AN OVERVIEW OF SOUND AND MUSIC APPLICATIONS FOR ANDROID AVAILABLE ON THE MARKET

Gaël Dubus, Kjetil Falkenberg Hansen and Roberto Bresin
KTH Royal Institute of Technology
\{dubus,kjetil,roberto\}@kth.se

ABSTRACT

This paper introduces a database of sound-based applications running on the Android mobile platform. The long-term objective is to provide a state-of-the-art of mobile applications dealing with sound and music interaction. After exposing the method used to build up and maintain the database using a non-hierarchical structure based on tags, we present a classification according to various categories of applications, and we conduct a preliminary analysis of the partition of these categories reflecting the current state of the database.

1. INTRODUCTION

Rapid technological advances have given rise to a new generation of mobile phones. These electronic devices, called smartphones, have thoroughly attracted the general public. Since they now possess sufficient computational power to support more advanced uses, new ways of interacting with technological artifacts have been enabled. Multimodal interaction design has been easier through the concentration of auditory, visual and haptic sensors and actuators in small and portable devices. As a consequence, mobile interaction design could grow up in a much more flexible way than for previous generations of phones. In particular, mobile applications dealing with sound and music interaction represent a flourishing market nowadays.

Among the various existing platforms for mobile development, Android has become one of the most successful operative system and possesses an extremely active community of developers. According to the latest estimations by Gartner [1], Android is by far the most popular operative system for smartphones: it approximately doubled its share of the worldwide smartphone sales in the space of one year, rising from 25.4% in the third quarter of 2010 to 52.4% in the third quarter of 2011. The total number of applications approved for publication on the Android Market exceeded 360 000 at the end of October 2011 [2], representing the second largest volume on the market of mobile applications behind Apple’s App Store, which could rapidly be overtaken by Android according to the current trends.

In spite of this dominant position, and although there exist an interest from several research communities – among which we firmly believe we can count the SMC network, there is currently no comprehensive overview of Android applications dealing with sound and music to our knowledge. In this article we introduce a study of the current state of the market, which aims at showing both what could be done and future potential areas. This work is necessarily an ongoing effort and is currently being performed in the frame of the Soundpark project presented in the next section. Since it is still at a preliminary stage, the main purpose of the present article is to expose the type of information that can be extracted and stored in a large-scale application database, as well as the structure of this database.

2. THE SOUNDPARK: CREATING INTERACTIVE EXPERIENCES FOR HEARING IMPAIRED

The Soundpark project has been urged by two trends. First, the number of people world-wide with hearing impairments is growing. This is due to several reasons, such as an aging population [3], increased listening habits as technology makes music omnipresent [4], and a progressively louder sound environment [5]. At the same time, common hearing aids are becoming more sophisticated and new technologies for hearing assistance are emerging. Second, smartphones are used for telephony and messaging, but also for listening to music, playing games and experiencing multimedia services on the Internet. From a related study within the project we have seen that this trend is not limited to persons with normal hearing.

Not everyone with hearing impairments can or wish to use the sound-based services available. The Soundpark project is about developing applications that can enable and attract more users to partake in these services. The main goal is to encourage active listening for hearing impaired users. One anticipated outcome is a proposal for novel methods for hearing training and self-assessment of hearing, based on causal interaction with sounds.

The Soundpark encompasses design of new applications as well as methods for interacting with existing services such as streaming sound and applications from the commercial market. The presented state-of-the-art mapping of sound-based applications is thus highly necessary for getting an overview, and it is an important undertaking that will both describe the diversity of sound applications, and in the next step be a resource for future application developers, to encourage and promote inclusive design. Even outside the scope of research projects, such a database may
help developers identify potential areas for introducing new applications gaining both the SMC field and the consumers.

