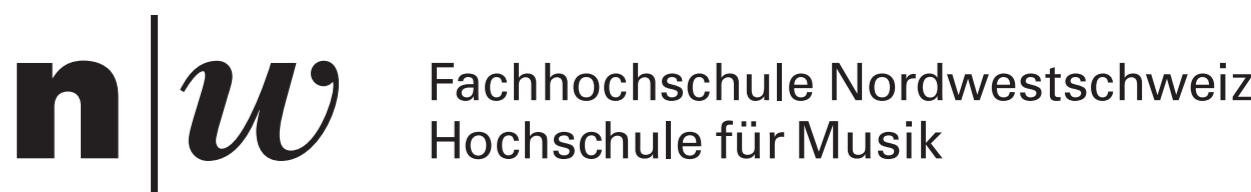
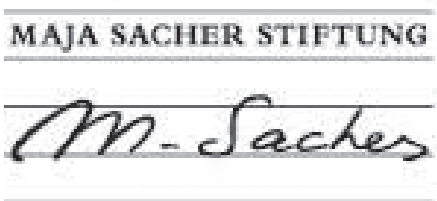


# Recorderology

## Web application using Web Audio API and research concerning playing techniques of recorders

Ulrike Mayer-Spohn, Keitaro Takahashi  
FHNW Basel, Elektronisches Studio Basel, Switzerland



### Aim

To enhance the knowledge and experiences of musicians, especially composers, in regards to the recorder family and to encourage their creative activities.

To develop a new interactive documentation method for music research, which integrates audio samples with their corresponding notation and explanations.

### Instrumentation

Analysis of the correlations between the mechanisms and the actual results of sound production by means of four primary components (instrument model - air - mouth - fingers).

Interaction between artistic research involving collaborations with composers and musicians and scientific research including audio analysis to investigate sound characteristics, e-learning and data-mining.

### Web Application

Employment of a large audio database to describe the mechanisms and correlations of different playing techniques and different recorders.

Interactive Graphic User Interface, which is developed with HTML5, JavaScript and Web Audio API, simplifies the navigation and access to the database.

#### E-LEARNING

- e-Learning comprises a number of educational / training modules based on internet technology.
- Compared to Face to Face (FTF) instruction or paper based documentation, e-learning modules are more interactively adapted towards a particular goal depending on individual learner's demands.
- The advantage of e-learning can be applied to musical study (instrumentation, composition, organology and sound analysis), where versatility is an important factor due to the unique demands of musicians and their creative work.
- Our employment of e-learning aims to interpolate self-study into the exchange with other musicians (in rehearsals) and to expand creative possibilities by optimizing the time and energy used for instrumentation study.

#### ISSUES CONCERNING RECORDER INSTRUMENTATION RESEARCH

- Diversity of instruments: The recorder family consists of significantly more sizes and models compared to other families of instruments. This increases the complexity of the correlations between their sound production, playing methods, notation and composition.
- Representation of the connection between notation, sound production and sound result.
- Effective accessibility to the various data.

#### RECORDEROLOGY

- Analysis of playing techniques by four components (model - air - mouth - fingers)
- Investigation of the relationships between the components and the sound results
- Determination of how the diversely produced sounds are associated with the combinations of the components.
- Construction of a database consisting of a large amount of material concerning various playing techniques using diverse recorder instruments
- Development of a web application with a Graphic User Interface, which presents the collected sample database arranged by the different instruments and components.

#### USER INTERFACE

On the main page, two players are installed in parallel. The user is able to assign a set of samples of different playing techniques or instruments to each player in order to investigate the sensitive differences between them.

- select one specific note
- the selection menu appears in a circle around the note and shows its possible variations of the playing technique as if a magnifying glass is focussing on the details of the timbre.
- play the samples

#### THE PROCESS OF OUR WEB APPLICATION

GUI	behavior
1 select a PlayingTechnique from the menu	show available instruments
2 select an instrument	draw notes/description and load all requested audio data from database
3 select a note	show a dynamic or variation menu
4 select a dynamic and a variation	play a specific audio data
5 select another PlayingTechnique or select another instrument	delete loaded audio data and go back to 2
6 open analysis window	draw waveform of previously played audio data and show analysis results

