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SEPARATION OF MUSICAL NOTES OF DRUM,BASS,GUITAR AND VOCALS MELODY USING NON-NEGATIVE TECHNIQUE

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ABSTRACT

Recently, Musical Notes separation of Musical signals source has been a focused research topic in digital signal processing particularly, in Music signal processing. The proposed Non-Negative decomposition method for the separation of musical notes from input recorded .wav file. The method is easy to execute, mathematically efficient. The proposed methodology contains the input .wav file is first transformed into time- frequency representation which is responsible for the generation of spectrogram which includes generation of windows with the help of sampling techniques. Afterwards, transformation of spectrogram into matrix form containing all non-negative elements, that why it is termed non-negative decomposition. Then by means of filtering or clustering technique it is possible to separate notes of musical sources and to recover the musical notes of respective musical source.

Musical Notes separation has a lot of applications including speech recognition, Music up-mixing ,music transcription, remixing and content creation, karaoke systems ,Audio post-production and re-mastering, Spatial audio and upmixing, Denoising (Separate noise speech , tools for remixing for disc jockeys or producers, (Remove background music from music, Remove bleed from other instruments) , instrument-wise equalizing and preprocessing in music analysis tasks.

KEYWORDS: — Excitation-Filter, Watermarking, Timbre., Non-Negative Decomposition, Spectrogram, Short Time Fourier Transform, Informed source separation

INTRODUCTION

In the current era, Musical source separation has been a central research topic in digital signal processing, particularly, in music signal processing with applications in speech recognition, Music up-mixing ,music transcription, remixing and content creation, karaoke systems ,Audio post-production and re-mastering, Spatial audio and upmixing, Denoising (Separate noise speech , tools for remixing for disc jockeys or producers, (Remove background music from music, Remove bleed from other instruments) , instrument-wise equalizing and preprocessing in music analysis tasks. Musical sources are however often strongly related in time and frequency, and without extra knowledge about the musical sources signals, a decomposition of a recording is often not feasible. To solve this complex task, many methods have recently been come into existence that exploit the presence of a musical score. The extra instrumentation and note information provided by the score guides the process of separation, leading to significant improvements in terms of separation quality and performance of separation. A major task in utilizing this heavy source of information is to bridge the gap between high-level musical events specified by the score and their corresponding realizations of acoustics in an musical recording.

In general, Musical source separation methods often based on assumptions, such as the availability of multiple channels or the statistical independence of the musical source signals, to identify and separate individual musical notes. In music, however, such assumptions are not acceptable in many cases. e.g. musical sources often outnumber the channels of information, such as a string quartet recorded in two channel stereo. Also, Musical sources in music are typically highly correlated in time and frequency: instruments follow the same rhythm patterns and play notes that are related by harmonics. High statistical methods such as analysis by independent components or nonnegative matrix factorization thus, often fail to completely recover individual sound objects from music mixtures. Perfect-quality musical source separation for general music remains an major problem. One of the approach is to use known spectrotemporal properties of the musical sources to facilitate the separation e.g. in a time-frequency representation, percussive instruments typically exhibit structures in the frequency direction(short bursts of broadband energy)

while harmonic instruments usually lead to structures in the direction of time (slowly changing harmonics). A lot of instruments, however, emit similar energy patterns, and thus they are hard to distinguish based on spectrotemporal characteristics alone. To overcome these problems, various approaches presented in recent years exploit (user generated) annotations of a recording as extra previous prior knowledge. For example, to simplify the process of separation, one able to specify the fundamental frequency of instruments , manually assign harmonics in a spectrogram to a specific source [4], or provide timing information for instruments. However, likewise such annotations generally lead to a significant increase in separation performance, their creation can be a complex task.

MOTIVATION AND RELATED WORK

Separation of musical notes by Excitation-Filter Model:

It is method for separation of musical notes of individual musical instruments. The mixture input is designated as a addition of the frequency spectra of separate musical notes which are further denoted as a multiplication of filters and excitations [2]. The excitations are limited to spectra of harmonics and their fundamental frequencies are calculated in advance for using a multiple path estimator, and the filters are limited to have responses of smooth frequencies by designing them as an addition of individual functions on the scale of Mel-frequency A very good expectation-maximization (EM) algorithm [2] is which combinely learns the responses of filter and manages the musical notes (Excitations) to instruments(filters). There are separation algorithms have been put which are based on factorization of matrix of the input spectrogram. The methods approximate the magnitude $\mathrm{y_t(k)}$ of the mixture spectrum in frame t and at frequency p as a weighted addition of basis functions as

$$\hat{y_t}(p) = \sum_{m=1}^{m} g_{m,t}\ b_m(p)$$

where g_m, t is the gain of basis function m in frame t, and $\mathrm{b_m(p)}$, m = 1,...,M represents bases. It means that the signal is represented as a addition of individual components having a fixed spectrum and a time-varying gain.

