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Stage Metaphor Mixing on a Multi-touch Tablet Device

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ABSTRACT

This paper presents a tablet based interface (the Music Mixing Surface) for supporting a more natural user experience while mixing music. It focusses on the so-called *stage metaphor* control scheme where audio channels are represented by virtual widgets on a virtual stage. Through previous research the interface has been developed iteratively with several evaluation sessions with professional users on different platforms. The iteration presented here has been developed especially for the mobile tablet platform and explores this format for music mixing both in a professional and casual setting. The paper first discusses various contexts in which the tablet platform might be optimal for music mixing. It then describes the overall design of the mixing interface (especially focused on the *stage metaphor*), after which the iOS implementation is briefly described. Finally, the interface is evaluated in a qualitative user study comparing it to two alternative existing tablet solutions. Results are presented and discussed focussing on how the evaluated interfaces invite for different forms of exploration of the mix and on what consequences this has in a mobile mixing context.

1. INTRODUCTION

Traditionally, interfaces for music mixing incorporate a channel-strip metaphor, where each channel-strip controls one channel in the mix and consists of buttons, knobs and sliders for controlling various parameters of that channel. A traditional mixing console thus consists of several channel strips corresponding to the amount of channels in a given track. In an ongoing research project the authors have taken a different approach by exploring an alternative overall control metaphor; *the stage metaphor* [1]. Here channels are treated as virtual sound sources on a virtual stage with a virtual listener. The placement of each virtual sound source in relation to the virtual listener is what determines the volume, panning and reverberation/filtering (associated with

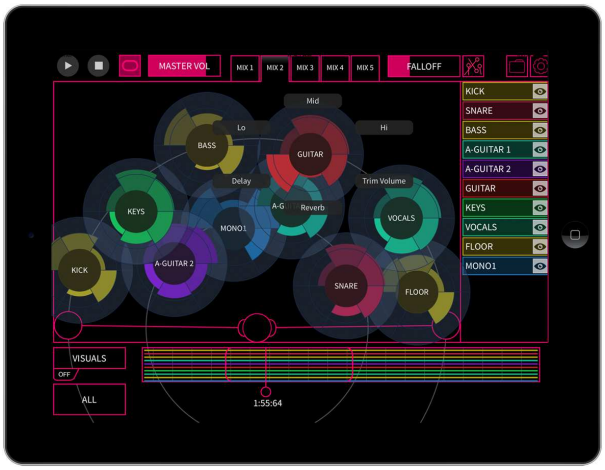

Fig. 1: Overview of the main interface. Widgets represent audio channels, which are positioned in relation to the listening position represented by the pink listener icon in the bottom centre of the stage view. The distance from the listening position determines the volume of the corresponding audio channel. The angle determines the panning.

the perception of distance [2]) of the corresponding audio channel in the resulting mix.

Peter Gibson's "Virtual Mixer" [3] was one of the first to explore this metaphor especially for mixing in virtual reality. Other examples of interfaces that incorporate the stage metaphor include Diamante's AWOL [4], Pachet and Delerue's MusicSpace [5] and Carrascal and Jordà's Multitouch Interface for Audio Mixing [6]. These interfaces all implement the stage metaphor in different variations. We believe that there is a need to explore how bringing this metaphor to different platforms influences such issues as workflow, creative exploration, control, overview, understanding of the mix, sharing and availability.

In recent years the tablet has gained popularity for music mixing—both for the implementation of standalone apps[1][2], but also as multi-touch graphical user interfaces (GUI) for controlling hardware digital mixers[3][4][5]. The authors have previously conducted studies dealing with the stage metaphor focusing more on specific interaction types [7, 8] where larger multi-touch surfaces were extended with tangibles [9] for more precise control. However, a more recent study [1] opens up for the possibility that directly touching the interface elements (in this case the graphical representations of audio channels—described in the next section) may provide the user with a sense of being in more direct contact with the actual sound than when manipulating tangible objects. In addition to this, we have been motivated to study the potential of employing the interface on a more mobile and accessible platform like a tablet device, trying to understand how the stage metaphor might be used in new contextual settings.

