The electrumpet, additions and revisions

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ABSTRACT
This short paper follows an earlier NIME paper [1] describing the invention and construction of the Electrumpet. Revisions and playing experience are both part of the current paper.
The Electrumpet can be heard in the performance given by Hans Leeuw and Diemo Schwarz at this NIME conference.

Keywords
NIME, Electrumpet, live-electronics, hybrid instruments.

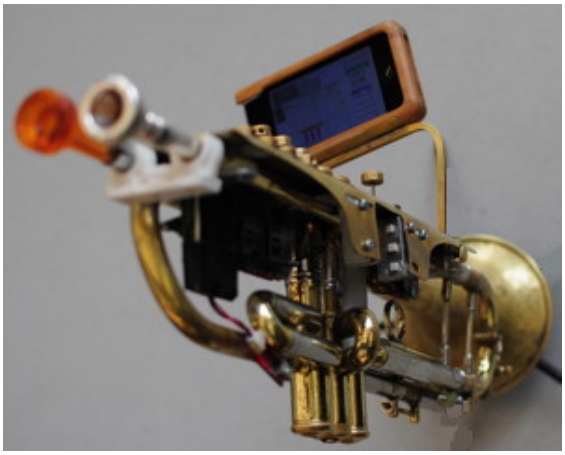
1. INTRODUCTION
Real hybrid instruments are a rare breed. They are familiar to augmented instruments but have some specific features. Hybrid instruments use the normal players technique on the normal instrument and use this as an advantage when playing electronically. This gives extra opportunities for expressive play. A good example of such an instrument is the only hybrid instrument presented at the previous NIME conference, the Overtone Fiddle by Dan Overholt [2].
It takes time and dedication to learn an instrument but also to improve the design to some final state. In this demo article some improvements and experiences are shared from the perspective of the artist / designer.

2. The Electrumpet
The Electrumpet was invented in 2008 and presented at the NIME conference in Pittsburg 2009 [1]. The purpose of the instrument is to combine acoustic and digital expression. The first version presented at Pittsburg has undergone a thorough revision. Except for obvious improvements on the stability of the construction and better looks there are also a number of improvements and embellishments on the original instrument.

2.1 Hardware additions since NIME 2009

2.1.1 Overview
Maximizing the expressive capabilities of the electrumpet has always been the driving force behind the development. Almost all embellishments of the electrumpet have been along this line.

2.1.2 Second mouthpiece
A second mouthpiece is added to the acoustic mouthpiece functioning as a breath controller. Choosing the form of a normal trumpet mouthpiece makes the switch between acoustic and electronic volume control very easy using the same embouchure. A plastic mouthpiece is used to reduce the weight.



Picture of the Electrumpet.

2.1.3 Infrared sensor
An infrared sensor is added measuring in the direction of the bell. The interaction is a digital analogy to playing the plunger. This muting technique made Ellington trumpet player Cootie Williams world famous. The infrared sensor is used for filtering techniques in analogy to the acoustic plunger gesture. [3]

2.1.4 Using fabric pressure sensors
Fabric pressure sensors have replaced some of the switches in the original design. This reduces noise and increases stability (no moving parts). It also opens the possibility for gestural use.
Self made pressure sensors from conductive solderable tape (Laird) and piezo resistive material (Eeonyx, 50 kOhm/square) are used to make these controllers [4]. Experimentation with different kind of rubbers has been conducted to create the optimal tactile feedback.
In total there are 10 fabric pressure sensors on the Electrumpet:

- Fabric pressure sensors cut in the optimal shape for this position replaced instable and fragile commercial sensors on the third valve.
- Four sensors are replacing noisy and instable switch buttons and are used in a Schmidt trigger kind of way.
- Four other sensors have been fitted with rubber to act as ‘moldable’ valve replacements.

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2.1.5 A new frame

Apart from the fact that the instrument looks much better because of the material used (brass instead of aluminum) the new Fablab produced design is also much more robust and that counts for a much better playing experience.

2.2 Other changes

2.2.1 Using XBEE's instead of Bluetooth

The Bluetooth connection in the last Electrumpet version suffered from jitter in latency. XBEE's seemed to be the best low cost easy implementable alternative. [5] These XBEE's (3 pairs) are used without microcontroller sensing the analogue inputs directly in the so-called API mode. Some tweaking and peaking (MAXMSP and FTDI drivers) is necessary to reduce the standard latency of this solution to an acceptable (stable) 15 ms. [5, 6]

2.2.2 Iphone instead of LCD

The LCD screen used in the previous version [1] is replaced by an iphone in shared desktop mode, which allows the player to see both the state of the sensors and audio information.
The software used for this configuration is iTeleport. Thus far it has been very reliable and the latency is small enough for use as a reference source.

3. Playing experience

In the 2009 paper there were some future improvements mentioned: Adding breath control (9.1), in depth sensor control exploration (9.2), musical notation of effect play (9.3).
The first is realized and described in 2.1.2, the second will be mentioned in this chapter and the third has not been part of investigation yet and it has to be seen if it will be implemented in the future.
It might be interesting to note that my original plans involved elaborate schemes to extract live sampled sounds and timed application of effects whereas the practice of using the instrument in a setting with acoustic (improvising) musicians urged me (musically) to keep working on the direct expressive capabilities of the instrument.

3.1 Hybrid play

Hybrid play has become increasingly important during the last three years. My original thought was that I would eventually use the Electrumpet as an expressive controller mainly but I found it harder to express myself manipulating recorded sounds then by manipulating the acoustic input directly.
The addition of the infrared sensor (see 2.1.3) is a typical feature that enables the combination of acoustic input and the live manipulation of an (suitable) effect.
The pressure sensors on the third valve of the trumpet are also used in this manner and can be played with the left hand while simultaneously playing the trumpet 'normally'.

3.2 Extended techniques

An implication of hybrid play is that the acoustic sound source forms an integral part of the electronic sound. Every acoustic musician playing with live electronics will feel the urge to alter his or her sound in order to cope with the electronics. In my case it is even more so. I form combinations of playing actions with gestural actions thus enhancing the acoustic effect. (eg exaggerated glissandi)

3.3 Integration of audio analyses

After the previous two headings this seems to be the logical next step. I use more and more audio analyses as part of the multisensory input that shapes my instrument. In a way this feels similar to using the sensors on the Electrumpet. It happens that I use extended techniques, microphone technique, sensors and analyses of the input signal all together to create the desired controlled expressive sound.

3.4 Monitoring

Hearing yourself is always important on stage. Normal monitoring did not suffice in my case though. The sound coming from a normal floor monitor is to diffuse to get a 'tactile experience' from. Therefor I use a studio monitor (Genelec 8030) on a microphone stand close to my ear for optimal feedback.

3.5 Visibility of gestures

It has been an eye opener to see the enormous effect the addition of the infrared sensor has had on both the perception of the public and of fellow musicians. It shows that it is wise to pay attention to semiotics if we want to design successful recognizable instruments. [7]
Asking around after a concert in the past would find a lot of the audience clueless where some of the 'strange' sounds came from: "It was probably the guitar player". (You have to consider here that the Electrumpet is most of the time played in a large ensemble of 14 musicians (small Big Band)).
Introducing the hand gestures with the infrared sensor lets the public connect a visible gesture to an auditory experience. The impression is that this also helps in appreciating and recognizing other forms of sound manipulation done with the electrumpet. [7, 8].

4. ACKNOWLEDGMENTS

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