Lunar Tabs: An Intelligent Screen Reader Friendly Guitar Tab Reader

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Abstract

Lunar Tabs is an intelligent screen reader friendly application that makes the millions of guitar tabs online accessible to persons with low vision. An accessible user interface is designed for different use scenarios including for desktop platforms and mobile devices. Methods are developed to convey repetition information in music effectively over a screen-reader, and capabilities to use the application in several hands-free modes are prototyped. User studies are conducted to evaluate the technology's potential impact in the blind/low vision community.

Keywords

Blind/Low Vision, Accessible Music Learning, Intelligent Accessible Interfaces

Introduction

Over 50 million people worldwide play the guitar. Music has been associated with improved creativity, scholastic gains and increased quality of life (Hargreaves, Marshall, North). Guitar tablature (or "tabs" for short) is a popular notation where a music piece is represented as notes on a guitar fretboard.

Recently, there has been an explosion of user-generated electronic guitar tabs online, with millions of tabs now available. This enables almost anyone to begin playing their favorite songs with just a guitar and the associated guitar tab that they can download online for free.

For the 285 million people worldwide with low vision, however, the existence of these tabs is of limited use ("Visual impairment and blindness"). Many blind/low vision users try to learn guitar purely by ear, but the process is time-consuming and frustrating. A significant effort has been made to build systems that convert sheet music to Braille Music, a format usable with refreshable Braille displays (Inthasara et al; Borges and Tomé; Langolff, Jessel, and Levy). Braille Music, however, is optimized for sheet music rather than guitar tab files. Guitar tab is a unique notation that is easy to understand and more intuitive to many guitarists than sheet music. Also, Braille music requires special hardware displays, which can be costly. Many users would like a software solution to access the litany of guitar tabs that already exist online for free.

While several guitar tab readers exist, none of the available solutions is as accessible to persons with low vision as they could be. Motivated with the goal of helping musicians who are blind or have low vision, we propose Lunar Tabs, a guitar tab reader designed from the ground up to be accessible and optimized to work with screen readers. Lunar Tabs takes as input an electronic guitar tab in a well-structured format and generates a sequence of text instructions for

playing the piece. For example, if an “A” appears in the tab, Lunar Tabs might output {“Play third string second fret, quarter note”}. A person with low vision could use Lunar Tabs to learn any song they wanted by harnessing the expansive tab libraries online.

This paper presents the Lunar Tabs system and user interface design, approaches to conveying repetition information in the music, and hands-free modes for the application. We conducted user studies to evaluate the technology’s impact with several users of screen readers.

Discussion

System Specification

Figure 1 shows the Lunar Tabs system data flow. A tab loader takes as input guitar tabs in structured format such as Guitar Pro (*.gpx) or Power Tab (*.ptb). An instruction generator component generates text instructions on how to play the guitar tab. The text instructions are then fed into the user’s screen reader software.

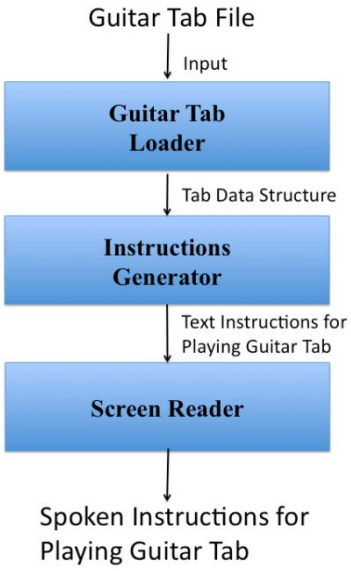

Fig. 1. Lunar Tabs System Flow Diagram

Guitar tabs can contain a lot of information, and design attention must be paid to what instructions should be presented to a user using a screen-reader, so as not to overload the user with information. The instruction generator component must generate sufficient instruction so the user can learn to play the tab but not be verbose. In vanilla Lunar Tabs, instructions are displayed to the user music measure by measure. Instructions are generated for each musical event (e.g. notes, chords, rests) in the measure. By default, instructions contain a description of the musical event, duration of the event, and playing effects (e.g. vibrato, tapping) for the event.

Instructions can be generated in two modes – "String/Fret" mode and "Note/Chord" mode. In String/Fret mode, the hand configuration of a playable event (e.g. note, chord) is presented in terms of the strings and frets to be played. Thus, the screen reader might indicate playing "third string, open fret" for playing a "G." Many intermediate to advanced guitar players, however, are conversant in higher-level elements of music such as chord progressions, keys, and note names. For these types of players, we also built a "Note/Chord" mode. This mode uses a database of chords and note names matched to hand configurations to generate the actual name of the chord or note signified by a particular hand configuration. Thus, if a "G Major" chord is coming up in the piece, instead of providing the verbose hand placement description, this mode succinctly tells the user about the "G Major" chord. This does rely on the user knowing the hand configuration for this chord and thus is a feature targeted at more advanced users.