Watermarking-Based Method for Notes Separation of Musical Signals:

In this method the estimation of several Musical source notes from a one observation of their mixture. There are a specific two levels coder–decoder configuration. At the coder, musical source Musical signals are considered for availability before the input musical signal is processed. Each Musical source signal is having a set of parameters that provide another useful information needed for separation. This method is using a watermarking method [4] to embedded this information about the Musical source signals into the input musical source signal. At the decoder level, the watermark is retrieved from the mix input signal to activate an final-user who has not permission to access to the original musical sources to segregate these musical notes from their input musical mixture. Therefore, this process is called informed source separation (ISS). Thus, several instruments musical notes or voice musical notes can be separated from a only one piece of music signal to enable after-mixing processing like control for volume, addition of echo, specialization, or transformation of timbre. Better performances are received for the segregation of three musical source signals, from mix input music of voice and music signals. The descriptor of the source signal Mi is defined as the energy ratio between a molecule of and the corresponding molecule of the mix y,

$$E_{\frac{M_i}{x}}(p,q) = \frac{\sum(f,t) \in \{p \times q\} | m_t^{S_i}[f]^2}{\sum(f,t) \in \{p \times q\} | m_t^{x}[f]^2}$$

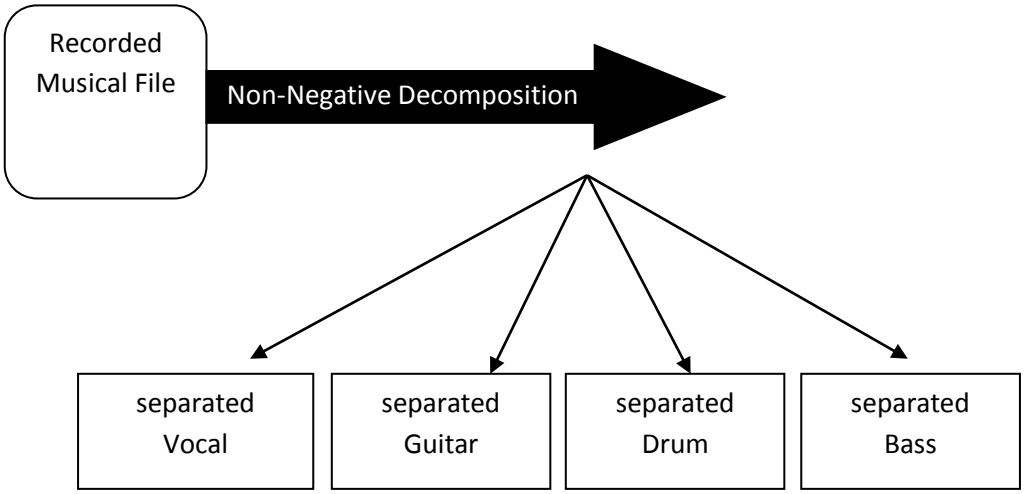
This ratio is $\mathrm{E_{M_{i/x}}(p,r)}$quantized to using a scalar quantizer and the resulting index is added as watermark information into the mix molecule $\mathrm{M_{pr}}$using $\mathrm{Q_2(1,f)}$ At the decoder, the descriptor is extracted and decoded. The molecule of the source signal is then re-constructed by the corresponding mix molecule $\mathrm{M_{pr}}$ weighted by according to,

$$\widehat{M}_{pr}^{M} = M_{pr}^{y} \times \sqrt{\widehat{E}_{\frac{S_i}{x}}(p,r)}$$

This is done for each molecule of each musical source signal. Hence, the separation is based on molecular energy segregation. The above mentioned techniques required a lot of improvement with the results.

PROPOSED APPROACH AND IMPLEMENTATION

The separation of Musical Notes of Musical source has been the latest research area in the field of technology and signal processing which has a lot of applications as discussed above. For the process of separation to be done, we need a recorded or Mixed musical file containing Musical notes of Bass, Drum, Guitar and Vocals. We have professionally recorded Musical File to carry out the separation. The basic architecture of the system is as shown in the following figure.1.0. We have used the non-negative decomposition technique for the separation purpose.



Basic Architecture of Separation

The professionally recorded or Mixed Musical File is initially converted into spectrogram with the help of Short Time Fourier Transform (STFT). Then, the generated spectrogram is converted into the matrix form with the help of windowing and sampling techniques. The Generated Matrix contains all the elements which are non-negative. Therefore this method involves the generation of Matrix containing all non-negative elements ,so termed as Non-Negativity approach. The Matrix again decomposed into Musical Notes with the help of Non-Negative Factorization technique. The generated musical notes are fed into iterative spectral matching with the available dataset of Drum and Bass. Then, the matching musical notes are clustered and resynthesis of musical notes has been done with maximum performance and accuracy.

