Organ Augmented Reality: Audio-Graphical Augmentation of a Classical Instrument

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ABSTRACT

This paper discusses the Organ Augmented Reality (ORA) project, which considers an audio and visual augmentation of an historical church organ to enhance the understanding and perception of the instrument through intuitive and familiar mappings and outputs. ORA has been presented to public audiences at two immersive concerts. The visual part of the installation was based on a spectral analysis of the music. The visuals were projections of LED-bar VU-meters on the organ pipes. The audio part was an immersive periphonic sound field, created from the live capture of the organ sounds, so that the listeners had the impression of being inside the augmented instrument. The graphical architecture of the installation is based on acoustic analysis, mapping from sound levels to synchronous graphics through visual calibration, real-time multi-layer graphical composition and animation. The ORA project is a new approach to musical instrument augmentation that combines enhanced instrument legibility and enhanced artistic content.

Keywords: Augmented Musical Instrument, Augmented Reality, Organ Augmented Reality (ORA), Real-Time Visualization, Sound to Graphics Mapping

INTRODUCTION

Augmented musical instruments are traditional instruments that are modified by adding controls and additional outputs such as animated graphics (Bouillot et al., 2009; Thompson et al., 2007). The problem with usual approaches to instrument augmentation is that it generally makes the instrument more complex to play and more complex to understand by the spectators. The enhanced functionality of the instrument often distorts the perceived link between the
performer’s actions and the resulting sounds
and images. Augmentation is likely to confuse
the audience because it lacks transparency and
legibility.

In addition to augmenting traditional
instruments with new controllers, like the
hyper-kalimba (Rocha et al., 2009) which
extends the kalimba (an instrument from the
percussion family), Augmented Reality is
also used to create new musical instruments.
Some of these instruments mimic real music
de devices like the Digital Baton (Marrin et al.,
1997), replicating the traditional conducting
baton, or the AR scratching\(^1\) imitating a DJ’s
vinyl scratch. Other musical instruments that
use Augmented Reality are totally innovative
and are not based on existing devices. The
Augmented Groove (Poupyrev et al., 2001)
is an example of such a device where novice
users manipulate a physical object in space to
play electronic musical compositions. The main
difference between creating novel instruments
and extending existing instruments is the level
of familiarity with the instrument. Instrument
extension seems more suitable for experimented
performers rather than novice ones due to the
experience level with the instrument and pos-
sibly a wider range of control.

Musical instrument augmentation is
interesting because it extends a traditional
instrument, while preserving and enriching
its performance and composition practices.
The Organ and Augmented Reality (ORA)
project focuses on a rarely stressed use of
augmentation, the enhanced comprehension
and legibility of a music instrument without
increasing its complexity and opacity. Our
research on output augmentation follows the
same purposes as (Jordà, 2003), making the
complexity of music more accessible to a larger
public. Jordà’s work focused on the playing
experience; similarly, we intend to improve
and facilitate the listening experience. These
principles have been used by Jordà et al. (2007)
for the design of the ReacTable, an augmented
input controller for electronic musical instru-
ments. The ReacTable is a legible, graspable,
and tangible control interface, which facilitates
the use of an electronic instrument so as to be
accessible to novices. Its use by professionals
in live performances confirms that transparency
is not boring and is compatible with long term
use of the instrument.

This paper presents the issues and technical
details of the ORA project and performance,
the augmentation of an historical church organ
for a better understanding and perception of
the instrument through intuitive visual and
audio outputs. It is based on the following
achievements:

- The visuals are directly projected onto the
organ pipes (not on peripheral screens),
- The visual augmentation is temporally
and spatially aligned: the visual rendering
is cross-modally synchronized with the
acoustic signal and the graphical projec-
tion is accurately aligned with the organ
geometry,
- The augmentation preserves the traditional
organ play. Traditional compositions as
well as new artworks can be played on the
augmented instrument,
- The augmentation offers a better under-
standing of the instrument’s principles by
showing a visualization of hidden data such
as the spectral content of the sound and its
position inside the instrument.

The aim of the ORA project was to make
an audio and visual Augmented Reality on the
grand organ of the Sainte Elisabeth church in
Paris. The ORA project was supported by the
City of Paris “Science sur Seine” program
for bringing science closer to citizens. The
pedagogical purpose was to present the basic
principles of sound and acoustics, and illustrate
them through audio and graphics live perfor-
mances. The two concerts were complemented
by a series of scientific posters explaining back-
ground knowledge and specialized techniques
used in the ORA project. The project involved
researchers in interactive 3D graphics and
computer music, a digital visual artist, an organ
player and composer, and engineers.\(^2\) ORA has
been presented to public audiences through two
visually and acoustically augmented concerts