Virtual DJ Mixing

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Abstract – Disc-jockeys have come a long way, through technological evolutions. This path led them to the status and recognition they have achieved in our society. But as impressive as those technological evolutions are as far as DJing is concerned, there are still few applications that support hands-on interaction over virtual DJ applications, and those are typically reduced to the traditional input devices. In the proposed solution, gestural interaction from Traditional Setups remains coherent while inheriting advantages from the virtualization of the DJing domain. The purpose of this thesis work is developing a digital alternative to a DJ system. Additionally, it support task improvements, such as dynamic re-routing of music flow, Controlling the amplitude (volume) of each input signal, as well as the ratio of each signal's contribution to the master output and Drag and drop functionality so that Songs can be dropped directly over the playlists. There are many reasons for this, such as the limitation of storage capacity and the update frequency of music is not timely we will apply the digital technology to build a new music system. The purpose is to build an application based system to run in an ordinary computer.

Our system allows DJs to exercise creativity with a natural interaction, creating scenarios that are not possible in the real world.

Index Terms – Information interfaces and presentation, Sound and music Computing.

1. INTRODUCTION

Music has power to liven up, chill out and change the atmosphere. Not only performed music but also played back music does have such power. There are people who can maximize the potential of music by playing them effectively who are called DJ. DJ selects music and mix songs to provide the best music for the atmosphere and DJ never stop the music.

Playing back pre-recorded music is something that anyone can do, and some who have no experience as a DJ may think that being a DJ only requires one to play music if the DJ does not perform scratching or play other digital instruments. Certainly playing one song is easy and can be done by simply pressing a playback button; however, DJs mix songs such that listeners do not notice song switching. DJs also construct entire set lists often adhering to specific themes or song medleys, which is not as easy as just playing the music. Note that this is not the only task that DJs perform, but it is the minimum and most fundamental factor for DJ performance. The inherent difficulty in son mixing is often hard to notice because DJs attempt to make song boundaries unnoticeable, which will not work by just switching songs using any timing. If we care about beats and sound, the suited timing for song mixing is available only for a moment. On the other hand, there are innumerable possibilities for song mixing timings and mixing destination, and it is possible for humans to consider all such possibilities. More specially the DJ must decide and set the next song and the timing before the currently playing song finishes. Selecting one best mixing from innumerable possibilities with in a limited is difficult for the inexperienced. Therefore, an effective approach for supporting song selection such that songs can be mixed naturally is to compute mix ability (i.e., "mix" + "ability").

2. RELATED WORK

Few studies have focused on DJ mixing. Ishizaki el al. proposed a DJ system that adjusts tempo of the songs played. They defined a measurement function for user discomfort in tempo adjustment based on subjective experiments. Cliff also presented a system to seamlessly mix music by adjusting both tempo and beat. He also enabled user to specify the trajectory of tempo in the resulting mix such that users can impact the entire mix. However, these systems do not consider factors other than tempo or beat. In addition, these systems do not retrieve a mixing point but forcibly changes the tempo of songs. [1]

Adrian Carroll proposed beat mixing rock music via Electronic dance music (EDM) has the capacity of producing not simply individual recordings but also a medium to create new soundtrack through live manipulation of these recordings by disc jockeys (DJs). [2]

Several studies have focused on generating a music playlist. Auto DJ generates a playlist based on one or more seed songs using Gaussian process regression. The Auto DJ project team has also proposed a method to infer the similarity between

music objects and have applied this to playlist generation [4]. However, these approaches focused on playlist generation, and the importance of mixing (connecting) songs was not considered.

3. WHAT IS MIXING?

Mixing is the craft of taking multiple audio tracks and combining them together on to a final master track- be it a 2-channel stereo master, or 4+ channels in the case of surround mixing. The way of combine tracks is equal parts art and computer science, and involves utilizing a variety of tools to bring out the most emotional impact from the song. Mixing can be as simple as presenting great-sounding tracks in a more impactful way. Other times, mixing may require repairing tracks that sound sub-par.

Each mix presents its own problems and challenges- Mixer to not only solves these problems, but to present the song the way it sounds in the client's imagination.

