Dr.Saxophone: Hybrid Saxophone Interface

Euyshick Hong
Dongguk University
MARTE
(Musical ARt and Technology)
Seoul, Korea
antaresax@dongguk.edu

Baron Kim
Dongguk University
MARTE
(Musical ARt and Technology)
Seoul, Korea
erodeus@dongguk.edu

Kiyeor Han
Dongguk University
MARTE
(Musical ARt and Technology)
Seoul, Korea
kiyeori@dongguk.edu

Abstract— **The purpose of this paper is about developing hybrid saxophone interface to use various performances. The interface device is controlled by natural gesture without special training. The data of interface sensors are digitized naturally through the actual fingering and gestures of playing. The main concept of hybrid saxophone will be used with originally acoustic sound and digital sensor. In this study will be applied to other instruments with creative conversion for interactive music and various media works**

Keywords-component; hybrid saxophone, saxophone interface, arduino

I. INTRODUCTION

Various types of saxophone interfaces were made by musician and music company through the rapid music technology. Developed interfaces have several type and shape: augmented saxophone, attached sensor on a key button, an electronic interface such as a synthesizer. The main goal of the interfaces is to express a musical emotion and creative works by the technological way. For example Gest-O's project [1] is expanded saxophone interface system for controlling the sound of saxophone by gestures and various sensors which are attached to the saxophone. But we should practice controlling. Sebastien's electronically-augmented saxophone [2] and M. Butner's Metasaxophone [3], Bent Leather Band's Gluisax [4], these saxophone interfaces are expanded with sensors and enables to control a number of parameters. Nevertheless, attached sensors and cords are possible to disturb playing and controlling. Such as like, Gluisax has a control board which contains various sensors to control effectors, sound processing, and interactive factors. Also, J. Impett's Meta-Trumpet [5] and C. Palacio-Quintin's Hyper-Flute [6] are the hybrid interface like Gluisax. These kinds of augmented and attached musical Interface can be applied on other instruments [7]. Also, it can apply another filed for convenience of life.

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This project was aimed at finding saxophone interface system by gestures of saxophone players that could be used to control a real- time multimedia works system.

1. Different fingering method from real saxophone
2. Awkwardness of timbre and breathing control
3. Problems of size and weight

To overcome these problems, the interface on [Figure 1-right] has been made, but [Figure 1-right] had following issues.

1. Disturbing look.
2. Restriction of a performer because of wires.
3. Uncomfortableness from the cords and the sensors.

The purpose of this research is to overcome the problems which are mentioned above and making a new saxophone interface which does not have disturbing look and controlled by a natural gesture. The interface device was designed to be played without special training or unnatural action, and the data values for the effectors are controlled naturally through the actual fingering and performances. The main of interface design is concerned with the comfortableness of to carry and play.

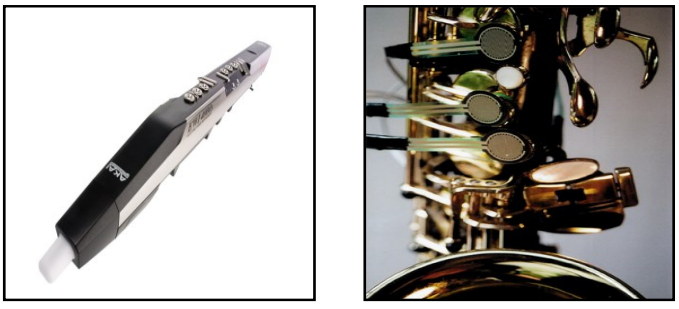

Figure 1. MIDI interface EWI and hybrid Metasaxophone. (left: http://akaipro.com, right: http://www.metasax.com)

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II. ANALYSIS THE GESTURES

Analyzing gestures of saxophone players were necessary in order to design the interface which can interacts and control the effects with player's performance. In this paper, on the study that analysis of saxophone gestures and fingering are preceding research for interface production and control.

A. Movement Analysis

Usually, the saxophone players make gestures as the mood of the music flows. In general, the player has no big gestures in the intro part of the music, as the music is in the process of building up the mood. As the music develops and melody becomes active, the player's movement is following the rhythm, like moving back and forth, or left and right. [Figure 2-left] shows player is lifting up the saxophone which is usual gesture in the climax part, is generally performed with long sustained high-pitched note. Due to the weight of saxophone, playing fast melody line is not suitable for the lifting gesture. [Figure 2-right] is a case of the saxophone player plays while bending forward, and is when playing repeating phrase and rhythm.