2. IMPLICATIONS OF GOING MOBILE

Earlier evaluations of the interface have suggested that the stage metaphor naturally targets novice users because of the fast and intuitive way that the music is mixed—intuitive in the sense that the control scheme mimics how one would perceive and manipulate sound sources in the real world. Additionally, the metaphor provides a clear visual overview of how audio channels contribute to the overall mix.

Several interfaces already exist for tablet mixing music—all with different features, functionality, capabilities, etc. It can be difficult to set clear goals for what a tablet based mixing interface should provide. The following presents several potential areas for ongoing research as a discussion about how the tablet platform might target different contexts.

2.1. Mobility

Previous evaluations have pointed out that for this sort of interface to really target professional users, integration with more elaborate systems, which provide extended functionality is important [1] (for instance using the interface as a controller for an existing Digital Audio Workstation (DAW) [6]). While this is definitely a concern, a large potential comes with the remote mobility of the tablet platform. An

[1] http://www.apple.com/dk/ios/garageband, *accessed May 2014*

[2] http://www.steinberg.net/en/products/mobile_apps/cubasis, *accessed May 2014*

[3] http://www.mackie.com/products/dlseries, *accessed May 2014*

[4] http://www.behringer.com/EN/Products/X18.aspx, *accessed May 2014*

[5] http://dev-core.org/mixing-station, *accessed May 2014*

[6] as e.g. http://hexler.net/software/touchosc, *accessed May 2014*

easy-access on-the-go platform fits well to the intuitive nature of the stage metaphor letting users explore mixing easily while not in the studio or at the desktop—especially for the non-professional user. Several concerns here include I/O capabilities, available functionality and workflow especially in terms of finalisation of mixes, since one cannot rely on integration with high end DAWs for finalisation.

2.2. Recording and mixing for novice users

The mobile tablet platform lends itself particularly well to demo recording, mixing and sharing. Many musicians/artists/bands/etc. do not have the resources or technical skills to handle a mixing console or a DAW. The availability of the tablet platform coupled with the intuitive mixing interface presented here, might open up for a multitude of different contexts of use that don't have to involve a skilled producer, especially when it comes to multiple users collaborating creatively around recording, mixing and sharing processes. We believe that the stage metaphor invites novice users to work more with especially stereo panning and depth in the music, as users are confronted with a spatial relation between sound sources that is not obvious in more traditional interfaces. The evaluation presented later somewhat confirms this assumption (See section 5).

2.3. Recording and mixing for experienced users

Many intermediate to expert users perform most of their mixing activities around a desktop or laptop Digital Audio Workstation (DAW)[7]. These software tools provide an abundance of functionality, which is important in order to really target a specific sound. The smaller real-estate of the tablet screen suggests that this deep level of functionality might be difficult to reach. If that is the case, developers should either focus the most central features for mixing or provide a different experience of mixing all together. The potential strengths of an alternative mixing interface like the one presented here, is that it can push users to think in different ways than they are used to (or as suggested in previous research by the authors [8], that the conceptual model of the system mimics closer how the user actually thinks about the mix—e.g. moving an instrument to the back of the mix). Essentially, we consider music mixing as much a creative activity as we consider it craft. Thus, an interface must balance freedom to explore a multitude of possibilities with constraints that guide the exploration (see e.g. [10, 11] for discussions about how constrained instruments can support creative processes).

[7] Logic, Protools, Cubase, Ableton Live, etc.

2.4. Availability / Flexibility

The tablet as a standard interface provides an available and flexible platform. Being widely adopted, developers are able to focus on software development instead of development of own dedicated hardware control surfaces. This also adds flexibility to the platform as interfaces can easily be updated as new features are developed.