User Interface Design

People traditionally have kept guitar tabs on their desktop/laptop computers, though an increasing number of users are using mobile devices for music learning. Thus, we prototyped both a Java Swing version that is usable with Java Access Bridge on all major desktop platforms (Figure 2a), and a version of the software for mobile devices (Figure 2b) currently on Android.

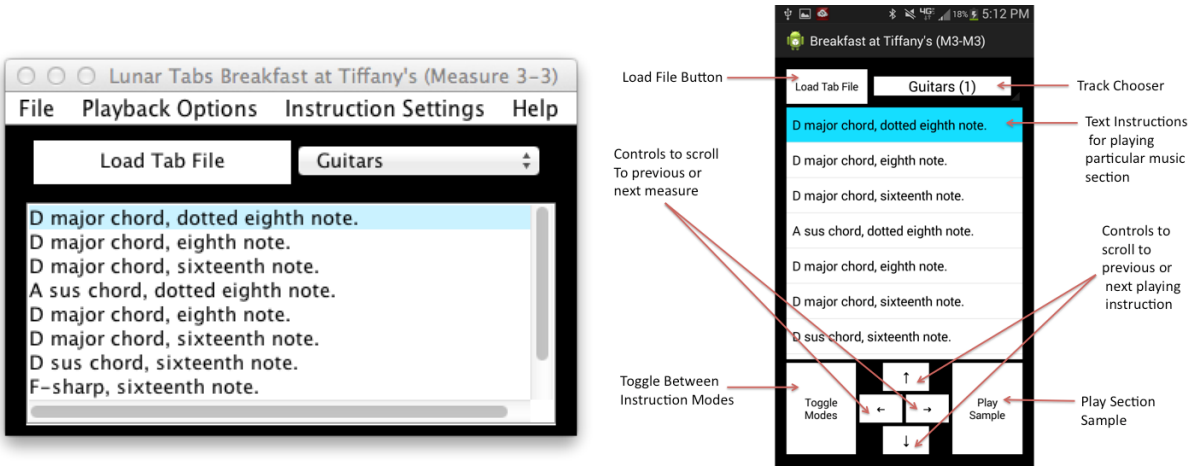

Fig. 2. GUI for Lunar Tabs Desktop application (left) and Mobile Device application (right)

The user interface for each version is designed to maximize functionality for a blind user. The Java Swing version features a grid layout that is completely usable via the keyboard "tab" key. All components are compliant with accessibility standards regarding clear labels and tool tip text so that a screen reader will pick them up when the user accesses a component. The mobile device version features a similar top-down layout that is usable via the "Talkback" (also known as "Explore by Touch") feature that provides the user a two-tap interface. The first tap only reads the component label, and the second tap actually performs the click action. Key components are placed on the edges of the screen, where low vision users normally look first for application controls.

Large and clear components on each version allow the user to load a guitar tab file from their file system, choose an instrument track in the file to generate instructions for, and see the instructions in either String/Fret or Note/Chord mode. A list presents playing instructions for a musical measure. The Java Swing version features hotkeys that allow the user to switch between modes, scroll back and forth between musical measures, as well as synthesize and play a MIDI sample of the currently viewed musical measure to hear a sample of what the measure sounds

like when played as written. In the mobile version, these hotkey features have corresponding buttons whose labels can be accessed via explore by touch.

Advanced Technical Features: Repetition Segmentation Mode

A person without visual impairments can scan the entire musical piece at once, identifying key repetitions. For a user with visual impairments, such capability must be facilitated through the instruction presentation. We experimented with algorithms to intelligently identify repetition in a music piece for presentation with a screen reader.

Users often find it helpful if unique measures are only taught once over a screen-reader. For instance, one arrangement of the song Breakfast at Tiffany's (originally by Deep Blue Something) contains 118 measures of acoustic guitar instruction. However, the rendition contains only 10 unique measures. The time required for scrolling through and hearing playing instructions for those 10 unique measures over a screen-reader pales in comparison to scrolling through and hearing the entire instruction stream.

Computer Music has studied approaches to identifying musical repetition such as Chrochemore's algorithm and the Local Boundary Detection model (Cambouropoulos). Drawing inspiration from such ideas, we developed Repetition Segmentation, a mode in Lunar Tabs that (1) finds the unique measures in the piece, (2) identifies how many times they repeat, and (3) presents the unique measures in chronological order while informing the user of number of subsequent repetitions. This allows users to get an understanding of the key unique measures in the piece and their occurrence frequency.