Figure 2. Lifting up and down gestures by Euyshick Hong

B. Fingering Analysis.

Usually, Fingering of the saxophone is variable in the pitch of melody goes. G1, C1#, G2, C2#, D3 and F3 are able to fingered with just left hand of the performer, while the right hand is free. The keypad of Bb, the lowest note of saxophone is not often used due to the difficulty of fingering. Therefore, the keypad of Bb was selected to be altered with one of the controller unit of the interface

III. INTERFACE PLAN

The interface has two tilt sensors, two switches, and a dial to control data. Saxophone player's gesture data will be collected from the tilt sensors in real-time, switches and dials are placed on the bell of the saxophone and manipulated during the performance by a right hand of the performer to control parameter data through the computer.

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A Interface Design

The design concept of the interface is comfortable to play and carry, controlled by a usual gesture of saxophone players, and easiness to use without special learning. Also, the interface device has wireless to be free from cords.

B. Interface Structure

Basically, the structure of the interface can be separated into two parts. One is the main board placed at the very entrance of the bell with cover to collect performer gesture data. This part contains power switch, tilt sensors, and sound sensor.

Figure 3. Installed saxophone interface

And the other one is set on lowest Bb tone hole, which can be easily detached and replaced with its cover as it is held by screws. The position of this part is carefully considered to control dial and two switches seamlessly during the performance. The whole interface device fits inside the bell pipe nice and clean. As shown in [Figure 3], the interface can be separated into two parts.

The multi-controller and mainboard of Arduino are controlled by a natural gesture of saxophone players and to control without special learning during playing. Also, the each interface device connected by wire in bell pipe of saxophone. [Figure 5] is separated multi-controller and mainboard.

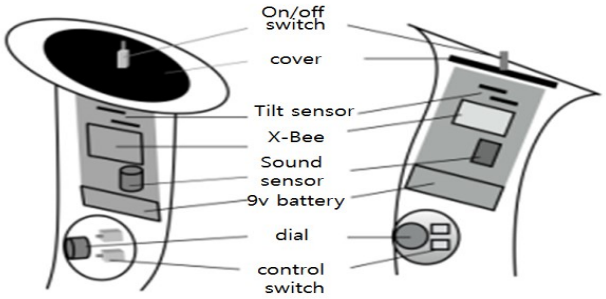

Figure 4. Structure and part of interface in saxophone

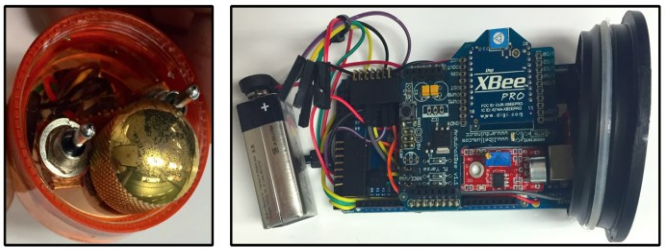

Figure 5. Multi-controller and mainboard of interface

C. *Interface setup*

Installation of the interface device to the saxophone does not need any special tool apart from a screwdriver. [Figure 9] is installation instruction for alto saxophone.

1. Remove lowest Bb tone-hole cover and replace with a multi-controller part.
2. Connect cables from multi-controller part to the main board of the interface device.
3. Putting the main board in the bell pipe of the saxophone.
4. Put on a switch on the hall cover.
5. Check a red light and then, play start.

Also, if you do not want to use this interface, you can remove the interface without some screw or device.

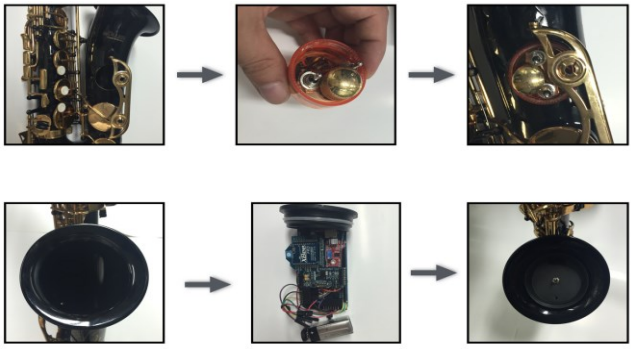

Figure 6. Interface installation procedure

D. *Motion Data through the Tilt Sensor*

Lifting and bending forward is a most noticeable gesture of saxophone player. By using tilt sensor, such gesture of performer is converted to digitized tilt value without interruption or overacting motion. Also, the collected data from the improvised performance is a useful resource to control acoustic effects or other media in real-time. [Table 1] is about the range of tilt data from performer's gesture and digitized tilt value.