A. Cross-correlation Technique

The cross-correlation between two signals gives us a good idea of how similar they are. This is attained by applying a constantly increasing delay to one of them and calculating the dot product between the correspondingly aligned samples. The circular cross-correlation of two signals x and can be defined by:

$$\frac{1}{N}(\mathrm{x} * \mathrm{y})(\mathrm{l}) \triangleq \frac{1}{N}\sum_{\mathrm{n}=0}^{\mathrm{N}=1} \bar{\mathrm{x}}(\bar{\mathrm{n}})\mathrm{y}(\mathrm{n}+\mathrm{l}), \mathrm{l} = 0,1,2 \ldots\ldots, \mathrm{N}-1.$$

The lag l is an integer value, and the resulting values go from -1 to 1. A value close to 1 means that both series are similar at that particular delay. In the same way, a -1 indicates that the series are exactly opposite at that delay. It's also important to note that the cross-relation is not commutative.

$$(x * y) \neq (y * x)$$

This means that even if we use some sort of cache on the system to further improve performance, our calculations have to be done in both directions anyway.

The use of cross-relation in this project allows the user to specify the evolution of a particular feature or feature set, which will then to be compared with the whole feature database using the sum of the cross-correlations and a weight system. After normalizing the data, we can calculate the cross-correlation with another feature set.

B. The mixing Desk

Let's start with the basics. A normal mixing table has a number of mono and stereo channels. Every channel has:

Gain: This can be found on all mixing devices. These changes the pre-amplification of the signals before it goes to the volume fader. The gain should be set as high as possible without clipping or distorting the music.

Equalizer: Depending on the mixing table it is a parametric or non-parametric equalizer. A non parametric equalizer is a filter which weakens or strengthens a signal in a certain frequency range. E.g. if a mixing table has 3 nodes one with 11 kHz. One with 3 kHz and one with 100 kHz it is non parametric equalizer. On the other hand if we have a mixing table with 4 knobs, 11 kHz, 100 Hz and a knob which let you chooses the frequency then it is a parametric equalizer. When changing the equalizing, the gain has to be changed too. E.g., when cutting down the bass, the gain can be raised.

Volume slider: This allows you to change the volume which goes to the main mix. Most mixing tables can go to + 15 dB, but there is no use in that. Avoid the trap of raising the volume relatively to Each other until the two songs are playing at +15 dB and you can't get higher. Volume 0 should be the maximum volume you apply.

PFL button: PFL stands for pre fader listening. If you push this button, regardless of the volume fader you will get the complete signal in your headphone/monitors.

Monitor: A monitor is a set of boxes next to you which gives you what you hear in your headphones.

Balance: This lets you choose whether you hear the left or the right channel for stereo channels. For mono channels the balance is replaced by a pan, which lets you direct the signal to the left or to the right. For mixing purposes a balance is not necessary. Just don't forget to place it in the centre.

AUX: Aux sends buttons to change the volume of the channels going to an effect unit. These can be pre-fader or post-fader and often no use for a DJ without an effect unit.

Mute: Mute button, which mutes the sound completely, nothing is send out over the AUX sends, nothing is send to the pre-listener. The latter depends on the kind of mixing table.

C. Beat Mixing

The Tempo: Beat mixing is mixing two beats exactly over each other during a certain period. The difficulty with this is that different songs have different tempos.

In general beat-mixing is only possible when the two songs are playing at the same speed. Therefore, one needs to bring the tempo of one of both songs to the tempo of the other song. However, knowing the tempo of song up to an accuracy of 1BPM is not even enough to keep two songs synchronized over 1 measure. Generally, you will need to stay in touch with both songs while they are playing. This however, forms a problem because the tempos of most acoustic songs have are not perfectly constant and depending on the technique used, the tempo can be measured slightly wrong. Therefore, during playing one needs the ability to shift a playing song a bit forward or a bit backward, such that they stay synchronized. This is called nudging.

