AIRduino: An Inexpensive DIY MIDI Wind Controller

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ABSTRACT
The AIRduino is a hardware MIDI controller featuring a bi-directional breath pressure sensor that has the ability to control different parameters by inhaling and exhaling through the sensor. The controller also features four videogame-controller thumbsticks for addition expression, along with eight trimpots for extra versatility. Through these two unique types of sensors, the AIRduino allows the performer a versatile and unique method of controlling his or her music. This MIDI controller is easy to assemble from inexpensive parts, and is open source in both code and circuitry schematics.

Keywords
Arduino, MIDI, Electronic Instrument, DIY, Breath Pressure Sensor, Thumbsticks

1. INTRODUCTION
As both a musician and an avid computer programmer, I often see other musicians express confusion about their electronic instruments. While they can easily accomplish tasks with their instruments, they seldom understand how their hardware works. My goal through this project is to use the AIRduino to allow the performer to distinguish the AIRduino from this well-established hardware and software involved, even those with little technical understanding required to construct a MIDI controller.

2. AIRDUINO: ABOUT THE CONTROLLER
2.1 Arduino at the Heart of the System
As the name AIRduino implies, the MIDI controller is built around the Arduino Uno Microcontroller board. Because of the relatively small price of the board, casse of hardware implementation, and wealth of online resources, the Arduino infrastructure was an obvious choice. At a price of thirty USD at time of writing, the board is an affordable microcontroller. Additionally, Arduino is easy to use in development, as no soldering is required. Instead, the Arduino is equipped with pin slots that wires can be inserted into. Because knowledge of complex circuitry isn’t a prerequisite to working with the Arduino, it becomes much more accessible to musicians interested in building a MIDI controller. The tutorials and examples on arduino.cc work to further bridge the gap of technical understanding required to construct a MIDI instrument. By having access to a plethora of tutorials on the hardware and software involved, even those with little circuitry experience can easily find answers to any problem they might have while constructing their own AIRduino.

2.2 Bi-Directional Breath Pressure Sensor
When I started working on this project, I was determined to create an interface that was simple and utilitarian, yet had some unique function that couldn’t be found elsewhere in MIDI controllers. However, since my main instrument is Saxophone, the first few ideas for this project looked similar to the Electronic Wind Instrument (EWI) by AKAI. In order to distinguish the AIRduino from this well-established counterpart, the AIRduino was equipped with a specialized breath pressure sensor that is able to read both positive and negative pressures. What this means to performers is that the pressure sensor sends one MIDI continuous controller for blowing through the device, and a different one for inhaling. By using two MIDI continuous controllers, new possibilities open up for the electronic musician. By linking inhaling and exhaling to the volume of two synthesizers in a Digital Audio Workstation (DAW), it is easy to add dynamics to an otherwise static line of music. Additionally, by changing the pressure the sensor is seeing, it is easy to switch from one synthesizer to another.

2.3 Why Thumbsticks?
As the creator, I was concerned that the AIRduino MIDI controller be an expressive, versatile instrument. However, this couldn’t counteract the need to keep the individual components as inexpensive as possible. After the eight trimpots were implemented, the instrument still seemed lacking. It was then that the thumbsticks were added. Since they have the unique feature of resetting to their centered position when not being manipulated, they added a unique performance option to the MIDI controller. As an additional layer of control, a switch on the back of the AIRduino allows the performer to switch between two preset controls. When the switch is up, the thumbstick reads its X and Y position and sends out the data as individual MIDI Continuous Controllers. However, if the switch is flipped, the data are broken into four individual controllers, corresponding to up, down, left, and right. In this way, the thumbsticks can provide more nuanced control over a MIDI instrument, and reset all the controls to zero when not being manipulated.

3. SUMMARY
At around ninety USD for all parts and materials, the AIRduino MIDI Controller is an affordable tool for any performer wanting distinctive, versatile instrument. By using the Arduino infrastructure and simple, inexpensive parts, it is my honest wish as its creator that the AIRduino allow performers easy access to new methods of expression.

4. ACKNOWLEDGEMENTS
I would like to acknowledge my professor, Charles Nichols, for supporting me on this project. I would also like to thank the people at Arduino Software for their excellent support, and helpful tutorials and examples on arduino.cc. I would also like to thank Nathaniel Shiftmore at Shiftmore.Blogspot.Com for the idea to use the MIDI to USB cable. And finally, I would like to thank my father, for all the support he has given me, and for the idea of the bi-directional pressure gauge.

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1. INTRODUCTION
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Figure 1. A top-down view of the AIRduino. The four thumbsticks each send MIDI data based on their current X and Y positions, and return to the center when not being manipulated.