2.5. Producer-client collaboration

Many artists hire professional producers to record, mix and produce their music. They rely heavily on the expertise of the producer to form the sound and thereby a large part of the identity of the recording artist (sometimes this is intentional, as certain producer can be used for creative stimulus or are hired as they can provide artists with a certain *sound*). An available interface with a gentle learning curve such as the one presented here would give more control to the artist in such a collaboration, as the artists themselves would be able to explore different musical expressions that the producer would then be able to fine tune in an iterative more collaborative process. Integration with existing more high-end tools would of course also be a concern here.

2.6. On stage monitor mixing

When performing artists play live music on stage they rely on a *monitor mix*, which is different from the mix that the audience hears as it is tailored to the needs of each band member. During a concert each musician must often signal to the producer (who is often far away) if they want to increase or decrease for instance the volume of certain instruments in the mix. The mobility of the tablet platform may provide the musicians on stage with extended control of this individual *monitor mix*. An interface tailored to suit this specific context is out of the scope of this paper but interesting when discussing mobility in terms of mixing[8].

The points discussed above have mostly been used to gain a broader perspective of the potential of the mo-

[8] Music Station for Behringer X32 is an example of a tablet app, which provides this kind of control.

bile platform. A common goal is balancing the simplicity of the controls with a fair amount of features in order to accommodate both the novice and the experienced user. In other words, the overall control scheme must be intuitive enough for the novice to understand right away how to use the mixing tool, while also supporting efficient exploration of several features normally available in more high-end mixers (or DAWs) for more experienced users. It is not enough that the system is capable of doing a lot, if the user never uses these features because they are complicated or inefficient to use. This balance is challenging to achieve and will be elaborated further during the evaluation in Section 5.

The rest of the paper is divided into the following: First the overall functionality of the Music Mixing Surface incorporating the stage metaphor is presented after which the implementation of the system is described. Finally, the paper presents an evaluation session where the Music Mixing Surface is compared to two existing mobile solutions (iPad[9] apps) for mixing music followed by a discussion of the potentials for using the stage metaphor in a mobile music-mixing context.

3. SYSTEM DESIGN OF THE MUSIC MIXING SURFACE

For this initial tablet version of the Music Mixing Surface an iPad app has been developed. This section will first describe the designed functionality of the interface after which details regarding the implementation are described.

The main interaction area of the interface is the *stage* with the *listening position* located at the bottom centre (represented by a listener icon—see Figure 1). Each audio channel is displayed as a graphical widget with a position on the stage relative to the listening position. The user is able to position the widget by dragging in the centre of the widget with one finger. When moving the widget left or right the sound is panned to the left or right speaker. Moving the widget closer to the listening position adjusts the volume upwards and vice versa [1] .

Additionally, the user is able to adjust an optional amount of different audio effect parameters associated with the audio channel by manipulating audio effect sliders. The effect sliders are constructed by dividing a circle into equally sized areas. The areas can be filled or empty depending on the value that they represent. These values are adjusted by dragging with one finger outwards or inwards within the area. This "pie" layout was chosen for its scalability and because it gives the user an impression of the values of each parameter by quickly interpreting the overall shape of the virtual widget.