3. METHOD

3.1 Building up a database of applications

A first step in order to create the application database is to define inventory methods and criteria for inclusion. For this purpose, we could take advantage of resources offered by Google Play 1, where almost all applications for Android are centralized, together with some basic tools for analysis and classification. Initially, the database consisted of applications belonging to two groups: some that were already known to the SMC community to be interesting (e.g. ScenePlayer using the library libpd [6], Reactable mobile [7]), and others resulting from a browsing process of the Google Play application database according to several relevant keywords (e.g. sound, music, audio, hearing, noise). In the latter case, no formal criterion was used for including the search results in the database: this was decided after skimming through the description of the application. On the other hand, in order to maintain a reasonable scope of the database, the following groups of application were systematically excluded:

- Strictly speech-oriented applications (e.g. text-to-speech, phone call recording, quotes collection)
- Ringtone collections
- Alarm clocks
- Sound or music-related wallpapers and screen savers
- Instrument learning without sound interaction (e.g. collection of guitar tabs and chords)
- Remote controls for music players
- Radio podcasts and streams
- Music file downloaders

Subsequently, for every application in the initial pool, the database was progressively expanded with related applications as indicated by the following features from Google Play: “More from developer”, “Users who viewed this also viewed” and “Users who installed this also installed”. The same decision strategy as described above was used for this step. This whole expansion process was then applied recursively to every added application.

Using this method, one can assume that the number of applications in our database will grow exponentially, at least in the first phase of its formation. Due to the dynamic nature of the market, it cannot be expected that the expansion will stop completely, but it might slow down at some point. We therefore anticipate to use this database as a tool evolving over time. At any rate, the objective of the present study is to collect a fairly large sample of applications to allow for statistical analysis exploring trends in the data.

3.2 What information can we extract?

Because we expect the database to become large – at present there are more than 1000 entries, it is crucial to ensure a reflection of the type of information that will be useful in the future to be extracted already at an early stage of the project. One of the meaningful features is to be able to gather the applications in categories in order to draw a map of the current state of the market. A certain type of classification (“Categories”) is already offered by Google Play, where an application is placed into one single category. However, the groupings are very coarse and not suited to our needs: applications that can be of potential interest for this study can either be labelled as “Music & Audio”, “Media & Video” or “Entertainment”, or even as “Tools”, “Education” or “Health & Fitness”. Even using a finer classification, we could predict that arranging applications following the same organizational principle, i.e. assigning a single category to a given application, would not be convenient: as an example, a music player including an equalizer should at least belong to the group ‘Multimedia player’ and to the group ‘Equalizer’. A greater precision is required, as well as a more flexibility, therefore we chose to use tags (non-hierarchical keywords), which is a widespread concept in the area of information systems, in particular as a web application feature.

3.3 Assigning tags

The process of assigning tags is performed manually after reading the description of the application on Google Play and testing the application on a compatible device. A semantic analysis using a systematic scan of the descriptions in order to provide some tags in an automatic way was considered, but we decided not to implement it. This choice was motivated by our observation that the description often does not reflect the contents of its corresponding application. Even the application name is sometimes misleading: as an example, the application Audio Equalizer is an animated wallpaper displaying a sort of spectral analysis of the microphone input in real time, but by no means an equalizer. In addition, many descriptions were found to be lacunary, imprecise or poorly written. By keeping the tagging process exclusively manual, we have the entire control over the quality of the extracted information.

The semantic information assigned to data (i.e. metadata) is therefore human-generated, as it is most often the case for tags used in Music Information Retrieval [8]. Because it corresponds to one’s contextual knowledge and interpretation of the data, it is essentially partial and subjective. The current set of tags present in the database resulted from the interpretation by the authors of the functions and properties of the applications. It corresponds to the perception of trends in the pool of applications that are considered interesting. Thus, this set is meant to evolve, either due to a novel perception of these trends by the authors (or by a newcomer to the project) or by an actual evolution of the application market. As a simple illustration, we can consider two applications: a guitar tuner and a piano tuner. The authors might have considered at first to assign the only tag ‘Tuner’ to both applications. Subsequently dis-

---

1 http://play.google.com, previously Android Market
covering a multitude of other applications dedicated to the

tuning of guitars and pianos, they might want to make a
distinction between the two groups, thus creating the new
tags ‘Guitar tuner’ and ‘Piano tuner’. Thereby, the list of
tag assigned to a given application is not meant to be con-
sidered as terminated whensoever, but can be updated re-
peatedly. The structure of the database, presented in Sec-
tion 3.4, allows for such a continual expansion. At the cur-
rent stage the list of tags includes such diverse keywords as:
‘OSC’, ‘Multitouch’. A list of tags currently used in the
database is shown in Table 1.

3.4 Structure of the database

The project database was created using the MySQL rela-
tional database management system. Its current structure
is shown in Figure 2: it includes a table for applications, a
table for tags and a table for developers. The primary key
of each table is an integer identifying respectively each ap-
lication, tag and developer in a unique way. In addition, each table contains a field name which is a string of char-
acters.

