Telesaxophone: Hybrid saxophone Interface

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ABSTRACT
This paper aims to develop a hybrid saxophone interface with real instrument and an electronic interface that enables to control sound and a multimedia data. Telesaxophone have developed for saxophone player with a dial sensor and several button sensors and original neck with mouthpiece combined electric interface produced by physical computing with Arduino [11]. We describe regarding software/hardware systems with Arduino and analysis the saxophone mechanism for interface development and demonstrate its performance of multimedia data control. In this paper, we have presented to find versatile multi-instruments that to control musical expression and various multimedia works over the trend of a new paradigm in art.

CCS Concepts
• Applied computing → Engineering • Applied computing → Sound and music computing •Computer systems organization.

Keywords
Saxophone; interface; Arduino; physical computing.

1. INTRODUCTION
In recent years, professional instrument interface for musical expression has expeditiously been developing by musician and music company that integrated acoustic instruments with electronic by advanced computer technology. Also, interfaces of a various type have been presented to control data by media artists for multimedia works. In this situation, it is required to create a new interface system that player can control to digital multimedia data during musical playing at the same time. Many methods have been proposed to address this issue.

In particular, various sound synthesis method by computer programming was developed that we enable to control synthesized computer sound with a computer, smart phone, an electronic controller such as synthesizer, furthermore, integrated acoustic instruments and electric instruments of di-verse forms have created according primary playing purpose by performers. Developed instrument integrated/electronic interface were played by musicians and multimedia performing artists in order to express artistic musical languages following the trend of time with new musical interface, music of various forms into novel trying has differentiated artistic factors such as fusion style music, electronics, multimedia art, interactive music, collaboration ensemble with computer system. Now, music not only already integrated but also gradually combined real instrument with electronics interface. In addition, combined musical interface can easily control that real-time audio processing, visualization, sound effects, physical modeling synthesis and media installation works with artistic emotions.

In this paper, this project aims to find novel hybrid inter-face that to control musical expression and various media works with the trend of a new paradigm. We have been working with various factors regarding software/hardware systems with physical computing and analysis the saxophone playing mechanism for hybrid interface development.

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2. DEVELOPED WORKS
In this paper, we introduce new integrated saxophone inter-face for musical expression and to control various multimedia data. Several years ago, by progressing musical technology with computer, various instrument interface already developed by musicians and musical company with a number of features in order to make variety of musical expressions. Especially, augmented saxophones have been developed recently. Example of various different augmented saxophones, M. Butner's Metasaxophone [1], Niels's psychophone [2], Gest-O [5] by John Melo, Sebastien's electronically-augmented saxophone [8], Bent Leather Band's Gluisax [3] are expanded saxophone interface by playing gestures with various sensors that are attached on the saxophone for controlling the sound processing of saxophone. Above augmented saxophone is an example of how a saxophone interface can be transformed into a definitely novel instrument system with electronic interface. Also, developed interface can integrate another instrument that woodwinds and brass. These augmented saxophone interface have extended the scope of musical expression. However, such as interface can disturb to play by weight and interface integrated. Also it can be to damage design of instruments. Also, Hyper-Flute [7], Meta-Trumpet [4] and D.Newton's research [6] (augmented instruments that Bassists, DJs, Vocalist, Saxophonist) are inte-grated interface like Gluisax. These a number of augmented Interface can be applied on other acoustic instruments that woodwinds and brass for musical expression. However, as shown interfaces remained issues regarding appearance de-sign and obstruction playing by integrated interface hard-ware. Digital saxophone interface by AKAI[2], the EWI[3] is most famous interface ever from Japan. After

[1] Arduino is an electronics device based on hardware and software

[2] AKAI is development of musical Instruments Music Company since 1929 from Japan

[3] EWI (Electric Wind Instrument) is the name of a wind controller, an electronic musical instrument invented by Nyle Steiner.

EWI, a number of musical interface have developed like EWI, also, the electronics interface enable to express wide range of the musical pitch, and controlling of using synthesized sounds and various computer sound effects.

However, it has following problems

1. Artificial mouthpiece discomfort to control unnaturally.
2. Different fingering and playing from real saxophone limited to expression various media controlling
3. Problems of size and weight

To overcome these problems, augmented saxophone inter-face has been developed, but had following various issues.