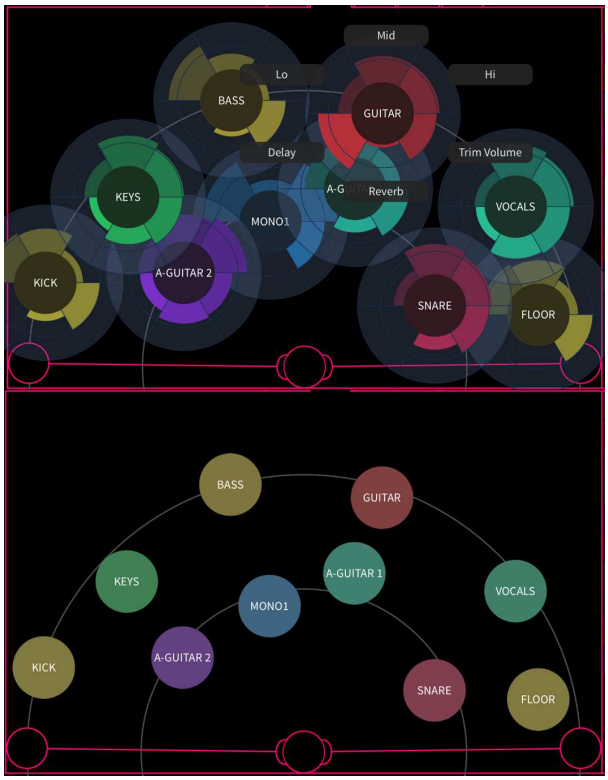

Fig. 2: Users can shift between full and limited visuals. Full visuals (top) provide access to adjusting effects, while limited visuals (bottom) provide better overview when balancing.

3.1. Additional Functionality

The stage metaphor comes with a set challenges especially to do with a lack of overview when the real estate of the screen is small as on a tablet. In order to deal with these issues and in order to increase different aspects of the creative workflow, additional functionalities have been developed.

[9] https://www.apple.com/ipad

3.1.1. Clutter

In order to deal with the issue of virtual widgets cluttering up the relatively small screen a visual layering mechanism was implemented. Using visual layers (see Figure 4, right) as known from for instance Adobe's Photoshop or Illustrator[10] one is able to hide or show widgets depending on where one's focus is at any given time in the workflow. Another feature that reduces clutter is giving the user the ability to hide the effect manipulation part of the widgets while focusing on balancing relative volume and panning. This is implemented by a toggle button toggling between *limited* or *full visuals* mode (see Figure 2).

3.1.2. Stage layout

Originally the main stage implements a semi-circle representing the listening area in front of the user. However, it was found that when audio channel widgets were placed very close to the listening position, the panning area was reduced substantially making the control space quite limited. A problem was for instance that a loud sound panning from one speaker to the other (representing a large change in the resulting sound output) was represented by quite a small movement of the widget, moving only a very short distance close to the listening position.

To compensate for this it was chosen to give the user the freedom to expand the mapping space. At any given time, the user is able drag on one of the four corners of the stage thereby controlling how wide the area closest to the listening position is depending on what gives the most intuitive overview of the stage—see Figure 3. When doing so, the position of each widget is automatically updated so their volume/panning settings correspond to the new stage layout.

3.1.3. Falloff coupled with Distance from Listening Position

It has previously been suggested [8] that not only should a widget's increased distance from the listening position result in a decrease in volume of the associated audio channel. It should also result in an increase in reverberation together with an attenuation of high frequency content, which corresponds to the way we as humans perceive sound sources coming from further away [2]. This feature has been implemented as a so called *falloff effect* that can be set using a graphical slider. The higher the falloff effect the more the distance of each audio channel will affect reverberation and filtering [1].

[10] http://www.adobe.com

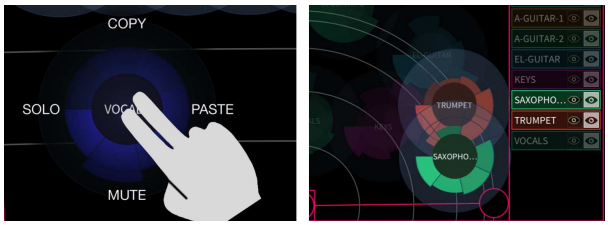

Fig. 4: Left: Touching the widget with two fingers brings up a menu providing additional settings. The user then moves up, down, right or left and releases to select the menu point. Right: Visual layers provide ability to show hide certain widgets.