The table for applications includes the following addi-
tional fields: a float indicating the price of the application,
and four strings of characters corresponding respectively
to a hyperlink to a download location in the market, the
name of the market (in the future, other platforms than An-
droid could be considered), a description, and a field for
comments. Moreover, it also includes a field which is a
foreign key pointing to the developer identifier in the table
for developers in a many-to-one relationship: a developer
can be linked to several applications, while an application
only has one developer. Finally, the application identifier
is linked to the tag identifier in a many-to-many relation-
ship: an application can be labelled with several tags, and
tags can be used to describe several applications.

This structure accommodates future needs, and other infor-
mation can easily be added when necessary. For example,
the average rating by users and the number of downloads
could give an idea of the popularity of a given application—
though bearing in mind that one should not consider these
simplistic indicators as a hard and fast measure of its inter-
est. Finally, since many developers publish two versions of
their applications (the full paid version and a free version
either with restricted contents or with advertisements), a
one-to-one relationship could be added between such ap-
lications.

4. OUTCOMES OF THE ONGOING STUDY

4.1 Original expectations

The original expectations of the authors, based on a pre-
liminary informal observation of a large variety of appli-
cations, are reported in [9]. The first impression was that
most applications are either very simple (e.g. sound ef-
effect button, drum emulator, piano keyboard) or represent
the porting of pre-existing computer programs (e.g. mul-
timedia players, equalizers). Only few of them were ob-
served as being especially original, or as making full use
of the characteristics of the mobile environment and smart-
phone’s features.

4.2 Classification of the applications into categories

The present study provides an example of how the infor-
mation contained in the database can be extracted to ex-
amine higher-level characteristics of the market. We aim at
conducting an elementary classification of the applications
according to their function. For similar reasons as when
assigning the tags, as exposed in Section 3.3, the choice
of the different categories of applications is realized manu-
ally. In a similar way as for the set of tags, it is not meant to
be necessarily static but could evolve over time. The cate-
gories presented below are not mutually exclusive, i.e. it is
possible for a given application to belong to several cate-
gories simultaneously (e.g. ‘Multimedia players and sound
recorders’ and ‘Equalizers and sound processing’ for a mu-
sic player including an equalizer).

4.2.1 Instrument emulators

A fairly popular use of sound-based applications for smart-
phones is emulation of musical instruments. The objective
is straightforward: without mastering the interaction with a
real instrument, and without having an actual instrument at
disposal, users should be able to create music that resem-
bles to some extent an authentic performance. The quality
of such an application can be judged by the yardstick of
the sound quality, which depends on the synthesizer that
is used, but also in relation to the nature of the interaction
between user and artifact. Some applications aim at emu-
lating a similar type of interaction as in reality (e.g. iBone
- the Pocket Trombone: in one mode, the user blows into
the microphone to generate tones) while others use a com-
pletely different modality (e.g. Virtual trumpet: tones are
produced through interacting with the touchpad). A large
variety of instruments are available, ranging from guitars
to accordions, drums, theremins or pan flutes.

4.2.2 Other applications related to instrumental practice

This category includes metronomes and instrument tuners,
for which many similar applications can be found. An-
other direction is game-oriented instrument learning pro-
grams, such as Angel Piano., where the user is encouraged
to practice in a game scenario, and thus potentially acquire fine motor skills accordingly to the interaction with the corresponding instrument emulator.

4.2.3 Multimedia players and sound recorders

There exist a large number of multimedia players, among which music players and audiobook players. The great majority of them do not differ much from usual multimedia players in non-mobile contexts. Some players make use of the built-in accelerometer to associate hand gestures to specific commands (e.g. AndirMusicPlayer (Free): shaking the device stops and resumes playback). The function of sound recorders is reduced to the one of a dictaphone. While some advanced options are available in some cases (e.g. RecForge Pro - Audio Recorder, which allows for change of playback speed, sample rate, output format), there are very few possibilities for interaction with these applications.

4.2.4 Equalizers and sound processing

Some music players have an integrated equalizer, but there exist stand-alone equalizer applications as well, which can filter the sound output from any application running simultaneously (e.g. Equalizer). Other applications are dedicated to sound processing such as Acoustics Filter which takes microphone input and performs noise cancellation, amplification and applies various filters to the signal in real-time.

