The Metabone: An interactive sensory control mechanism for virtuoso trombone

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Abstract

The aim of the project was to create a completely new instrument and performance environment taking as a starting point the dynamics and characteristics of the trombone. Custom designed proximity sensors were employed, augmented by commercially produced transducers. These sensors were built into the performance space so that the instrumentalist could affect various sound transformation parameters by using a modified trombone slide and a custom designed anechoic mute.

The first performance of the resulting electro-acoustic piece entitled Zero in the Bone was given by the Trombonist Barry Webb in April 1997 as part of the University of Huddersfield’s Electric Spring programme.

1 Background

The Metabone project is a continuation of the author’s research into interactive performance environments and interactive sound installations which has both explored sensitised theatrical performance spaces (1), and interactive sound sculpture (2).

2 Instrument mechanics

It was of paramount importance that absolutely no sound emanating from the trombone was leaked into the performance space. The exclusion of the integral acoustic of the instrument presented a challenge to the performer in that he had to re-learn and re-sensitize himself aurally and kinesthetically to what is fundamentally a new instrument and performance space.

A custom anechoic mute was designed and built which consisted of a high density polypropylene cone into which was inserted a 120mm piece of acoustic foam, this absorber was required to minimise compression effects that were found to occur using a conventional mute (Fig 1).

A Shure radio instrument microphone was embedded into the acoustic foam, the cable exiting a small hole in the body of the mute - this hole also served to allow minimum of expressed air out of the mute. To ensure accurate orientation and detection by the sensor elements 2 aluminium plates measuring 250 X 120mm were affixed to the end of the trombone slide, these plates were constructed from material only 5 thousandths of an inch thickness. It was found that using heavier gauge material made the instrument impossible to play due to the trombone slide binding at full extension. A small 50 X 50 mm window was cut centrally in the right hand plate to allow the performer to see a laser spot on the inside of the adjacent plate. Each plate was coated with a thin layer of textured enamel which was required to achieve reliable detection. The Polaroid ultrasonic sensors behave as specular reflectors in that they do not reliably detect surfaces which are smooth with respect to the wavelength of the ultrasonic wave. This only occurs when the reflecting surface is positioned off axis to the ultrasonic beam resulting in the beam being reflected at an angle away from the source. As it is almost impossible to achieve a right angle surface from a moving trombone slide a solution was to paint the plates with the textured enamel creating a diffuse surface ensuring reliable detection.

It was extremely important that the performer had total freedom of movement to interact with the sensor elements so a radio microphone was used to transmit the acoustic signal to the sound processors. The only wire attached to the performer was a thin headphone feed suspended from above the performer.

3 Implementation

The control voltages from the sensor elements were connected to 2 'Midi Creators' multichannel analogue to midi converters (Fig 2).

Each converter was programmed to output only the midi controller information required for real time control of the SE70 digital effect units. These controller assignments were stored in 2 EEPROM cards which were required to hold the necessary controller information.
The midi controller information was fed to the sound processors via a midi controlled router which in turn was switched by the host computer. Opcode's Studio Vision Pro was chosen to store the necessary program change information and audio synthesized cues were stored as digital audio sound files fed to the performer via a headphone system. Audio synchronisation cues were also stored as digital audio sound files led to the performer via a head phone system; timing information was given to the performer in the form of a midi click track. The program also held visible acting information in the form of simple note on/off messages connected to a midi to light interface feeding bright LED's mounted in the sensor elements. A small powered HeNe laser assists the performer to establish physical orientation within the performance space. The laser system was used in conjunction with the Ultrasonic sensors ensuring that the performer entered, moved and exited the Ultrasonic beams cleanly and accurately. The single beam being split into 2 via a system of mirror reflectors to indicate the 2 sensor paths. 2 x 110mm Acoustitle absorbers were mounted 3 metres away, directly opposite the ultrasonic transducers ( each transducer operating at the same frequency of 30 kHz ) this stopped the ultrasonic beams from reflecting around the performance space and interacting with each other. A way was needed to remotely switch input sources to the SE70 processors from the various console auxiliary outputs. A solution was to connect the live trombone signal to 3 channels of the MM1 console, as the auxiliary sends are muted with the channel mutes then patches could be designed to achieve the input routing without using a dedicated audio switcher. Stereo outputs from the 2 effect processors were routed to the MM1's direct channel outputs at the required time by sending program change messages to mute the redundant channels.

3.1 Sensor Elements
Elements with a wide range of proximity detection were required to give the performer differing degrees of sensitivity for the various sections of the piece. These were: 2 Midi Sensors, capacitive sensors, were used with a detection range of between 0 and 100mm (Fig 3). 2 Midi Gesture Ultrasonic sensors, with a range of between 1 and 3 meters gave the largest detection range. The Midi Gestures do not hold their sensing voltages when exiting the ultrasonic beams so a positional detector and a simple hold mechanism was designed and built to facilitate the this voltage memory requirement. An infrared photoreflective switch was employed, mounted adjacent to each ultrasonic sensor, this switch detection was used to trigger the simple and hold circuitry. The HeNe laser was mounted centrally between the ultrasonic and infrared detectors (Fig 4). 2 Radio Shack metal detectors were customised to give a medium sensing range of proximity detection (Fig 3). Modifications were required to convert the pulse width frequency output of the metal detector circuitry to the 0-3.2V output voltage required for the Midi Creators. A frequency to voltage converter circuit was designed and built to give a linear sensing range of between 10 and 400mm.

3.2 Computer system

Macintosh Quadra 650 c/w 24Mb ram, 500Mb HD and Digidesign Audiomedia 2 with Opcode Studiovision pro V.3.1 software.

3.3 Audio System

2 Roland SE70 digital multi effects modules, Tascam MM1 mixing console with Midi mixing. Soundcraft series 300B mixing console, Alice MicPak preamplifier, Drawmer DL 251 Spectral compressor.

3.4 Midi system

Opcode Studio 3 Interface. Akai ME30P midi router 2 Midi Creators - 14 channel analogue to midi interface dw 2EEPROM cards holding the 8 channels of midi controller data. Peavey PC1600 Midi Controller, MidiLight-8 channel midi to light interface. Midi balanced line transmitter/receiver.

4 Conclusions

The combination of Metabone and Meta-environment proved to be a powerfully expressive medium in which the performer was both challenged, in terms of the degree of physical skill required, and emancipated by the broad virtuoso qualities that the environment offered. Current research into the implementation of radio and infrared transmission/reception systems will provide a greater degree of physical freedom for the instrumentalist, and banish much of the aching from the performance environment.

References
