Providing a feeling of other remote learners' presence in an online learning environment via realtime sonification of Moodle access log

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ABSTRACT

When people learn using Web-based educational resources, they are sitting in front of their own computer at home and are physically isolated from other online learners. In this study, an Open Sound Control based prototype system for sonification of the access log of Moodle, a popular e-learning system, has been developed as a way to provide a feeling of other learners' presence. To generate sound from access log in Moodle, we designed a mapping of the log data to sound parameters.

Keywords

e-learning, online learners, Moodle, Csound, realtime sonification, OSC (Open Sound Control)

1. INTRODUCTION

When people learn using online educational resources that are provided by Learning Management Systems or other e-learning related systems, they are sitting in front of their own computer at home and are physically isolated from other online learners. In some courses they are getting in touch online with each other for doing some particular group work assignments, but most of the time they must do their own learning tasks alone. In other courses simply the assignments and quizzes for individuals are provided, so the learners are alone all the time from the beginning until the end of the course.

In order to keep the learners' motivation, it helps much to feel other learners doing the same learning activities and to feel others belonging to the same course. Communicating formally or informally with other learners via Social Networking Services or something is one way for learners to get such a feeling, though in some aspects it might sometimes disturb their learning. Sonification of the access log of the e-learning system could be another indirect way to provide such a feeling.

2. ACCESS LOG OF MOODLE

Moodle[1] is one of the most popular Web-based opensource systems that are used as online learning environments. Almost all the activities that a user do are recorded in a Moodle database table named `mdl_log`. The table includes the information about every step of each user's activities such as time stamp, user ID number, user's IP address, course ID number, type of the module used, action type, accessed URL, etc as shown in Table 1.

The method that is executed in Moodle for inserting those data into the log table is defined as `add_to_log()` in a Moodle system file of `lib/datalib.php`, so it is appropriate to add some triggering command for realtime sonification just before the line of

```
$DB->insert_record_raw('log', $log, false);
```

in `add_to_log()`.

3. SONIFICATION OF LOG DATA

To generate sound from the access log in Moodle, we set a mapping of the access log information to sound parameters of a note. The single note, an element of the sound, that we are currently using is a sine wave oscillation. We used a mapping as follows:

- time stamp : note-on timing[1]
- user ID number : frequency
- user's IP addresses : pan (sound placement)
- module type, action type : (static) frequency deviation

Currently we use the frequencies of 5-TET tones, e.g., $f = 440 \times 2^{\frac{n}{5}}$ Hz where $n = -22, -21, .., 0, ..6, 7$. The value of n is determined by ID number, that means we can use different frequencies corresponding to 30 persons ranging from approximately 20Hz to 1200Hz. As these frequency zones (from one tone to the next tone) are wide enough, one can perceive independent sinusoidal tones that can be identified as from independent learners. And the frequency is slightly (2% or less) shifted according to the frequency deviation value. To determine the frequency deviation value, we calculated the degree of similarity of the module type and the action type compared to 'course view' (the most typical one as in the first line of Table 1) using `levenshtein()`[2], a PHP function to calculate Levenshtein distance between two strings. This function returns 0 if the two strings exactly match. If a user does various kinds of activities in a short time, the generated sound is like $\sin(2\pi f(1+\delta_1)+\theta_1)+\sin(2\pi f(1+\delta_2)+\theta_2)+\sin(2\pi f(1+\delta_3)+\theta_3)+...$ where frequency deviation δ_k is defined as the `levenshtein()` value (20 or less) multiplied by 0.001, θ_k denotes an arbitrary

[1]only for sonification of the existing log data. For realtime sonfication, the sound notes are instantaneously triggered by users' Moodle operation.