1. It can be to damage design and body surface of instruments.
2. Restriction of the performer by wires.
3. Discomfort from the cords and the sensors.

The goal of research is to develop the problems which are mentioned above, and creating a hybrid saxophone inter-face which does not have disturbing design and controlled. The interface device was designed to be played without new training or unnatural action. Data values of the effecters are controlled naturally through the actual playing fingering and performances.

As a result proceeding research, Telesaxophone aims to lead versatile new interface that to play musical expression and various multimedia factors with new paradigm in art. The main goal of studying is to express an emotion and creative works by technological way and finding new inter-face system like saxophone that could be used to play an interactive media works.

TeleSaxophone have based on the idea to develop integrated saxophone interface and electronic controller. The goal of the interface is comfortable to control and to play like acoustic real saxophone. Also, the interface device was integrated with original saxophone neck and mouthpiece for natural of playing. Original neck and mouthpiece are important that air breathing and tonguing has to synchronize with fingering.

3. INTERFACE SPECIFICATION

Telesaxophone was developed for saxophone player with original neck and mouthpiece combined electric interface produced with Arduino like saxophone mechanism that physical computing system. The design concept of the interface is comfortable to play and to control that the interface de-vice has wireless to be free from cords. It also is possible that detaching a neck from main body of interface when it controls multimedia data.

3.1 Interface Design

The Tele saxophone is shown in Figure 1. The device consists of one 14 button sensor, 3 dial sensors, sound sensors, LCD display, Arduino board for signal processing and control, X-BEE wireless module to control parameter data through the computer. The measurement range of the but-ton sensor is 0 to1 and the dial is 0 to 127. button sensors are controlled fingering manner like a saxophone. The two dial sensors provide analog data by rolling gesture of thumb finger and the last dial enables to control the LCD display that shows setting text. Sound sensor detects a sound of a neck in real time.

Arduino[4] is used to obtain sensor data, fingering and controlling recognition, and then to transmit processed signal data to the wireless module.

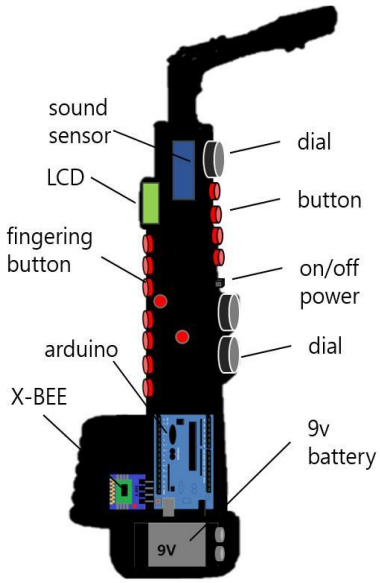

Figure 1. Structure and part of interface.

The inter-face communicates with the computer via X-BEE. Also integrated real neck and mouthpiece make players comfortable to play the saxophone naturally.

3.2 Wireless Signal Flow

Figure 2 shows the signal ow chart of data and signal processing. The acquired sensor data by player's fingering can be transmitted to the host computer.

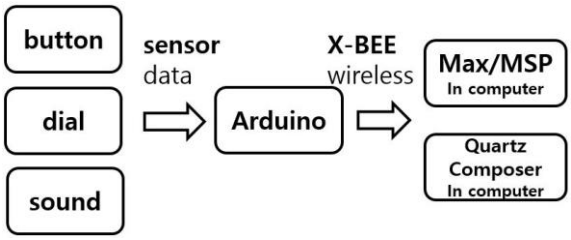

Figure 2. Data flow of the interface signals.

All these data will be collected to the Arduino, and transferred to a computer through wireless X-Bee module. Two X-Bee modules are required to set up a wireless connection between the computer and the interface. The gathered data are processed through Max/MSP with control sound and visual that parameter data of Quartz composer.

4. UTILIZING OF INTERFACE

Telesaxophone have created for saxophone player and multimedia performing artists. The interface can control wide data range and various sound effects. In this study, Arduino is used as a data receiver and transmitter to Max/MSP. To convert the sensor data into Arduino. We used the Max/MSP programming environment.