TABLE 1. Data Value of Tilt Sensor

	Angle	**Data**
normal	0°	0
lift up	0~45°	0 ~ 1023
bending forward	0~60°	0 ~ 1023

As shown in [Figure 7], tilt value of tilt sensor is 0 when normal playing form, 45 when the saxophone is raised up, and -60 when it is inclined to the player's body. The player is free to set conversion range of detected tilt data for the performance.

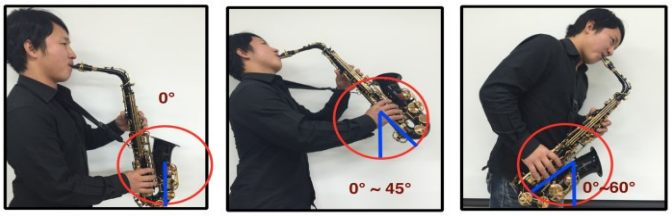

Figure 7. Gestures angle by saxophone player

E. *Data from Sound Pressure Sensor*

The sound pressure sensor receives volume data from very quiet breath to strong blow, and convert into a range of 0~1023. This feature also allows controlling the data in addition to the melodic elements, acoustic material like tonguing to control parameter data.

F. *Data Through Switches and Dial*

To play the instrument and controlling interface smoothly, a dial and two switches are placed on lowest Bb tone hole which is on the right side of the saxophone. setting switch controller on the tone hole gives high accessibility to the performer, especially while playing high notes which are fingered by left hands. With two switches, four presets can be set by of on/off combinations.

The dial is designed to be controlled by right hand, and very effective for the sound processing and sound effector parameter control on the setting of the presets. Also, dial is suitable for a quick change on parameter of effectors to gain dynamic expression while playing saxophone by left-hand only without right-hand fingering.

Figure 8. Dial and switches

IV. DATA SIGNAL FLOW

The tilt sensor detects saxophone player's gesture and digitizes to tilt data, and data values collected from a dial and switches. All these data will be collected to the Arduino and transferred to a computer through wireless module X-Bee. Two X-Bee modules are required to set up wireless connection between the computer and the interface, assigned as master and slave. The gathered data are processed through Max/MSP and control various parameter values. [Figure 9] is the signal flowchart of the interface

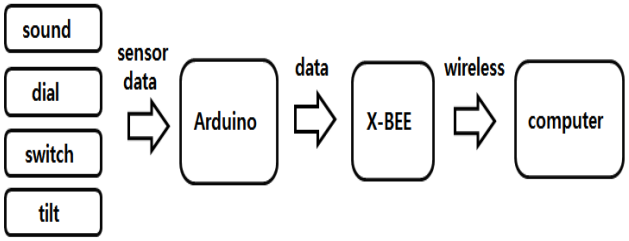

Figure 9. Data flow of the interface signals

V. DATA MAPPING

A. Use of Tilt Data

Usually, the saxophone player plays sustained notes or short phrases when the moment of the movement getting active and suitable effector type is spatial effectors such as reverb, delay, and chorus. For this demo, reverb and delay effectors are applied. The parameter of reverb room size is controlled by the tilt value of the saxophone. The upward tilt value 0 ~ 1023 is scaled to 0 ~ 127, to make easier adaption with various MIDI- based system.

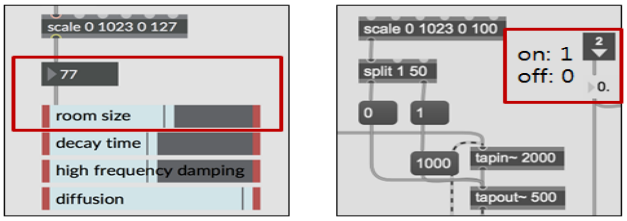

Figure 10. Reverb (left) and loop on/off(right) data mapping

[Figure 10] is the patch used to control effector by tilt data, and is effective on climax part of the performance as the reverb room size get huge with dramatic raise of the saxophone. Commonly, it is so hard to play that dynamic or rhythmical phrase during upward a saxophone because of weight and fingering gesture. The delay effector can be used as a looper for live looping with feedback option. The downward tilt value 0 ~ 1023 is scaled to 0 ~ 100, to set as the trigger to start looping played phrase when the data is over 50 such as bang. The performer can create own continuous rhythm track and play on it as long as the saxophone is down. Looping effects is controlled by the gesture.