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Table 1: Example of Moodle log in the database table

id	time	userid	ip	course	module	cmid	action	url	info
87079	1350808027	6626	133.95.aa.bb	1	course	0	view	view.php?id=1	1
87080	1350808031	6626	133.95.aa.bb	5267	course	0	view	view.php?id=5267	5267
87081	1350808071	6626	133.95.aa.bb	5267	page	921	view	view.php?id=921	104
87082	1350808075	6626	133.95.aa.bb	5267	course	0	view	view.php?id=5267	5267
87084	1350808076	6626	133.95.aa.bb	5267	resource	917	view	view.php?id=917	149
87085	1350808406	7446	117.55.cc.dd	8944	quiz	1159	view summary	summary.php?attempt=936	168
87086	1350808411	7446	117.55.cc.dd	8944	quiz	1159	close attempt	review.php?attempt=936	168
.....									

```
$c = new OSCClient(); $c->set_destination("receiver.host.name", 47120);
$c->send(new OSCMessage("/moodlesound", array($freq,$pan,$amplitude,$vib)));
```

Figure 1: Triggering command in the sender written in PHP

phase value. They sound as a whole like a sinusoidal wave with the amplitude being slowly (like $f\delta_k$ Hz) modulated.

The sound to be generated is designed so that the listeners (online learners) can feel other online learners are also doing learning activities at the same time as they are, and also the sound is intended to be soft and non-disturbing to the users who are doing learning activities. If a learner is simply viewing the content pages, the generated sound is a simple solid sinusoidal wave tone, but the learner is doing more interactive activities such as posting to an online discussion forum, or making an attempt at an online quiz, the generated sound is a mixture of sinusoidal wave tones with slightly (2% or less) different frequencies.

4. SENDING SOUND PARAMETERS VIA OSC TO CSOUND

Csound[3, 4, 5] is used for sound generation, and the values of sound parameters are sent via Open Sound Control[6] in real time from Moodle server to Csound. The sender is written in PHP using the class defined in `OSC.php`[7]. The triggering command in the sender is like Figure 1.

The receiver is written in Csound launguage using Opcodes like `OSClisten`[8] as shown in Figure 2.

The source code of the Csound and PHP scripts and the sound examples are on the web[9]. The sound examples were created using the 5-TET scale, that means frequency of every tone was quantized to the nearest frequency of a 5-TET tone. After that the frequency was slightly modified according to the frequency deviation value mentioned above. Each tone has a long attack time (1 second) and decay time (9 seconds) as indicated in Figure 2, so if users do many activities in a short time, a number of tones are seamlessly overlapped that somehow indicates the users (learners) are active.

```
<CsoundSynthesizer>
<CsOptions>
-odac -iadc -d
</CsOptions>
<CsInstruments>
sr     =  44100
ksmps  =  100
nchnls =  2
0dbfs  =  1
gil  OSCinit   47120
#define DEST #"/moodlesound"#

turnon 1000

instr   1000
 kfreq init 0
 kpan init 0
 kamp init 0
 kvib init 0
 next:
  kk OSClisten gil,$DEST,"ffff",kfreq,kpan,kamp,kvib
  if (kk == 0) goto done
  event   "i", 1002, 0, 10.0, 0.05, kfreq, kpan, kamp
 kgoto next  ; process all events in queue
 done:
endin

instr 1002
 k1 linseg 0,  1.0,1, p3-1.0,0
 a1 oscil  k1*p4, p5, 1
outs a1*p7*p6, a1*p7*(1-p6)
endin

</CsInstruments>
<CsScore>
f1 0 8192 10 1 ; sine wave table
f0 3600  ; dummy
e
</CsScore>
</CsoundSynthesizer>
```

Figure 2: Receiver written in Csound language

5. CONCLUSIONS

An OSC-based prototype system for sonification of the access log of the e-learning system has been developed as a way to provide a feeling of other learners' presence. To generate sound from the access log in Moodle, we used a mapping of the information in the log table to sound parameters. We will further investigate what kind of sonification is nice for learners to listen to by trying a variety of mapping of data to sound. For that, we are planning to let online learners evaluate the generated sound from our system.

6. REFERENCES

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`http://csound.sourceforge.net/`

[4] Csounds.com `http://www.csounds.com/`

[5] Csound at FLOSS Manuals
`http://en.flossmanuals.net/csound/index/`

[6] The Open Sound Control
`http://opensoundcontrol.org/`

[7] Open Sound Control for PHP
`http://opensoundcontrol.org/implementation/open-sound-control-php`

[8] OSClisten
`http://www.csounds.com/manual/html/OSClisten.html`

[9] `http://tkita.net/paper/nime2013/`