4.2.5 Audio analysis

These applications analyze incoming signal from the microphone and perform audio analysis, using diverse visualization techniques to display the results. Examples of sound processing include spectrogram (AndroSpectro Lite), sonagram (Audalyzer), sound level meter (Sound Meter) and sonar (ActivePinger) can be found on the market.

4.2.6 Sound banks and sound effects

A very large proportion (cf. Table 2) of the applications in the database correspond to audio effects or sound banks (often referred to as “sound boards” on Google Play). In this category, interacting with the application is often reduced to pushing a simple button. Because of their simplicity, many applications are extremely similar to each other; as an example, there are 34 different applications playing only the sound effect of an air horn in the database.

4.2.7 Synthesizers

A wide array of applications can be classified as ‘Synthesizers’, even though many of them belong likewise to other categories such as ‘Instrument emulators’. This is for instance the case for the large part of synthesizers using a virtual piano keyboard as control interface (e.g. Augur-52 Synth, AnalogSynthesizerDEMO). However, this category contains also a certain number of applications using more unconventional and creative interfaces, often exploiting thoroughly the potential of the mobile phones: Ethereal Dialpad (synthesizer) and Plasma Sound HD use of the entire touchpad screen as space for audio-haptic interaction, MonadPad OJ - Online Jamming is based on the same principle and has an additional social dimension, making it possible to interact with other users in jam sessions over the Internet. Finally, Synthoid - Analog Synthesizer provides an example of controlling various parameters of a synthesizer using both the smartphone’s accelerometer and touchpad.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Tag</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument emulator</td>
<td>Touchpad input</td>
<td>DJ</td>
</tr>
<tr>
<td>Microphone input</td>
<td>Accelerometer input</td>
<td>Mixing</td>
</tr>
<tr>
<td>Gyro input</td>
<td>Multitouch</td>
<td>Loops</td>
</tr>
<tr>
<td>Sound processing</td>
<td>Sound visualization</td>
<td>Rhythm generator</td>
</tr>
<tr>
<td>Spectrogram</td>
<td>Spectrum analyzer</td>
<td>Drum machine</td>
</tr>
<tr>
<td>Audio analysis</td>
<td>Computer program</td>
<td>Step sequencer</td>
</tr>
<tr>
<td>Sound FX</td>
<td>Sound synthesis</td>
<td>Sound game</td>
</tr>
<tr>
<td>Whistle</td>
<td>Instrument tuner</td>
<td>Percussion</td>
</tr>
<tr>
<td>Accordion</td>
<td>Guitar</td>
<td>Trumpet</td>
</tr>
<tr>
<td>Xylophone</td>
<td>Piano</td>
<td>Trombone</td>
</tr>
<tr>
<td>Vuvuzela</td>
<td>Theremin</td>
<td>Sonification</td>
</tr>
<tr>
<td>Bell</td>
<td>Metronome</td>
<td>Farting machine</td>
</tr>
<tr>
<td>Multimedia player</td>
<td>Audiobook player</td>
<td>Granular synthesis</td>
</tr>
<tr>
<td>Music player</td>
<td>Sound bank</td>
<td>Mosquito repellent</td>
</tr>
<tr>
<td>Siren</td>
<td>Noise</td>
<td>Amp simulator</td>
</tr>
<tr>
<td>Soundscape</td>
<td>Controller</td>
<td>Delay/echo</td>
</tr>
<tr>
<td>Sequencer</td>
<td>Instrument learning</td>
<td>Filter</td>
</tr>
<tr>
<td>MIDI</td>
<td>OSC</td>
<td>Stomp box</td>
</tr>
<tr>
<td>Air horn</td>
<td>Drums</td>
<td>Recorder machine/Dictaphone</td>
</tr>
<tr>
<td>Equalizer</td>
<td>Rattle toy</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Tags used in the application database.
4.2.8 Sequencers and samplers

Like ‘Synthesizers’ presented in the previous section, ‘Sequencers’ applications often include a piece of software such as a synthesizer or a sampler or both. The interface can be minimalistic (e.g. nanoloop, MusicGrid) or more advanced (e.g. PocketBand Uloops Lite, Budgerigar - Midi Sequencer).

