological feedback systems

I will also discuss about a possibility of "hearing pulse" without using ears. In experiments during development of this system, I found many interesting experiences to detect "sounds" without acoustic method (speaker, etc). The numbed ache from this bio-feedback system is different with the waveshape, frequency etc, like as timbre of sound. This shows the possibility for hearing-impaired person that a sound can be perceived without using an ear. Another experiment, the source is changed from simple pulses to musical signals also shows the possibility of listening to the music with this feedback.

APPLICATIONS

I report applications as some works and performances. The SHO breath sensor was developed for Tamami Tono (SHO player/composer), and used in works "Visional Legend"(1998/2001, composed by Y.Nagashima) and "I/O" (2001, composed by T.Tono, Fig.8) and performed in Japan, France and Germany [7-9]. The sensor "MiniBioMuse-III" was used in a work "BioCosmicStorm-II" and performed in France and Germany [8]. The biological feedback system was used in performances (2002 M.Akamatsu Fig.9, and M.Miwa) in Japan [10].

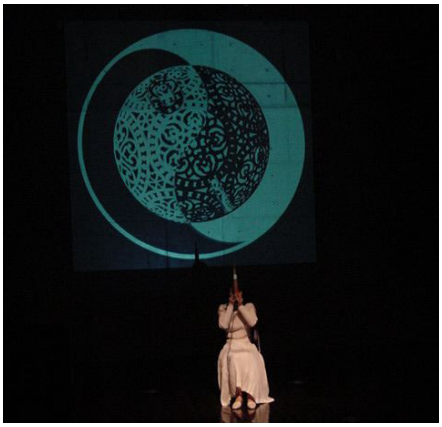

Figure.8 performance of Tamami Tono's work

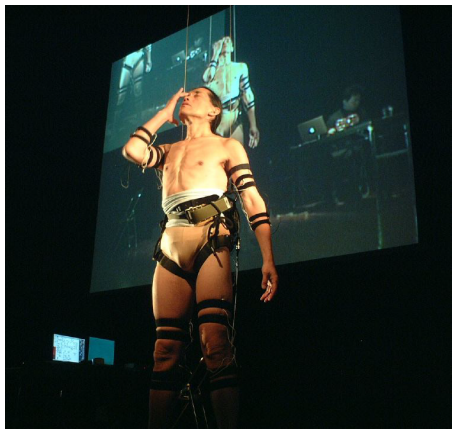

Figure.9 performance of Masayuki Akamatsu's work

SUMMARY

I reported some environments for interactive multimedia art with biological sensors and biological feedback. I will continue this research both with other sensors for music and with human interface applications. I want to describe acknowledgement to cooperation of the following collaborators finally: Masaki Teruoka, Fumitaka Nakamura, Tamami Tono Ito, Masayuki Akamatsu and Masahiro Miwa.

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