Dooremi: a Doorway to Music

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ABSTRACT

The following paper documents the prototype of a musical door that interactively plays sounds, melodies, and sound textures when in use. We took the natural interactions people have with doors — grabbing and turning the knob and pushing and puling motions — and turned them into musical activities. The idea behind this project comes from the fact that the activity of using a door is almost always accompanied by a sound that is generally ignored by the user. We believe that this sound can be considered musically rich and expressive because each door has specific sound characteristics and each person makes it sound slightly different. By augmenting the door to create an unexpected sound, this project encourages us to listen to our daily lives with a musician's critical ear, and reminds us of the musicality of our everyday activities.

Author Keywords

Door, bend sensor, pressure sensor, user recognition, Max MSP, ambient music, sonic interaction design, site specific installation

ACM Classification

[500] Applied computing Sound and music computing, [300] Human-centered computing User centered design, [300] Hardware Tactile and hand-based interfaces.

1. INTRODUCTION

This work lies at the intersection between sonic augmentation and sound awareness, and is also in some extent, inspired by memory research. In the literature, especially from the NIME community, an important place is given to musical augmentation of everyday objects [2, 7, 3], either to simply give a voice to objects through technology, in a sustainability and recycling perspective, or in the context of performing art. Some applications involve inventing new ways to interact with the objects [15], while others invest the natural affordance of objects to create new experiences using natural interactions [5]. The Dooremi project enters in this second category. Here we use surprising sounds and music to raise phonological awareness based on one door at a specific location.

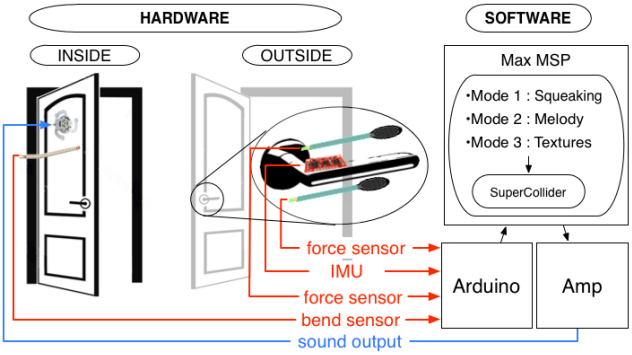

Figure 1: Dooremi system diagram

Dooremi's interaction design is inspired by sound installation arts such as Max Neuhaus' "Three to One": a site specific sound installation designed for a staircase [6]. The visitors experience sound as they move on stairs to change sound qualities [8]. Such works often approach a space in which the sonic experience might come as a surprise. In addition, composer and revolutionary musician John Cage's view on placing silence, noise, and sound at the core of music and the process of listening at the heart of music is philosophically relevant to our work [1]. For him, "[w]herever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating". We sought to raise the same kind of awareness in sounds through interactions with a door. The sound design for Dooremi is influenced by Schaeffer's idea on acousmatic music and Smalley's spectromorphology in thinking about how door users' sound experience becomes compelling enough to raise phonological awareness of space [11, 12].

The shamelessness of the technology used by the Dooremi project was inspired by previous projects using the natural affordances of regular doorknobs such as the Touchknob [4] that detects a user's grasp using touch sensors embedded in the knob and also the project Touché [10] from Disney Research that uses Swept Frequency Capacitive Sensing technique for gesture recognition.

The choice of using a door for this project was also motivated by research on the influence of spatial environment on people's cognition. The mnemonic *Method of loci* [9] consisting of mentally placing thoughts in real precise known location in a familiar building is known since antiquity and is still used by a lot of memory contest champions. On the other hand it has been shown that walking through doorways might be linked with our brain forgetting things we had remembered[14] which let us suppose a cognitive reset, the doors serving as 'event boundaries' in the mind [13]. Doors appears to be an important cognitive object in the subconscious part of our brain.

NIME'16, July 11-15, 2016, Griffith University, Brisbane, Australia.

Motivated by this shared quality of music and spatial cognition, we present Dooremi, an interactive musical door that changes the user's experience of traveling though spaces.

2. DOOREMI

2.1 The System

We used a bend sensor placed on the hinge to detect the rotation angle of the door, pressure sensors to detect some parameters of the way the user grabs the handle, and an inertial measurement unit (IMU) on the handle to measure the rotation of the handle. A future version will be entirely embedded in the knob and will also contain a capacitive sensing system to detect first touch and more precision on the user's grip. The signals are read with arduino which communicates with Max MSP via OSC. For mode 3, Max sends data to a SuperCollider patch that generates different layers of ambient sound by granular synthesis. Max or SuperCollider then output the sound signal which is amplified and sent to a transducer directly attached on the back of the door. In doing so, the door is also used as a "speaker" which makes the system more embedded. In addition, the resonance and vibratory feeling on the door reproduce more closely the sensation of regular door cracking.

Figure 2: A person interacting with Dooremi and details of the handle one stripped with and without protective cover

2.2 Interaction Design

We designed three modes of interactions. The *first mode* plays a squeaking door sounds among a library of 15 sounds. The angle of the door controls the scrubbing of the sound and to appear like a normal squeaking door. The user can choose between very different sounds such as an old castle door or an elevator door. In its current state, the system is set up to change sound randomly several times a day to bring an effect of surprise to the user.

After several days of playing different squeaking sounds, our office-mates started to complain and asked us for more pleasant sounds to be played. We then made a *second mode* that plays a melodic sequence in which the time is also controlled by the door swing angle. Each note corresponds to a specific angle of the door so that the melody is played forward during opening and backward during closing. The audio samples we used have been recorded from a music box. In addition to the bend sensor, the *third mode* also takes into account parameters of the way the user grasps the handle. The signals from the two pressure sensors and the IMU placed on the handle shape the texture of an ambient sound being played. The swing angle is used to shift the sound pitch. We placed the three sensors to detect different gripping techniques so that the system varies with individual differences in how the users interact with the door. In this mode, we aimed to produce different type of sounds altogether when different person use the door. The swing angle in this mode is used to shift the pitch of the sound.

2.3 Evaluation

We asked several people to test the system and recorded their reactions. One comment was that people can feel the vibrations from the handle and the door surface and they really felt the sounds come from the real door itself. People who started to seriously play the door as an instrument recommended to add haptic feedback for the second mode.

3. CONCLUSION AND FUTURE WORK

The implementation of Dooremi is an ongoing process. Improvements to the interface design, mapping strategy, and applied sensors are being considered. For instance, we are currently working on a second form factor entirely embedded in the door knob itself and will also contain a capacitive sensing system to detect first touch and more precision on the user's grip. We hope to enhance the door users' surprise experience through sounds with such improvements.

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