Syncing: When a suitable song has been selected and it is playing at the correct tempo one needs to start the song at the correct moment. Typically this moment is at the beginning of a phrase (that is the beginning of 8 measures). Normally, when the song is started it won't start exactly at the moment you intended it. Therefore, you will need to nudge a little bit. This however is not easy because it is difficult to decide whether the song you threw in started too late or too early. For instance, in the figure below, the white line is the timeline of same song. The red line is monitor song which has been started too late. The blue line is the same monitor song but started too early. As can be seen, if we only listen to the beats, it is possible to distinguish whether the song is too late or too early.

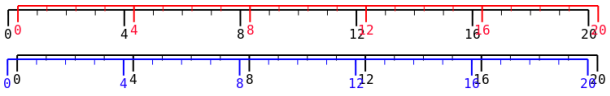

Fig 1. Representation of syncing beats

Nevertheless, we do not necessarily need to listen only to the bass-drums; we can also listen to the entire song. This however is also a problem because simply a chaotic piece of audio which is very difficult to interpret consciously. However, unconsciously it is possible to hear the difference. Therefore, one only needs to try to follow the music and focus specially on one of the both songs. The song for which it is easy to differentiate it from the rest and keep on focusing on it is the first song. For instance, in the red case, the song which can relatively easily be listened to is the white one, our main song. Hence the monitor comes too late. In the blue case, we will easily focus on the blue song, the monitor songs come too early. Another pragmatic way to solve this problem is to nudge two times backward.

Nudging: During the time the two songs overlap the tempo difference between the two songs (even if it is a very small tempo difference) will result in a slight synchronization drift.

Fig 2. Representation of nudging

To solve this one needs to know beforehand which song is the slowest one of both before a mix is done. Solve this problem is easy. Make sure both songs are synchronized; now wait until the two beats sound double. Nudge forward. IF it becomes better, you should keep on nudging forward since the second song is going a bit too slow If it becomes worse you should nudge 2 times backward and conclude the second song is going a bit too fast. To be workable a DJ should maximally nudge every 4 beats, otherwise he has simply a wrong tempo and should change the tempo one of both. The direction determined by these techniques is the direction you need to use to keep them synchronized once they have been synchronized.

Cross Fading: When you finally have the two beats exactly over each other in your headphones you want to switch slowly to song B. Before you do these be sure to cut off the bass drum with the equalizer. Otherwise you get a very ugly flanging effect on the bass drums.

Breaking: Once you have learned how to cross-fade two songs, you might want to experiment with sudden breaks and gaps in the music. This will give the music more punch and keep people dancing.