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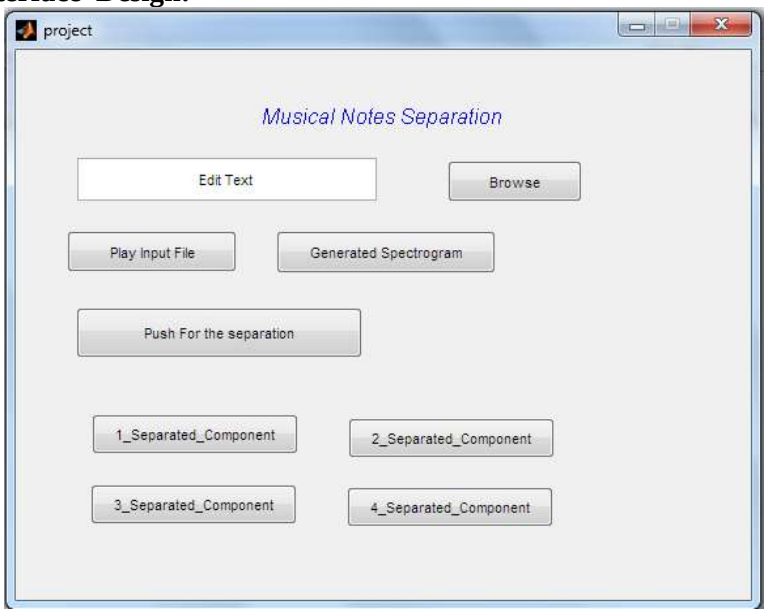
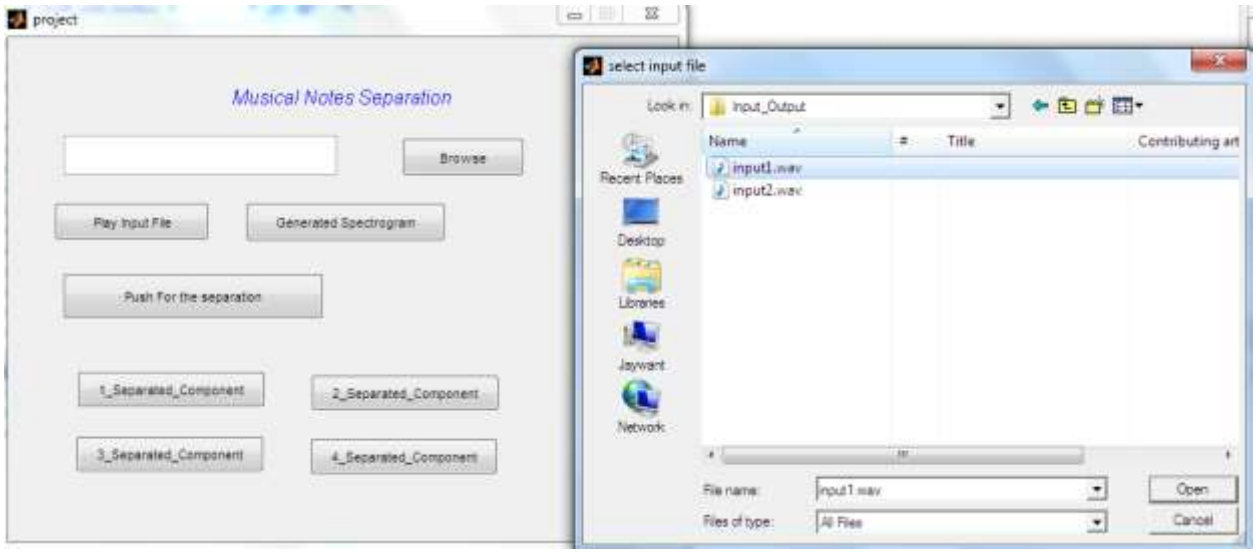
Graphical User Interface Design:



Graphical User Interface

RESULTS AND DISCUSSION

a) Browse The Input Musical File:



Browse the Musical File

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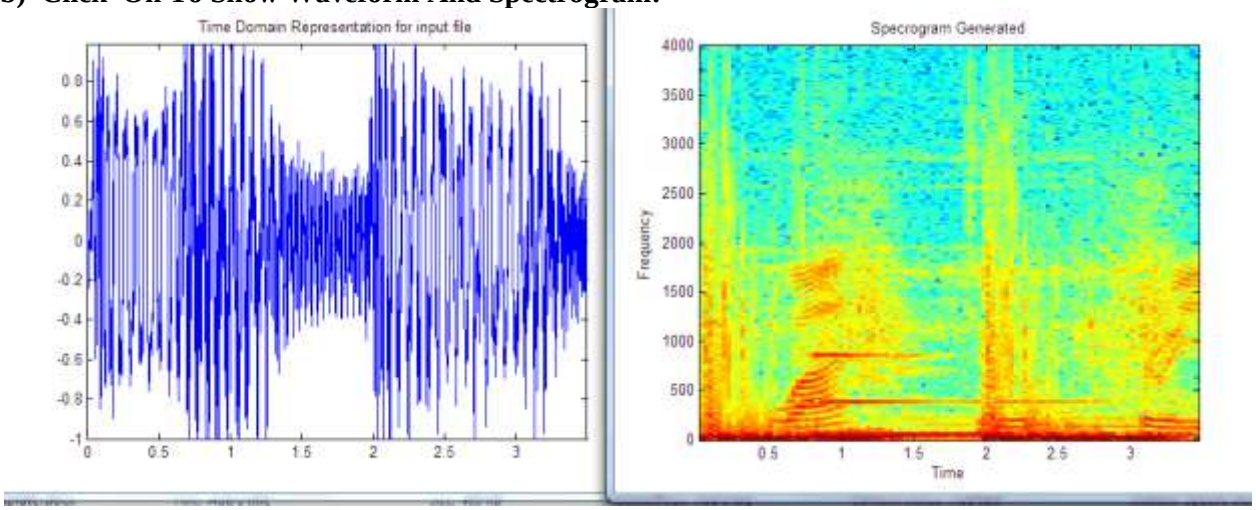
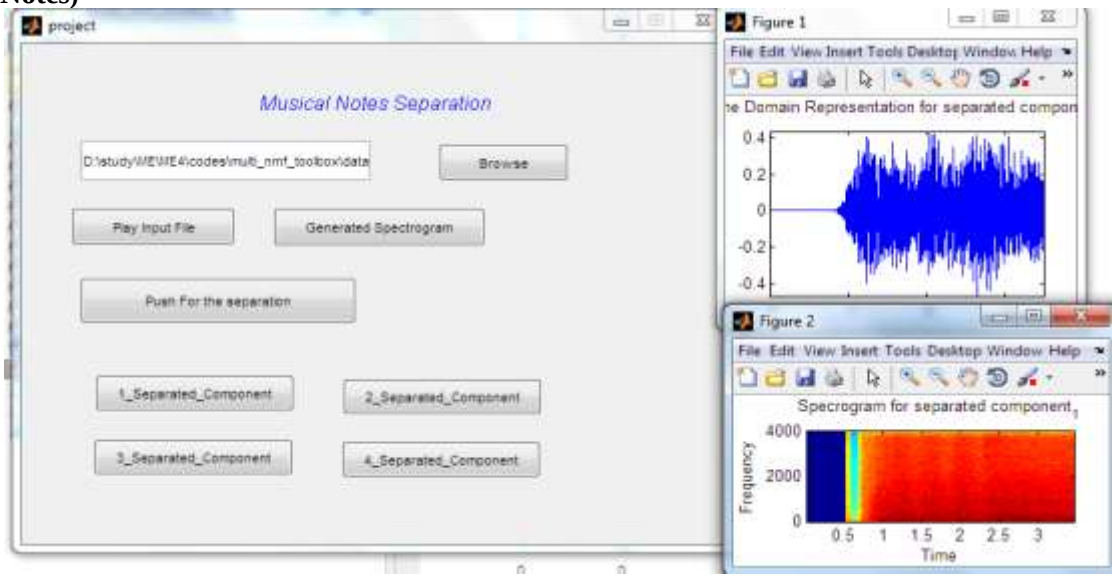
b) Click On To Show Waveform And Spectrogram:



Spectrogram Generation

c) Results After Click On Separated Component _1 (Drum) Notes (Same For Other Separated Notes)



Listen and Spectrogram of Separated Drumr Notes

As seen in the above graphically represented results, in the fig. 1.0 shows browse the input file.Fig.2.0 shows the results after clicking on show waveform and spectrogram push button and finally fig 3.0 shows the separated guitar notes with spectrogram shown. In the same way when we click on the separated voice or separated drum we able to listen the separated musical notes with spectrogram .

CONCLUSION

From the above results, it should be concluded that the musical notes Bass, Drum and Human vocals with Guitar can be separated from each other according to their musical source by using Non-Negative Decomposition methodology. The accuracy obtained by this technique is very much good as compared to the existing techniques.

FUTURE SCOPE

The separation of Musical Notes from recorded musical file is a laborious task. By the proposed technique we get the results. It is work well with limited number of sources. As the number of sources goes on increasing in the recorded file the results can not show the expected performance. So with the increasing number of musical sources, separation of musical notes of sources is the future scope for the musical Notes Separation.

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