3.1.4. Trim for each Channel and Master Volume

Since the *falloff* functionality has been implemented in order to approximate the way that sound is normally perceived as coming from different distances, it should also be possible to increase the volume of an audio channel even if it is placed further away. Therefore we introduced trim control as one of the parameter controls for each channel for increasing or decreasing its overall volume. We also introduced an overall Master Volume control slider for manipulating the output level of the overall mix.

3.1.5. Exploration of different Mixes

Imagine that a user is happy with a mix, but he or she would like to try out some new direction. First and foremost, they should have the freedom to do so without loosing the mix they were initially satisfied with, but also have the opportunity to shift quickly back and forth between two or more mixes in order to compare them instantly. Five dedicated mix buttons give users the possibility of creating five different mixes, which they can instantly switch between at will. This was included to increase exploration.

3.1.6. Mute/Solo/Copy/Paste

Touching the widget with two fingers brings up a menu that lets the user choose to mute/unmute, solo/unsolo, as well as copy and paste parameter settings between different widgets or between the same widget in different mixes (see previous section). Moving one's fingers towards one of the four

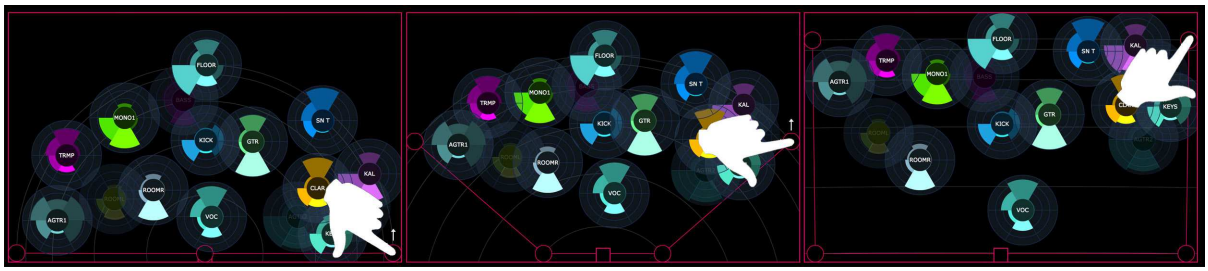

Fig. 3: The user is able to dynamically alter the stage layout by dragging in one of the four corners of the stage.

areas and releasing them selects the corresponding function (See Figure 4 - Left). Previously solo and mute were controlled by double tapping on various parts of the widget, which proved to be confusing to the users. The two-finger menu approach was implemented for two reasons: (1) to clearly displays menu options for new users and (2) to make it very fast for expert users to target one of the four functionalities as they simple need to swipe two fingers from the centre of the graphical widget up, down, left or right. It must be noted that this additional settings menu was quite confusing for most of our test participants (See section 5 for more details).

3.1.7. Playback and looping

In order to target specific playback positions in a song a simple looping function has been added together with a manual scroll button. Finally, simple play and stop buttons let the user control playback.

4. SYSTEM IMPLEMENTATION

As mentioned earlier the current implementation of the system is targeted towards Apple's iPad tablet. The graphical interface has been created using the native rendering tools of iOS[11] such as Quartz, Core Animation and UIKit, while the underlaying audio processing is handled by using *libpd* [12]. Libpd is a library that lets developers program patches in Pure Data [13] (a visual programming tool for interactive audio) and embed those into many different existing platforms—including an iOS app. This way the audio engine was built as collection of Pure Data patches and was connected to the graphical user interface by passing messages between the graphical interface and the embedded Pure Data main patch (see Figure 5). The great advantage of this architecture is that audio processing can be easily developed separately from the control interface.

As mentioned above, linking the two is done with simple messages. Specifically panning is linked to the angle of a widget relative to the listening position, while the distance from the listening position to the widget is proportional to the dry/wet amount of the falloff effect and inversely logarithmically proportional to the volume (similar to how volume is most often controlled using the decibel (dB) logarithmic unit). The Pure Data patch also implements an effects chain with a 3-band EQ, a simple reverb unit and a feedback delay unit. Solo/Mute functions are also embedded into the Pure Data patch. Finally, the patch sends playback positions and information about loaded audio files back to the graphical interface.