[4] Arduino is an open-source electronics platform based on easy-to-use hardware and software

Button sensors of interface have designed like fingering mechanism of saxophone that three octave buttons have added above original octave place on the back. It is able to control wide data range, various sound effects and preset. By playing, such fingering of performer is converted to digitized button value without interruption or overacting motion. Also, the acquired data from improvised performance is useful data to control sound effects or other multimedia works in real-time. [Figure3] is shown about the location of button and four-octave button.

Figure 3. Display and sensors in Telesaxophone.

4.1 Fingering data

The Telesaxophone is designed to be controlled by original saxophone finger style button and four-octave button that effective for the changing data: octave, timbre preset, background color, preset change.

4.2 Sound Sensor Data

The sound pressure sensor obtains volume data from breath to huge blow, and change into a wide range of 0~1023. This features of the interface also allow playing the data value that acoustic material like tonguing to control sound on/off.

4.3 Dial Data

To play the instrument and controlling interface smoothly, two dials are placed on a body which is on the back side of the interface. Placing dial controller gives high accessibility to the performer, especially while playing high notes which are fingered by left hands.

The dial is designed to be controlled by right thumb finger, and very effective for the sound processing that controls effector parameter and particle color/number on the set of the presets. Also, the dial is suitable for a quick change of a parameter of effctors to gain dynamic expression during playing saxophone by left-hand only without right-hand fingering.

4.4 Interface Strategy

In this study, the Telesaxophone is mainly divided into two modes; musical instrument and multimedia controller. For this study, Max/MSP is used as a data receiver, sound generator and transmitter to Quartz Composer which is used by multimedia controller.

1. Musical instrument: As shown in gure4, the system allows players to control and play like real saxophone with a various timbre of sound and processing effect by Max/MSP. The user plays the Telesaxophone, and sensory data are sent to the computer. When the user plays some musical fingering like saxophone, the computer translates them into produce sounds processing.
2. Multimedia controller: We explain about a multimedia controlling which is regarded as media art, physical computing and installation by using signal data of interface. As illustrated in figure 4, the system al-lows users to use like remote controller that to control visual with Quartz composer.

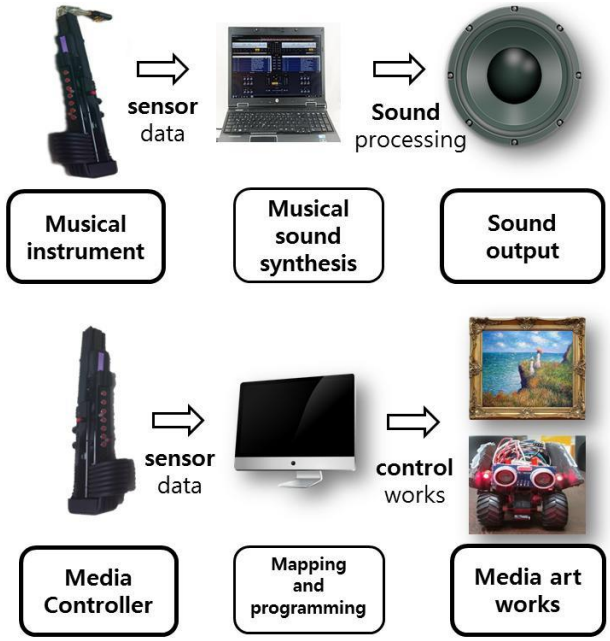

Figure 4. Using of interface strategy.

Table 1. Using interface

Mode	Function	Control sensor
musical instrument	melody playing	like saxophone fingering
	octave change	octave button 1
	timbre preset change	octave button 2
	effect data control 1	dial 1
	effect data control 2	dial 2
	sound on/o	sound sensor
multimedia controller	background color	octave button 1
	preset change	octave button 2
	particle color	dial 1
	particle number	dial 2
	particle position	like saxophone fingering

5. DATA MAPPING AND PLAYING

In this section, we show some performance demonstrations with the Tele saxophone. We first describe musical instrument

examples of sensors and playing. Next, a example of multimedia controller regarding the visual particle will be shown in figure 5.