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2.4 The Advantages of the MIDI Port
The AIRduino connects to the computer through a standard MIDI connector. While sending MIDI information out the USB port on the Arduino board seems to be popular with other projects, it has inherent downsides. In many cases, special drivers have to be written to read the sent data. In other situations, multiple pieces of software are needed to convert to usable MIDI data. However, by implementing a MIDI port, the AIRduino requires no drivers or software. Instead, the AIRduino may be connected through an audio interface's MIDI port, or into a USB port from a MIDI to USB converter cable. This change allows the AIRduino to be plug-and-play compatible with any Windows or Mac system.

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8. REFERENCES
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ABSTRACT
The project, called Mórimo, aims to provide a platform for musical expression, with an emphasis on tactile properties of sound. It regards music in a very sensuous way - as a tactile composition perceived physically through the body. In addition to being heard, the human body may experience sounds also as haptic sensations, from subtle vibrations to shaking. This phenomena is produced by natural as well as artificial sources; and so it may also be experienced when listening to music. The idea of a tactile sound aesthetic experience brings an artistic view to this phenomena.

Among existing familiar projects, this work investigates the human body-music interaction, within the performative context in particular. This experience is shared between listener and performer. Additionally, both roles (listener and performer) can easily be taken through the body. In addition to being heard, the Human experience during his travel in Switzerland. He was lying inside a tent in sleeping bag, while it was raining outside. Although I didn't even touch or see the raindrops, the feel of the tiny drops was intimately tangible. The membrane of the roof of the tent was synchronized in my imagination with my feel of skin and became a sort of second skin. Satoshi developed the piece Sound capsule (2010), that is intended for one person lying inside this cocoon-like object and perceiving recorded sound via vibrotactile stimuli [3]. Few years earlier similar project called Sonic Bed, was conceived by Kaffe Matthews. This object seems to allow the listener to interact in more dynamic way, since it is not closed. The listener is invited to lie in foam mattress framed with the wood, that covers a series of loudspeakers and subwoofers. Person is immersed in low frequencies sounds, penetrating the body [2].

1. INTRODUCTION
Tactile sensations, especially those from the sound waves, very rarely play a role in artistic expression. There are only few known examples of touch based art works. Performers don't tend to explore this modality from many possible reasons. Provided audible and visual messages can be received by a number of people at the same time from a distance. It seems there is much more limitations with engaging the sense of touch, which is associated with direct skin contact. We don't expect to feel the sound, we don't think about it as a tactile energy, we don't even use such expression in our language.

The human perception is, however, an active process and it is able to being shaped by experience and expectations. Sense of touch can be developed with the conscious awareness of sound frequency perception. Evelyn Glennie (b. 1965) is a Scottish virtuoso percussionist, who aims to raise the consciousness about sound perception. Since she has been profoundly deaf at age 11, she learned to recognize the audible qualities through the haptic system. Glennie feels various frequencies with different parts of her body used as a resonance chamber. In fact, she teaches people, how to listen [1]. This example might be an inspiration for several artists/researchers, who would investigate "bodily listening" during the last decade. We explore this subject, creating another medium for tactile sound aesthetic experience.

2. RELATED WORKS
Satoshi Morita produced an object inspired by his experience during his travel in Switzerland. He was lying inside a tent in sleeping bag, while it was raining outside. Although I didn't even touch or see the raindrops, the feel of the tiny drops was intimately tangible. The membrane of the roof of the tent was synchronized in my imagination with my feel of skin and became a sort of second skin. Satoshi developed the piece Sound capsule (2010), that is intended for one person lying inside this cocoon-like object and perceiving recorded sound via vibrotactile stimuli [3]. Few years earlier similar project called Sonic Bed, was conceived by Kaffe Matthews. This object seems to allow the listener to interact in more dynamic way, since it is not closed. The listener is invited to lie in foam mattress framed with the wood, that covers a series of loudspeakers and subwoofers. Person is immersed in low frequencies sounds, penetrating the body [2].

2.1.1. Mórimo
Our issue is the ability of immersion in the sound matter in different context, that afford the listener to perceive a music performed alive and to receive the performers expression. It is not only about exploring body-music interaction. We investigate in new form of artistic expression and performer-listener relation.

3. DESIGN SOLUTIONS
The platform consists of a sound transmitter, intended for one listener. It acts as musical instrument controlled live by a performer through a haptic interface. The listener together with the performer are enclosed within one environment, where the studied interaction takes place.

The system is designed in a way that this experience include tactile, sonic and visual sensations and it is based on the direct involvement of its participants. Both of them stand vis a vis; the listener is resting his back on the membrane, immersing himself in the sound and looking at the performer, that manipulate this sound with a gesture. One can name this performance as playing the music on another's body in a distance.