5. EVALUATION

The tablet version of the Music Mixing Surface described above was evaluated by comparing it to two existing tablet mixing solutions: Cubasis[12] and StudioTrack[13]—see Figure 6 for an overview of the three interfaces that were compared. Cubasis was chosen since it is one of the most high-end iPad solutions on the market providing functionality close to that of a traditional desktop DAW. StereoTrack was chosen because it is among the simplest solutions for iPad, which offers multitrack recording and mixing,

[11] iOS - the operating system of Apple's iPhone- and iPad platforms

[12] http://www.steinberg.net/en/products/mobile_apps/cubasis, *accessed May 2014*

[13] http://www.sonomawireworks.com/iphone/studiotrack, *accessed May 2014*

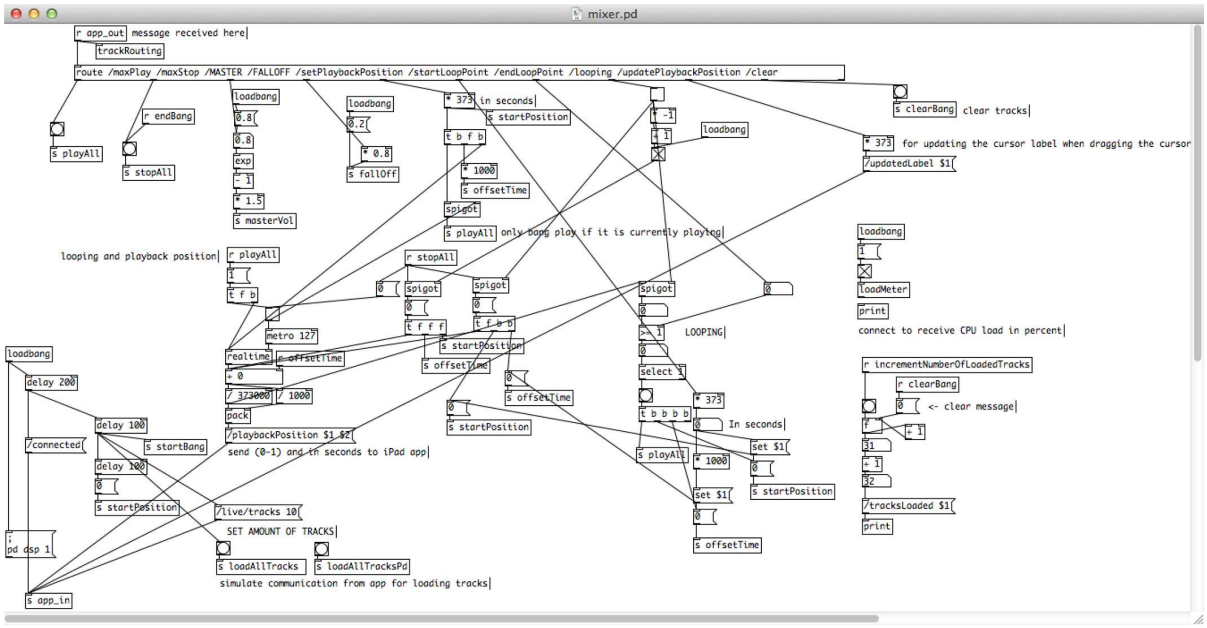

Fig. 5: Displaying the main Pure Data patch.

while also providing access to a limited amount of effects for each channel (functionality-wise it has very similar features to the Music Mixing Surface, but in terms of control it is very different). Both interfaces incorporate the channel strip control metaphor.

The goal of the evaluation was to understand how the stage metaphor was experienced compared to the more traditional channel strip metaphor. Besides evaluating specific features of the Music Mixing Surface from a usability point of view, it was important that the evaluation triggered discussions about the potential of the stage metaphor for different tablet contexts.