TABLE 2. Reverb Data Mapping by Angle

	Angle	Data value	Reverb size	Loop
normal	0°	0	-	-
lift up	0~45°	0 ~ 1023	0 ~ 127	-
bending forward	0~60°	0 ~ 1023	-	0 ~ 100

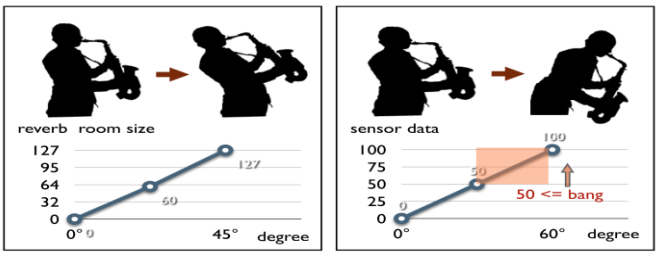

Figure 11. Reverb and loop data mapping by gestures

B. Data Control of Sound Pressure Sensor

The data value from the sound pressure sensor is 0 ~ 1023. As the nature of sound pressure sensor, the performer may have a hard time if this sensor is mapped on effectors those need delicate control. Therefore, the sound pressure sensor on the interface for saxophone is used as on/off switch. The tilt sensor on this interface activates when the sound pressure sensor's data value is over 500 by blowing the instrument. This feature can keep effector setting from unwanted motion data when the performer is not playing. Also, it is possible mapping to other effectors with different sound pressure value setting.

C. Data Setting of Dial and switches

A dial and two switches are set on lowest Bb tone hole to receive data from the performer's right-hand control. Theoretically, it is possible to use four effectors with a combination of two switches. Two effectors are applied on switches and the dial is in charge of change each effectors parameter.

TABLE 3. Data Mapping of Switch and Dial

	Switch	Dial
data value	0 , 1	0 ~ 1023
mapping	effector on/off	0 ~ 1023

The effector used on the switch-1 changes pitch and feedback-time of delay with presets, which sounds like a chord or a perpetual canon(round) and using right amount of feedback to create live looping sequence. The dial controls feedback time, a data value 0 ~ 1023 from the dial is scaled to 0.0 ~ 1.0. On the two switches, delay effector is applied to control delay time in real-time. The produced sound from instrument stacks up gradually through the effector, and builds up pad-like sound by controlling dial. Turning the dial to 0 quickly gives effect of sweeping out the whole pad built up.

TABLE 4. Data Use of Sensor

	Switch	Dial	Effector
effector1	on/off	feedback	pitch and delay
effector2	on/off	delay time	delay

The dial and switches are most effective when the performer is fingering the instrument with the left-hand. The switches are controllable with a sense of touch without checking the location. The dial is suitable for quick data control. These features will expand live saxophone performances possibility with its ease of use.

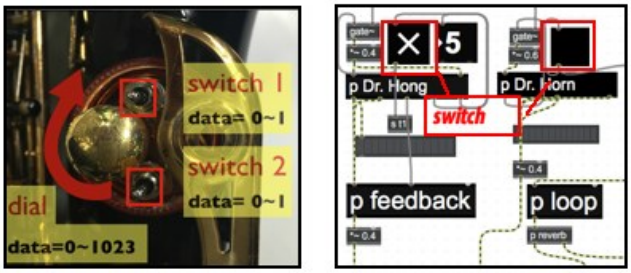

Figure 12. Effector control by switch and dial

VI. PERFORMANCE AND DISCUSS

In this paper, we have suggested developing and to overcome about some issues on augmented saxophone interface. So, In order to demonstrate, we had a interactive live performance with Dr.Saxophone interface on the stage by Euyshick, Hong. Above all, main interface placed in the saxophone bell was naturally controlled by gestures and right-hand without special training or unnatural action, we could control through the actual fingering and performances. Also, the wireless system didn't disturb to carry and play, but during playing, the player couldn't exactly find a location of a dial and two switches in Bb key pad hole. It can cause some problem and misunderstand a flow of works. To solve, the player should exactly understand about part features of work and sound effect by controlling.

VII. CONCLUSION

The purpose of this paper is about making hybrid saxophone interface which interacts with the performer's natural gesture, portable and suitable for live performance without any visually/physically artificial add-ons. The main idea of this hybrid interface will be used on both acoustic and digital saxophone, and will be applied on other types of instruments with a creative conversion.

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