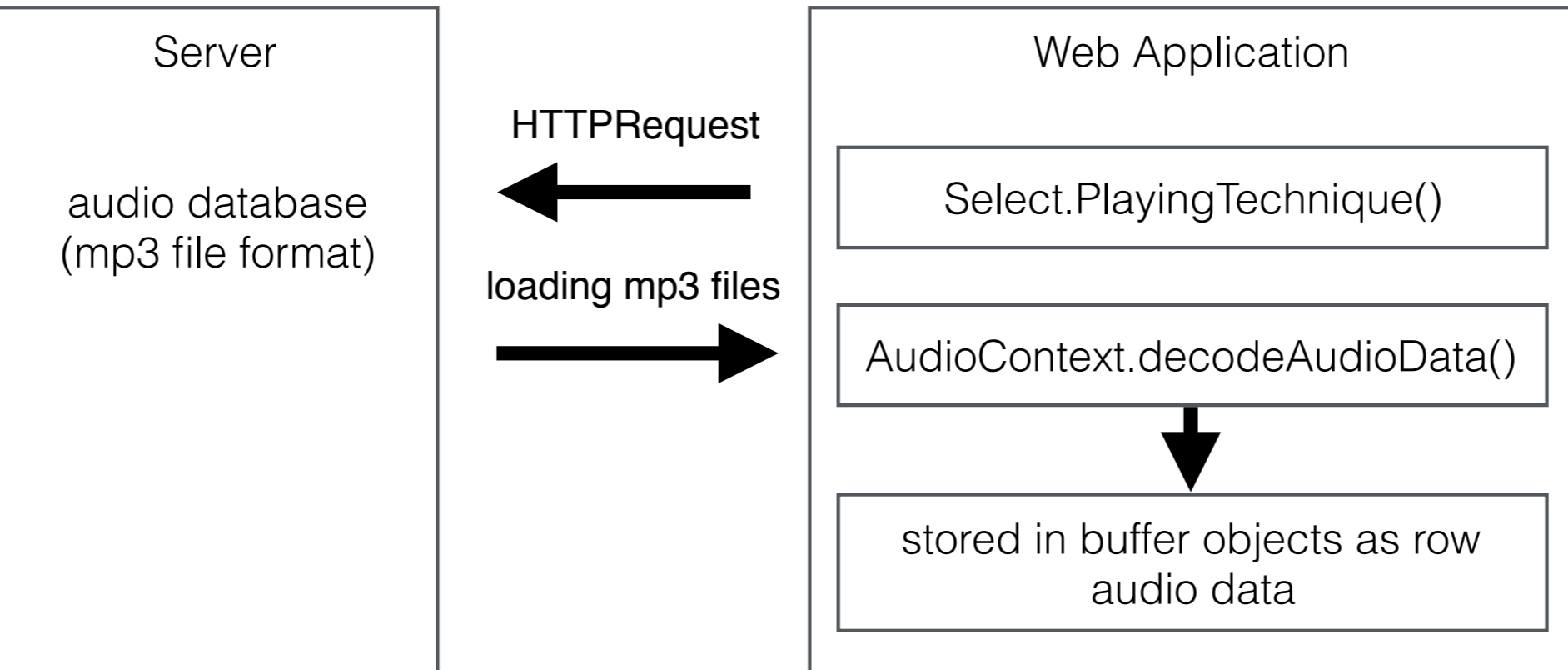
#### SAMPLER SYSTEM - WEB AUDIO API

We defined a labeling rule, which identifies each audio file and illustrates its information about pitch, instrument, dynamic and so on, in order to simplify the data retrieval from our database:

- ▶ instrument number\_tuning pitch reference (Hz)\_pitch number (Midi)\_playing technique number\_variation number\_dynamics (p or f)

Following the labeling rule, the name of audio file and buffer object in JavaScript are defined as shown in the following examples:

- ▶ Audio file name: 15\_442\_77\_3\_1\_p  
Buffer object in JavaScript: Audio\_15\_442\_77\_3\_1\_p



Many audio files of a particular playing technique for each instrument are loaded to each corresponding buffer object at once (in process 2, Table: The process of our web application) and are stored until they are discarded (in process 5).

#### PROVISORY TEST RESULTS

Recorderology is being tested by several composers around the world in a number of projects involving recorders. It enables them to prepare sketches of their new compositions before the first meeting with the musicians. The first feedback shows, that the presentation of the audio samples in context with the notation improved significantly the understanding of the various timbres of the instruments.

▶ Keitaro Takahashi  
Surge (2013)

▶ Luis Codera Puzo  
oscillation ou interstice (2013)

▶ Christophe Schiess  
11 estaciones (2014)

#### CONCLUSIONS

We expect this application to enable users to develop their understanding and increase their experience of the instruments in a way that will stimulate them with new artistic ideas. Until now we received a good response from the composers through their actual creative work, as they could translate their artistic ideas into music and represent them in practical and precisely notated scores.

So far, we have attempted to describe the differing playing techniques based on the combination of the components. However, our sampler system does not cover all of the small variations and users still have to investigate them by themselves.