The evaluation was carried out by asking participants to mix a piece of music consisting of 8 channels of audio using each of the three applications. 7 subjects participated in the evaluation, each with different levels of mixing experience. 2 were novices, 3 had intermediate mixing experience and 2 were experts. For each of the three mixing sessions participants were told that they had a maximum of 10 minutes, but that they were free to stop once they were satisfied with the mix. Before each session they were shortly introduced to the interface and told to ask if they were in doubt about any functionality. After each session participants filled out a quantitative questionnaire about their experience with using that particular interface. The Likert scale questionnaire asked participants to rate to which degree they agreed with various statements including how comfortable they felt working with the interface, whether it was easy to understand, performed as expected, was pleasing to work with, felt creative, whether there were missing features and whether they made many errors. Each session was observed and notes were taken especially focusing on work flow, differences in what features were utilised and what difficulties participants had. Participants were aloud to comment during the mixing sessions. Finally, a short non-structured interview was carried out asking participants to comment on the differences between the interfaces, and to elaborate on certain answers given in the questionnaires.

The data was analyses using a bottom up approach inspired by Grounded Theory [14] where notes and interview recordings were scanned in order to establish certain themes in the data. The data was then scanned again noting down central actions and statements labelling them using the established themes. These were finally compared and contrasted in or-

Fig. 6: The Music Mixing Surface (top) was compared to Cubasis (middle) and StudioTrack (bottom).

der to find central tendencies in the qualitative data. The quantitative questionnaires were mostly used to help participants elaborate during the interviews.

6. RESULTS

Various themes emerged from the analysis of the evaluation data. They have been grouped together in the following overall categories: overall impressions, panning and depth, issues/errors, amount of available features and future.

6.1. Overall impressions

In general, experienced users felt comfortable working with especially Cubasis - one described it as "business as usual". There was plenty of functionality and everything worked as expected. While the experienced users felt comfortable using Cubasis, they also used noticeably longer time on working towards a finished mix. As one participant stated: "One can go more detailed, but I would have to spend much more time than I was given." For the two novice users, Cubasis was too complicated. While they did explore various features (mostly effects), they clearly fell short in understanding how they worked. StudioTrack provided a simpler interface, with the same familiar channel strip metaphor. While the interface worked as expected without any major issues for more or less all participants, even the novice participants stated that it felt limited and uninspiring to work with. It was possible to achieve a decent mix with StudioTrack, but the work flow was rather limited. Comparing Cubasis and StudioTrack, experienced users all preferred Cubasis for its more advanced capabilities.

While Music Mixing Surface was initially unfamiliar to the experienced participants it was generally rated most intuitive and pleasing to work with because of its intuitive and fast workflow. Not only was it easy to setup a working mix very fast (one participant said: "it feels very comfortable having a visual representation of where the channels are in the mix. With this interface I can almost create a first mix without listening") it also invited the experienced participants to step out of their comfort zone exploring alternative mixes. Thus, 6 out of 7 participants agreed or strongly agreed that they felt creative when using the Music Mixing Surface (in comparison this was 4 out of 7 for Cubasis, and 1 out of 7 for StudioTrack). Inexperienced partici-

pants also found the Music Mixing Surface intuitive to understand. As one stated "is was very easy because it corresponds to the real world". Effects were also easier to use for the novice user, as they were not hidden and there were no complicated parameters to adjust. While experienced users found this direct access to overall effect parameters fast and easy to use, they would also like to be able to go deeper into a given effect for tweaking further parameters like in Cubasis.

