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CONTENT-BASED MUSIC RETRIEVAL OF IRISH TRADITIONAL MUSIC VIA A VIRTUAL TIN WHISTLE

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1. INTRODUCTION

We present a mobile phone application associating a virtual musical instrument (emulating a tin whistle) to a content-based music retrieval system for Irish Traditional Music (ITM). It performs tune recognition, following the architecture of the existing query-by-playing software Tunepal (Duggan & O'Shea, 2011). After explaining the motivation for this project in Section 2 and presenting some related work in Section 3, we describe our proposed application in Section 4. Section 5 discusses current shortcomings of our project and potential future directions.

2. MOTIVATION

Tunepal[1] (Duggan & O'Shea, 2011) has become a popular tool among practitioners of ITM, with more than 20 thousand monthly active users. It allows searching for a tune by playing a short excerpt on an instrument. Tunepal transcribes the audio into a sequence of notes, and attempts to identify the tune by finding the most similar sequence in a database of existing tune notations.

Obtaining a good transcription of the recorded audio is challenging, especially as Tunepal is often used in rather noisy environments (typically a pub where an Irish session is taking place). By offering a similar tune recognition system using a virtual instrument instead of a real one, thus requiring no audio input, we believe that our app can be a useful alternative or complement to Tunepal.

Several reasons guided our choice of the tin whistle. First, its dimensions and the simplicity of its fingering, consisting of combinations of six tone holes, make it a good fit for the limited input capabilities of a smartphone. Second, the tin whistle is among the most popular instruments in ITM (Vallely, 2011), and most practitioners have at least some rudiments of this instrument and will thus be able to use the app.

3. RELATED WORK

A number of projects have investigated the use of mobile devices as musical instruments. Essl & Lee (2017) offer a recent survey of existing projects. An early example of mobile musical instrument is the "Ocarina", released in 2008 (Wang, 2014). In addition to on-screen buttons simulating the finger holes, it uses the microphone as input so that breath controls articulation, and accelerometers so that motion controls vibrato. Our app does not aim at allowing expressivity, but merely at recognizing tunes. Hence, only the multi-touch screen is of use to us.

The websites Folk Tune Finder[2] and Musipedia[3] offer the possibility of query-by-playing using a virtual in-browser piano keyboard. Our app allows for a more portable solution, and more importantly emulates an instrument more familiar to ITM practitioners.

The SoundTracer app (Wallace & Jensenius, 2018) allows query-by-gesture. Accelerometers are used to record vertical motion of the device, by which a user imitates a pitch contour, that is then searched for within a database of automatically transcribed recordings of Norwegian folk music. The main difference with our approach is that the type of interaction chosen is not modelled on the playing of an existing instrument, and that the search space consists of automatic transcriptions of audio recordings.

4. APP STRUCTURE

This section describes the architecture of the app, dubbed "Virtual Flute", as illustrated in Figure 1.

4.1 Virtual instrument

The main interface displays 6 buttons disposed in the fashion of the tone holes of a tin whistle, as can be seen on Figure 2. A pitch-mapping following the standard fingerings is defined, and used both to record the played sequence and to play the corresponding pitch as feedback to the user. Non standard fingerings are ignored.

The form factor of modern smartphones allow for the buttons to be placed in a realistic layout. The distance between the centres of the top and bottom holes on a tin whistle was measured to be about 11 cm. A screen with ratio 16:9 and diagonal 5.5 in, found in a number of smartphone models, has a height of about 12.2 cm.

4.2 Tune recognition

A query is obtained from the touch screen interaction described above, in the form of a pitch contour. Then, the rest of the app functions in a similar manner to Tunepal

[1] https://tunepal.org

[2] https://www.folktunefinder.com

[3] https://www.musipedia.org/

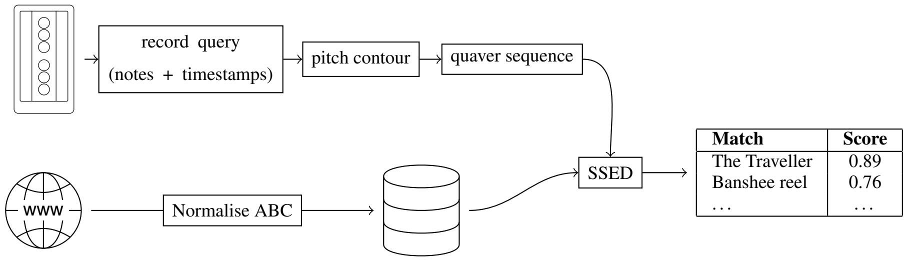

Figure 1: Architecture of the "Virtual Flute" app

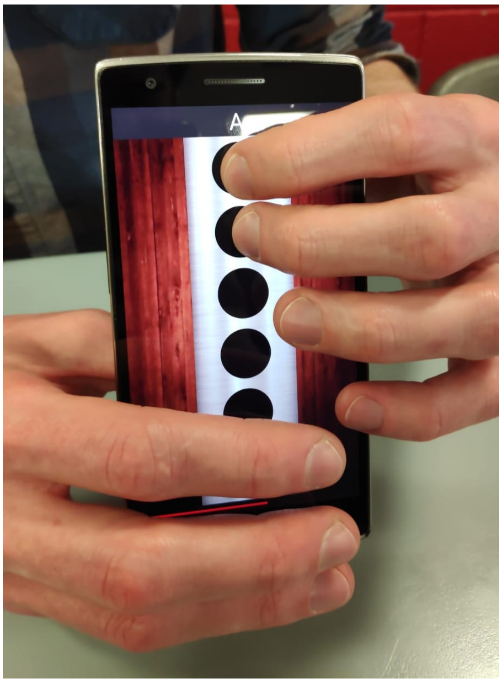

Figure 2: Photograph of a user holding the phone as a tin whistle to use the app. The text bar at the top indicates the note being played. The red bar at the bottom shows the recording progress.

(Duggan & O'Shea, 2011), itself based on the MATT2 algorithm described in (Duggan et al., 2009) which is now briefly described. The first step is to find the quaver duration q by finding the most common note duration in the recorded sequence. The pitch contour is then quantized into a quaver sequence: a note of duration d and pitch p is transformed into *round*(d/q) quavers of note p.

A database of tunes is built from the collection from The Session.[4] The ABC notation used in this collection is normalised to sequences of quavers. The recorded query is compared, using substring edit distance (SSED), to all the tunes in the database. Results are sorted in order of ascending SSED, and the 15 closest ones are returned to the user. In its current state, the database is embedded in the app, allowing offline search. Future iterations could communicate with the servers of Tunepal or Musipedia.

[4] `https://thesession.org`

5. CONCLUSION AND FUTURE WORK

Although we do have a working prototype of the app, we have, as of yet, not asked for feedback from potential users. An important next step would be to follow approaches from User Centered Design (Tanaka et al., 2012).

Duggan et al. (2009) reports a retrieval accuracy of over 90% for MATT2, which is at the core of the app. Other melodic similarity measure than the SSED could be used (Janssen et al., 2017), and investigating the impact of this choice on the performance of the app would be worthwhile.

Our code is open source, and available along with a compiled APK file.[5] We intend to make it available from an app store when it reaches a further state of development.

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[5] `https://github.com/pierrebeauguitte/VirtualFlute`