#### FURTHER DEVELOPMENT

- Implementation of an automatic data retrieval module, which represents related playing techniques, variations, and score examples from various contemporary compositions, based on the criteria of audio analysis and audio categorization.
- The application of this system is open to other instrument families such as strings, percussion, keyboards, brass instruments etc.

The current version of our web application is available from the link below:

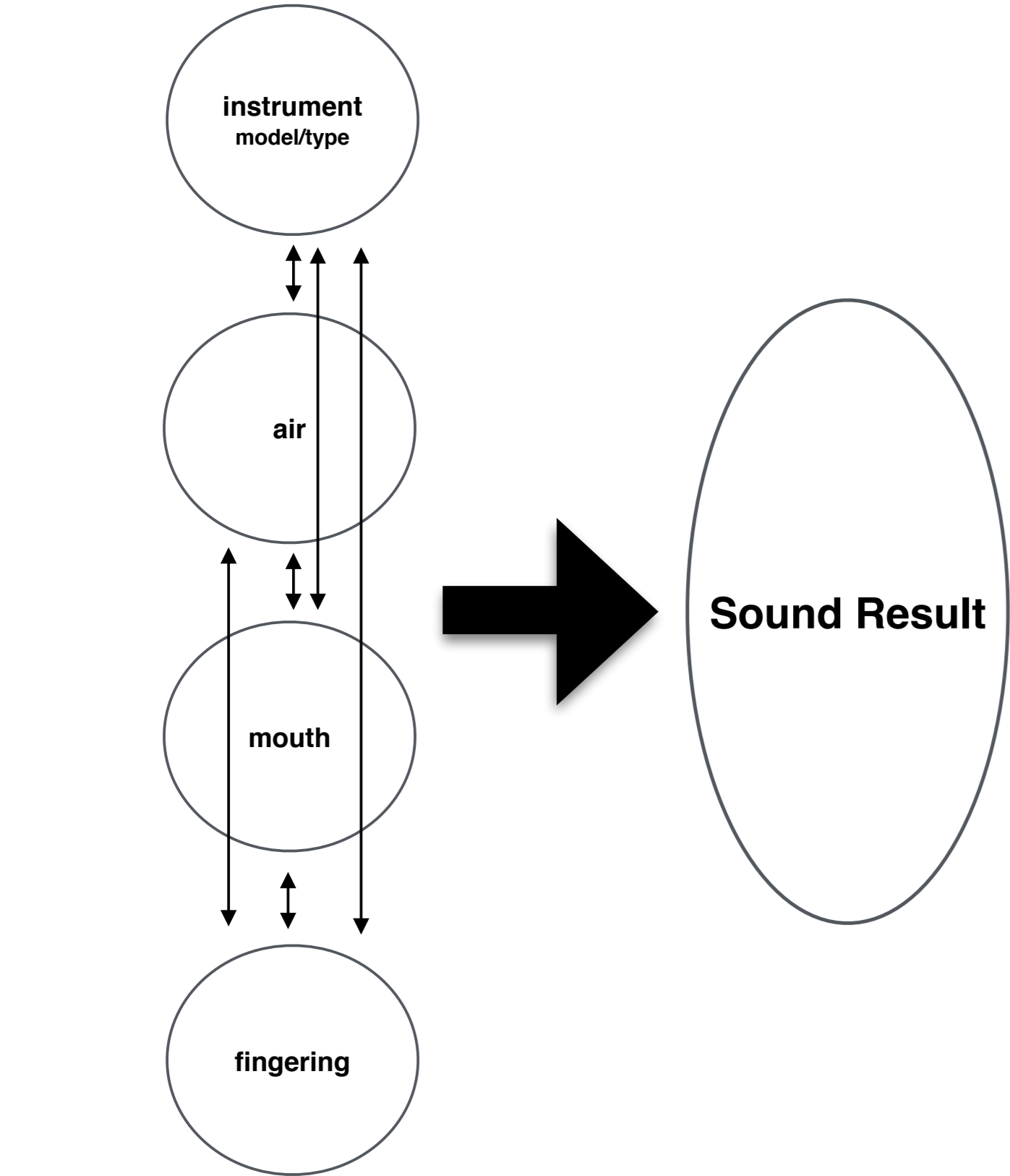


#### ACKNOWLEDGMENTS

We give thanks for support to the Elektronisches Studio Basel and Forschung und Entwicklung Dept. of FHNW Basel and gratefully acknowledge the financial support of Maja Sacher Foundation for the RecorderMap project during 2013-2014.

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This figure illustrates the relationship between the 4 components. A particular sound result is produced by a specific combination of the 4 indicated components.