4. RESULTS

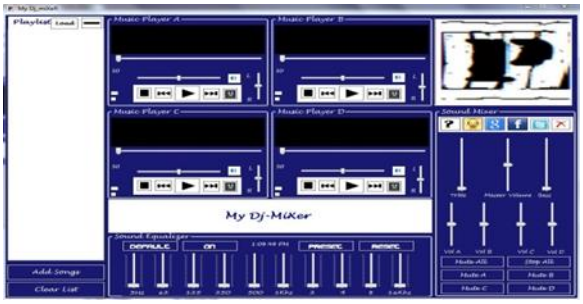

Figure 1 DJ mixer

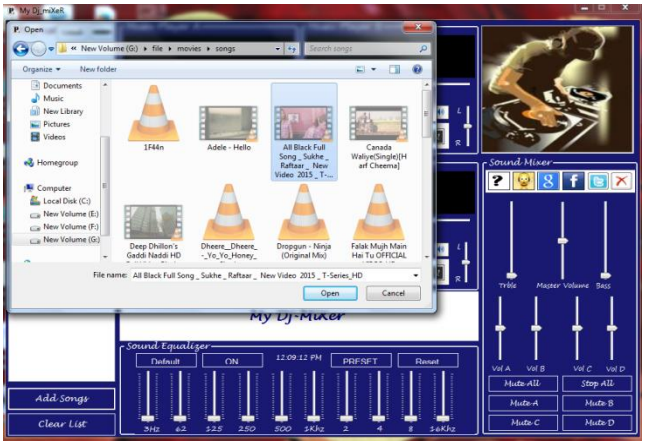

Figure 2 Adding vedio/audio tracks in DJ mixer

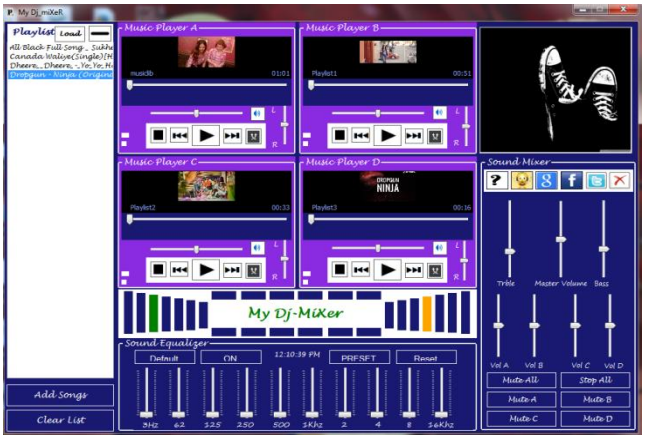

Figure 3 Playing more than one song at same time DJ mixer(Drag and Drop Functionality)

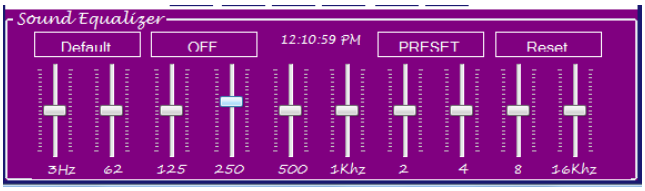

Figure 4 Equalizer Pannel

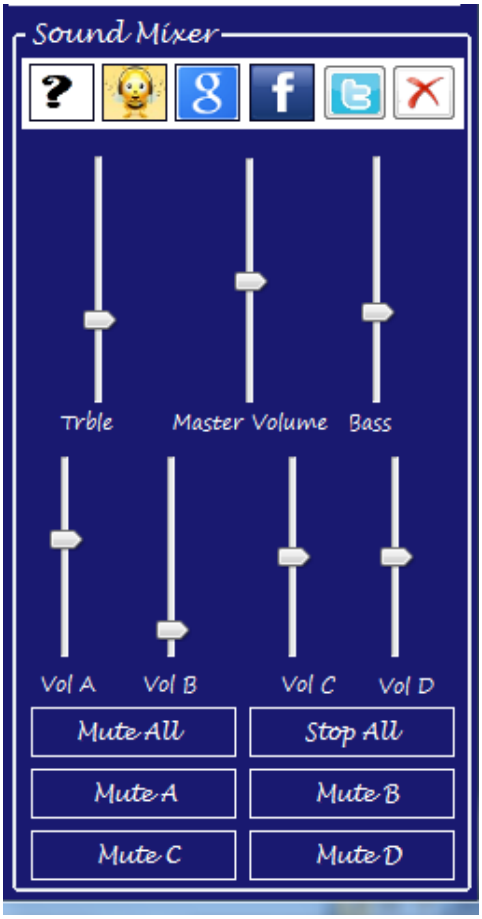

Figure 5 Adjusting Bass and Treble

5. CONCLUSION

In this paper, we presented virtual DJ mixer, a computer-aided DJ system that provides automatic song mixing. Music Mixer takes advantage of computing power to calculate good mixing points of input songs and enables the user to select the next song from the suggestions by the system. This can be regarded as one style of collaborative content generation between human and computer. Music Mixer not only supports people performing DJ mixing but also enhances the listening experience. Since it is difficult to hire personal DJs for all events, especially on a day-to-day basis, Music Mixer can serve as a user's personal DJ fully integrated within music player as an application.

6. LIMITATIONS AND FUTURE WORK

As Virtual DJ Mixer focuses primarily on song mixing, there are limitations in terms of DJ performance. For example, DJ scratching, another key DJ technique, cannot be performed using Music Mixer. We currently assume that Music Mixer users are people with no experience with DJ mixing. Therefore, after acquiring a sense of song selection and song mixing with Music Mixer, it might be easier to then use actual turntables rather than attempting this as a complete beginner.

The other limitation is that we do not change the tempo of existing songs. In practice, DJs often change the playback speed to make natural mixes, even though the tempo of two songs may be drastically different. We will implement such tempo alterations to Virtual DJ Mixer in the future update.

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