6.2. Panning and depth

All participants at some point explicitly stated that the Music Mixing Surface invited for more exploration of panning—this was also observed as generally channels were panned more compared to the two other interfaces. The two novice participants hardly used any panning at all using the two channel strip controlled interfaces. One of the expert users stated that: "It feels comfortable knowing from the visual representation, that instruments do not interfere with each other in the mix. This takes much more effort when using traditional interfaces". Another stated: "I found myself taking the mix to a completely different place than I would normally do." The fall-off effect of the Music Mixing Surface was too subtle so especially the novice users were not able to understand and make use of it.

6.3. Issues/Errors

A few errors were made with Cubasis - mostly in understanding how to adjust effects on single channels and because of a glitchy panning control. Errors were also made with StudioTrack, where some participants were not able to adjust gain and panning knobs efficiently, or understand how to apply/remove effects. However, most errors were made with the Music Mixing Surface, especially working with the solo / mute functions. Most participants found the two finger swipe too complicated and did not like that it was implemented as a "hidden" menu system. Finally, when in limited visuals mode (see Figure 2 - bottom) the track widgets were too small to comfortably apply two fingers to it. Additionally, a few participants would try to tap or double-tap widgets when in limited visuals mode to bring up effects controls instead of toggling the visuals toggle button.

5 out of 7 participants explicitly stated that they missed a waveform view in both StudioTrack and Music Mixing Surface for better overview of the track.

Clutter in the Music Mixing Surface was only explicitly mentioned as being a problem by one participant. Participants were generally good at using the visual layer system for targeting specific channels. Metering was also mentioned by 4 of the 7 participants—this could for instance be done by making the widget pulsate with an ambient colour that turns red, if the audio limit is exceeded.

Besides being able to adjust more effect parameters of the Music Mixing Surface, experienced participants asked for a compressor. Finally, two participants brought up the need for applying effects to the master output for finalisation of the mix. This was especially important if this was to be used as a standalone tool for demo production or live audio.

6.4. Amount of available features

According to the experienced participants, Cubasis was really the only tool that could be considered as a dedicated mixing tool. Although Music Mixing Surface provided a more experimental interface, it did not provide enough features. Because of this one of the participants stated that the Music Mixing Surface felt more like an interesting toy than a real mixer. While the few effects that were available for StudioTrack were appreciated for their intuitive use, the amount of possibilities was too limited. As one participant stated: "Especially with iPad apps, you quickly carry on to a different tool if there are not enough possibilities."

6.5. Discussion of future use

When discussing how to develop the Music Mixing Surface for future use it became clear that for it to be used as a standalone tablet mixer, it has to incorporate recording functionality, more effect options, more intuitive mute/solo functions and waveform view of some sort. Finally, there was also a need for adding effects to the master output for finalisation. Having said that, 4 out of 7 suggested that the stage metaphor view would make perfect sense as an add-on to for example Cubasis. Not only would one be able to flip to that view for experimentation with especially depth and panning, but also it would be interesting to get a visual representation of the mix one had achieved using the traditional interface. Most would use the Music Mixing Surface either for mixing demo recordings (especially

for fast experimentation) or for mixing live sound. The importance of integration with high-end DAWs was also mentioned as a great advantage—something that Cubasis is already capable of. Alternatively, it would work as many tablet tools today, where the tablet is used for rapid idea generation and whereafter the ideas are taken to a more professional setting.

7. CONCLUSION

We have presented a tablet based interface for mixing music, which incorporates the stage metaphor, where audio channels are represented by graphical widgets on a virtual stage. Volume and panning of separate audio channels can thus be manipulated by dragging widgets around on the stage in order to position them in relation to a virtual listening position. Challenges associated with the stage metaphor have been addressed resulting in several extended functionalities for increasing overview, reducing clutter, improving workflow, and supporting creative exploration. Finally, an evaluation revealed that the stage metaphor was appreciated for providing an intuitive visual representation of depth and panning in the music, not only helping novices understand the mixing better but also leading to a very fast and more experimental work flow for the experienced users. Certain important features were however missing for the tool to work as a dedicated standalone mixing interface.

8. ACKNOWLEDGMENTS

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