4.2.9 Controllers

Applications in this category do not incorporate sonic interaction by themselves, but are used to send sensor data to an external application running on a computer. The interaction can be basic (e.g. andOSC sending raw data from accelerometer, gyroscope and touchpad) or more elaborate (e.g. TouchOSC providing advanced touch controls to send data such as faders, rotary control, toggle buttons and XY pads). These applications support usual standard communication protocols for sound and music control (OSC, MIDI).

4.2.10 Sound programming engines

The only application in this category that was found in the Google Play database is ScenePlayer, a porting of PureData on Android. Other experimental portings can be found on the Internet (e.g. PdDroidParty, Pd webkit), as well as a project for porting SuperCollider. These applications correspond to the most advanced stage of interactive sonic design on mobile platforms, representing the porting of tools that are used for sound design and prototyping in a non-mobile context.

4.3 Preliminary analysis

At the current stage of the project, over 1000 applications have been included in the database but the labelling process (assigning tags) is far from being complete, having been carried out for approximately 150 entries only. As a consequence, no advanced statistical analysis was performed. Only the percentage of applications belonging to the different categories presented in Section 4.2 was computed as a preliminary indicator and is presented in Table 2. In line with our original expectations, we observe that the large part of the applications are very simple, belonging to the category ‘Sound banks and sound effects’. However, as it was mentioned throughout the description of the different categories, there exist some applications that are specifically designed for the mobile context, taking advantage of the features of the phone.

5. DISCUSSION

We initiated a process to create a database of applications dealing with sound and music interaction. This work is still at an early stage, it will be developed further in a near future in order to build a state-of-the-art of sound-based applications for mobile devices. We chose to start this process by considering applications running on Android, but the database was designed in a way that would allow to include applications running on other platforms.

<table>
<thead>
<tr>
<th>Category</th>
<th>Proportion in the database (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument emulators</td>
<td>14.7</td>
</tr>
<tr>
<td>Other app. rel. to instrumental practice</td>
<td>8.0</td>
</tr>
<tr>
<td>Multimedia players and sound recorders</td>
<td>20.7</td>
</tr>
<tr>
<td>Equalizers and sound processing</td>
<td>8.0</td>
</tr>
<tr>
<td>Audio analysis</td>
<td>6.0</td>
</tr>
<tr>
<td>Sound banks and sound effects</td>
<td>39.3</td>
</tr>
<tr>
<td>Synthesizers</td>
<td>8.7</td>
</tr>
<tr>
<td>Sequencers and samplers</td>
<td>8.0</td>
</tr>
<tr>
<td>Controllers</td>
<td>1.3</td>
</tr>
<tr>
<td>Sound programming engines</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 2. Distribution of the categories of applications in the current state of the database (tagging process ongoing).

Conducting a comprehensive listing and categorization of sound and music applications for mobile devices and maintaining this database up-to-date may appear infeasible tasks, due to the constant growth of the pool of applications and to the dynamic nature of this market. Indeed, this project – for which both tasks have to be conducted in parallel – may represent an excessively ambitious undertaking for a restricted group of researchers. To address this issue, and since this work can be beneficial for many other researchers, the database has been designed in the perspective of being integrated to a collaborative website in the style of a wiki. Many examples of successful websites based on the involvement of a large community can be found throughout the Internet, among which SensorWiki.org, a project aiming at reviewing the main types of sensing technologies used in musical applications. Following this example, we believe that this work offers interesting perspectives for further development by involving research communities such as the SMC network.

Mobile applications that bring original ways of interacting with sound and music can be hard to spot in the multitude of other applications flooding the market. Since the database is intended to contain a large number of entries, some tools making use of quantitative characteristics of the applications such as those presented in Section 3.4 (average rating by users, total number of downloads) could be developed in the future. In this way, popular applications could be automatically detected in the perspective of a further evaluation of their “interest”. Although this is a subjective concept, it could be advantageous to create a specific tag in our database to assign to applications of particular interest as assessed by members of the research community.

6. CONCLUSION

In this paper, we introduced a method to build up a database of sound-based applications running on the Android platform. We decided to use a non-hierarchical structure based on tags to ensure flexibility when organizing the database. After having described the structure of the database, we
presented different categories into which applications can be classified. Finally, we conducted a preliminary analysis of the distribution of applications according to these categories.

Acknowledgments
The Soundpark project is funded by PTS, Post och Telestyrelsen.

7. REFERENCES