5.1 Musical Instrument Playing

We can play the Telesaxophone as real saxophone that playing a melody with various timbre by sound processing.

Basically, real saxophone has an only one-octave key, but we have added three-octave button sensor to change timbres and wide octave range.

The sound of timbre has generated with FM synthesis method that set ten timbre presets and pitch range is from C4 to C7. Usually, the saxophone player plays sustained notes or short phrases when the moment of getting active and suitable effector type is spatial effectors such as reverb, delay and chorus.

Table 2. Reverb data mapping by angle

Function	Setting	Preset	Range
melody playing	FM synthesis	0-10	C4 - C7
octave change	1 octave	0, 1	
timbre preset change	1 preset	0-10	-
effect data control 1	reverb size	-	0-100
effect data control 1	delay time	-	0-100
sound on/o	on > 600	-	0-1023

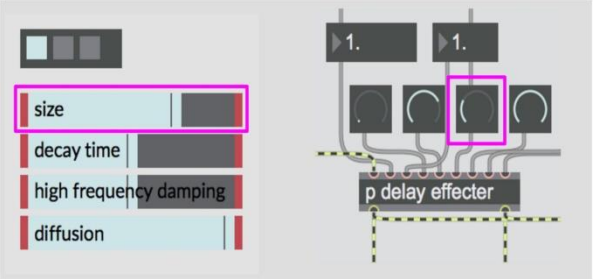

Figure 5. Reverb (left) and Delay(right) data map-ping.

[Figure 5] is the patch used to control effector by dial-1 and dial-2 data, and is effective on climax part of the performance as the reverb room size get huge with dramatic raise of the saxophone. The delay effector can be used with feedback. The two dial value 0 ~1023 is scaled to 0 ~100. The data value from the sound pressure sensor is 0~ 1023. When the sound sensor data is over 600 by blowing the instrument, the sound pressure sensor can control as on/o switch.

5.2 Controlling Multimedia Visual

Four buttons are set on body back to receive data from the performer's thumb finger on left hand. Octave but-ton one was used to control background color that seven rainbow colors and octave button two select three value: red, green, blue. Two effectors are applied on a two-octave button and the dial is in charge of change each effectors parameter.

Table 3. Visual data mapping

Function	Setting	Preset	Range
background color	rainbow colors	0-7	-
preset change	RGB data	0,1	
particle color	RGB color		0-127
particle number	0 -100	-	0-127
particle position	x, y position	-	0-36

The dial-1 controls particle color that can control data of each red, green, blue that data value 0~1023 from the dial is scaled to 0 100. Red, green, blue is changed by octave button one. Particle number is also controlled by the dial two that data value 0~1023 from the dial is scaled to 0~100. Turning the dial to 0 quickly gives an effect of sweeping out the whole pad built up. Figure 6 is shown changed particle number and colors. The dial and octave button are most effective when the performer is fingering the instrument with a left hand. The dial is suitable for quick data control. Particle position is changed x, y position by real saxophone finger style on Tele saxophone that range value is 0-36 such as C4 - C7 notes. We set like that x position: 0-12, y position : 13-26.The range of 27-36 is so high area, so it is not useful to control. These features will expand multimedia performances possibility with its ease of use.

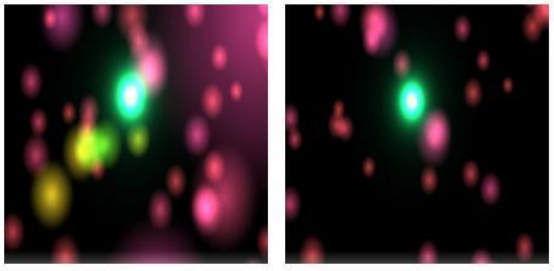

Figure 6. Particle controlling.

6. DISCUSS AND CONCLUSIONS

Many musicians were trying to express musical emotion through real instruments or various interface advanced. The development of saxophone interface is gradually used by musician. We have developed an audio-visual control sys-tem that saxophone interface and multimedia controller. In this paper, we describe the development of integrated musical interface with real instruments, and demonstrate its musical expression and various multimedia works. Further-more, using a hybrid interface by music player aims to find new paradigms into harmony between natural potential and developing technology.

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