To estimate timesaving of Repetition Segmentation, we defined the compression ratio of an instrument track as: **Compression Ratio = 1 – (#Unique Measures / #Total Measures)**

Since a user's time in learning in piece over a screen-reader is dominated by the number of screen-reader instructions read out to the user, the compression ratio measures the time savings of Repetition Segmentation in terms of the number of saved audio playing instructions. Tested on a data set of guitar tabs from Ultimate Guitar's "Top 100 Downloaded Guitar Tabs," the repetition segmentation mode achieved favorable theoretical timesaving with a mean compression ratio of 0.58. We estimate the algorithm can save a user nearly 50-60% of the time by listening to the instruction stream from Repetition Segmentation rather than the full one.

Advanced Technical Features: Hands-Free Application Use Scenarios

When one has a guitar in their hands, it can be inconvenient to press buttons on an application. We prototyped three hands-free modes to automate Lunar Tabs: voice actions, stomp mode, and midi following.

Lunar Tabs allows voice commands like "next," "back," "up," and "down" to enable scrolling through sections in the piece. A "play" command generates a midi synthesis of the current measure. Audio icons help users understand a chord by playing its component notes.

Stomp Mode allows a user to go to the next playing instruction by stomping their feet. If a mobile device is placed on a sufficiently tensile floor surface, a user's foot stomp vibration will propagate through the floor surface and register as a spike on the accelerometer. Using a filtering algorithm, Lunar Tabs detects foot stomps near the device to advance playing instruction.

In Midi Following mode, inexpensive hexaphonic guitar pickups are used to allow Lunar Tabs to follow the user's playing. Hexaphonic pickups (such as Fishman Triple Play) mounted on the guitar can be used to obtain midi from the guitar, streamed over Bluetooth to a USB receiver on the mobile device. Lunar Tabs uses string-matching algorithms to match what the

user plays with instruction, advancing instruction upon successful playing of current instructions.

Interviews and User Studies

To measure the usability and usefulness of Lunar Tabs, end user studies were conducted with seven low-vision guitar players. Users communicated feedback through semi-structured interviews, independent test sessions, and survey questionnaires. Feedback was compiled into a text corpus, and analyzed for emergent themes. Key identified themes are shown in Figure 3.

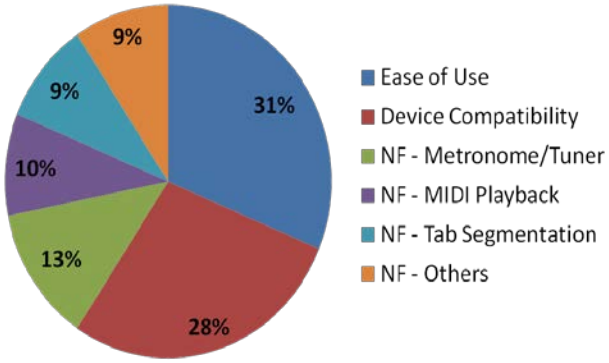

Fig. 3. Thematic Analysis of User Feedback Sessions

User feedback was categorized into three specific themes: Ease of Use, Device Compatibility, and New Feature Suggestions. Ease of Use is defined as any discussion surrounding the user's efficiency in accessing guitar tabs. The survey asked users to compare Lunar Tabs to other guitar tab readers they knew about, and Lunar Tabs consistently ranked first in Ease of Use. Users appreciated the range of methods available to interact with the application, especially the hands-free modes. Device Compatibility includes all the user discussion around integration of Lunar Tabs with their existing mobile and desktop technology. Users owned a variety of devices, and requested implementations across different platforms. The remainder of the user feedback was comprised of New Feature Suggestions – specific features that would

improve the overall functionality of Lunar Tabs for users. These included metronome functionality, MIDI playback capability, and additional song segmentation options.

A key finding is that incorporating the user-inspired features created a more usable and useful application for both low-vision and sighted users. For example, the Repetition Segmentation mode described earlier would enable all guitar players to learn tabbed songs more quickly than they otherwise might. The hands free modes could be useful to many different types of users. The application of usability principles in the design and development of Lunar Tabs allows us to create improved and universally inclusive technology.

Conclusions

We have created Lunar Tabs, a screen-reader friendly guitar tab reader that allows persons who are blind or have low vision to access information in guitar tabs. In addition to building an accessible user interface, we experimented with intelligent methods to convey repetition information in the piece and use the application in hands-free modes. User studies with guitar players with low vision identified key dimensions of user feedback that help evaluate the technology's impact. By implementing our experimental designs and incorporating users feedback, we hope to empower persons with low vision to access the wealth of guitar tabs online.

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